Indian aids solar power invention

GAINESVILLE (Florida), Mar. 6 (AP). — A student from India, hoping to turn parched areas of his homeland into productive farmland, is refining a professor's solar energy inventions.

Mr. Anil Rajvanshi, a University of Florida graduate student from Lucknow is improving one of Dr. Erich Farber's inventions, a solar-powered distillation process that turns salt water into fresh water.

In India, technologists are adapting another Farber invention, a prototype solar-powered water pump.

Mr. Rajvanshi, 26, working side-by-side with Dr. Farber, said he believes by adding dyes or introducing electrical charges into the system of distilling salt water, he may be able to lower the temperature at which it evaporates — thus making more fresh water.

"If we can solve the problems of distillation and pumping, we can irrigate our land and feed our people", Mr. Rajvanshi said.

He believes solar energy is ideal for India, where there are over 300 days of sunshine each year along with terrible drought.

"Professor Farber was the main reason I came here", he said. "He told me right off I should work on problems that will help my own country and that I can continue working on when I return there".

Mr. Rajvanshi said a new and promising field like solar energy can be damaged by people rushing into it without proper knowledge and preparation.

"Back in 1955, the Indian Government became very excited about solar ovens", he said, "and even provided subsidies to help people buy them. But the housewife didn't want to go out in 110-degree heat to cook, and the evening meal in India is eaten late. You can't cook with the sun after it has set".

He said the same thing can happen in the United States, as it did with the solar-energy-heated stand at President Jimmy Carter's inauguration.

"President Carter had to put his coat on, but it wasn't because solar energy didn't work", Mr. Rajvanshi said. "It's because they didn't have a storage tank big enough and didn't put it up soon enough to overcome the days of snow.

"I feel that we in the developing countries can sometimes provide answers to industrialised nations because we always have been closer to nature and had to use it because that's all we had", he said.

The Indian student plans to continue his studies and research here until December 1978. Then, he will go home and apply his knowledge for his nation's benefit.

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HIS PAPERS ARE HERE

John D. MacDonald Benefit For UF Library Scheduled



JOHN D. MACDONALD
'Travis McGee' Author

John D. MacDonald, the Sarasota spinner of Travis McGee mysteries and other yarns, will introduce his newest novel at a benefit for the University of Florida Library.

"An Evening with John D. MacDonald" will be March 26 at the Daytona Museum of Arts and Sciences, 6-8 p.m., with specially imprinted autographed copies of his latest book, **Condominium**, going to couples who donate $50 (individuals, $35). Reservations should be made by March 21 through Sam Gowan, 217 Library West, and checks made out to the UF Foundation, specifying "MacDonald benefit." [illegible]ations will be limited to 1,000 and Gowan estimates the library will receive up to $18,000.

In a recent interview, MacDonald explained his reasons for cooperating in the benefit.

Back in 1962, before the McGee series, when the prolific writer still had only 39 books to his name, the University's rare books and special collection librarian Laura Monti read "A Flash of Green," MacDonald's novel about citizens fighting landfills in Tampa. Miss Monti decided that he was a very good writer indeed and asked him to donate his papers to the school. It was six years and 16 books later before any other library asked MacDonald for his papers.

Photos, professional correspondence, clippings, fan mail and copies of books from UF's collection will be on display at the Daytona Museum for the two weeks, March 20-April 1, surrounding the library benefit.

At last count, MacDonald's 65 books (including the most recent McGee adventure, **The Dreadful Lemon Sky**) were selling at a rate of 8,000 per day, totalling somewhere between 60 and 70 million copies sold since he began publishing books in 1950. He has about 500 short stories in print.

The Harvard School of Business graduate has a very businesslike approach to writing: eight hours each weekday at the typewriter, with afternoons off on weekends. At this rate MacDonald averaged three books a year in his first 20 years of writing (he began when he was about 30 after a stint in the secret service during World War II).

But his 66th book **Condominium**, the Book-of-the-Month Club's April selection, took him two years to complete.

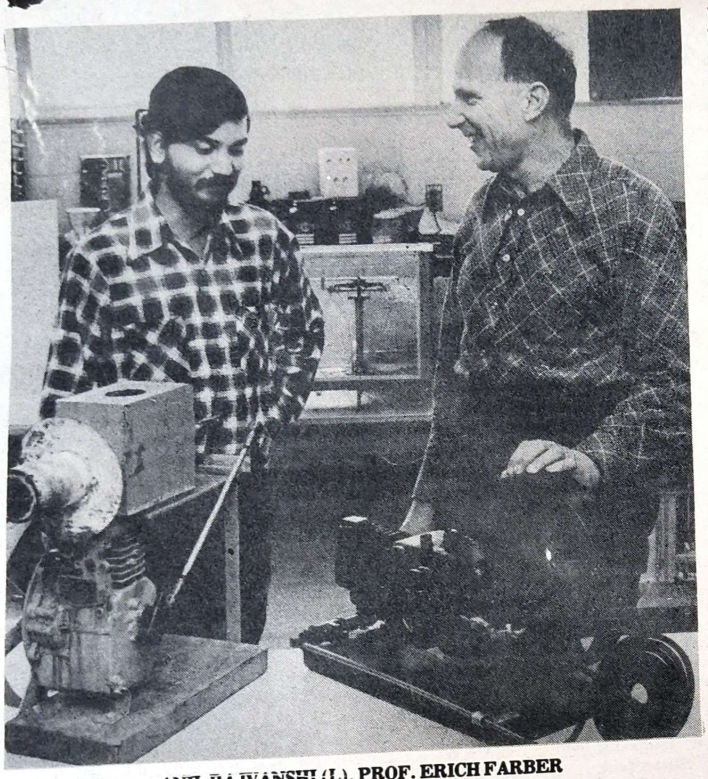
"It's getting more and more difficult for me to please myself," said MacDonald, whose wife Dorothy is an artist.

With **Condominium**, there were a lot of false starts. It's hard to structure a book so it has some theme to it without being preachy.

"And **Condominium** is about the rip-offs of condominium living. It sounds dull as dishwater until you start looking at a particular character in the situation."

One of only about 100 Americans who make a living entirely from writing fiction, MacDonald thinks he knows what people are looking for when they buy his books.

"People of all races, of all times in history, have had a hunger for a story. They want to listen to, or read, tales of suspense, excitement and magic that they can identify with. They want it believable, economical and swiftly paced."



ANIL RAJVANSHI (L), PROF. ERICH FARBER
With equipment offering hope for India

Indian Student Upgrades Solar Water Distillery

The following article appeared in newspapers throughout the state following distribution by the Associated Press:

GAINESVILLE (AP)—A student from India, hoping to turn his parched homeland into productive farmland, is refining a professor's solar energy inventions.

Anil Rajvanshi, a University of Florida graduate student from Lucknow in north central India, is improving one of Dr. Erich Farber's inventions, a solar powered distillation process which turns salt water into fresh water.

Meanwhile, back in India, technologists are adapting another Farber invention, a prototype solar-powered water pump.

Rajvanshi, 26, working side by side with Farber, said he believes by adding dyes or introducing electrical charges into the system of distilling salt water, he may be able to lower the temperature at which it evaporates—thus making more fresh water.

"If we can solve the problems of distillation and pumping, we can irrigate our land and feed our people," Rajvanshi said.

No Requests For APA Hearings On Rule Changes

The tentatively scheduled March 10 hearing on 12 proposed rule changes will not be held since no request was filed during the 14-day period following publication of proposed rule changes.

Under the state's Administrative Procedures Act, proposed rule changes must be published and citizens given the opportunity to request a hearing before a rule is put into effect.

The rules were published in the February 24 edition of the Independent Farmer and Rancher, and, in addition, notice of that publication was included in the February 18 University Digest pages in the Independent Florida Alligator.

The rules, which will now be filed with the Secretary of State's office this week, deal with establishment of new financial aid forms, eligibility and restrictions in married housing, changing language in rules mentioning "Honor Code" to "Academic Honesty Guidelines," recognition of new editions of catalogs and bulletins as providing rules for course and degree requirements, and changes in rules dealing with certain types of parking decals.

Employees Are Advised How Not To Lose Leave

Career Service employees who accrue more than 240 hours of annual leave during a calendar year must take those credits in excess of 240 before the end of the year or forfeit them. Employees nearing that amount may wish to begin to plan now to take leave time this year.

The Personnel Division suggests that the person in each campus work area responsible for maintaining leave records should also periodically check employees' total l ave hours and remind those nearing the 240 limit.

The Department of Administration requires that no Career Service employee have more than 240 hours of leave available as of January 1 of each year.

Speech Research To Be Discussed

UNIFLADS '77, a program of papers and panel discussions on current research being done in the Speech Department will be held Friday from 8:30 a.m. to 5:15 p.m. in Rooms 346-347 of the Reitz Union. All members of the University community are invited to attend. (UNIFLADS is an acronym combining syllables of University of Florida Department of Speech.)

The program will include discussions on research being performed in the following areas: persuasion and resistance to persuasion, language acquisition, non-verbal communication, speech evaluation, the Florida Language Screening system and the neurophysiology of speech. Presentations will be made by faculty and graduate students.

Aid Students Can Phone for Appointment

Students who have not received an appointment for spring quarter financial aid pick-up, but who plan to receive either financial aid, a deferment or fee waiver, should contact the Office of Student Accounts in the Hub, 392-0181 as soon as possible. Appointment times were mailed last week.

Appointments begin March 21 and extend through April 11, between 8:30 a.m. and 3:30 p.m. weekdays. Each student will have a 15-minute time period to complete the transaction, and, for the first time this quarter, students will be able to pick up all of their various aid funds at one time.

Students who received appointment times during the March 21-24 period were provided instructions with their appointment slips on how to reschedule if the between-quarters appointment causes undue hardship.

The appointment system was designed, after consultation with a Student Government Task Force, in an effort to reduce students' line-waiting time.

The University of Florida is an Equal Employment Opportunity/ Affirmative Action Employer.

Miami Herald March 12, 77

To Help Native India

Student Generates Solar Energy Ideas

GAINESVILLE — (AP) — A student from India, hoping to turn his parched homeland into productive farmland, is refining a professor's solar energy inventions.

Anil Rajvanshi, a University of Florida graduate student from Lucknow in north central India, is improving one of Dr. Erich Farber's inventions, a solar-powered distillation process which turns salt water into fresh water.

Meanwhile, back in India, technologists are adapting another Farber invention, a prototype solar-powered water pump.

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"**IF WE CAN** solve the problems of distillation and pumping, we can irrigate our land and feed our people," Rajvanshi said.

He believes solar energy is ideal for India, where there are over 300 days of sunshine each year along with terrible drought.

"Prof. Farber was the main reason I came here," he said. "He told me right off I should work on problems that will help my own country and that I can continue working on when I return there.

"I believe America can do more by sending foreign students back with the knowledge they need to help their countries than any amount of foreign aid can ever do."

Rajvanshi said a new and promising field like solar energy can be damaged by people rushing into it without proper knowledge and preparation.

"**BACK IN 1955**, the Indian government became very excited about solar ovens," he said, "and even provided subsidies to help people buy them. But the housewife didn't want to go out in 110-degree heat to cook, and the evening meal in India is eaten late. You can't cook with the sun after it has set."

He said the same thing can happen in the United States, as it did with the solar energy heated stand at President Carter's inauguration.

"President Carter had to put his coat on, but it wasn't because solar energy didn't work," Rajvanshi said. "It's because they didn't have a storage tank big enough and didn't put it up soon enough to overcome the days of snow.

"I feel that we in the developing countries can sometimes provide answers to industrialized nations because we always have been closer to nature and had to use it because that's all we had," he said.

The Indian student plans to continue his studies and research here until December 1978. Then, he will go home and apply his knowledge for his nation's benefit.

Times of India
March 14th, 1977

Sun On The Water

The mind boggles at the enormous quantum of energy which the earth intercepts in its voyage around the sun. Its average incidence in this country is 2 billion kilowatt-hours per square kilometre per year. A roof-top ten metres by ten collects enough sunlight to produce, at a very low efficiency factor, as much as seven kilowatts of electricity. Why then don't we use more of it? There are historical reasons for it, two of them being that technologies based on cheap fossil fuels were those that developed first and most applications of solar power in western research (which unhappily tends to influence our thinking a shade too much) are aimed at conversion processes requiring expensive, complicated and relatively undeveloped devices such as solar cells. With 300 days of bright shine to bless us, this neglect is tragic. It is heartening therefore to learn that an Indian research student in Florida, working with Dr Erich Farber, is trying to improve the latter's solar-powered distillation process. By adding dyes to brackish water or by introducing electric charges, ionising saline water, it is possible to reduce the temperature at which it evaporates, thus speeding and simplifying the distillation process. Combined with solar pumps this technique can change the very nature of farming. Water is the key and the sun shining on it will solve the problem of shortages. What is more, there is something enchanting about it: our star sustainer of all life, purifies the water, lifts it and transports it to where it is needed and then warms the tender leaves of our cereal grasses. Solar energy is being used abroad to heat homes and greenhouses as well as in many other ways, but techniques specifically aimed at the farmland are more useful to us. This is appropriate technology at its happiest.

The Times of India Editorial
March 14, 1977

Hindustan Times
21st June, 1978

Hindustan Times
21st June 1978

Desert farming with sun, wind

GAINESVILLE (Florida), June 20 (AP)—A Lucknow graduate believes he has found a way to use the sun and wind to turn India's deserts into productive farmland.

The plan devised by Mr Anil Rajvanshi, a mechanical engineering student at the University of Florida, would use the Thar desert floor as a giant solar heat collector to power a desalination plant.

Winds sweeping across the desert would power turbines to pump water 50 km from the Indian Ocean.

Salt water would circulate through ten square km of sand, then go to the plant where condensed steam would become fresh water at the rate of 53 million gallons a day, he says.

This is enough for a city of 200,000 people, but it could be used to irrigate the land.

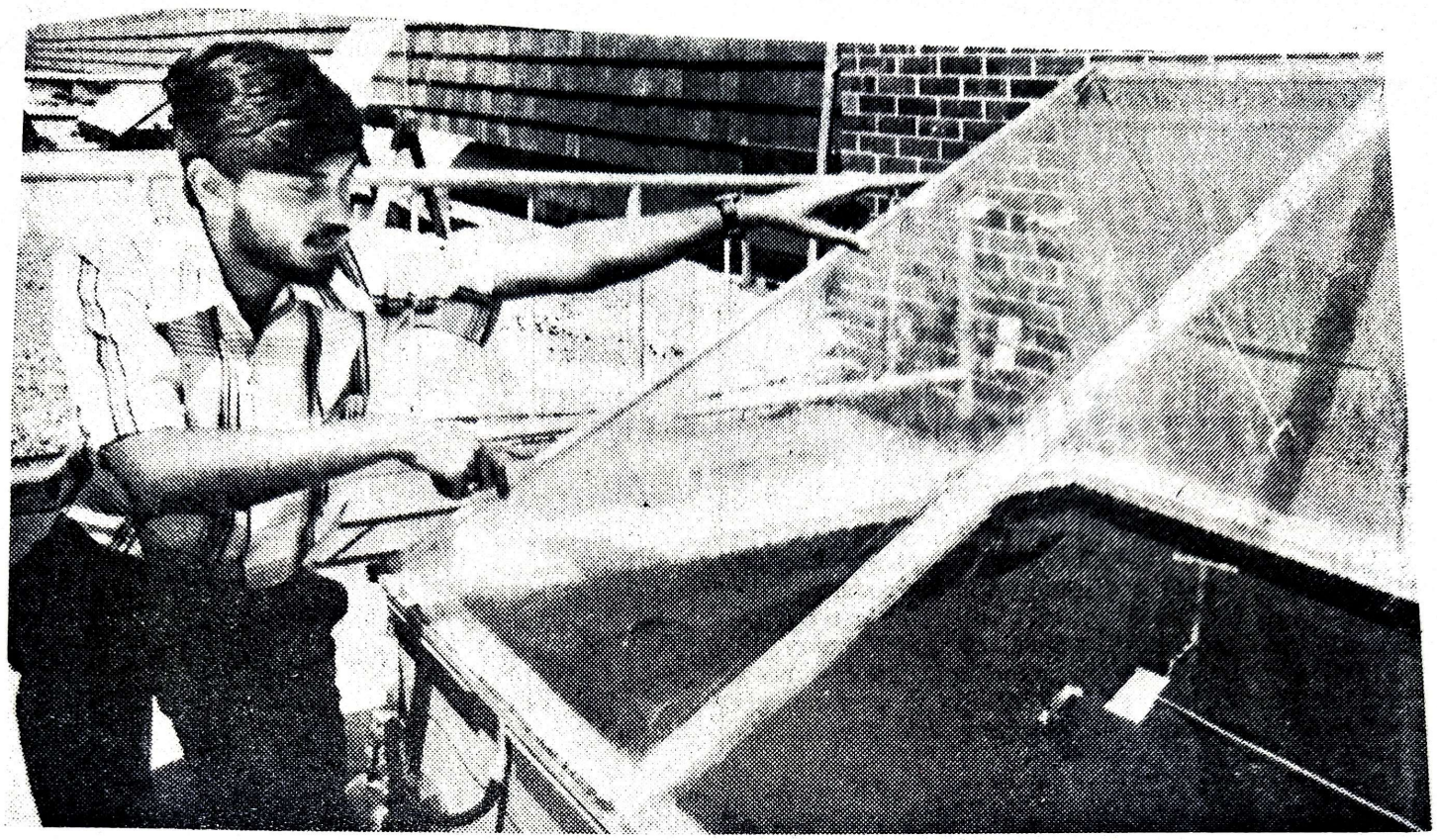
Although designed for the Indian desert region, the plan could be adapted for use in other deserts of the Middle East Latin America and Africa, Mr Rajvanshi said. Deserts in those continents are advancing as the climate enters a drier cycle.

"The irony is that most deserts are near the sea with no lack of water," said the 28-year-old student.

Mr Rajvanshi developed his proposal at the university's solar energy and energy conversion laboratory under the direction of Prof Cal Oliver.

The distillation system he has devised would cost an estimated $600 million. He has submitted it to the Indian Government.

"Though the cost of distilled water with this scheme is initially high the running cost is very low as compared to fossil fuel-fired desalination units," he said. He plans to return to India after he gets a degree next December.



Associated Press

Anil Rajvanshi checks solar energy collector in studies aimed at making desert bloom

India student finds answer to desert blowing in the wind

Associated Press Dispatch

GAINESVILLE — A graduate student from India believes he has found a way to use the sun and wind to turn desert sands in his native country into productive farmland.

The plan devised by Anil Rajvanshi, a mechanical engineering student at the University of Florida, would use the Thar Desert floor as a giant solar collector to power a desalination plant.

Winds sweeping across the desert would power turbines to pump water 50 miles to the from the Indian Ocean.

Salt water would circulate through four square miles of sand, then go to the plant where steam would condense as fresh water at the rate of 33 million gallons a day.

This is enough for a city of 200,000 people and could be used to irrigate the land.

Although designed for the Indian desert region, the plan could be adapted for use in other deserts of the Middle East, Latin America and Africa, Rajvanshi said.

Deserts in those continents are advancing as the climate enters a drier cycle. Scientists have calculated that the Thar Desert is advancing at the rate of one-quarter square mile every year.

"The irony is that most deserts are near the sea with no lack of water," said the 28-year-old student, a native of Lucknow.

"People are always asking me 'what is the money value of that water?' But the question doesn't really make sense over there," he said. "The water is priceless. It makes life possible."

Rajvanshi developed his proposal at the university's Solar Energy and Energy Conversion Laboratory under the direction of Professor Cal Oliver.

The distillation system devised by Rajvanshi would cost an estimated $600 million. He has submitted it to the Indian government, which hasn't yet accepted.

"Though the cost of distilled water with this scheme is initially high, the running cost is very low as compared to fossil fuel-fired desalination units," Rajvanshi said.

He plans to return to his native country after he gets a degree next December.

Indian student's plan to make deserts bloom

Times of India 21/6/78

FLORIDA, June 20.

A LUCKNOW graduate believes he has found a way to use the sun and wind to turn India's deserts into productive farmland.

The plan devised by Mr. Anil Rajvanshi, a mechanical engineering student at the University of Florida, would use the Thar desert floor as a giant solar heat collector to power a desalination plant.

Winds sweeping across the desert would power turbines to pump water 80 km. from the Indian Ocean. Salt water would circulate through ten sq. km. of sand, then go to the plant where condensed steam would become fresh water at the rate of 33 million gallons a day, he says.

This is enough for a city of 200,000 people, but it could be used to irrigate the land.

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Student develops solar desalination plant

By CINDY WILLIAMS
Alligator Writer

The world's vast desert regions may some day be converted to productive land with the use of a solar-powered plant that converts salt water to fresh, developed by a UF mechanical engineering student.

Anil Rajvanshi has proposed a plan for a water desalination plant that could produce 33 million gallons of water a day. For his native country — India — that means such arid regions as the Thar Desert could become farmable land.

TURBINES POWERED by prevailing desert winds would pump water through 2,000-foot-long rectangular concrete tubes where it would be heated to 130 degrees Fahrenheit from the sun's rays.

The water then would be taken to a multi-stage evaporator where it would be condensed into fresh water, Rajvanshi said.

The proposal, however, still is in the planning stages. The construction of such a plant, using today's technology, would cost an estimated $600 million, he said.

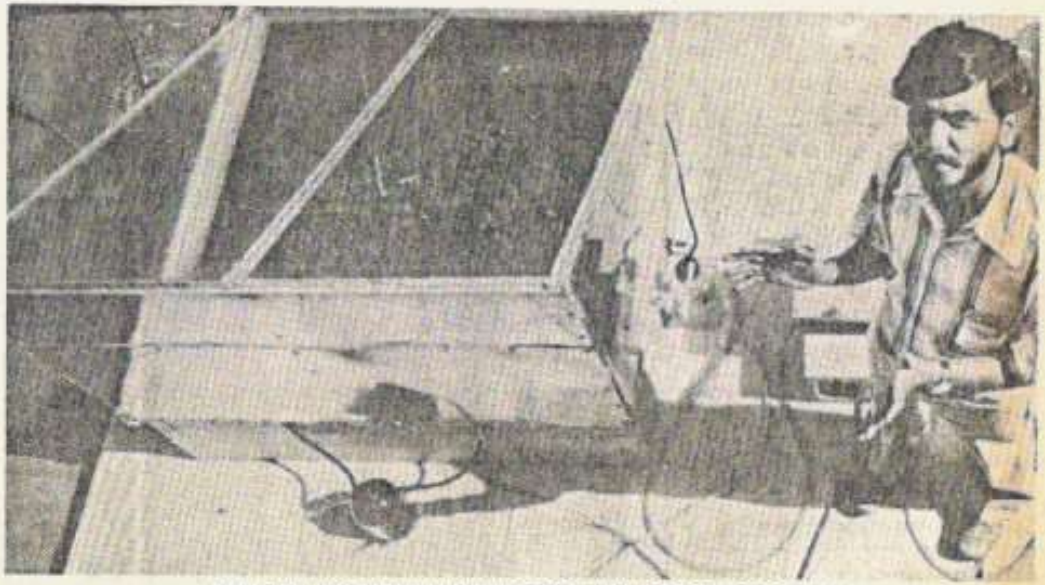
There are water desalination plants throughout the world. But all are fossil fueled. With the continuous rise in the cost of fuel, operation of such a plant eventually will become impractical. Yet, if the solar plant were in operation, costs would be less than the conventional plants now in use.

"THE TECHNOLOGY has to be improved upon," Rajvanshi said. "The whole idea is to make it economically feasible."

Another aspect of the solar plant is that it could be workable in any of the world's desert areas.

"The world must start conserving now. Even in the U.S. there are water shortages in such areas as California," Rajvanshi said.

A NATIVE of Lucknow, India, Rajvanshi has been a student at UF for 3 1/2 years.



ANIL RAJVANSHI WITH WORKING MODEL OF PLANT
. . . could bring new hope to his homeland, India

Thar as giant solar heat collector

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Salt water would circulate through ten square km of sand, then go to the plant where condensed steam would become fresh water at the rate of 33 million gallons a day, he says.

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Israel evasive, says Sadat

CAIRO, June 20 (AP).

President Anwar Sadat said today that Isral's latest statemen on the future of the West Ban and the Gaza Strip was "non positive and evasive".

In his first reaction to th Israeli Cabinet decision on th future of these territories, M Sadat complained that th Israelis "left things up in th air." But he said "I am optimistic". If Israel presented new elements "we are ready to discuss them directly".

Mr Sadat, who was speaking to a meeting of top political and legislative leaders, said Egypt still demanded the return of all Arab land occupied by Israel in the 1967 war and a settlement of the Palestinian question.

Five-day visit

Forida News
26th Aug 1980

Third World researchers leave with energy lessons

GAINESVILLE (AP)—One of the many lessons researchers will take home from the University of Florida's first alternative energy course for developing nations is the reassurance that even technologically developed nations are not immune to mistakes.

"There were a lot of mistakes here that they saw, even simple plumbing mistakes," said Anil Rajvanshi, one of the program instructors who came from India six years ago to study solar energy.

"It gives them confidence to know that even here in the most technologically developed country in the world, people can make mistakes," said Rajvanshi.

Scientists, engineers and government officials from developing nations around the world gathered at UF for a 15-week course titled "Training for Alternative Energy Technologies." Sponsored by the U.S. Agency for International Development, the researchers were taught energy principles, how to purchase energy equipment, and even some basic lessons about the American work ethic.

The first session behind him, Rajvanshi now awaits 38 more participants from 22 nations scheduled to arrive Sept. 8.

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Third World Countries Receive Energy Lessons

GAINESVILLE, Fla. (AP) — With the first group of Third World participants on their way home, an instructor at the University of Florida's alternative energy course for developing nations says the program is a success.

Scientists, engineers and government officials from developing nations around the world gathered at UF for 15 weeks of training for alternative energy technologies. Sponsored by the U.S. Agency for International Development, the course teaches energy principles to allow researchers to use materials available in their homelands to solve problems there, said Anil Rajvanshi, one of the instructors who came from India six years ago to study solar energy.

"Here they were exposed to hydro (such as dam generators) and geothermal energies, or learned how to use agricultural wastes as an energy source," Rajvanshi said.

Participants also learned some fundamental lessons about the American work ethic.

"They learned the dignity of labor," Rajvanshi said. "You have to understand that these people are the elite in their countries and they have workmen do everything.

"Now they see it doesn't have to be that way. Everybody works with their hands here," he said.

Another new experience for some participants was the ability to challenge the printed word — something Rajvanshi also learned when he came to the United States. "Before I came here, when I was in India, anything I read was the law simply because it was in black and white," he said.

The fact that even developed countries make mistakes was a reassuring lesson for the participants, Rajvanshi said. "There were a lot of mistakes that they saw, even simple plumbing mistakes. It gives them confidence to know that even here in the most technologically develope country in the world, people can mal mistakes."

ST. PETERSBURG TIMES ■ SUNDAY, NOVEMBER 9, 1980

Beetle may have key for desert dwellers

United Press International

GAINESVILLE — Inspired by the darkling beetle's trick of gathering moisture from the desert air, a University of Florida (UF) researcher has devised a scheme he hopes will help provide fresh water for desert dwellers.

The darkling beetle of the Namib Desert climbs the crest of a sand dune each day at dawn, stretches its cold body over the slope and waits as the moisture in the sea air collects on its body, eventually forming a drop that it drinks.

Thus, the beetle survives while children living in coastal desert towns often go hungry because man cannot find enough water to grow crops to feed them.

"All the deserts of the world except the Gobi Desert in China have some coastline," Anil Rajvanshi, a native of India, said Tuesday. "When I learned of the beetle, I thought, 'Of course. Couldn't man do that?'"

Trained as a solar distillation-desalinization expert by UF's solar pioneer Erich Farber, Rajvanshi sat down and worked out the details of a system he believes could provide food and water for people in crowded coastal cities.

Rajvanshi's scheme would use windmills to pump 45-degree (Fahrenheit) water from an ocean depth of about 1,600 feet.

The cold water would run through a vast array of radiator-like pipes, 32 acres of which condense 170,000 gallons of dew drops a day, he said.

To make the project more economical, Rajvanshi said, "The deep-sea water used to cool the collection plates could be used like a fertilizer for farming fish and clams."

Rajvanshi conceded that fuel prices would have to double before his idea would be economically feasible.

Indian scientist taking 'powerful' ideas home

United Press International

JACKSONVILLE — Dr. Anil Rajvanshi is going home to India, a nation steeped in tradition, to launch an energy research institute where tradition-smashing ideas such as a solar crematorium will be tested.

Rajvanshi, 30, of Lucknow in northeast India, is a University of Florida Ph.D. in mechanical engineering who specializes in solar desalinization. He was an instructor at the school's two-year-old Alternative Energy Institute.

The solar crematorium, Rajvanshi said, could help solve India's reforestation problem, aggravated by the rite of Hinduism, the religion of 80 percent of his countrymen, of incinerating the dead.

"This requires a tremendous amount of wood — about two tons to cremate one body," he said. "In Bombay and Calcutta, of course, they now use electric arc crematoriums, but that is not the case in the countryside."

Rajvanshi envisions a parabolic concentrator which would focus the sun's rays on the body at such a high temperature as to burn it to ashes.

"Any technology such as this, however, must take into account the socio-economic attitudes of the people and here I think the feeling would be, 'what better way to cremate the body,'" he said.

"Since the sun occupies the highest position among the planets in the Hindu religion and is considered the provider of all life, I think it will conform very nicely to the religious sentiments of the people."

The cremation question is one of many that Rajvanshi will be researching at the institute, which will be located near Poona about 100 miles from Bombay. He is scheduled to leave for his homeland in late July.

Another is how to produce alcohol fuels from sorghum and sugarcane through solar distillation. The alcohol then could be used to replace fossil fuels to run the small engines that pump fresh water from India's rural wells.

"India is the largest producer of sugarcane in the world, but anything containing starch or sugar could be used in this process," he said.

After the juice from the sugarcane has been extracted and fermented, the alcohol is heated, evaporated and condensed.

Rajvanshi said he also will be looking at the use of solar energy in the production of ice for refrigerating and storing food.

A technique he has been working on at UF to produce fresh water from dew condensation also holds promise for a country whose water supply is being taxed by a burgeoning population.

The process calls for the pumping of cold sea water from 25 miles off the coast or closer, the use of heat exchangers along the shore, which produce a relative humidity of nearly 100 percent, and "a tremendous condensation."

"It's like ice in a glass," he said. "The ice water condenses into dew on the outside of the glass."

But Rajvanshi acknowledges that thermal desalinization plants still may not be economically feasible.

Distilled water, he added, runs up against yet another social problem: taste. Distilled water has a bland taste and only becomes palatable with the addition of salt and through aeration.

In the cities, solar energy may reduce India's energy bill — it now spends 80 percent of its foreign exchange on imported oil — by air conditioning offices, drying grains and fibers, dying fabrics and heating water and chemicals.

"(Prime Minister) Mrs. (Indira) Ghandi has set aside $175 million for renewable energy research," Rajvanshi said. "That compares favorably with the $450 million allocated to the U.S. Department of Energy."

The "dynamism" Mrs. Ghandi is trying to inject in the Indian economy must contend with "the inertia and bureaucratic infrastructure" that is inherently opposed to change, the Indian scientist said.

Economic Analysis

Irrigating the Thar Desert with Solar Energy

Anil K. Rajvanshi

WATER WATER, everywhere, but not a drop to drink. That sums up the sandy wastes of the Thar Desert bordering the Rann of Kutch. The sea water is unfit for drinking or irrigation. But it is possible, using only the sea-breezes of the area and the heat of the desert to distil the sea water and make it available for human use.

Windmills on the sea-shore will pump sea-water through concrete pipes into the desert. The heat of the sun will warm the water to a point where it can be distilled in a multi-stage flash evaporator. The pure water can be used for irrigation and drinking, while the residual brine flows back by gravity into the sea. If it is allowed to flow back in an open canal, that will increase the evaporation and concentrate the brine so that it can be used for making salt cheaply on the sea-shore.

The scheme will be costly—perhaps 600 million dollars. But there is scope for reducing the cost, especially through designing a flash evaporator for this specific purpose. Over a period of eight years, the scheme will prove more economical than a fossil-fired desalination plant. While it has been proposed for the Thar Desert, it may be more appropriate for oil-rich countries of the Gulf which have a lot of money and very little fresh water.

The northwest region of India is covered with a large desert known as the Thar Desert which occupies an area of about 200,000 sq. km. Figure I shows the location of this desert and the proposed site for the desalination unit. The desert is inhabited by about 3 million people, most of whom eke out a modest existence through subsistence agriculture. The average annual precipitation is about 150 mm, the monsoon months being from late July to early September; most of the deep wells are saline; and the water table is every low, in some places as deep as 100-220m. In some locales it has not rained for the past 80 years. There is always the threat of famine in this area resulting in great loss of animal and human life. Nevertheless, through the ages local population has been able to identify and use some of the wild plants that grow in this area. These plants grow with very little water available during the monsoon months. and it is hoped that if adequate water is available in this region the quantity of such food together with other staple foods like *bajra* can be greatly increased. Such optimism is also borne by the past history of the region which indicates that the confluence of man and nature has turned this rich area of fluorishing Harrappan culture into a desert.

Several schemes for watering this area have been proposed, but most of them have proven to be economically unfeasible. Among one of the schemes that is being actively pursued by the Government of India is the construction of a huge canal known as the Rajasthan Canal. This canal, when completed, will be able to irrigate a substantial portion of the northern part of the desert, but the scheme has been bogged down by the rising cost of the canal and the lowering of the level of the Sutlej River, the source of this canal.

Other schemes that have been proposed are the desalination of sea water by fossil fuel and nuclear energy, but the rising cost of fuels and their shortages have shelved most of these schemes. The best possibility, then, of achieving the goal of supplying fresh water rests with desalination of sea water using solar energy.

The scheme envisages bringing about 57.0 MG of sea water every hour in three (10 ft diameter) concrete pipes to the location of the "solar field". The proposed location of this field in the Thar Desert is at about 80 km from the Arabian Sea and at an elevation of (150 ft) from sea level. The sea water passes through the heat exchanger tubes of a 20 stage multi-stage flash (MSF) evaporator where it is heated from 15.5°C (the inlet temperature) to about 54.4°C at 2 pm on a typical June day, as a result of the vapour condensing on the outside of the tubes.

Water at 60°C is then flash evaporated in the desalination unit to yield 3.6 MG/hr of fresh water for a typical day in June at about 2 p.m. The pumping of the sea water to the site through the solar collectors and through the desalination unit is powered by wind turbines. The effluents from the plant are allowed to run by gravity back to the sea.

Below are given the details of the design and the cost of the system.

Solar Field: This is the most important component of the system since it provides the energy to effect desalination. Thus the need for right choice of

solar collector cannot be underestimated. For the present scheme the solar collectors should meet the following criteria: (1) Ease of fabrication and maintenance; (2) Cost effectiveness: (3) Minimum corrosion with sea water; and (4) Durability and ruggedness to last the life of the plant.

Several collectors and materials which would meet the above criteria were looked into, and finally concrete was chosen as the collector material. Apart from meeting all of the above criteria, there is an added advantage for picking it as the collector material. The clay (a necessary ingredient of concrete) content of the Thar soil is high (15 per cent), and thus it has been felt that local raw materials can be used effectively in making these collectors, thereby reducing the cost.

Desalination Unit : The heated sea water from the "solar field" goes to the desalination unit for production of fresh water. The desalination unit is the regular multi-stage flash evaporation (MSF) type. Normally, these MSF units are used for brine temperatures of approximately 100°C and thus would seem inappropriate at a first glance, for our scheme where the maximum brine temperature is 60°C. Nevertheless, in the absence of any other viable desalination technology we have used this system. We do, however, feel the need of better and more efficient systems for evaporation of sea water which would ultimately bring down the cost of the scheme. It will be seen later that the MSF unit is one of the costliest item in the whole scheme and thus the need of a better unit.

The distillate output starts as soon as the outlet temperature from the "solar field" reaches 32.2°C. Thus for the month of June the scheme operates for 24 hours while for the month of March it works for 19 hours and for the month of January only 9 hours.

Figure II shows the output for various months. There is no output during the months of July, August and half of September since in these months the sky is mostly cloudly. More over these months can be used for yearly maintenance, if any. The integration of Fig. II thus gives us the yearly output of $5.25 \times 10^7 m^3$ (13860 MG) of fresh water.

In most of the existing desalination plants with MSF units, scale build up is quite a major problem requiring large clean-up operations thereby shutting down the plant and also use of costly chemicals for reducing it. The scale problem becomes more acute after temperatures of 71.1°C while below this temperature the severity of this problem is substantially reduced. Thus, in the present scheme since the maximum brine temperature is 60°C, the scale problem is minimized. This is one of the major advantages of operating at low temperatures.

Pumping Requirements : The sea water has to be pumped from the Arabian Sea to the desalination site which is 80 km from it and at an elevation of 150 ft from the sea level. The pumps., hence, should be large enough to overcome the pressure loss in the feed pipes and the elevation. The feed pipe are three in number and are 10 ft in diameter. They are made of concrete and are 4 inches thick and will be buried in ground so as not to be heated.

In addition to the above requirements, pumps are also needed to effect desalination. Thus in the MSF unit, they should be able to overcome the pressure loss in heat exchangers as well as be able to create enough suction for flash evaporation.

The effluent from the MSF, it is proposed, will be allowed to flow by gravity back to the Arabian Sea in a canal 39 ft wide and 3 ft deep, at a velocity of 4 mph.

The average wind velocity in this area is about 20 mph and sometimes goes as high as 80 mph. Thus, it is quite logical to use wind turbines to pump the sea water. The wind turbines used in the present scheme are the 200 kW each capacity machines which are being actively experimented by the Department of Energy (DOE) for large scale deployment in the 1980's. The machines will be staggered throughout the length of the feed pipes and in the solar field.

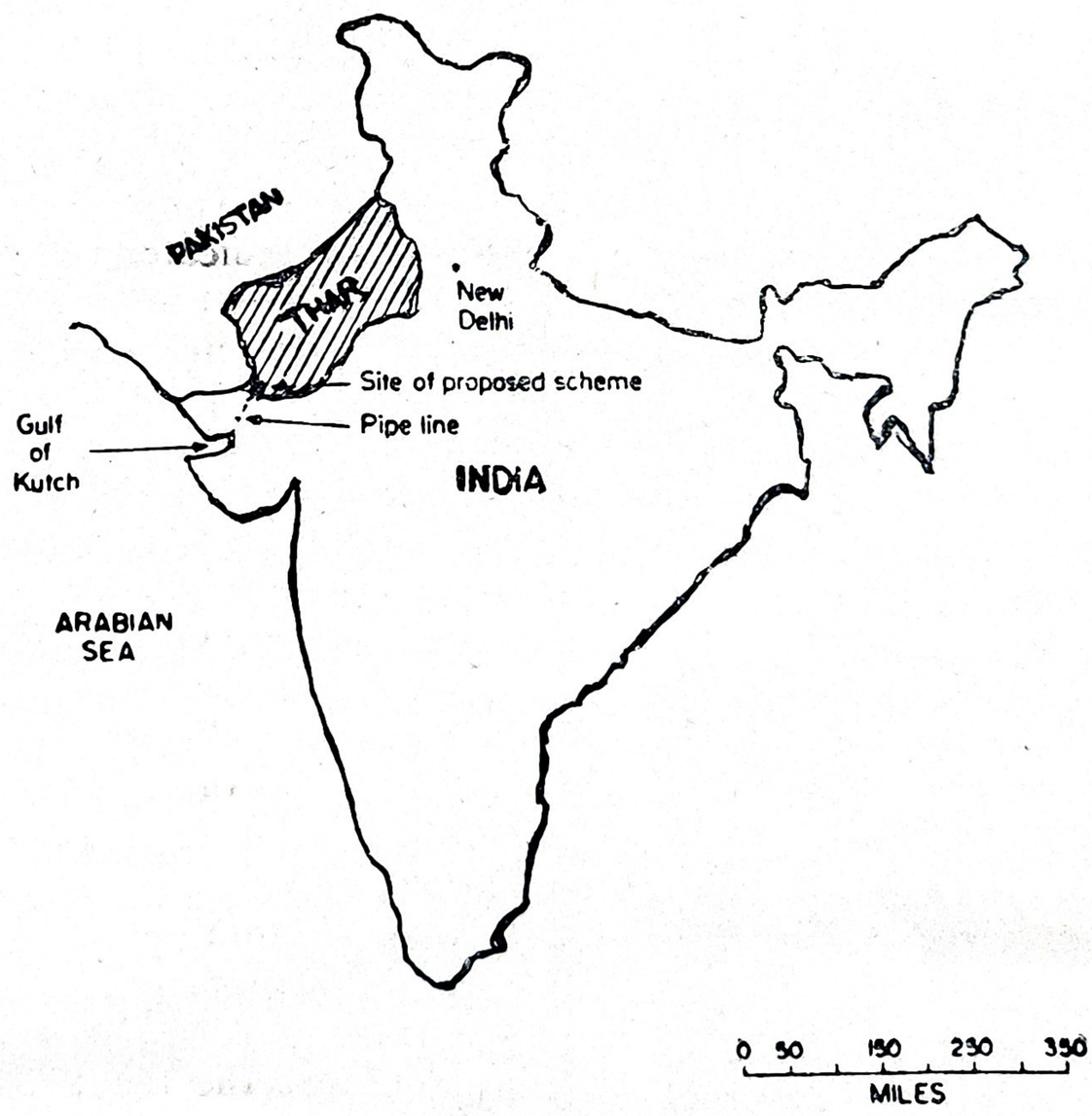


Fig. I

P. T. O.

In the feed section they will be arranged in such a manner so that each machine just overcomes the pressure loss and the elevation head equivalent to its capacity. At the same time there will be one elevated storage tank attached to each machine, which will be filled up when the wind velocities go above 32 km/hr. Thus during the "wind lean" periods the steady flow rate in the feed section will be maintained. The exact analysis on the size of these tanks and their location has not been done since it is beyond the scope of this article.

Disposal of Effluents : In the present scheme, the rejected seawater is on an average about 53.0 MG per hr, and it is but natural to inquire if we cannot use this brine to extract salts like NaCl, KCl and others. However, the effluents have a salt concentration of only 3.7 per cent, which is still 96 per cent pure water and is not sufficiently shown to be, in general, an economically viable feed stock. Nevertheless, the decision on whether to extract the salts from this brine has to be made, taking into consideration many local, national and economic factors that it is again beyond the scope of the present article.

In such a large scale desalination plant study, it is also worthwhile to look at the effect of effluents on the marine environment. Very little work has been done on this aspect, but the studies do indicate that there is very little or negligible effect on the marine environment. Specifically, in our case, since we are operating at very low concentrations of salts and at the same time very near to the feed water temperature of 15.5°C, the harmful effects will be negligible to the environment. In any project of the magnitude and complexity like the present scheme, the calculations for the cost of water can be an approximation. There are a multitude of local conditions that have to be taken into account for the final figures. In the absence of any such data, like the cost of water in this re-

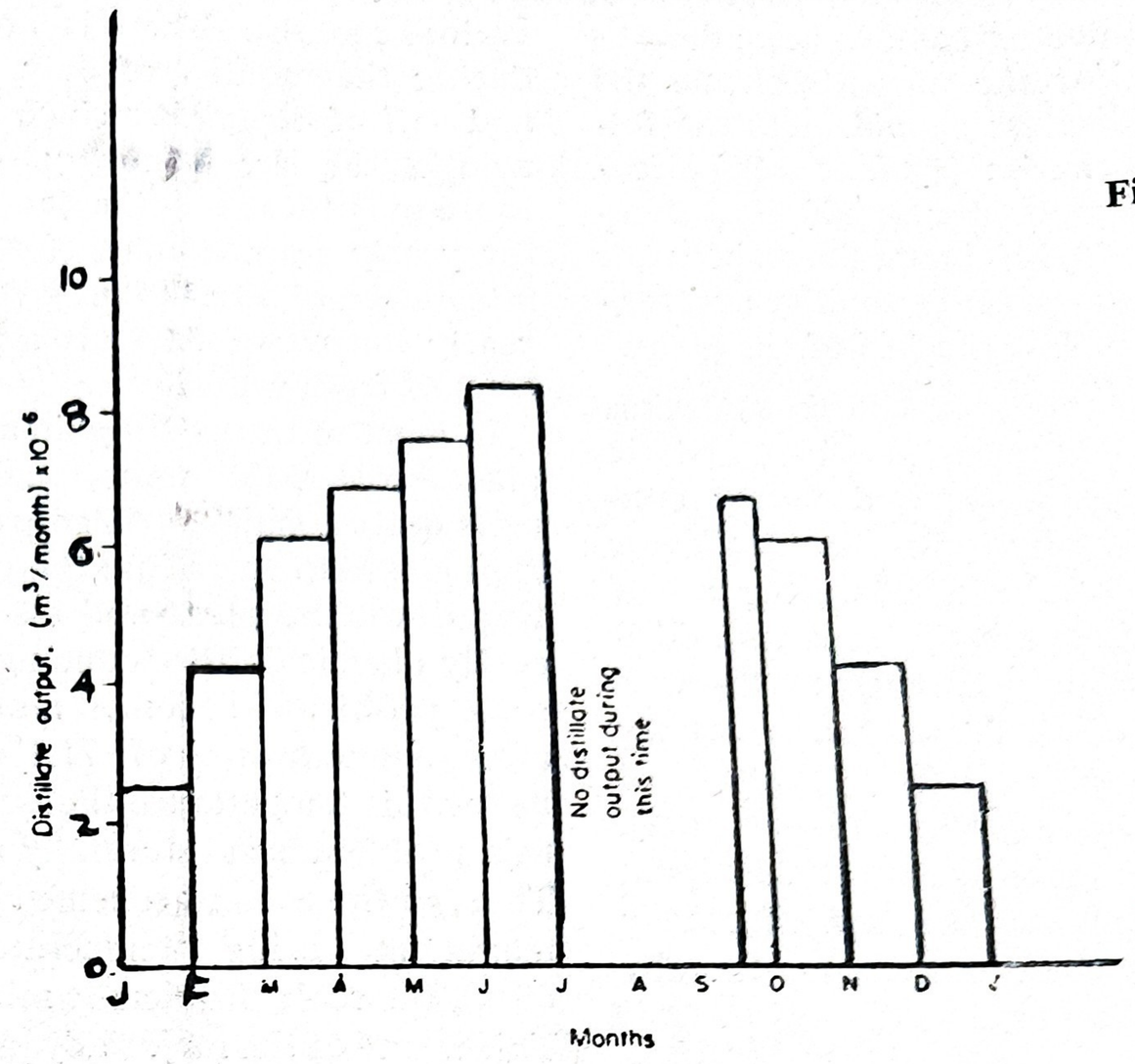


Fig. II

tion, cost of other alternatives and the payback mode for a desalination plant, it is appropirate that a simple minded cost calculation based on the capital and running cost of the system should be sufficient. The capital cost includes the cost of wind machines, the cost of 20 stage MSF unit and the cost of concrete tubes. Also included in the capital cost is the labour which has been taken arbitrarily to be 20 per cent of the capital cost. The running cost includes the maintenance and the chemicals for scale reduction. Based on the existing technology for such plants, the maintenance cost has been taken to be 7 per cent of the capital cost.

Though the cost calculations done above are justified for the sake of completeness of the study there are other things which sometimes are given priority than cost, to make the scheme work. In an area where the level of poverty is unimaginable and where a small amount of water together with the will and determination of these people will bring wonders to the land, it can be argued from the philosophical point of view that the water is priceless. Thus, a scheme of this nature and magnitude can only be funded by the Government as a part of the social commitment to the people.

The purpose of this article has been to look at technical and economical feasibility of a scheme to desalinate sea water using solar energy for Thar Desert in India. Based upon this study the following conclusions can be drawn: (1) An area of 4.5 sq miles of desert will be sufficient to produce 13860 MG of fresh water every year. (2) The pumping requirements for the whole scheme will be met by 415 wind machines each of 200 kW capacity. (3) The cost of water from the present scheme compares favourably with that from a fuel fired MSF plant, the cross-over taking place in about 8 years.

Finally, it is realized that the technological implications are staggering, but the impact on the national economy, the welfare and employment of the local rural population and the effect on the environment in terms of converting this desert into a great productive area, appear to be favourable and thus warrant further development and evaluation of the present scheme.

A light for every household

Indian Express - Pune - 30.09.1983

By Dr. Anil K. Rajvanshi

Even after 36 years of independence only 26 per cent of the rural households have been electrified. For a majority of households, the only source of illumination is the humble kerosene lantern. The country where the Government's rural electrification programme till now has meant one pole at the outskirt of the village the role of kerosene will increase rather than decrease.

The existing kerosene hurricane lantern is an extremely inefficient device. Its illumination efficiency is just one per cent as 99 per cent of the energy goes out as heat. This is very low as compared to the 10 per cent illumination efficiency of the electric light bulb and about 20 per cent of the fluorescent tube. Besides, the light from a lantern is only equivalent to a two watt light bulb an extremely poor output that puts a tremendous strain on the eye.

There are about 100 million lanterns in the country consuming about 2200 million litres of kerosene every year. Thus if the lantern illumination efficiency can be improved to 10 per cent (not a difficult number to achieve) a net saving of about 220 million litres will result (for the same light output). This will save the country about Rs. 40 crore per year in precious foreign exchange. Thus the stakes are high and point to the need to improve the lantern.

No real improvement has been made in the hurricane lantern for the last 200 years. The principle of the lantern is based on incomplete combustion of kerosene which results in the bright yellow light. If the combustion were complete, then the resulting flame would be blue (as is found in kerosene stoves) and no appreciable light will, therefore, result. Thus the very nature of the incomplete combustion process is the cause of poor efficiency of lantern. Hence there is a need to design lanterns which have complete combustion of kerosene.

Petromax type lanterns with a mantle, achieve this. These are pressurised lamps (similar to primus stove) where Kerosene is vaporized by combination of heat and compressed air. The mantle is made of fibreglass cloth coated with rare earth oxide material and the bright light results because of its incandescene. Since the source of light is the mantle, there is complete combustion of kerosene, resulting in a higher temperature of the mantle. The efficiency of such a lamp is about 5 per cent. However, there are drawbacks in these lamps. Firstly the cost is high, about Rs. 200-Rs. 300 per lamp. Secondly the mantles are very fragile, necessitating frequent replacement thus increasing the maintenance cost. Thirdly the washer on the piston gets worn out very easily and has to be replaced often, increasing the cost of maintenance. Finally because these lamps work at high pressures, they are safety hazards.

Various high efficiency lamps have been designed in western countries but they all run on compressed LPG or propane, a costly and nonrenewable fuel. Thus no high efficiency lantern exists today which can run on kerosene or any liquid fuel.

One of the ways of improving the lantern is the use of better materials for the mantle. With high temperatures the fibreglass cloth becomes very brittle and hence disintegrates. Better materials like ceramics could be used instead.

Secondly extensive research should be conducted in use of thermoluminscent materials like phosphers (oxides and sulphides of calcium, bariumm etc.) for mantles. These materials store energy, so that when heated (temperatures of about 200-300 °C), they release it in the form of light. Thus they are very different from incandescent materials (filament of light bulb, petromax mantle etc.) where the light is produced because of thier being heated to high temperatures (about 2000 °C-3000 °C). Hence thermoluminescence is also called cold light because of a lower temperatures of solids. The very nature of the thermoluminescent process, therefore, makes the illumination efficiencies of such systems extremely high, which can reach 60-70 per cent. Thermoluminescent materials have not however, been tried for illumination and the existing ones still suffer from drawbacks like high cost and poor cycling efficiencies. Thus to make a cheap and lasting thermoluminescent mantle requires extensive R and D.

Thermoluminescene is similar to bioluminescene (cause of firefly illumination) except in the latter case, light is produced by release of chemical energy while in thermoluminescene it is produced by thermal energy or heat. Extensive research should also be conducted on bioluminescene because a breakthrough in this area could completely revolutionize the whole lighting industry, both rural and urban. Beside efforts in improving the lantern, they should be directed towards finding an alternative fuel to kerosene. Three alternatives appear feasible at the present moment.

Ethyl alcohol or ethanol is an excellent source of fuel and is renewable. Normally high quality ethanol (90-95 per cent concentration is used for internal combustion engines as gasohol (mixture of petrol and ethanol) or as a feedstock for chemical industries. However it is the low quality (55-60 per cent concentration) ethanol which becomes extremely attractive as fuel for lighting or cooking. Results at our laboratory have shown that it is very easy to distil 55-60 per cent ethanol (which is of burnable quality) by solar energy. The fermentable liquid can be obtained from sweet sorghum or sugarcane. However to use this percentage of ethanol either in lantern or for cooking, one requries a wickless burner because water in the ethanol swells the wick and hence stops the combustion. Our results have also shown that the cost of producing ethanol from sweet sorghum is Rs. 1.50/litre.

This price is extremely attractive as compared to Rs. 2 per litre of kerosene which is subsidised. With sweet sorghum as raw material it will require only 2 per cent of India's total land presently under cultivation, to produce ethanol which can displace the present yearly kerosene consumption for cooking and lighting.

Another source of fuel is non-edible oils. Before kerosene, these oils were the traditional source of illumination in India. According to a KVIC report published in 1978, the total potential in India of tree borne oilseeds is about 7.5 million tons/year whereas actual consumption has been only 0.5 million tonnes/year (mostly for soap making) or about 6 per cent of the potential. There are about 56 known species of trees that have the ability to produce oilseeds. Normally exploited species have been sal, mohwa, karanja etc. There has been no attempts at yield improvement through breeding of these species, and thus the true potential of the non-edible oil bearing trees is phenomenal. The Government should incorporate non-edible oil tree species into the social forestry programme.

Recent pioneering work in western countries in wood stoves has opened the possibility of using wood or briquettes for lighting. The key element in the new design of woodstoves is a catalytic burner. This is a wire mesh coated with certain elements and is put above the wood crarte. All the unburnt gases (or smoke) produced, passes through the mesh and is easily burnt because of the catalyst. The result is production of intense heat and absolutely no smoke. Thus a wood powered lantern based on the above concept and with a thermoluminescent mantle could revolutionize rural lighting.

All these possible soultions are also applicable for cooking.

Finally it is interesting to compare the overall efficiencies of electric lighting and kerosene lighting. With thermal power station effeciency of 35 per cent, transmission losses of 30 per cent and light bulb efficiency of 10 per cent, the overall efficiency of conversion of fossil fuel to light is only 2 per cent. The overall effeciency of the lantern on the other hand is 1 per cent. Together with the overall low efficiency of light bulb, is also the heavy investment in transmission lines etc. therefore with improved lantern, it should be possible for the energy planners to think of decentralised lighting systems as an attractive alternative to rural electrification and lighting.

Producer gas from biomass

By Anil K. Rajvanshi

SRI Lanka recently hosted the First International Conference on Producer Gas Technology in Colombo in which 65 of the world's top producer gas experts and equipment manufacturers participated. The consensus of the participants was that producer gas technology provides an economically viable alternative energy for developing countries and that the present state of art of this technology is sufficient for mass production of producer gas units.

The feasibility of using producer gas technology on a large scale has been amply demonstrated. The Philippines is the first country in the world in present times to mass-produce producer gas units for water pumps, automobiles, boats and electric generators. The real value of these efforts lies in the success with which the technology was simplified, brought down and accepted at the grassroots.

Basically producer gas is produced by incomplete combustion (burning) of biomass like wood, charcoal or farm waste like rice husk, sugarcane leaves, etc. The resulting gases of this combustion process are carbon monoxide, hydrogen and some traces of methane. This gas mixture – called producer gas – is highly combustible and can directly run internal combustion engines (both petrol and diesel). On an average one kilo of dry wood, charcoal or any dry biomass produces about one kwhr of energy. It is this high energy density, coupled with the fact that it can run on farm waste (a renewable energy source) makes producer gas systems an extremely attractive source of energy.

Producer gas technology itself is quite an old technology, but considerable development work was done in Europe during the Second World War. By the end of the war there were close to five million vehicles in Europe running on producer gas. Besides being used for automotive purposes, stationary producer gas plants were generating electricity and were also used in farms for water pumping, post-harvest processing and in timber mills. In India itself there were quite a number of vehicles running on producer gas during this time, including a fleet of 50 buses plying between Poona and Bombay.

With the cheap and abundant supply of petrol assured after the war the whole producer gas technology was completely abandoned. However, the energy crisis brought about renewed interest in this form of power generation. Nevertheless these gasifiers could not match the glamour of solar and wind energy systems. When these systems failed to deliver energy, producer gas became the focus of attention.

INITIAL RESULTS

In 1977 the Philippines Government piloted a project in Laguna to determine the applicability of producer gas as a diesel supplement for irrigation systems. The initial results were extremely encouraging and after thorough testing and debugging of various kinds of producer gas equipment, the Philippines set up the Gasifier and Equipment Manufacturing Corporation (GEMCOR) in July 1981. GEMCOR's mandate is to initiate commercial gasifier production and to encourage private sector participation in its efforts. Till now, 1,200 units have been manufactured and installed for various applications. These include sets for irrigation, rice mills, vehicles (jeeps etc.), fishermen's boats, electric generation (about 30-40 kw. capacity sets), ice plants in remote islands, threshers and grain dryers.

These 1,200 sets are already saving the country 1.1 lakh barrels of oil or equivalent of about Rs. 4 crore in foreign exchange per year. The targeted production of gasifiers in Philippines over the next five years is about 4.2 lakhs. They are expected to save the country about Rs. 1,600 crore or the equivalent of 34 million barrels of oil over this period. It is estimated that 750,000 hectares of plantation will produce the necessary fuel for gasifiers.

Most of the gasifiers produced are for rural application. Their acceptance in these areas has been based on two reasons. Firstly they make economic sense. On an average the payback period of gasifiers for irrigation systems is 1.5 to two years. With shortage of diesel and its rising price this payback period is extremely attractive. Secondly, the Farm Systems Development Corporation (FSDC) the parent organisation of GEMCOR, through its various incentive schemes like soft loans to farmers, its ready rural market and extension services coupled with a massive media campaign has made these gasifiers available to farmers at easy and attractive terms. Besides, GEMCOR also installs and services these units.

We can learn much from the Philippine experience. In India about 200 million tonnes of farm waste (rise husk, sugarcane leaves, cotton stalks etc.) are available annually. Most of this is burned on the ground itself. This, therefore, provides an excellent source of fuel for gasification. Even if 50 per cent of this waste is utilised in gasification it will be equivalent to about 10,000 mw or 300 million barrels of oil, a saving of about Rs. 10,000 crore per year in foreign exchange.

Besides saving the country foreign exchange, electricity generation by gasification (on a small scale) makes economic sense even today. Work at our laboratory has shown that for sugarcane leaves as fuel for gasifier the cost of electricity production is 30 paisa per kwhr (the cost of harvesting etc. of sugarcane leaves is Rs. 80 tonnes). If fuelwood – e.g. Leucaena (Subabul) – at Rs. 400 per tonne is used then the electricity generation cost becomes 60 paisa per kwhr.

GREAT BOON

Biomass gasification provides the first economically viable alternative energy technology for rural electrification. It is decentralised and uses the locally available fuel. Besides it will also provide a great incentive for farmers to grow trees which will complement the special forestry programme of the Government of India. It is also interesting to note that 10,000 mw can power close to two million diesel pumping sets (this is about half the population of 5-10 hp diesel pumping sets employed in India). It is this application of gasifier technology that offers the greatest boon to the farmer. Besides, the use of gasifiers for running tractors (used extensively in Europe during World War II) is another strong area of application in rural areas.

For industrial applications 150-200 kw gasifier generating sets provide an attractive alternative to diesel sets. The fuel could be provided from rural areas. This could be either charcoal, charred briquettes or just dry wood. Besides use for standby generators, gasifiers provide an extremely attractive alternative to furnace oil for high temperature and process heat applications since high quality producer gas is an excellent fuel for industrial boilers.

It should, however, be noted that not all the technical problems in biomass gasification have been solved. The gasifier unit is very fuel specific. The wood, charcoal or biomass has to be of certain size, its moisture should be less than 20 per cent and the fuel should be relatively ash-free. Such is however not the case with rice husk, sugarcane leaves etc. which have high ash content. This result in slagging and the ash has to be removed constantly from the gasifier. With constant removal of ash the unit becomes mechanically complex and requires increased maintenance, making it unsuitable for rural areas. However, China has reported success in running a 150 kw unit based on this technology.

The maintenance problems are least with use of charcoal as fuel – a path chosen by GEMCOR and FSDC in the Philippines. Production of charcoal, however, requires processing of biomass fuel. FSDC therefore delivers a package deal to the customers – gasifier and one years' supply of charcoal. Besides it also gives incentives to grow trees and produce charcoal in rural areas.

The area of fuel processing and modification of gasifier running on rice husk, sugarcane leaves etc. requires extensive R & D and should be embarked upon aggressively. Thus as a first step the Government should either set up an organisation similar to GEMCOR in collaboration with Philippines or give appropriate incentives to the private sector. The rural and urban market for the gasifiers already exists and thus a time-bound targeted national programme should be started.

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Light for Every Household—A Need for Development of Kerosene Lantern

Dr. Anil K. Rajvanshi*

Light for Every Household—A Need for Development of Kerosene Lantern

Dr. Anil K. Rajvanshi*

It is a great shame for all of us, that even after 36 years of independence there are hundreds of thousands of households in the country whose only source of illumination, at night is the light coming from a chulha. With heavy investment made in the rural electrification, only 26% of the rural households have been electrified. Thus for majority of the 74% of the households, the source of illumination is the humble kerosene lantern. With frequent blackouts and brownouts, even the households which have been electrified have to depend upon the kerosene lantern for part of the time.

In a country where the Government's rural electrification program till now has meant one pole at the outskirt of the village and an electric wire coming to it, the role of kerosene will increase rather than decrease. It is therefore safe to say that till 2000 A.D. the country will still have millions of kerosene lanterns in use.

The existing kerosene lanterns (the hurricane type) is an extremely inefficient device. Results at our laboratory have shown that its illumination efficiency is just 1% i.e. 99% of the energy goes out as heat ! This is very low as copared to 10% illumination efficiency of electric light bulb and about 20% that of flourescent tube. Besides,

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the light from a lantern is equivalent to a 2 watt light bulb only-an extremely poor output that puts tremendous strain on the eyes.

There are about 10 crore lanterns in the country consuming about 220 crore litres of kerosene every year. Thus if the lantern illumination efficiency can be improved to 10% (not a difficult number to achieve) a net saving of about 200 crore litres will result (for the same light output). This will save the country about 400 crore Rupees per year in precious foreign exchange. Thus the stakes are high and point to the need of improving the lantern.

No real improvement has been made in the hurricane lantern for the last 200 years. The principle of the lantern is based on incomplete combustion of kerosene which results in the bright yellow light. If the combustion were complete then the resulting flame would be blue (as is found in kerosene stoves) and no appreciable light will, therefore, result. Thus the very nature of the incomplete combustion process is the cause of poor efficiency of lantern. Hence there is a need to design lanterns which have complete combustion of kerosene.

Petromax type lanterns which are in vogue in the country, and have mantle, achieve this. These are pressurised lamps (similar to Primus stove) where kerosene is vaporized by combination of heat and compressed air. The mantle is made of fibreglass cloth coated with rare earth oxide material and the bright light results because of its incandescence. Since the source of light is the mantle, there is complete combustion of kerosene, resulting in higher temperature of mantle. The efficiency of such a lamp is about 5%. However there are following drawbacks in these lamps. Firstly the cost is high, about Rs. 200—Rs. 300 per lamp. Seeondly the mantles are very fragile, necessitating frequent replacement thus increasing the maintenance cost. Thirdly the washer on the piston gets worn out very easily and has to be replaced often, incressing the cost of maintenance. Finally because these lamps work at high pressures, they are safety hazards.

Various high efficiency lamps have been designed in Western countries but they all run on comparessed LPG or propane, a costly

and non-renewable fuel. Thus no high efficiency lantern exists today which can run on kerosene or any liguid fuel.

Possible Solution

One of the ways of improving the lantern is the use of better materials for mantle. With high temperatures the fibreglass cloth beomes very brittle and hence disintegrates. Better materials like ceramics (which are sturdy) could be be used for the mantles. Ceramics at present are extensively used for high temperature applications and hence can be used here also.

Secondly extensive research should be conducted in use of thermoluminescent materials like phosphers (Oxides and sulphides of calcium, Barium etc.) for mantles. These materials store energy, so that when heated (temperatures of about 200—300°C), they release it in the form of light. Thus they are very different from incandescent materials (filament of light bulb, Petromex mantle etc.) where the light is produced because of their being heated to high temperatures (about 2000°C—3000°C). Hence thermoluminescence is also called cold light because of lower temperatures of solids. The very nature of thermoluminescent process, therefore makes the illumination efficiencies of such systems extremely high, which can reach 60—70%. Thermoluminescent materials have not however, been tried for illumination process and the existing ones still suffer from drawbacks like high cost and poor cycling efficiencies. Thus to make a cheap and lasting thermoluminescent mantle requires extensive R & D.

Thermoluminescene is similar to bioluminescence (cause of the firely illumination) except in the latter case, light is produced by release of chemical energy while in thermoluminescence it is produced by thermal energy or heat. Extensive research should also be conducted on bioluminescence because a breakthrough in this area could completely revolutionize the whole lighting industry, both rural and urban. The science and technology of thermoluminescent and bioluminescent materials is at the leading edge and thus a study and improvement of a humble lantern provides a great challange and opportunity for our scientists and technologists to utilize their best knowledge for the betterment of poor people.

Alternative Fuels

Besides efforts in improving the lantern, they should also be directed towards finding an alternative fuel for kerosene. Three alternatives appear fesible at the present moment.

Ethyl Alcohol or Ethanol is an excellent source of fuel and is renewable. Normally high quality ethanol (90—95% concentration) is used for internal combustion engine as Gasohol (mixture of petrol and ethanol) or as a feedstock for chemical industries. However it is the low quality (55—60% concentration) ethanol which becomes extremely attractive as fuel for lighting or cooking. Results at our laboratory have shown that it is very easy to distill 55-60% ethanol (which is of burnable quality) by solar energy. The fermentable liquid can be obtained from sweet sorghum or sugarcane. However to use this percentage of ethanol either in lantern or for cooking, one requires a wickless burner because water in the ethanol swells the wick and hence stops the combustion. Our results have also shown that the cost of producing ethanol from sweet sorghum is Rs. 1.50/litre. This price is extremely attractive as compared to Rs. 2/litre of kerosene which is subsidised any way. Obviously there are social problems in distillation of ethanol but once government makes a bold policy decision then these problems can be solved. It is also interesting to note that with sweet sorghum as raw material it will require only 2% of India's total land presently under cultivation, to produce ethanol which can displace all the present yearly kerosene consumption for cooking and lighting.

Another source of fuel is non-edible oils. Before kerosene, these oils were the traditional source of illumination in India. According to KVIC report published in 1978, the total potential in India of tree borne oilseeds is about 75 lakh tons/year whereas actual consumption has been only 5 lakh tons year (mostly for soap making) or about 6% of the potential. There are about 56 known species of trees that have the ability to produce oil seed. Normally exploited species have been Sal, Mohwa, Neem, Karanja etc. There have been no attempts at yield improvement through breeding of these species, and thus the true potential of the non-edible oil bearing trees is phenomenal. In fact the Government should seriously consider incorporating the non-edible oil tree species into their social forestry program.

All the non-edible oils are excellent fuel for burning both for lanterns and cooking stoves. However a modification will have t, be made in these devices. In fact a positive policy by Govt. of India on non-edible oil tree plantation will have far reaching agricultural implications in terms of employment and money generator.

Recent pioneering work, in Western countries in wood stoves has opened the possibility of using wood or briquettes for lighting. The key element in the new design of woodstoves is a catalytic burner. This is a wire mesh coated with certain elements and is put above the wood grate. All the unburnt grass (or smoke) produced, passes through the mesh and is easily burnt because of the catalyst. The result is production of intense heat and absolutely no smoke. Thus a wood powered lantern based on the above concept and with a thermoluminescent mantle could revolutionize the whole rural lighting.

It should be noted that all the above possible solutions outlined for lighting are also applicable for cooking. With almost 55% of India's total inanimate energy used in cooking and lighting it is essential that solutions like above should be aggressively researched and pursued.

Finally it is interesting to compare the overall efficiencies of electric lighting. With thermal power station efficiency of 35%, transmission losses of 30% and light bulb efficiency of 10%, the over all efficiency of conversion of fossil fuel to light is only 2% ! The overall efficiency of the lantern on the other hand is 1%. Together with the overall low efficiency of light bulb, is also the heavy investment in transmission lines etc. Therefore with improved lantern, it should be possible for the energy planners to think of decentralised lighting systems as an attractive alternative to rural electrification and lighting. *(Courtsey—Indian Express)*

of the Central Electronics Engineering Research Institute, Pilani and Dr A Alluriah of the Regional Engineering College, Warangal. The device accepts the supervisory channel signals generated in the system and records the sequence of events.

Presenting a paper at a seminar in Pune, the scientists said the circuit have been so arranged that the reading of 'sequence of events is direct, without the necessity of interpretation by the user, unlike the conventional systems. Though the device has been initially designed for a four-channel system, it can be extended upto eight channels easily with the addition of appropriate circuitry.

Explaining the working of the indicator, they said first the input signals from the process system are fed to the input sense and latch circuitry. Once any event for fault is sensed it will be latched and communicated to the control unit. This binary code corresponding to the channel number is generated by the logic circuit and is placed at the inputs of display latches as data. Then the control unit issues strobe signals to the display system, the scientists said. □

Method to produce alcohol from sorghum stalks

A new method for producing alcohol, from sweet sorgum stalks using solar distillation units has been developed at the Nimbkar Agricultural Research Institute (NARI), in Phaltan, Maharashtra.

With the vacuum distillation unit it is possible to distil 40 to 60% ethanol by solar energy—on an average of 1.4 kg of 40% ethanol per metre square of the solar collector per day, Dr Anil Rajwanshi, director of the Institute told PTI Science Service.

He said the efficiency of solar ethanol distillation unit is about 13 per cent which is extremely favourable compared to the two to three per cent obtainable from existing fossil fuel fired ethanol distillation plants.

The conventional alcohol distillation technology, Rajwanshi said, is based on use of costly fossil fuels and, therefore, results in net negative energy value, i.e. more energy has to be put in for producing alcohol than is obtained by burning it. 'Distillation of ethanol by solar energy is a potential answer to this.' Asked why sweet sorghum is preferred, he said, experiments conducted at the institute and elsewhere indicate that it may be possible to produce more ethanol 4000 to 5000 litres per hectare per year compared to 3,500 litres of sugarcane.

The distillation plant essentially consists of an solar array, a vacuum pump, a storge tank for storing the alcohol water mixture to be purified and a vacuum distillation unit. The fermented sweet sorghum solution is first distilled in the conventional distillation units for 15 days to reduce the chances of corrosion of the new plant. The alcohol water solution thus obtained is then put in the tubes of the solar collectors and the vapour is then allowed to condense in the distillation unit. The vacuum pump is attached to reduce the boiling point of ethanol, Rajwanshi adds. □

Sophisticated rocket propellants developed

HIGH performance rocket propellants which can be used for rockets of range 30 to 40 km are now ready for use at the Explosive Research and Development Laboratory, (ERDL) Pune.

The propellants developed by the ERDL scientists using ammonium percholate will go a long way in increasing the efficiency of the

West Begnal, Madhya Pradesh and Haryana, and the latter, a bold seeded variety with multiple field resistance to disease like wilt, stunt, stem rot and ascochyta blight, is recommended for cultivation both in irrigated and rainfed conditions in the states of Madhya Pradesh, Rajasthan and Gujarat, Michael said. □

Alcohol stove

SCIENTISTS at the Nimbkar Agricultural Research Institute, Phaltan in the Satara district of Maharashtra, have developed a novel stove which uses alcohol as fuel.

The new wickless stove which uses 40 to 60% ethanol and water mixture as fuel could give a thermal output of three kW, Dr A K Rajwanshi, Director of the Institute told PTI Science Service.

The stove, which was totally designed and fabricated indigenously has a cooking efficiency of 30 to 35%, compared to the 20 to 25% of conventional kerosene stoves. It is designed to ensure a constant evaporation of the alcohol and enable the user to control the flame easily, he said.

Explaning why the conventional wick stoves cannot be used with ethanol and water mixture as fuel, Rajawanshi said, 'this is because, water together with ethanol is drawn up by the capillary action of the wick and thus interferes with the combustion of ethanol.' The existing kerosene stoves are also not applicable 'as they are designed for kerosene which has a different heat of vapourisation compared to the ethanol water mixture and thus the atomisation of the fuel does not take place for proper combustion.'

The new stove which is essentially a 2 kW burner overcomes all these problems and it would continue to burn even with a low concentration of 3% of alcohol. □

INDIAN INSTITUTIONS

Nimbkar Agricultural Research Institute

AT a time when so much of work carried out in laboratories for developing methods and devices for producing non-conventional sources of energy get bruited, a research centre right in a rural area is quietly but all the more fruitfully conducting investigations to quench the growing energy needs of rural masses.

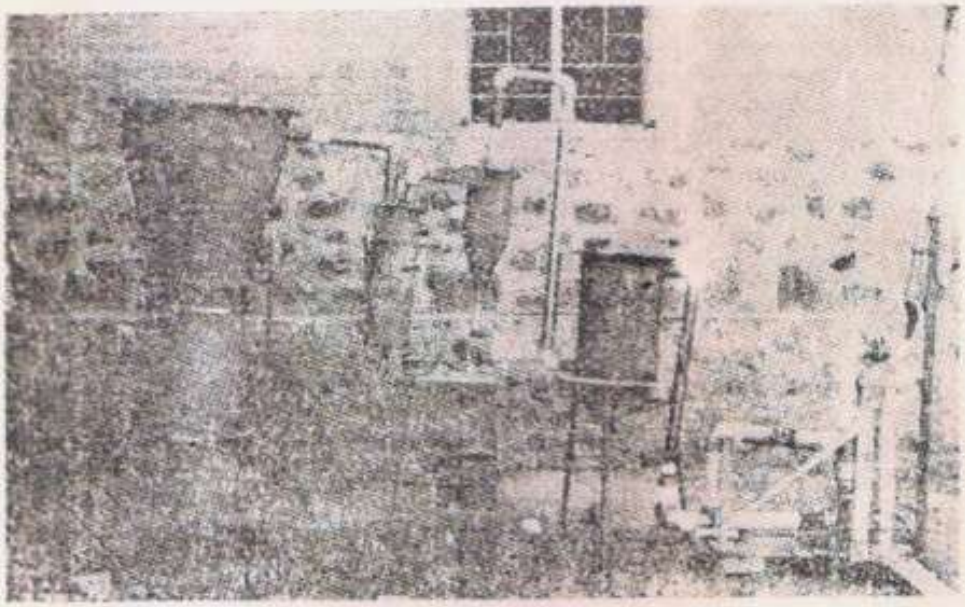
Situated in the middle of a relatively underdeveloped Phaltan village in the Satara district of Maharashtra, the Nimbkar Agriculture Research Institute (NARI) is working on various projects, which include production of alcohol from sorghum stalks, solar distillation of alcohol, development of stoves with alcohol-water mixture as fuel and virus-free sugarcane. Imbued with a dedication to develop new but inexpensive techniques, the institute is concentrating in the field of forestry, agroforestry and various forms of energy like solar and wind power.

The institute was set up as a research wing of the privately-owned Nimbkar Seeds Company, but later was dissociated and in 1968 became an independent public foundation, working on a non-profit basis. Adjoining it is a 60-acre farm, for carrying out research. Spread over 1,000 sq m., the institute has well-equipped labs for undertaking studies in tissue culture, chemistry and alternative energy areas.

The energy division, set up in 1981, and claimed to be first in many respects, carries out investigations in less explored areas.

Dr Anil Rajvanshi, director of the division, says that a major problem in rural areas of the country is the lack of power supply, and the best way is to tap the immense solar energy, which is freely available. With this view, the institute has developed a solar distillation unit for producing alcohol from sweet sorghum mash. Studies done at the institute show that it is possible to distill 1.5 kg of 40 to 60% ethanol per sq m of collectors a day.

Rajvanshi says distillation of alcohol from sweet sorghum has twin advantages—from the same piece of land, food (sorghum grain) and ethanol could be obtained, and that too without any energy input.



First generation producer gas plant

Researchers at NARI have developed a stove, which uses 40 to 60% alcohol-water mixture as fuel. This novel wickless stove has a cooking efficiency of 30 to 35%. This is well comparable with the 20 to 25% efficiency of conventional kerosene stoves. Research is also underway to develop an improved lantern for rural use. The project aims at unfolding an efficient fuel burner, use of unbreakable mantles as light sources and investigations on various thermoluminescent materials to be coated on the mantle so that light efficiency could be improved.

Scientists are attempting to improve the efficiency of popular janata cookers. Experiments conducted indicate that with 700 gm of lucaena wood, four items (rice, dal, and two vegetables weighing about 3.2 kg) can be cooked within two hours. Besides, it requires no attention once the fire is lit.

Though the principle on which an earth pot works as water cooler is well known, indepth studies have not been done to understand its different parameters and to improve and make it as a cheap refrigerator. Investigators are addressing this novel probability, and have already found the coefficient of performance of this simple passive water cooler.

Under a major project, the energy division will evolve a small gas plant that will run on the locally available farm waste, mainly sugarcane leaves. The plant, with an efficiency of 3 to 5 kW, will be used to run water pumping sets. The project is being funded by the Department of Non Conventional Energy Sources.

The institute has received a proposal from the USA to undertake breeding studies to develop drought tolerant and high yielding trees. In the field of agroforestry, various methods like contour planting and water harvesting are being tested. In collaboration with the National Chemical Laboratory, Pune, the NARI is making efforts to apply the tissue culture technique to grow virus-free sweet sorghum, which is a major crop in Maharashtra. □

T Ramavarman

Liquid fuels for cooking

By Anil K. Rajvanshi

COOKING energy consumes the biggest chunk of energy in rural India. In some villages about 90 per cent of all the energy used is for cooking. Already the cooking energy crisis is upon us. There are reports that women have to walk five to 10 km every day to collect firewood for cooking. Besides the energy crisis, it also puts a very heavy burden on the land. Large tracts of land are being shorn of trees and will in a matter of years be converted into wasteland.

Commendable efforts by the Government of India through the Department of Non-Conventional Energy Sources (DNCES) are being directed towards solving the cooking energy problem. These include introduction of improved chulhas and biogas. However, as things stand today no fuel can beat kerosene in terms of convenience in rural areas. In certain rural areas with an increase in income levels there has been a shift to kerosene as a cooking fuel.

Historically the development of any technology is related to the increased convenience of the users. It is therefore safe to assume that there will be a trend in rural areas to use liquid and gaseous fuels for cooking energy. At present both liquid (kerosene) and gaseous fuels (LPG) are petroleum-based and thus have a limited resource life and are susceptible to price rise. India spends about Rs. 1,300 crores per year in importing kerosene and it is a major drain on the foreign exchange reserves.

One liquid fuel that can replace kerosene and be produced cheaply and locally (from a renewable source like biomass) is alcohol. Alcohol (Ethyl alcohol or Ethanol) has been used as motor fuel all over the world but has never been looked at as a cooking fuel. Ethanol, traditionally, has been produced in India and elsewhere from sugarcane, grain, molasses etc.

FODDER

However, with the debate on food vs. fuel from the same piece of land going on, it is extremely attractive to use sweet sorghum (jowar), a dual purpose crop. It provides grain from its earhead and sugar from its stalk. This sugary juice then can be converted into alcohol via the regular route of fermentation and distillation. The bagasse (stem residue after the sugar is extracted) is also an excellent fodder. Thus from one crop itself one can get food (grain), energy (alcohol) and fodder (bagasse). No other crop known to man yields all these three things together.

Besides being a dual purpose crop, sweet sorghum has a great tolerance to a wide range of climatic and soil conditions. It is a short duration crop, maturing in 100 to 140 days (as compared to 12 to 18 months for sugarcane), is cheaper to grow than sugarcane and requires less water as compared to sugarcane.

Breeding work on sweet sorghum at the Nimbkar Agricultural Research Institute, Phaltan, in Maharashtra, has since 1970 produced varieties which can easily give yearly about two to three tonnes of grain and about 2,000 litres of ethanol per hectare. Potential exists to develop a variety that will produce about four tonnes of grain and about 4,000 litres of alcohol per hectare per year from the same crop. With a concentrated effort on the part of breeders this potential can be achieved in five to ten years.

Experiments at our laboratory have also shown that one can easily distill alcohol from sweet sorghum by using solar energy. A simple solar distillation unit distills about 1.5 kg of 50 to 60 per cent ethanol-water mixture per square metre of solar collector area. The cost of ethanol produced this way will be Rs. 2.76 per litre. This compares very favourably with the subsidised cost of kerosene (Rs. 2 per litre).

A special wickless stove has also been designed and tested to run on this percentage of alcohol. Thus even a 40 to 60 per cent concentration is an excellent cooking fuel. The stove obviously can take any alcohol mixture of above 40 per cent concentration. However, ethanol-water mixtures of 75 per cent and above can easily be used in existing kerosene wick stoves. Thus no special stove is needed for higher concentration mixtures.

Examine the potential of sweet sorghum in India as a cooking fuel crop. At present the area under grain and fodder sorghum crop in India is 17.6 million hectares. This area produces about 8.52 million tonnes of grain for human consumption. With the new sweet sorghum varieties the same area will easily yield 17.6 million tonnes of grain. This is nearly twice the existing sorghum grain production in the country. We have taken an average yield of one tonne/ha/yr as against two tonnes already available. This is done assuming that a majority of farmers will grow a rainfed crop instead of irrigated.

The same area can also produce about 35 million litres of alcohol, equivalent to 18 million tonnes of kerosene. Recent report from the Advisory Board of Energy has projected the country's demand for kerosene for the year 2000 AD to be 18 million tonnes! Thus from 17.6 million hectares (an area already under sorghum crop) we can get twice the present yield of grain and at the same time enough alcohol to completely replace projected 2000 AD kerosene requirements. Only thing needed is the replacement of grain sorghum by sweet sorghum.

Since the bulk of kerosene is used for cooking and lighting energy the use of sweet sorghum can easily alleviate the cooking and lighting energy crisis. Besides, the amount of foreign exchange saved in not importing kerosene will be phenomenal.

WONDER CROP

Work at our Institute has also suggested that an average farmer can make about Rs. 6,000/ha/year net profit by growing sweet sorghum. The profit break-up consists of grain 60 per cent, alcohol 30 per cent (at Rs. 2.76 per litre) and bagasse 10 per cent (at Rs. 150 per tonne).

An obvious question that can be asked is, if sweet sorghum is such a wonder crop then why are the farmers not growing it? The answer is two-fold. Firstly, it is a new crop in India. Secondly, the Government has to change and liberalise its policy regarding ethanol manufacturing in the small scale sector. Once the ethanol manufacturing policy is liberalised, we will see a rural revolution similar to what we have seen in milk production during the last few years.

The economic and social impact of such a liberal policy will be phenomenal in rural areas. Mini distillation plants of 5,000 to 10,000 litres per day capacity can radically transform the rural industrial scene. Such a transformation is already under way in Brazil which has the world's largest sugarcane-based alcohol programme. In fact there is a perceptible shift in Brazil from sugarcane to sweet sorghum as a raw material for ethanol production.

Besides ethanol other renewable liquid fuels which can be used as cooking energy are methanol and non-edible oils. Methanol is produced on a small scale by destructive distillation of wood. However, on a large scale it is produced from synthesis of natural gas.

Presently there is a glut of meth in the world market. The whole international price is 40 cents gallon (about Rs. 1.37 per litre). S the calorific value of methanol is that of kerosene, the equivalent ca ific value price of methanol wo therefore be Rs. 2.74 per litre. Th equivalent to the international p of kerosene. Thus with a price crease of kerosene it can be rea ably assumed that methanol will come attractive as an alternative f Fuels like ethanol and methanol be produced, not so kerosene.

SOCIAL FORESTRY

Non-edible oils are generally borne. According to the KVIC re published in 1978, the total pote in India of tree borne oilseeds is a 7.5 million tonnes per year whe actual consumption has been 500,000 tonnes per year (mostly soap making) or about six per cen the potential.

There are about 56 known spe of trees that have the ability to duce oil seed. Normally explo species have been sal, mohwa, ne karanja etc. There have been attempts at yield improven through breeding of these spe Non-edible oil tree species should a place in social forestry and en plantation programmes. Non-ed oils with a slight change in t viscosity can be easily used in exis kerosene stoves.

Other renewable fuels like pro er gas (a mixture of carbon mono and hydrogen) have also been rec mended by some people for cook However, there is a tremendous ger in using producer gas for coo since one of its main componen carbon monoxide – is an extre dangerous gas. It has no odou heavier than air and in the confi spaces of rural housing can e convert the house into a death ch ber. Thus the only and good us producer gas is in running IC eng for water pumping and power gen tion.

In all issues regarding alcohol main concern is obviously of drin it. Various additives exist today w can be mixed with it to give i extremely bad taste and odour thus can deter people from drin it. Once the villager accepts its us ness as a fuel then the drin problem can be reduced. Thi evident from the Brazilian prog me.

Finally, once the rural ethanol duction technology from sweet ghum is established, excess alc can either be used as a chem feedstock for industry or it ca used to fuel rural transport syst Already there is a strong trend wards the use of two-wheelers in r areas. Because of their large wh and better manoeuverability in r terrain these vehicles can improve rural transportation considera Use of locally produced ethanol them will also revolutionise r transport.

(Dr Rajvanshi is Director, E Division, Nimbkar Agricultural search Institute, Phaltan, Mahar tra.)

INDIAN EXPRESS
TUES.
JUNE 18, 1985

Solar Distillation Of Alcohol

Nimbkar Agricultural Research Institute (NARI), Phaltan, Maharashtra has set up Asia's first Pilot Plant for Solar$_2$ Distillation of Alcohol. The plant uses 38m flat plate solar collectors together with 2150 litres hot water storage system. The hot water at 80-85°C from this system is then used as heat source in the distillation plant to produce between 50-100 litres/day of 85%-95% ethanol. The plant has a distillation packed column of 6 m height.

Rajvanshi believes that with the use of solar energy for distillation large scale savings in energy cost in terms of fossil fuel saves will result. Data collected from the distillation plant shows that about 70% load is carried by solar energy whereas rest is carried by electric heater. Experiments at present are being conducted on evaluating the plant's performance for round the year working.

This alcohol has successfully been used in an improved lantern and cooking stove de-

Indian News - 27/04/1987



Alcohol Distillation plant showing Solar hot water storage (right in the photo) and the plant including the distillation columns, condensors, evaporators, etc. The plant distills 50-100 1/day of 95-85% ethanol.

The feedstock for the plant is fermented juice from sweet sorghum stems. Varieties bred at NARI have yielded 40 tons/ha of stem and between 1-2 tons/ha of grain. The crushed stems produce about 20 tons of juice fit for fermentation. Dr. Rajvanshi, the Director of the Institute said that because sweet sorghum is a dual purpose crop, hence the use of same piece of land for fuel and food can be effected.

This product on solar distillation had been funded by Department of Non-Conventional Energy Sources (DNES), New Delhi. Dr. veloped at the Institute. The lantern developed at NARI is a non-pressurised Petromax type lantern and produces eight times more light than the hurricane lantern. The cooking stoves developed to use this alcohol are both wickless and with wick. They are equivalent to existing kerosene stoves. According to Dr. Rajvanshi it is envisaged that alcohol can be an excellent replacement for kerosene in terms of rural lighting and cooking.

Courtesy: PTI Science Service

Using sorghum to light up India

The Indian Post
Bombay, May 26, 1987

Anil Rajvanshi

Cooking and lighting needs in rural areas constitute about 57 per cent of the total energy consumed in the country. There is a major cooking energy crisis in rural areas, with reports suggesting women having to walk as many as 10 kilometres every day just to collect firewood. The cutting of trees puts a heavy burden on land which, in a matter of years, will be converted into wasteland.

The major fuel used for cooking in rural areas is wood. But studies show that as the income levels among the rural population increase, people tend to switch to liquid fuels, like kerosene. This is basically because kerosene happens to be convenient, the hallmark of any technological development. Liquid fuels are usually more convenient because of their easy transportability, energy density and cleanliness. In rural areas, therefore, kerosene is the most preferred fuel for both cooking and lighting. However, because of our dependence on imported kerosene and uncertainty in the international market about its price and availability, it is useful to look at an alternative liquid fuel for cooking and lighting energy.

One such fuel is ethanol, which can be produced from locally available biomass source. Ethanol traditionally has been produced from sugarcane, cereal grains, molasses, etc. Sweet sorghum (*jowar*) can serve the purpose as well. This crop provides grain from its earhead and sugar from its stalk. The leaves and also the *bagasse* is an excellent fodder. The crop provides three things from the same piece of land—fuel, food and fodder. No known crop yields all these three things.

Beside being a multi-purpose crop, sweet sorghum requires much less water than sugarcane and is a shorter duration crop, maturing in 100 to 140 days. Thus one can easily have two crops per year and, possibly, even three. Breeding work at our Institute since 1970 has produced sweet sorghum varieties which produce 2 tons/ha/season of good quality grain from their earheads and 2,000-2,500 litres of 95 per cent ethanol per hectare/year. The grain and the stalk mature nearly at the same time and thus can be harvested simultaneously.

Another experiment at the Institute is Asia's first pilot plant for distilling ethanol by solar energy. Ethanol distillation consumes almost 50-80 per cent of the total energy required in ethanol production. At present, distillation uses fossil fuels like coal, *bagasse* or wood as an energy source. The use of solar energy for distillation has a tremendous advantage—saving in fossil energy. The cost of ethanol produced this way will be between Rs 4-5/litre. This is almost double that of kerosene. However, since this energy will be used for the vital sector of rural cooking, the Government could provide a subsidy, akin to that given for biogas plants, improved *chulhas* and solar cookers. The farmer will also be able to make between Rs 6,000-8,000/ha/year profit by growing sweet sorghum for grain and alcohol.

A related development is of cooking stoves and lanterns which run on alcohol. A new type of lantern, which gives three times more light than the conventional hurricane lantern, has also been developed. Even regular wick stoves have been known to run on 85 per cent ethanol concentration with special, non-burning wicks.

The potential of ethanol from sweet sorghum for providing cooking and lighting energy needs is tremendous. If sweet sorghum is planted on the 17.6 million hectares presently under grain sorghum in the country, the alcohol production from this will completely replace kerosene demand by the year 2000. A land area of 17.6 million hectares under new varieties of sweet sorghum can produce 35 billion litres of alcohol, which is equivalent to 18 million tonnes of kerosene, which, in turn, is the projected demand of kerosene in the year 2000.

Beside producing ethanol, the same area will also produce about 17.6 million tonnes of grain, which is nearly twice the present output.

The only stumbling block to large-scale deployment of this technology is the archaic excise and prohibition laws of the Government of India. These laws were made in the early 1900's and were made for potable liquor. In a modern society which is trying to march to the 21st century, the role of ethanol as household energy and industrial fuel cannot be underestimated. Brazil has already shown the way by running its economy on ethanol. Thus the rules must change in order to facilitate manufacture of ethanol from sweet sorghum in the decentralised sector. The distribution and selling of ethanol for household fuel will also have to be carefully worked out.

Finally, the social concern remains about the unauthorised drinking of such alcohol. But the solution is simple and tried whenever alcohol is to be used for non-consumable purposes. Various additives exist which can be mixed with it to give it an unappetising taste and a pungent odour to discourage people from consuming it.

Anil Rajvanshi is the Director of Nimbkar Agricultural Research Institute at Phaltan, Maharashtra.

Economic Times
19/2/87

Raintechtalk

SCIENTALK

By Raju Chellam

It is the middle of August and the heavy rains are nowhere in sight. If the showers don't show up during the remaining half of August and September, it would make this monsoon the worst India has had in the last five years. A truant rainfall this year may also put in doubt 86 million tonnes of foodgrains grown during this period and lead to hundreds of thousands of animal and human deaths throughout the country.

This is thus the right time to look at the how and why of the monsoon. To take a scientific peep at some of the alternatives that could provide India with good and sufficient drinking water. And to find out what new technologies are doing worldwide to ease the water problem.

But first a brief peep at what has the lack of monsoon wrought in a thirsty country. Of the 35 meteorological chunks into which India has been divided, almost 25 of them got scanty or extremely scanty rainfall from June through early August this year. According to The Economic Times Research Bureau, "the Kharif crop is likely to be much less than the estimated 84 million tonnes harvested in 1986-87. The target of 90 million tonnes set for the current year would, of course, be a far cry."

The north Indian rice growing belt is under severe strain for lack of rains. The Gujarat groundnut crop is shaky. In most south Indian cities, water has become as costly as diesel. In western India, almost continuous drought conditions are threatening governments. In the east, things are not that bad, especially in the heavy rainfed areas of the north east. But the overall picture is dismal, to say the least.

The prime reason of a bad monsoon is rather hazy. According to some meteorologists, swift increases in temperature in south America, around Peru, has prevented rainbearing clouds from coming to India. How could conditions in a country halfway round the globe affect the south-west monsoon is tough to understand. Another reason given is that there have not been enough rainclouds coming from Australia, from where they normally come. A third reason is the right atmospheric depression is not forming around the Bay of Bengal and north Indian regions for the rains to fall.

That has led to a lot of mental depression anyway. Especially in the government which is facing other tougher precipitations, political and otherwise. According to India Today, "On July 20, when it (the monsoon) still didn't cross the capital, it made dubious history by becoming the first time in 80 years that it hadn't done so."

Even with all the advances in science and technology, does man have to necessarily depend on uncontrollable nature to make his day? Are there no alternatives to the monsoons? Of what use is getting the world's best and costliest supercomputer to predict the weather for us if we can't do anything about the weather in times like this?

There is some hope, though. Water can still be wrested out of nature if natural rains fail. Else, how would the great Arabian deserts have survived all these centuries? Let's take a look at each new bit of technology and if it can be applied here.

The first, and the one used in some parts of India is "Cloud Seeding". This was first tried out about 25 years ago, using Silver Chloride crystals. The logic is the particles sprinkled on the clouds by airplanes cause the water vapour in the clouds to condense and thus lead to rain. The problem, apart from the cost, is that the clouds should basically be rain-bearing ones — just "seeding" any darned cloud is not going to achieve anything. The other bigger problem is that winds may make the clouds drift and the rain may fall in unwanted areas like in the nearby seas.

About 75 countries have tried this method to induce rain and the most successful have been the Israelis. They have reportedly increased rainfall by 15 to 25 per cent. But given the costs involved, and the increasing prices of aviation fuel, this is an expensive — and risky — method to get rain to fall.

A better way out is to "treat" the seas. It is called "desalination" and all the Arab world swears by it. The water got by this process is clean, clear, quick and costly. But it is guaranteed, unlike in the "seeding" process.

The process itself is simple. Collect seawater in huge vats, heat it in the sun and collect the evaporated water off the top. The salt remains at the bottom. The other process is to apply pressure on the water. This is called "reverse osmosis" and it literally squeezes fresh water out of brine, or seawater. When pumped with enough pressure, water molecules pass through a tough membrane that keeps out all salts. The problem with both kinds of desalination is they need a hell of a lot of energy — about three kilowatts to make five litres of water a minute.

But some more hope is on the way. A Boston company, called Reliable Water Inc. has just come up that uses a different process with a computer to get out more fresh water from brine at a lower longterm cost. The cost of the equipment initially is high, but it evens out over a period. The market for such equipment is reportedly a billion dollars a year, and growing 30 per cent p.a. If countries like India keep facing water problems continuously, it may be wiser to go the Arabic way....

"Reverse Osmosis" would also work with brackish and dirty water. An Indian company is into this venture. Ion Exchange India Ltd. has tied up with Hydraulic Water Systems Inc. of California to make the equipment in India. The product will be out later this year and Ion Exchange president G. S. Ranganathan claims the process works better than multistage evaporation or electrodialysis.

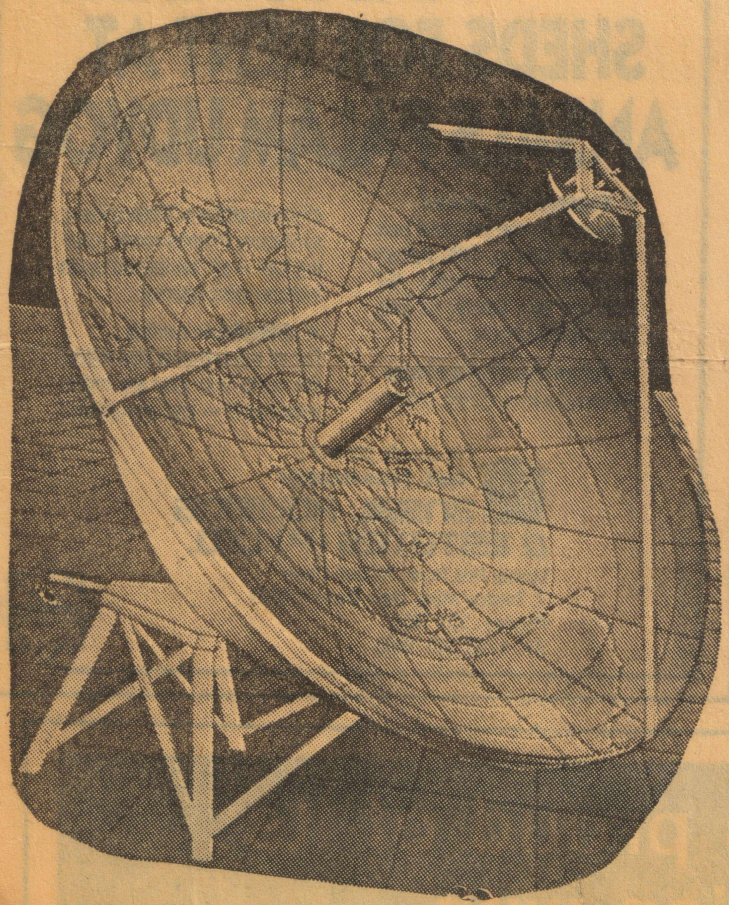
The French have come out with a device that gets rid of organic solvents in water. Called the TESCO-851 Purifier, it can process 40 litres of water an hour, using four "modules". The company, called S2M Corp., does not however favour the water thus treated, for potable purposes. But it can be put to good effect for industrial and agricultural use.

A totally fresh approach to getting water on a mass scale is through the neglected dew drops. It is a shame we have neglected this promising field, though an Indian researcher has been one of the pioneers of the technology.

A couple of years ago, Anil Rajvanshi of Maharashtra's NARI (Nimkar Agricultural Research Institute) proposed dew collecting plants to be set up throughout India to tap a clean source of drinking water. He proposes passing cold sea water through heat exchangers. This adds to the natural dew condensation and can give up to 700 cubic metres of fresh water per 24 hours. The "used" sea water can be passed through ponds that culture fish. The only cost is pumping the sea water to the heat exchangers. The "exchangers" can be any industrial unit which uses any heat.

Can any of these technologies be useful for India? Come to think of it, all of these can. They may not be applicable for use throughout the country. But then certain cities, towns or townships can utilise one or more of these technologies to solve the perennial drinking water problem. Most work best in areas near a coast. So, much of coastal India can greatly benefit.

The question is would the government and industry have the will to seriously try to work with any of these technologies? Most of them are costly in the immediate and short term, but the investment is one-time in most cases. For the long run, their cost falls geometrically. In any case, isn't leaning totally towards a monsoon the biggest gamble we face each year? And isn't a failed monsoon one year far costlier than any other technology that assures at least a minimum supply of water throughout the year....?



The Pioneer : Friday, April 8, 1988

Gas from waste runs diesel engine

NEW DELHI, April 7 (UNI) — The Nimbalkar Agricultural Research Institute at Phaltan in Maharashtra has developed the technology for running small diesel engines with the help of gas obstained from waste sugarcane leaves.

According to institute director Anil Rajvanshi this is probably the first time that a small 5 horse power diesel engine has been run by sugarcane leaves gas-producer. Most of the existing technologies for small diesel engines are based on wood fuel.

The technology developed at the institute produces gas from loose sugarcane leaves in a reactor which operates at 800 to 1000 degrees C. The gas is then cooled and cleaned in appropriate scrubbers and fed into the engine.

Test results showed that between 60 to 80 per cent diesel saving in engines can be effected while running on this gas. Besides, the reactor also converts the biomas into fine charcoal particles, which mixed with cowdung can make good smokeless briquettee fuel for 'Chulhas'.

It is estimated that last year about 15 million tonnes of sugarcane leaves were burnt after harvesting since no use was made of them. This means a total loss equivalent to production of 2000 MW of electricity Dr. Rajvanshi said. In terms of money this loss would amount to Rs. 300 crores a year.

Sugarcane leaves for gasification

Express News Service

SATARA, April 23.

Nimbkar Agricultural Research Institute (NARI) situated at Phaltan (Satara district) has successfully developed a technique to use sugarcane leaves for gasification as an alternative energy source to run small 5 HP diesel engines. The gas thus produced will take the place of diesel used as fuel to run these engines.



Sugarcane leaves gasifire NARI, Phalton.

Dr. Anil Rajwanshi, the director of NARI and in-charge of the wing of the institute meant for research in alternative energy for rural and semi-rural areas of the country said, most of the producer gas technologies at present for 5 HP diesel engines are based on wood fuel. But NARI for the first time not only in India but probably in the world also has succeeded to run these engines on sugarcane leaves gas producer.

While explaining the new technique at the exclusive credit of the NARI research wing Dr. Rajwanshi said, loose sugarcane leaves are used to produce gas in a reactor. It operates at temperatures between 800 to 1000 degrees centigrade. Appropriate scrubbers cool and clean the gas. The gas is then fed into 5 HP diesel engine as an alternative energiser instead of diesel.

Dr. Rajwanshi discussed the merits of the technology. He said, our experimental results have proved that about 60 to 80 per cent diesel is saved when engine in run on cane leave gas. The gasification system has logged about 250 hours of operation.

Dr. Rajwanshi described other benefits. The reactor converts 24 to 35 per cent of the biomass into fine charcoal particles. These particles when mixed with cow-dung in the ratio of five to one produce excellent smokeless briquette fuel for Chulhas used in the countryside. Any other loose biomass such as wheat-straw, chopped sweet sorghum bagasse and safflower husk and straw can be used in the reactor for the generation of gas.

The cost of the gasifier may be around Rs. 10,000 said NARI director Rajwanshi. He added, NARI is contacting aspiring manufacturers for the gasifier production. One gasifier is necessary to run one diesel engine and about 8 to 10 kilograms bio-mass (sugarcane leaves) is needed to run the engine for an hour. The consumption of diesel is saved by about 60 to 50 per cent and hence it is economical.

When asked about availability of raw material, the director said, the sugarcane leaves are amply available when cane harvesting season is on. Cane leaves in the season are left on the ground, since no use is made. They are burnt in the fields as waste. Last year alone according to our information about 15 million tonnes of such leaves were burnt. It meant a total loss 2.5×10^{11} M.N. per year, for the country. This comes to producing 2000 MW of electricity.

The director further stated that in terms of money the total loss is about Rs. 300 crores per year. Hence, the technology we have developed is most useful to the rural and semi-rural of our country.

The development of this technology has been a team effort, said Dr. Rajwanshi. The other members of the team are Mrs. M.S. Joshi and Mr. Baban Kumbhar.

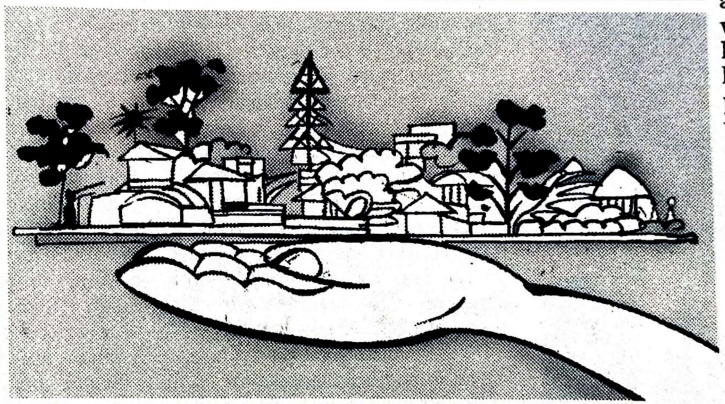
THE ALTERNATIVE MODEL

The Economic Times - 24/05/1998

The Taluka plan can become a reality if the private sector participates in it

GUEST COLUMN

Anil K Rajvanshi



IN 1931 Mahatma Gandhi gave one of his finest political speeches at the London Round Table Conference. In essence he told the conference that Britain — a great nation with its technology, and an independent India — a proud and ancient civilisation with its workforce and natural resource can work together as a Commonwealth to produce the world's largest economy for the benefit of mankind. To my mind the greatest apostle of Swadeshi and peace of this century understood much ahead of his time that the well being of India lies in international cooperation.

All the talk of the BJP government regarding Swadeshi is therefore hollow. By stopping few MNCs (who may also produce potato chips) will not bring in Swadeshi movement but is a retrograde step. BJP's talk of Swadeshi comes from a feeling of insecurity and the policy of protectionism is another name for incompetence and insecurity.

I present a possible solution in this article whereby a thesis is developed which shows that food and energy self-sufficient Talukas can reduce the energy import bill of India, increase the exports, increase the inflow of foreign Institutional funds for development and can be a new paradigm of sustainable development not only for Indian but for the rest of the developing world.

Taluka Development Model

India's energy scenario is quite bleak. There is a shortfall of about 15,000 MW of electric power every year and last year we imported about Rs 25,000 crore worth of petroleum products. With increased economic growth the situation of both electricity and liquid fuel supply will deteriorate further. There are also estimates that oil energy consumption in developing countries should surpass that in developed countries within 20 years. This will create great conflict among nations and it is quite possible that in future the wars will be fought over energy sources. There is therefore a need for an alternative development model based upon renewable energies.

Developing countries (DC) in the absence of any other alternative are presently following 100 years old unsustainable model of developed countries which is megacity oriented and is based on fossil fuel and environmentally unsound technologies. This model is creating in DCs' problems of overcrowded and extremely polluted cities.

A Taluka is an administrative and geographical block consisting of an average of 80-100 contiguous villages. It has a geographical area of about 1000-1500 sq km and a population of about 2 to 2.5 lakhs. There are 3,342 Talukas in India and the major activity in them is agricultural. The fixed geographical boundaries of a Taluka can be thought of as a closed biomass and rain water basin. Hence each Taluka can produce majority of its demands of food, fuel, fodder and fertiliser.

Taluka Development Strategy

India produces in its Talukas — 400 million tons/yr of surplus agricultural residues which theoritically can produce — 53,000 MW of power. This power is 70 per cent of the total amount available in the country as of today from all other sources. Not only can these residues produce adequate power to supplement existing power production, but husbanding this resource properly, can also produce adequate animal feed and fertiliser. With increasing food production the agricultural residues quantity will also increase.

My Institute — Nimbkar Agricultural Research Institute (NARI) did a study for Phaltan Taluka in Western Maharashtra, where it was shown that all the energy needs of the Taluka for 2000 AD could be supplied by the use of its biomass resources. This study became the basis for National Policy on Energy Self-sufficient Talukas in 1997 and is being implemented nation-wide by the Ministry of Non-conventional Energy Sources (MNES).

The NARI study showed that Phaltan Taluka produces — 100,000 tons/yr of surplus agricultural residues which are presently burnt in the fields as a part of waste disposal process and hence are total loss of useful energy. These residues in conjunction with energy plantations (Leucaena, Prosopis, Eucalyptus etc) and energy crops like sweet sorghum and sugarcane can produce about 40 MW of electric power (via biomass based power plants) and liquid fuels (pyrolysis oil and ethanol) which are equivalent to 30 million liters/year of petroleum products. This will take care of all the commercial energy needs of Taluka for 2000 AD via renewable energy and hence the production could be done on a sustainable basis.

The study also showed that this strategy has the potential of creating 30,000 jobs and giving — Rs 200 crore/year income to the Taluka. For this programme a total capital investment of about Rs 300 crore/Taluka will be required in the plants, machinery and technology. Hence for 3,342 Talukas a massive investment of about one million crore rupees will be required. This can be very attractive for foreign institutional investors and can result in large inflow of foreign funds.

The study also showed that Taluka has adequate amount of other biomass derived materials like night soil, vegetable waste, weeds, municipal solid waste and animal/ chicken manure which can be processed via technologies like vermiculture, composing and generally husbanding them so that they yield excellent fertilizer for the farmers.

The above strategy will create wealth in Taluka and improve the quality of life of its citizens, provide employment to them and reduce their desperate exodus to big cities. This increase in wealth of Taluka will lead to decentralization of economic and hence political power — the essence of democracy.

Lessons for North

Societies are living and dynamic structures. In evolutionary process they can be thought to follow the laws of a natural living system. Hallmark of evolution of a dynamic system is its size reduction; increase in energy usage efficiency, increase in complexity and possession of critical mass. Shape of societies is like energy structures.

It depends upon the quality and the quantity of energy passing through them. From this evolutionary model it can also be conjectured that in future with the increasing use of renewable energy all societies will evolve to be decentralized, high technology dependent and rural based. Similarly the megacities will break into smaller sustainable units.

The Taluka plan can become a reality if the government of India can create conditions for the private sector to take part in it. This could include giving the usual tax incentives given to renewable energy sector and to set up a Taluka Development Corporation to facilitate this process.

(Anil K Rajvanshi is Director of the Nimbkar Agricultural Research Institute)

Univ of Florida Alumni Magazine June 1988

Kismet and Conscience

Was it in the stars? They came to UF from opposite ends of India to find ways to help their people. They found each other along the way.

By Darcy Meeker

They were worlds apart. He was Anil Rajvanshi, from northern India. She was Nandini Nimbkar, from southern India.

He was from a middle-class family, and learned the energy needs of his people by collecting cow "chips" for the evening fires. She was from a long line of intellectual aristocracy, including relatives who worked closely with Ghandi, pacifist of world renown.

He wanted to study solar energy, a free energy source. She wanted to study the peanut, a major source of protein for her people. If they had stayed in India, they probably never would have met.

But fortunately, for them and the people of India, they did meet — as Ph.D. students at the University of Florida in the mid-70s. They chose UF because it is a world leader in both their fields. Anil wanted to study with solar energy pioneer Erich Farber in the mechanical engineering department. Nandini chose the agronomy department in UF's Institute of Food and Agricultural Sciences (IFAS), where many tropical-growing peanut varieties were created.

It was kismet, fate. Their goals meshed — his to have a research institute in rural India, and hers to work at the research institute her father had founded — and they chose to spend their lives working together to make life better for people in their homeland.

Now, their institute near Bombay has developed an innovative lamp named for their first-born daughter, Noorie, 6, whose name means "bringer of light." They have another daughter, Madhura, 3. The couple has licensed a manufacturer to market the lamp — which should be available later this year — and a percentage of the profits will help support further work.

"If you look at the energy expenditures of India," Anil says, "you will see that we spend $3 billion a year on kerosene for lighting our homes. I thought, if I could reduce that, it could really make a difference to people."

And there are vast numbers of people to profit from the difference such a lamp would make. India, where Buddhism originated in 6 B.C., is a country of more than 800 million people packed to a density of 650 per square mile, in a land mass one-third the size of the U.S.

"The Noorie lamp produces five times as much light as traditional kerosene lanterns," Anil says. "It's the same technology as people here are used to, so they know how to use it and repair it, and they're comfortable buying it. But it's a combination of low-tech and high-tech. What I changed most is the wick. Mine is ceramic, and it's coated with thermoluminescent salts that glow when they get hot."

The lamp will also burn alcohol, which Indians can make themselves from crops such as sorghum. The alcohol can then be distilled with solar energy, as demonstrated at the couple's Nimbkar Agricultural Research Institute. The new lamp will provide one more means to whittle away at the staggering $3 billion annual fuel bill for India's kerosene lamps.

Anil knew what it would mean to help his people toward energy independence. "You look at India and you might think that hunger, disease and erosion are the problems. But it all boils down to energy.

"The land is eroded because people stripped away everything that would burn — they needed energy," he explains. "They're hungry because the land won't produce without energy to pump irrigation



Dr. Nandini Nimbkar and daughters, Madhura, 3, and Noorie, 6.

…ater. And the reason most people get sick is because of bad water; there isn't the necessary energy to purify it. Even tooth decay, a terrible problem here, is from lack of energy to purify the water. People add sugar to the water so they can stand to drink it."

The couple could have easily chosen different lives.

"They could've done what a lot of our foreign students do: stay in the United States and make money," says Richard Downie, director of UF's International Student Affairs. "And they could've made a lot of money, too, because they are such excellent scientists."

Downie fondly remembers the two friendly alumni. "It's an indication of Nandini's commitment to her country that she could have come to graduate school as a U.S. citizen, since she was born in Arizona while her father was attending graduate school," he says. "And Anil. How do you describe a mind like his, able to synthesize so much information? He's such a creative thinker.

"They are both genuine and warm, always interesting and interested, wanting to hear about new things. They can both explain what they're doing very clearly in lay terms, and can put it in precise technical language for their scientific colleagues as well."

Dr. Frank Gardner, the IFAS peanut specialist who directed Nandini's doctoral research, agrees. "Nandini was one of the top graduate students we've had here at in our field. She was so cordial and friendly with everyone, and eager to assist them, despite the fact that she came from rather high social standing in India. She is just a distinguished person, beautiful in heart and mind, in every way."

But the couple would not have their lives any other way than the way they have chosen.

"We love being home and putting the knowledge from the University to work at last," Nandini says. She is also demonstrating how quick-growing leucaena trees can be used for cooking fires and as a way to circumvent the erosion problem that steals food from children's mouths; arid land means a diminishing food supply.

Their institute is also producing disease-free sugar cane in a biotechnology laboratory, testing agrochemicals for use in India, and demonstrating ways of growing safflower, sugar beet, cotton, maize, sunflower and mustard greens. Another area of research delves into discovering how sheep can turn the sparse environment's meager nourishment into milk, wool and meat.

"One of the most important things we do is resource assessment," Anil says. "When you look at our resources and what we're spending them on, you find some surprises. For example, one-third of a rural Indian's money typically goes to keeping him in transportation — on a bicycle. The roads are so bad that upkeep is a major problem. A fact that directs my work is that 70 to 90 percent of the energy used in an Indian home goes to cooking and lighting. That compares to cooking and lighting taking about 25 percent of the energy in an American home."

Those are the types of resource assessment skills he learned from UF's Dr. Erich Farber. Later, as an instructor for the Training in Alternative Energy Technologies program sponsored at UF by the U.S. Agency for International Development, Anil helped teach those abilities to 300 Third World scientists from 50 countries. The exhaustive program built a network of 300 energy scientists in those developing nations.



The Nimbkar Agricultural Research Institute is a center for learning how to more efficiently feed and provide energy for the people of India. Anil is shown at the institute inspecting the solar energy distilling plant.

Farber, a solar energy pioneer who started one of the first solar houses in the country at UF and who helped make Gainesville one of the most solar-efficient cities in the world, explains: "The goal of the program was to give people knowledge. If you give people a trinket, they'll use it until it breaks down. Then, since they can't understand it, they can't fix it and they abandon it. With knowledge that lets them build their own solutions, they have pride, and they can fix things and keep going."

Another goal of the program was to get the Third World scientists to think about what constitutes a good standard of living. "We Americans tend to define standard of living in terms of money: a big house, two cars, stereo, VCR, etc." Farber says.

In Farber's mind, Anil and Nandini returned to India to help people attain a higher standard of living. "They don't make a tenth of the money they would make in the U.S., but I think their lives are better. They have happiness because, there, they are making more of a contribution to the betterment of mankind than they could have here."

"Anil and Nandini are contributing to a better life for people without discarding their heritage."

During the alternative energy program, Anil learned something very important from the scientists he was training: Americans think of India as a land of poverty, and he had come to accept that view. But to many Third World nations, India is a "have," not a "have not," country. "It gave me a new perspective on India and America, both."

Remembering his days of learning at UF, Anil says a couple of the most important lessons were "the dignity of labor and a spirit of can-do. Nothing is impossible," he adds. "But to *achieve* it, one must go ahead and *do* it."

Dr. Austin Creel, UF professor of religion and Asian studies, knew Anil and Nandini when he was advisor and Anil president of the India Club on campus. His comments on how his friends arrived on campus, found their lives' work and found each other offer an interesting insight into the lives of two Gators halfway around the world.

"I can discern a tendency in India toward increasing imitation of the West," Creel says. "Their goal is to revitalize rural areas while maintaining the best features of Indian culture. Anil and Nandini are contributing to a better life for people without discarding their heritage. A country needs people like that." UF

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Substitute for kerosene developed

Indian Express - 25/12/1988

Express News Service

PHALTAN, Dec. 24.

A substitude for kerosene for cooking and lighting has been developed at the Nimbkar Agricultural Research Institute (NARI), Phaltan.

The replacement – industrial alcohol – has been produced from sweet sorghum using solar energy.

Dr. Anil K. Rajvanshi, the director of the institute, and the principal investigator of the project, showed the press the pilot plant recently. It is capable of producing from 30 to 50 litres per day of 90 to 95 per cent pure industrial grade alcohol. The process runs completely on solar energy set up at the institute's campus.

The NARI has pioneered the development of sweet sorghu in India, starting as early as the seventies.

At present the NARI is in the process of designing mini distilleries of 5000 litres per day.

Indian Express 4/1/89

New technique for solar energy utilisation

Express News Service

SATARA, Jan. 3.

The Nimbkar Agricultural Research Institute (NARI), Phaltan, has developed a new technique of utilising solar energy to produce industrial alcohol on large scale from sweet sorghum (jowar) crop.

The institute has developed a pilot plant for this purpose, which is claimed to be the first of its kind in Asia.

The plant has a capacity of producing 30-50 per cent industrial alcohol daily which is 90-95 per cent pure.

The plant consists of a solar energy collector and a hot water tank of 2150 litre capacity.

The Director of NARI, Dr. Anil Rajvanshi, said that the yearly results showed that 75 per cent of the energy required for distillation is obtained from the solar plant while the remaining is derived from fossil fuels.

He further explained about the organic matter – the sweet sorghum – used in the plant to produce industrial grade alcohol.

The institute at present has around 20 different types and four hybrid varieties of sweet sorghum. These have been grown by crossing local crop with a sweet sorghum plant from USA.

The plant has a high utility value which include usage of its stalk for alcohol and bagasse for fodder.

The results obtained by the NARI further prove that if the land currently under grain sorghum is replaced by the newly grown sweet sorghum, the yield of the grain would be around 12 million tonnes per year.

Bank assn. to hold dharna

By A Staff Reporter

PUNE, Jan. 3.

Bank of Maharashtra Officers Association (affiliated to National Organisation of Bank Officers and Bhartiya Mazdoor Sangh) will be holding a dharna outside the Lokmangal office at Shivajinagar from January 9.

According to a press release issued by the organisation, the protest is to focus attention on their grievances regarding transfer policy, vehicle allowance and so forth, which have not been dealt with by the management.

The lamplighters

A pair of dedicated young scientists are working on ingenious ways to conserve energy says SHAHNAZ ANKLESARIA AIYAR

HE uses space shuttle technology for a lantern wick. And solar energy for distilling alcohol. Both become part of a lantern – which flips open into a stove.

She "makes" trees. With a little help from nature, that is. She shops for germ plasms from Mexico, Chile and the US, then does a little delicate mixing, fusses over test tubes – and scatters the results over tracts of barren land. The result – tough, fast-growing trees which function as soil cover, livestock feed and even edible food for humans.

Meanwhile, he collects dew from cold sea water and the soil. The first is turned into a perennial source of drinking water. The second waters the trees she grows in arid wastelands.

Together they work over the humble, unsung sweet sorgum plant. She breeds hybrids of this sturdy, sugar cane look-alike. Which in turn becomes high yielding sources of jaggery, sugar and alcohol. He works at creating the machinery and techniques to market these products.

What's all this, friends – another story of "perfect harmony"? No it's a description of teamwork between two scientists – Anil Rajvanshi and Nandini Nimbkar. Their focus: efficient natural resource management to meet the energy demands in this country. Their tools: modern science and technology. Their workshop: rural Maharashtra and the Nimbkar Agricultural Research Institute (NARI).

Graduates of the University of Florida, USA, Rajvanshi and Nimbkar came to India eight years ago armed with formidable degrees plus the determination to use their skills to "increase the wealth of the countryside." Their work, they say, is like "reinventing the wheel." Both come from political backgrounds. Rajvanshi's father was a close and old associate of the late Hemlal Bahuguna. Nimbkar's father, a well-reputed scientist who established the Nimbkar Agricultural Institute over a decade ago, is closely identified with the Congress faction led by Chief Minister Sharad Pawar of Maharashtra.

For a while, Rajvanshi toyed with the idea of playing student politics at the Indian Institute of Technology, then saw greater potential in solar energy and went off to Florida, to join the engineering department at the university. There he met Nimbkar, who was doing research into the different uses of the peanut at the University's agronomy department.

Separately and together, despite their political backgrounds, both had clearly rejected a personal involvement in politics. He wanted to set up an agricultural institute which would address some of the seemingly intractable but urgent issues facing rural India. She, for near-identical reasons, wanted to return to India to work with her father at his institute. So – both came home to Phaltan.

They spent a year living in a room at the edge of a slum, which was commuting distance from the Institute, and slowly evolved both their own work and the development of the Institute. Clearly, a priority area of research for both of them is energy sources. Many Indian states claim cent per cent electrification of their villages. In fact, less than 20 per cent of rural households actually have electrical connections.

The rest, some 100 million families, use the kerosene lantern. But such is the nature of this country's technological progress, that, as Rajvanshi says "as soon as we discovered electricity, we forgot the lantern."

So he set about improving it. The process required much of his not inconsiderable skills in innovative engineering. Claiming he was challenged by the task of matching his own excellent designs and thoughts with the very poor material available, Rajvanshi is today poised to enter the market with his Noori lantern.

The wick of existing lanterns burns, chars and is has a low energy efficiency. Laboriously, Rajvanshi experimented with all kinds of high temperature materials, settling finally for a silica cloth used by the Indian Space Research Organisation in the space shuttle. The result – a non-charring efficient wick.

Next, he maximised the use of heat and light from the lamp's conversion of chemical energy, to create a small stove at the top of his lantern. He altered the existing mantle by using a special glass which reduces explosions and heightens the light. To improve the flame, he worked out a detailed analysis of heat, the mass transfer of combustion chemistry and flue gases to get a clear and bright flame.

His Noori gives out 6-7 times more light than hurricane lanterns, produces light equal to a 40 watt electric bulb, and costs just under Rs 200. The lantern also operates on Ethanol. Both Rajvanshi and Nimbkar see it as the fuel for the future.

The major source of fuel for cooking in rural India is wood. There is also a growing shift towards liquid fuels like kerosene (6 million tonnes imported each year for Rs 13,000 million). A renewable replacement source is necessary, and Ethanol is their answer.

Traditionally, alcohol is extracted from sugarcane or molasses. To increase its production would mean diverting shrinking land resources for growing sources of fuel, not food.

Sweet sorgum, say these two scientists, is the "multipurpose" solution. It is cheaper to grow than sugarcane, uses less water and matures faster on poor soils. You get grain from its earhead, sugar from its stalk and the bagasse is excellent fodder for animals. "No other crop yields all these things together." At NARI they have developed some 20 varieties and two hybrids of the plant. And from its juice comes Ethanol. Here too, the focus of NARI remains energy conservation. Usually the fuel for alcohol distillation is wood or bagasse at NARI they decided to use solar energy. Which meant re-designing the entire distillation process.

The result is a pilot plant claimed to be the first in Asia which can produce between 30-50 litres a day of Ethanol, run completely on solar energy. Their data shows that on a yearly basis some 67 per cent of the distillation plant's energy comes from its flat solar plates and the remainder from bagasse, with experiments underway to improve its efficiency.

But quite the most fascinating experiment conducted by these maverick scientists is dew collection. How do you grow plants, even simple ones yielding fuelwood on hot and arid wastelands with only marginal rainfall?

First you dig a pit, cover it with plasic or glass. Solar energy passes through this shield, heats the soil which releases water bound within it. In normal circumstances this water would not be available to a plant because of its shallow roots and insufficient osmotic capabilities. The water thus released from the soil evaporates and condenses on the underside of the plastic/glass cover. It is collected into a bottle and fed to the seedling. Tests show such plants flourish better than rainfed ones. It has exciting potential for this country.

So does NARI's experiment in desalination. By bringing cold sea water to the shore in pipes and passing it through a heat exchanger, you get dew – in 24 hours. It can be collected, treated and distributed as potable drinking water. The ponds can become marine farms. Rajvanshi is convinced that with a little more research, he can price such desalination plants at figures lower than those of existing ones.



The NARI laboratory: resourceful experiments

Indian Express (Sunday Magazine)
August 27, 1989.

Times of India
October 26, 1990

Alcohol Can Ease Energy Crisis

By ANIL K. RAJVANSHI

THE recent Gulf crisis has again brought into focus the precarious energy situation that India finds itself in. This together with the fact that India's petroleum consumption has been increasing at a rate of six to eight per cent annually has brought about a serious hydrocarbon crisis. The demand for petroleum products for 1990-91 is estimated to be 57 million tonnes, of which about 22 million tonnes are to be imported. This year, India's import bill for hydrocarbons may touch Rs 10,000 crores. This whopping foreign exchange drain poses a serious threat to India's economic future.

The genesis of this crisis goes back to the beginning of this decade when the Indian economy took off, with a consequent increase in the use of hydrocarbons. Despite the fact that the Planning Commission, the advisory board on energy and other government organisations warned about the impending crisis, no worthwhile action was taken by the political leadership. Now that the crisis is upon us, it has to be tackled on a war footing.

Less Polluting

One of the possible solutions to this crisis is the use of ethanol (ethyl alcohol) as a replacement for petroleum products. This replacement can take care of petrol, kerosene and fuel oil usage for process heating. Use of alcohol to replace petrol is a well-known technology. Being a renewable fuel, alcohol also burns cleaner than petrol and hence is less polluting. Fuel oil can be substituted by alcohol in any industrial application with relatively minor changes in equipment design.

India's demand for petrol, kerosene and fuel oil is estimated (for 1990-91) to be 3.8 million tonnes, 9.36 million tonnes and 8.5 million tonnes respectively (total of about 22 million tonnes). These three fuels account for 40 per cent of all petroleum products used in India and is equal in quantity to all petroleum products imported yearly.

To replace 22 million tonnes of oil every year with alcohol will require about 42,000 million litres per year of alcohol production. At present, alcohol produced in the country is about 840 million litres per annum or only two per cent of the total requirement.

Short Duration Crop

Traditionally, alcohol has been produced mainly from sugarcane or molasses. However, with debate on food Vs fuel from the same piece of land going on, a multi-purpose biomass source for alcohol production is required. One such source is sweet sorghum (sweet jowar). It provides grain from its earhead, sugar and hence alcohol from its stalk and the bagasse is an excellent fodder for animals. The bagasse can also be used for making paper or as fuel for distillation. Thus one single crop provides food, fuel and fodder simultaneously.

Sweet sorghum has a great tolerance to a wide range of climatic and soil conditions. It is a short duration crop, maturing in 100 to 140 days, and requires much less water than sugarcane. Breeding work on sweet sorghum done at various institutions has produced varieties capable of yielding two to four tonnes of good quality grain and 3,000-4,000 litres of alcohol from one hectare of land per annum.

The total area under grain sorghum in India is about 16 million hectares, which produces about 10 million tonnes of grain per year. Calculations show that if only 10 million hectares of the grain sorghum area is brought under sweet sorghum, it has the potential of producing 40,000 million litres of alcohol and about 20 million tonnes of grain a year.

Keeping in mind the future increase in demand for alcohol, multiple sources of biomass for alcohol production have to be found. Sugarbeet is an excellent crop for saline soils. Thus large tracts of land in the Indo-Gangetic plain in Uttar Pradesh and Bihar can be brought under this crop. Research has shown that between 2;000-3,500 litres of alcohol per hectare per year can be produced from sugarbeet. Besides, in some states surplus sugarcane can also be converted into alcohol. There are also certain sweet varieties of pearl millet (bajra) which have potential of producing alcohol from the stem while producing grain.

Preliminary research has shown that mini-distilleries of 5,000-10,000 litres per day will be economically viable. With an average 10,000 litres per day capacity distillery, about 11,500 distilleries will be required to produce 42,000 million litres of alcohol per annum.

Capital Cost

Economically, alcohol production from renewable energy sources makes good sense. For producing 42,000 million litres per year Rs 6,000 crores is required as capital cost. The amount of foreign exchange saved per year in not importing oil itself will take care of this. With about a 50-fold increase in alcohol production, the money flow to the national exchequer in terms of taxes will also increase. Alcohol production from sweet sorghum will also be remunerative to farmers. With the sweet sorghum stalk price at Rs 200 per tonne, the cost of alcohol production will come to Rs 3 per litre.

It must be realised by politicians and policy planners that measures like reducing the oil supply and increasing the price of petroleum products will put brakes on the Indian economy. This will have a very detrimental effect on future progress. The measures taken should always be positive and changing over to an alcohol economy will be a step in the right direction. In fact, at this stage of our economic development the fuel supply should be increased rather than decreased.

A national alcohol commission should be set up with a mandate for accelerating the alcohol economy. This commission should be on the same lines as the Telecom Commission or Atomic Energy Commission. A firm commitment should be made by the government that all oil imports to the country will be stopped by the year 2,000 A.D. and the country will become self-sufficient in liquid fuels from renewable sources.

(The author is director of the Nimbkar Agricultural Research Institute in Maharashtra).

RAJVANSHI



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Lighting Strategies for Rural Areas of India

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SUMMARY

This paper presents strategies for rural lighting. It is shown that till the year 2010 liquid fuel and electric lighting will be simultaneously prevalent in rural areas. Strategies for alternative production of liquid fuels and electricity are outlined here. Small-scale (10-20 MW) biomass-based power plants are shown to be the key element in the rural electric lighting strategy. Use of ethanol as a substitute for kerosene for liquid lighting fuel is also recommended. Recommendations are given on how best to provide lighting to rural areas by the year 2000.

INTRODUCTION

It is a national shame that even after 40 years of independence, there are about one million households where the only source of illumination at night is the light from a chulha. Even with a heavy investment in rural electrification and proud acclaims by various states that 100% of their villages are electrified, the sad and hard fact still remains that in these so-called electrified villages less than 20% of households have electric connections and use them for lighting [1]. Thus, for the rest of the 80% or so of rural households (about 80 million), the humble hurricane kerosene lantern, with a very poor light output, is the only source of light. With unreliable electricity supply in rural areas, even some of these electrified households use kerosene for lighting. Thus, around 95% of the total rural households use kerosene for lighting.

Rural lighting in the scheme of planners, has always been synonymous with rural electrification. With the past record of state electricity boards, it is safe to assume that the total goal of electrifying every rural house will remain elusive for the next 15-20 years. Hence, an alternative rural lighting strategy based on other fuels will have to be chalked out. Lighting with the presently known technology can be achieved only by electricity or using liquid fuels like kerosene. Therefore the focus in this paper will be directed only to strategies for electric and liquid fuel lighting. It should, however, be pointed out that at present no national rural lighting strategy exists. There are plans and strategies for cooking, for power generation etc. in rural areas, but for so crucial a need as lighting there is no plan or strategy.

Around 60% of total kerosene consumption in India is for lighting only; out of this 51% is in rural areas alone [2]. India imports, every year, about Rs. 900 crores worth of kerosene for this purpose. Even after paying such a heavy price, the quality of light from the hurricane lantern is abysmal. It produces the light equivalent to one-tenth that of a 60W bulb, which is inadequate for most needs [2]. It is well known that the history of modern civilization is also the history of good lighting [3]. The social and economic impact that better illumination has made on populations is already evident in developed countries.

RURAL LIGHTING NORM

Conveniencewise, electric lighting technology is the best alternative. Hence, the long-term strategy should obviously be based on electric lighting. However, as a minimum requirement, the norms for rural lighting should be the same as those for urban areas at present. Thus, in the urban areas of India about 210 KWhr/household-yr is used for lighting. This should be contrasted with the highest figure of 540 KWhr/household-yr for Delhi [1]. Moreover, in the rural areas at present the consumption is only 30 KWhr/household-yr [1]. It is interesting to note that with a consumption of 210 KWhr/household-yr, every household will have the light equivalent of two 60W light bulbs running for four hrs/day. Thus, this should be the minimum lighting requirement for every household by 2010, and should form a part of the minimum needs programme. Research work at Nimbkar Agricultural Research Institute (NARI) has produced improved kerosene lanterns that produce light greater than a 60W bulb [2]. NARI has also developed lanterns that run on ethyl alcohol and produce a similar light output. These improved lanterns can play an important part in any rural lighting strategy, and are cheap and easily operable [Appendix 1].

Thus the major requirements of a strategy for rural lighting should be: Zero import bills for fuel; adequate light (equivalent to two 60W light bulbs); affordability in rural areas and possibility of becoming operational by the year 2000.

STRATEGIES FOR ELECTRIC LIGHTING

If all the lighting energy needs (210 KWhr/household-yr) in rural areas are to be met with electric lighting, then it will be necessary to set up about 3000MW capacity power generating plants (the total energy requirement will be 2.5 x 10 KWhr/yr). With the present plant load factor (PLF) of such plants being 0.5 to 0.6, the installed capacity may have to be doubled to about 6000MW. Power stations to produce 6000MW will require about Rs. 120,000 million capital cost and 10-12 years to set up. With the present resource crunch, it is difficult to see these plants being set up by the government. Besides, supplying electricity for lighting will also require a national grid which does not exist presently. Even with this massive capital investment, the supply of electricity to each household will still involve tremendous red-tapism as it exists today.

An attractive alternative to electricity generation for lighting purposes is the setting up of private decentralised and small (10-20MW) power stations in each *taluka* or *tehsil*. These power stations will run either on wood or biomass residue, or both. For a 10MW power station about 83,000 tons (dry) of biomass per year will be required [4]. If the plant is to run on 50% wood and 50% biomass residue, then about 3,000 hectares of land will be required. This land will be used for growing high biomass yielding trees like L.Leucocephala, P.Juliflora etc. [4]. This technology of 10-20MW power generation from wood is a proven technology and there are hundreds of such plants in USA and Western Europe. Calculations also show, that the power from such plants will cost about Rs. 1.3/KWhr and the lighting cost will be Rs. 0.9/day per household [4]. However, the benefits to the farmers and the environment, and the overall availability of power locally, will be tremendous. Since the generation of power will be based on agriculture, it will increase the wealth of rural areas. Though these plants have double the capital cost of the existing large-scale plants, they have a PLF of about 0.9. They will be set up as joint stock companies and thus will be owned by the people who use the electricity. Besides, the setting up of these plants will be accomplished in 3-4 years as compared to 10-12 years required for existing centralised plants.

STRATEGIES FOR LIQUID FUEL LIGHTING

Use of liquid fuels such as kerosene for lighting should be a stop-gap arrangement. Ultimately all the rural lighting will have to be electricity powered. However, for the present and till the year 2000 and beyond, liquid fuel lighting has and will play an important role. Thus, there is a need to evolve a strategy on how best to use liquid fuels and to provide adequate lighting for every household. Since liquid fuel lighting will be a stop-gap arrangement, there is a need to provide lighting from it only to the most needy section of society. Around 58% of rural households live below the poverty line. Liquid fuel lighting should be directed to this group only.

Assuming a norm of giving two improved lanterns per household for the above group (with each lantern producing the light equivalent to, or greater than a 60W light bulb), the kerosene consumption will come to about nine million tons per year. This fuel will be used by about 135 million improved lanterns. Presently, about one million tonnes of kerosine is used for lighting in these 58% rural households. Hence it is safe to assume that

about eight million tonnes of Kerosene will have to be imported, which will cost about Rs. 26,000 million per year in foreign exchange (at 1990 prices). This assumes that the rest of the existing kerosene consumption will continue as it is. Obviously, laws can be made that will allow most of the kerosene to be used only for lighting and not for cooking. This is because light can only be produced by kerosene, whereas for cooking other fuels are also available. The cost of lighting with Kerosene in these lanterns will be Rs. 1.20/household-day.

An alternative and attractive strategy for liquid fuel is the use of ethyl alcohol for lighting. Work done at NARI has shown that alcohol can be produced easily and economically from sweet sorghum (Sorghum bicolor (L.) Moench)—a multipurpose crop [5]. It provides grain from its earhead and the juice from the stem can be converted into alcohol. This alcohol can be easily used in the new type of lanterns developed at NARI, which also produce the light equivalent of a 60W light bulb. With the same norm of two lanterns for each household, the alcohol requirement comes out to be 1.5 x 10 litres/yr. This alcohol will be produced in decentralised mini-distilleries of 5,000-10,000 litres/day. The cost of setting up these distilleries to produce this quantity of alcohol will be about Rs. 1500-1750 crores. The alcohol production cost will be about Rs. 4.50/litre and the lighting cost will be Rs. 2.68/household-day. Also, since this fuel is biomass based, it can be produced in India and no foreign exchange is involved. Besides, it will also increase rural income and one will get grain and alcohol from the same crop. It is envisaged that the alcohol distillation plants will be in the private sector and will be set up in two or three years.

Interestingly enough, though the lighting cost from kerosene and alcohol is higher than that from electricity, the overall energy efficiency of lighting is the same. Thus, with the efficiency of a power plant at 35%, electricity transmission losses at 20% and the efficiency of a light bulb at 2.5% the overall energy efficiency of fossil fuel to light is 0.75%, whereas the efficiencies of improved lanterns developed at NARI are also 0.7 to 0.8%. Thus, in terms of energy, liquid fuel lighting is equal to or better than electric lighting.

Based on the above scenarios, the overall strategy for rural lighting should be as follows:

(1) By the year 2000 all kerosene imports should be stopped. This will result in saving of foreign exchange to the tune of Rs. 1000-1500 crores/yr. Kerosene for lighting should be phased out completely by the year 2010.

(2) Kerosene imports should be frozen at the present level. Priority should be given to using kerosene for lighting rather than for cooking.

(3) Alcohol production should be increased and excise laws liberalised, so that it is easily available for lighting, Alcohol usage for lighting will peak by the year 2000 and will be phased out by 2010.

(4) Use of improved lanterns should be encouraged and liberal tax laws should be enacted for their large-scale production and deployment.

(5) By the year 2010 all rural lighting should be electricity powered. Hawkers and other such decentralised systems will still use liquid fuel lighting or some other efficient lighting systems.

(6) Work should at once be started on setting up decentralised power generation plants of 10-20MW capacity. Availability of electricity connections in rural areas will have to be simplified and made less bureaucratic. Supply of electric connections on similar lines as selling insurance may be one avenue for its rapid spread.

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APPENDIX I

A new and efficient lantern running either on kerosene or ethanol has been developed at NARI. It

is called "Noorie".

It is a pressurised mantle lantern similar to a petromax lamp but is more efficient. In designing and developing this lantern, the main considerations were:

(1) The fuel consumption should be lower than that in the existing petromax lantern.

(2) It should produce light equivalent to that from a 100W light bulb and that its efficiency should be higher than that of a petromax.

(3) It should be very easy to light. In the existing petromax lantern, the lighting arrangement requires alcohol fuel. Since most consumers do not have access to alcohol fuel, they light the lantern by heating the fuel tube by rags dipped in kerosene, which makes the glass chimney extremely dirty, thereby reducing the light output considerably. This also necessitates frequent removal of the glass chimney for cleaning, which leads to more frequent damage to mantle.

(4) It should run on low tank pressures (of the order of 0.3—0.5 kg/cm^2 (g)). Existing petromax lanterns run on 1.5—2.0 kg/cm^2 (g) pressures, thereby increasing the hazard of the fuel tank bursting.

(5) It should have a self-cleaning mechanism of the nozzle. In the petromax lantern, the cleaning of the nozzle is by a fine pin supported by an elaborate cam mechanism. This cam mechanism increases the cost of the lantern and also provides a place from where the high pressure kerogas can leak.

(6) It should be easily affordable and very convenient to use. It should also be small and light in weight.

(7) It should be able to run on renewable fuels like ethanol.

All the above problems were solved by designing a completely new lantern. The main components of the design were:

a) Proper air-fuel mixing arrangement.

b) Ability for self-cleaning of the nozzle.

c) Optimum fuel tube sizing for better heat transfer.

d) Extremely simple and convenient initial lighting arrangement.

e) Use of light weight and sturdy materials of construction.

TEST RESULTS

Table-1 shows the comparison of various light sources. It is easily seen that the Noorie kerosene lantern is as cost-effective as a 100W light bulb. Besides, it is 1.5 times more efficient than the existing petromax lantern. The Noorie alcohol lantern can run on alcohol concentration of 80% (v/v) and above.

The Noorie lantern also doubles as a cooking stove. By removing the top cover and placing a utensil over the chimney, cooking is effected by flue gases. The heat of flue gases is completely wasted in petromax lanterns. Tests conducted show that 0.4 litres of water in a covered pot is boiled in 25 minutes. Also 100 gms of rice and 100 gms of dal can be cooked easily in 25 and 60 minutes respectively. The flue gas temperatures are about 500°C and the boil-

Table-1 Comparison of Various Light Sources

Light Source (Fuel)	Light output lumens(lm)	Fuel Consuption	Efficacy (lm/W)	Initial Cost (Rs.)	Light Output Unit Cost (Lm/Rs/day))
100W Incandescent bulb (electricity)	1340	100 W	13.4	400	2436
Noorie (kerosene)	1253	41 gms/hr (494.5 W)	2.53	125	2278
Noorie (alcohol)	1270	65 gms/hr of 93%(v/v) (450 W)	2.82	125	1206
Hurricane (kerosene)	68	16 gms/hr (193 W)	0.35	36	440
Petromax (kerosene)	1300	65 gms/hr (784 W)	1.66	250	1480
Fluorescent tube, 40W (electricity)	2400	40W	60.00	650	8856

ing-water efficiency is 18-20%.

Assumptions: a) Total cost of getting an electric connection for two points together with wiring is Rs. 400; b) Electricity cost is Rs. 1.00/KWhr; c) Number of bulbs fusing are 4 per year with cost of each bulb being Rs.7; d) fluorescent tube fixtures cost Rs. 125 each; f) Kerosene cost is Rs. 2.30/litre; g) Alcohol cost is Rs. 3.00/litre for 95% (v/v) alcohol; h) Cost of mantle replacement and minor repairs is Rs. 2.00/month; i) Thermoluminescent mantle life is 100 hours; j) Interest rate is 12% p.a.; k) Lighting is to be provided for 4 hours/day.

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Alternative tech for power generation

Biomass - based units at taluk level mooted

NEW DELHI, March 25.

ENERGY experts are suggesting the establishment of biomass-based power stations, at the *taluka* level, to mitigate the severe electricity shortage in rural areas, reports PTI.

The techno-economic feasibility of 10 megawatt biomass-based power plants has been confirmed in a recent study, conducted in Maharashtra's Phaltan *taluka* (one of smaller units in a district, comprising several villages).

The study was carried out by the Nimbkar Agricultural Research Institute (Nari), Pune.

A biomass-based plant may not only satisfy rural electricity demands, but also, generate employment, by encouraging biomass production, in the form of crops and fuelwood species, Nari scientists said in a report, presented at a workshop on electric power generation from renewable sources, held last month in Pune.

The technology for generating electricity from biomass in the 5-25 MW range, is already established in the US, where, 4000 MW is produced from wood wastes and crop residue, every year.

A US firm is willing to transfer technology to India either on a turn-key or consultancy basis.

At present, most energy projects for rural areas focus on villages, which do not have technical, economic and administrative infrastructure.

Hence, most projects have become "one-time shows, with little to contribute to the long-term solution of the rural energy problems", Nari scientists Anil K. Rajvanshi and Rajeev Jorapur reported.

A *taluka* or *tehsil*, on the other hand, has infrastructure, to run and maintain energy production technologies.

Energy experts expect a shortfall of 12,000 MW, during the Eighth Plan. Studies show that inspite of the government's claim that nearly 100 per cent of villages have been electrified in most states, only one-fifth of rural households have electricity.

India has already made a beginning towards generating electricity from biomass, with a proposal to set up a privately-sponsored pilot plant in Punjab, to produce 10 MW from rice hulls. Besides, most sugar mills produce both steam and electricity, from sugarcane bagasse.

An energy survey in Phaltan showed that each *taluka* has an electricity demand of 10-15 MW. The annual fuel need for a 10 MW power plant is about 73,000 tonnes, which can be met through two sources, agricultural residue and large-scale energy plantations.

Each 10 MW plant is expected to cost about Rs 300 million and it takes one to two years to construct one such plant, compared to the 10-12 years taken for a conventional big plant.

India produces about 300 million tonnes of crop residue every year. Theoretically, this can generate about 41,000 MW of electricity, equivalent to the capacity expected to be added during the Eighth Plan.

In areas where fuel requirements are met through crop residue and solid wastes, such as paper and wood, the cost of electricity generation works out to Rs 1.50 per kilo watt hour.

Where agricultural residue barely meets one-fourth of annual fuel needs, energy plantations offer a second option, with electricity generation cost coming to about Rs 1.70 per kilo watt hour.

Discussions with farmers have shown they are ready to plant trees on their lands provided they are assured a regular demand for fuelwood.

A 10 MW plant can also give employment to about 1,000 people for seedling preparation, transplanting and harvesting and running the plant.

Studies on fuelwood species, such as *eucalyptus hybrid leucaenia leucophila* and *prosopis juliflora*, show that 25-30 tonnes of biomass, per hectare, can be expected from good soils, every year and 10 to 15 tonnes from poor soils.

A grower can earn a profit of Rs 7,000-12,000, at a biomass price of Rs 650 per tonne, on well-irrigated soils, comparable to net profits from conventional crops, such as wheat and cotton, in Phaltan.

The energy plantations need only 5 to 10 per cent of the total irrigated land in Phaltan and 4 to 24 per cent of the irrigation canal water. A 10 MW station will require a maximum of 5,000 hectares, under energy plantations.

"Setting up such power plants offers the only hope for making up the Eighth Plan shortfall in a short time," the Nari report concluded.

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THE ECONOMIC TIMES
TUESDAY 25 FEBRUARY 1992

Rural technologies hindered by poor marketing efforts: NARI report

PTI

NEW DELHI 24 FEBRUARY

RURAL technologies developed in India have hardly touched the lives of villagers because of poor marketing efforts and a gross mismatch between technologies wanted and technologies received in rural areas, says a report.

There have been few efforts to create a demand for rural technologies despite the fact that they possess high market potential and would benefit nearly 250 million Indians, says the report by Mr Anil K. Rajvanshi, director of the Nimbkar Agricultural Research Institute (NARI), at Phaltan in Maharashtra.

The technologies available so far stressed only on catering to the needs of the people rather than on creating a demand for the new products, it says.

An example of demand creation is the setting up of supermarket by sugar cooperatives in rural Maharashtra, which stock goods at cheaper prices than local traders' shops.

"These supermarkets in one shot have changed the perception of rural people and have created a demand for better quality goods," the report says.

Many of the technologies are developed with the aim of keeping them so simple that they can be adopted in rural areas. But expecting poor villagers to make their own "Chulhas" and bullock carts is "asking for too much just as no one expects consumers to make their own cooking stoves and scooters."

Another aspect that is often ignored is convenience, according to Dr Rajvanshi's study.

Citing the example of bicycles, it says the vehicle has spread to every nook and corner of rural India because it is convenient to get the spare parts or repair facilities anywhere.

Developmental groups working on improved "Chulhas" do not similarly realise that every housewife, irrespective of the economic strata she comes from, would like the convenience of a gas stove. "A Chulha is still a Chulha, even if it is slightly better."

Noting that the feedback from the improved "Chulha" programme has not been encouraging, the report says negligible work has been done on stoves that work on biogas produced from fuelwood and biomass residues.

There is also a gross "mismatch of groups with perception of, and those with resources for, rural technologies." Thus national laboratories with adequate resources do not have a proper idea of the needs of villagers, and grass-root non-government organisations, although aware of the demands of the rural population, do not have "means to solve their problems."

"Most of the technologies suggeted for rural areas are urban-based and biased and do not meet the aspirations of rural people," the report says.

One of the possible solutions is to link rural technologies to the industry. "With the industry in the picture right from the beginning, there is scope for ensuring better sales efforts."

For example, NARI's kerosene lamps that give as much light as a 100-watts bulb have not spread in rural areas because of difficulties in marketing the product.

Development and propagation of rural technologies should be a consortium project that includes industry, grass-root non-government organisations researchers and workers, the report says.

Once industry linkage is established, the creation of consumer demand automatically follows. No technology has successfully reached the masses without good quality products, media advertising, sales outlets and after-sales services and rural technologies too should follow the same process, Dr Rajvanshi says.

Technology developers also should not shy away from complex and sophisticated technologies for rural areas, as long as they are backed by good after-sales services, and are convenient to use and reasonably priced, he suggests.

It is equally essential that any new technology should meet the specific requirements of the rural people and solve problems unique to India.

For example, two-wheelers for rural masses should be so designed that they run well on the muddy and bumpy Indian rural roads, can carry highloads at low speeds and have internal combustion engines that run on alcohol.

Rural technologies will spread faster if they generate employment also, Dr Rajvanshi's report says. Such technologies include agro-based industries, food processing, energy production through biogas plants and making raw materials for chemical industries.

DEVELOPMENT OF TECHNOLOGIES FOR RURAL AREAS - NEED FOR NEW THINKING

Anil K. Rajvanshi *

A large number of voluntary organizations are involved in developing technologies for rural areas. However, these technologies have hardly touched the lives of rural population. Data on rural market potential shows that a population of about 250 million in rural areas exhibits a high level of market potential. This is almost 1/4th the total population of India. With such a high market potential, why have the good efforts of organizations developing technologies, devices and products for rural areas not borne any fruit? This article tries to analyse the reasons and to give some possible solutions.

Present Situation

The following points will highlight the existing situation :

- Most of the technologies being propagated in rural areas are urban-based and biased. They trickle down to rural areas.
- Rural population is not composed of subhuman beings. Their needs and aspirations are similar to those living in urban areas. Technology development should take place keeping these aspirations in view.
- Most of the technology development that takes place for rural areas is carried out with an aim to keep it simple so that the devices can be made in rural areas itself. This is a peculiar mindset of technology developers. For poorer sections of rural population, it is asking too much to have them make their own chulhas, bullock carts etc. At least nobody in urban areas asks consumers to make their own scooters or cooking stoves!
- Again the emphasis of technology developers for rural areas has been on catering for needs (with small improvements) rather than creating a demand. History shows that technological development has been fueled by creation of demand. And the watchword is convenience. Thus convenience is the vehicle of development. For example, a large number of developmental groups are working on making better chulhas. Feedback from the 'better chulha' programme has not been very encouraging. Developers do not realise that chulha is still a chulha, even if it is slightly better. Every housewife, irrespective of the economic strata which she comes from, would like to have the convenience of blue flame of a gas stove. There is a

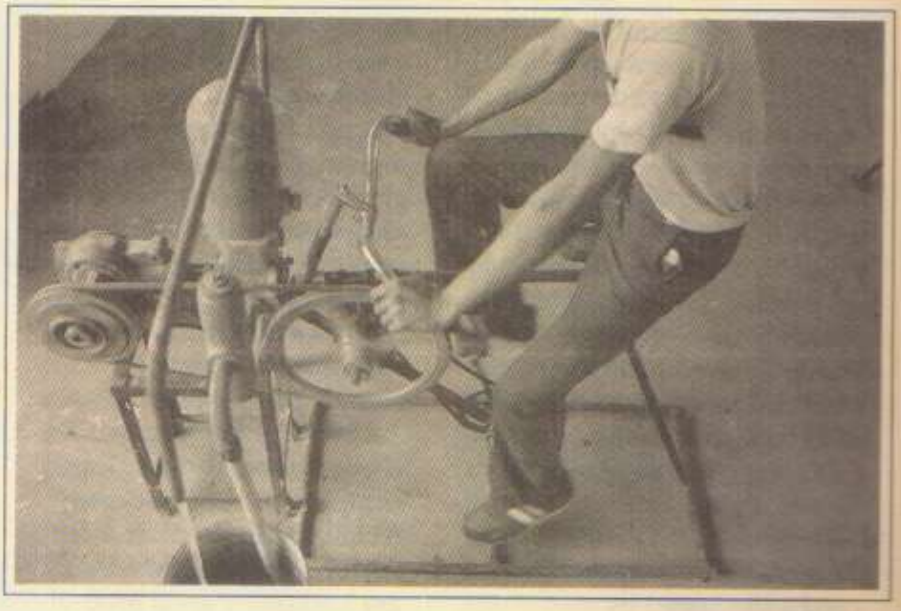
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demand for it. Negligible work has been done on developing technology for producing blue flame from fuelwood and biomass residues.

- There is also a peculiar mismatch of groups with perception of, and those with resource for, rural technology development. Thus labs, especially National labs, who have resources, do not have any perception of the needs and demands of rural population. On the other hand, the grass-root NGOs who have the perception of the problem, do not have the technological resources to solve them.

- Again there is a mindset for simple technologies in rural technology developers. Why it is so, is difficult to comprehend when right in front of them are examples contradicting it. For example, bicycle which is the mainstay of rural transport is a complex piece of machinery and is manufactured in sophisticated plants all over the country. It has spread in every nook and corner of rural India because of the convenience of easy availability of spare parts and a large number of repair facilities. This kind of example should be followed in all rural technological development. Also no government subsidy is given for bicycle purchase. It stands on its own.

- Another interesting example of demand creation is the setting up of supermarkets in rural Maharashtra. These supermarkets in Taluka areas are similar (though on a smaller scale) to those found in western nations. These supermarkets are owned by local sugar cooperatives and because of their size and economic clout, these markets stock goods at cheaper prices than those available in the local *bania* shops. Besides, the variety of goods available is very large. These supermarkets in one shot have changed the perception of rural people and have created demand for better quality goods. The local *bania* shop could have been enough to take care of the needs but these supermarkets have created demand. In doing so they have helped in upgrading the life style of a certain section of rural population.



Possible Solutions

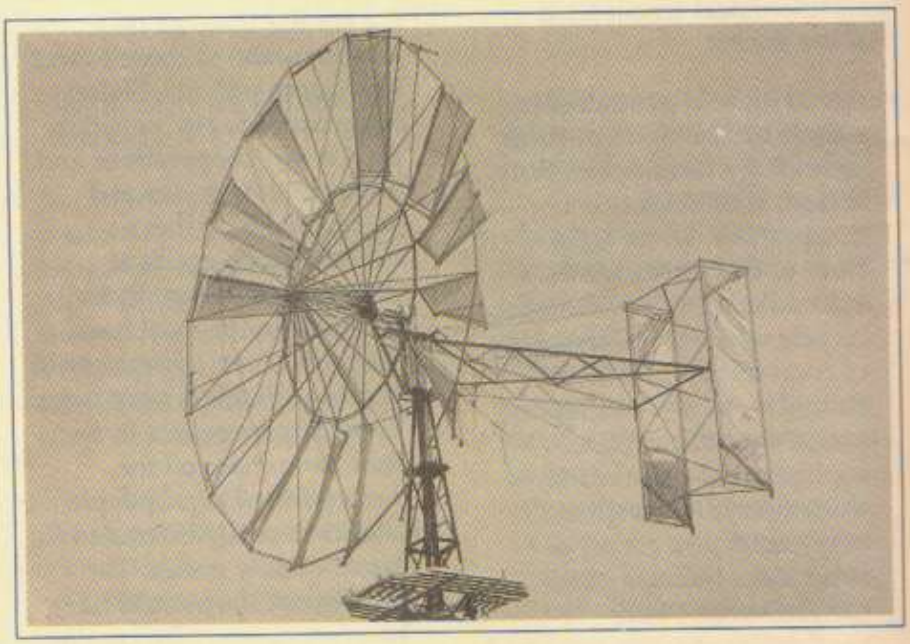
Below are possible solutions or the strategies for developing rural technologies and how best to propagate them:

- Rural technology development and propagation should be a consortium project. The members of such consortia will include industry, grass-root NGOs, researchers and workers. With industry in the picture right from the beginning, there is a scope for ensuring better sales efforts. An example will illustrate this point. Nimbkar Agricultural Research Institute (NARI) has developed an extremely efficient kerosine lantern capable of giving light output equivalent to a 100 w light bulb. Getting this technology marketed through various high volume consumer products groups is proving to be quite difficult. This was despite the fact that preliminary consumer survey data showed an overwhelmingly satisfactory response to the lantern. Generally the response of these consumer product companies was either NIH (Not Invented Here)

syndrome or there was no perception of the market potential of this lantern. This could be because of the urban bias of these companies. If one of these companies was involved with NARI right from the beginning in developing this lantern, then probably these lanterns would have come in the market. The companies need to have a stake in the technology development to be serious about it.

- This consortium approach can be facilitated by organizations like CAPART. Thus in giving funds for any technology development scheme to an NGO, CAPART should insist on industry linkage. The problems of patent rights, royalty etc. can be amicably solved to the mutual satisfaction of all parties. A similar strategy needs to be adopted by other government organizations in their rural development programmes.

- Once the industry linkage is established, then automatically the whole machinery of consumer demand creation comes into play. This includes high volume production, good quality products, media advertising, sales outlets and after sales service. No technology has successfully reached the masses without the above attributes and rural technology should follow the same evolutionary process.
- As discussed before, the vehicle of development is convenience. Rural technology development should take place with this as a major theme. There are a large number of cases where people are ready to pay a higher price for goods which give them convenience. Also associated with the theme of convenience is sophistication. Hallmark of evolution is size reduction and increased sophistication and complexity of systems. Technology developers should not shy away from complex and sophisticated technologies for rural areas. As long as these technologies are backed by good after-sales service, are convenient to use and are reasonably priced, they will spread rapidly.



- Till now most of the technologies have been borrowed from the west. They have been taken up in urban areas and then filtered down to rural areas. Some examples will highlight this point. Bicycle was designed to run on good roads. For rural roads there is a need to have simple shock absorbers and better seats. Similarly two wheelers (like Honda, Ind-Suzuki etc) have been designed to run at high speeds and on good roads. Thus they are light and very unstable on muddy rural roads. There is therefore a need to develop technologies specifically for rural areas. Since the rural conditions are unique, they also require unique solutions. Besides most of the western technologies are energy intensive and will make the growth pattern of rural India similar to that of the West. With perennial resource constraint, it is in the interest of India to develop alternative routes. For example an excellent two wheeler for Indian rural roads should have internal combustion engine running on alcohol. Besides, it should have the ability to carry high

load at low speeds. No such engine exists since almost all the engine development technology has been based on the premise that these systems should run at high speed. The challenge to develop such an engine is tremendous and will tax the best brains, materials and technology.

- The spread of rural technologies will be facilitated if they also are employment generators. Thus high-tech agrobased industries can provide a possible solution. These industries will be in the areas of food processing, energy production (electricity producing plants running on biomass and ethanol production) and production of raw materials for chemical industries. Sugar cooperatives (which are chemical industries) have shown that in rural Maharashtra all round development takes place right from agriculture development to consumer items growth to increased employment around them.

Finally, it should be pointed out that in any such discussion about rural technology development and propagation, the question boils down to whom this technology is for. Most of the funding agencies and the participatory groups like NGOs would like to see these technologies benefit the lowest strata of the rural population. However, the economic situation of these people precludes any or little participation in this process. It is however possible that if the technologies help 250 million people (high market potential group) in rural areas, the whole process can snowball to include the poorest sections into the economic revolution. This vast rural market can produce whole economic systems which will span from manufacturing to service industries.

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Indian Journal of Rural Technology

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14/07/1994

Jaggery made from sweet sorghum

SCIENTISTS of the Nimbkar Agricultural Research Institute in Maharashtra, who have produced jaggery from sweet sorghum, say their technology has become relevant in the context of the current sugar crisis, reports PTI.

"If the Government decides to ban production of gur from sugarcane, an alternative crop like sweet sorghum can still be used to make jaggery", the NARI Director, Dr Anil K. Rajvanshi, said.

He proposed sweet sorghum as the crop that may provide some relief during the current sugar crisis in the country.

The NARI has developed a technology for using sweet sorghum to produce a table variety syrup and jaggery for making candy and confectionaries. It developed the technology under a special project, the findings of which were submitted to the Council for Advancement of People's Action and Rural Technology here.

Dr Rajvanshi said about 350 kg of syrup from sweet sorghum have already been sold all over India in past one year and it has been accepted more readily than jaggery.

The syrup from sweet sorghum has a honey-like taste, has low sucrose content but is rich in glucose and fructose, and is an excellent natural source of calcium and Vitamin-C, proteins and nicotinic acid which forms part of the Vitamin-B Complex.

Feedback from users indicates that it can be eaten with bread, pancakes and "chapattis", can be used as a sweetener in cake and biscuit making and as an ice cream topping. It can also be taken with lukewarm milk.

NARI, the only organization from India to be made a member of Sweet Sorghum European Network, has bred high-yielding hybrids for making jaggery, syrup and alcohol, of which the hybrid "Madhura" has been found to be most promising.

"Madhura" has also been introduced in France, Thailand and Zimbabwe where preliminary results confirm it as an excellent source for alcohol.

Jaggery and "Khandsari" production is a Rs 30,000-crore rural industry in India and provides employment to about 2.5 million rural people, Dr Rajvanshi said.

About 40% of the total sugarcane produced in India is diverted to make jaggery in spite of poor and inefficient manufacturing techniques that lead to huge revenue losses to farmers in the long run.

NARI, which has set up a 100-kg-capacity pilot plant, says that with the use of sweet sorghum, jaggery making can become a year-round occupation.

Indian Express, May 13, Col 5.

Greening deserts the solar way

Indian Express - 13/05/1992

by J. Srinivas

LACK of water need not be a hurdle to grow trees in arid regions of the world if planners adopt a novel technology developed by a group of researchers in India. The technology employs the most abundant natural resource available – solar energy.

Scientists at the Nimbkar Agricultural Research Institute (NARI) at Phaltan in Maharashtra have successfully tested a simple method of raising plants using water extracted from soil using solar energy.

A single solar still, on an average, produces 300 mililitres of water per day, which is enough to sustain four seedlings.

"We find this method far more practical than strategies like aerial seeding, hand-watering, and sowing seedlings during rainy season," says NARI director Anil Rajvanshi.

Six years ago India launched an ambitious afforestation scheme for raising trees on five million hectares but it failed largely because water could not be provided at the seedling stage.

All soils contain some moisture and plant roots tap this water by osmotic pressure difference. But in arid and semi-arid regions, the water is so tightly bound to the soil, it is not easily available to the seedlings because of their shallow root system and inadequate osmotic potential.

"We decided to use the heat of solar radiation to free the water that is bound to the soil, and use this water to irrigate the seedlings," Rajvanshi states.

The NARI technology for harvesting soil-bound water is extremely simple and cheap. First a box shaped pit about 60 cm deep is dug. Then, a solar water evaporation still with reflecting sides and a sloping glass roof is installed over the pit. The heat generated by solar radiation releases the moisture in the soil and the water vapour condenses into droplets on the glass roof.

The water thus produced, automatically collects in a bottle attached to the sloping roof and is used to nourish the seedlings planted immediately around the pit.

The still is required only until the seedling gets established on the ground. After that it can be removed and used over another pit.

The NARI team that started testing this system in July 1988 says it has been working very well. A single pit, on the average, produces 300 ml (mili litres) of water per day – enough to sustain four seedlings.

"That this little amount of water is capable of helping the seedlings to survive came as a surprise to us," says Rajvanshi adding that "it is possible that it is acting like a drip irrigation system."

Tests showed that the seedlings grew better when they received their share of water – however small – every morning than when they were given a big dose once a week.

The solar still costs less than Rs 200 to build and Rajvanshi and his team built five of them for their experiments. By reusing these stills on different pits the team covered 900 square metres of an experimental plot in Phaltan, a semi-arid region in Maharashtra. Today, about 130 plants are growing in this plot that include *P.juliflora*, *A. indica* and *L. leucocephala*.

Presently NARI scientists are trying to raise bamboo, a species that is relatively more susceptible to water stress. According to Rajvanshi, seedlings raised with water from solar stills had 100 per cent survival rate !. In contrast, the survival rate of rain-fed seedlings was 70 to 80 per cent.

NARI scientists first presented their work at the Solar World Congress held in Denver, United States, in August 1991. "Since then we have received numerous enquiries," says Rajvanshi, who believes that the simple technique could play a major role in greening arid zones in other parts of the world.

Besides Maharashtra, Madhya Pradesh has shown interest in the novel technology. The state's land use and wasteland development board is planning to spread this method in low rainfall areas where afforestation programmes have failed due to lack of water.

(The author is a science writer)

Economic Times

Sugarcane leaves to generate power

PTI

NEW DELHI 23 AUGUST 1992

SUGARCANE leaves, millions of tonnes of which go waste in India every year, can be used to generate power, save diesel and produce enough heat to run jaggery units and even burn small animals in a crematorium.

"Production of power via loose leafy biomass is a unique technology and we believe that in gasification of sugarcane leaves we are the first in the world," report scientists from the Nimbkar Agricultural Research Institute (NARI) at Phaltan in Maharashtra.

They presented their findings at an international conference in Switzerland in May this year and have also submitted them to the Department of Non-conventional Energy Sources.

In view of the India's pressing need to identify indigenous and renewable sources of energy, NARI initiated the project to gasify loose sugarcane leaves to generate electricity in the 10-15 KW range.

Besides producing power, th scientists have successfully use sugarcane leaves to genera heat for jaggery-making unit and specially-designed furnaces to incinerate small dead animals like sheep.

Tests on a 15 KVA diesel genset powered by a sugarcaneleaves gasifier showed that 70-90 per cent diesel substitution could be achieved with a 5 KW load.

Power now from sugarcane leaves

Times of India -1992

NEW DELHI, August 23 (PTI).

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Tests on a 15 kilo volt ampere (KVA) diesel genset powered by sugarcane leaves gasifier showed that 70-90 per cent diesel substitution could be achieved with a five kw load.

NARI GASIFIER: The NARI gasifier, which is non-polluting and safe, also produces char which is 15-28 per cent of the fuel.

The char boosts the overall efficiency of the system to 80-85 per cent and when mixed with a suitable binder it forms an excellent briquetting fuel for cooking purposes.

For developing countries like Inida where biomass residues are available in plenty and there is an acute shortage of power, leafy biomass gasifiers offer an excellent opportunity to produce power and generate heat.

Major work in biomass gasification around the world has focussed on wood or charcoal as primary fuels which are, however, not available in adequate quantities in developing countries. Use of agricultural residues is an attractive alternative in such cases.

In India alone, about 430 million tonnes of crop residues are produced every year, out of which 330 million tonnes are used as feed or fodder and the remaining 100 million tonnes simply disposed off by burning in open fields.

WASTE OF ENERGY: "This is a colossal waste potentially useful source of energy", says the report by the NARI director, Anil K. Rajvanshi, and his colleague Rajiv Jorapur.

Most of the residues are in a loose leafy form such as sugarcane leaves, wheat husk, rice husk and safflower straw.

The residues usually have high amounts of ash and are, therefore, difficult to gasify.

In their studies, the NARI scientists used sugarcane leaves that have been chopped into one-to-five-cm-long pieces and sun-dried.

Statesman - 25/08/1992

Power from cane leaves

Sugarcane leaves, millions of tons of which go waste in India every year, can be used to generate power, save diesel and produce enough heat to run jaggery units and even burn small animals in a crematorium, reports PTI.

"Production of power via loose leafy biomass is a unique technology and we believe that in gasification of cane leaves we are the first in the world," report scientists from the Nimbkar Agricultural Research Institute at Phaltan in Maharashtra.

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They have also designed a gasifier-powered diesel generator set, comprising a gasifier, a cooling-cum-cleaning system and 15 kva diesel engine genset.

The biomass and air are fed from the top and ash and char continously removed from the bottom into a water seal. The gasifier is an open top unit,

Renewable energy systems 26/09/1992

Small power packs

Biomass-based power plants can help overcome energy shortages and could be the answer to rural unemployment.

ONE energy source that has attracted the attention of energy technologists in recent years is that of biomass fuels. In India, energy shortage by the end of the Eighth Plan will be around 12,000 MW. In this context biomass gains significance given the evidence of its success elsewhere.

In an energy crunch it is always the rural areas which bear the brunt. This results in a high degree of unemployment and low purchasing power in rural population. Biomass generation of electricity can, therefore, solve both the problems of power and unemployment.

At present the planning of most rural energy projects have a village as their focus. Due to the lack of infrastructure—economic and technological—such projects are bound to serve short-term gains only with little to contribute towards a long term energy solution. Witness the failure of *urja grams*.

Talukas or *tehsils* are more suited to run and maintain energy production systems on a long term basis. Besides, the solution to a *taluka*'s power needs (which has been estimated to be around 10-20 MW) means taking care of the energy needs of a large number of villages which constitute it.

A recent study has shown that for a 10 MW biomass-based power plant, about 83,000 tonne of dry biomass/yr is required. This can either be provided from crop residues or captive energy plantations.

Talukas or tehsils are more suited than villages to run energy production systems on a long term basis.

India produces about 300 million tonne of crop residues (including rice husk) every year, which theoretically can generate about 40,000 MW of electricity. This is nearly equivalent to the total electricity generating capacity to be added during the Eighth Plan. A study conducted for Phaltan *taluka* in western Maharashtra, for example, has shown that about 100,000 tonne of crop residues are available. This exceeds the annual requirement for a 10 MW plant.

In a majority of cases where sufficient crop residues are not available, the only viable option would be a mix of crop residues and plantation wood. The concept of energy plantations, with fast growing species of trees like *Leucaena*, *Prosopis*, *Eucalyptus* and *Acacia*, has been mooted precisely for this reason. These yield between 25-30 tonne of dry biomass/hectare-yr in good soils with irrigation and about 10-15 tonne/ha-yr in poor soils with good irrigation.

These yields are for a five-year cropping cycle. Hence, for a 10 MW power station, a maximum of 5,500 ha will have to be brought under energy plantation, if it is to run only on plantation wood. Already in Maharashtra, Gujarat, Karnataka and Tamil Nadu large areas have been planted with trees both for timber and fuelwood.

BESIDES, given an assured demand for the wood, farmers too have shown interest in having such plantations on their own land. Large scale tree plantation in some areas of Maharashtra has shown that their labour and input requirements are easier to manage and in some cases give remuneration equivalent to or even better than that from traditional crops.

It is estimated that energy plantations grown on good soil can give farmers a net profit of Rs 7,000-Rs 12,000/ha-yr, if one takes the power plant factory gate price of wood to be Rs 650/tonne. Besides, a 10 MW power plant can give direct employment to about 1,000 people year round for seedling preparation, transplanting and harvesting of these plantations and for running the power station. These plantations can also provide environmentally beneficial green cover.

The infrastructure required for these power plants will be similar to that of sugar factories. If power production is privatised, these small plants can be set up as joint-stock companies with farmers and promoters as shareholders.

The technology for such biomass based power plants is a proven one. These run exactly on the same principles as a coal-fired plant. In the US about 4000 MW of electricity produced from wood waste/crop residues is being supplied to the national grid. These plants are modular in nature and are in the 5-25 MW range. They run on any combustible material. There are plants which run only on rice husk.

These plants cost about Rs 3 crore/MW for a new plant and about Rs 1.5 crore/MW for reconditioned plants. In India, the technology is available and the cost of electricity works out as follows. For crop residues at Rs 400/tonne the cost is Rs 1.40/KWhr for reconditioned plants and with a rate of return on capital at 15 per cent for investors. If, however, there is a complete tax write off for investors setting up power plants, it works out to Rs 1.10/KWhr.

If the power plant is fuelled by 50 per cent wood from energy plantations and 50 per cent biomass residues, the electricity cost will be about Rs 1.45/KWhr for reconditioned plants and Rs 2.25/KWhr for brand new plants. These costs would compare favourably with tariff from regular thermal power stations in 1995. Even today, the electricity cost from thermal plants is Rs 1.75/KWhr. The power produced from these plants can be directly fed into the national grid. Industrial development corporation centres in each *taluka* should also be encouraged to put up such plants for their captive use.

Thus, the deployment of 10-20 MW renewable energy power stations—a mix of biomass-powered or solar/wind-powered stations is also feasible—in each *taluka* may be the only way to ease the power shortage in India.

■ **Anil K. Rajvanshi**
The author is the director of Nimbkar Agricultural Research Institute, Phaltan.

BIOMASS FUELS

A broad framework to understand the biomass situation in the country could be based on the way biomass fuels are obtained or supplied. Biomass energy systems can be categorised into three major types: (1) Urban fuelwood systems, (2) Semi-urban biomass energy systems. In each of these cases system boundaries are different ; supply mechanisms vary; impacts on resources are different; and opportunities to improve the situation may or may not exist. Therefore, for examining the role of biomass in the energy sector, it is important to look at the resource in totality.

Assessments of the three major programmes --- improved cookstoves, biogas plants and social forestry---initiated in the last 10 years to address the scarcity of fuelwood, reveal that the current approach is unlikely to be highly successful in making a positive impact on the rural energy situation.

Source: TERI

The Economic Times Bombay

Sweet sorghum for the sweet tooth

NEW DELHI, January 17 (PTI): THOSE with a sweet-tooth may find an ally in sweet sorghum, a crop widely grown in parts of peninsular India and emerging as an alternative source of jaggery for making candy and confectionaries.

Scientists in Maharashtra have devised, for the first time in the country, a complete protocol for making jaggery or *gur*, a table-variety syrup from sweet sorghum.

The Nimbkar Agricultural Research Institute (NARI), at Phaltan, has set up a pilot plant of 100-kg capacity, and its scientists say that with sweet sorghum as the raw material, *gur*, making can become a year-round occupation instead of a seasonal one as in the case of sugarcane.

NARI's project report was submitted recently to the Council for Advancement of People's Action and Rural Technology (CAPART). The findings may not only offer an alternative source for jaggery, but also reduce diversion of sugarcane for making *gur* instead of sugar.

Jaggery and khandsari production is a Rs 30,000-million industry in India and provides employment to about 2.5 million people, says NARI director, Dr Anil K. Rajvanshi.

About 40 per cent of the total sugarcane production in India is diverted to make jaggery inspite of inefficient manufacturing techniques that lead to revenue losses for many farmers, he says.

ALTERNATIVE SOURCES: NARI scientists, therefore, explored alternative sources for making *gur* especially short-duration crops needing less water.

Besides evaluating some 38 varieties and four hybrids of sweet sorghum, they designed an improved 50-90 kilo watts (kw) gasifier running on loose biomass to make *gur*.

They reported an average 8 per cent recovery of *gur* and 48 per cent juice extraction from the crop.

On analysis, the crop was found to have a high ratio of sucrose to reducing sugars, which favours good-quality *gur*.

A hybrid Madhura was found to be the best, with sucrose content more than 11 per cent and the ratio of sucrose to reducing sugars higher than six.

Although the fresh stalks and juice lose their sucrose within 24 hours of storage, the scientists found that there was virtually no change in the sugar and reducing sugar concentrations in the stored juice, when it was autoclaved at 120 degrees celsius and kept in a closed container.

Studies at NARI showed that good *gur* could be made from sweet sorghum by boiling its juice within 10 minutes of exraction which helps in efficient removal of any scum in the juice.

GUR PROCESS: After 25 minutes of boiling, the right temperature for making *gur* 114-116 degrees celsius--is attained.

A pilot-plant set up by NARI using a 48-cms-wide gasifier could process 100 kg of juice to produce *gur* in about two hours.

The studies also showed that in a year, *gur* from Madhura variety could be made for 160 days from April to June and again from August to November, while sugarcane units can run from October to March.

Times of India, Delhi (Jan 18-A), 1993

Financial Express - New Delhi

Sweet sorghum may ease sugar crisis: Scientists

NEW DELHI, July 13 1994

Scientists of the Nimbkar Agricultural Research Institute (NARI) in Maharashtra, who have produced jaggery from sweet sorghum say their technology has become relevant in the context of the current sugar crisis in the country.

"If the Government decides to ban production of gur from sugarcane, an alternative crop like sweet sorghum can still be used to make jaggery", the NARI Director, Dr Anil K Rajvanshi, told PTI and proposed sweet sorghum as the crop that may provide some relief to the current sugar crisis in the country.

NARI Phaltan has developed technology for using sweet sorghum to produce a table variety syrup and jaggery for making candy and confectionaries. It developed the technology under a special project, the findings of which were submitted to the Council for Advancement of People's Action and Rural Technology (CAPART) here.

Dr Rajvanshi said about 350 kg of syrup from sweet sorghum have already been sold all over India in the past one year, and it has been accepted more readily than jaggery.

The syrup from sweet sorghum has a honey-like taste, has low sucrose content but is rich in glucose and fructose, and is an excellent natural source of calcium and vitamin C, proteins and nicotinic acid which forms part of the vitamin B complex.

Feedback from the users indicates it can be eaten with bread, pancakes and 'chapattis', can be used as a sweetener in cake and biscuit making and as an ice cream topping, an can also be taken with lukewarm milk.

NARI, the only organisation from India to be made a member of sweet sorghum european network, has bred high-yielding hybrids for making jaggery, syrup and alcohol, of which the hybrid 'madhura' has been found to be most promising.

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Financial Express
New Delhi
14/07/1994

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"Madhura" has also been introduced in France, Thailand and Zimbabwe where preliminary results confirm it as an excellent source for alcohol.

Jaggery and "Khandsari" production is a Rs 30,000-crore rural industry in India and provides employment to about 2.5 million rural people, Dr Rajvanshi said.

About 40% of the total sugarcane produced in India is diverted to make jaggery in spite of poor and inefficient manufacturing techniques that lead to huge revenue losses to farmers in the long run.

NARI, which has set up a 100-kg-capacity pilot plant, says that with the use of sweet sorghum, jaggery making can become a year-round occupation.

Biomass power projects in taluks favoured

Hindu
09/08/1994

NEW DELHI, Aug. 8.

India should adopt biomass-based energy programmes at the 'taluk' level, rather than go in for foreign-funded massive power projects to solve its energy problems, recommends a study.

For the first time, the study in Maharashtra has shown that taluk-based energy systems can serve as a possible model for rural areas, and be a viable alternative to village-level systems that have proved to be a drain on energy and economy.

A *taluk* or *tehsil* is an administrative block comprising 90 to 100 villages, with a small town as its headquarters.

All the energy needs of Phaltan taluk in western Maharashtra in 2080 A.D. can be met by proper use of agricultural residues and energy plantations via agro-energy systems, says Dr. Anil K. Rajvanshi, Director, Nimbkar Agricultural Research Institute (NARI), Phaltan, which pioneered the study.

A decentralised energy system running on renewable energy sources can be an alternative to mega city-based centralised energy system.

In the euphoria of getting foreign funds for power projects, national security is being compromised, says Dr. Rajvanshi. Most of the foreign-funded power plants are going to run on imported natural gas and if the international supply becomes critical, all of these plants can become non-functional, he says.

The NARI's study shows that biomass at the taluk level can provide food, fuel, fodder and fertilizer to the inhabitants, besides employment.

In the case of Phaltan, the taluk produces over two lakh tonnes of agricultural residues every year, most of which are simply burnt in the fields.

NARI scientists suggest that electricity, liquid and gaseous fuels that account for 93 per cent of the total energy purchased in Phaltan can be replaced by renewable energy options.

Two options suggested

The scientists have recommended two major options. The first is production of liquid fuels such as ethanol from sweet sorghum and molasses, and pyrolysis oil, a potential diesel substitute for compression ignitions (CI) engines, by rapid burning of biomass.

The second option is production of electricity through 30 to 40 MW biomass-based stations and cogeneration from sugar factories.

NARI scientists estimate that after taking care of fodder requirements, Phaltan has 2,40,000 tonnes of sweet sorghum stalks that can produce 9.6 million litres of ethanol every year.

The study shows that an additional 3.8 million cubic metres of biogas can be produced every year from the ethanol distilleries. Electricity to the tune of 8.7 MW can be generated by a biomass power plant running on sweet sorghum bagasse.

Similarly, the 23,300 tonnes of molasses produced in Phaltan every year can generate 5.6 million litres of ethanol, while the crop residues can give 45,000 tonnes of pyrolysis oil, sufficient to take care of diesel and kerosene oil requirements of Phaltan, and 9,000 tonnes of producer gas. The 370 million KW hours of electricity that will be needed by Phaltan by 2080 A.D. can be provided by cogeneration from sugar factories and from biomass-based power stations.

According to NARI scientists, biomass based programmes offer three options — ethanol production from molasses and sweet sorghum; electricity production from energy plantations and agro residues; and pyrolysis oil production from agricultural residues.

Job opportunities

An analysis has showed that these energy supply options can not only replace petrol, Liquid Petroleum Gas (LPG), diesel, kerosene and electricity, but also provide employment to about 30,000 people in a taluk.

They can also take care of some of the characteristic and chronic problems of developing countries — high levels of unemployment in rural areas, shortage of fossil fuels, severe balance of payments crisis due to huge oil imports and poverty that is directly related to energy supply, says Dr. Rajvanshi.

NATION

Where bioresources have made their mark

By Aditi Kapoor
The Times of India News Service

BANGALORE, October 14.- The three international conferences on bioresources, held in Nevada, Vienna and in the city last week, provided an opportunity to share experiences on the successful use of bioresources for energy across the world.

The "BioResources'94" conference held here began with a visit to Pura and three other villages, where community projects using biogas have been working successfully.

Pura was supplied grid electricity by the state government but only 39 of the 87 households could afford to get a connection. In 1987, the village got its first biogas plant with the help of ASTRA (centre for the application of science and technology to rural areas) based in the Indian Institute of Science and KSCST (Karnataka State Council for Science and Technology).

Besides power, the village women use bioenergy to draw clean drinking water from a borewell. As a result, they are spared the gruelling ordeal of carrying home 25 litres of water in the cruel sun.

Another benefit is that they earn twice as much as they used to, one by selling cattle dung for the biogas plant and two, by saving on buying chemical fertilisers, as the dewatered sludge from the plant is a nitrogen-rich natural farm manure.

Now, the village flour mill owner too has asked for power from the biogas plant because it is more reliable and within the control of the village community.

In one of the working sessions, Mr Anil K. Rajvanshi showed how the energy requirements of Phaltan taluka, Maharashtra, can be met with its bioresources. A study by the Nimbkar Agricultural Research Institute (NARI), indicated that 80 per cent of the taluka's total purchased energy is imported at a cost of about Rs. 6.2 crores a year.

This cost would be much higher if the agriculture sector, using 56 per cent of the power, pays less subsidised rates. Power and LPG are the fastest growing energy components in the taluka, followed by liquid fuel. Together, they account for 93 per cent of the taluka's demands.

Ethanol from sweet sorghum (jowar), molasses (by-product of the sugar factory), pyrolysis oil from biomass residue and direct use of biomass can together, with a realistic electricity pricing policy, supply the energy requirements of the 2.76 lakh residents.

The Vienna conference talked about Europe's biggest heating plant at Vitry. Located in the Champagne region of France, the experiment shows the benefits of marrying modern technology with one of the oldest and most widespread energy sources --wood.

The Vitry-Habitat heating plant saves the average household over US $ 1000 per annum by subsituting sawmill waste for oil. The heat generation costs have been reduced by about 63 per cent due to continual refinement of the combustion dynamics.

Ashes are recycled to a nearby farm, thus closing the nutrient cycle. Particulate emissions are reduced to a minimum by using an electrostatic precipitator. Plans to treble the 9 MW plant include increasing levels of efficiency, reduce costs and improve the environment.

U.K.'s non-fossil fuels obligation (NFFO) has a strong economic stimulus for using renewable energy. NFFO taxes electricty production from conventional resources and uses this revenue to subsidise non-fossil electricity generation technologies. A premium price for "clean electricity" has encouraged expansion of this sector.

Under NFFO, two large-scale power stations are being fuelled by chicken litter, poultry litter, wood or straw shavings of relatively low moisture content. Conventional boilers and steam turbines are used to produce a total of 27 MW. The ash from the power plants are used as a potassium-rich fertiliser.

The Brazilian sugarcane ethanol programme, launched in the late 1970s, to produce alcohol-driven vehicles has been well-known for some time now. Says Mr Julio Maria Borges of the Copersucar University of Sao Paulo, "The gasoline substitute from biomass has generated high-income employment in the sugarcane belt which produces 240 mt of sugarcane. However, less than one per cent of the country's fertile area is used for sugarcane."

Still, over two lakh barrels of imported oil are substituted by the 12 billion litres of ethanol produced. Another 4.5 million litres are made from a blend of gasoline and ethanol. The cost of ethanol production is falling, as sugarcane productivity has gained by 30 per cent since the mid-1970s.

The parallel incentive given for growing plantations has borne fruit by yielding pulp for paper production and large quantities of charcoal for making iron and steel. Over 30 per cent of the charcoal comes from here, thereby reducing pressure on the fragile natural forests.

Zimbabwe, caught in a cycle of rainfall followed by periods of drought and dwindling fuelwood for its rural populations, is getting ready to frame a national energy policy. While the Global Environment Fund-sponsored photovoltaic project does not promise longterm gains, Mr Christopher J. Chetsanga of the Energy Institute, Scientific & Industrial Research & Development Centre sees hope in the biogas units promoted by the government. "To date, over 40 biogas units have been installed with a great degree of social acceptance by village dwellers," he says.

(Concluded)

Train to Ooty running at heavy cost

Press Trust of India
COIMBATORE, Oct. 14, 1994

The narrow guage train takes about five hours to cover 45.9 km at an average speed of 13 km per hour. Time-consuming and boring it may sound, it isn't.

Anyone who has travelled by the Niligiri mountain rail (NMR) from Mettupalayam to Udhagamandalam, Ooty, over the past 95 years, will tell you that the steep journey from 330 metres mean sea-level (MSL) to 2200 MSL, is really a fascinating one.

Started way back in 1899 initially between Mettupalayam and Coonoor before being extended to Ooty in 1908, the NMR is one of the legacies the British left us.

But in patronising the legacy on



Toy train to Ooty — cherished legacy or white elephant?

"The decision to run the diesel locomotive between Coonoor and Ooty is a conscious one in deference to the tourists preference," Mr Dasarathy says and adds that the diesel engine had been reconstructed at the IR's Golden Rock workshop in Tiruchirapalli since it was abandoned after a mishap in 1987.

Besides, a steam locomotive had been modified by the locomotive workshop in Perambur near Madras for oil firing so that either diesel or furnace oil could be used instead of coal, he said, adding that oil-fired engines were more en-

be cut down on this count.

But the fact that there is no escape from cutting down the costs in maintaining the unique rails, which are pretty overaged, also cannot be wished away, Mr Dasarathy says.

One of the biggest hurdles in maintaining them are landslides. Last year, at least half a kilometre of track was damaged due to a landslide at Marappalam near Coonoor and it took the IR Rs 25 lakhs and four months to restore it.

"We had to overcome the difficulty of having to clear a major portion of the debris manually and most of the places, where minor

the reconstruction of each wou cost Rs five lakhs.

Among other plans to justify t cost inputs into the service a running a second train in pe seasons so that tourist waiting tir to catch connection trains would minimised, and beautification all the stations on the way.

The IR has another plan to r a picnic train from Ooty to Ru neymade. The idea is that it cou provide the tourists a "welcon change" and they could trek ar lunch out, Mr Dasarathy says ar adds that the picnic train would run on contract.

Nari receives shot in the arm

From our correspondent

PHALTAN, Feb.24: Nimbkar Agricultural Research Institute (NARI), has received Rs. 1.50 lakh from the Rockefeller Foundation, New York, to develop low density and leafy biomass gasifier for thermal application, disclosed Dr. Anil Rajvanshi director of NARI at a press conference.

Dr. David Hall, Head of European Economic Community's sweet Sorghan Network, recently visited NARI and Dr. Nandini Nimbkar, chairman NARI, organised a press conference on the occasion to give the media-persons first-hand information about the gasifier.

On this occasion Dr. Hall handed over a cheque for Rs. 75000 as an advance installment to Dr. Nandini Nimbkar.

Speaking to media-persons Dr. Rajvanshi said the multi-fuel gasifier NARI produces, produces gas which burns with an intense bluish-white flame exceeding 1000° C in temperature and can be used directly for thermal applications like in bakeries, brick kilns, metallurgical furnaces or for making jaggery (guri).

Dr. Rajvanshi showed the working of this computerized gasifier to Dr. Hall who seemed to be quite satisfied.

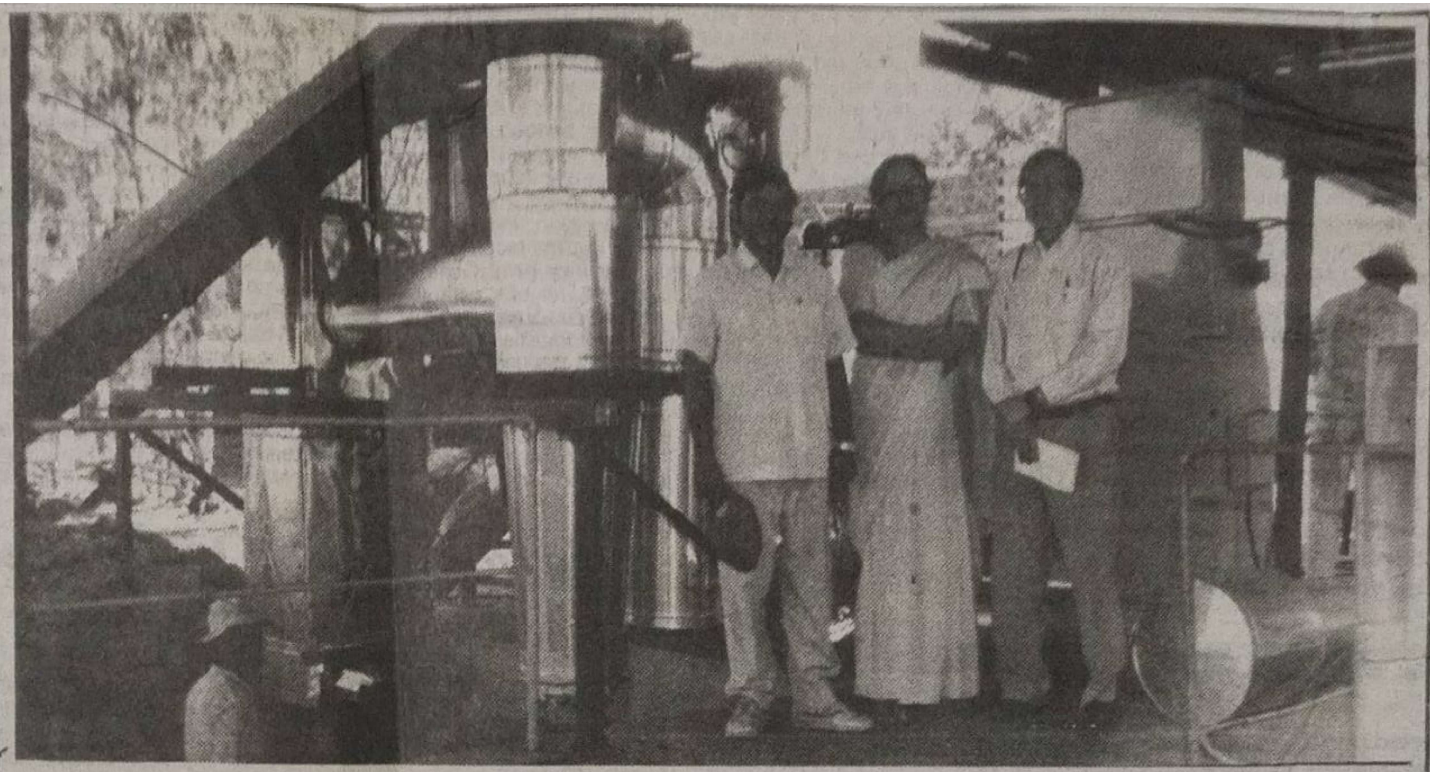
The Dr. Rajvanshi described the silent features of NARI Gasifier as follows:

Biomass fuels like sugarcane leaves and bagasse wheat husk, sunflower residue can be gasified.

About 24 per cent by weight of fuel is converted into char which is of value added by the product.

No process water is required for the operation and so no waste water is generated.

Lastly, Mr. Rajvanshi said one such unit is ordered by a metallurgical industry in Pune and they would not have any need for light diesel oil which is used now.



Dr David Hall, of the European Economic Community, shown the working of the NARI Gasifier by Dr Nandini Nimbkar and Dr Anil Rajvanshi.

Maharashtra Herald Feb. 25, 1995

Rs 1.5 lakh aid for NARI

Indian Express - Satara - 25/02/1995

EXPRESS NEWS SERVICE

PHALTAN – Nimbkar Agricultural Research Institute (NARI) will receive Rs 1.5 lakh from the Rockfellar Foundation, New York to develop low density and leafy biomass 'gasifier' for thermal application, said Dr Anil Rajvanshi, director of NARI at a press conference recently.

Speaking to mediapersons, Dr Rajvanshi said that the multi-fuel gasifier developed by NARI produces producer gas with an intense bluish-white flame with flame temperature exceeding 1000 degrees centigrade and can be used directly for thermal applications in bakeries, brick kilns, metallurgical furnaces or even for producing jaggery.

He also said that any metallurgical industry ordering such a unit will not need light diesel oil for their production.

An electrifying solution to urban pollution

Economics Times - 23/12/1996

Introduction of electric rickshaws will reduce the pollution in large cities, says **Anil K Rajvanshi**

An electric cycle rickshaw can provide a non-polluting and very silent transport system for urban areas of India. Besides it is very energy efficient and cost effective. Work done at Nimbkar Agricultural Research Institute (NARI) in Maharashtra has shown that improved cycle rickshaws powered by electric motor and batteries have a potential to provide an attractive alternative to petrol and diesel powered three wheelers.

The cycle rickshaw has hardly changed since it was introduced in 1930s and '40s in India. The gearing and the mechanical advantage of the pedal is very poor. Similarly the seating arrangement is very uncomfortable and the aerodynamic drag of the system is very high. The rickshaw manufacturing is a footpath industry with no quality control and there are as many rickshaw designs as cities in which they ply.

NARI has designed a very efficient rickshaw with ample luggage space, five speed gears, back wheel braking and better aerodynamics. This improved rickshaw enables a rickshaw puller to take two persons on a 6 per cent slope quite easily and effortlessly. NARI improved rickshaw is expected to cost Rs 5000 which compares very favourably with the existing rickshaw costs of Rs 4000-4500. Now this improved rickshaw is being converted into an electric one.

A pedal assisted electric cycle rickshaw with a very efficient 1 KW DC motor, suitable lead acid batteries and a smart interface card can provide a suitable transport system in urban areas and can be an attractive replacement for the existing petrol and diesel powered three wheelers. The electric rickshaw is designed to go about 60-70 km in one charge.

Data collected has shown that electric rickshaw is very energy efficient and will consume specific energy of about 103 whr/person-km. A petrol powered three wheeler however consumes 198 whr/person-km. These petrol powered rickshaws are designed to run at 40-50 km/hr. Normally in cities they operate at 20 km/hr. At these low speeds they not only become even more inefficient but also pollute much more than their designed exhaust levels. Also the running cost of a petrol powered three wheeler is 85 paise/person-km whereas the electric rickshaw running cost will be 6 paise/person-km or about 14 times less than that of a petrol powered one.

The electric rickshaw can be easily designed with the existing motor and battery development technology. Our estimates show that electric rickshaws can be mass produced for about Rs 25,000. This is much cheaper than Rs 53,000 that one pays for diesel or petrol powered three wheelers.

Besides creating a non-polluting transport system in India, electric rickshaws will also provide dignity to rickshaw pullers. Besides giving dignity, electric rickshaws can also provide extra income to the rickshaw puller since he can ply his rickshaw to greater distances in one day.

Similarly pedal assisted electric bicycles can be a replacement of petrol powered two wheelers. There are quite a number of good designs developed by companies all over the world. Last year Japanese companies Yamaha and Honda sold about 200,000 such bicycles. These bicycles go about 30-40 km at a speed of 20-25 km/hr in one charge. However they are presently being sold at $1500. Nevertheless with more R&D their prices can be brought down.

It should however be pointed out that for electric bicycles and the electric rickshaws to succeed they require very efficient and lightweight permanent magnet DC (PMDC) motors. These small motors (capacity one one KW or less) are not manufactured in India.

(1) Policy decisions need to be made by the government that in the centre of cities only improved or electric rickshaws and bicycles will ply. Or at least a preference should be given for parking these vehicles. This type of decision will also help spur the R&D and manufacturing of such rickshaws.

(2) More R&D needs to be done in developing better and efficient PMDC electric motors for these rickshaws. Even importing of battery and motor technology will be very useful to reduce the time taken for introducing electric rickshaws in India. Electric rickshaws should be put in renewable energy system category and hence should get all the incentives presently available to these system.

(3) Loan facilities at easy interest rate should be made available to the buyers of electric rickshaws and bicycles.

Introduction of electric rickshaws will not only reduce the pollution existing in large cities but will help arrest the trend of increasing pollution in small Taluka towns as well.

The author is director, NARI

NARI work on pg 199

LOST CROPS of AFRICA

volume I
Grains

Board on Science and Technology
for International Development

National Research Council



NATIONAL ACADEMY PRESS
Washington, D.C. 1996

LIQUID FUELS

For the economic stability and expansion of nations, liquid petroleum fuels—kerosene, gasoline, and diesel, for instance—have become essential. As noted, these liquids not only power factories, trains, trucks, and buses, they also generate electricity and produce thousands of items from machines to medicines. Moreover, maintaining mobility is critical to the public welfare: police, fire fighters, ambulances, mass transit, and construction fleets all depend on liquids that will explode in the cylinders of internal combustion engines.

For these and other reasons, the growing dilemma over future petroleum supplies makes it imperative to investigate renewable fuels, especially those suited for use in existing engine types. Of all the nonpetroleum possibilities, ethanol is the only one now significantly used in motor transport.[3]

At present, ethanol is made from either sugarcane or maize. In the future, however, sorghum is likely to also be a prime supplier. The stalks of certain sorghums are just as packed with sugar as are sugarcane's. Their juice contains 13–20 percent total fermentable sugars. They can yield about 6 percent alcohol.

Sweet-stalk types are sparingly distributed across sorghum-growing areas of Africa and India, where people chew the green and tender stems like sugarcane or make syrups, molasses, sugar, or confections from them. They were once a major source of sweeteners in the southern United States. Now, however, they have a rising potential as sources of fuel.

All in all, sweet sorghums are important for future ethanol production because they have:

- High biomass yield;
- High percentage of fermentable sugars;
- High percentage of combustible materials (for fueling the processing);
- Comparatively short growth period;
- Tolerance to drought stress; and
- Relatively low fertilizer requirement.

Moreover, sweet sorghums may produce some grain for food or feed. Indeed, as sorghum is one of the most efficient plants, and as it produces fermentable sugars as well as grain, it seems almost ideal for

[3] See companion report, *Alcohol Fuels: Options for Developing Countries*. National Research Council, Washington, D.C. 1983. Research on another renewable-energy alternative, vegetable oils, is described in E. Griffin Shay. Diesel fuel from vegetable oils: status and opportunities. *Biomass and Bioenergy*. Vol. 4, No. 4, 1993. pp. 227–242.

producing both energy and food. Technologies used in the sugarcane industry can be applied virtually without modification.

Sweet sorghum has a number of potential advantages over sugarcane. For example, it is adapted to many growing conditions, unlike sugarcane, which is restricted to tropical climates. It requires less water and fertilizer. It can be planted more easily (from seeds not stems). And it also has a potential for low unit costs because it can be fully mechanized and the fields need not be burned (unlike sugarcane fields).

Sorghum's advantage over maize (in which the grain is converted to alcohol) is that it produces sugar rather than starch. As a result, sorghum juice can be directly fermented without the expense or delay of an initial hydrolysis.

Recently, researchers in at least three countries have begun to appreciate the potential of sorghum as a fuel as the following examples show.

India

In southern India, the potential of sorghum varieties that yield both grain and sugar-filled stems is being explored.[4] Engineers at the Nimbkar Agricultural Research Institute (NARI) have found that these dual-purpose varieties solve three problems: they yield food, the fuel to cook it with, and the fodder to feed the farm animals that help produce it. From the top of the plant comes grain for food; from the stalk comes sugar (and hence alcohol) for fuel; and from the pulp remaining after the sugar is extracted comes animal fodder.

In the past, multipurpose sorghums were dismissed or at least overlooked, probably in the expectation that the individual yields of the various products would be low. But the NARI researchers are showing that this may not be the case. Indeed, they claim that 1 hectare of their sorghums can annually yield 2–4 tons of grain, 2,000–4,000 liters of alcohol, and enough crushed stalk to feed from three to five cattle year-round.[5]

The idea of "growing" fuel alcohol is of course not new. However, most other programs have faltered because the cost of the fuel needed to distill the alcohol rendered them economically unattractive. NARI engineers circumvented this by designing a solar-powered still, incorporating a solar collector and a distillation column that can run at 50–70°C—temperatures that the solar collector can easily provide.[6] Also,

[4] Rajvanshi et al., 1989.

[5] For the fermentation, NARI uses strains of *Saccharomyces cerevisiae*. The average fermentation efficiency was 90 percent and the fermentation process took 48–72 hours to complete.

[6] The pilot model consists of flat-plate solar collectors (38 m^2 in area) coupled to a hot water storage tank (2,150 l capacity).

they have developed pressurized and unpressurized lanterns as well as a wickless stove that will run on aqueous alcohol taken directly from the still.

NARI suggests that this combination of multipurpose sorghum and appropriate technology could, in theory, meet all the automotive fuel requirements in India by the year 2000, completely replace the kerosene now used in Maharashtra, and supply 80 percent of the fodder for all the cattle in Maharashtra. Although such levels will never be approached in practice and it seems axiomatic that grain yields will tumble when sugar is also produced, the NARI concept is a powerful one that could be a big breakthrough that boosts sorghum into an energy resource worldwide. And perhaps, after all, it is not too far-fetched to envisage sorghum producing both high contents of sugar in the stem and high yields of grain.[7]

United States

A large sorghum-for-alcohol project was carried out across the United States between 1978 and 1984. As part of this project, the University of Nebraska developed a demonstration farm based entirely on renewable fuels. Sweet sorghum was the principal crop for alcohol production. Hybrids that grew rapidly and produced large amounts of sugar were created.[8]

A major constraint of sweet sorghum in the temperate zone is the harvest period. Wherever the potential of a freeze exists, the harvest period is greatly reduced because the crop must be gathered before any freezing weather. Sugar in the damaged stalks begins to ferment.

Brazil

Of all the nations in the world, Brazil is the ethanol-fuel pioneer. It already has fuel alcohol in large-scale nationwide use. So far, however, this has come almost entirely from sugarcane. Now, Brazil's scientists are exploring the use of sweet sorghum. The two crops, it has been found, supplement one another: sorghum can provide alcohol during the season in which sugarcane is unavailable.[9] Therefore, using the two together increases the period of production, decreases the unit cost, and increases the total amount of alcohol that a distillery can

[7] Researchers in Texas have also discovered that high yields of sugar are not incompatible with high yields for grain. Information from F.R. Miller.
[8] Information from M.D. Clegg.
[9] Sugarcane in Brazil is normally ready to harvest between June and November; the harvesting period for sweet sorghum is from February to May. Information from R.E. Schaffert.

Will Brazil's Cars Run on Sorghum?

Brazil leads the world in the use of fuel alcohol. In 1993, about 4.3 million vehicles—one-third of the country's total fleet and about 40 percent of its car population—operate on ethanol. Almost all that alcohol now comes from sugarcane, but in the future it may come from sorghum as well.

Brazilian researchers have shown that sweet sorghum can yield from 22 to 45 tons of raw biomass per hectare in 110 days. Fermentable solids (80 percent sugars and 20 percent starch) in the stalks amount to 2.5-5 tons per hectare. To optimize the output, enzymes are added so that the starch in the stems is also converted to alcohol. Research has shown that in this way 1 ton of sweet-sorghum stalks has the potential to yield 74 liters of 200-proof alcohol.

Such discoveries have implications for countries everywhere. In that distant but inevitable day when the world's petroleum runs out, maybe people will turn to sorghum to keep civilization humming. Brazil is showing us yet another way this remarkable plant will be important in our future.

produce each year. The same equipment is used to process both sugarcane stalks and sweet-sorghum stalks.

The Brazilian scientists are also extending their studies to incorporate sorghum into an integrated system in which the by-products are used as food, feed, fertilizer, and fiber. Further, they are adapting this technology to a microscale to allow the economical production of fuel in a decentralized industry. This reduces transportation costs and may perhaps allow the farmers to generate their own energy.

SORGHUM IN SUPPORTING ROLES

Around the world, sorghum is mostly grown for food or feed and (as just mentioned) a little is being grown for fuel. However, there are several interesting uses in which sorghum is grown not for its own sake but for the benefit of other crops. Below are three examples.

Soil Reclamation

Saline Soils It has recently been found that crosses between sorghum and sudangrass (a special race of sorghum), have the capacity to repair saline soils made crusty by sodium compounds. David L. Carter, director of soil and water management research at the U.S. Department

SCIENCE AND ENVIRONMENT FORTNIGHTLY

Down To Earth

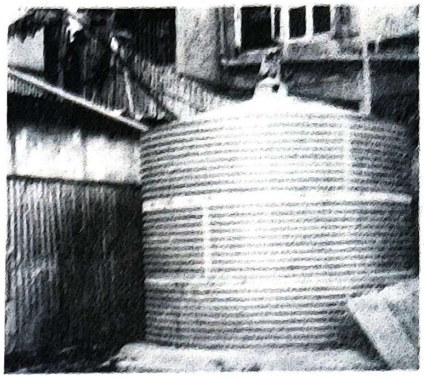
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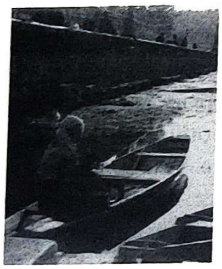


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COVER: J EAMES / BIRDLIFE INTERNATIONAL

(Photograph of Lophura hatinensis, *a new pheasant species which was recently discovered in the Vu Quang Nature Reserve, Vietnam)*

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BRIEFS

Danger sensors

Electrical utility transformers that use oil as an insulating barrier between the high and low voltage wire windings often fail because moisture and explosive gases build up in the oil, forming a pathway for a sudden, dangerous electric arc between the windings. Larson-Davis Inc of Provo, Utah, US, have developed an early warning package that is placed inside the transformer. It includes a vibration sensor that predicts mechanical failure from change in the transformer's hum and Cross Check, a sensor developed in conjunction with scientists from Birmingham Young University, Utah, US, which monitors the oil's effectiveness as an insulator by detecting changes in an extremely low frequency electrical signal that is sent through the oil.

For peat's sake

With its total peatland extending over 26 million ha, Indonesia has the world's fourth largest reserves of peat. This Indonesian peat has a calorific value of 22 mega joules per kg. Experts say that at an average depth of six metres, the peat produced from an area of this size can provide 15,000 mega watt hour of power.

Going far

Researchers at Northeastern University of Boston, Massachusetts, US, have developed cartridges made of graphite nanofibres, which, they claim, can store 10 times more compressed hydrogen at room temperature than conventional tanks. They claim that these cartridges will enable hydrogen-powered cars to travel upto 8,000 km.

The nanofibres, which are made from stacks of graphite platelets that vary from five-10 mm in length and five-100 nanometres in diametre, have a closely packed structure. Several layers of hydrogen molecules get condensed inside the pores between the platelets by capillary action. The narrow pores stop oxygen and other larger molecules from squeezing in and this minimises the chance of an explosive reaction (*New Scientist*, Vol 152, No 2061/62).

ENERGY TECHNOLOGY

Useful wastes

Agricultural residues could help in the making of energy sufficient talukas

ANIL K RAJVANSHI

CAN India's dependence on imported fuels to meet her energy needs be reduced? The answer seems to lie in the creation of energy self-sufficient talukas (administrative blocks comprising about 100 villages) through biomass-based systems of energy generation, as suggested by a recent study by the Nimbkar Agricultural Research Institute (NARI) for Phaltan taluka in western Maharashtra.

The NARI study shows that enough resources are available within the geographical boundaries of the taluka for the sustainable development of energy systems based on agricultural residues. The taluka produces about 100,000 tonnes (t) of surplus agricultural residues (sugarcane leaves, and wheat and sunflower residues), which are mostly burnt in the fields.

The strategy for supplying the energy needs of Phaltan by AD 2000 envisages electricity production through two 22 MW power plants, supplemented by cogeneration from two existing sugar factories in Phaltan taluka, the total crushing capacity of which is 3700 t of cane per day. The power plants will use about 60,000 t of agricultural residues. In addition, fast growing trees like *Prosopis* and *Luceana* will have to be planted on about 16,000 ha of land (14 per cent of the total taluka area) to meet the fuel demand of these power plants.

The liquid fuel supply option can be based on ethanol production from sweet sorghum and molasses from sugar factories, as a substitute for petrol and liquid petroleum gas (LPG). This can be supplemented by pyrolysis oil production from biomass residues as a substitute for diesel and kerosene. If the 48,500 ha land in Phaltan taluka under grain sorghum is supplanted by sweet sorghum varieties developed by NARI, this can supply about 12,000 t of grain and will meet the fodder requirements of the area. At the same time, it can produce 9.6 million litre (ml) of ethanol while molasses from sugar factories can produce an additional 5.6 ml. The ethanol distilleries can also produce about 3.8 million cubic metre of biogas, which will not only supply power to the distilleries but will also take care of a part of the distillery effluents.

Prosopis juliflora: *hope for energy-starved talukas?*



Pyrolysis oil is produced by rapid decomposition of biomass residues by treating them with heat. The 40,000 t of agricultural residue that is not used by the power plants, together with surplus biogas from the sweet sorghum distillery can produce 45,000 t of pyrolysis oil, which is sufficient to meet the diesel and kerosene requirements of the taluka. With these supply options, about 26 hundred million mega joules (MJ) per year of energy can be supplied to the taluka as compared to the demand of 25 hundred million MJ per year by AD 2000.

But with all agricultural residues being used for energy production, there may be a critical shortfall in the availability of bio-fertilisers.

LEADER

Rickshaws to the rescue

WHEN the Delhi Rickshaw Chalak-Malik Sangharsh Morcha (rickshaw drivers and owners agitation committee) staged a demonstration in front of the office of the Municipal Corporation of Delhi (MCD) on May 19, it was drawing attention to the harassment its members were facing at the hands of the authorities. Rickshaws are repeatedly fined, towed off by the MCD and the police, and rickshaw owners have at times even to grease palms to slip through police dragnets.

What is surprising is that rickshaws are non-motorised transport, emission-free and eco-friendly. Today, they are being introduced in cities in the industrialised North. Unfortunately in India it is becoming increasingly clear that city planners have forgotten to make a provision for them.

Wrong signals have been sent out repeatedly by the authorities to discourage non-motorised transport without showing any concern for the increase in toxic pollutants in the air from smoke-belching vehicles. As a result, cycle rickshaws which have been around on Indian roads since the 1930s, are facing extinction as the odds are heavily tipped in favour of transport like three-wheelers. Studies conducted by the Indian Institute of Petroleum have indicated that three wheelers along with two-wheelers are responsible for more than 70 per cent of the hydrocarbon emissions in India.

The state-sponsored crackdown on cycle rickshaws is complemented by a middle class disdain for this mode of travel. A lack of infrastructure and management support systems has deprived them of their traditional driving space. This space is being taken up by the auto-rickshaws which are increasing at the rate of 15 per cent per annum. These are creating imbalances in the composition of the traffic mainly in cities and small towns, with a drastic impact on the air quality profile. As a result, even smaller towns like Agartala, Kanpur, Lucknow, Patna, Agra and the like where scooter and car populations are relatively small as compared to the metropolitan cities have seen a sudden decline in air quality.



Ironically, what has been rejected as an unnecessary relic from the past, has been grabbed up eagerly by their former colonial masters. Recently, the media was abuzz with the news that Indian cycle rickshaws have hit the roads in the town of Oxford in Britain and that the local authorities there have enacted bylaws permitting rickshaws to operate between fixed points. The cycle rickshaws are also being marketed in the US and Europe as green taxis and pedicabs.

There is also an immense scope for upgradation in the design of the cycle rickshaw to make it lightweight and easy to pull — thus relieving the puller of the extra drag. Detractors should note that in Oxford, more than 40 per cent of the rickshaw pullers are women. With upgraded gears, hydraulic brakes, rear end differential, comfortable seats and halogen lights, the cycle rickshaw which today covers a distance of 60 km per day on an average, can emerge as one of the most efficient non-motorised means of transport in the cities.

Despite indigenous initiatives to improve the technology , the upgraded rickshaw is not available commercially — thanks to the complete indifference of state authorities. The authorities are poised to clamp 15 per cent excise tax on it if it is produced for commercial use. This has pushed the manufacture of cycle rickshaws to the informal sector where private initiative for improvement cannot be expected.

Improved prototypes can never hit the roads unless favourable conditions are created for its wider acceptance. In the 1970s and 1980s there were two attempts by Canadian, British and Indian NGOs to improve their design and technology. But industry did not show any interest. Recently, Nimbarkar Agricultural Research Institute in Maharashtra drew media attention when they developed the electric cycle rickshaw. Even this may get pushed into oblivion if the public attitude towards cycle rickshaws does not change.

Since rickshaws are on the hit list of the city planner, welfare plans for rickshaw pullers are accorded the lowest priority, if at all. Though some states have fixed the minimum fare for rickshaws, sharing system in autos undercuts the rickshaw fare and lures away the commuters. Rickshaw pullers have to fend for themselves as there are no special health schemes or social security schemes for them. Apart from being an environment friendly vehicle, the rickshaw is also a source of employment for the urban poor.

Policy pundits cannot ignore the importance of promoting non-motorised transports in the urban centres. Or may be promises made occasionally by the Delhi government to set up cycle tracks indicates that much as they may want, the importance of this segment of traffic cannot be ignored. Even today, 40 per cent of the work trips in the range of two to eight km in Delhi, is catered to by bicycles.

When the left front government in its drive to clean up Calcutta pulled the cycle rickshaws off the road and confined them to an immensely restricted zone, they were only interested in creating more road space for the motorised traffic — another sop to the urban middle class. Even in Delhi, cycle rickshaws can ply only in a few localities. This only indicates that city planners may not have a green agenda at all. ■

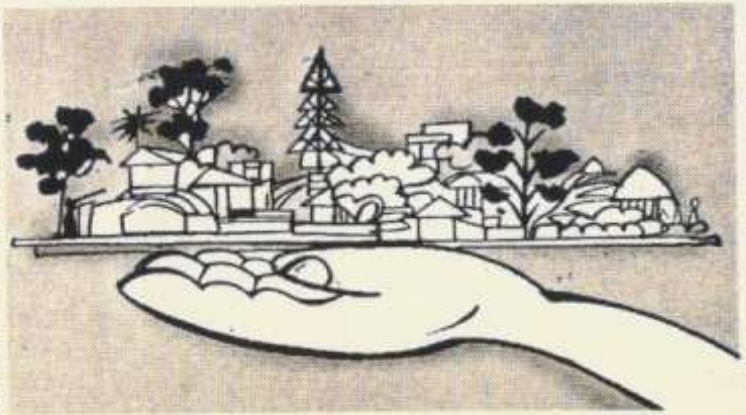
THE ALTERNATIVE MODEL

Economics Times - 24/05/1998

The Taluka plan can become a reality if the private sector participates in it

GUEST COLUMN

Anil K Rajvanshi



IN 1931 Mahatma Gandhi gave one of his finest political speeches at the London Round Table Conference. In essence he told the conference that Britain — a great nation with its technology, and an independent India — a proud and ancient civilisation with its workforce and natural resource can work together as a Commonwealth to produce the world's largest economy for the benefit of mankind. To my mind the greatest apostle of Swadeshi and peace of this century understood much ahead of his time that the well being of India lies in international cooperation.

All the talk of the BJP government regarding Swadeshi is therefore hollow. By stopping few MNCs (who may also produce potato chips) will not bring in Swadeshi movement but is a retrograde step. BJP's talk of Swadeshi comes from a feeling of insecurity and the policy of protectionism is another name for incompetence and insecurity.

I present a possible solution in this article whereby a thesis is developed which shows that food and energy self-sufficient Talukas can reduce the energy import bill of India, increase the exports, increase the inflow of foreign Institutional funds for development and can be a new paradigm of sustainable development not only for Indian but for the rest of the developing world.

Taluka Development Model

India's energy scenario is quite bleak. There is a shortfall of about 15,000 MW of electric power every year and last year we imported about Rs 25,000 crore worth of petroleum products. With increased economic growth the situation of both electricity and

further. There are also estimates that oil energy consumption in developing countries should surpass that in developed countries within 20 years. This will create great conflict among nations and it is quite possible that in future the wars will be fought over energy sources. There is therefore a need for an alternative development model based upon renewable energies.

Developing countries (DC) in the absence of any other alternative are presently following 100 years old unsustainable model of developed countries which is megacity oriented and is based on fossil fuel and environmentally unsound technologies. This model is creating in DCs' problems of overcrowded and extremely polluted cities.

A Taluka is an administrative and geographical block consisting of an average of 80-100 contiguous villages. It has a geographical area of about 1000-1500 sq km and a population of about 2 to 2.5 lakhs. There are 3,342 Talukas in India and the major activity in them is agricultural. The fixed geographical boundaries of a Taluka can be thought of as a closed biomass and rain water basin. Hence each Taluka can produce majority of its demands of food, fuel, fodder and fertiliser.

Taluka Development Strategy

400 million tons/yr of surplus agricultural residues which theoritically can produce — 53,000 MW of power. This power is 70 per cent of the total amount available in the country as of today from all other sources. Not only can these residues produce adequate power to supplement existing power production, but husbanding this resource properly, can also produce adequate animal feed and fertiliser. With increasing food production the agricultural residues quantity will also increase.

My Institute — Nimbkar Agricultural Research Institute (NARI) did a study for Phaltan Taluka in Western Maharashtra, where it was shown that all the energy needs of the Taluka for 2000 AD could be supplied by the use of its biomass resources. This study became the basis for National Policy on Energy Self-sufficient Talukas in 1997 and is being implemented nation-wide by the Ministry of Non-conventional Energy Sources (MNES).

The NARI study showed that Phaltan Taluka produces — 100,000 tons/yr of surplus agricultural residues which are presently burnt in the fields as a part of waste disposal process and hence are total loss of useful energy. These residues in conjunction with energy plantations (Leucaena, Prosopis, Eucalyptus etc) and energy crops like sweet sorghum and sugarcane can produce about 40 MW of electric power (via biomass based power plants) and liquid fuels (pyrolysis oil and ethanol) which are equivalent to 30 million liters/year of petroleum products. This will take care of all the commercial energy needs of Taluka for 2000 AD via renewable energy and hence the production could be done on a sustainable basis.

The study also showed that this strategy has the potential of creating 30,000 jobs and giving — Rs 200 crore/year income to the Taluka. For this programme a total capital investment of about Rs 300 crore/Taluka will be required in the plants, machinery and technology. Hence for 3,342 Talukas a massive investment of about one million crore rupees will be required. This can be very attractive for foreign institutional investors and can result in large inflow of foreign funds.

The study also showed that Taluka has adequate amount of other biomass derived materials like night soil, vegetable waste,

weeds, municipal solid waste animal/ chicken manure w can be processed via technol like vermiculture, composing generally husbanding them so they yield excellent fertilizer the farmers.

The above strategy will cr wealth in Taluka and improv quality of life of its citizens, vide employment to them reduce their desperate exod big cities. This increase in w of Taluka will lead to decentra tion of economic and hence p cal power — the essenc democracy.

Lessons for North

Societies are living and dyn structures. In evolutic process they can be thought t low the laws of a natural livin tem. Hallmark of evolution dynamic system is its size r tion; increase in energy usage ciency, increase in complexit possession of critical mass. S of societies is like energy s tures.

It depends upon the qualit the quantity of energy pa through them. From this e tionary model it can also be jectured that in future witl increasing use of renewable gy all societies will evolve decentralized, high techn dependent and rural Similarly the megacities will into smaller sustainable unit

The Taluka plan can bec reality if the government of can create conditions for th vate sector to take part in it could include giving the usu incentives given to rene energy sector and to set Taluka Development Corpo to facilitate this process.

(Anil K Rajvanshi is Director Nimbkar Agricultural Re Institute)

Strategy for Rural Lighting

ANIL K RAJVANSHI

URJA - May 1999

IT IS A NATIONAL SHAME THAT EVEN 40 years after independence, there are about one million households where the only source of illumination at night is the light from a chulhas. Even with heavy investment in rural electrification and proud acclaims by various states that 100% of their villages are electrified, the sad and hard fact still remains that in these so called electrified villages less than 20% of households only have electric connections and use them for lighting. Thus for the rest 80% or so of rural households (about 80 million), the humble hurricane kerosene lantern with very poor light output is the only source of light. With unreliable electricity supply in rural areas, even some of these electrified households use kerosene lighting. Thus around 95% of total rural households use kerosene for lighting.

Rural lighting in the scheme of planners nas always been synonym with rural electrification. With the past record of state Electricity Boards it is safe to assume that the goal of electrifying every rural house will remain elusive for next 15-20 years. Hence an alternative rural lighting strategy based on other fuels will have to be chalked out. Lighting with presently known technology can be achieved only by electricity or via liquid fuels like kerosene. It should however be pointed out that at present no rural lighting strategy exists.

Around 60% of total kerosene consumption in India is for lighting only, out of which 51% is in rural areas alone. India imports about Rs. 9000 million worth of kerosene for this purpose. Even after paying such a heavy price, the quality of light from the hurricane lantern is abysmal. It produce light equivalent to 1/10 of that from a 60W light bulb which is inadequate for most of the needs.

Rural Lighting Norm

Convenience wise, electric lighting technology is the best alternative. Hence the long term startegy should obviously be based on electric lighting. However, as a minimum requirement, the norms for rural lighting *should be same as those for urban areas at present*. Thus in urban areas of India about 210 Kwhr/household/Yr is used for lighting. This should be contrasted with the highest figure of 540 kwhr/household/yr for Delhi. However, in rural areas presently the consumption is only 30 Kwhr/household/yr It is interesting to note that with a consumption of 210 Kwhr/household/yr, every household will have light equivalent to that from two 60W light bulbs running for 4 hrs/day. *Thus this should be the minimum lighting requirement for every household by 2010 A.D.* and should form a part of minimum needs programme. Research work at Nimbkar Agricultural Research Institute (NARI) has produced improved kerosene lanterns which do produce light equivalent to a 60W bulb. NARI has also developed lanterns which run on ethyl alcohol and produce similar light output. These improved lanterns can play an important part in rural lighting strategy, and are cheap and easily operable.

Thus the major requirements of strategy for rural lighting should be: zero import bill for fuel; adequate light (equivalent to two 60W light bulbs), affordability in rural areas and possibility of becoming operational by 2000 A.D

Strategies for Electric Lighting

If all the lighting energy needs (210 Kwhr/household/yr) in rural areas are to be met with electric lighting, then it will be necessary to set up about 3000 MW capacity power generating plants (total energy requirement will be 2.5×10^{10} Kwhr/yr). With the present plant load factor (PLF) of such plants being 0.5 to 0.6 the installed capacity may have to be doubled to become 6000 MW Power stations to produce 6000 MW will require about Rs. 120,000 million capital cost and 10-12 years to set up. With the present resource crunch it is difficult to see these plants being set up. Besides supplying of electricity for lighting will also require a national grid which does not exist presently Even with this massive capital investment, the supply of electricity to each household will still involve temendous red-tapism as it exists today.

An attractive alternative to electricity generation for lighting purposes is of setting up of decentralised and small (10-20 MW) power stations in each Taluka or Tehsil. These power stations will run on wood. Work at NARI on feasibility of such plants has shown that for production of 10 MW of power about 4700 ha of land will be required for growing high biomass yielding tress like *Leucanea leucocephala*. *Prosopis juliflora* etc. This technology of 10-20 MW power generation from wood is a well proven technology and there are hundreds of such

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plants in USA and Western Europe. Calculations also show that the power from such plants will cost about Rs. 1/Kwhr and the lighting cost will be Rs. 0.77/day per household. However, the benefits to the farmers and environment and the overall availablity of power locally, will be tremendous. Since the generation of power will be based on agriculture, it will increase the wealth of rural areas. Though these plants have double the capital cost of the existing large scale plants, they have PLF of about 90%. They will be set up by cooperative societies and thus will be owned by people who will use electricity. Besides, the setting up of these plants will be accomplished in 3-4 years as compared to 10-12 years required for existing centralised plants.

Strategies for Liquid Fuel Lighting

Use of liquid fuel like kerosene for lighting should be a stop gap arrangement. Ultimately all the rural lighting will have to be electricity powered. However, for present and till 2000 A.D. and beyond liquid fuel lighting has and will play an important role. Thus there is a need to evolve a strategy on how best to use liquid fuels and to provide adequate lighting for every household. Since liquid fuel lighting will be a stop gap arrangement, there is a need to provide lighting from it only to the most needy section of the society. Around 58% of rural households live below poverty line. Liquid fuel lighting should be directed to this group only.

Assuming a norm of giving two improved lanterns per household for the above group (with each lantern producing light equivalent to a 60W light bulb), the kerosene consumption will come to about nine Million tons per year. This fuel will be used at about 135 million improved lanterns. Presently about one million tonnes of kerosene is used for lighting in these 58% rural households. Hence it is safe to assume that about eight million tonnes of kerosene will have to be imported, which will cost about Rs. 26000million per year in foreign exchange. This assumes that the rest of the existing kerosene consumption will continue as it is. Obviously laws can be made that will allow most of the kerosene to be used only for lighting and not for cooking. This is because light can only be produced by kerosene, whereas for cooking other fuels are also available. The cost of lighting with kerosene in these lanterns will be Rs. 1.20/household/day.

An alternative and attractive strategy for liquid fuel is the use of ethyl alcohol for lighting. Work done at NARI has shown that alcohol can be produced easily and economically from sweet sorghum (*Sorghum Bicolor* (L) Moench) - a multipurpose crop. It provides grain from its earhead and the juice from the stem can be converted to alcohol. This alcohol can be easily used in the new type of lanterns developed at NARI which also produce light equivalent to a 60W light bulb. With the same norm of two lanterns for each household, the alcohol requirement comes out to be 1.5×10^{10} liters/yr. From Maharashtra State alone 2.7×10^{10} l/yr alcohol can be produced from sweet sorghum. The cost of setting up distilleries to produce this quantity of alcohol will be about Rs. 15,000-17,500 million. The alcohol production cost will be about Rs. 2.40/l and compares very favourably with kerosene prices. The lighting cost will be Rs. 1.79/household/day. Also since this fuel is biomass based, it can be produced in India and no foreign exchange is involved. Besides it will also increase the rural income and one will get grain and alcohol from the same crop. It is envisaged that the alcohol distillation plants will be in cooperative sector and will be set up in 3-4 years.

Interestingly enough, though the lighting cost from kerosene and alcohol is higher than that from electricity, the overall energy efficiency of lighting is the same. Thus with efficiency of power plant at 35%, electricity transmission losses at 20% and the efficiency of light bulb at 2.5% the overall energy efficiency of fossil fuel to light is 0.75%, whereas the efficiencies of improved lanterns developed at NARI are also 0.7 to 0.8%. Thus energy-wise liquid fuel lighting is comparable to electric lighting.

Based upon the above scenaries, the overall strategy for rural lighting should be as follows:

(1) By 2000 A.D. all kerosene imports should be stopped. This will result in saving of foreign exchange to the tune of Rs. 10,000-15,000 million/yr. Kerosene for lighting should be phased out completely by 2010 A.D.

(2) Kerosene imports should be frozen at present level. Priority should be given to using kerosene for lighting rather than for cooking.

(3) Alcohol production should be increased and excise laws liberalised, so that it is easily available for lighting. Alcohol usage for lighting will peak by 2000 A.D. and will phase out by 2010 A.D.

(4) Use of improved lanterns should be encouraged and liberal tax laws should be enacted for their large scale production and deployment.

(5) By 2010 A.D. all rural lighting should be electricity powered. Hawkers and other such decentralised systems will still use liquid fuel lighting.

(6) Work should at once be started on setting up decentalised power generation plants of 10-20 MW capacity. Availability of electricity connections in rural areas will have to be simplified and made less bureaucratic. Supply of electric connections on similar lines as selling insurance may be one avenue for its rapid spread.

Finally it is a sobering thought to realise that one foreign trip of our leader costs the national exchequer about Rs. 20 million. In this money, about 1.6 lakh rural households can be provided with adequate lighting via improved kerosene and alcohol lanterns. In this year of Nehru Centenary is it too much to ask of our leaders? □

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The Indian EXPRESS
PUNE ■ MONDAY, AUGUST 30, 1999

'Elecshaw' for non-polluting transport

PRESS TRUST OF INDIA
NEW DELHI, AUG 29

FOR those sick of the din and choking exhaust fumes of two-and three-wheelers, a potential alternative has emerged in the form of an electric cycle rickshaw.

Prototype electric cycle rickshaws developed and patented by the Nimbkar Agricultural Research Institute (NARI) at Phaltan in Maharashtra were successfully tested on Lucknow roads recently.

The Uttar Pradesh Government is considering a proposal to introduce them in the city on a small scale, NARI director Anil K Rajvanshi said.

The country's present level of battery technology is ideal for use in small systems like rickshaws, Rajvanshi said. An electric cycle rickshaw or 'elecshaw' could provide anon-polluting and noiseless transport system for urban and rural areas of India, serving as an attractive alternative to petrol-and diesel-powered two-and three-wheelers, he said.

The beneficiaries would be considerable as about one million cycle rickshaws ply on the Indian roads, carrying about 3-4 billion passengers per km per year. A major means of transport in some cities, rickshaws provide employment to about 7 lakh rickshaw pullers.

Rather than phasing out these non-polluting vehicles and replacing them with polluting two-and three-wheelers, India can do the reverse — use modernised electric rickshaws as an alternative to the petrol and diesel-driven vehicles, says Rajvanshi. India has estimated 18 million petrol-powered two wheelers and 1.5 million three-wheelers running on petrol or diesel. Their numbers are increasing by 15 per cent each year.

Nari's 'elecshaw' has claimed to solve several of the current problems with today's rickshaws that have hardly changed since they were introduced in 1930s in the country.

The gearing and mechanical advantage of the pedal are very poor, because of which the puller has to work very hard while climbing even a steep slope. Often the puller has to climb down and pull on foot the rickshaw with passengers. The braking system is also very poor, with only frontbrakes, with the result that when the

CONTINUED ON PAGE 4

Enter 'Elecshaw,' for non-polluting transport

FROM THE FRONT PAGE

vehicle is going downhill at high speed, sudden braking produces a catapult effect.

The seating system is very uncomfortable and the aerodynamic drag is very high.

Despite these disadvantages, extreme poverty drives many labourers to become rickshaw pullers whose health suffers adversely while pulling an inefficient, poorly designed vehicle, according to a NARI report.

NARI's 'elecshaw' has logged more than 3500 km in testruns. It runs on lead acid batteries which powers a 1.3 kilo watt direct current (dc) motor.

Elecshaw is estimated to cost Rs 50,000-60,000 in mass production.

NARI has also designed two more improved modernised versions of the pedal-pushed rickshaw.

One version has five speed gears, back wheel braking, better suspension and less aerodynamic drag than existing ones.

Tests have shown that it enables a puller to take twopassengers on a 6-10 per cent slope quite easily, without getting down from his seat. (it is estimated to cost Rs 7000 compared to current ones that cost Rs 5000.)

A second version is a motor-assisted pedal rickshaw equipped with a small battery-driven motor that can be switched on to help the puller take passengers uphill or at higher speeds. The cost of this rickshaw is estimated at Rs 17,000.

A snag, however, will be developing a network of battery-charging stations, possibly powered by solar power units, or any other renewable energy transports system like biomass or wind energy.

sections: pre-treatment section and membrane section. To pass through the former, water from the tertiary treatment plant is pumped into a pond from where it is transferred to a sump through passive screens. The water is then pumped to a battery of roughing filters, which provide sand filtration to remove suspended solids that is generated by residual biological oxygen demand (BOD, which indicates the presence of micronutrients in water).

The effluent water is then chlorinated in steps past roughing filters, after which it is stored in a tank where it is treated with 10-15 parts per million (ppm) of ferric chloride with 0.5-1.0 ppm of polyelectrolyte to destabilise the mixture and collect them. The water undergoes chlorination for a period of 30 minutes and is then pumped through a series of dual media filters. The feed water is then dechlorinated by sodium, after which it is filtered and forwarded to the three-stage membrane system.

The system consists of three separate streams. The product is then collected and conductivity control directs it either to the blend tank or to the treated effluent sump.

While MRL commissioned its tertiary operations in August 1991 with an investment of Rs 24 crore, MFL operations began in May 1993 — both years of tremendous water shortage in Chennai.

The successful functioning of the plants at both these major industrial units has proved the viability of tertiary treatment of sewage water for uninterrupted running of these plants. ■



AMIT SHANKER / CSE

Scientists find a better way to treat distillery waste than creating effluent ponds

Distilled waste

A way to detoxify distillery wastes

USING a chemical catalyst and energy from the Sun, scientists in Maharashtra have developed a technique to treat foul-smelling distillery wastes. Tests on a small laboratory-type reactor showed that the method can be used to detoxify 100 litres of diluted distillery wastewater in five days. Results of the project at Nimbkar Agriculture Research Institute (NARI) at Phaltan, Maharashtra, have been submitted to the ministry of non-conventional energy sources.

According to NARI director A K Rajvanshi, the scientists, who have applied for a patent on the catalyst, are now trying to improve the technique to cut down the time by three days.

Distillery wastes, especially those originating from cane molasses-based industries, are among the worst pollutants. Almost black in colour, they have high amounts of dissolved solids and a pungent smell (*PTI Science Service*, August 16-31, 1999).

The scientists took the cue from work on solar detoxification of groundwater and industrial wastes using titanium dioxide as a catalyst. This method, however, did not give the desired results with distillery wastes and the team used another chemical, which they declined to reveal.

The scientists adjusted various parameters such as dilution of the effluent to ensure adequate penetration of sunlight; the chemical concentration to ensure maximum detoxification without increase in cost of treatment; and temperature and alkalinity of the effluent.

In the reactor designed by the institute, the colour and chemical oxygen demand (COD) declined in five days when the effluent was diluted 15 times and treated for eight hours daily at a flow of 100 litres per hour.

The COD dropped from 2,500 milligrammes per litre (mg/l) to 100 mgl, and colour transmittance (which indicates how clear the liquid is) was 90-95 per cent at 500 nanometre wavelength.

The chemical A was recycled by allowing the treated effluent mixture to settle in a container and then draining the water, while the slurry was Sun-dried. ■

Safe fibres

A technique to create 'safe' ceramic fibres

FINE ceramic fibres have been in use in a variety of forms since a long time. Finer fabrics are strong, flexible and, unlike coarser fibres, they do not irritate the skin. But in recent times, the question of ceramic fibre use has returned to haunt us as a major health issue. Ceramic fibres finer than 1 micron in diameter are known to be carcinogenic and fibres finer than 3 microns can be inhaled.

Working towards achieving the desirable properties of finer ceramic fibres in an absolutely safe product, scientists and chemists at the Warwick Process Technology Group, University of Warwick, UK, seem to have addressed the problem. They have developed a process which can manufacture a range of these high-technology ceramic materials free from both dangerously fine fibres as well as coarse fibres that cause irritation (*Spectrum*, September-October 1999).

The Fibres Research Group at Warwick uses the Sol Gel blow-spinning technique, which is configured to produce even finer fibres — none less than 3 microns in diameter. They can make fibres of magnetic and conductive

CYCLE RICKSHAWS AS A SUSTAINABLE TRANSPORT SYSTEM FOR DEVELOPING COUNTRIES

by Anil K. Rajvanshi

ABSTRACT

Most cities in developing countries are highly polluted. The main reasons are the air and noise pollution caused by transport vehicles, especially petrol-powered two- and three-wheelers called autorickshaws. We have developed three types of improved rickshaws: (a) a pedalled rickshaw (IPCR); (b) a motor-assisted pedal rickshaw (MAPR); and (c) a completely battery-driven rickshaw called ELECSHA™. The details of these rickshaws are presented in this paper. It is shown that these rickshaws can provide an environmentally friendly, energy-efficient and cost-effective transport system and can replace the existing autorickshaws. An economic analysis of these rickshaws is presented and policy issues are identified. Besides reducing pollution, these rickshaws could provide large-scale employment in urban and rural areas of India.

INTRODUCTION

To illustrate the pollution problem mentioned above, in India there are close to 18 million petrol-engine-powered two-wheelers and about 1.5 million petrol- and diesel-powered three-wheelers. The population of these vehicles is growing at a rate of about 15% per annum. Besides being a major hazard to people's health, these machines consume petroleum products for which the country has to pay dearly in foreign-exchange outflow.

An electric cycle rickshaw can provide a nonpolluting and silent transport system for urban and rural areas of India. It is in addition a very energy-efficient and cost-effective vehicle. Work done at our institute has shown that improved cycle rickshaws powered by electric motors and batteries have a potential to provide an attractive alternative to petrol- and diesel-powered three wheelers. They can also provide large-scale employment and extra income to the rickshaw puller.

EXISTING CYCLE RICKSHAWS

There are approximate estimates that close to one million cycle rickshaws ply the Indian roads carrying about three to four billion passenger km/year. In some cities they are the major means of transport. They provide year-round employment to about 700,000 rickshaw pullers (plus work for migrant and seasonal workers), are very maneuverable, and are completely nonpolluting—hence they provide an environmentally friendly means of transport. It is very unfortunate that deliberate policies in most of the urban towns of developing countries have been made by the concerned authorities to phase out these rickshaws. These nonpolluting vehicles are being replaced by polluting (both air and noise pollution) petrol- and diesel-powered three-wheelers. Our data show that three-wheeler diesel "tempos" in Lucknow city (capital of Uttar Pradesh) produce a noise of close to 70–80 decibels at a distance of 1–2 m, besides emitting huge amounts of particulates into the air .



Figure 1. NARI improved pedal-cycle rickshaw (IPCR)

Nevertheless the existing standard rickshaw is poorly designed so that it takes a heavy toll on the health of a rickshaw puller. The existing cycle rickshaw has hardly changed since it was introduced in India in the 1930s and '40s. The gearing gives a very poor impedance match. Hence the rickshaw puller has to work very hard while climbing even a slight slope. A common sight is of a rickshaw puller dismounting so that he can, on foot, pull the rickshaw and passengers. The braking system is also poor in that only front brakes are fitted. Thus when going downhill at high speeds sudden braking produces a catapult effect. Similarly the seating arrangement is very uncomfortable and the aerodynamic drag of the system is very high. It is therefore humanly degrading to pull the existing inefficient cycle rickshaw. Yet because of poverty, laborers become rickshaw pullers and suffer adverse consequences to their health.

Rickshaw manufacturing presently is a footpath industry with no quality control and there are as many rickshaw designs as cities in which they ply. These rickshaws are so poorly made that often they have to be replaced completely every two years. Thus there is a need to improve the existing rickshaw and bring quality control into its manufacture.

NEWLY-DEVELOPED MODELS

Our institute has therefore designed and developed three types of rickshaws: (1) an improved pedal-cycle rickshaw; (2) a motor-assisted pedal-cycle rickshaw; and (3) a completely battery-driven rickshaw called ELECSHA™. The details of the work accomplished follow.

Improved pedal-cycle rickshaw (IPCR)

The new design of pedal rickshaw has a five-speed gear, a reduction in the length of the long chain drives used in existing rickshaws, back-wheel braking, better suspension and a lower aerodynamic drag than the existing

rickshaws, as shown in figure 1, the improved NARI rickshaw. Tests done at our institute have also shown that it enables a rickshaw puller to take two passengers on a 6–10% slope quite easily and without getting down from his seat. This rickshaw is made of mild-steel angles, is light in weight and is sturdy. The weight of the rickshaw is 90 kg; its life estimated to be 7–10 years.

Our data from urban towns of India have shown also that many rickshaw pullers are migrant laborers from villages whose sole possessions are their rickshaws. Hence at night they often sleep on the cramped seat of the rickshaw for fear of its being stolen. Our new design allows the seats to be arranged in such a way that a long bed results which allows a rickshaw puller to sleep properly without the fear of his rickshaw being stolen at night.

The cost of this rickshaw is estimated to be Rs 7000 in mass production and compares very well with Rs 4000–5000 which is the cost of existing regular rickshaws.

[In October 1999, $1.00 = Rupees (Rs) 43.44; 1 Euro = Rs 46.84. —Ed.]

Motor-assisted pedal rickshaw (MAPR)

Our data (from discussions with rickshaw pullers) also revealed that with a small battery-driven motor [permanent-magnet DC (PMDC) type] attached to the improved rickshaw (with a five-speed gear) it may be possible for the rickshaw puller to go uphill with ease. Similarly he can also carry loads at speeds of 10–15 km/h. Consequently calculations showed that a 0.375 kW PMDC motor with a 24-V, 40-A-h lead-acid battery could easily take two passengers on a 10% slope at a speed of 10 km/h without the rickshaw puller getting down from his seat. This would be a major improvement for him. A simple strategy has been employed in this rickshaw. A manual contact switch allows the rickshaw puller to switch the motor on or off depending upon his convenience and load. Thus the gearing is arranged such that pedal and motor work in tandem to ease the load on the rickshaw puller. A current-overload switch cuts off the circuit when motor draws more than 20 amps. However the rickshaw puller has to pedal continuously: thus it is a motor-assisted pedal rickshaw (MAPR). The weight of this rickshaw (including batteries) is 129 kg (figure 2).

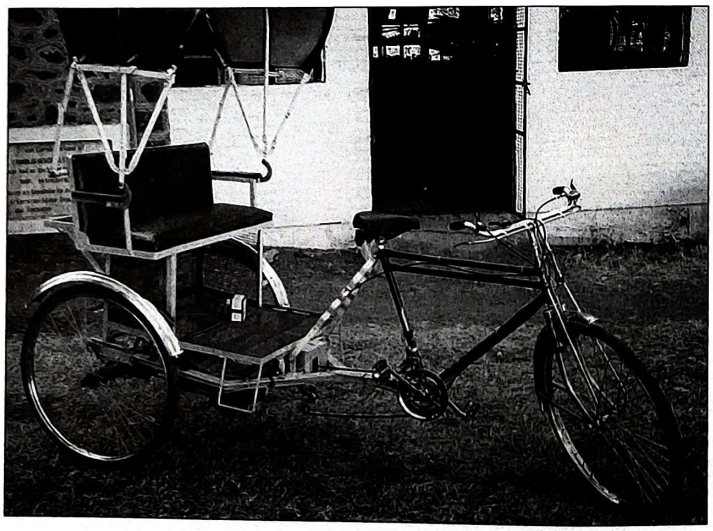


Figure 2. Motor-assisted pedal rickshaw (MAPR)

The cost of this rickshaw is envisaged to be Rs 17,000 in mass production. The price includes rickshaw, PMDC motor and battery. Patents have been applied for for both the IPCR and the MAPR.

ELECSHA

In major cities of India there are petrol- and diesel-powered three-wheelers called autorickshaws. They are some of the most polluting vehicles on Indian roads. They use two-stroke engines, inherently more polluting than the regular four-stroke engines. In addition, data we have collected show that in the traffic conditions prevalent in most inner-city areas these autorickshaws run at only 15–20 km/h. They therefore produce even more pollution because they are designed to run efficiently at 40–45 km/h. The pollution is further compounded because they are continually starting and stopping. Our data also show that on an average these autorickshaws travel about 50–60 km per day. Based upon these data it was felt that an electric rickshaw designed to run 60–80 km/charge and with speeds of 25–30 km/h would be an excellent substitute for these autorickshaws. In a fair-weather country like India, a silent and nonpolluting electric rickshaw with the above attributes could be a boon.

Consequently an electric cycle rickshaw has been designed and built. It has been patented and registered as ELECSHA™ (figure 3). At the time of writing it has logged more than 3500 km in test runs. It runs on a 36-V 100-A-h lead-acid battery that powers a 1.3-kW PMDC motor. An electronic card "soft starts" ELECSHA and provides dynamic braking. It is estimated to cost about Rs 70,000 in mass production, which would compare very favorably with the cost of petrol- and diesel-powered three-wheelers which are priced in some cities between Rs 75,000–1,00,000. Table 1 shows the specifications of the ELECSHA. Efforts are being made to reduce its weight and to make it easy to drive. This could also help it to become a low-cost personal vehicle for middle-class families.

ECONOMIC ISSUES

We plan to introduce these rickshaws in Lucknow and Pune, cities having the maximum number of cycle rickshaws and autorickshaws respectively. The comparison of electric rickshaws and autorickshaws can take place only when ELECSHA is used in actual conditions. However, a simple economic analysis based upon existing data has been accomplished, as follows.

IPCR

Discussions with rickshaw pullers in various cities reveal that they propel their rickshaws to a maximum of 25–30 km/day. During the hot season (which is the majority of the year) their range is reduced to 15–20 km/day. On an average they charge Rs 3–5/km. Hence they can make between Rs 75–125/day. After giving Rs 15/day as rickshaw hiring charges they can earn about Rs 60–110/day. Data on our rickshaw have shown that with gears

the rickshaw puller can easily go 30–40 km/day. The addition of a five-speed gear could therefore increase his earnings substantially.

MAPR

In this case our data have shown that a rickshaw puller can easily pedal 50 km/day and in some tests he has increased this distance to 70 km/day in two shifts. Thus with the cost of MAPR at Rs 17,000 he can earn at least Rs 150/day (by charging Rs 3/km). If the rickshaw owner charges Rs 40/day as hiring charges (the puller will get at least Rs 110/day as net income) then the owner will be able to repay the rickshaw loan in five years. He will also at the same time earn a profit of about Rs 4,600/year for ten years on each rickshaw. This includes battery replacement cost every third year and 18% interest on the loan.

ELECSHA

The ELECSHA owner can make a net profit of Rs 25,400 every year for ten years. This requires that the fare will be Rs 3.50/km and that the rickshaw will travel 70 km/day. Other assumptions are:

- Driver will be paid Rs 75/day;
- ELECSHA will run for 300 days/year;
- Battery replacement cost is Rs 15,000 and it will be replaced every other year;
- Interest is 15% per annum and loan has to be paid back in five years; and
- The electricity cost is Rs 5/kWh.

Presently the petrol autorickshaws charge Rs 4.50/km and hence, even with the reduced fare for ELECSHA, the owner can make a good profit. This is because of the low running cost of ELECSHA. Thus it seems that for both rickshaw puller and owner it is economically viable to ply these rickshaws.

OTHER ISSUES

The battery and its charging

One of the major issues facing the large-scale introduction of electric vehicles is the issue of batteries. With the present level of technology development the batteries used virtually have to be lead-acid. Deep-discharge lead-acid batteries are presently imported into India and are very heavy. The issue of battery charging can be tackled in two ways.

1. An onboard charger that can be plugged into any electrical outlet can be fitted. This concept has been used in most of the electric vehicles. This concept can be attractive for private owners of ELECSHA. However the disadvantage of this method is that it increases the cost of ELECSHA since the charger will be a part of it.

2. A network of battery-charging stations could be developed. In this concept it is envisaged that the battery-charging station would take out the discharged batteries from ELECSHA and put in a set of charged ones.

The advantages of this concept are that one does not need to worry about charging and the battery could be of lower capacity and hence lighter weight, which in turn will improve the performance of the vehicle. Also, regular automotive batteries could be used which can be discharged to only 50% depth. At the same time no extra cost of a charger is incurred. This concept will be very useful for rickshaws being used as taxis. Nevertheless, the issues of old vs. new batteries and the economic viability of charging stations will have to be sorted out.

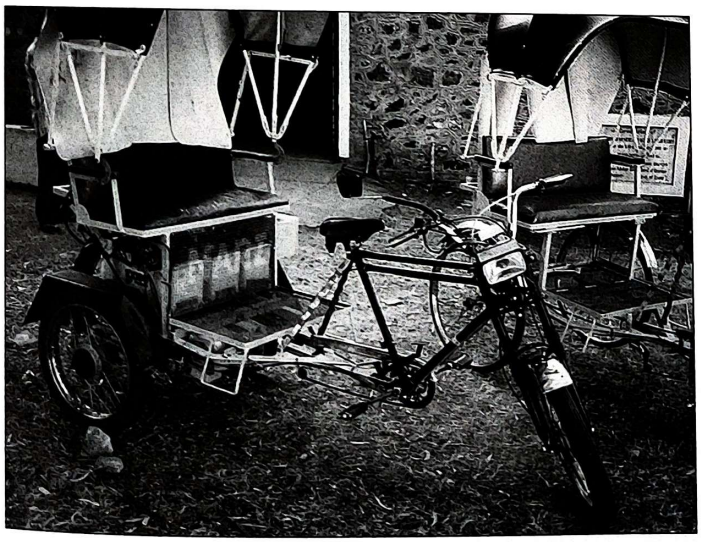


Figure 3. Electric cycle rickshaw (ELECSHA™)

The electricity to power these batteries could come from any renewable power plants like biomass, solar thermal, solar photovoltaic, wind, etc. In these cases these rickshaws could truly be called a renewable-energy transport system. To convert all existing one-million rickshaws in India into electric rickshaws would require only one 600-MW power plant to run them. [If battery-charging is carried out off-peak, including during the night, no additional generating plant would be required. —Ed.] It is also instructive to look at the energy efficiency of electric rickshaw vis-à-vis petrol-engine-powered autorickshaws. From power-plant to traction-energy point of view ELECSHA consumes 110 Wh/passenger-km as compared to 175 Wh/passenger-km consumed by petrol autorickshaws. In this calculation we used the following assumptions.

ELECSHA

- The efficiency of electric power plants including transmission and distribution losses = 0.255;
- Charging/discharging efficiency of batteries = 0.64; and
- The Elecsha takes two passengers and travels 80 km per charge.

Petrol autorickshaw

- Average mileage = 25 km/l of petrol
- Calorific value of petrol 8.74 kWh/l

Thus if the ELECSHA uses batteries charged from fossil-fuel power stations, it would use 60% less petroleum energy than a petrol autorickshaw. Besides being environmentally-friendly ELECSHA is also very energy-efficient. We also feel that small systems like rickshaws are most suited for electric-vehicle development. This is because the present level of battery technology precludes large power outputs from lightweight batteries. Hence, the electric rickshaw can be easily designed with existing motor and battery technology.

Policy issues

There is need for a policy decision by governments of developing countries to permit only improved cycle rickshaws and electric rickshaws in congested areas of inner cities. This

TABLE 1. Specifications of the NARI ELECSHA™

Payload	180 kg
Gross vehicle weight	230 kg
Range	60–80 km (for 60%–80% depth of discharge)
Top speed	30 km/h
Battery type	Exide Automotive Battery
Battery weight	96 kg for 3 batteries
Battery capacity	100 Ah
Battery specific power	7.95 W/kg
Battery energy density	39.7 Wh/kg
Battery pack voltage	36 V (Nominal)
Cycle life and self discharge	150–200-cycle for battery at 60% discharge depth
Charger	36-V 10-A standard Indian make, running from wall plug
Charge time	10–12 h
Motor	1.2-kW PMDC, Indian make
Transmission	belt pulley/sprocket with 6:1 ratio
Controller	Indian make, high-frequency, micro-processor-based MOSFET controller
Frame/body type	Rolled-steel-angle construction
Frame/body material	Mild steel
Length/width/height	2390/1050/1330 mm
Ground clearance/turning radius	200 mm/2.3 m
Maximum gradeability	6–10%
Tires	Regular two-wheeler tyres
Wheel	Regular two-wheeler wheels
Brakes	Hub braking (both front and back wheels)

will help reduce pollution, provide a clean sustainable transport system and provide employment. Already courts have banned three-wheeled diesel "tempos" from certain parts of Lucknow. Electric and improved rickshaws could provide an attractive alternative to help the "clean air" movement. There is also a need for the government to enact legislation such that banks could provide lower-interest loans to the rickshaw owners. Since this is a renewable energy system, it should get all the benefits presently available to such systems in other areas. Besides creating a non-polluting transport system in India, electric rickshaws would also provide dignity to rickshaw pullers. Presently rickshaw pullers are treated as belonging to the lowest rung of society. Many rickshaw pullers told us that a motorized rickshaw would give them dignity. It is felt that the police and the people in general treat the drivers of motorized transport with slightly more respect. Besides giving dignity, electric rickshaws could also provide extra income to the rickshaw puller since he can ply his rickshaw to greater distances in one day.

CONCLUSIONS

In developing countries most of the cities are very congested with narrow roads that for historical and political reasons cannot be broadened. For such roads non-polluting vehicles like those described could provide a very attractive transport system. With enlightened government policies allowing only such vehicles in these areas, the cities of developing countries could become pollution-free and livable.

ACKNOWLEDGEMENT

Grants from E&Co, New Jersey and Ministry of Non-conventional Energy Sources, New Delhi are gratefully acknowledged.

By the time this issue of Human Power is mailed, this paper will have been published in the proceedings of "International Symposium on Automotive Electronics and Alternative Energy Vehicles" to be held in I.I.T. Kanpur from 19-21 November 1999. Anil K. Rajvanshi is a mechanical engineer. He earned his B.Tech. and M.Tech. from I.I.T.Kanpur in India and his Ph.D. from University of Florida, Gainesville, USA. He is the director of Nimbkar Agricultural Research Institute (NARI), a non-profit organization. NARI does R&D in renewable energy and agriculture.

—Anil K. Rajvanshi, Director
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Is the .deciMach Prize attainable?

by Michael Eliasohn

In 1986, Fred Markham pedaled the Easy Racer Gold Rush to 65.5 mph (105.4 kph) to win the DuPont Prize of more than $18,000 for the first human-powered vehicle to exceed 65 mph. In 1992, Chris Huber pedaled the Cheetah 68.7 mph (110.6 kph) to break Markham's mark. There was no monetary prize, but being on the cover of *Popular Science* may have been compensation.

The new barrier for straight-line speed is 75 mph (120.7 kph). It's the barrier established by the .deciMach Prize for Human Powered Speed, the prize being $21,000 plus interest to the first rider/team to exceed that speed, which is approximately one-tenth of the speed of sound. There's no deadline for winning the prize. (Contributors to the prize are Garrie L. Hill, 10 shares; the HPVA, five shares, and one share each from the Indiana chapter of the HPVA, Easy Racers, Inc., and Rob Hitchcock.)

The speed has to be attained over a distance of 200 meters on a course "flat to within 2/3 of 1 percent," to quote from the rules. Making the task more difficult are some of the requirements: Attempts (scheduled annually) must be made at a course specified by the prize committee and the altitude cannot be more than 700 meters (2,297 feet) above sea level.

.deciMach Prize organizer Garrie Hill, a long-time HPV builder/racer and HPV race organizer from Granville, Ohio, points out one change has been

see next page

Ethanol - fuel of the future

Newstime - Hyderabad - 28.05.2000

Press Trust of India

New Delhi: Environment-friendly biofuel, ethanol, is a good substitute not only for petrol but also kerosene and its commercialisation would bring manifold benefits to the country.

``Commercialisation of ethanol will save the country valuable foreign exchange, cut government expenditure, reduce carbon emission as well as increase rural employment and income,'' say energy experts. ``National energy planning should be towards making ethanol as a substitute for kerosene in cooking and lighting,'' says Dr Anil K Rajvanshi, director, Nimbkar agricultural research institute (Nari), Phaltan, Maharashtra.

India's oil import bill for 1999-2000 is expected to touch a whopping Rs 60,000 crore. Further, the government subsidy on kerosene is estimated at Rs 11,000 crore for the year. Rajvanshi says oil imports can be cut drastically by commercialisation of ethanol, produced from various crops, including sugarcane and sorghum.

While, ethanol is an established biofuel for transport, and industrial sectors in several countries, notably Brazil and US, India has taken no serious initiatives for its development despite a working group recommendation way back in 1989 to the government that it should work for development of the fuel.

A working group on minimum domestic energy requirement had recommended that the eighth plan promote distillaries producing ethanol from sweet sorghum. ``Nothing has happened on these recommendations,'' says the US-educated mechanical engineer, Rajvanshi, in dismay.

Recently, the Union agriculture ministry has shown interest in ethanol and sponsored a project by the National centre for sorghum research. Nari has been chosen as part of the project. ``But, Nari having worked on the subject for two decades feels that this work is a duplication of our 20-year-old work,'' says Rajvanshi.

Nari, a leading non-government organisation working for sustainable agriculture and rural development, has carried out extensive research in ethanol extracted from sweet sorghum and its use as a cooking and lighting fuel for rural areas. ``We are many years ahead in ethanol research,'' says Rajvanshi, whose institute has developed a variety of sweet sorghum that produces two to four tonne per hectare per year and is capable of producing 2,000-4,000 litres of 95 per cent alcohol (ethanol).

Nari's work on ethanol has been widely recognised by European and US energy and environment institutes. At present, the installed capacity of ethanol in the country is around 2.7 billion litres per annum. But, only 50 per cent of this is utilised. Production is estimated at 1.3 billion litres per annum and is used mainly for industrial purposes, exports and some remains unused.

``The reasons for India lagging behind in developing ethanol as a fuel for automobiles are lack of government policy, resistance of oil companies, lack of commitment of relevant players like ethanol suppliers and oil companies and differential state policies,'' says Saroj Mishra, project officer (biomass), Winrock International India (WII), an NGO, involved in promotion of renewable energy.

Mishra too stresses that ethanol development can bring properity to rural area.

Strongly advocating ethanol use, Rajvanshi says, ``neither solid nor gaseous fuels can compare with liquid fuels in terms of transportability, high energy density, cleanliness and convenience of use.'' Allaying the fear that production of ethanol will take land away from food production, he explains that sweet sorghum is a multipurpose crop providing food, fuel and fodder.

While, in India, ethanol is still in the laboratory, it is a big industry in Brazil, the world's largest sugar-cane producer, and the United States. Brazil's Alco, an association of 28 companies producing ethanol alcohol, says alcohol has helped the country to save $ 33 billion in foreign currency. ``It is the future fuel.''

In the us, politicians, ethanol producers and consumers have come together to support the production and use of ethanol as a clean fuel. A 23-state governors' ethanol coalition is working to increase ethanol's market share through state rules and incentives.

Oregon state recently issued tax-free bonds for construction of its first $ 140-million ethanol plant. In India too, incentives should be given for setting up mini-distilleries in rural areas, says Rajvanshi. Further, excise laws need to be liberalised for alcohol production and farmers should be provided with good support prices for sweet sorghum.

Referring to Maharashtra, Rajvanshi notes that grain sorghum is planted on 6.65-million hectares in the state. The production is about 4.65 million tonne per year.

``If all this land is brought under sweet sorghum, 27,000 million litres of alcohol, 13 million tonnes of grain and 84 tonnes of bagasse could be produced,'' he says, adding, ``this would meet all the petrol requirements of automotive industry and replace kerosene consumed in Maharashtra and provide 80 per cent of the fodder needs of the state.''

A chief ministers' ethanol coalition may help to develop this eco-friendly fuel.

 New Delhi 29/5/2000

Ethanol: Fuel Of The Future

Most energy experts agree on the fact that commercialisation of ethanol as a fuel would bring manifold benefits to the country

ENVIRONMENT-friendly biofuel, ethanol, is a good substitute not only for petrol but also kerosene and its commercialisation would bring manifold benefits to the country.

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A chief ministers' Ethanol Coalition may help to develop this eco-friendly fuel. ▷(PTI)

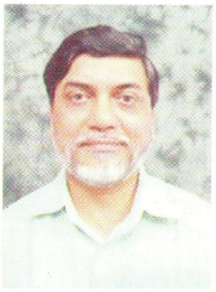
Sunila Swaraj



Ethanol is a cleaner and more efficient than many other fuels currently in use

Congratulations

Anil K Rajvanshi
gets Jamnalal Bajaj Foundation Award and Solar Hall of Fame Award



Dr Anil K. Rajvanshi (BT/ME/72), the Director of Nimbkar Agricultural Research Institute (NARI) has been selected for the prestigious International Award of the Year 2001 of Jamnalal Bajaj Foundation for his contributions in application of science and technology for rural development. Past awardees for this prestigious award have included Baba Amte, Sunderlal Bahuguna, Manibhai Desai, etc. form India and Nelson Mandela, Desmond Tutu, among others in the international community. This award will be conferred on him on a suitable date. Anil has also recently received the US based Solar Hall of Fame Award. Established during the Bicentennial of USA, this award is given *for promoting Excellence in the field of Solar Energy Utilization through public testimonials and tribute to outstanding contributions in the field*. Started in 1976, the Solar Hall of Fame Award need not be conferred to some one or other in any given year and several years have seen no awardees. Anil Rajvanshi is the second Indian to receive this honour.

After doing BTech and MTech in Mechanical Engineering from IITK, Anil obtained his PhD from University of Florida in 1979. Anil's areas of specialization are solar distillation; heat transfer; solar energy thermal processes, biomass gasification and combustion, electric vehicles, rural energy R&D and policy and sustainable development. He has given many invited lectures at a large number of organizations and institutions like IITB, Indira Gandhi Institute of Development Research (IGIDR), Bombay; IISc, Bangalore, Staff College, Hyderabad, Centre of Cellular & Molecular Biology (CCMB), Hyderabad (in India) and at UC, Berkeley, UC, Davis, University of Florida, Gainesville, Carleton College, Minnesota, NC State A&M, Greensboro (in US). He has served as a Visiting Professor at IITB. Rajvanshi has also served as a member, Working Group on Biomass Gasification, Department of Non-conventional Energy Sources, Ministry of Energy, GOI (1985-87), member, Expert Panel on Rural Domestic Energy, Advisory Board on Energy, Govt. of India (1983-1988), member, Working Group on Rural Cooking Energy Needs, Planning Commission, (1988-89), member, Task Force on Biomass based Power plants at Taluka level, Ministry of Non-conventional Energy Sources, (1994), member, Sub-Group on Resource Mobilization for NRSE, Planning Commission, (2001) and is a member, Expert Committee, Maharashtra Electricity Regulatory Commission (2000-2002). Since 1987 Anil is an advisor to International Foundation of Science (IFS), Stockholm, Sweden on Energy Projects, and is India Representative of E & Co, a US based and Rockefeller Foundation, NY sponsored energy investment company. He is the creator of the first venture fund for renewable energy in India. This is a $10 million fund for which an MOU has been signed between Winrock International, NARI and United Western Bank Ltd. Member, Expert Committee, Maharashtra Electricity Regulatory Commission (2000-2002). Anil has 87 publications in various national, international journals and conferences, 16 editorial articles in some of the leading newspapers and magazines of India; 5 patents; one chapter entitled "Biomass Gasification" in a book Alternative Energy in Agriculture", published by CRC Press, USA (1987), a chapter entitled "Sustainable Energy Development - A Gandhian Approach " in a book Gandhi in 21st Century, published by Prachee Publications, Hyderabad (1999).

Located in the rural town of Phaltan near Aurangabad in Maharashtra, Nimbkar Agricultural Research Institute (NARI) is a non-profit organization and an NGO working in rural India. It develops technologies which provide sustainable and holistic development for rural areas. NARI was established in 1968 by Mr BV Nimbkar who remained its first President till 1990. Anil is the Institute's director since then. The Institute undertakes research and development programmes in agriculture, renewable energy, animal husbandry and sustainable development. The basic philosophy of the Institute is to solve the age-old problems of rural India with the use of modern science and technology. Consequently, very innovative research and development programs have been undertaken. Till 2000 about 75 funded projects with total funding of Rs. 33 million have been undertaken. Further information on NARI and its activities may be obtained from http://nariphaltan.virtualave.net. Our heartiest congratulations to Anil.

D Sangeeta
receives General Electric's Lewis H Latimer Award



D Sangeeta (MSc2/Chy/83) Manager of Component Repair Marketing at GE Aircraft Engines, has been recognized with GE's Lewis H Latimer award for her outstanding technical achievements in helping develop a new repair process called coating rejuvenation. The award is named for Lewis H Latimer, a founding member of the Edison Pioneers who began working at the Edison Electric Company in 1883. Latimer is credited, among other things, with inventing the light bulb socket design and improving carbon filaments for light bulbs. He also wrote the first book on electrical lighting, spoke three languages, taught English and Mechanical drawing to newly arrived European immigrants and was an avid civil rights activist. The award has been established in his honour to recognize minority employees success as GE moves into the 21st century.

Sangeeta was one of the seven GE employees company wide, and the only GE Aircraft Engines employee, to receive the award. Sangeeta's innovative process provides up to 30 percent cost savings for GE Aircraft Engines' customers in the area of high-pressure turbine blade materials. She currently holds five patents on the process and has another 10 patents pending on related coating rejuvenation techniques. Sangeeta holds a PhD in Materials Chemistry from the University of Illinois at Urbana-Champaign. "Sangeeta's outstanding contributions to technology at GE Aircraft Engines strongly support our commitment to deliver high-quality, cost-effective solutions to our customers," said Dave Calhoun, President and Chief Executive Officer of GE Aircraft Engines. "Her expertise and talent are truly remarkable, and we're proud that she's a member of our team." Our heartiest congratulations to Sangeeta.

Vinay P Aneja
receives Lyman A Ripperton Award of Air & Waste Management Assoc.

The 2001 Lyman A Ripperton Award is bestowed by the Air & Waste Management Association upon Vinay Pal Aneja (BT/ChE/71), Research Professor of the

Rural innovator makes global 'Net' gains

U.K., U.S. clients evince interest in improvised lantern and cycle-rickshaw

By Abhay Vaidya
The Times of India News Service

SATARA: Phaltan-based innovator Dr Anil Rajvanshi has found an unlikely messiah in e-commerce.


Dr Rajvanshi

When the Indian Institute of Technology (IIT)-trained engineer developed 'Noorie,' a multi-fuel improvised lantern for India's rural poor 11 years ago, it failed to grab the attention of manufacturing companies and the government. However, when he recently posted the product on the Internet, it attracted client queries from as far off as California, U.S.

When this was reported in the local press and the Internet, Dr Rajvanshi to his complete surprise, was flooded with enquiries from India and abroad.

"Apart from manufacturers and the managing director of a large group, three people from the US have written to me with large orders," an overjoyed Dr Rajvanshi told *The Times of India*.

With this, the Internet has proved to be a great leveller, with a product essentially developed for the rural poor in India, finding takers in countries like the United Kingdom (U.K.) . "A Sussex-based buyer has not only shown interest in the Noorie lantern, he has made enquiries about my improvised cycle rickshaw for the benefit of tourists," Dr Rajvanshi adds. "I had essentially developed the rickshaw to reduce the hardships caused to the rickshaw-pullers. After developing the product, I had travelled across the country trying to convince cycle manufacturers to buy my design," he says.

Dr Rajvanshi said that it was in 1981, after receiving a doctorate in mechanical engineering from the University of Florida, that he and his wife Dr Nandini Nimbkar decided to return to India.

The engineer and his agronomist wife settled at Phaltan (Satara district), 25 km from Baramati, where they head the well-known Nimbkar Agricultural Research Institute (NARI).

Founded in 1968 by animal husbandary expert Dr B.V. Nimbkar, NARI has been undertaking a number of projects for the welfare of rural masses and the urban poor.

Dr Rajvanshi said that on his return to India, he decided to improve the lantern as large portions of rural India were still to be electrified in the 1980s.

He therefore developed the Noorie lantern as a pressurised multi-fuel lantern that produces light equivalent to a 100W bulb. The lantern is more efficient than the conventional petromax lamp. It can run on ethanol, diesel or kerosene, and it also doubles up as a cooking device.

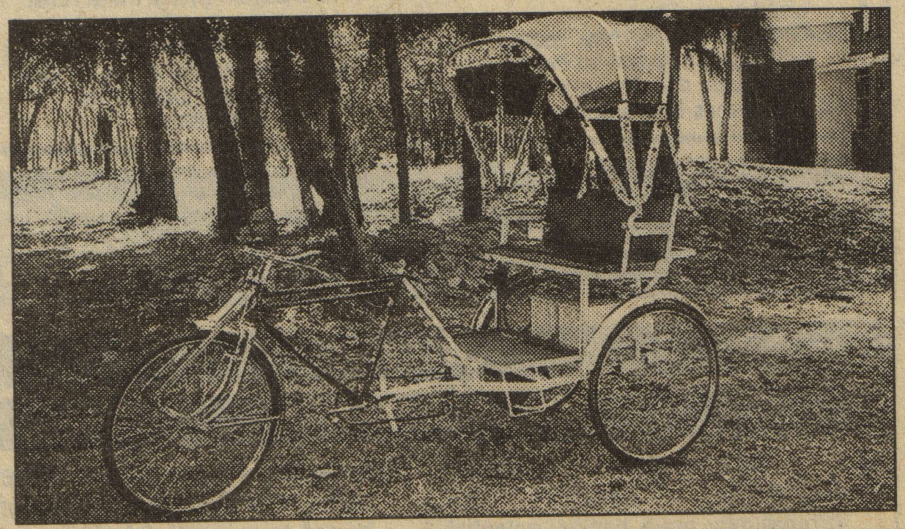
The improved cycle rickshaws are available in a "motor-assisted" version and in another version which has five-speed gears, back-wheel braking and better suspension.

The Rajvanshis after two decades of consistent efforts for the rural poor are, however, dissappointed with their experiences here. "I was the only person from my class of 70 students at IIT-Kanpur to return to India. We came to India with great idealism, but feel that there is degeneration at many levels in society," he said.

Cycle rickshaws on Pune varsity campus?

PUNE: Following in the footsteps of reputed western universities, the University of Pune too is contemplating the introduction of cycle rickshaws on campus. According to Dr Rajvanshi, vice-chancellor of the University of Pune, Dr Arun Kolaskar, has expressed keen interest in introducing his improvised design on campus.

"Dr Kolaskar plans to put a stop to the indiscriminate plying of vehicles on the university campus," he adds.



Times of India - Pune - 04/08/2001

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From Phaltan with love : To London, on a cycle rickshaw

■ Developed by NARI, these improvised vehicles will ferry tourists as they snap the Big Ben at Trafalgar Square

AISHWARYA MAVINKURVE
PHALTAN (SATARA), SEPT 3

CYCLE rickshaws may be trundling off most city roads, given their lowly small-town status and dubious distinction of congesting traffic everywhere. But the curse of Indian roads has a new lease of life as far away London waits to delight its tourists with another jewel from its erstwhile empire.

For the Nimbkar Agricultural Research Institute (NARI) in the non-descript town of Phaltan, which lies a little over 100 km from Pune, this will finally be a recognition of Indian ingenuity and innovation, of a design originally meant for India.

Three of the Improved Pedal Rickshaw (IMPRA), designed and developed at NARI, have been bought by a British entrepreneur who plans to use them to show tourists the sights of London.

The fourth IMPRA has been picked up by an individual buyer from Germany. The buyers got to know of the rickshaws through the NARI website.

"It's a simple idea but a lot of thought went into designing the IMPRA which originated with the aim of re-engineering the cycle rickshaw to make it simpler for rickshaw pullers," says Anil Rajvanshi, NARI director, who designed the IMPRA in 1995 keeping in mind the travails of a rickshaw-puller on Indian roads.

The remodelled pedal rickshaw has a three-speed gear system with back wheel brakes and can comfortably seat two passengers.

Two chain drives, instead of the usual long one, and ball bearings which themselves act as shock absorbers, make it comfortable for the driver to pull it even on a gradient of six percent without dismounting, says Rajvanshi.

Going a step further, he and his team of four technicians have since developed the non-polluting Motor Assisted Pedal Rickshaw (MAPR), an improvised rickshaw run on a DC electric motor powered with two batteries. A project funded by the Ministry of Non Conventional Energy Sources, the MAPR can carry two passengers at a speed of 10-15 km/hour uphill, claims NARI.

Incidentally, five of these should be plying within the campus of the University of Pune by next month once the proposal gets a final okay. With the Agra Tourism development corporation also evincing interest, a batch of 20 is being readied in the next six months.

While he acknowledges the great use that such improved pedal rickshaws could play in rural transport, Rajvanshi has also had to contend with hiccups in marketing these innovations.

"We're a research institute and are looking for manufacturers for these cycle rickshaws. Cycle rickshaw manufacturers whom I have approached in places like Lucknow, Kanpur, Agra and Hyderabad don't seem willing to take the risk of investing in what they call a 'grey market.' Manufacturing cycle rickshaws is a footpath industry with no quality control, so the concept of engineering in it is alien to them." The tragedy is while I have got several serious inquiries from Europe and USA about both IMPRA and MAPR, manufacturers in India are not interested in a design which will consider the comfort of the rickshaw puller," he says.

Determined not to let market forces dictate the hapless rickshaw puller's plight, he hopes to start a rickshaw pullers' co-operative in Nagpur to facilitate loans for rickshaw pullers to buy these user-friendly IMPRAs tentatively priced at Rs 7,000.

For transport in a faster lane, the idea of ELECSHA, an electric autorickshaw powered by lead acid deep discharge batteries, has also materialised. Although yet to be test-marketed, the ELECSHA, which can take two passengers at a speed of 30 kmph could prove to be cost effective at 60 to 70 km per single charge. A mechanical engineer from IIT, Kanpur, Rajvanshi gave up the American dream to return to India along with wife, Nandini Nimbkar, an agronomist (now president, NARI) in 1981 "because engineers should address rural problems through technology."

With the availability of these innovations on a large scale, perhaps some of these problems would be solved. Meanwhile, Rajvanshi has another little challenge to contend with. "A BBC correspondent who had called up recently about the rickshaws in London, was wondering how they would use the cycle rickshaws when it snowed there," he smiles, shaking his head.



Anil Rajvanshi, director, NARI with the models of IMPRA (left), and an MAPR staff at work. *Newsline photo by Anand Chaini*

6 November 2001

Pedalling a revolution

Moishree Vaid
Times News Network

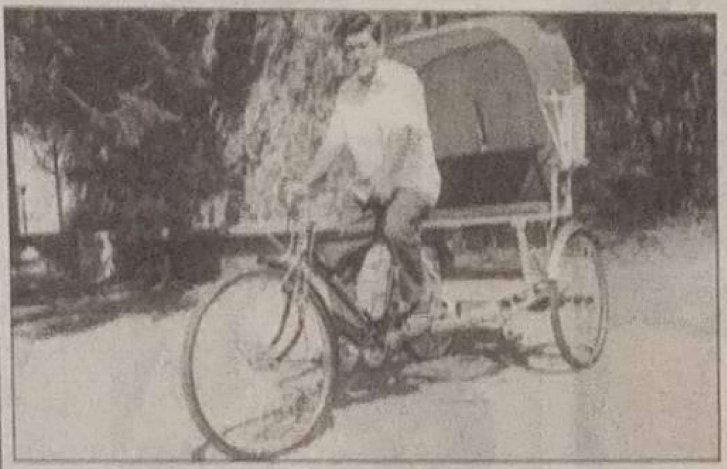
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Ironically, that is exactly Dr Rajvanshi's point about the importance of the cycle-rickshaw as an eco-friendly and economically viable means of transport for a country that does not exactly have

— Continued on page 5

PEDALLING A REVOLUTION



Dr Anil Rajvanshi will receive the Jamnalal Bajaj award today for his use of science and technology for the development of rural India

— Continued from page 1

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But it was not urban comfort that inspired Dr Rajvanshi's re-invention of the cycle-rickshaw. It was more the plight of the one million rickshaw pullers who still exist across India, that drove this IITian (Kanpur) and University of Florida doctorate holder to create the IMPRA - an improved pedal cycle-rickshaw; the MAPR - the motor-assisted pedal cycle-rickshaw, and the ELECSHA - the electric rickshaw. Dr Rajvanshi, who hails from Lucknow, has for some time now been dedicated to improving rural life. At NARI, he has already come up with a water purification plant, 'Noorie' - a multi-fuel lantern and authored a national policy on making talukas self-sufficient in terms of energy. Add these to the IMPRA and MAPR, and it's not difficult to see why it is fitting that Dr Rajvanshi joins the likes of Baba Amte and Sunderlal Bahuguna, as recipient of the Jamnalal Bajaj award in Mumbai today.

For the last few years, Rajvanshi has concentrated on improving the cycle-rickshaw. "The basic design has not been improved on for the last 70 years. Something desperately needed to be done for the rickshaw puller, plying away under tremendous strain," Dr Rajvanshi says.

Dr Rajvanshi's re-modelled pedal rickshaw (IMPRA) has a three-gear system, a reduced chain-drive and better suspension and aerodynamics for stability. "It is safe because of rear-wheel braking and is supplemented with comfortable seating space for two passengers. The puller can easily take two passengers on a six-ten degree slope without alighting from his seat to pedal with more pressure," Dr Rajvanshi says.

Then there is the MAPR, where a small motor, powered by batteries, propels the cycle-rickshaw. "This can travel at the speed of 40-45 kms per hour. The batteries need to be charged every eight hours," he adds. Finally, Dr Rajvanshi and his team at NARI developed an autorickshaw, that is electrically operated. The ELECSHA can carry three passengers, reaching a maximum speed for 60-65 kms per hour in one battery charge.

according to Dr Rajvanshi, will reduce the physical burden on rickshawallahs and hence, improve their efficiency and health.

But this is where the rickshaw joy-ride grinds to a halt. Dr Rajvanshi's rickshaws are finding no takers in the Indian market. With a hint of frustration, he says, "Manufacturers seem to be lacking long-term vision and a sense of social responsibility. With all their attention focused on high-speed vehicles, they are unwilling to enter the 'unglamorous' rickshaw category. This sector is un-organised and hence, is a footpath industry with no considerations for a comfort-friendly design."

On the other hand, Dr Rajvanshi is getting many enquiries from USA and Europe. Three IMPRAs have already been purchased by a British entrepreneur for sight-seeing in London. Another IMPRA was picked by a German.

As for Pune city, Dr Rajvanshi is quick to point out that in Pune, traffic moves at an average speed of 15 km per hour, which makes most vehicles ineffective, thus, causing more pollution. "These rickshaws are ideal for narrow and congested roads like Laxmi road and Main Street," he points out.

"India is eagerly waiting for such revolutions," he says.

moishreev@indiatimes.com

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UP TO 10th Nov.



PUNE TIMES

6 Nov. 2001.

Fazalbhoy, Rajvanshi named for Bajaj Foundation awards

Times of India - 20/09/2001

Times News Network

PUNE: Noted social worker from Pune, Rehmat Sultan Fazalbhoy, and an IIT engineer from Phal-tan in Satara district, Anil K. Rajvanshi, are among the four winners of this year's Jam-nalal Bajaj Foundation awards.



Rajvanshi

While Ms Fazalbhoy has received the prestigious Jankidevi Bajaj award for her contribution to the uplift and welfare of women and children, 41-year-old Mr Rajvanshi has been honoured for "application of science and technology for rural development."

Starting in 1958, Ms Fazalbhoy conducted an experiment, the first of its kind, of integrated education, where blind students were admitted to regular schools.

The concept was dismissed as a fancy till the principal of the New Activity School in Mumbai, Daulat Doongaji, agreed to admit three blind students to the school, with Ms Fazalbhoy as the resource teacher. The experiment worked and is today official policy, supported by the Union and state governments.

Ms Fazalbhoy was also responsible for introducing Braille reading competition for blind students in Maharashtra and Gujarat in 1958, followed by Braille writing, elocution and speech contests.

In 1962, she established the first day school for crippled children and in 1985 helped establish the Multiple Sclerosis Society of India, which helps people with incurable diseases of the central nervous system. Neighbouring countries like Bangladesh, Sri Lanka and Pakistan drew inspiration from Ms Fazalbhoy's pioneering work and established similar organisations.

Mr Rajvanshi, who has done a commendable job in rural development through the Phaltan-based Nimkar Agricultural Research Institute (NARI), was recently in the news for receiving purchase orders from the U.S. and the U.K. for his 'Noorie' lantern and improved cycle rickshaws on the Internet.

NARI's successful projects include utilisation of sweet sorghum for energy and food, improved lanterns for rural areas, development of solar energy-based technologies, utilisation of safflower and development of improved cycle rickshaws.

The other two winners of the awards are Sisir Sanyal, secretary of Gandhi Vichar Parishad (West Bengal) and Satish Kumar from the U.K., for promoting Gandhian thoughts abroad.

The awards, each of which comprises a citation, a trophy and Rs 2 lakh in cash, will be presented in Mumbai on November 6.

Turning handicap into asset



Fazalbhoy

"WHEN you have put in certain amount of effort, it feels good to know that someone cares. I have devoted over 40 years to the disabled and the handicapped. It has been a fulfilling life and I feel grateful for it," Ms Fazalbhoy (72), told the *Times of India* at her residence here on Wednesday.

Ms Fazalbhoy, who has only 15 per cent of vision due to albinism, was refused job by a company in the U.K., following which she joined the Royal National Institute for the Blind in London.

There she did a diploma in teaching the blind, a first by an Indian woman. "I am thankful to the agency which refused me a job because of my handicap, after which I started doing what I am doing today," she said.

'The Lucknow I recall has got lost somewhere'

Times of India - 26/10/2001

Jamnalal Bajaj Award winner for the use of science and technology in rural areas, Dr Anil K Rajvanshi in an exclusive interview with ***Lucknow Times***

Swati Bajpai
Times News Network

He is a son vying to repay a debt to the city in which he was born, but sadly there seem to be no takers. Not even when the man in question is Dr Anil K Rajvanshi, winner of the prestigious Jamanalal Bajaj Award for the Year of 2001 for the use of science and technology in rural development for the year 2001.

"I have developed Improved Pedal Rickshaw (IMPRA), a re-engineered cycle rickshaw to ease the lives of rickshaw pullers." Four such rickshaws find a pride of place on the streets of London and Germany. "I know that Lucknow has predominantly relied on rickshaws for human transport since time immemorial. This modification makes it faster and humane as otherwise the rickshaw puller bears severe physical strain," states he. The IMPRA has further developed into a Motor Assisted Pedal Rickshaw (MAPR) consisting of a three gear system and a battery assistance.This Franciscan of the 1966 batch is has passed out from IIT Kanpur where he did his B Tech and M Tech in Mechanical Engineering which later culminated in attaining a Ph D from the University of Florida at Gainesville, Florida, USA. "I worked there for a while and during this period I met my wife Nandini Nimbkar who is a grand daughter of Lilavate Karve.

After a while we were fed up of the fast life and wanted to come back to do something for our nation. And thus was born Nimbkar Agricultural Research Institute (NARI), in the non descript town of Phaltan which lies a little over 100 km from Pune.

"Life was tough, initially as the areas were very backward but now this very same town has computer institutes and a supermarket. "The entrepreneurial spirit of Maharashtra and the powerful status of women. My NGO is a live example of this in which my wife an agronomist is the president and not me.

Son of a freedom fighter whose father was in prison with Gandhiji, Rajvanshi has won many a laurel. He has served on committees in Advisory Board of Energy, Planning Commission and Ministry of Non-Conventional Energy Sources. He is also the second Indian to be inducted in the prestigious US based Solar Hall of Fame.

PASSING THROUGH



He remembers Lucknow as a city of gardens, in which cycle rides along various beautifully laid out parks used to be his favourite past time as a child. "That Lucknow has got lost somewhere and I would blame the political ruckus that has become the predominant feature of Uttar Pradesh. I tried innumerable times to set up a co-operative society that can act as a guarantor for rickshaw pullers, in the various finance schemes of banks. Do you know huge amount of funds are released every year to assist the downtrodden but where that amount disappears is anybody's guess. I talked to various officials and private organisations but corruption is the key word locking all doors," is his disgusted reply. "These rickshaws have a great market and relevance in Lucknow but the corrupt system will not let them reach here."Anil has a vision for India despite all odds. "The future of India is a hi-tech rural decentralised society in which my generation will act as a bridge between the rural and hi-tech," is his observation.

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Pedalling a revolution

Molshree Vaid
Times News Network

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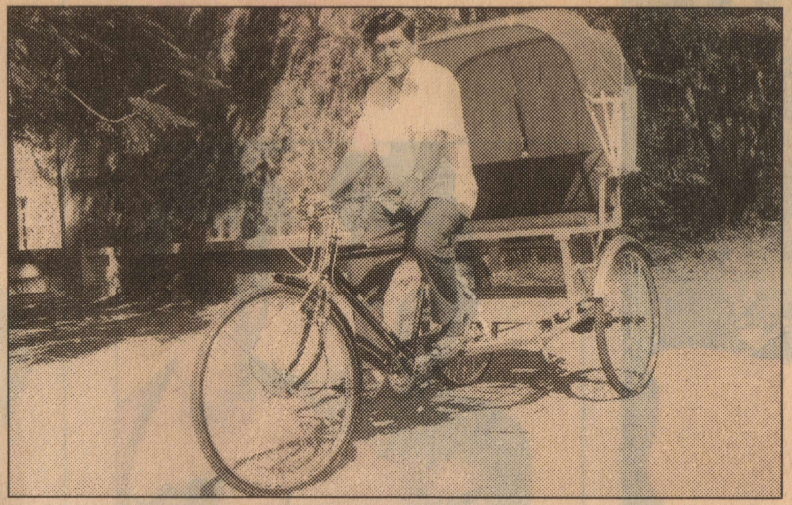
— Continued on page 5

PuneTimes - Nov 2001

PUNE TIMES

Nov. 2001.

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For the last few years, Rajvanshi has concentrated on improving the cycle-rickshaw. "The basic design of the cycle-rickshaw is poor and has not been improved on for the last 70 years. Something desperately needed to be done for the rickshaw puller, plying away under tremendous strain," Dr Rajvanshi says.

Dr Rajvanshi's re-modelled pedal rickshaw (IMPRA) has a three-gear system, a reduced chain-drive and better suspension and aerodynamics for stability. "It is safe because of rear-wheel braking and is supplemented with comfortable seating space for two passengers. The puller can easily take two passengers on a six-ten degree slope without alighting from his seat to pedal with more pressure," Dr Rajvanshi says.

Then there is the MAPR, where a small motor, powered by batteries, propels the cycle-rickshaw. "This can travel at the speed of 40-45 kms per hour. The batteries need to be charged every eight hours," he adds. Finally, Dr Rajvanshi and his team at NARI developed an autorickshaw, that is electrically operated. The ELECSHA can carry three passengers, reaching a maximum speed for 60-65 kms per hour in one battery charge.

These remodelled rickshaws, according to Dr Rajvanshi, will reduce the physical burden on rickshawallahs and hence, improve their efficiency and health.

But this is where the rickshaw joy-ride grinds to a halt. Dr Rajvanshi's rickshaws are finding no takers in the Indian market. With a hint of frustration, he says, "Manufacturers seem to be lacking long-term vision and a sense of social responsibility. With all their attention focused on high-speed vehicles, they are unwilling to enter the 'unglamorous' rickshaw category. This sector is un-organised and hence, is a footpath industry with no considerations for a comfort-friendly design."

On the other hand, Dr Rajvanshi is getting many enquiries from USA and Europe. Three IMPRAs have already been purchased by a British entrepreneur for sight-seeing in London. Another IMPRA was picked by a German.

As for Pune city, Dr Rajvanshi is quick to point out that in Pune, traffic moves at an average speed of 15 km per hour, which makes most vehicles ineffective, thus, causing more pollution. "These rickshaws are ideal for narrow and congested roads like Laxmi road and Main Street," he points out.

"India is eagerly waiting for such revolutions," he says.

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Ace innovator holds up Aladdin's lamp for rural uplift

By Vithal C. Nadkarni
Times News Network

MUMBAI: "Inventing a new device seems like child's play compared to marketing and making it widely available. This is always the hardest part of any Operation Eureka," says ace innovator and champion of appropriate technology Anil Rajvanshi, winner of this year's Jamnalal Bajaj award for application of science and technology for rural development.

A case in point is the Noori lantern invented and patented by Mr Rajvanshi's team at the Nimbkar Agricultural Research Institute (NARI) at Phaltan, 100 km southwest of Pune.

Named after Mr Rajvanshi's eldest daughter, the Noori multi-fuel lantern produces a light output of a 100 W light bulb running on ethanol, diesel or kerosene, while saving 40 per cent fuel as that used by an equivalent petromax lamp. It can also double as a cooking stove.

"The key idea was to provide light with minimal fuel combustion," Mr Rajvanshi says. "That required a thorough understanding of the basics such as heat and mass transfer. The science and technology applied was, therefore, of the same level as in rocket design. The technology development of this humble lantern, which took four to five years, bears that out," he adds.

"But the commercial part has not been encouraging. We put in a lot of ads in leading national dailies, but hardly got any feedback."

The lantern would have continued to languish in the backwoods but for the Internet Revolution. "Sitting in Phaltan, we'd mastered the art of web design and interface and suddenly, we were being flooded with these huge enquiries," Mr Rajvanshi explains. "More ironic, the lantern developed for rural (read backward) India, proved to be a great hit in California, where it is providing light in the blackout hit areas."



PEDAL POWER FOR RURAL RICHES: An eco-friendly electrical cycle-rickshaw invented by Anil Rajvanshi (inset) and his team at the Nimbkar Agricultural Research Institute at Phaltan.

Mr Rajvanshi has a master's degree in mechanical engineering from the Indian Institute of Technology at Kanpur and a doctorate on solar energy from University of Florida, Gainsville, where he taught for two- and-a-half years. "That's where I met my wife, Nandini, who did her doctorate in agronomy," Mr Rajvanshi recalls. "What's interesting, the first woman was allowed into University of Florida in 1947 and in 1997, the president of the university wanted 20 member commission to identify 47 most distinguished alumni out of 85,000 who had passed out in 50 years. Nandini happened to be the only non-American, among others, including Clinton cabinet members and Supreme Court justices."

The Rajvanshis came back to India in 1981. Spurning lucrative offers, they decided to join the Nimbkar Agricultural Research Institute with "a view to propagating sustainable development through the use of modern science and technology, tempered by ancient Indian thought".

"The Institute was set up by Nandini's father, B.V. Nimbkar. When we arrived there was nothing but a flat piece of land. We had to develop the infrastructure and decide what we wanted to do," Mr Rajvanshi reminisces.

Another example of the critical role played by the Internet in marketing of technologies is NARI's eco-friendly rickshaw. "The cycle rickshaw was introduced in India since the 1920s and nothing has been done to improve its design or efficiency," says Mr Rajvanshi. "This takes a heavy toll on the health of the rickshaw puller—haven't we seen the inhuman sight of the poor fellow who is forced to get off his vehicles on an uphill slope and to pull the vehicle like a straining draught animal?

"In totally re-engineering the rickshaw, therefore, we put in three gears, backwheel-braking, better aerodynamics and more comfortable seating," he adds. "We also converted it into an electrical rickshaw by fitting a small electrical motor onto it. Again, our initial foray into marketing the eco-friendly-humane-rickshaw was disappointing," he continues.

"With the Internet, however, we got orders from Europe and America. Four have gone to Europe. They will ply in London as part of a pedicab company, ferrying tourists. If the experiment succeeds, many more rickshaws are likely to be ordered."

Mr Rajvanshi's institute is also in the forefront in oilseed research. "We are proud of our work on the poor man's crop safflower or kardi," Mr Rajvanshi say. "This is maximally grown in Maharashtra and Gujarat for this is the only crop that can be used in rain-fed conditions, along with millet (which is liable to fail with poor rain). We are one of the all-India coordinating centres for research on safflower and we have produced two varieties which are nationally released by the government of India. Intriguingly, it was while following the whole plant approach that we found that petals were excellent medicine for hypertension. The most interesting part is that while the seed is selling for ten rupees a kilo, the petals were quoted at Rs 400. Thanks to our medicinal Phaltan tea, the seed has become a by-product, turning the petal has become the main one. Commercialisation is apace, and Dabur has bought the technology."

In his speech accepting the Jamnalal Bajaj award, Mr Rajvanshi likens sustainability to a chair. "The four legs can be thought of as four 'Es'-energy, economics, environment and equity," he says. "All four have to be equal for comfortable sitting and interconnected to provide stability. The base has to be of the right size. Too big a base will make the chair of sustainability sag. If it's too small, it will be unstable. For building a sustainable India, the size of a taluka seems to be the right sort of base."

ENVIRONMENT-FRIENDLY PEDAL-POWERED 'RIKKIES' WILL FERRY CAMPUS RESIDENTS

Varsity set to foot out pollution

Times of India - Pune - 02/01/2002

By Siddhartha D. Kashyap
Times News Network

PUNE: Anyone who has trudged through the verdant but sprawling university campus on their tired feet will shower silent blessings on the head of Anil K. Rajvanshi. The Phaltan-based innovator has devised an environmentally sound, motor-assisted pedal rickshaw, which the university has decided to put into use on campus.

On January 23, the day of its 95th annual convocation, Andhra Pradesh governor C. Rangarajan, chief guest, will ceremoniously introduce five such "rikkies", thus doubtless earning the gratitude of many a foot-sore student and professor. Vice-chancellor Ashok Kolaskar says the one-year trial project is being launched in the hope that the number of vehicles plying on campus will be reduced, and with it, air pollution levels.

"When there is an alternative available to us so easily, why not make use of it and set an example for others to follow?" he queries. The improvised cycle rickshaw was developed by Jamnalal Bajaj Foundation award winner Rajvanshi at the Nimbalkar Agricultural Research Institute in Phaltan, Satara. It had made headlines recently when several of them were imported by the United Kingdom by an English entrepreneur.

Rajvanshi, incidentally, also designed the 'Noorie' multi-fuel lantern, which, when marketed over the Internet, found buyers in California! Preliminary tests carried out by the university found that the rickshaws were easy to manoeuvre and are both non-polluting and silent, besides being energy-efficient and cost-effective.



But will students leave their scooters and bikes behind and be tempted to ride in the rickshaws? Kolaskar admits he is somewhat apprehensive about the reaction on campus, but is determined to give it a shot. "When everyone is crying about the high pollution levels, why can't we set an example?" he said.

The enthusiastic inventor, whose idea failed to attract Indian buyers on a large scale, says the rickshaws, which costs Rs 20,000 each, have been given free of cost to the university. "The aim is to popularise the concept," Rajvanshi says. The Indian Institute of Technology, Kanpur is also a customer. "It has already banned the plying of autorickshaws inside the campus as a result of which 100 cycle-rickshaws are transporting people there."

The 'rikkie' has 3-speed gears and a small battery-driven motor which enables the driver to tackle uphill slopes with ease. A key feature of the 129-kg rickshaw is that the gears are arranged in such a manner that the pedal and the motor work in tandem to ease the load on the rickshawman.

A current overload switch cuts off the circuit when the motor draws more than the predetermined current. "However, the driver has to continuously keep on pedalling," Rajvanshi says, adding that the rickshaw can easily cover 40 km in one battery charge.

The motorised rickshaws were originally designed to ease the strain and suffering of rickshaw pullers, but they seemed uninterested in changing their ways. It is hoped that the university population will be more receptive and pay more than just lip service to environment-friendly technology.

Times of India

2 MONDAY, JANUARY 7, 2002

Difficult Choice

A pollution-free environment seems to be very high on the list of priorities of the University of Pune. This is evident in its latest move to introduce motor-assisted pedal cycle-rickshaws to ply within its precincts. As a corollary to this, the university will ban all other forms of transportation, including cars, and two-wheelers.

This, the authorities hope, will considerably lower the pollution levels of the verdant, sprawling campus. This move really comes as a breath of fresh air in the pollution-ridden Pune. But sceptics question the feasibility of this exercise. They feel that it was highly unlikely that the students and staff of the university would abandon their vehicles and mobility for the cause of the environment. That's asking for a bit too much, they feel.

But detractors apart, the innovator of the rikkie, Dr Anil K. Rajvanshi, feels that it can be a success. Perhaps his hopes are buoyed by the fact that the IIT, Kanpur, has also expressed its willingness to use these rickshaws and successfully banned the entry of all other vehicles within its campus.

Sadanand Godse

The Indian Express - 19.01.2002

Travel in style, pollution-free

Anil Rajvanshi's MAPRAs are the University of Pune's mantra for a pollution-free campus

JANUARY 23, 2002 will be a day to remember for the University of Pune. On this day, an improved battery-operated cycle rickshaw will make the rounds of the University of Pune (UoP) campus. According to inventor Anil Rajvanshi, "It will be the first university to use such a pollution free cycle rickshaw."

Christened 'MAPRA', which stands for Motor-Assisted Pedal Rickshaw, it is the creation of Anil Rajvanshi of the Nimbkar Agricultural Research Institute (NARI) situated at Phaltan, Satara.

On January 23, Pune University's 95th convocation, five MAPRAs will be introduced in the UoP by the Andhra Pradesh Governor, C Rangarajan.

If implemented, this project will be the second of its kind to be introduced in the university. The first experiment was conducted during the Indian Science Congress (ISC), 2000, when two battery-operated 'Vikrams' were introduced in the University.

"The 'Vikram', manufactured by a Lucknow-based company named Scooters India Limited, could carry six passengers and were used to ply visitors to the ISC from one point to another within the University," says Bhushan Patwardhan, Director, School of Health Sciences, University of Pune.

This time around, it is the two-seater modified cycle-rickshaw which will soon be seen shuttling within the UoP. To be introduced for an initial trial period of one year, it's future and more long-term use will be decided once its feasibility can be determined.



Anil Rajvanshi with his battery operated modified cycle rickshaw, MAPRA, which is to be introduced in the Pune University on January 23, 2002. *Pic by Anand Chaini*

As Patwardhan says, "A vehicle-free campus at the UoP has always been a fond dream, and we have been experimenting with different battery-operated vehicles."

Explaining the functioning of MAPRA, Rajvanshi says, "MAPRA is basically an improvised cycle rickshaw with three gears and a small battery driven motor. It can cover upto 40 kilometers in before the battery has to be recharged."

He adds, "The working is simple. The pedal and the motor work in such a way as to ease the load on the rickshaw driver. A switch cuts off the circuit when the motor draws more than the predetermined current. This, however, means that the driver has to keep pedalling continuously."

While only the coming year will tell how successful MAPRA will be, students at the University are thrilled about the upcoming project. Says University student Mukta Kumtekar, "I am a regular at the University of Pune and the battery-operated cycle rickshaw seems to be a great alternative to the auto rickshaws. Rickshaw drivers, at present, take undue advantage of students by charging more than the meter reading. With no alternative conveyance available, we students are forced to pay extra."

Though there are PMT buses which go right through the university, due to limited frequency, students have to resort to auto rickshaws.

"The auto rickshaws have a share scheme, but even that comes to much more than normal. In such a situation, the modified cycle rickshaw is a welcome change," says Archana Nirwan, another student.

The modified cycle rickshaws developed at NARI by Rajvanshi come in three varieties, one of them being MAPRA.

Rajvanshi, who is also a Jamnalal Bajaj Foundation award winner, says, "Five MAPRAs have been provided free of cost to the University of Pune on a trial basis and each will seat two passengers."

The MAPRA, which weighs about 129 kgs, costs Rs 25,000.

"In future, with an increased demand we are hoping to reduce the cost to about Rs 20,000," says Rajvanshi. Though auto rickshaws have not been completely banned at the University, with the introduction of the MAPRA, a definite reduction in the number of auto rickshaws is what the University is hoping for.

■ MEERA KAUP

Starting trouble for 'green' rickshaw

THE university failed to introduce eco-friendly motorised rickshaws on its campus on convocation day, as it had announced earlier with much fanfare.

University officials conceded that even before their launch, the batteries of the three-speed gear rickshaws had developed a snag. "As per the agreement with the Nimbalkar Agricultural Research Institute, Phaltan - which makes the rickshaw - it was supposed to be fitted with solar batteries. Since they failed to do so, regular auto batteries were used," the sources said, adding that the trial runs were still in progress. "Unless we are completely sure, we cannot put them on the roads."

Neither Dr Kolaskar nor Anil K. Rajvanshi of NARI was available for comment.

Verdant campus finally gets its green rickshaws

Times News Service

PUNE: If you suddenly see an old fashioned cycle rickshaw coming towards you in the University of Pune campus, don't fall over in disbelief. With a little help from modern technology, this clean and green form of transport is all set to convey students up and down the extensive campus.

The motor-assisted cycle rickshaws were inaugurated at the university by Madhur Bajaj vice-chairman of Bajaj Auto Limited on the foundation day of the university on Sunday. Designed by Jamnalal Bajaj Award winner Dr Anil K. Rajvanshi, director of the Nimbkar Agricultural Research Institute (NARI) at Phaltan in Satara district, they will run on a trial basis for one year. A contractor will maintain the rickshaws and ferry passengers from the university entrance to the main building for Rs 2 per person. "The idea is to cut down on the number of vehicles plying within the campus, and consequently lower the level of air pollution," said vice chancellor Dr Ashok Kolaskar.

Earlier in the day, the university gave away excellence awards announced on Friday. Pune-based Nowrosjee Wadia College of Arts and Science won the first prize for the best college (urban) and its lecturer in physics, Dr Farad Surve won the innovative teaching award. P V P College of Arts, Science and Commerce at Pravaranagar in Ahmadnagar district won the best college prize in the rural catgory and its reader in botany Dr Subhas M. Karande got the best teacher award. Dr Meera Kulkarni, lecturer at the Institute of Management Studies, Career, Development and Research, Ahmednagar won the second prize in the innovation in teaching category.



(From left) Industrialist Madhur Bajaj, inventor Anil Rajvanshi and Ashok Kolaskar hop on-board the first eco-friendly rickshaw.

Dr Kolaskar announced that the Bank of Maharashtra has sanctioned a one-time grant of Rs 25 lakh to the university to establish an independent energy study centre at its school of energy studies. The centre will be dedicated to study various aspects of non-conventional energy.

SPECIAL REPORT

Battery-run cycle rickshaws provide cheap, easy transport from university gate to main building

Eco-friendly carriers run high on popularity at UoP

PREETI RAGHUNATH
MARCH 18

SHALAKA Joshi never understood Keats better. An endless wait for the bus to the English department or a nasty haggle with the *autowallah* hardly left her with any enthusiasm for the nuances of poetry once she reached class. Today, she simply hails a cycle rickshaw at the gates of the Pune University and enjoys the ride with lines by Keats.

Barely two months into the launch of the motor-assisted pedal rickshaws (MAPRA) service on the Pune University campus, the response has been tremendous. Plying from the main gate to the university Main Building, the



users of this service are mainly students. Donated and developed by Nimbkar Agricultural Research Institute (NARI) at Phaltan, the five cycle rickshaws can run up to 50 km once the battery is charged. From 7.30 am to 7.30 pm, these rickshaws seat two passengers and charge Rs. 2 per person.

The facility has brought about the much-needed difference for visitors and students alike. Says Mansi Deodhar: "No more do I have to wait for buses, the frequency of which is quite bad. Now, every 15 minutes I get a cycle rickshaw."

The rickshaw seems to suit every student's pocket. For Rajesh Jadhav "the bus costs Rs 2.50 but these cycle rickshaws charge only Rs 2. It's just a matter of 0.50 paise, but I'm not financially well off and it's a real boon."

Tired of being harassed by unscrupulous autorickshaw drivers, the cycle rickshaw comes as a welcome change. "I'm travelling by these cycle rickshaws for the first time, I think it is great and more should be introduced," says a parent, M R Deshmukh. Anwant Jadhav, a cycle rickshaw driver says, "Getting passengers is no problem, in fact, they are always saying how thankful they are for this service."

House manager of Pune University Bhuke Pude says, "The best thing about these cycle rickshaws are that they are environment friendly since they run on battery."

Now, students could well start their day with an airy trip before settling down to Calculus.

The Indian Express - Pune Newsline, Thursday, March 19, 2002

'Government incentives are not attractive'

Project Manager - Mumbai - May 2002

– Dr Anil K. Rajvanshi, Director, Nimbkar Agricultural Research Institute



DR ANIL K. RAJVANSHI HAS BEEN the director of NARI since 1981. Dr Rajvanshi, a B.Tech and M.Tech from IIT-Kanpur and a PhD in mechanical engineering with specialisation in solar energy from the University of Florida, Gainesville, US, has won numerous accolades for his work in rural development. NARI is a registered trust and does pioneering work in the areas of agriculture, renewable energy, animal husbandry and sustainable development.

Excerpts from an interview:

In your opinion, is the capacity addition target set for the 10th plan for solar power (155 mw) and biomass power (1,000 mw) achievable?

The 10th Plan targets are achievable provided the Government of India shows the political will and is serious about renewable energy. When the political leadership is firefighting most of the time it is very difficult for them to focus on issues which will be beneficial to the country.

Are the incentives offered by the government sufficient to attract investments in this sector?

The incentives provided by the government are not very attractive enough. The rates of interest are high and in quite a number of cases the state electricity commissions are not giving proper tariffs to the electricity generated by renewable energy.

What additional steps should the government take to popularise non-conventional energy sources?

The most important steps that GoI can take will be:

- To make sure that ERCs fix proper tariffs (as laid by MNES) for all renewable energy projects
- To make available soft loans from the banks
- To help set up a venture capital fund for renewable energy
- To allow third party sale of electricity generated by renewable energy
- To accelerate and fund generously R&D in renewable energy.

Are any impediments hampering the growth of this sector in the country?

The major impediments are, one, lack of soft loans and tax incentives so that an entrepreneur can make reasonable rate of return and, two, unavailability of venture capital fund.

SWEET ALCHEMY



A special hybrid of sweet sorghum has been developed as a more economical alternative to sugarcane, for quality jaggery. Dr Anil K. Rajvanshi elaborates

Innovation is the key to making Indian agriculture vibrant, productive and efficient. The need of the hour is to diversify and move away from traditional crops and look for cheaper and better alternatives. The Nimbkar Agricultural Research Institute (NARI), Phaltan, has developed a hybrid sweet sorghum variety, Madhura, which could provide the raw material for producing high quality jaggery and syrup. Scientists of the institute have also worked out detailed protocols for processing the sorghum and to study its cost benefits, along with an economic analysis and future R&D plans.

Jaggery is a preferred food item for cooking and other uses in a large number of households in both rural and urban areas of India. Besides, it is more nutritious than white sugar. Jaggery and *khandsari* production is a Rs 3,000 crore industry and provides employment to about 2.5 million people in rural areas. About 40 per cent of the total sugarcane produced in India is diverted towards jaggery and *khandsari* production, because farmers can get instant cash by selling jaggery in the open market. Selling their cane to sugar factories is not as profitable, as the farmers are paid in instalments, sometimes even after 2-3 years! The price realisation in selling to sugar factories is also lower, since harvesting is often delayed due to labour problems, particularly in Maharashtra, resulting in reduced weight of the cane.

NEED FOR ALTERNATIVES

However, there are quite a number of problems in the jaggery industry. First, since sugarcane harvesting, and hence jaggery-making, is seasonal, the "gurhals" only operate for 3-5 months in a year, which makes them uneconomical. Thus, to facilitate year-round operation, there is a need to have alternative feedstock to supplement the sugarcane season. Second, cane, at present the only feedstock for jaggery-making, is an 18-month crop, which notoriously guzzles water, requiring about 30 irrigations a year. With perennial water shortages, an urgent need arises to find an alternative feedstock for jaggery-making. Third, in Madhya Pradesh and parts of Maharashtra, jaggery-making is not allowed within 15-20 kms of a sugar factory. Probably this was intended to prevent any large-scale diversion of cane from sugar factories. This problem could be solved by an alternative feed stock for jaggery, which can be grown in the area and will not pose a threat to sugar

Table I: Characteristics of sugarcane and sweet sorghum juice

Parameter	Sugarcane (Co 740)	Sweet sorghum (Madhura)
pH	5.8-6.4	4.7-5.5
Brix (degrees)	16-22	12-21
Sucrose (%, w/v)	13-18	10-15
Reducing sugar (RS) (%, w/v)	0.2-1.0	0.75-3.0
Starch (%, w/v)	0.001-0.05	0.02-0.22
Aconitic acid (%, w/v)	0.01-0.03	0.08-0.56
Minerals (%, w/v)	0.4-0.7	0.4-0.5

factories. Fourth, the furnaces used in "gurhals" are antiquated and work on the principle of free convection combustion. The result is poor thermal efficiency, 10-15 per cent, due to which, these "gurhals" have to use wood, or tyres to supplement bagasse as fuel. Besides, this low efficiency also results in tremendous smoke and fly-ash in the flue gases, thereby increasing local pollution.

THE PROPERTIES

Sweet sorghum has properties that would make it an alternative feedstock for jaggery production. Sweet sorghum, or Sorghum bicolor (L.) Moench, is a multi-purpose crop, which provides grain from its earhead and sugar from its stalk. The bagasse is an excellent fodder for animals. Moreover, sweet sorghum thrives in a wide range of climatic and soil conditions. It is a short duration crop, maturing in 120-140 days (as compared to 12 to 18 months for sugarcane) and requires much less water than sugarcane. These characteristics make it an ideal crop for jaggery and syrup production. Sugarcane syrup (or "Kakvi" in Marathi) is commonly used as a liquid sweetener in rural and urban Maharashtra and in some parts of UP. Hence sweet sorghum syrup can be an attractive marketable product.

The yearly production of jaggery from the hybrid variety 'Madhura' is 3-6.4 tonnes per hectare. NARI's scientists have presented a pioneering effort at developing both a technology for production of jaggery and syrup from sweet sorghum and for an efficient gasifier-powered furnace run on biomass residues. These residues, like sugarcane leaves and bagasse, produce a high quality flame, which is pollution free.

THE BREEDING

The breeding programme for sweet sorghum at NARI, begun in the late 1970s, has resulted in the development of about 38 varieties and 4 hybrids of the crop. The NARI hybrids contain maximum sucrose at grain maturity. Thus, both the grain and sugars are obtained simultaneously, making sweet sorghum a multipurpose crop. The hybrid "Madhura" was found to be best suited to jaggery and syrup production. The brix and sucrose level in the juice of this hybrid closely approaches that of sugarcane. Table 1 compares the juice characteristics of sugarcane cultivar Co 740 (a variety normally used in jaggery-making) and "Madhura" sweet sorghum.

Jaggery and syrup recovery strongly depend on the crushing equipment. The 3-roller crusher used at NARI yields only 40-50 per cent extraction. There is a great need to develop efficient crushers with yields approaching the extraction percentages found in sugar factories. This can enhance jaggery recovery by 30-40 per cent.

Table 2: Agronomic practices for growing "Madhura" for jaggery and syrup production

Planting date	April-May	Mid November -Mid January
Duration of crop, (days)	110-120	120-130
Seed rate, (kg/ha)	7.5 to 10	7.5 to 10
Plant density	1.5 to 2 lakh plants/ha; spacing 45 cm between rows and 15-20 cm. between plants	
Fertiliser dose, (kg/ha)	N:P:K: (100:50:50) at planting and N (50)one month after planting	
Irrigation number	4-6	8-10
Irrigation interval, (days)	8-10	13-15



Shorgum fields

Courtesy: NARI

THE AGRONOMY

In general, agronomic practices for sweet sorghum are similar to those for grain sorghum, and are outlined in Table 2 for irrigated conditions at the NARI farms in Phaltan.

It is evident that good jaggery can only be made when this hybrid is planted during the months mentioned in Table 2.

Interestingly, the usual season for jaggery-making from sugarcane in Maharashtra is from October-end to March. Thus, with sweet sorghum as a supplementary raw material, the "gurhal" can be run almost year round, thereby significantly improving utilisation. "Madhura" is an excellent fodder crop and can also be planted in the winter season (1-15 October) for grain and fodder purposes. However, as the usual planting dates for sorghum during monsoon and summer are 15 June-15 July and 1-28 February respectively, planting for jaggery production will have to be undertaken on a large-scale, so as to minimise grain damage by birds during these slightly off-season plantings.



Shorgum-making in process

TO FACILITATE YEAR-ROUND OPERATION, THERE IS A NEED TO HAVE ALTERNATIVE FEEDSTOCK TO SUPPLEMENT THE SUGARCANE SEASON

PROTOCOL FOR JAGGERY AND SYRUP-MAKING

It is evident from Table 1 that the sweet sorghum juice characteristics are different from those of sugarcane juice. The regular sugarcane jaggery protocol resulted in sweet sorghum jaggery of unacceptable colour and texture. Hence there was a need to develop a protocol for making jaggery and syrup from sweet sorghum. Experiments were conducted to study in detail the effect of each juice and process parameter on jaggery production. About 560 samples were produced during different seasons to study their effect. Jaggery quality was ascertained by standard organoleptic tests for colour, texture and taste. Briefly, the parameters tested are given below.

JUICE PARAMETERS

Excellent jaggery could be made when the brix of juice was greater than 15 degrees and when the ratio of sucrose to reducing sugars (Su/RS) was greater than nine. Starch and aconitic acid normally present in sweet sorghum juice did not affect the jaggery quality.

Good quality syrup could be made when brix of raw juice was greater than 14 degrees. No chemicals were added either for jaggery or syrup-making. This is in marked contrast to the manufacture of cane jaggery where various chemicals are added mainly to improve the colour of jaggery.

PROCESS PARAMETERS

Experiments conducted on various parameters like boiling rate, scum removal, striking point, etc. resulted in the following recommendations for jaggery production:

- Maximum scum removal (13-15 per cent (w/w of juice) took place when the boiling was achieved within 10-15 minutes. No external flocculent or clarificant was required. It should be emphasised that proper scum removal is the most important parameter in jaggery production from sweet sorghum.
- Best quality jaggery was made when the striking point was between 114-116 degrees Celsius.
- Excellent jaggery crystallisation took place when the cooling time of the heated mass was between 7-10 minutes. Due to lower Su/RS in sweet sorghum as compared to that in sugar cane, more vigorous working of the concentrated mass is required during the cooling period for better colour and quality in the jaggery.
- Jaggery produced in aluminium utensils ("kadhai") had a better colour than that made in M.S. vessels.

Following the above protocol, excellent syrup with good colour and consistency was made when the final brix reached 70-75 degrees (corresponding to a syrup temperature of ~105 degrees Celsius).

SHELF LIFE OF JAGGERY AND SYRUP

Sweet sorghum jaggery was stored using the protocol for sugarcane jaggery storage. It was found that the shelf life of sweet sorghum jaggery is similar to that of sugarcane. However, in storage of syrup, there is a possibility of partial crystallisation and mould formation due to fungal attack. In order to prolong the shelf life of sweet sorghum syrup, various procedures like storage of stalks for conversion of sucrose, to reducing sugars, etc. were studied. Eventually a protocol was developed which prolonged shelf life to more than three months. Efforts are underway to study other factors so that shelf life can be prolonged further.

It is also tempting to suggest that besides jaggery production, sweet sorghum can also be used as a feedstock for sugar production. Thus the sugar factories can run year-round with NARI variety "Madhura" as a supplementary feedstock. This could make it possible to further improve the economy of sugar factories. Another technology pioneered by NARI is the production of ethanol from sweet sorghum. Thus sweet sorghum being a multi-product crop, it is very attractive from the farmers' point of view.

BIOMASS RESIDUE GASIFIER FOR JAGGERY FURNACE

A major improvement in jaggery-making can be effected by improving furnace efficiency. Existing furnaces are normally very inefficient with 10-15 per cent overall efficiency. A major program for development of a furnace coupled to a low-density biomass

Table3: Assumptions made for economic analysis of jaggery and syrup from sweet sorghum

Basis: one tonne of sweet sorghum stalks/batch.

A. Gasifier system		
1. Gasifier cost (Net output: 309 kW), Rs	:	5,00,000
2. Gurhal cost (including crusher, pan and furnace), Rs	:	70,000
3. Operating life, years	:	10
4. Discount rate, % pa	:	20
5. Operation and maintenance cost (including replacement cost of materials, labour for operating the gasifier etc), Rs/batch	:	115
6. Char production, w/w of input fuel	:	0.20
7. Net profit from char briquettes, Rs/kg	:	0.50
8. Fuel required, kg/batch		
: Bagasse 250	:	300
: Leaves 50		
B. Sweet sorghum		
1. Recovery, % (w/w) of stalks		
: Jaggery	:	5-8
: Syrup	:	9-12
2. Bagasse availability w/w of stripped stalks, (dry)	:	0.25
3. Leaves availability w/w of stripped stalks, (dry)	:	0.05
4. Total (bagasse + leaves) availability, kg/batch	:	300
5. Sweet sorghum cost, Rs/tonne of stripped stalks	:	100-600
C. "Gurhal"		
1. Wage bill (including 1 supervisor and 7 labourers), Rs/batch	:	120
2. Diesel and other utilities cost, Rs/batch	:	40
3. Number of batches/year, N	:	900-1800

gasifier was therefore initiated at NARI. This is a multifuel gasifier, which can run on sweet sorghum bagasse, sugarcane leaves, wheat husk, grasses etc. This pilot gasification plant is of 100 kW (thermal) capacity and produces about 15-20 kg of jaggery per batch. The advantages of this gasifier over a conventional furnace are:

- Being fully automated, it does away with the drudgery of continuous manual feeding of bagasse.
- It produces a bluish white flame with flame temperatures in excess of 1250 degrees Celsius. Hence the system is environmentally very clean and smokeless.
- The overall efficiency (biomass to useful heat) of the system is 20-27 per cent. This is much higher than that of existing furnaces.
- The gasification system produces 'char' as a by-product. Mixed with a suitable binder, like cow dung, it makes excellent smokeless fuel briquettes for *chulhas*. Besides, preliminary results indicate that this char also acts as a soil conditioner.



Courtesy: NARI

The gasification system can also be used to run a diesel engine or genset and thus the gasifier-powered jaggery unit has the potential to be energy self-sufficient, where the same gasifier can power the crusher and jaggery unit.

Economic analysis

A simple economic analysis for jaggery and syrup from sweet sorghum was carried out. Since both syrup and jaggery-making are batch processes, the costing was done for processing of one tonne of stripped sweet sorghum stalk per batch. The major assumptions made are given in Table 3.

It was seen that all the bagasse and leaves generated from the stalks were sufficient to make jaggery or syrup from the same stalks. Thus, the 'gurhal' is self sufficient in fuel.

The results of the study showed that jaggery or syrup recovery and the number of batches made per year greatly affect the cost of production. Using efficient crushers can ensure higher recovery. Besides, 1800 batches/year are possible by using sweet sorghum and sugarcane as complementary raw materials as was outlined earlier. In this case, the cost of jaggery (assuming 8 per cent recovery) comes to Rs 6.80 per kg at a sweet sorghum cost of Rs 200 per tonne. The corresponding syrup cost comes to Rs 4.56 per kg assuming a recovery of 12 per cent on stalk basis.

The technology for producing jaggery and syrup from sweet sorghum and supply of "Madhura" seed is available for commercialisation from NARI.

THE AUTHOR, AN M TECH FROM IIT KANPUR AND PHD FROM UNIVERSITY OF FLORIDA, IS DIRECTOR, NIMBKAR AGRICULTURE RESEARCH INSTITUTE, PHALTAN

Green rickshaws pedal to workshop

Times of India - Pune - 18.08.2002

TIMES NEWS NETWORK

Pune: The much-hyped eco-friendly drive of the University of Pune has finally taken a back seat with all the five motor-assisted pedal rickshaws (Mapras) lying in the workshop for over 15 days now.

While sources at the workshop said that the rickshaws were under maintenance, and would require another 15 days to become operational again, the designer of the rickshaws and Jamnalal Bajaj awardee Dr Anil K. Rajvanshi said that there was absolutely no mechanical fault with them.

According to Rajvanshi, who is the director of the Nimbkar Agricultural Research Institute (Nari) at Phaltan in Satara district, the real problem is, however, with the attitude of the university authorities in running the environmentally-sound rickshaws. "It is the contractor who had failed to pay the dues to the rickshaw- pullers for three months, as a result the latter had stopped plying them," he added.

"When it was decided that the university will run the rickshaws for a year, on a trial basis, how can they be at the workshop for 15 days," he asked, expressing anguish at being totally kept in the dark.

"This is in gross violation of the agreement signed between us and the university, where the latter had said it would furnish all

relevant data regarding details of any problems encountered in running and other technical details," he said. Rajvanshi said that his technicians had, over a dozen times, carried out minor repairs, which otherwise is the university's responsibility. "And we are not charging a single paisa for the services apart from giving the rickshaws free-of-cost." "We've given them enough time but now, I think the matter needs to be taken up seriously," he said.

It was on February 10 this year — the university's foundation day — that vice-chancellor Ashok Kolaskar along with industrialist Madhur Bajaj put the rickshaws on the campus amidst much fanfare. Kolaskar had then told TNN that the main purpose was to decimate the level of pollution within the campus, besides reducing the number of vehicles and keeping the campus as clean as possible.

The V-C had even claimed that if the desired results were yielded during the trial period, more such rickshaws would be introduced and space created near the main entrance so that people may park their vehicles there and travel by the rickshaws.

One basic problem, according to Rajvanshi, is the over dependence of the rickshaw-pullers on the motors fitted on the rickshaws. "They were supposed to pedal the rickshaw for some distance and then switch on the motor which they didn't," he said, adding, this resulted in the breakdown of certain components. "This wasn't, however, any fault in the technology."

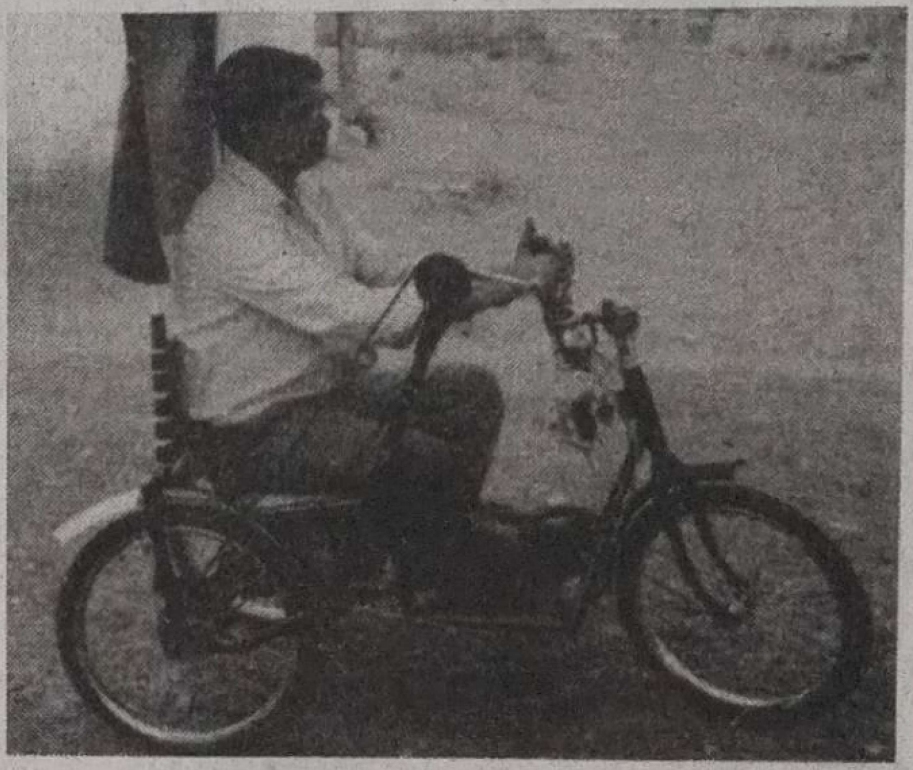
Although Kolaskar was not available for comment, Rajvanshi said that he has already taken up the matter with the former. "The V-C has agreed to look into the matter," he said.

Motor-assisted wheelchair to the aid of handicapped

Indian Express - Pune - 05.09.2002

EXPRESS NEWS SERVICE

SEPTEMBER 4



A LOW-PRICED wheelchair for the physically disabled is the latest product that Phaltan-based NGO Nimbkar Agricultural Research Institute (NARI), has developed. Called MANHARA (motor-assisted NARI handicapped rickshaw), this vehicle is powered by a small electric motor running on batteries, which helps the person to propel it to longer distances, said Dr. Anil K Rajvanshi, director, NARI.

"The idea came about when a Chandigarh resident asked if we could improvise on the motor-assisted pedal rickshaw developed earlier for his handicapped son," he said.

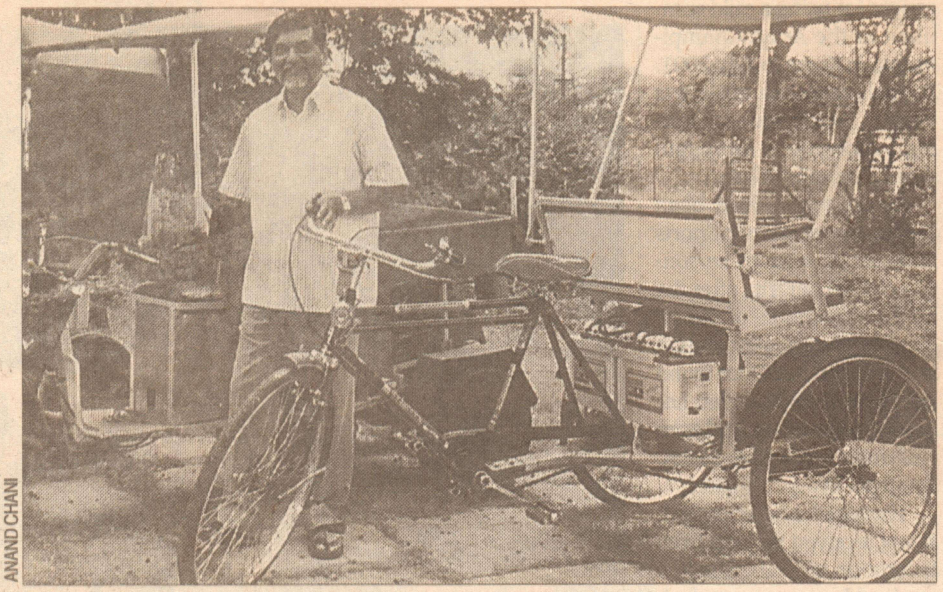
In one battery charge, MANHARA can run up to 20 km at a speed of 8-10 km/hr. This low-cost vehicle - it is expected to be priced at Rs 8,000 when mass produced - will be a boon to physically-handicapped who travel long distances, unlike currently available wheelchairs which are hand-powered, difficult to drive and fatiguing.

In MANHARA the motor assists the hand pedalling, it is easy to drive and is completely silent and comes with a hood to shade from the sun and a basket at the back. "There are close to 3-4 million physically handicapped persons in India who have capable hands but need a wheelchair for mobility. MANHARA will be a great blessing for them. Presently, a completely battery operated wheelchair costs between Rs 1 to 2 lakh and these have to be imported," Rajvanshi, winner of last year's Jamnalal Bajaj Award said.

The Cycle Rickshaw's Electric Dreams

SAMAR HALARNKAR
NEW DELHI
Sunday Express - 20.10.2002

Fitted with a battery and motor by grassroots inventors, the modified version may soon hit the Indian streets



ANAND CHANI

THIS is a story about a mode of transport that rarely figures with transport planners. Its technology is as old as your grandparents. Its finance is uncertain — this is not the territory of banks or financial institutions. This is also about one of those supreme Indian ironies: It's been nearly a year since this ingeniously redesigned Indian vehicle was exported to the United Kingdom. But the motor-assisted pedal rickshaw, or MAPRA, as its inventor calls it, just isn't finding Indian buyers.

In the geography of small-town India, the cycle rickshaw — with its extreme manoueverability and affordability — is king. Yet, not only are its drivers mostly paupers, they must also bear some of the worst physical burdens on our roads.

If all goes well, the government might lend a helping hand to Anil Rajvanshi, whose team of grassroots inventors fixed a battery and small motor to the humble cycle rickshaw. In its present antique form, this bucket of bolts provides a hard living to at least — there are no reliable records of their numbers — two million Indians. At present, the ministry of non-conventional energy resources is considering a proposal to seed 50 of Rajvanshi's revolutionary rickshaws in locations all over India. That includes areas in need of quiet like the sprawling campuses of the Indian Institute of Technology (IIT) and tourist spots that need non-polluting transport, like the world heritage site at Hampi, Karnataka.

"We are trying out these vehicles as an alternative for the future," says J.R. Meena, director in the ministry. "But speed, range and cost are all limitations today." Meena says the electric rick has an advantage over other battery operated vehicles — experimental autos and vans — in that it can be pedalled as well. For now, he doesn't see them as more than technology demonstrators.

NEWSPOSITIVE

In a study published in the latest issue of the journal *Current Science*, Rajvanshi, an IIT graduate and Phd from the University of Florida, positions the new electric rick against its polluting petrol and diesel cousins, whose noisy, inefficient engines have fouled the air of towns and cities nationwide.

Rajvanshi says the electric ricks can increase a rickshaw driver's present annual income of Rs 12,000 to Rs 18,000 — apart from easing their back-breaking labour. The vehicle treads the middle ground between an unaffordable all-electric runabout and the mechanical wrecks on the streets. The motor kicks in only when the rickshaw reaches a speed of 4.5 km per hour.

Rajvanshi's credentials are impeccable: he's a visiting professor at IIT Powai, and last year he became the only engineer to win the Jamnalal Bajaj award for application of technology for rural development. He's been a member of numerous state and central government expert committees on energy resources.

Cycle rickshaws have been the subject of numerous studies by economists, sociologists and engineers. But all of India's advances and engineering prowess hasn't helped change the cycle rickshaw fundamentally since a Jesuit priest welded a cycle wheel and pedals to the front of the hand-drawn rickshaw nearly 80 years ago.

Four of the electric ricks have been on trial at Pune University campus for the last nine months. But they haven't convinced those who matter most: the rickshaw overlords who control fleets of rickshaws nationwide. The rickshaw drive who see the little moto kicking in after some pe alling are greatly enthuse but simply don't have th resources to buy one.

"I haven't lost hope says Rajvanshi, who's als created a more efficie manual version (with gear improved suspension an braking) at his researc base in the town of Phalta 100 km southwest of Pun in the heart of Maharas tra's sugarcane country. H is trying to enthuse ric shaw drivers to start coo erative societies, which ca not just finance the ric shaw — they cost Rs 20,0 or four times the norm cost — but offer a source electricity to recharge th battery.

"I'm even ready with m own money to fund a coo erative society, to set up t initial process," says Ra vanshi, an inveterate inve tor who returned to India 1981 after a teaching sti at the University of Florid Gainsville. At Phalta Nimbalkar Agricultural R search Institute, where he the director, Rajvansh barefoot scientists have cr ated everything from mul fuel lanterns to improve safflower seeds.

Meanwhile, the Auto Gears Up for America

YES, you heard right. The sputtering Bajaj autorickshaw is closing in on a licence to run on the roads of sunny California. Once that happens, the Americas will be the latest staging ground for this Indian charmer, courtesy an American inventor and entrepreneur, Maurice Kanbar. Known in America as the maker of the second-best selling Skyy Vodka, Kanbar is a friend of Bajaj Auto CEO Rahul Bajaj.

Already more than 1,000 Bajaj scooters are running around on America's road. But the auto must first meet California's stringent emission standards, about the world's stiffest. If it does pass muster, perhaps some of the clean tech could be reverse engineered into its poorer Indian cousins?

Back to basics

Every* taluka *in India can meet its own food, water and energy needs



ANIL K RAJVANSHI

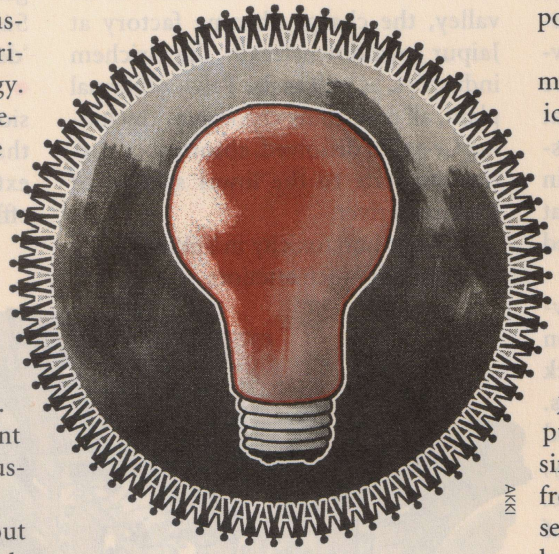
The energy situation in most developing countries is quite alarming. Energy production and distribution patterns in developing countries, including India, have been modelled on the 50 to 100 year old model of the Western countries, which includes centralised energy production, development of megacities at the expense of rural areas and the unsustainable husbanding of land. Agriculture is most dependent on energy. Lack of energy is, therefore, the single-most important reason for the decline of agriculture-based activity and, consequently, economic activity in rural areas. What is required, then, is a shift in energy policy. An attempt to improve the quality of life in rural areas through an alternative model based upon sustainable growth and renewable energy. Therefore, a *taluka*-based development model is proposed as the basis for sustainable rural societies.

India produces in its *talukas* about 400 million tonnes per year of agricultural residues, which can theoretically produce 53,000 megawatts (MW) of power through biomass-based power plants. This is 70 per cent of the total amount of power available in the country at present from all other sources. However, this agricultural residue is dispersed all over the country. We are, therefore, looking at decentralised power production systems.

Following this approach, an energy self-sufficient *taluka* model was developed by the Nimbkar Agricultural Research Institute (NARI) and adopted for Phaltan *taluka*. This study became the basis of a national policy on energy self-sufficient *talukas*, and was adopted by the government of India in 1996 (Task Force Report, ministry of non-conventional energy sources, government of India, New Delhi, March 1995).

The crux of the study is that a *taluka* provides the critical mass for production of agro-based and value-added products. Smart production facilities and improved technology, like gas-based microturbines and fuel cells, will further usher in an era of efficient small-scale manufacturing facilities. Technological issues, in fact, need to be tackled before the *taluka* model can become truly sustainable and self-sufficient in energy and food production.

In this context, transportation is a



AKKI

key issue. The Phaltan study showed that ethanol and pyrolysis oil production could take care of the demand for fast-moving vehicles, while also reducing emissions. An alternative to these vehicles are electric cycle-rickshaws. These can travel at about 60 kilometres an hour, and take up to three passengers.

A large number of *talukas* in various states have woefully inadequate water supply. Mega-irrigation projects have not helped the cause. It is perhaps time now to consider private, decentralised water utilities. This will include rainwater harvesting and treating and recycling used water. NARI has data, which shows that rainwater harvesting in Phaltan *taluka* can yield four to five times more water per year than the existing canal supply. The cost of water from such supply will come to one paisa per litre. A private utility could manage this better than the corrupt public system.

The third, equally important, issue is fertiliser production. The availability of organic fertilisers is important for maintaining the fertility and sustainability of land. With almost all agricultural residues taken for energy generation, the fertiliser issue could become critical. However, the NARI study showed that there is enough potential for making fertiliser from night soil and composting of weeds and vegetable waste. These materials could be composted in fast reactors.

At the end of the day, though, this model needs to be backed by strong policy. For one, the government must set up a '*taluka* development corporation' and invite private sector participation in setting up power and water utilities in the *taluka*. Secondly, the corporate sector will not only produce power and water, but will also be allowed to carry out its distribution. Most independent power projects have been bogged down by disputes regarding distribution. Besides, since power and water production is from renewable sources, the corporate sector involved in this programme must have the benefits available to renewable energy sources. Lastly, municipal corporations must allow only environmentally sound vehicles to ply within the town. The number of vehicles in a *taluka* is small, and it may be possible to manage this issue.

In a democratic society, sustainable *taluka* development will decentralise economic, and hence political, power. Decentralisation is India's best bet against economic deprivation, corruption and an unaccountable ruling elite. ■

Anil Rajvanshi is director of the Nimbkar Agricultural Research Institute, Phaltan, Maharashtra

Ficci award in rural development for Nimbkar institute

TIMES NEWS NETWORK

Pune: The Phaltan-based Nimbkar Agricultural Research Institute has been selected for the prestigious annual Ficci award for 2001-02 in recognition of institutional initiative in the field of rural development.



Rajvanshi

The award, which includes a shield and a certificate, will be presented to Nari director Anil Rajvanshi by Prime Minister Atal Bihari Vajpayee at Vigyan Bhawan, New Delhi, on Friday.

Rajvanshi, who is also the proud winner of the coveted Jamnalal Bajaj award for the year 2001, told TNN that the award is a recognition of his institute's initiatives in carrying out research and development in agriculture, renewable energy resources and animal husbandry.

Known for developing and designing Noori, a multi-fuel lantern which produces a light output of 100 watt light bulb running on ethanol, diesel or kerosene, and can also be doubled as a cooking stove, the institute has also recognition for developing a battery-powered cycle rickshaw.

Rajvanshi, who has a master's degree in mechanical engineering from the Indian Institute of Technology at Kanpur and a doctorate on solar energy from University of Florida, Gainsville, came back to India with his wife, Nandini, in 1981, and joined the institute with a view to propagate sustainable development through the use of modern science and technology, tempered by ancient Indian thought.

Safflower rediscovered



Though Safflower flowers find mention in of Ayurveda and in European and Japanese pharmacopoeias, the interest in this crop has been rekindled in the last few years, says Dr Nandini Nimbkar



Safflower, *Carthamus tinctorius L.* is a thistle-like herb belonging to the family Asteraceae or Compositae. It is one of humanity's oldest crops cultivated in India mainly for oil from the seeds and a reddish dye from the flowers. Nonetheless, it has mainly remained a minor crop grown on small plots for the growers' personal use. Though, safflower flowers have been used in preparations of ayurvedic medicines in India and also merit mention in European and Japanese pharmacopoeias, the interest in this crop has been rekindled in the last few years as the medicinal use of these flowers in China has become more widely known. China has a significant area under safflower plantation, but it is grown almost exclusively for its flowers, which are harvested for use in traditional medicines, and the production is not included in international crop estimate reports. Safflower flowers are used in China for the treatment of many illnesses as well as in 'tonic tea'.

Production in India

India is the largest producer of safflower (2.0 lakh

tonnes) in the world with highest acreage (4.3 lakh hectares) but with an average productivity of only 465 kg/ha. Poor crop management under input-starved conditions is the most important reason for such low per hectare yields. It is mainly grown in Maharashtra, Karnataka and parts of Andhra Pradesh, Madhya Pradesh, Orissa, Bihar, etc. Maharashtra and Karnataka are the two most important safflower growing states accounting for 72 and 23 per cent of area and 63 and 35 per cent of production, respectively.

Safflower is now mainly grown in India for its much-valued edible oil. Safflower produces oil rich in polyunsaturated fatty acids (linoleic acid 78 per cent), which play an important role in reducing blood cholesterol level and is considered as a healthy cooking medium. Safflower oil is suitable where high level of stability at low temperature is required as in frozen desserts. It is also used in infant foods and liquid nutrition formulations.

The safflower crop is usually grown in the rabi or winter season from October/November to March/April, generally as an intercrop with cereals such as wheat and sorghum. It is one of the most important crops for marginal farmers. Traditionally it is grown as a rain-fed crop on residual soil moisture. However, research carried out at the Nimbkar Agricultural Research Institute (NARI) at Phaltan during the 1960s showed that safflower has a potential to produce as much as 4.0 tonnes/ha seed yield under irrigated conditions. NARI became the first centre for irrigated safflower research under the All India Co-ordinated Research Project on Oilseeds in 1975. It was shown that just one or two irrigations given to safflower crop at the critical growth stages could boost its seed yield by as much as 50 per cent.

NARI was also a pioneer in starting safflower hybrid development in India. The first non-spiny hybrid in India NARI-NH-1 (PH-6) was developed at NARI and released in 2001. Efforts to popularise safflower flowers as herbal tea in India were also pioneered at NARI. Their use for medicinal purposes is steadily increasing and this is expected to help farmers get increased remuneration from their crop.

Conditions for Cultivation

Although safflower has gained the reputation of being a drought-resistant crop, it is basically true only as far as its dependence on rainfall is concerned. With its deep taproot capable of penetrating to a depth of 2-3 metre, it can draw moisture from deep in the subsoil from levels not available to a majority of crops. Although grown without irrigation over the major portion of its range, as a large-scale commercial crop highest yields are obtained only under some type of irrigation. The crop may use considerable amounts of soil moisture, but it cannot survive standing water for even a few hours in warm weather.



Battery-operated flower collector being operated in the field.

The "allergy" which safflower has to "wet feet" is partly due to the rapid spread of soil borne pathogens such as Fusarium, but also because anaerobic conditions cause plant death very quickly. Excess rainfall, especially after flowering begins, contributes to a vast array of leaf and capitulum's diseases, which reduce yields and can cause a substantial crop loss. Well-drained, deep, fertile, sandy loam soils support maximum safflower yields. In heavy clay soils, crusting may reduce emergence of seedlings and higher than normal seed rates may be needed.

The safflower plant yields several products. Some of the important ones are:

Safflower seed oil: Around the world, safflower is mainly grown for its edible oil, which can be used, for cooking and in preparation of mayonnaise, salad oil and margarine. Safflower oil has the highest ratio of polyunsaturated/saturated fatty acids of any oil available. It has been observed on administration to patients with 'Hypercholesterolemia', the unsaturated fatty acids of safflower lower the serum cholesterol level. This effect is variable and not discernible in patients with normal or near normal cholesterol levels, nor does it occur unless the total fatty acid intake is reduced. Though clinical value of safflower oil is still considered to be incompletely proven, there is a considerable health food market for safflower oil, especially in North America, Germany and Japan.

Oil levels in the seed ranging from 10 to 50 per

Field of NARI-NH-1 in flowering stage at NARI, Phaltan



cent have been reported from around the world for safflower. The commercialisation of safflower in the 1950s was driven, in part, by the paint and varnish industry. The oil's properties contribute to unsurpassed quality in paints, alkyd resins and coatings. However, less costly petroleum products and a shift to water-based paints have limited their use.

Safflower dye: Until this century, when cheaper aniline dyes became available, safflower was mainly grown for dye. The water-soluble yellow dye, carthamidin, and a water-insoluble red dye, carthamin, which is readily soluble in alkali, can be obtained from safflower florets. Dye manufacture has virtually ceased in Asia, but dye is still prepared on a small-scale for traditional and religious occasions. Carthamin is found in the florets to the extent of 0.3-0.6 per cent and imparts a bright red colour to cotton and silk fabric. In order to get a better colouring effect from carthamin, the yellow colour first has to be separated from it. For extracting the dye, fully-grown flower heads are collected every second or third day before they fade. They are then dried in the shade. Florets can be collected, after the crop ripens, so that dye and oilseed can be obtained from the same crop. Colouring 1 kg of cotton yarn crimson requires 1 kg of dye, rose pink requires 500 gm, and light pink, 250 gm. There is currently in many countries a reaction against the use of chemicals for colouring of yarn, with an increased use of naturally coloured cotton. This has also resulted in a small revival for safflower dyes.

Safflower cake: The meal left after oil extraction from the decorticated seed is used for animal feed, while that obtained from un-decorticated seeds is used for manure. The cake contains about 7.9 per cent nitrogen, 1.9 per cent potash and 2.2 per cent phosphoric acid and its application as manure is supposed to greatly improve the physical properties of heavy soils. Although cattle apparently find safflower cake palatable, its bitter taste maker it unacceptable to humans. Protein isolates prepared from debittered meal can be used to fortify bread, pasta and nutritional drinks. Only lysine is limiting, while methionine and isoleucine are borderline.

Safflower vegetable and fodder: The tender leaves, shoots and thinnings of safflower are valued as pot-herb and salad. They are high in vitamin A, iron, phosphorus and calcium. Bundles of young seedlings are commonly sold as a green vegetable in markets in India and some neighbouring countries.

Safflower can be grazed or stored as hay or silage. The forage is palatable and its feed value and yields are similar to or better than those for oats or alfalfa. Tests have shown that fairly good seed production from a ratoon crop is possible by cutting at about 3-4 cm above ground at 30-45 days after planting in crops planted before the end of September.

Safflower food colour: Addition of safflower florets to food is a widespread and ancient tradition. Health concerns regarding synthetic food colourants has increased interest in safflower-derived food colouring in recent times. Carthamin is the only chalkone-type pigment suggested for colouring foods. It finds use in colouring cakes, biscuits, butter, ice cream, rice, soup, sauces, bread and pickles, yellow to bright orange. Both safflower yellow and carthamin can be used as

Table 1 : Performance of released safflower varieties and hybrids developed at NARI in comparison with the checks

Variety / hybrid	Seed yield (kg/ha)	per cent increase over check	Oil yield (kg/ha)	per cent increase over check	Flower yield (kg/ha)	per cent increase over check
Nira (NRS-209)	1,576	17.19 (Bhima)	512	26.93	–	–
NARI-6	1,024	16.8 (JSI-7)	304	25.97 (JSI-7)	125	20 (JSI-7)
NARI-NH-1 (PH-6)	1,936	11.36 (A-1)	628	30.74 (A-1)	192	118.18 (JSI-7)

Table 2 : Characteristics of released safflower varieties and hybrids developed at NARI in comparison with the checks

Sr. No	Variety / hybrid	Year of release	Average seed yield (kg/ha)	Oil content (per cent)	Reaction to diseases and pests	Days to maturity
1	Nira (NRS-209)	1986	1,576	31.5	–	130
2	NARI-6	2000	1,024	35	Tolerant to alternaria and cercospora	137
3	NARI-NH-1 (PH-6)	2001	1,936	35	Moderately resistant to cercospora and wilt and tolerant to alternaria and aphids	140
4	A-1 (National check)	1969	1,716	30	–	128
5	Bhima (Local check)	1982	1,305	30	–	135
6	JSI-7 (Non-spiny check)	1990	852	30	–	175-180

non-toxic food colourants. True saffron, which is probably the world's costliest spice, is quite commonly substituted or adulterated with safflower florets due to the similarity in their appearance.

Safflower medicine: In India flowers of safflower are regarded as stimulant, sedative and as a promoter of menstrual discharge. In large doses, they are laxative. In China, safflower is grown almost exclusively for its flowers, which are used in treatment of many illnesses as well as in 'tonic tea'. The main active ingredient in safflower medicines is safflower yellow, which is water-soluble, but alcohol extracts are used in some preparations. Many clinical and laboratory studies support the use of safflower medicines for menstrual problems, cardiovascular disease and pain and swelling associated with trauma. Safflower yellow is present in the dried florets to the extent of 26-36 per cent.

Research on safflower at the Nimbkar Agricultural Research Institute (NARI) commenced in mid-1960s even before the institute was officially registered in 1968. The safflower research and development at NARI during last 35 years has been devoted to developing suitable agro-production technologies and varieties and hybrids for limited irrigation situations.

Development of Varieties

The major emphasis of the variety improvement programme at NARI is on developing varieties with enhanced oil and seed yield and better tolerance to pests and diseases in addition to responsiveness to limited irrigation. The following cultivars developed at NARI have been released by the government for commercial cultivation (Tables 1 and 2).

Nira (NRS-209): Nira was released for cultivation under protective irrigation in the state of Maharashtra during 1986. It is a spiny cultivar and gives about 17 per cent higher seed yield than the safflower cultivar Bhima, which is the most widely cultivated safflower variety in the state. It gives seed yield of 15 to 18 q/ha under irrigation and 12 to 15 q/ha under rain-fed conditions. It contains 30-33 per cent oil in its seeds. Due to its earliness, it escapes pest infestation and hence is considered to be moderately tolerant to different pests.

NARI-6: This is a non-spiny cultivar released in 2,000 for cultivation in rain-fed areas of the country (Fig. 1). NARI-6 on an average produces a seed yield of 10 to 11 q/ha under rain-fed conditions. It contains 35 per cent oil in its seeds. It also yields 1 to 1.5 q flowers/ha. It possesses greater drought tolerance than the other cultivars, which are presently cultivated.

THE MAJOR EMPHASIS OF THE VARIETY IMPROVEMENT PROGRAMME AT NARI IS ON DEVELOPING VARIETIES WITH ENHANCED OIL AND SEED YIELD AND BETTER TOLERANCE TO PESTS AND DISEASES

Hybrid Development

NARI pioneered hybrid development in safflower in India during 1983-84. The preliminary evaluation of these hybrids based on genetic male sterility showed them to give 19 per cent higher seed yield than the national check A-1 in the multi-location trials of All India Co-ordinated Research Project on oilseeds. However, these hybrids could not be commercialised due to the undesirable characteristics of the genetic male sterile lines available. This led to the

Table 3 : Analysis of safflower flowers of NARI-NH-1

Sr. No.	Parametre	Value
1	Protein, per cent by wt.	10.4
2	Total sugars, per cent by wt.	11.8
3	Zinc, (mg per cent)	2.6
4	Sodium, (mg per cent)	17.0
5	Potassium, (mg per cent)	3,264.0
6	Iron, (mg per cent)	42.5
7	Calcium, (mg per cent)	708.0
8	Magnesium, (mg per cent)	142.0
9	Copper, (mg per cent)	1.1
10	Cadmium, (mg/kg)	0.33
11	Manganese, (mg per cent)	4.7
12	Lead, (mg/kg)	1.84
13	Arsenic, (mg/kg)	Nil

thorough search of the available germ plasm at NARI and a programme for development of several male sterile (MS) lines. These MS lines are high-yielding, uniform and possess desirable traits. They are being exploited for hybrid development at NARI.

In 2001 for the first time a non-spiny hybrid NARI-NH-1 (PH-6) was released for cultivation in all the safflower growing regions of the country. It gives a seed yield of 18 to 20 q/ha under irrigation, has 35 per cent oil in its seeds and produces nearly 2 q flowers/ha (Tables 1 and 2).

Identification and release of the non-spiny variety and hybrid in safflower is expected to be a boon to farmers due to the extra income they are expected to give the farmers from the flowers. Due to their non-spiny nature it is easy to harvest and thresh as also pick flowers from them. This will not only increase their popularity among traditional farmers who had discontinued safflower cultivation due to reluctance of labourers to carry out any operations in it due to its spiny nature, but will also increase the spread of safflower in non-traditional areas.

The success of hybrids of any crop depends upon the simplicity and cost effectiveness of hybrid seed production. Thus at NARI considerable efforts have been spent on perfecting the technology of hybrid seed production in safflower.

However, there are some inherent problems associated with the seed production in genetic male sterility system, one of them being its labour-intensive nature. Ultimately only the cytoplasmic male sterility-based system can provide the most feasible way of hybrid seed production especially in spiny hybrids of safflower. Therefore, efforts are underway at NARI to develop cytoplasmic male sterility in safflower, and to identify suitable maintainer and restorer genotypes for producing highly productive hybrids.

Battery-Operated Flower Collector

The manual collection of safflower flowers from spiny varieties is not very cost-effective due to the presence of spines on the capitulum. Thus, a knapsack-type lightweight battery-powered flower collector has been developed to enable the collection of dried flowers from spiny safflower plants. The battery of this collector can be charged, using a solar photovoltaic module.

Popularisation of Safflower

To commercialise safflower flowers in India, efforts have been initiated to popularise them as an herbal health tea for curing several chronic diseases. Regular users of this tea have reported its usefulness in alleviating diseases like hypertension, spondylosis, angina, arthritis, constipation, menstrual disorders and hypercholesterolemia. Analysis of flowers for nutritional qualities was conducted recently at the Central Food Technological Research Institute (CFTRI) at Mysore and the results of this investigation are given in Table 3. They were found to contain substantial quantities of amino-acids and minerals such as potassium, calcium, magnesium and iron.

Package of Practices

In general, highest seed yields could be obtained from safflower when

- Safflower was planted in the first week of October.
- Plant population of about 1,00,000/hectare was maintained.
- Fertiliser containing 60 kg/ha nitrogen in split dose (30 kg at the time of planting and 30 kg after 1 month of planting) and 30kg/ha phosphorus was applied to the crop.
- Irrigating twice – first at elongation (35 days after sowing) and second at flowering stage (75 days after sowing) were applied, in addition to a pre-sowing irrigation.
- Crop was protected against diseases such as alternaria leaf spot and wilt and insects such as aphids and heliothis.

Seeds of spiny variety Nira, non-spiny variety NARI-6 and non-spiny hybrid NARI-NH-1 are available at NARI. NARI is also ready to transfer the technology of seed production to any interested parties.

THE AUTHOR DR. N. NIMBKAR HAS AN M.S. AND PH.D. IN AGRONOMY FROM UNIVERSITY OF FLORIDA, GAINESVILLE, USA AND IS THE PRESIDENT, NIMBKAR AGRICULTURAL RESEARCH INSTITUTE, PHALTAN.

Merc urged to permit captive power plants

Times of India
Pune
07/02/2003

By Abhay Vaidya
TIMES NEWS NETWORK

Pune: A member of the advisory board of the Maharashtra electricity regulatory commission (Merc) has urged the apex power-related body in the state to "bring in a revolution" in power generation by allowing private players to establish small captive power plants (CPPs).

Anil Rajvanshi, principal author of the national policy on "taluka self-sufficient power plants", has pointed out that the current power situation in Maharashtra is extremely grim with minimum eight-hour load-shedding daily in rural areas and three-hour load-shedding in urban areas.

Consequently, "there is a need to give a free hand to all players to produce power in Maharashtra", Rajvanshi told TNN. The Phaltan-based IIT alumnus is a recipient of the 2001 Jamnalal Bajaj award for his pioneering work on renewable energy and sustainable development.

On January 31, Rajvanshi wrote to Merc chairman P. Subramanian urging the power regulatory body to pass an order permitting the setting up of CPPs of 50 kVA capacity in Maharashtra. "The tariff for all CPPs should be the same and should be based on opportunity cost of putting a power plant by the MSEB (Maharashtra state electricity board)," Rajvanshi recommended.

He said the MSEB's cost should be based on thermal power production with the calorific value of coal (high ash content) available in India. He has specifically emphasised the need for CPPs in rural areas, while pointing out that given the present scenario, rural areas were unlikely to get grid electricity in the next decade or so.

His letter to the Merc chairman states that allowing CPPs without the permission of the MSEB "will provide tremendous incentive for setting up micro-utilities in rural Maharashtra". It could also result in a "revolution for agricultural development, besides providing relief to rural areas in terms of lighting and other household needs".

Rajvanshi said that a Merc order on CPPs would also apply to urban areas and could significantly help alleviate the power shortage in towns and cities. Stating that industries were already operating under capacity due to recession over the last two years, he said, "The situation is so bad that we must take whatever steps are necessary to solve the power problem."

Rajvanshi also urged Merc to allow private CPP-based utilities in MIDC units to enable them to provide captive power to industries.

dents feels the only option after persisting with science and completing M.Sc. is being is dropping. Especially at the undergraduate level, it is in a state of crisis. The receding interest in pure sciences is paradoxical at a time when the frontiers of science ising exhibitions or conduct ing seminars wouldn't help much," she said.

'Scientists yet to give back to the public'

Are Indian scientists doing enough for the masses? Is the pursuit of science and technology in India losing its direction? Top minds in the field addressed the questions on the eve of Science Day.



Dr Vasant Gowariker: *Former vice-chancellor of Pune University, Vasant Gowariker, was also head of the Vikram Sarabhai Space Centre and succeeded in putting India into space with the SLV multi-stage rocket series.*

Is it enough? Frankly, nothing is — science always chases human aspirations. Not just here, elsewhere too! Generally, I rank high Indian scientists' contribution towards the betterment of our masses.

India has created a massive world class infrastructure to conduct research in national or regional labs, autonomous or industry-owned institutions, IITs, universities, some colleges and specialised institutions. Science is a multi-splendoured activity, pursued in India by large groups working on almost every scientific aspect.

Are the masses any better off because of the work of the scientists, along with that of the farmers, industrialists and other players? Yes. The essence of many accomplishments is that in 1947, out of the 20 Indians, 18 lived in stark poverty; today 16 are above the poverty line and nearly half of them, says one estimate, have an average per capita income comparable to the US. An Indian lives, on average, for over 65 years, more than double of what he did in 1947, with much more dignity than in the times of the constantly imported grains! Now we have vast surpluses of food for export!



Anil K. Rajvanshi: *Director of the Nimbkar Agricultural Research Institute (NARI), Phaltan, Rajvanshi is the the first agricultural scientist to receive the prestigious Jamnalal Bajaj International Award for his contribution to rural development.*

The problem is not with the national laboratories. They are manned by the best

VIEWPOINT

brains and have excellent research facilities. What is lacking is direction and policy. Are there any clear-cut guidelines that research laboratories should work for rural development? I have serious doubts.

To my knowledge, there is hardly any laboratory in the country working towards rural development. It is a matter of great shame.

About sixty-three per cent of Indian households are still without electricity. Another 100 million households are still dependant on the inefficient kerosene stove. Is this what we call scientific development for the country?

I do not think our laboratories, are incapable of alleviating the problems of the rural poor.



Dr A.D. Karve: *The senior botanist won the coveted, £30,000 Ashden international award for environment in March 2002 for converting the leaves of sugarcane plant into fuel. He heads the Pune-based Appropriate Rural Technology Institute (Arti).*

The obvious answer is no but I don't blame the scientists for the state of affairs. Our science managers, bureaucrats and politicians are the culprits. The scientists are after all paid servants and they do what they are told to do. Indian scientists do well in other countries but not in our own country. In all advanced countries, the local industry and government research laboratories work in close collaboration, but not in India. The fees charged by the national laboratories are so high, that only foreigners can afford to pay them. The Indian industrialist finds it cheaper to import technology from abroad than pay for an indigenously-developed technology. Also, the priorities of our politicians are all topsy-turvy. The Parliament, for example, enacted a law curtailing animal experiments. This has harmed indigenous medical research.



Jayant Narlikar: *Director of Inter-University Centre for Astronomy and Astrophysics (Iucaa), Naralikar is a recipient of several national and international honours.*

No, we scientists are not doing enough for the masses. The Science Day is an ideal occasion to conduct open houses in the various scientific institutions to reach out to the people. However, this should not be a one-day affair. It should be a continuous activity to keep a dialogue open with the man on the street. However, this is not being done sufficiently.

There are many institutions like Iucaa, who had mentioned science popularisation as one of their mandates. However, I wonder how many institutions have kept the mandate.

As our research laboratories are funded by tax payers' money, we must give back to the tax payer. It is important that people get involved. The common man should be able to have a dialogue on topics like cloning and astronomy. There is no set pattern to pursue these objectives, but scientists must make this happen.

Sahara Times - April 2003

EcoTalk

SUVIRA SRIVASTAV

Just one chance to live



AREN'T WE living our lives as if there is another earth to move on? What else can explain our zealous response to emotive issues like Ayodhya, eclipsing real ones like dying rivers, contaminated water, polluted cities and garbage littered streets, where everyone from cows and dogs to a man on cycle or a fast-moving vehicle have a thoroughfare. We pause to think only when these realities morph into nightmarish images splashed on TV. But all too often the impact of our detached attitude on life support systems is ignored.

Being wedded to a self-centered attitude we fume at the idea of changing our lifestyle and often retort with "what can I do?" Fortunately, refusing to be bogged down by complacency, there are many that have scripted an entire chapter of the 'way forward' by their indefatigable resolve, not only attacking the root cause of environmental deterioration but also by taking up cudgels towards a new generation of environmentally benign technologies. And, the roadmap that has thus emerged owes its presence to the exhaustive efforts put in by individuals like Navreet Energy Research Information(NERI)Director Shiv Darshan Malik, TERI Fellow Banwari Lal and Maharashtra-based Nimbkar Agricultural Research Institute (NARI) Director Anil Rajvanshi, to name a few. Their optimistic approach has given India a new green regime for problems of pesticide-laden soil, indoor pollution and waste management.

There are many who have scripted an entire chapter of the 'way forward' by their indefatigable resolve

Accordingly, rural folks now have a multi-fuel and energy efficient *Noorie* lantern, far superior to the conventional lantern available in the market, which runs on kerosene, ethanol, or diesel; produces light equivalent to a 100-watt bulb and also doubles up as a small cooking stove-a far cry from the days of smoke spewing and soot-emanating lantern. What makes it stand apart is its ability to run on homegrown fuel like alcohol, made from feedstocks like sweet shorghum and sugarbeet. It eases the country's exchequers of Rs 15-20 billion that are otherwise utilised in importing kerosene in the country.

The *Noorie* lantern designed by NARI and the DEEP (Decentralized Electrical Energy Producer) genset, developed by NERI, are in tune with the necessary mega trends of global environmental protection and sustainability. DEEP is a 'green' surprise that offers an eco-friendly and economical way to light millions of homes using local waste. The initial cost of installing this genset is about Rs 1 lakh per KW, but the maintenance and running costs are almost negligible. A 5 KW genset can easily support 15 homes in a village, using 4-5 kgs of waste to run for an hour.

In another transition towards future are the non-pathogenic pesticide-eating bacteria developed by Banwari Lal, in association with Prof Ruplal of Delhi University and Rakesh Jain of Institute of Microbial Technology, Chandigarh. Together, they have been able to separate bacterial strains that merely take 15 days to degrade 90% of the pesticide present in contaminated soil.

Such innovative handholding of environmental demand with scientific solutions is the only way out. But, can we bring in the changes fast enough to avert the environmental disasters that are waiting to topple our civilization is the million dollar question! ■

– The columnist is Executive Editor of TerraGreen, TERI

Sunday Times of India - Pune - 27/06/2003

'Tech. mission' for rural areas

TIMES NEWS NETWORK

Pune: The Planning Commission has taken note of grassroots technologies for cooking and lighting, developed by the Phaltan-based (Satara) Nimbkar agricultural research institute (NARI), and has decided to establish a "technology mission on cooking and lighting" for rural areas.

This mission, which aims to draw on technologies developed by NARI and other government and non-government organisations, should be constituted "on an emergency basis", according to the commission. "This problem has remained unresolved, despite huge investments in power generation, the grid system and rural development," it noted.

LOCAL POWER

Significantly, the decision to establish a technology mission on cooking and lighting for rural areas resulted from a detailed presentation to the commission by the Phaltan-based Jamnalal Bajaj Foundation awardee and NARI director Anil K. Rajvanshi on June 14.

NARI is the recepient of FICCI's 2001-02 Institutional Initiative award in Rural Development, instituted by the Federation of Indian Chambers of Commerce and Industry (FICCI). Its work in the production of ethanol from sweet sorghum since 1980, and innovations such as "NARI cotton", battery-powered cycle rickshaws, and utilisation of locally-available biomass, were taken note of by FICCI.

Speaking to TNN, Rajvanshi said that his presentation emphasised that nearly half of India's population in rural areas continues to suffer due to lack of access to electricity.

In his presentation, Rajvanshi highlighted the fact that, while a large number of people in Bihar, Assam and other states depended on hurricane lanterns or an open flame for lighting, and inefficient biomass-based *chullas* for cooking, the introduction of modern technologies developed by domestic and foreign agencies, could help alleviate their sufferings.

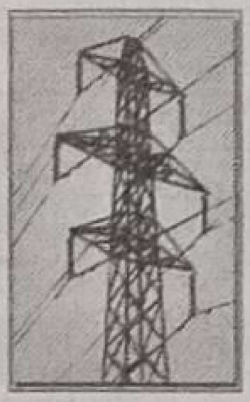
Issues discussed at the meeting included the use of bio-diesel, non-edible oil in place of diesel in engines, the use of biomass residue for animal feed, fuel and manure and hi-tech agriculture based on the use of local resources.

Times of India - Pune - 06/10/2003

'Activating new law a must for empowering villages'

TIMES NEWS NETWORK

Pune: A member of the advisory board of the Maharashtra Electricity Regulatory Commission (MERC) has urged the commission to seize the opportunity provided by the new Electricity Act, 2003, and take bold steps to address the problem of rural electrification.



Anil K. Rajvanshi, recipient of the Jamnalal Bajaj award, has emphasised, in a letter to MERC chairman P. Subramanyam, that the acute shortfall in rural electrification can be overcome if the MERC allows captive power plants or microutilities to generate up to 500 kWe of power.

A large number of such microutilities, functioning along the lines of cable operators, will help ease the problem of power shortages, Rajvanshi has said in his letter, dated October 1.

Rajvanshi, incidentally, is the principal author of the national policy on "taluka self-sufficient power plants" which is a part of the prime minister's programme on rural electrification.

He has emphasised that MERC can invoke sections 13 and 86 (2) of the new Electricity Act, 2003, and exempt all such microutilities from the provisions of tariff fixation and licensing. While section 86(2) empowers the MERC to advise the government on policy issues, section 13 allows the commission to exempt rural co-operatives and gram panchayats from seeking licences for setting up captive power plants.

The Phaltan-based IIT alumnus, who has done pioneering work in renewable energy and sustainable development, has pointed out that in rural areas, 500 kWe of power "can easily provide electricity for lighting and other usage to about 2000 households."

The insistence on a co-operative society structure for such microutiliites would ensure community participation while providing protection against the negative aspects of a private enterprise, he said.

Significantly, Rajvanshi has highlighted that a captive power plant of 500 kWe capacity could be run on alternative energies such as biomass or bio-derived fuels such as ethanol and pyrolysis oil. Besides, the power co-operative society can also use a mix of wind, solar, diesel and biomass which might help in developing innovative technologies for such applications, he stated.

Allowing microutilities to function in this manner would not only prove to be a revolutionary step for the MERC but also be the first order of its kind with far-reaching consequences, Rajvanshi said.

Tap local resources

To meet rural India's fuel needs



ANIL K RAJVANSHI

The use of kerosene for lighting and biomass for cooking is predominant throughout rural India. And since provision of grid electricity to rural India is still a far cry, there is an urgent need to develop alternative sources of liquid fuels for lighting and cooking.

Studies at the National Agricultural Research Institute (NARI), Phaltan, Maharashtra have shown that ethanol can be a good alternative. Traditionally it has been produced from sugarcane and molasses. However, in view of the current debate on the use of the same piece of land for both food and fuel, it is better to look for multi-purpose biomass sources for ethanol production. One such source is sweet sorghum. It provides grain from its earhead, sugar and hence ethanol from its stalk, and the bagasse and leaves make excellent fodder. Besides, it matures faster than sugarcane (requiring 100-140 days as compared to 12 to 18 months for sugarcane), can withstand a range of climatic conditions and requires far less water than sugarcane. Per-unit of water it is perhaps the highest sugar yielding crop.

Another alternative liquid-fuel produced from biomass is pyrolysis oil. It has a medium calorific value and can be produced from any biomass and agricultural residue by the fast pyrolyisis method. Its medium calorific value and low moisture content makes it appropriate for modified lanterns and cookstoves. But cookstoves and lanterns that can use this fuel with efficiency need to be developed.

A majority of households in India today use biomass cookstoves irrespective of economic strata. These stoves are very inefficient and smoky with about 10-15 per cent cooking efficiency. An extremely efficient thermoelectric device attached to the stove can produce 50-60 watts of direct current power. This power can be stored in suitable high efficiency batteries for lighting. At the same time, part of the power can also be used to run a small fan for cookstoves. Recent bomass cookstove designs have shown that air draft powered by a 5 megawatt fan can double the efficiency of these stoves.



Biogas is another fuel, which can improve cooking facilities in rural areas. That is, if it is produced by a process more efficient than the one in use currently. And for that to happen, research and development needs to be directed towards efficient biogas reactors and improved storage facilities.

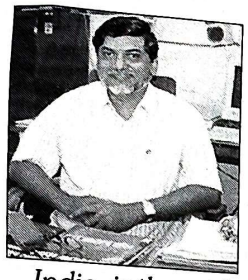
Locally available sources can provide fuel for safe, clean and convenient cooking and lighting system to rural areas. But they need to be tapped efficiently. And then they have all potentials of becoming a lucrative venture. Take the case of ethanol. To replace all the kerosene used in rural areas will require ethanol production of 14,700 million litres. With an average price of ethanol currently offered by the government of India — Rs 18 per litre — the ethanol production will be of the order of Rs 2,65,000 crore per year. Besides the implications for rural industry in terms of wealth and foreign exchange generation, it will certainly help the country save foreign exchange that goes in importing kerosene, and improve energy security.

The lighting and cooking energy programme can be a very major national effort touching every aspect of rural life. However, for it to be so important, policy changes are required. A technology mission for cooking and lighting should be set up on lines of existing technology missions. All cooking and lighting energy programmes, which are scattered under different heads in different ministries, need to be brought under one umbrella ministry. Setting up industries in rural areas to produce fuels from biomass should be encouraged by providing them easy finance and tax incentives. And most importantly, the focus should be now on putting very intense efforts into areas of emerging technologies, such as nano-technology and biotechnology. ■

Anil K Rajavanshi is at the National Agricultural Research Institute, Phaltan, Maharashtra

With rural India shining, India will shine!

Project Manager - Mumbai - 16/05/2004



Dr. Anil K. Rajvanshi, *Director, Nimbkar Agricultural Research Institute (NARI), has more than 25 years of experience in renewable energy R&D and rural development. Dr. Rajvanshi, who has been a member of many prestigious committees of the Government of India, is the author of the national policy on Energy Self-Sufficient Talukas, which was run by the Union Ministry of Non-conventional Energy Sources. In 1999, he was inducted in the US-based Solar Hall of Fame. He was also awarded the prestigious Jamnalal Bajaj Award for Rural Development in 2001. In this article, Dr. Rajvanshi makes out a case for sustainable energy development programme as a means to creating all-round rural development.*

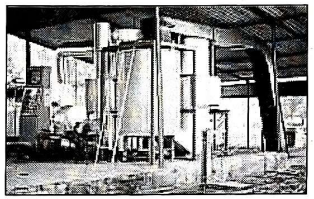
INDIA'S ECONOMY IS GROWING presently at the rate of 10 per cent per annum. This means that we will double up all the inputs in seven years. Thus, by 2011, we will double the consumption of petroleum products, electricity, food and other commodities to keep this growth rate. Last year we imported about Rs 85,000 crore worth of petroleum products. India will also require about 140,000 mw of installed electricity capacity by 2010 at an *estimated outlay of Rs 5.5 trillion. Thus, financial outlay needed for the energy sector alone is staggering and to maintain "India shining" it is necessary that we produce as much as possible, energy and liquid fuels internally. There are about 60 per cent of rural households, which do not have electricity, and without the basic amenities in rural India the progress of the country will be hampered. A sustainable energy development programme can create all-round development. One of the possible ways to do it is the increased use of land based renewable energy resource like biomass. This will help rural development and create tremendous wealth in these areas. With rural India shining, India will automatically shine!

Land-based renewables

There are three ways in which energy production from land-based renewables can be effected:

- Production of electricity from biomass and agricultural residues.
- Liquid fuel production from *biomass which can be grown in arid regions and on wastelands and saline soils. Besides producing liquid fuels, this will also help in land reclamation.*
- Creation of synergy between corporate sector, national government labs and institutions and NGOs so that energy technologies can be developed and disseminated in rural areas.

A study done by the Nimbkar Agricultural Research Institute (NARI) in Maharashtra showed that existing agricultural residues can produce all the electricity demands for a taluka. The study done for Phaltan taluka in western Maharashtra showed that these residues could produce about 10-15 mw of power from biomass based power plants. Besides, it was also shown that with a capital input of Rs 300 crore in power production technologies, each taluka could produce wealth of Rs 200-250 crore per year besides giving employment to 30,000 people year round. With about 3,340 talukas in India, there is a possibility of creating about Rs 7,00,000 crore per year of wealth and employment for about 100 million people per year. The implications of this strategy for rural development are staggering and can create a quantum jump in the quality of life for rural population. With availability of assured electricity supply the growth in rural industrialisation can be exponential. With the new Electricity Act 2003 and Prime Minister's Rural Electricity Supply Technology (REST) Mission this strategy can become a reality



A study by done by NARI in Maharashtra showed that agricultural residues can produce about 10-15 mw of power from biomass based power plants.

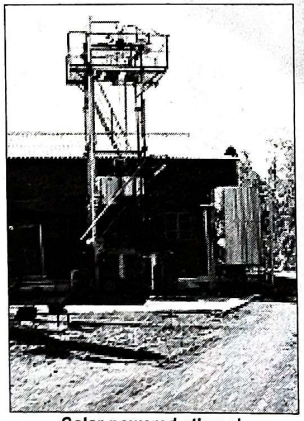
and it is quite possible that in the coming years the whole face of rural India can change. Availability of assured electricity for lighting will make rural India shine!

India is following the world trend of increasing reliance on liquid fuels. Last year 75 per cent of all liquid fuels consumed was imported. By 2010, this figure might jump to 85-90 per cent. Increasing reliance on imported fuel will compromise our security and thus there is a need to develop an indigenous liquid fuel production policy based on renewables. The liquid fuel policy should, therefore, be centered on the production of ethanol and biodiesels. Presently, ethanol production in the country is mostly molasses based. However, with expanded use of ethanol, both for transportation and as cooking and lighting fuel, there is a need for its production to have a broader biomass base. Thus, the use of alternative feedstock like sweet sorghum, sugarbeet, cassava etc., can help in its increased production. Besides, these crops require less water than sugarcane and some of them can be grown on saline soils. Thus, a national technology mission on alternative crops for alcohol production should be set up by the Government of India. It is estimated that ethanol production itself can bring in about Rs 40,000-50,000 crore wealth to rural India.

Technology mission

Similarly, the technology mission for new crops for producing biodiesel also needs to be set up. Some of the crops like Jatropha and tree borne non-edible oilseeds like Neem and Karanja can be grown on waste and degraded lands. This will also help the country in land reclamation. With very little processing required for biodiesel, the farmers can get substantial remunerations by growing them.

However, for the technology missions to succeed, it is necessary that very intensive R&D is carried out in agriculture, materials and renewable energy technologies. The Government of India should substantially increase the level of R&D funding in renewable energy and agricultural crops for liquid fuel production. Research done at NARI has shown that the emerging areas of nanotechnology and



Solar powered ethanol distillation plant

biotechnology can play a vital role in creating novel renewable energy technologies. Thus, new materials for storing biogas in small cylinders, increasing the efficiency of photovoltaic solar cells and producing new thermoelectric materials, which can efficiently convert heat directly into electricity, are being researched and developed via nanotechnology all over the world. Similarly, biotechnology can be used for increasing the efficiency of crops for liquid fuel and biomass production. *It can also help develop organisms, which can increase the efficiency* of ethanol fermentation and biogas production from their respective biomass.

For the fruits of extensive R&D to reach the rural areas, it is necessary that a strong synergy is developed between the corporate sector, the Central government R&D establishments and non-governmental organisations. Both the corporate sector and national labs can work together to research, produce and commercialise renewable energy technologies, which can be disseminated through NGOs in rural areas. Finally, the development of rural India should be taluka based for it provides the critical mass for rural development.

Machinery for disaster management

If tsunami strikes again

By Anil K. Rajvanshi



THE FEARFUL TSUNAMI tragedy that killed over 1,60,000, left millions homeless and destroyed property worth billions of dollars all over South-East Asia and its aftermath have shown once again that India is totally unprepared in disaster management. A lot of hand wringing and knee-jerk reactions take place after such large-scale catastrophes, followed by a round of blaming government welfare agencies and NGOs for not coming up to the mark.

A major problem faced in such calamities is the supply of food and clean drinking water to survivors. Clean drinking water is extremely essential to prevent the spread of diseases like cholera. Other problems are availability of lighting for both shelters and rescue workers, mechanisms to quickly dispose bodies, and fuel for cooking. However, these problems can be solved by proper technology and their expert management.

The foremost technology needed to prevent these disasters is advance information and warning system. Its development is now being taken up as priority by the Government of India organizations. However, it will take years before such a system can be put in place. Till that time, it may be worthwhile to invest in simple technologies on the ground which can be installed to help disaster-affected persons and areas.

These technologies should fulfill the following needs: Provision of adequate light; clean water supply; rapid disposal of human and animal bodies; fuel for cooking; and, communication network.

Provision of light

A truck-mounted 200 hp diesel genset may provide enough energy for lights and also produce clean drinking water. The flue gases from the genset can be used to power a small desalination plant or boil water so that germs are destroyed. Both these units can also be mounted on the same truck. A simple analysis reveals that about 10,000-15,000 l/day of excellent drinking water could be produced from 200 hp diesel genset as a byproduct. Thus, the truck-mounted unit will be a dual-purpose plant for producing electricity and water. This will also help increase its efficiency.

In areas where roads are washed out and power truck cannot reach, improved kerosene lanterns and solar lanterns should be provided for giving light. Nimbkar Agricultural Research Institute (NARI) has produced an extremely efficient multifuel lantern called *Noorie*, which runs on kerosene and diesel and also doubles up as a small cooking stove. *Noorie* lanterns can provide good light (equivalent to 100 W bulb light) and also cook a small quantity of much-needed food items.

Clean water supply

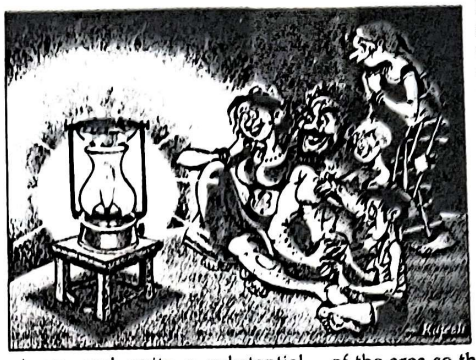
As mentioned above, the truck-mounted genset can provide good drinking water. In remote places and on marooned islands, small solar stills and hand-powered reverse osmosis units can be provided for drinking water requirements.

Disposal of bodies

One of the major wasted efforts in the tsunami tragedy has been the digging up of huge pits for burying bodies. A small earthmover needs to be employed to dig up a trench of 3 m x1.5 m (wide) and 1 m deep for a single body. These shallow trenches can be dug up quite rapidly and are sufficient for burial.

Fuel for cooking

It has been seen that in disaster events, major national and international efforts are focused on giving food supplies to disaster-affected persons. However, in the absence of adequate cooking fuel these supplies do not help survivors, and quite a substantial amount gets spoiled. Thus, supply of stoves,which can run on both diesel and kerosene or solar cookers,may be useful. Instead of using kerosene or wood for burning bodies, it can be saved as a cooking fuel.



Communication network

The power truck can have a small VSAT dish by which it is possible to communicate to the world from ground zero. With the advancement of communications technology it is possible to use these systems powered by the truck-mounted genset. The communication also helps in sending information on requirements of the area so that essential supplies can be brought to that place.

However, for all these technologies to be rapidly deployed, it is necessary for appropriate government agencies to prepare a list of vendors who can supply these goods at a short notice and at reasonable price. Also, there is need for government and NGOs to work together when natural calamities strike.

For vendors to make these systems available to gover agencies on short notic necessary that these tec gies should be used on stantial scale during times. Thus the 200 hp truck can be easily used vide electric power an much-needed clean dr water to a village.

With the present thrust vide power to all villa 2012, deployment of such should be encouraged. Th can give fiscal incentives t ty vendors so that these nologies can become ec cally viable. With new th tricity Act such micro utilities will spread to areas, and the act will also available such technolog disaster areas.

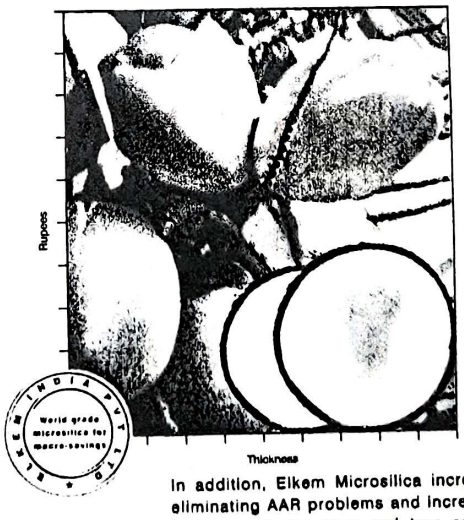
(The writer is Director of th bkar Agricultural Researc tute, P.O. Box 44, Phaltan 4 Maharashtra. E-mail: na tan@sanchar

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Times of India - Pune - 25.01.2005

India among leaders in nanotech R&D

By Abhay Vaidya/TNN

Pune: India, along with China and South Korea, has emerged as a front-runner among developing nations doing research in nanotechnology, which is being viewed as the "next transformative technology like the Internet or electricity".

The Meridian Institute, a major US think-tank that has worked closely with the White House on policy research, has cited the Satara-based Nimkar Agricultural Research Institute (Nari), Banaras Hindu University and the Central Scientific Instruments Organisation of India as agencies that have begun noteworthy initiatives in nanotechnology.

In India, more than 30 institutions are involved in research and teaching/training programmes in nanotechnology with the government having allocated Rs 1 billion ($22.8 million) under its 10th five-year plan (2002-07), Meridian has noted in its paper, 'Nanotechnology and the poor: opportunities and risks'.

Presenting an overview of the world-wide forays into nanotechnology along with the opportunities, risks and challenges in this emerging area, the monograph is a preparatory document to the Global Dialogue on Nanotechnology and the Poor (GDNP), that has been planned later in 2005.

Satara-based NGO and Banaras Hindu varsity find mention in US document

Nanotechnology — the manipulation of materials at the atomic, molecular and macromolecular scales — not only has revolutionary commercial applications, but also holds enormous promise in providing safe drinking water, low-cost lighting systems and better agro output to the world's poor.

At the same time, the development and application of this new technology is fraught with serious human and environmental risks, warns the US National Nanotechnology Initiative, British government agencies, Swiss Reinsurance Company and Greenpeace among others.

The Phaltan (Satara) based Nari, which has done pioneering work in developing bio-fuels and higher efficiency lanterns for rural areas, has been cited by Meridian as one of the few NGOs world-wide "which mentions nanotechnology in its research strategy and advocates for R&D (research and development) to develop cheap and efficient solar energy devices".

Nari researcher and Jamnalal Bajaj Foundation awardee Anil K. Rajvanshi, in his paper on 'R & D strategy for lighting and cooking energy for rural households', has pointed out that nanotechnology can be used for developing better mantles for liquid fuel lanterns and efficient thermoelectric and thermionic elements for rural energy systems.

The Times of India, Pune
Wednesday, May 11, 2005

$6-bn rural energy untapped: study

By Abhay Vaidya/TNN

Pune: A $6-billion rural lighting/cooking opportunity seems to be lying untapped in the country even as politicians in the state continue to grapple in the dark over the power crisis in the state. The acute shortfall between electricity demand and supply in Maharashtra recently sparked a violent reaction in Pune and Nagpur after political activists attacked state electricity board offices to draw attention to the people's ire on power shortage.

While this has prompted the government to work on a war footing to improve the power scenario in the state, the fact remains that even after 50 years of independence, nearly 60 per cent of India's rural population is without electricity and continues to use primitive, wood-based methods to cook food.

This situation could undergo a sea-change with far reaching implications if due attention is paid to the development of low-cost lighting and cooking technologies with the help of biofuels, biomass gassifier-based microturbines, nano-engines and other technologies, says energy systems expert Anil K. Rajvanshi.

A member of the Maharashtra electricity regulatory commission and director of the Nimbkar Agricultural Research Institute, Phaltan, Rajvanshi received the prestigious Jamnalal Bajaj Foundation award in 2001 for the use of science and technology for rural development.

"In rural India, preliminary economic analyses show that lighting and cooking technologies based on liquid and gaseous fuels could become a $6-billion-a-year industry," Rajvanshi has said in his paper 'Rediscovering fire in the 21st century', published by the Science and development network (SciDev.Net).

Supported by the prestigious scientific journals *Nature* and *Science*, and funded by the Rockefeller foundation and other agencies, this network seeks to promote the use of science and technology for development.

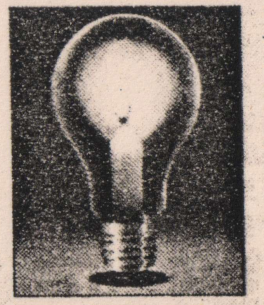
Rajvanshi's paper has drawn attention to developments in the scientific world that could be pressed to provide better cooking and lighting technologies for the vast majority of rural poor in India, Africa, South America and Asia.

Thus, for example, biogas could be made more productive and even 'bottled' in cylinders as has been shown by P. Pfeifer's research at the National Centre of Scientific Research, France. "These findings could pave the way for small utility companies to be set up, revolutionising the way cooking is done in rural areas," the paper states.

While the Chattisgarh government's experiments with *jatropha* biodiesel has raised hopes on the viability of alternative fuels for rural poor, the development of stoves run on biofuels, such as ethanol, pyrolysis oil, *karanja* and *jatropha*, could go a long way in meeting the cooking and other energy needs in rural areas.

The development of better mantles to enhance light efficiency from liquid fuel lanterns, establishment of biomass gassifier-based power plants, generating 5-10 KW of power for 30-60 households and bringing down the cost of light-emitting diodes could also go a long way in providing lighting for rural homes, the paper states.

OPPORTUNITIES FOR RURAL LIGHTING



- Increase efficiency of biogas production
- Develop biofuels from *jatropha, karanja*, sweet sorghum, sugarcane and pyrolysis oil from dry biomass
- Use new materials for high-efficiency mantles in lanterns
- Biomass gassifier-based power plants for small clusters of rural households

Stop blame game, says consumer organisation

TIMES NEWS NETWORK

Pune: Annoyed by the "blame game" started by Nationalist Congress Party president Sharad Pawar, the Maharashtra state electricity consumers association has demanded that the state government should take some tough decisions to solve the power crisis in the state.

A statement released by Pratap Hogade, president of the association and vice-president of the state unit of Janata Dal (S), said the government should declare a "Power emergency" and take some tough measures to prevent power thefts, reduce transmission and distribution (T&D) losses and restrict wasteful use of energy.

"It is unfortunate that the leaders are resorting to blame game to shift the responsibility of the crisis on the Godbole committee, which was instrumental in exposing how Enron had cheated the state," Hogade said, pointing out that the saffron alliance and the Democratic Front governments in the state relied too much on Enron, refusing to invest in new projects.

Hogade said the Godbole committee had asked the government to renegotiate and restructure the Enron deal, along with the deals with Reliance and Ispat. "It is not the committee's fault if the companies did not submit fresh proposals or if Enron failed to meet the contractual obligations, which subsequently led to its closure," he said.

Hogade suggested that the MSEB should take effective steps to stop power thefts, reduce T&D losses and save energy by advocating the use of solar water heaters and compact fluorescent lamps, besides restricting wasteful use of power.

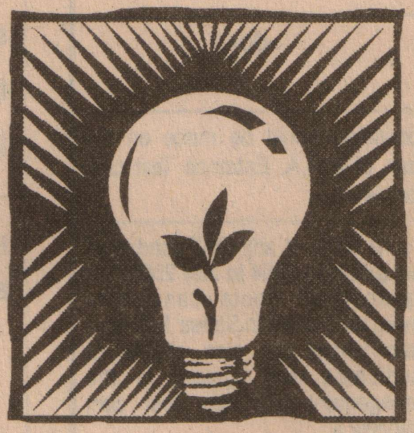
Hi-tech at the grass roots

Times of India - 11/05/2005

By ANIL K RAJVANSHI

Cooking and lighting account for 75% of total energy consumed by rural households. User-friendly products to satisfy these requirements from locally available resources can go a long way in improving the quality of life.

Biogas is a clean cooking fuel, but the existing generators are inefficient. They require considerable cowdung and other nitrogenous material and are not suitable for a household with less than three to four cattle. Genetically engineered microbes can help substantially increase gas production efficiency. Besides, biogas, a mixture of methane and carbon dioxide, cannot be liquefied and requires very high pressure (more than 100 atmospheres) to be compressed for it to be used over extended periods. We need to develop appropriate storage materials, which can store biogas at medium pressures.



Recent experiments show that biogas can be stored at medium pressures (less than 40 atmospheres) in hydrates, porous carbon and porous organic structures similar to those used in hydrogen storage. Micro-utility companies can be set up in rural areas which buy locally available raw materials like cowdung and biomass, and use them in a hitech biogas reactor to efficiently generate biogas. This gas can then be stored in small cylinders lined with gas absorbent structures and be transported to households like LPG cylinders.

Liquid fuels like ethanol, biodiesel and pyrolysis oil from biomass can be used for cooking. We should develop stoves running on these fuels. The Nimbkar Agriculture Research Institute (NARI) has developed a stove running on low concentration of ethanol.

In the pressurised mantle lamp, called *petromax*, the combustion of kerosene lights up the rare earth oxide mantles. These mantles have not changed since their development in late 1880s and have a low light efficiency of about two or three lumens per watt. In comparison, the efficacy of a light bulb and compact fluorescent lamps is 10-15 lm/W and 50-70 lm/W, respectively. With nanotechnology, it is possible to develop new materials for these mantles so that use of rare earth oxides is reduced and their efficacy increased.

Nanotechnology involves the study and manipulation of matter on a nanometer (1-100 billionth of a meter) scale. With increased efficacies, liquid fuel lighting can emerge superior to electric lighting. The overall power plant-to-light efficiency for fluorescent lamps is about 14 lm/W. This includes thermal power plant efficiency of 30%, transmission and distribution losses of 20% and fluorescent lamp efficacy of 60 lm/W. A liquid fuel lamp running on ethanol, biodiesel or pyrolysis oil with efficient mantles can be an excellent distributed light source. Research is also needed in developing better substrates for mantles since they break very often. Space age materials based on ceramics and carbon composites can make them durable.

Microtechnologies for producing electric power from heat and fuels like ethanol can also help in rural lighting. Nanotechnology is helping develop efficient thermoelectric elements, which directly produce power from heat. These elements if attached to cookstoves can produce 40-50 W power — enough to light up a household via LED lamps. Nanotechnology also helps produce microturbines and microengines. These engines, of the size of a 50 paise coin and capable of running on fuels like ethanol and methanol, can produce 8-10 W of power to light a household via LED lamps. Any technology becomes attractive if it is economically viable.

R&D helps in increasing the efficiency of a technology and hence improving its economics. A preliminary economic analysis for rural India shows that lighting and cooling technology-based liquid and gaseous fuels can be a Rs 25,000-30,000 crore industry.

To make this a reality, a national technology mission on cooking and lighting energy should be set up. This can help lay out an R&D blueprint and at the same time bring together stakeholders like the government, R&D laboratories, NGOs and the corporate sector.

The writer is Director, NARI.

Can we switch over to CFL lighting?

Economic Times - 13/06/2005

Use mix of LEDs, CFL and liquid fuel lamps

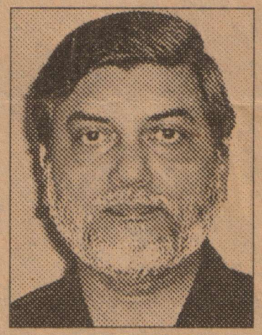
COMPACT fluorescent lamps (CFL) are long lasting and about 5-6 times more efficient than the regular incandescent light bulbs. Thus, using them in place of bulbs can result in substantial energy savings. Yet their initial cost is high (they cost about Rs 150 as compared to Rs 10 for an equivalent light bulb) and this cost can only be justified if they last for 3-4 years. However, the quality of some of the CFLs available in the market specially the Chinese and some Indian brands is atrocious. There is therefore a need to improve their quality and reduce their initial cost so that they can be used widely.

However, for remote rural areas of the country where there is no reliable supply of electricity, light emitting diode (LED) lamps can play a significant role in household lighting. These LEDs are extremely efficient and long lasting. They use very small amount of power (5-10 W) which can easily be obtained from small solar photovoltaic panels and with the ever increasing improvement in their quality will produce in future more efficient light than CFLs. R&D is therefore needed in India to produce better LEDs and to also manufacture them. Presently they are imported.

For rural areas, efficient liquid fuel-based mantle lamps can also play an important role. Thus multifuel Noorie lamps running on kerosene, diesel or ethanol and developed at the Nimbkar Agricultural Research Institute (NARI) can provide light equivalent to that from a 100 W bulb. Calculations show that power plant-to-light efficacy of CFLs is 10-15 lumens/W. This efficacy can easily be matched by making better and efficient mantles. Use of nanotechnology and new space age materials can easily make these mantles very efficient and can drastically increase the liquid fuel lamp lighting efficiencies. Besides the use of home grown ethanol to run these lamps can make liquid fuel lighting very sustainable.Thus for energy conservation it is necessary that better quality CFLs, LEDs and liquid fuel-based mantle lamps should be used at appropriate places in the country.

(Nimbkar Agricultural Research Institute)*

FACE-OFF



A RAJVANSHI
Director
NARI*



V M C GOWDA
Director (Technical)
BESCOM*

Unique advantages make CFL a winner

LIGHTING technologies have evolved over the years. If it was the electric arc lamps in 1800s, 1910 saw neon lamps, 1930s had fluorescent lamps, there were high pressure sodium lamps in 1960s and CFLs in 1980s. Conventionally, lighting technologies were used to improve the quality of life by "illuminating lives". With the concerns over increased use of electricity in the urban households and commercial sector, the real quality of life can be improved by "illuminating or lighting up lives efficiently". CFLs play an important role towards achieving this goal by ensuring optimal use of electricity in the households at the right applications.

BESCOM is reaching out to customers via a unique programme targeted at promoting efficiency by providing price advantages under the BESCOM Efficient Lighting Program (BELP). CFLs offer a unique opportunity to reduce the residential electricity bill by providing the same light output with 12% of the electricity used by a conventional incandescent lamp. BESCOM's unique residential lighting program gives consumers an opportunity to replace energy-intensive conventional lamps with energy efficient CFLs in areas of high usage such as corridors, kitchen and portico. Every light replaced with a CFL will result in a saving of Rs 15 per month. The preliminary market barrier — high first cost, can be overcome by interventions by the electricity utilities to demand better pricing and utility-backed-up warranty to protect consumer interests.

BESCOM experience and dissemination strategy to promote efficient lighting has been to promote CFLs for right applications and to promote the use of lower ratings of fluorescent tube-lights of 36 Watts in place of 40 Watts. BESCOM has made efforts to promote "efficient lighting" that is technology neutral; however, unique advantages of CFLs for the right applications make this technology a clear winner. It is feasible to replace conventional lighting with CFLs with right kind of fixtures in the areas where 1,000 to 2,500 lux illuminance (at eye) levels are ensured.

*(*Bangalore Electricity Supply Company Ltd)*

Times of India - 27/07/2005

Solutions for rural India

By ANIL K RAJVANSHI

The two most crippling problems of rural India — lack of electricity and clean drinking water — and their consequences on health and economy can be dealt with indigenously and simultaneously.

Village-level power plants that run on locally-produced renewable fuels like biogas, biodiesel, ethanol and pyrolysis oil can be set up. These internal combustion power plants, like diesel gensets, of 500 kW capacity each, can supply enough electricity for an average village with a population of 2,000-3,000.

In addition, the high temperature exhaust gases from these plants can easily distil or boil water via a suitably designed unit, which can be attached to the genset. A 500 kW power plant can produce about 1.5 lakh litres of clean drinking water every day. In producing both electricity and clean water, the power plant efficiency will jump from the existing 35% to around 65%. Most of the energy of these gensets is lost in exhaust gases and cooling the engine. This energy can easily be utilised for distillation or boiling water.



A microutility company could own the plant, whose shares in turn could be owned by villagers, and be managed professionally, without the political pitfalls of a cooperative society. The microutility could also lease village-level transmission lines and infrastructure from the local State Electricity Boards (SEBs) at a 'social cost', based on the cost of electricity most SEBs charge farmers.

The gensets could be run on biogas, biodiesel, ethanol or pyrolysis oil. Biogas, produced either from cow dung or any biomass, has been used for almost 100 years in India as cooking fuel. It can easily be used to run diesel gensets. The microutility could buy biomass residue from villages and use it to produce biogas.

Biodiesel, produced from non-edible oils like Karanja, Neem or Jatropha, can also be used by diesel gensets. There is a national technology mission on biodiesel, and large-scale plantation of some of these crops is planned. However, for it to become a viable alternative to diesel, it is necessary that the present crop yields are increased manifold.

In India, ethanol is produced mainly from molasses, a by-product of the sugar industry. However, with the government promoting a 5% ethanol mix in petrol for automotive uses, ethanol production needs to be increased. Other crops, which require less inputs than sugarcane and grow faster, can be used. Sweet sorghum is a multipurpose crop which produces grain, sweet juice from its stem and the bagasse is excellent as cattle feed. Besides, it uses almost 50% less water than sugarcane and is a 4-month crop, so farmers can grow two crops/year on the same land. Sweet sorghum planted on the same area where grain or fodder sorghum is grown can yield about 2,000 million litres of ethanol and 10 million tonnes of grain every year.

Similarly, spoiled grain, which cannot be used for human or cattle consumption, can also be used for ethanol production via the starch hydrolysis route. Recently, US and European scientists successfully tested a technology for using any agricultural residue for ethanol production.

Pyrolysis oil is similar to diesel and can be used in the diesel gensets directly. It is produced by rapid combustion of dry agricultural residue. India produces more than 400 million tonnes of agricultural residue every year — potentially, pyrolysis oil equivalent to 86 million tonnes of diesel can be produced in a year. This is nearly 60% of the total oil demand of the country. This oil has been successfully tested in 5 MW diesel gensets in Europe.

Renewable liquid and gaseous fuel production in rural areas could become a Rs 20,000-30,000-crore/year industry, bringing wealth, electricity and water to villages. But for this plan to work, a national mission on electricity and water production needs to be set up to provide grants for setting up such power plants and encourage government, corporate sector and NGO partnership in this area.

The writer is founder of Nimbkar Agricultural Research Institute, Maharashtra.

Sustainable development for rural poor

Anil K. Rajvanshi



Development and deployment of technologies specifically designed for the two-three billion rural poor can help improve their lifestyles and livelihoods, while bringing them in mainstream development process. Technology intervention will also help in rural employment generation. Thus the north, from where most of the new technologies originate, should encourage rural technology development and its availability on very soft terms for e.g., make freely available drug recipes, charge very little for technologies etc.

Most of the technology efforts in the past for providing basic facilities to rural areas have been based on a "tinkering" approach, meaning a small adjustment here and there, and using "low" or appropriate technology. This approach, which has been used by aid agencies, normally resulted in incremental changes like development of improved cookstoves or better bullock carts. Tinkering, however, has barely made a dent in the quality of life of poor people. And often, the introductions of these technologies brought other problems such as increased workloads for women.



Noorie lantern with cooking arrangement

I believe that sophisticated—or "high"—technology is needed to convert efficiently the locally available resources and materials into useful products. This is the hallmark of evolution where natural systems evolve into very efficient materials and energy converters.

In this process, size reduction and sophistication of system takes place. Some of our designs and technologies are following the size reduction route, for example, computer chips, cellphones, power plants etc. Technology developers should follow this strategy in developing rural technologies. In fact, much more sophisticated thought and high technology is required for solving rural problems since the materials and energy resources available in these areas are fewer and often only available in "dilute forms". The strategy of high technology could be used in poor areas of the world to allow maximum energy and materials to be extracted for useful end products.

Strategy

Three technology areas need to be given priority for rural areas:

1. Provision of clean cooking fuel and stoves.
2. Provision of adequate lighting.
3. Availability of clean drinking water.

Cooking and lighting constitute ~75 per cent of total energy used by rural households. Together with the provision of clean water, the total energy used from locally available renewable resources like biomass becomes quite large. I believe that by using technology to improve the availability of above three items - clean cooking fuel, lighting, and clean water - to rural areas, a quantum jump improvement in the quality of life for the poor would be achieved.

The engine of rural development has to be fueled by locally produced energy. Thus efficient biomass, solar and wind technologies need to be developed. Since they are low-grade energies, very efficient energy converters are needed to provide useful end products. Emerging high technology areas like biotechnology and nanotechnology can provide solutions.

For example, liquid and gaseous fuels from biomass can provide clean cooking fuel. High technology biogas digesters running on locally available biomass and in conjunction with space age storage materials to store this gas can revolutionise the cooking energy industry in rural areas. These storage materials are similar to what is being used for hydrogen storage for fuel cells and other applications.

Similarly, ethanol, biodiesel and pyrolysis oil from locally available biomass resources can provide clean cooking fuel. NARI has developed a high tech stove running on low concentration ethanol/water (50 per cent and above) mixture. This safe mixture can be easily distilled in rural areas and can provide clean cooking fuel. Breeding techniques for crops and using genetically modified bacteria for fermentation can further help in increasing the yields of these fuels from the biomass resources so that less land is utilised for energy producing crops. Liquid fuel production from biomass will also help create rural wealth and employment through the creation of possibilities.

The strategy for rural lighting should be based on renewable liquid fuels and small-scale electricity producers. Nanotechnology can help in producing better mantles for biodiesel or alcohol lamps. These mantles can glow and produce light efficiently at lower flame temperatures thereby effecting energy savings. Similarly, nanotechnology can also help in providing more durable and unbreakable mantle materials. Our institute has developed a very efficient multifuel lantern called Noorie, which produces light equivalent to that from a 100-watt bulb. This lantern runs on kerosene, diesel and with slight modifications on ethanol. With efficient and durable mantles these lanterns can provide very good light for rural households.



NARI ethanol stove

Recent developments in materials technology has also made it possible to produce very efficient small steam engines for power generation. Similarly small-scale (~100 kW) gas turbines, fuel cell plants etc., running on renewables can be used for powering light sources in rural areas. Nanoengines producing 10-20 W of power and running on ethanol or methanol can power LED lamps for lighting thereby bypassing the need for bulky storage batteries.

Nanotechnology may also help to produce cheap and efficient photovoltaic (PV) systems for rural areas.

In the field of clean water production, nanoparticles based filters are helping to purify water. For rural areas, a micro-utility which can produce both power (~100-500 kW) and clean water would be a great boon. This utility company can produce power through renewables and the heat from flue gases can be used to produce clean water either through distillation or simply through boiling it. This will help in increasing tremendously the power plant efficiency. The utility can also access water resource by rainwater harvesting techniques.

Conclusions

The outlined strategy can help improve the quality of life of rural poor. It will have other benefits:

1. The use of renewables will help in improving local and ultimately global environment.
2. Fossil fuels will be conserved. These can then be used as raw material for chemicals and value added products. Using less fossil fuels might help reduce world conflict since the pressure on fossil fuels from emerging economics like India and China could be lessened. It is therefore in the interest of the North to provide the latest energy technologies to developing world at very soft terms.
3. Electricity and liquid fuel production from biomass would increase rural wealth and generate employment. Preliminary economic analysis shows that in India alone this could be a $6 billion/year industry.
4. New technologies will create huge market for technology providers.
5. Providing clean fuels, light, and clean water will help bring the 3 billion people into the mainstream of progress.

Thus I believe that the provision of high technology for meeting the basic needs of rural poor together with their spiritual strength may provide a new model of sustainable development and in the process may teach the North a lesson or two in sustainability.

[Excerpted from a talk given in the forum 'Spirit and Sustainability' at ISES Solar World Congress 2005, Orlando, Florida, USA, August 8-12, 2005.]

(The writer is Director of Nimbkar Agricultural Research Institute (NARI), P.O. Box 44, Phaltan, Maharashtra 415523. He can be contacted at anilrajvanshi@gmail.com)

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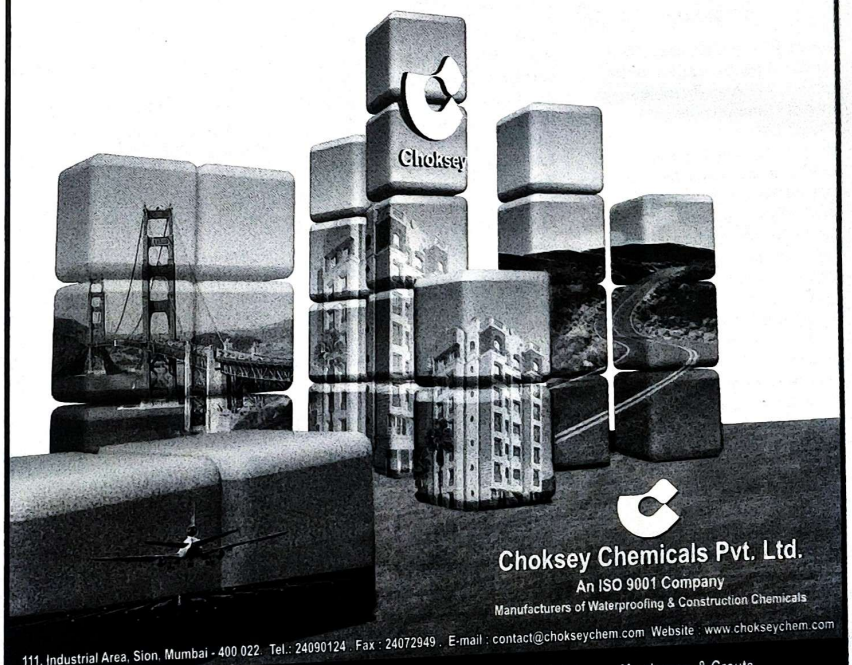
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Realising Gandhi's village ideal

Times of India - 19/10/2005

By ANIL RAJVANSHI

This is the Age of Electricity. Yet, 55-60% of rural India has no electricity; drinking water supply is poor and a majority of rural population uses 180 million tons of biomass every year as fuel for cooking using primitive, inefficient and smoky chulhas. Rural India hasn't really changed much since Mahatma Gandhi's time.

Villages can easily get electrified if modern hi-technology synergises with locally available resources. Biomass is an abundantly available local resource, obtained from agricultural residues. The 600 million tons of agricultural residues India generates every year can theoretically produce 70,000 MW of electric power. A hi-tech biogas producer can generate biogas with energy of about 13 MJ per kg of biomass, which is similar to that produced by burning these residues in a power plant.



Freshly harvested biomass contains about 50% moisture. For using it in power plants or gasifiers one has to reduce the moisture content to about 10-15%. Drying biomass requires energy. The freshly harvested biomass can be directly fed into biogas reactors to produce gas, saving considerable amount of energy and time. Besides, the slurry produces excellent fertiliser and soil conditioner.

For a biogas economy to succeed, it needs efficient biogas producers. At present, biogas is produced inefficiently in fixed and floating dome systems, requiring considerable amount of cowdung and other nitrogenous material. It is not suitable for a household with less than three to four cattle. Then there are problems of gas production during winter and improper mixing of inputs like biomass, night soil and cowdung.

Biogas reactors should be so designed that the production/unit of biomass inputs is maximised. This can be done by properly maintaining pH of the slurry, temperature and other biochemical indicators. Use of genetically engineered microbes can also increase gas production efficiency. A village-level microutility company can be set up in rural areas which will buy locally available raw materials like cowdung and biomass, and use them in these reactors for power generation and supply the gas for cooking and other purposes.

Europe has an installed electric generating capacity of about 2,500 MW from biogas alone. Besides there are reports that cars and buses are running on compressed biogas. The raw gas, which is a mixture of methane and carbon dioxide, is scrubbed to remove carbon dioxide and the resulting methane is compressed for use in automotive applications. In Sweden, an experimental train is being run on compressed biogas. In India, extra biogas can be used for running modified autorickshaws and two-wheelers.

Biogas-powered diesel gensets can also produce clean drinking water as a by-product. The strategy of using locally available agricultural residues-based biogas gensets will produce electric power, excellent fertiliser and clean drinking water for the village. Besides the excess biogas can also be used to provide clean cooking fuel.

A village-level utility company can set up a 500 kW biogas powered diesel genset which can supply enough electricity for an average village with a population of 2,000-3,000. The high temperature exhaust gases from these plants can distil or boil water via a suitably designed unit, which can be attached to the genset. A 500 kW power plant can produce about 100,000 litres of clean drinking water every day. In producing both electricity and clean water, the power plant efficiency will jump from the 35% to around 65%.

The microutility company could own the plant, whose shares in turn could be owned by villagers, and be managed professionally, without the political pitfalls of a cooperative society. The microutility could also lease village-level transmission lines and infrastructure from the local State Electricity Boards (SEBs) at a social cost, based on the cost of electricity most SEBs charge farmers.

A national biogas technology mission should be set up to help research institutes do R&D for hi-tech biogas reactors, provide soft loans for entrepreneurs to set up such microutilities and to encourage government, corporate sector and NGO partnership in this area.

The writer is director, Nimbkar Agricultural Research Institute, Maharashtra.

RENEWABLE ENERGY

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ISSN 0971-9296 Vol 33 Jan-Mar 2006

Strategy for Rural Electrification

Anil K Rajvanshi, *Director, Nimbkar Agricultural Research Institute (NARI)*



THE electricity situation in India is really precarious. In Maharashtra alone there is a shortfall of about 4,000 MW (peak), and without any generation capacity being added, it will become worse. The worst affected are rural areas where electricity outages of 12-16 hours are the norm. Besides the rural population, this has also affected the agricultural industry.

The Government of Maharashtra, which has been the main provider of electricity in the state, has no money to install additional capacity. However the new Electricity Act of 2003 provides a mechanism to address electricity shortages in India. Now a private company can produce, distribute and sell electricity. Nevertheless it seems that most major players such as Tata Power, Reliance, etc. are interested in supplying electric power only to big cities and industrial clusters, and not to rural areas.

In this context, an alternative strategy for rural electrification has been submitted to the Maharashtra Electricity Regulatory Commission (MERC), and is under active consideration presently. The basic tenet of the strategy is to supply 500 kW electric power to each village by setting up a micro utility company (MC) for supplying electricity using the infrastructure of the existing Maharashtra State Electricity Board (MSEB) grid. The basic components of the strategy are as follows:

- **Electricity supply:** It is envisaged that a 500-kW genset powered by any fuel will produce electricity. This could be either biogas, producer gas, diesel, petrol, kerosene or ethanol. Besides, the micro utility may also utilize solar PV, thermal or wind generators to produce 500 kW. The idea is to produce reasonably priced electricity from any fuel, but preferably renewables. The 500 kW generation provides enough electricity for a village of 2,000-3,000 during the night, and for mostly irrigation purposes during the day.

The use of a 500 kW genset can also allow the use of flue gases at 300-400°C for either boiling or distilling contaminated water.

contd on pg 19



Vilasrao Salunkhe
'Pani Baba'
1937-2002

Water has to be treated as a common property resource with all villagers having equal rights and access to it.

Shri Salunkhe pioneered the radical technological and social innovations that repaired and restored degraded watersheds and guaranteed each family within the community an equal share of the water harvested.

It was in 1972, after the terrible drought that affected some 400,000 people in Maharashtra, that Shri Salunkhe realized that environmental regeneration and watershed development with the full participation of the community was the only solution. Conserving soil and harvesting water was given top priority. Slowly production from the land increased and water was treated as a common property resource.

Shri Salunkhe won the International Inventors Award, Sweden in 1985 for his rural technology initiatives, and the Jamnalal Bajaj Award for meritorious social service in 1986.



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contd from pg 1

The water could either be from a rainwater harvesting tank, river, canal or any other source. Thus the MC can sell both electricity and clean drinking water to villages, thereby enabling the overall efficiency of the 500 kW genset to be doubled to about 65%. This will also help in energy conservation.

■ **Distribution and sale of electricity:** It is envisaged that the micro utility company (MC) will lease the village grid from the existing state electricity distribution company (MSDCL) at a "social cost". This is the cost taken into consideration by the Government of Maharashtra when supplying power to rural areas. The leasing of existing infrastructure by the MC offers two advantages – it provides backup power for the utility, so that at the time of maintenance or breakdowns it can draw upon the SEB's power. Secondly, the existing MSDCL infrastructure, that is lying almost idle since there is hardly any electricity flowing through it, can start earning money for itself.

The sale of electricity by the MC will follow the same norms as those of the existing MSDCL. The cost however will have to be worked out based upon actual conditions.

■ **Stakeholders:** There will be three stakeholders in this project – the promoters who set up the MC, the state electricity distribution company that owns the infrastructure of electric lines, poles, transformers, etc., and the villagers/consumers. The promoters and the consumers will own the company.

The Government of India has recently proposed a new policy of rural electrification in which they have mooted the idea of *panchayats* and *zilla parishads* to run and own such micro utilities. This suggestion is fraught with danger since neither the zilla parishads nor the panchayats have the knowledge or the training to run such utilities.

Similarly there is also a suggestion in some quarters that the model should be based on a cooperative. However the cooperative model, especially in the sugar sector, has been discredited, and hence may not be a fit model to emulate.

It has been proposed by me that major corporate leaders in the electricity sector like Tata Power, Reliance, etc. should enter this field. They have the managerial and technical expertise required to run such MCs. They can initiate a few projects with the help of local NGOs so that the corporate-NGO-Government partnership can be fostered. If a few projects are successful, then they can be replicated all over the country by a franchising mechanism.

For existing private power companies, the MC concept also makes good business sense. Each MC will cost about Rs 3,500,000, and with about 20,000 villages being identified by the Government as totally unelectrified, around Rs 7,000 crore for these companies can be generated.

■ **Policy issues:** To foster a corporate-NGO-government partnership, the following issues have to be addressed:

- The capital cost of the plant should be either heavily subsidized or loans should be available on very soft terms. The Government has recently begun a scheme called *Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)*, which provides 90% capital subsidy for unelectrified villages. However for real rural electrification to take place it is necessary that this subsidy should also be provided to villages that get equal to or less than 8 hours of electricity. After all, the capital cost of such projects is about 1/6th that of big power projects (500-1,000 MW). Thus capital subsidy can really help the government's rural electrification efforts.
- Depending upon the fuel used, the cost of electricity from such MCs may vary from Rs 5-20/kWh. For fixing tariffs, all such utility companies are supposed to approach MERC as per the 2003 Electricity Act. Maybe a blanket policy by MERC is required that all such MCs, which are going to produce power, equal to or less than 500 kW in rural Maharashtra, should be exempt from MERC's tariff structure. The local NGO, villagers, and the promoter can fix this tariff in an amicable way.
- If the MCs use only renewable energy for generating electricity then they may be given further soft credit for leasing MSDCL infrastructure.

Finally it should be pointed out that India Inc cannot prosper if rural India lags behind. Without economically viable rural industries, the whole country will remain backward. The electrification of rural India is the first step in that direction. This also provides an excellent opportunity for the Indian corporate sector to participate in nation building by building rural electricity infrastructure. That was Mahatma Gandhi's dream, and I am sure that is the dream of every Indian.

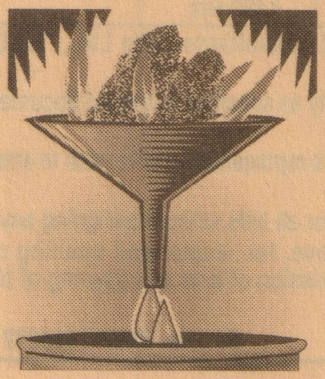
Shri Rajvanshi is the Director of the Nimbkar Agricultural Research Institute in Phaltan, Maharashtra
Email: anilrajvanshi@gmail.com

Go for ethanol

Times of India - 09/06/2006

By ANIL K RAJVANSHI

Sixty per cent of rural India lives in utter poverty, with no electricity. Rural India uses 180 million tonnes of biomass every year for cooking, creating indoor pollution and health hazards. The WHO estimates that 1.5 million deaths per year are caused by pollution from chulha smoke. Making available locally grown clean and renewable cooking and lighting fuel can improve the quality of rural life. Liquid fuels are far superior to solid fuels for cooking because of their clean combustion, higher energy density and existing supply chain convenience. Ethanol is one of the best as it is an excellent substitute for kerosene and burns better, with no particulate output or unpleasant smell. Its combustion is almost as clean as that of LPG.



Ethanol can be produced from any sugary or starchy material and is presently produced world over from sugarcane and corn. However, as the ethanol economy grows, there is a need to produce it from a crop, which uses much less water than sugarcane and also produces food. Sweet-stalk sorghum (jowar) is one such crop. Its earhead produces grain, which can be used for making bread; its sweet stem has nearly the same amount of sugar as in sugarcane and hence the juice can be fermented and used for ethanol production. The bagasse, left after juice extraction, together with leaves is excellent fodder for animals. So from the same piece of land one can get food, fuel and fodder. Besides, sweet sorghum uses nearly 50 per cent less water than sugarcane to produce the same amount of sugar. It is a four-month crop so farmers can grow two crops per year from the same piece of land. Also the energy output/input ratio of producing ethanol from sweet sorghum is very positive.

The Nimbkar Agricultural Research Institute (NARI) introduced sweet-stalk sorghum in India in late 1960s and has developed the technology for its production and usage as a cooking and lighting fuel. An efficient ethanol cooking stove running on 50 per cent ethanol-water mixture has been developed. This mixture, which can be distilled efficiently in a rudimentary rural distillation unit, is safe and less flammable fuel than pure ethanol. The stove works just like an LPG stove with high and low flame settings. Field-testing shows that rural users like this stove.

NARI has also developed a lantern running on ethanol. It burns cleanly without smoke or smell. The ethanol lantern produces light equivalent to that from a 100W bulb. Presently the government is propagating solar lanterns running on PV cells. They use compact fluorescent lamps costing over Rs 2,000, producing light equivalent to that of a 40W incandescent bulb. This light is not sufficient for children's reading or for doing household work. The CFL lanterns are only twice as efficient as ethanol lanterns when we consider the power plant-to-light efficiency. With a little more R&D, we could make ethanol-based lanterns more efficient than electric lighting. In the absence of grid electricity to most rural areas, liquid fuel lanterns running on ethanol provide an attractive alternative.

To facilitate the use of ethanol for rural households the government should remove excise duty. The cost of ethanol from sweet sorghum after excise duty removal can be as low as Rs 10-14 per litre. The use of ethanol for rural applications will also create great wealth in rural areas in terms of growing crops and producing ethanol from them. It is estimated that the industry to produce ethanol for such purposes for rural areas can be of the order of Rs 2,00,000 crore a year and can make the ethanol economy 100 times bigger than the present one based on automobile consumption only.

Another unique way in which ethanol can be used for lighting in rural areas is via electricity generation through two-wheelers. For this, existing two-wheelers need to be converted to a hybrid vehicle where the small internal combustion engine running efficiently on ethanol or petrol charges the battery to run the electric motor system. When the vehicle is not running the system can act like a power plant producing electric power. Every two-wheeler can potentially become a mobile power plant.

The writer is director, NARI.

Energy experts haul govt. over coals

Times of India - 09/06/2006

Salute 'Green Oscar' winner Anand Karve

By Rahul Chandawarkar

Pune: Renewable energy technologists have hailed scientist Anand Karve who won the prestigious Ashden award, or so-called British 'Green Oscar', for sustainable energy for a second time in four years (TOI, June 16) and slammed the government for not encouraging entrepreneurs in this field.

In an exclusive interview to the *Times of India* on Thursday, Karve had said that financial support from the government to entrepreneurs in the field of renewable energy was not forthcoming.

While terming Karve's achievement as excellent, Anil Rajvanshi, director, Nimbkar Agricultural Research Institute (NARI), Phaltan, lambasted the government for neglecting the renewable energy sector completely.

"The ministry for non-conventional energy (MNES) sources is sitting with a whopping budget of Rs 1,000 crore, but they have no results to show," he said.

According to Rajvanshi, as the capital cost involved in renewable energy was high, it was necessary for the MNES to extend soft loans to entrepreneurs to make their businesses viable. "However, very little support is forthcoming."

He said, "Ten per cent of all the energy produced in Germany was from renewable sources, while the corresponding statistic in India is an abysmal 0.001 per cent."



Rajvanshi



Revankar

On Karve's compact biogas plant, Rajvanshi said it needed to use more sophisticated technical equipment like sensors to make it more efficient. "This is necessary to generate maximum biogas. In Europe, they produce close to 3,000 mega watts of power through biogas. And in Sweden, a train runs on biogas."

Rajvanshi said NARI had developed a technology to use sweet sorghum (a variety of jowar) to produce cooking and lighting fuel. "We have developed a very efficient ethanol stove running on 50% ethanol-water mixture. It works just like an LPG stove with high and low flame setting. Field tests have shown that the rural housewives like this stove and compare it very favourably with an LPG stove."

Yogesh Kulkarni, executive director of the Vigyan Ashram in Pabal village, 70 km north of Pune, said, "We are in regular touch with Karve and he has always been a source of inspiration for us."

The ashram, which was started by the late Shrinath Kalbag, has been running a unique one-year entrepreneurship course, titled Diploma in basic rural technology, for rural youth.

Kulkarni said it was Karve's use of kitchen waste in his compact biogas plant that had opened their eyes to the use of alternatives to the traditional cattle dung for biogas plants.

The biogas plant at the ashram generates electricity for the entire ashram, he said.

Presently, the students at the ashram are working on making light emitting diodes which can work on solar energy.

Hemant Revankar, managing director, Bipin Engineers Private Limited, manufacturers of solar water heating equipment, hailed Karve's achievement. "This is a proud moment for Pune city and an encouragement for entrepreneurs like us," he said.

Expressing dissatisfaction at the lack of government support in the field of renewable energy, Revankar said, "The soft loans offered by the MNES to customers of solar water heating equipment is reduced to nought because of excessive paperwork and lack of interest on the part of nationalised banks."

Revankar also pointed out how the co-operative banking sector, which had evinced interest in dispensing the MNES soft loans, could not do so because of lack of approval from the finance ministry.

Agriculture policy for energy security

Dr. Anil K. Rajvanshi

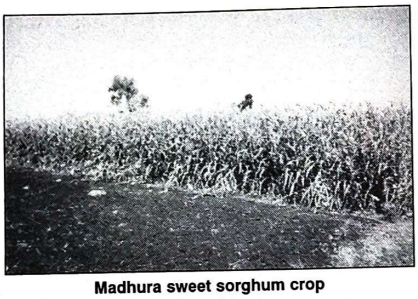
After nearly two years and about Rs 1.5 crore of expenditure, the National Commission on Farmers (NCF) has put out a document outlining a policy for farmers, which leaves much to be desired. Even the ministry of agriculture, which set up the commission, has recently remarked that no worthwhile recommendations have come out of the commission's report. In fact, the most important recommendation of the commission is to set up some more commissions and committees! The NCF is a shining example of what Albert Einstein once said, "Existing problems cannot be solved by the level of thinking that created them."

What the NCF and the planners who sit in Delhi forget is that farming is presently non-remunerative. This is because of the policy of low support price for farm produce by the Government of India, which is the biggest buyer of agricultural commodities. Thus no amount of soft financial packages will prevent farmers' suicides or help marginal farmers. These are all short-term solutions. There is a Chinese saying "You can feed a farmer for a short time by supplying him fish, but if you teach him how to catch fish he will feed himself the rest of his life." Thus if we create a long-term agricultural policy which brings wealth to the countryside without much government support then automatically the farmers' lot will become better. Such an agricultural policy will help the marginal farmers as much as the big farmers.

The only way in which farming can become remunerative is when it is tied up very closely to the industry. This can happen when farms also produce energy besides food. Thus a new agricultural policy should facilitate setting up fuel producing industries in rural areas.

Three types of fuels can be produced easily via agriculture - liquid fuels like ethanol or biodiesel; gaseous fuels like methane; and electricity. When the major demands of fuel and electricity of the country are met by the farm then wealth will automatically flow into rural areas.

The ethanol liquid fuel can be produced from agricultural crops like sweet sorghum, sugarbeet, sugarcane etc., while biodiesel can be produced from a horde of oil producing crops like Jatropha, Karanja and Castor. Estimates are that the agriculture-based liquid fuel industry can be of the order of Rs 40,000-50,000 crore per year thereby providing increasing wealth to farmers.

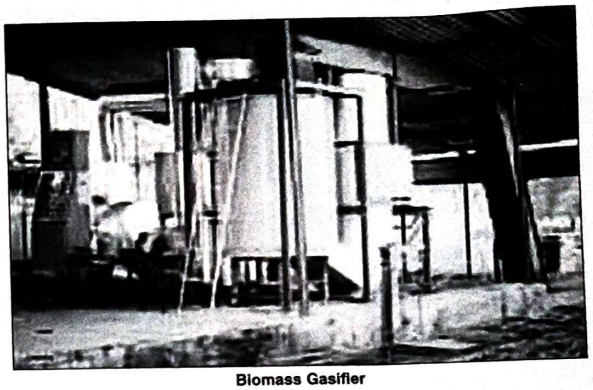


Madhura sweet sorghum crop

In any agriculture only 25-40 per cent of the produce is food. Rest 60-75 per cent are the agricultural residues. These residues can produce both electricity (via biomass-based power plants) and ethanol fuel (via enzymatic hydrolysis process). Any marginal farm can produce agricultural residues even if the main food crop fails. On an average a farmer can get an extra income of Rs 2,000-4,000 per acre from the residues alone if they are used for producing energy. This income can give him benefits even in case of a distress sale of his crop.

Today about 600 million tonnes per year of agricultural residues are produced in India. Most of these residues are burnt in the fields as a solution to the waste disposal problem. This not only wastes the precious resource but also produces tremendous air pollution. Theoretically, these residues can produce ~80,000 mw of power year round. This is around 60 per cent of the total installed electricity capacity of India. Part of these agricultural residues can also be used via the methane (biogas) route to produce fertiliser for the crops and gaseous fuel to either run rural transport, irrigation pump sets or be used as cooking gas. The production of electricity via residues will require an investment of about Rs 160,000 crore. However, it will bring about 10 times more money to rural areas in terms of revenues from electricity generation. Besides it can potentially create almost 120 million extra jobs in rural areas.

As the industrial demand for fuels and electricity increases, we might see large tracts of farmland coming under fuel crops and food production may suffer. Thus there is a need to debate the food vs. fuel issues. Consequently, R&D needs to be done on crops which produce both fuel and food from the same piece of land. Sweet sorghum is one such crop. Nimbkar Agricultural Research Institute (NARI) pioneered the development of this crop in India. Sweet sorghum produces food (jowar grain) from its earhead, fuel from its stem (the sweet juice can be fermented to produce ethanol), and bagasse and leaves make excellent fodder for animals or they can also be used as fuel in power plants. Similarly, if the agricultural residues can be broken down by suitable enzymes to produce ethanol then both food and fuel can be produced from all food crops.



Biomass Gasifier

A policy has to be made by the Government of India that by 2015 AD around 80 per cent of all our liquid fuel and 30-40 per cent of all our electricity will have to be produced from renewables, especially biomass. This will result in tremendous growth in the farm sector and can provide a solution to the problems of the marginal farmers. In recent times alcohol economy in Brazil and biogas economy in Europe has brought prosperity to farmers in these countries.

For farming to increase so that it can take the load of food and energy production, adequate water supply has to be assured. Thus there is a need to change the existing irrigation policy in which the government owns most of the irrigation water bodies. A new water act on the lines of the Electricity Act of 2003 needs to be enacted so that adequate water can be economically available for agriculture.

When farms start supplying energy besides food it will generate additional wealth for the 65 per cent of the population who live in rural areas. Production of energy from agriculture will be a single most important step in bringing prosperity to rural India as well as energy security to the country. ●

(Anil K. Rajvanshi is Director, Nimbkar Agricultural Research Institute (NARI), Phaltan, Maharashtra. He can be contacted at anilrajvanshi@gmail.com.)

TECHNOLOGY

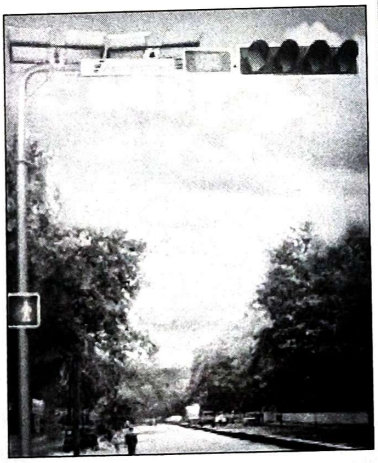
Traffic signals run on solar energy

Public sector Bharat Electronics Ltd, which manufactures electronic systems primarily for the defence services, has launched state-of-the-art traffic signals using ultra bright LEDs powered by solar energy—which reduce power consumption by 85 per cent. The systems are configured to meet the requirements at each junction in terms of the number of signal heads, programming for the duration of signal and blinkers, and the configuration of battery and solar modules. The systems are also configured for fully AC and DC operation or a hybrid configuration.

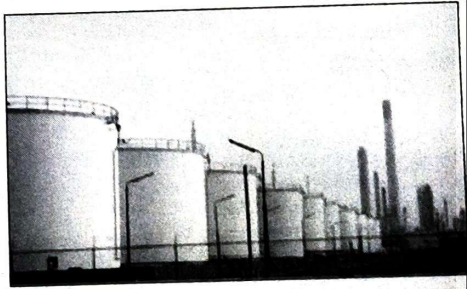
Features include:

- Signal heads conform to NEMA standards for environmental sealing
- Compatibility with other traffic controllers for synchronisation
- Eco-friendly solar power system independent of grid power.
- Low voltage DC supply ensures better electrical safety
- Solid State Charge Controller with battery/SPV array/load voltage and current monitoring.
- Special optical design ensures 100 per cent conversion of energy emitted from LEDs to visible light (as compared with 2 per cent conversion in conventional signals)
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- Long life maintenance-free LED lamps and solar modules
- Signal heads controlled by intelligent programmable logic controller

Contact: Bharat Electronics Ltd, Nagavara, Outer Ring Road, Bangalore, Karnataka 560045. Tel: 080-25039300; Fax: 080-25039305



Jet cleaning device for sludge cleaning



Cleaning the inside of giant storage tanks at refineries and bulk chemical storage facilities is set to get a whole lot easier, safer and cheaper, with the development of an innovative jet cleaning device, CSIRO, one of the largest and most diverse scientific institutions in the world, has announced. The patented R-jet device is placed inside the tank where it generates a high-velocity rotational jet which re-suspends sediment, and keeps solids suspended so they can't settle and create the tough layer of sludge that currently has to be removed manually.

This typically involves workers using water cannons, shovels or even mini-bulldozers and can mean a tank being offline for several months. Regulations require tanks, which can measure more than 60 metres in diameter, to be regularly inspected - meaning regular cleaning.

The R-jet, developed by the Canberra, Australia, based company, is considered a breakthrough for the petrochemical industry, and one that should save millions of dollars.

Dr Jie Wu, who led the CSIRO team that developed the R-jet device, says the idea o an automated device arose when researchers were helping Exxon Mobil to help decommission its Adelaide refinery couple of years ago. "We came up with th idea of a high velocity rotating jet located in the tank for suspending and mixing an cleaning operations so people don't have to do it manually," says Dr Wu.

Contact: Dr. Dilip Manuel, Commercial Manager - Industrial Research Services, CSIRO Manufacturing and Materials Technology, Canberra, Australia. Tel: +61 9545 2176 (International); E-mail: Enquiries@csiro.au

The Times of India, Pune
Wednesday, December 27, 2006

'Hooch tech' put to good use by IITian

Develops stove, lamp that run on ethanol



A woman cooks on an ethanol stove, which was designed by Anil K. Rajvanshi (inset) of the Nimbkar Agricultural Research Institute

By Abhay Vaidya/ TNN

Pune: The rudimentary technology which is behind the production of illicit liquor in rural areas could be put to healthy use in meeting the vast demand for lighting and clean fuel for cooking in India's five lakh villages.

Anil K. Rajvanshi, a Phaltan-based IITian who has devoted his life to addressing the energy needs of rural India, has developed an innovative stove and a lamp that works on locally-made 'low concentration ethanol.' This fuel is much cheaper than kerosene and has distinct advantages over biogas, which requires bulky equipment for gas production.

Rajvanshi, who heads the Nimbkar Agricultural Research Institute (Nari) at Phaltan in Satara, received the 2001 Jamnalal Bajaj Foundation award for the use of science and technology in rural development. His institute has pioneered a number of initiatives in agriculture, renewable energy, animal husbandry and sustainable development.

Speaking to TOI, he pointed out that illicit alcohol units in make-shift backyards across the country use rudimentary distillation units to produce alcohol with 40-60 per cent ethanol-water concentration. Taking this into consideration, Nari, developed a cooking stove and a lantern that is fuelled by a 50 per cent ethanol-water concentration.

The large-scale production of this fuel in rural areas, through simple distillation of any sugary biomass such as sugarcane or sweet sorghum, would not only provide a very safe and efficient cooking fuel but also go a long way in reducing the hardship of women who use firewood, biomass or kerosene for cooking.

The misuse of the ethanol concentration for drinking could be prevented by doping the fuel and making it unfit for human consumption.

Field trials by women farm labourers, who did their cooking on wood stoves, were immensely satisfying as they found it very easy to light and run the stove, there was no smoke or smell and the eyes didn't burn.

"Some women who cook on kerosene stove said this stove is much better than the kerosene stove because it is completely silent and no smell comes out after extinguishing it. Some of them also felt that it is much safer than kerosene stove since it requires much less pumping," Rajvanshi said.

Rajvanshi explained that the heart of the stove is the ethanol burner assembly, which allows the ethanol-water stream to evaporate and ethanol to combust. "The burner is designed so that the water in the fuel converts into steam. The resulting flame has no smell and the carbon monoxide emissions near the stove are well within the acceptable range."

While the stove could be mass-produced for Rs 800-1000/ piece, low concentration ethanol could be produced around Rs 16/litre, which is highly affordable as compared to Rs 25/litre for kerosene or Rs 310 per cylinder for LPG.

"There is a need to change government policies so that low-grade ethanol can be made available as a cooking and lighting fuel for household purposes. It will not only improve the quality of life for the rural population but also help in creating wealth in these areas," he said.

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Farming For Energy

Generate power, fuel from agriculture residues

Anil K Rajvanshi

A farmer is a multi-purpose entrepreneur. His farm produces multiple crops which he sells in the market. Yet only 25-40 per cent of his crop fetches him money, whereas the rest of his produce (agricultural residues), which constitutes 60-75 per cent of the product, is totally wasted. Often, he has to burn it in the fields.

There is perhaps no other economic activity where 60-75 per cent of the product is simply junked. No industry can survive on such low productivity. But for agriculture this wastage is taken for granted. Apart from the government's low support prices, it is wastage that has made farming non-remunerative.

In this situation, no amount of subsidies or government support prices can help farmers. Farmers will really benefit when they get money for agriculture residues. This can only happen when these residues can be used to produce energy for powering India. Any marginal farm can produce agricultural residues even if the main food crop fails. On an average a farmer can get an extra income of Rs 2,000-4,000 per acre from residues alone if the waste is used to produce energy. This income can give him benefits even in the case of a distress sale of his crop.

India generates 600 million tonnes of agriculture residues every year. Most of this is burnt by way of waste disposal, as the farmer wants his fields ready for next crop. A small part of the residues may be used for mulching, for fuel (for cooking) or as fodder.

Three types of energy can be produced from these residues. Liquid fuels such as ethanol or pyrolysis oil; gaseous fuels like biogas (methane) and electricity.

Ethanol, which can be used as transport, fuel can be produced by lignocellulosic conversion of residues. Extensive R&D is being done the world over to optimise this technology. A few large plants in Canada, Japan and US have already been set up with this technology. Nevertheless, a lot of research needs to be done to make ethanol production from residues economically viable and environmentally sound. Theoretically, residues in India can produce 156 billion litres of ethanol, which can take care of 42 per cent of India's oil demand for the year 2012.

Pyrolysis oil is produced by rapid combustion of biomass, which is rapidly condensed so that the ensuing vapours or smoke yield oil that is nearly equivalent to diesel. Around 20 per cent of charcoal is also produced as a by-product in the process. The charcoal can be used as cooking fuel for rural households. Pyrolysis oil technology was developed in early 1990s in Europe and North America and is now maturing. A few plants have been set up in Canada, US and China. Nevertheless, R&D is still needed to make it suitable for use in existing internal combustion engines. Recent experiments in Sweden on running a 5 MW diesel power plant on pyrolysis oil have been successful.



India can produce about 400 billion kg of pyrolysis oil from its agricultural residues, which is equivalent to 80 per cent of India's total oil demand for 2012.

Similarly, these residues can theoretically produce 80,000 MW of electric power all the year round through biomass-based power plants. This power is about 60 per cent of the present installed capacity of India. The power plants could either be small scale (500 kW), running on producer gas from agricultural residues, or medium scale (10-20 MW) running on direct combustion of these residues. The technology for this is very mature and there are thousands of such plants running all over the world.

A part of these agricultural residues can also be used via the bio-digester route to produce fertiliser for crops and methane gas to either run rural transport, irrigation pump sets or kitchens. Another stream can also be used to produce fodder for animals. Hence, the residues, if properly utilised, can produce fuel, fodder and fertiliser besides taking care of a huge chunk of India's energy needs. Which stream of residue conversion technology is eventually followed will depend upon existing market forces. Energy from agricultural residues in India can generate 30 million jobs in rural areas.

As the demand for energy increases we may see huge tracts of land coming under energy crops like sugarcane for ethanol production or jatropha for producing biodiesel. This can adversely affect food production. These effects are being felt in US where huge acreage under corn has been diverted for ethanol production. Similarly, large tracts of land in Brazil are being directed from food production to growing sugarcane for ethanol production. The use of agricultural residues for energy production is, therefore, the best way to settle the food vs fuel debate.

When farmers are forgotten, long-term sustainability of the country is threatened. When farms produce both food and fuel, their utility becomes manifold. Sixty-five per cent of India's population depends on farming for its livelihood. If energy from agriculture emerges as an area of interest, India can emerge as a high-tech farming community.

Agriculture is trapped in a low growth rate of 2-3 per cent per annum because it is non-remunerative. If food and energy are produced from the same piece of land, agriculture growth will be rapid.

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Energy for the rural poor – Challenge for the global community†

Anil K. Rajvanshi

The dismal situation and poor quality of life in rural India is because of unavailability of energy. It is shown that sophisticated technology can help solve this and other problems of rural areas. A call is made to the global technological community to help provide such technologies. Finally issues of how much energy is needed for sustainable development are discussed.

Keywords: Energy, global community, rural poor.

THIS article related to globalization is divided into three parts. The first part reports the plight of the rural poor. In the second part we will discuss the technologies that might help in alleviating their poverty. The last part will focus on how the global community can participate in lighting up the lives of the rural poor, especially focused on those in India. However, the methodology developed can be used in any part of the developing world.

Just to give you some idea regarding the plight of the rural poor in India, consider the following:

(1) About 60% of the rural population or almost 400 million people live in primitive conditions[1]. They have no electricity and their lives are in darkness. They use inefficient kerosene lanterns for light, and primitive and ancient biomass cook stoves for cooking. Modern technology somehow has not touched their lives. Besides, the poor quality of these devices creates tremendous household pollution. Thus there are estimates that around 300,000 deaths every year are attributable to inhaling smoke from these inefficient and primitive stoves[2].

(2) Around 54% of India's population is below 25 years of age, and most of them live in rural areas and are unemployed. Creation of rural-based enterprises is the best way to create wealth, improve their quality of life and bring these people into the mainstream of development. Our national leaders are talking about making India the third biggest economy by the year 2012. Unless the lives of this population are improved, this will not be possible. The so-called India poised slogan which the Western and Indian English media harp on is not reflected in the lives of the rural population.

(3) There is tremendous poverty in rural areas. According to the World Bank estimates, around 3 billion people live on less than 2 dollars per day[3]. In India alone there are around 260 million people or one-fourth of the population who live on one dollar per day or less[4]. Except for barely filling their stomach, this meagre amount of money allows them neither the acquisition of material goods like utensils and clothes, nor any quality products like light or decent cooking fuel. These low wages also prompt the rural poor to have a large family, so that each member can earn one dollar per day and increase the daily family income.

(4) Because of poverty there are continuous suicides by farmers. In the last 10 years about 100,000 farmers have committed suicide[5]. This is according to the government figures. I am sure the actual figures are much higher. Farming is presently non-remunerative. This is partly because of the policy of low support price for farm produce by the Government of India, which is the biggest buyer of agricultural commodities. Secondly, increased aspirations of farmers to improve their quality of life have made them get into a never-ending debt of loan sharks. Thus no amount of soft financial packages will prevent the farmers' suicides or help the marginal farmers. These are all short-term solutions. There is an old Chinese saying, 'You can feed a person for a short time by supplying him fish, but if you teach him how to catch fish he will feed himself for the rest of his life'. Thus there is a need to create a long-term agricultural policy which brings in wealth to the countryside without much government support. This will automatically improve the farmers' lot.

(5) There is a serious energy crisis in rural India. In various States there is a tremendous shortage of electricity. For example, per capita consumption of electricity in rural areas is only 250 kWh/yr or about 2% of that in the US[6]. As we all know, without electricity very little

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development can take place and this is reflected in these areas. In Maharashtra, which is one of the most industrialized states of India, about 5000 MW peak shortfall exists[7]. Blackouts and brownouts are a regular feature of daily life. In rural Maharashtra where I live, around 12–15 h of daily blackout takes place. This has created havoc in the lives of people. Besides, it has spawned a whole industry of small and inefficient fossil-powered electric gensets of 1–10 kVA capacity, which produce huge pollution in rural areas.

(6) Last year India imported about 45 billion dollars worth of petroleum products. With ever increasing price of crude, this number will increase in the coming years and will put a heavy burden on balance of payment account[8]. Besides, the uncertainty of supply from various countries can play havoc with the energy security of India.

I feel most of these problems have come because of non-governance. In a corrupt society which unfortunately India is, the first casualty is governance and we are seeing the effects. Part of this non-governance has been a very poor energy planning, which has resulted in unavailability of adequate energy in rural areas.

Energy is the basis of life. All other activities flow from it. Therefore, availability of affordable energy in rural areas is the only way to improve the quality of life of its inhabitants.

I believe that one of the best solutions to the above problems is energy production via agriculture and the development of high technology devices to provide the basic needs of cooking, lighting and clean water to rural areas. Energy production via agriculture can produce rural wealth by providing energy, creating employment, increasing wages and providing services to improve people's quality of life. In the development of a viable energy technology and in producing devices, the role of global technological community becomes important and I will discuss in detail what it can do.

Production of energy

Three types of fuels can be produced easily via agriculture. Liquid fuels such as ethanol, pyrolysis oil, or biodiesel; gaseous fuels like methane, and production of electricity. Though the basic technology for their production exists, much more R&D is needed for increasing their efficiency and making them affordable. This is the challenge for the global technological community.

Ethanol fuel can easily be produced from agricultural crops like sweet sorghum, sugarbeet, sugarcane, corn, etc. However, to produce it in an affordable and environmentally sound manner will require tremendous inputs of biotechnology and good engineering. Thus research is being done in the US and all over the world in converting agricultural residues into ethanol via the enzymatic hydrolysis process.

Similarly, biodiesel can be produced from a horde of oil-producing crops like jatropha, soybean, pongamia, castor, etc. Though the production of biodiesel is quite easy, there is a need to increase the yield of oil-bearing plants and to develop internal combustion engines which can run on a whole bouquet of biodiesels. Presently the high-speed diesel engines require tailored biodiesel.

Pyrolysis oil on the other hand, is produced by rapid combustion of biomass and then condensing rapidly the ensuing vapours or smoke to yield oil which is nearly equivalent to diesel. Pyrolysis oil still requires much more R&D in terms of producing it economically, improving its keeping quality and making it suitable for use in existing internal combustion engines. Nevertheless, recent experiments in Sweden on running a 5 MW diesel power plant on pyrolysis oil have been successful[9].

In any agriculture only 25–40% of the produce is food. The rest 60–75% forms the agricultural residues. It is these residues which can produce electricity via biomass-based power plants or pyrolysis oil or ethanol fuel. Any marginal farm can produce agricultural residues even if the main food crop fails. Our calculations show that on an average a farmer in India can get an extra income of $50–100/acre per year from the residues alone, if they are used for producing energy[10]. This income can give him benefits, even in case of a distress sale of his crop. The farmer is a multipurpose industrialist producing a variety of outputs from the same piece of land. We do not know of any other industry which can exist or can survive selling only 25–40% of its produce, with the rest being wasted. So why should farming be treated differently? Thus unless and until the farmer gets remuneration for his entire produce, farming will never become economically viable.

About 600 million tonnes of agricultural residues is produced annually in India[11]. Most of these residues are burnt in the fields as a solution to the waste-disposal problem. This not only wastes the precious biomass resource, but also produces tremendous air pollution.

Theoretically, these residues can produce about 80,000 MW of electric power year round through biomass-based power plants. This power is nearly 50% of the total installed capacity of India. Alternatively, they can produce 156 billion litres of ethanol, which can take care of 42% of India's oil demand for the year 2012. Similarly, the residues can also produce about 400 billion kilograms of pyrolysis oil, which is equivalent to 80% of the total Indian oil demand for 2012. Thus the agricultural residues if properly utilized, can take care of a huge chunk of India's energy needs.

A part of these agricultural residues can also be used via the bio-digester route to produce fertilizer for the crops and methane gas to either run rural transport, irrigation pump sets or for cooking purposes. Another stream can also be used for producing fodder for animals. Thus the resi-

dues can produce fuel, fodder and fertilizer. Which stream of residue conversion technology is eventually followed will depend upon the existing market forces.

The production of electricity in India via residues or the use of wood from fast-growing tree species will require an investment of about 35 billion dollars[12]. However, it will bring about ten times more money to rural areas in terms of revenues from electricity generation. Besides, it can potentially create almost 120 million extra jobs in these areas[12].

As the industrial demand for fuels and electricity increases, we might see large tracts of farmland coming under fuel crops and food production may suffer. People who have cars have money and when they give good money for the homegrown fuel, the farmers will put majority of their land under fuel crops. This is already happening in India and will happen in almost any country, including the US. Thus there is a need to seriously debate the food vs fuel issues.

Consequently, R&D needs to be done on crops which produce both fuel and food from the same piece of land. Sweet sorghum is one such crop. Our institute, NARI has pioneered the development of this crop in India[13]. We introduced it in the country in early 1970s. Sweet sorghum produces food (grain) from its earhead, fuel from its stem (the sweet juice can be fermented to produce ethanol) and bagasse and leaves make an excellent fodder for animals. Alternatively they can also be used as fuel in power plants. Sweet sorghum is a thrifty crop and produces maximum sugar per unit of water of any crop known to man. Presently our hybrid MADHURA produces 2000–3000 l/ha of ethanol per year. It is presently planted in large areas of India and has been exported to various countries, including the US.

Similarly, if the agricultural residues can be broken down by suitable enzymes to produce ethanol, then both food and fuel can be produced from all food crops. Extensive research in this field is being done by universities and industry the world over and this technology will be very useful for rural areas of the world[14].

I strongly feel that when the farmers are neglected, the long-term sustainability of the country is threatened. When farms produce both food and fuel, then their utility becomes manifold. Now with the ethanol and biodiesel programmes taking shape in the US, I feel it will again become a land of farmers. In India, 65% of its population depends upon farming and with energy from agriculture as a major focus India has the potential of becoming a high-tech farming community.

Water issues

However, for farming to increase so that it can take the load of food and energy production, adequate water supply has to be assured. To my mind supply of adequate water to poor regions of the world is a much bigger challenge than even energy availability, and where the global technological community can play an important role. Not only is there a water shortage, but lack of clean potable water results in millions of deaths every year due to diarrhoea.

With the green revolution in India, there has been an extensive use of water, resulting in shortage in some parts of the country. This is despite the fact that there is enough rainfall. Every year India receives ~4000 billion cubic metres of rainfall, whereas the present yearly water consumption is only 650 billion cubic metre or 16% of the total rainfall. Thus theoretically we have enough water, but the rainfall is not evenly distributed over India and it comes in short spells, thereby pointing to the need for rainwater harvesting and storage programmes.

However, the issues of rainwater harvesting and its supply to the community in rural areas raise a question of who will own the water bodies. This is a touchy issue and quite a few developing countries are grappling with it. I feel there is a need for the local governments to develop policies so that rural water utilities can be set up which can harvest the rainwater, store it and then supply this water to a village throughout the year. These water utilities may also be able to buy water from the government through the existing canal system. Presently, all the water utilities in India are owned by the government and this leads to corruption in supply of water and its very inefficient usage. In 2003, the Government of India passed an electricity act allowing for the first time the private players to produce, sell and distribute electricity anywhere in the country. This act has allowed power producers to break free from the clutches of inefficient and corrupt government power utilities. I feel a similar water act will help in the supply of water to rural areas.

Two most important issues for rural development are supply of clean water and electricity. NARI has developed a strategy, whereby it is shown that a microutility producing 500 kW power for rural areas can easily use the heat of the flue gases of the engine to boil or distil water to make it potable[15]. The 500 kW power plant is sufficient for a village of 2000–3000 people. The combined cycle of electricity and water production will increase the efficiency of the power plant to almost 65–70% from the existing low of 35%. Nevertheless, R&D is needed in improving the distillation process and developing a compact water-treatment plant, so that potable water can be delivered at affordable price.

Development of efficient energy devices

The rural population has the same aspirations as you and I have. With increased exposure to mass media, their desire to improve their lot has also increased. Thus technology intervention is required in using local resources to provide products and services to these people. Filtering-down

approach of urban goods to rural areas will not work in the long run because of lack of infrastructure, resources and different local situations.

This is a technological age. Whatever we do is governed by technology and thus technology plays an extremely important role in our lives.

Most of the technological efforts in the past for providing basic facilities to rural areas have been based on a 'tinkering' approach, meaning a small adjustment here and there, and using 'low' or appropriate technology. This approach, which has been used by various agencies, normally resulted in incremental changes like development of improved chulhas (cook stoves) or better bullock carts. Tinkering, however, has barely made a dent in the quality of life of the poor people. And often, the introduction of these technologies brought other problems such as increased workload for women.

I therefore believe that sophisticated or 'high' technology is needed to convert efficiently the locally available resources and materials into useful products. This is the hallmark of evolution, where natural systems evolve into very efficient materials and energy converters. In this process, size reduction and increased complexity of the system take place[15]. Some of our designs and technologies are following the size reduction route. For example, computer chips, cellphones, power plants, etc. have reduced in size, increased in complexity and become more efficient. Technology developers should follow this strategy in developing rural technologies. In fact, much more sophisticated thought and 'high' technology are required for solving rural problems since the materials and energy resources available are limited and often in 'dilute forms'. Thus the strategy of high technology allows maximum energy and materials to be extracted for useful end-products.

A few examples where high technology intervention can provide a quantum jump in the quality of life of the rural population are given below. These examples are for lighting and cooking, since they constitute 75% of the total energy used in the rural households.

Strategy for lighting

The history of civilization is the history of lighting. Lighting allowed mankind to extend daylight hours and hence increase productivity and commerce. It is a sad state of affairs in India that nearly 60 years after independence, around 60% of the rural population is without electricity. They use a simple but very inefficient hurricane kerosene lantern for lighting. Similar is the story of the rural poor in other parts of the world. For example, in some parts of Africa, around 80% of rural population has no electricity.

NARI has therefore developed a very efficient lantern called Noorie[16]. This lantern produces about 1350 lumens (lm) of light, which is equivalent to that from a 100 W electric bulb and runs either on kerosene, diesel or with slight modification on low-concentration ethanol. It is reasonably priced at US$ 10, is very light-weight, efficient and also doubles up as a cooking device.

However, in developing the lantern we became aware that the stumbling block in improving its efficiency was the thermoluminescent (T/L) mantle, which produces light. Presently, these T/L mantles have an efficacy of 2–3 lm/W. In comparison, a 100 W light bulb has an efficacy of 10–13 lm/W and a compact fluorescent lamp (CFL) ~50–70 lm/W. If by R&D we can match the mantle efficacy with that of a light bulb then the liquid fuel lighting can become better than the electricity-based lighting. How can this happen?

Consider the power plant-to-light efficiency (PPL) or the amount of energy that you finally get in your household socket. The PPL of CFL is only 10–14 lm/W or nearly that of the light bulb. This is so since 70% of the energy from the thermal power plant is lost as heat and further 30–33% energy loss takes place in transmission and distribution (T&D). The T&D losses in developing countries are high because of electricity theft. Thus only 20% of the total fuel energy is available as electricity in the household socket. Research in producing better T/L mantles therefore can provide very efficient decentralized liquid fuel lighting.

These T/L mantles have not changed since the early 1860s, when Welshbach in Germany made them out of radioactive thoria/ceria mixture. Many people have tried to improve them, but have not succeeded. We still do not understand how light is produced from this mixture. For example, the 1500–2000°C flame produces light as if it is coming from a 3600°C blackbody. I feel that the emerging field of nanoscience can help in developing materials, which can glow efficiently even at low temperatures of 1000–1500°C. Besides, R&D is necessary in making these mantles out of sturdier materials like carbon composites, ceramic-based thermoluminescent materials, etc. Presently, these mantles are very fragile and break easily.

Ultimately for decentralized light based on chemical fuels we should try to copy the bioluminescence mechanism of a firefly, where visible light is produced very efficiently and at room temperatures. Similarly, it is possible that mankind one day will develop a strategy where sunlight will photocatalyse two liquids, which when mixed together will produce brilliant light. The time is now to work on this strategy and that is the challenge for the global community. With grid electricity still a distant dream for a major portion of the rural areas, efficient liquid fuel lighting needs to be encouraged.

Simultaneously, we have to continue exploring decentralized, electricity-based lighting, since 100 years of R&D has gone in to perfecting it.

NARI has pioneered the strategy of biomass-based power plants for providing energy self-sufficiency at the taluka level[12]. (Taluka is an administrative block in India

consisting of a town and about 100 contiguous villages and is equivalent to a county in the US, both in terms of land area and population.) The taluka strategy was based on producing power from agricultural residues and wood from fast-growing trees. Thus the biomass available in a taluka could easily support two 15 MW biomass-based power plants. This strategy became a national policy and was implemented by the Government of India from 1996 till 2002. Consequently, 40–50 biomass-based plants of 6–10 MW capacity each were set up in different talukas, but the whole programme had a mixed success. This was because the Electricity Act of 2003 had not come into being. With the advent of this act, there are indications that there will be an explosive growth of such biomass power plants all over the country.

In the range of 10–500 kW power, R&D is needed in biomass gasifier-based plants, steam engines, sterling engines or biogas-based gas turbines. There is a whole array of technologies to be developed so that power is generated from renewable fuels, which are biomass-based, environment-friendly and produced locally. This is the challenge for the global community.

On a micro scale, in the range of 10–20 W, there are exciting possibilities for lighting. For example, there are indications that a new class of materials is being researched, which can produce three electrons per photon thereby providing a quantum jump in the efficiency of solar cells[17]. These type of solar cells together with ultra capacitor batteries (instead of regular lead-acid batteries) can revolutionize rural lighting.

Similarly, there has been a quantum jump in the efficiency of thermoelectric elements – a device which converts heat directly into electricity[18]. These elements can be incorporated into any biomass cook stove and about 40–50 W of power can be produced. This power is enough to run a small fan, so that the combustion efficiency of the cook stove is nearly doubled and part of the power can be stored in ultra capacitors for lighting. We recommended such a strategy about four years back and Philips International last year has produced such a stove.

Work is also in progress in the US in producing 10–20 W micro engines[19]. These engines can run on ethanol or methanol and hence can eliminate the need for heavy storage batteries, since the energy is stored in the fuel. Thus an extremely efficient, compact and light-weight, decentralized lighting system can be thought of, which consists of a micro engine powering a light emitting diode (LED) or CFL lamp.

Cooking energy strategy

Only liquid and gaseous fuels produced renewably can provide clean cooking energy. Two fuels fall into this category. Liquid fuels like ethanol or biodiesel, and gaseous fuel like biogas.

Ethanol is an excellent fuel for cooking. NARI has developed a stove which runs on 50% ethanol–water mixture[20]. This mixture is very safe and can be easily distilled in a backyard still with much less energy than that required to distil high concentration of ethanol. The stove has a maximum thermal capacity of 2.5–3 kW and has a flame control for simmer and high settings, so that it works just like an LPG stove. Large-scale testing in the field has been positive and almost all the rural women who have tried it, compare it favourably with an LPG stove. However, in order that ethanol can be used as a rural household fuel, the presently tough excise laws have to be modified. The Noorie lantern also works on 50% ethanol–water mixture. Thus we have developed high-tech, environmentally sound cooking and lighting systems which can run on homegrown fuel.

Biodiesel is another fuel which can be grown locally. Various governments all over the world are embarking on a major programme of using biodiesel for running automobiles. However, R&D is required in improving its yield per ha and also its use in cooking stoves. Presently, there are no reliable cooking and lighting devices which can run on biodiesel.

A clean gaseous fuel that can be produced from the existing biomass sources is biogas. Biogas has been used extensively in the rural areas of India. However, it is produced inefficiently in fixed and floating dome systems and requires considerable amount of cowdung and other nitrogenous material. It is not suitable for a household with less than 3–4 cattle. Besides, there are problems of gas production during winter and improper mixing of mixed inputs like biomass, night soil, cowdung, etc. Biogas, which is a mixture of methane and carbon dioxide, cannot be liquefied and requires high pressure of more than 100 atmospheres to compress it so that it can be used over extended periods.

Thus R&D is necessary in two areas. One is in the development of extremely efficient biogas reactors, so that the production per unit of biomass inputs could be maximized. The second is to develop appropriate storage materials which could store biogas at medium pressures.

Research is in progress in methane storage and recently experiments have been conducted in storing it at medium pressures of less than 40 atmospheres in hydrates, porous carbon and porous organic structures[21]. There is thus a need to develop low-cost storage materials so that biogas could be stored in them for usage in households. New materials developed through nanoscience and nanotechnology can be used for this purpose. Thus a scenario can be thought of where a micro-utility company in rural areas will buy locally available raw materials like cowdung, biomass, etc. and will use them in a high-tech biogas reactor to generate biogas efficiently. This gas can be stored in small cylinders lined with gas-absorbent materials and transported to households, just like the present LPG cyl-

inders. This will revolutionize the cooking system in rural India and other parts of the world.

Optimization of biogas production from a reactor requires sophisticated electronics-based controls and biochemical engineering technology. A small utility can afford to do it, whereas for a household it might be too costly. Tinkering around with existing biogas reactors will not solve the problem. A sophisticated science and technology input has to be brought to bear on the problem for optimizing biogas production in rural areas.

The use of high technology in lighting and cooking energy can result in considerable economic development in rural areas. Our estimates show that this energy industry both for fuel and device production can be of the order of 10 billion dollars per year in India alone[21]. Since fuel production will be rural-based, it can bring in substantial wealth to these areas both in terms of biomass production and also in processing it to produce fuel.

Role of the global community

There are two ways in which the global community can help in improving the lives of the rural poor around the world. One is by providing liberally the technologies, knowledge, intellectual property, funds, etc. on extremely soft terms and secondly, by putting their own house in order. I will discuss these in detail below.

In recent years many rural development experts, especially C. K. Prahalad of University of Michigan have talked about the bottom of pyramid approach to development[22]. They contend that helping the rural poor makes good business sense and the example of Mohammad Yunus, who last year won the Nobel Peace Prize for his micro credit work in Bangladesh, attests to that. What Prahalad says makes sense, since we saw that the energy industry for rural areas in India could be of the order of 10–20 billion dollars per year and that empowering the rural poor to produce energy through agriculture could improve their lot. However, I feel that we should look beyond the issues of business and getting financial gains from the rural poor.

In this era of globalization, the whole world is one global village where the actions of one part directly affect those of the others. Thus global warming, environmental pollution and migration of a large number of people from one country to another for better opportunities are all a result of the globalization process.

One of the impacts of globalization has been the rise of international terrorism. In fact, poverty breeds terrorism which ultimately affects all of us. It is therefore in the interest of the North to help the South, so that wealth is created in its rural areas and poverty removed. This can happen when the North, which has the resources to produce new ideas, technologies and financial instruments, uses them for providing services to rural areas as outlined above. In this process, the US universities, corporations and businesses will need to work with developing-country NGOs and businesses in a meaningful and cooperative relationship. I also feel that the governments of both the North and South should have a minimal role in such ventures.

The second way in which the global community, especially those in the North can help the world is by reducing their consumptive lifestyle. The North, especially the US is the role model for the world. The citizens of the world try to copy the US lifestyle, even though it is totally unsustainable. For example, if every citizen of this earth follows it, then we will need the resources of four earths to sustain it[23]. Recent reports have shown that last year there were 1 billion obese people (mostly in the developed world) as against 600 million malnourished ones in the developing world[24]. For global sustainability this consumptive lifestyle has to change. In this age of instantaneous communication, whatever happens in New York, London or Paris is immediately copied by the elite of the developing world. Hence if the North shows the way towards sustainability, then it will have a great impact on the rest of the world.

Every citizen of this earth aspires to a decent lifestyle. I believe such a lifestyle is possible with much less energy than is consumed by an average US citizen. For example, in the US the per capita energy consumption is 350 GJ/yr, whereas in India it is a low[25] of 10 GJ/yr. I feel energy consumption of 50–70 GJ/person/yr or one-fifth that of the US can provide a decent and emotionally satisfying lifestyle[26]. This type of energy consumption will put much less pressure on the earth's resources besides reducing substantially the environmental pollution. However, it can only happen if we follow the maxim of 'simple living and high thinking'. This is the genesis of spirituality which helps us become internally secure and less greedy for materials and resources[27].

To my mind the highest spiritual work for mankind is to help poor people improve their quality of life. As engineers and scientists we can do it by providing right-sized technologies at the right 'price' to the poor. It is a doable goal. What is needed is the direction and will of leaders in both the North and South to make the life of poor people better.

Once our basic needs are satisfied, all of us long for some meaningful existence. Even the very rich are looking for some meaningful actions and purpose in their life. Happiness cannot be obtained by money alone. It only comes when there is some meaning to life. That meaning, I feel comes from helping other less fortunate people and by giving back something to the society. I believe that the whole purpose of our existence is to increase personal and societal infrastructure. Personal infrastructure includes our health, happiness and general well-being. By improving our personal 'infrastructure', we become better human beings and it helps in our emotional growth and evolution. By giving back to the society so that its 'infrastructure' increases we help in mankind's evolution. Both

these activities when carried out simultaneously, can give us great joy and satisfaction.

Finally, the rural population of the world has a great strength of being satisfied with fewer material comforts. Partially this is because they never had many material goods in the first place and partly because they have not been corrupted by the so-called notions of 'good life'. Thus I believe that the provision of high technology for meeting the basic needs of rural poor together with their spiritual strength may provide a new model of sustainable development and in the process may teach the North a lesson or two in sustainability.

I will end this article by telling you a story, a tale from our ancient scriptures, the *Puranas*[28]. It is a typical Indian story of a sage and his disciples. The sage asks his disciples, 'When does the night end?' And the disciples say, 'At dawn, of course'. The sage says, 'I know that. But when does the night end and the dawn begin?' The first disciple, who is from the tropical south of India which is similar to South Florida replies: 'When the first glimmer of light across the sky reveals the fronds on the coconut trees swaying in the breeze, that is when the night ends and the dawn begins'. The sage says 'no'. So the second disciple, who is from the cold north, ventures: 'When the first streaks of sunshine make the snow gleam white on the mountain-tops of the Himalayas, that is when the night ends and the dawn begins'. The sage says, 'No, my sons. When two travellers from opposite ends of our land meet and embrace each other as brothers, and when they realize they sleep under the same sky, see the same stars and dream the same dreams – that is when the night ends and the dawn begins'. I feel that when the citizens from the North light up the lives of residents of the South through technology and resources, then it will bring in the dawn of a new age for the civilization and promote global harmony.

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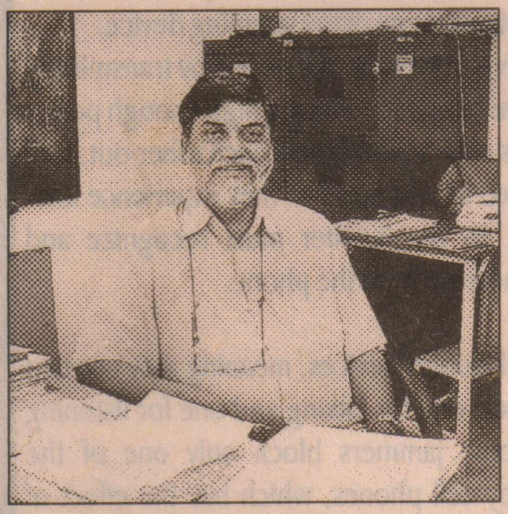
Times of India - 30/10/2007

Nari goes to China

UNDP Invites Rajvanshi To Share Insights on Rural Energy

TIMES NEWS NETWORK

Pune: Phaltan-based Nimbkar Agricultural Research Institute's (Nari) director Anil Rajvanshi has been invited by the United Nations Development Programme (UNDP) to share his thoughts on rural energy development with the Chinese government.



THE CHOSEN ONE: Anil Rajvanshi

Nari, under Rajvanshi, has pioneered work related to development of renewable energy technologies for rural areas, and the Chinese government has expressed a desire to learn from these experiences.

A statement released by Nari, said the government of China was in the process of preparing a national energy law, and rural energy issues figured prominently in it.

Though China has managed to achieve a lot in the overall development of its urban areas, the rural areas on the other hand have by and large remained neglected, leading to discontent and frustration in the rural population.

The statement said the Chinese government was preparing the energy plan on a massive scale, to develop the impoverished rural areas. "Lack of energy is one of the main reasons for this poverty, and hence the energy law," the statement said.

As a part of this effort, the government of China is organising an international symposium in November, in the field of rural energy, in order to learn from the experiences of various international experts.

Rajvanshi is one of the six experts, and the only Indian, to be invited for the symposium. Other experts, scheduled to speak at the symposium, are from Brazil, United States, Europe and Africa.

Besides giving a talk on Nari's efforts, Rajvanshi will also visit some of the Chinese rural energy projects.

DNA - Pune

Your views on news : *DNA* takes delight in presenting you a highly interactive forum to express your views on current issues. Tap that keyboard and make yourself heard — by neighbours, *babus*, *mantris* and everyone who matters. Speak Up. Question, criticise, comment on anything or anyone. E-mail us on punespeakup@dnaindia.net or Fax: 5667981 - *Editor*

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Team Speak Up: Avinash Rajput & Kiran Dahitule

Six days a week, *DNA* will dig up historical trivia about our city that you perhaps never knew. And, if you know a 'Poona-trivia' that others don't, dash it across to us. Your entry might be selected for publication, and fetch you a cash prize. E-mail us your trivia on **punespeakup@dnaindia.net** along with your name, contact number and postal address



Where is the Poona I knew?

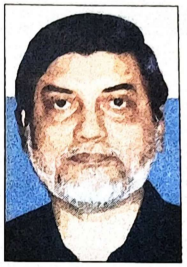
Pune has developed immensely, but the progress has come at the expense of peace and the city's endearing middle-class feel

Anil Rajvanshi

I live in Phaltan, a small town 100km south-east of Pune. The air here is less polluted than in the city and the pace of life is slow. Pune -Poona of old- in 1970s and '80s was similar to what Phaltan is today. But the Pune of today is one of the most polluted and congested cities of India. Traffic jams, driving sense — or lack thereof — and the overall ambience of the city have deteriorated beyond comprehension. Pune always had a conservative middle class feel to it, but with the influx of IT and other high tech industries, that atmosphere is on the decline.

I first came to Poona in December of 1971, as part of a trip that we IIT-ians had to undertake. Along with 73 batchmates, I made the trip in a hired train bogey which was parked in the station yard as we toured the city. Poona then was a very quiet town with a lot of greenery, very little traffic and cool December air. My wife, who then lived in Gultekdi, has similar memories and recalls hearing jackals howl at night. Today, Gultekdi is one of the most crowded parts of Pune.

In the 1980s, it would take me around 15 minutes to reach my friend's bungalow in Aundh from the railway station bus stand. Today, the same distance will cost you 45 minutes, that too, after inhaling all possible pollutants from noisy vehicles. For some of us, who come from rural towns, Pune is like a gas chamber. There is a constant irritation in the throat. In face, while coming down the Dive ghat from Saswad, one can see a pall of smog hanging over Pune.



my city
my voice

I have been flying out of Pune airport since 1983. It used to be a small tin shed with one or two flights per day. Because of the monopolistic nature of Indian Airlines, I was often stranded at the airport for an entire day without any idea about when the flight would take off. Today, the scene is as chaotic with scores of flights, poor airport infrastructure and confusion at the runway where one does not know who is coming and who is going.

The general chaos that Pune finds itself in is thanks to rapid expansion — both, in population and industry — which has taken place without proper planning. The messy traffic scene is claiming lives every single day. The congestion and pollution is symptomatic of the mess the city is getting into.

Pune can help itself a great deal by switching to eco-friendly vehicles in some parts. Plying electric bicycles, electric three wheelers or even electric buses on MG Road or Laxmi road can reduce pollution immensely.

At one time, Beijing was grappling with a severe pollution problem. However, when I visited it in November, I found the air to be much cleaner than that in any Indian city. This was achieved by banning all diesel-powered vehicles, extensive use of electric buses and only allowing vehicles which complied with Euro II and Euro III emission standards.

These simple measures transformed a city with small roads and severe traffic snarls into an amazingly clean city. I am sure Pune can take some lessons from it.

Rajvanshi is an alumnus of IIT Kanpur and director, Nimbkar Agricultural Research Institute, Phaltan

my byline...

ARE GIRLS



Outsiders don't take enough precautions

Manoj Mudholkar, Editor

Lessening their sweat

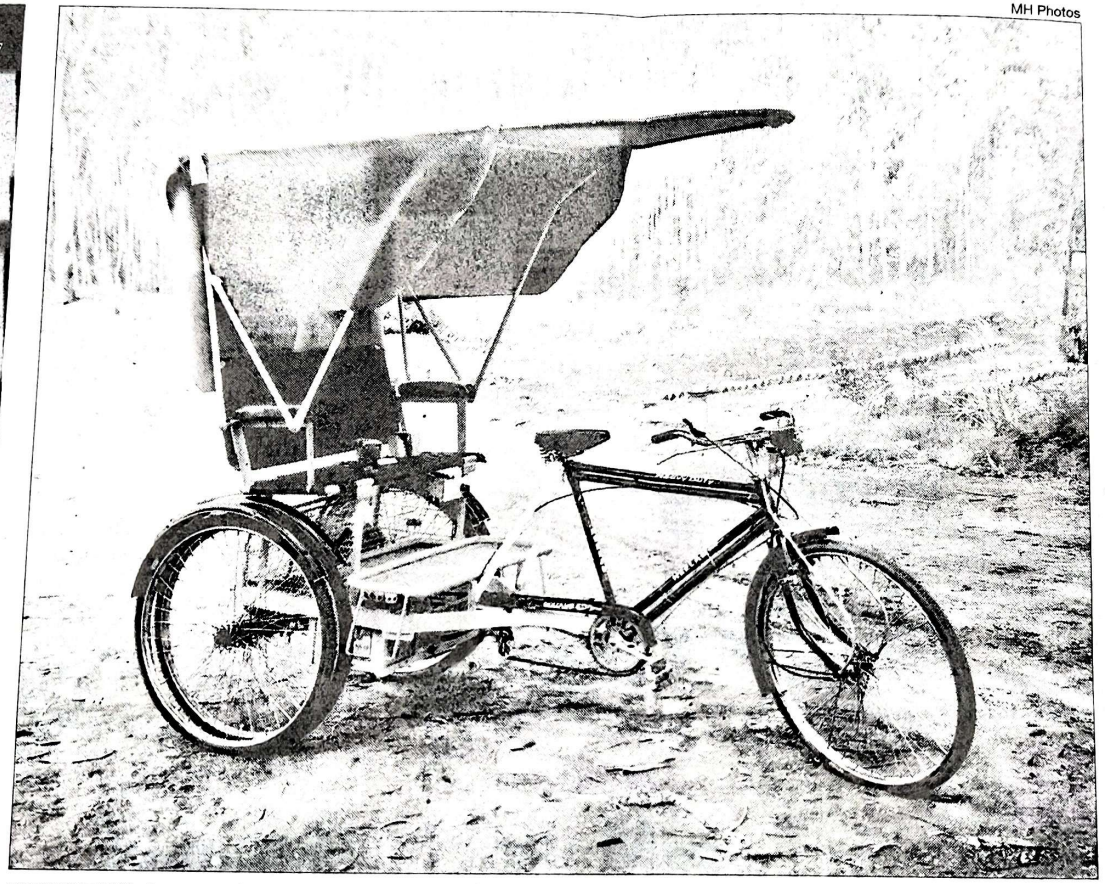
The Maharashtra Herald - 24/01/2008

Kartiki Shastry reports about an environment friendly pedal *rickshaw*



Anil Rajvanshi

MH Photos



INNOVATION: Improved pedal cycle rickshaw that Anil Rajvanshi developed

How can one mechanically haggle over the fare or complain about slow speed when the *rickshaw* puller is a human being, who's sweating it out to give you a comfortable ride? It was this question, this concern about the *rickshaw* driver that led Anil Rajvanshi to the discovery of the Improved Pedal Cycle Rickshaw (IMPRA). These electric cycle *rickshaws* not only reduce the stress required to pull the passengers and pedal the *rickshaw*, but also provide a very environmentally sound, rural and urban transport system for India, Rajvanshi, director, Nimbkar Agricultural Research Institute (NARI) said.

A Ph D in mechanical engineering with specialisation in solar energy, Rajvanshi, who left a very lucrative career in the US to work for rural development in India, is now gearing up to help the estimated 700,000 *rickshaw*-pullers driving close to one million cycle *rickshaw*s on Indian roads.

"The IMPRA is a 65-kilogram pedal *rickshaw* that has three speed gears, with a reduced length of chain drives, back wheel breaking, better suspension and less aerodynamic drag than the existing ones and runs efficiently for seven to 10 years," informed Rajvanshi. He established the energy and sustainable development work at NARI from scratch in 1981 to make it nationally and internationally renowned. Going beyond the Institute's philosophy of solving age-old problems of rural India with the use of modern science and technology, he is also trying to set up *rickshaw*-pullers' cooperative societies in different cities so that they can get loans from the banks to buy the *rickshaw*s.

However, a few of them far away from Pune might be the first lucky ones to benefit from Rajvanshi's innovation. "A Canadian person has approached me and he is planning to buy IMPRA's from us and give them to the pullers in Kolkata," Rajvanshi said, adding that the model has already been exported to a few countries till now.

With a mission to achieve environmentally sound rural development for the last 25 years, Rajvanshi's accomplishment doesn't end with IMPRA. He also has the Motor Assisted Pedal Rickshaw (MAPRA) and ELECSHA to his credit. While the MAPRA uses a manual electronic contact switch that allows the *rickshaw*-puller to switch the motor on or off depending upon his convenience and load, the ELECSHA is an electric cycle-*rickshaw* that has logged more than 6000 kilometres in test runs.

The man, who's all set to ease the burden of the *rickshaw*-puller's back, has always directed his technological expertise towards fulfilling social goals. It was a small lantern that lit the way for Rajvanshi's bright future in the world of science and technology.

During his early stay in Phaltan, the poor electricity situation resulting in frequent blackouts in the city, prompted him to develop a very efficient and improved liquid fuel lantern, using very sophisticated tools of heat and mass transfer, combustion mechanics and fluid dynamics.

This lantern christened NOORIE, named after his first daughter, is a multi-fuel lantern that runs on kerosene, diesel and low concentration ethanol. According to experts, development of NOORIE is the first major advancement since early 1920s in lantern technology.

The lantern, which is more efficient than the available existing designs and is much easier to light, also doubles up as a cooking stove and is in good demand internally and internationally. The lantern and the man have been spreading light where there is none, ever since.

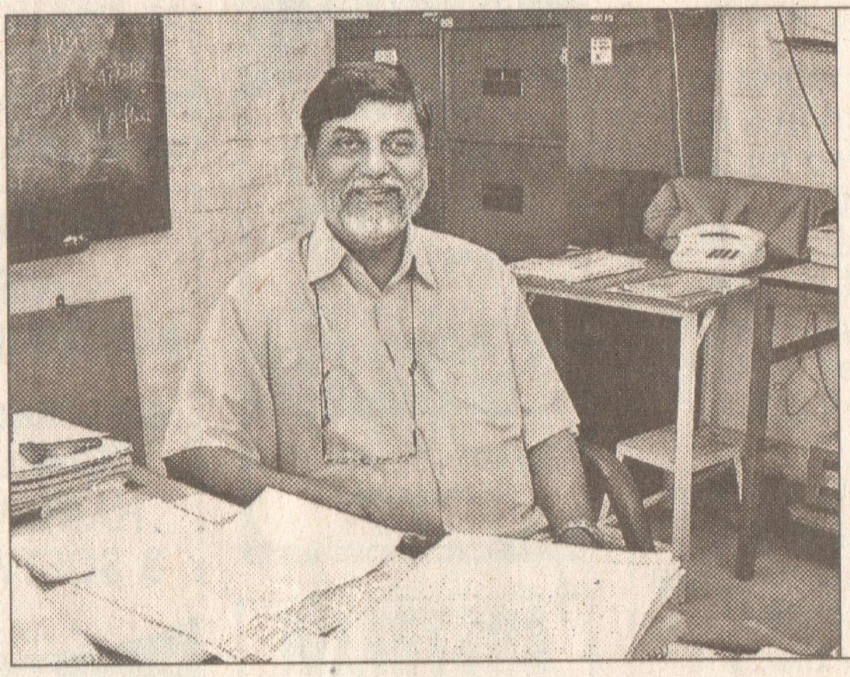
RECOGNITIONS

- Nandini Nimbkar, president of NARI, awarded by University of Florida in 1997
- Anil Rajvanshi inducted in US Solar Hall of Fame in 1998
- Anil Rajvanshi was received the prestigious Jamnalal Bajaj Award in 2001 for application of science and technology in rural areas
- NARI received the FI2CCI Annual Award for Rural Development for 2001-02
- V Singh, the safflower breeder of the Institute, received HARDF Award of Indian Society of Oilseeds Research in January 2003
- NARI's work on electric and improved cycle rickshaws won the Energy Globe Award (the World award on sustainability) in AIR category in 2004
- NARI's founder B V Nimbkar was awarded the Padma Shri in 2006
- The Institute was given the prestigious Vasantrao Naik Award for 2006 for its pioneering contributions to agriculture
- NARI received 2007 CSIR award (science and technology for rural development) for its sheep breeding work

— including 286 civilians, 24 se- groups are under sustained pres- ber of attacks on civilians is the move around," said Bhargava.

TOI, May 4, 2008

Real life hero writes his biography



Anil Rajvanshi, who returned from the US about 25 years ago, applied science and technology to solve basic problems of the rural populace in Phaltan, a town in Satara district. The enigmatic engineer has now written of his experiences in a book titled '1970s America - An Indian Student's Journey', to be released on May 5

Anil Rajvanshi did in real life 25 years ago what Shah Rukh Khan tried to do in Ashutosh Gowarikar's now classic movie, 'Swades.'

An alumni of IIT-Kanpur, with an engineering degree from the University of Florida in the US, Rajvanshi gave up a lucrative job there for the uplift of Phaltan, a small town in Satara district.

Rajvanshi returned to India in 1981 and set up base in Phaltan to run his NGO - Nimbkar Agricultural Research Institute (NARI). After doing pioneering work in electric cycle rickshaws, efficient kerosene lanterns, biomass gasification system, low concentration ethanol stoves and lanterns, he's all set to release his book , '1970s America: An Indian Student's Journey,' based on his life, about revamping Phaltan and his decision to come back to India.

Says Rajvanshi, "When I took the decision, people said I was making a mistake. My bosses in the US tried to dissuade me, saying, "When everybody in the world is coming to the US, it's strange that you are going back." But I told them, India is my own country and I would like to go back and try to do something worthwhile with the knowledge I have gained here."

The basic philosophy of NARI was to solve the age-old problems of rural population using modern technology in a sustainable manner. With various technological changes like collecting water from soil and a multi-fuel lantern called 'Noorie' which produces light equivalent to that of a 100 watt light bulb and can run on diesel and kerosene, Rajvanshi has indeed changed the face of Phaltan.

He has received a number of prestigious awards, such as the Jamnalal Bajaj award, induction into the US-based solar hall of fame, the Federation of Indian Chambers of Commerce and Industries (FICCI) annual award and the Energy Globe award among others.

The book will be released on May 5 by Baba Kalyani, chairman, Kalyani Group, in the presence of Madhur Bajaj, president of the Mahratta Chamber of Commerce, Industries and Agriculture and Rakesh Sharma, chief commissioner of customs and excise, Pune division.

THE TIMES OF INDIA READER'S OFFER

Short stories



■ Maharashtra Navnirman Sena's environment cell stopped illegal tree cutting by a private contractor on Kalyan Road recently. City chief of the cell Sanjay Bhosale and member Shahabaj Punjabi filed a police complaint.

Kamble reviews welfare measures

Vice chairman of National Commission for Scheduled Caste NM Kamble visited Pune division of Central Railways on Wednesday to review the reservation policy and welfare measures undertaken by the division. Divisional railway manager DK Jain briefed Kamble regarding the work and appraised about the action taken by Pune division. He also met the president and office bearers of All India SC/ST Association of Pune division.

Railway gate to remain closed

The railway crossing gate no 588 at Ghorpadi-Mundhwa Road will remain closed for vehicular traffic for ten hours from 10 pm on December 27 to 8 am on December 28. The gate will be closed in view of the works undertaken by the railways of over hauling and examination of the level crossing gate.

Man held for theft

Judicial magistrate (first class) GG Ratkalkar on Wednesday remanded Suraj Sharma (32) of Indore in police custody till December 31. Police had arrested Sharma in connection with the theft of engineering spare parts worth Rs7.5 lakh. A case in this regard was earlier filed by Sanjay Mehtre (38) of Paud Road, who is the manager of Piramgut Real Tech Auto Engineering located at Lavale Phata. Police sub inspector Narayan Narawane said that the suspect, a tempo driver had transported the spare parts of the company from its facility here to Indore. Police said that instead of delivering the consignment at the designated address, Sharma allegedly sold it somewhere else.

Youth electrocuted

Govind Ramsaheb Sarode (20), a resident of Dalvinagar in Chinchwad was electrocuted after working on a construction site located in Bijlinagar in Chinchwad December 10. Following the incident, Chinchwad police booked the house owner Dhanraj Chaudhari (65) for neglecting the safety measures at the construction site. According to Chinchwad police, Sarode was working on the roof from where high-voltage overhead wire was passing. Sarode got electrocuted and was rushed to the Sassoon general hospital, where he breathed his last.

Cry for quality footpaths grows louder in city

NGO forms human chain to draw attention of the civic body towards the plight of pedestrians

DNA Correspondent

Members of the social organisation Lokayat on Wednesday formed a human chain at Mahatma Phule Mandai demanding construction of quality footpaths for pedestrians on all the city roads.

The human chain wanted to draw the attention of the civic authorities towards the lack of footpaths in Pune.

Over 60 volunteers from Lokayat and other organisations in the city formed the human chain alongside a footpath on a traffic-congested road close to the market. The volunteers also prevented private vehicles from occupying footpaths, which are a hurdle to pedestrians.

Lokayat founder Neeraj Jain said that there were no footpaths alongside the roads in the city. "The municipal corporation every year spends around Rs800 crore on various road-related works, but only spends around Rs50 crore on footpaths," he said.

A few roads in the city where footpaths have been built are not in a good shape and mostly occupied by venders and others. At other places, vehicles are parked on the footpaths, he said, stressing that an efficient public transport is the only solution to solve the growing traffic problem in the city.



■ Over 60 volunteers from Lokayat and other organisations formed the human chain.

"This will help reduce the number of private vehicles on the city roads and thus prevent blocking of the footpaths," Jain said.

Members of Lokayat also demanded that the civic body make available footpaths alongside all roads for pedestrians.

Jain said that as part of the initiative to create awareness among pedestrians about using footpaths, Lokayat will organise another human chain on the University Road on January 6.

> Often, existing footpaths are blocked by pipes, holes, hoardings, and other construction material. Cars are parked on footpaths, and two-wheelers are found driving on them.
>
> —Neeraj Jain, Lokayat founder

Currently, the entire emphasis of the Pune Municipal Corporation is on building new roads, widening roads and building flyovers to accommodate the increasing number of cars and other private vehicles on Pune's roads.

"It has been said that the number of private vehicles are increasing at the rate of 600 a day that is more than 2 lakh a year.

The growing traffic congestion, accompanied by a near-complete absence of footpaths, has made walking on Pune's roads a most hazardous task for people. People simply have to manoeuvre their way through the traffic, often causing accidents," Jain and other members said.

NCP to woo professionals in politics: RR

Mumbai attacks have shattered faith of people in govt machinery: RR

Varsha Welankar

Former deputy chief minister RR Patil, who has been recently appointed as the state unit president of the Nationalist Congress Party (NCP), on Thursday said that efforts were being made to regain the trust of people.

He said the NCP, as part of its new strategy, will also try to woo professionals including corporates, lawyers, doctors and others to bring them into the party fold.

Patil, who was in the city, admitted that all political parties including the NCP had to bear the brunt of people after last month's terror attacks in Mumbai.

With an eye on the forthcoming Lok Sabha and state elections, Patil said that his party will work hard to regain the confidence of people and project its secular image.

"We need to work in a corporate style," he said, explaining that one of the priority areas would be to reach out to Generation Next wanting to get engaged in constructive activities. The party, he said, will also try to reach out to people from all walks of life.

Patil admitted that the Mumbai terror attacks have shattered the faith of people in the government machinery. "We need to overcome it by changing our working style," said the former deputy chief minister, who was asked to step down by NCP chief Sharad Pawar.

"Although we have a pact with the Congress, other like-minded secular parties should also give a serious thought to the possible vote division if they fight independently in the next general elections," Patil said.

Nari develops unique ethanol stove-cum-lamp

The stove can also produce power equivalent to a 100 watt bulb

Nilanjana Ghosh Choudhury & Varsha Welankar, Phaltan (Satara)

With an aim to solve two grave problems facing rural India – power and cooking fuel crisis – researchers at the Phaltan-based Nimbkar Agricultural Research Institute (Nari) have developed a unique low-concentration ethanol stove that can also produce power equivalent to a 100-watt bulb.

"It all started with a desire to stop the alcohol menace in rural areas and provide adequate means of cooking fuel when we chanced upon this idea of using alcohol both as a means of lighting lamps and cooking fuel," said Anil K Rajvanshi, director and honorary secretary of Nari.

It took Rajvanshi and his team of researchers and technicians several years before they could develop this single product which could solve both the problems simultaneously.

"First we developed an ethanol lamp and later the cooking stove. But it was only last month that we could accomplish the task of making a lamp-cum-stove which can cook food for at least four persons at one time," Rajvanshi explained.

State-of-the-art centre

Nari is building a state-of-the-art Centre for Sustainable Development at Phaltan.

The estimated cost of the centre will be Rs70 lakh.

The centre would work on a corporate-NGO partnership.

It would promote and work on various researches and studies in agriculture.

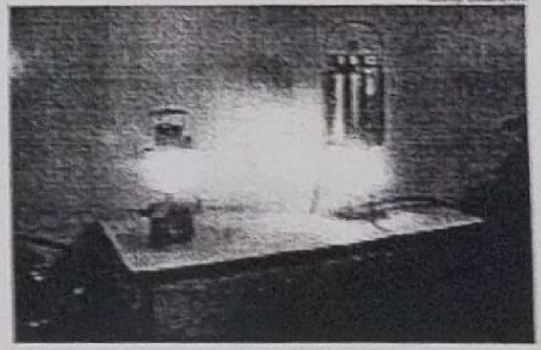
Running on 50% ethanol-water mixture, the output of the stove is quite similar to that of kerosene and LPG stoves and has an easy flame control.

"The 50% ethanol-water mixture is less flammable than pure ethanol, making it safe to handle and hence ideal for household cooking purpose. Moreover, it is easy to distil and can be produced in a one-step distillation process (even using solar energy as the driving force)," Rajvanshi said.

The institute has been flooded with offers for commercial production.

"So far, we have been approached by the World Bank and various government and non-government organisations in Africa to use this technology for mass production of the equipment," Rajvanshi said, adding that Nari is almost in the final stages of talks with the Nagarjuna group which has shown a keen interest in producing the lanterns and stoves on a mass scale.

Pradeep Bute/DNA



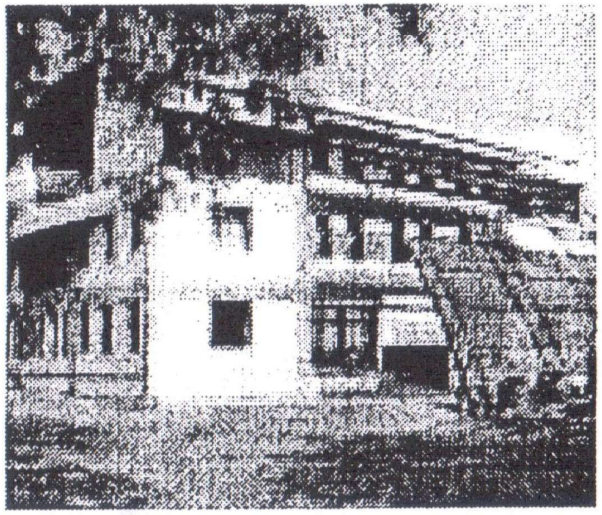
Earlier, the ethanol lamps developed at Nari have been exported to the US and Europe. The same lanterns are multi-fuel and can even run on diesel and kerosene.

Nari proposes a sustainable development centre at Phaltan

DNA - Pune - 28/12/2008

It will support agri, environment and energy research

Nilanjana Ghosh Choudhury & Varsha Welankar



Nimbkar Agricultural Research Institute (NARI) in Phaltan has proposed to build a state-of-the-art centre for sustainable development.

Scheduled to be completed within a year's time, the new centre would come up right next to the sprawling Nari campus in Phaltan en route Satara.

"Nari is proposing to set up a centre for sustainable development on its campus which would carry out research and study in the fields of sustainable development, environment, agriculture and renewable energy," said director and honorary secretary of NARI Anil Rajvanshi.

Nari undertakes research in renewable energy, rural and sustainable development and spirituality.

NEW DAWN

The estimated cost of the project is slated at about Rs70 lakh, most of which is being raised through corporate funding. The building of the proposed centre has been designed by a group of students from the University of Louisiana, USA.

Once ready, the centre will showcase all technologies developed by Nari and those available around the world for solving problems of the rural poor.

"The centre would be a corporate NGO partnership to carry out researches in different fields," said Rajvanshi.

It will also conduct seminars and lectures by corporate heads and academicians. There would also be hostel facility and seminar at the campus.

"The idea is to sensitise the corporates on different aspects of sustainable development and develop ideas which can be used for the overall development of the rural areas, "he added. Work on the centre is likely to begin by January 2009.

A mechanical engineer from IIT, Kanpur and PhD from University of Florida USA, Anil Rajvanshi and his wife Nandini Nimbkar run Nimbkar Agricultural Research Institute (NARI) at Phaltan in Satara district.

Rajvanshi left a lucrative career in US and returned to India in 1981 to pursue work in rural areas. He is a recipient of the Jamnalal Bajaj Award for 2001 and has seven patents to his name.

Sustainable living for a simple life

It is possible to lead a satisfying life using minimum energy

Anil K Rajvanshi

I live in Phaltan, a small town in Satara, and run an NGO called Nimbkar Agricultural Research Institute (NARI).

We work in areas of agriculture, renewable energy, animal husbandry and sustainable development. Since I work on sustainable developmental issues, I also try to live sustainably. I would, therefore, like to share my experience of living a sustainable, but intellectually and emotionally-satisfying life.

I live in a house designed by me. It is built of stone with 18" thick walls that allow tremendous thermal lag-time, so that heating and cooling due to ambient atmospheric temperature is delayed. It is passively cooled in the summer by laying old wet gunny bags on the roof.

The evaporating water from the bags cools the roof and takes away 80% of the thermal load entering the house. Thus, when the temperature outside is about 40-450C, the house is cool with the average temperature of the rooms ranging from 25-300C in the afternoon. The trees surrounding the house also help.

The old gunny sacs are either used as mulch in the garden or burned in our hot water boiler. The boiler is a grate-type multi-fuel boiler with a 10-metre chimney attached to it. The ash from this boiler is used as fertilizer.

All our kitchen waste is fed to our rabbits (about 25-30 of them). These rabbits produce fertilizer (droppings) that makes excellent manure for the garden. All other items inedible for the rabbits, like egg shells or tea waste, are put in the compost pit. After every two or three months, the output from this pit is used as fertilizer.

Our house is on a two-acre plot that has a lot of trees. Their leaf litter rots in the soil during the rainy season and provides mulch. The dead branches of trees provide wood for heating our bath water in the boiler. When we bought this land in 1981, it was completely barren and its quality was poor. Today, the leaf litter and the compost fertilizer have improved the soil quality immensely. The soil is now springy and quite fertile.

Most of our vegetables are grown within 10-15 km from our home. The eggs are from free ranging chickens, milk from cows across the road. We use safflower seed produced in our institute farm for oil. Thus, the oil is fresh and without chemicals.

FOR A BETTER FUTURE

We get most of our groceries and vegetables in cotton carry bags. I usually drive my Maruti 800 car. It gives me between 13-16 km/litre and is small enough to go in the lanes and bylanes of Phaltan. For long distance travel, I use a Maruti Esteem that gives me 18-20 km/litre.

I wear khadi or cotton-spun clothes made in cottage industries. Khadi is a comfortable material to wear and it makes for excellent dusters and wipers later. After they become tattered, they are used in the boiler to heat water. Similarly, all the papers in office are used on both sides. They are then brought home to again heat the water. Thus, everything is recycled.

We use electricity sparingly and this is facilitated by the state government with the 7-8 hours of power cuts every day. We have battery-powered inverters, both in the offices and at home, which supply enough juice for the lights and fans. So the television or refrigerator does not run on them. Power cuts are a good time to read and discuss.

We work in areas of agriculture, renewable energy, animal husbandry and sustainable development. Since I work on sustainable developmental issues, I try to live sustainably

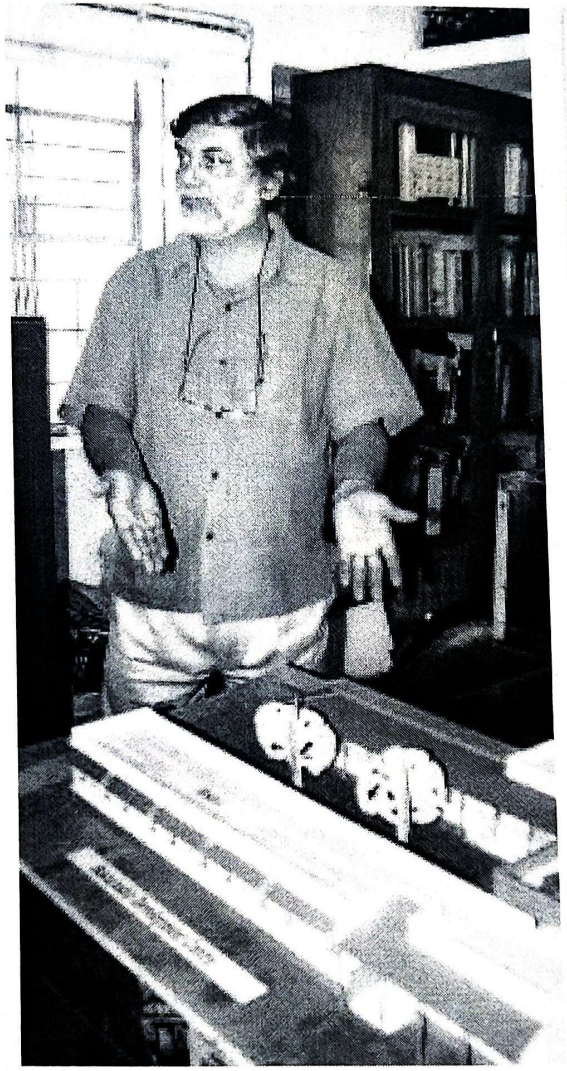
We do not travel much, but communicate via phones of the Internet. I believe this is a more energy-efficient way of keeping in touch. On an average, we travel only 15,000 km/yr, thus very low energy is used for transport.

We buy only things that are needed. One of our TV sets is 25-30 years old. Most of our gadgets are repaired when they stop working rather than being thrown away.

There is hardly any electricity consumption since we use only fans and CFLs and almost no air conditioning. Our offices also have evaporative roof cooling.

Thus, a very satisfying and decent lifestyle can be maintained using less energy and water as compared to that in western societies. This is a lesson for our leaders who are hell-bent on following the Chinese and US patterns, both of which are consumptive and unsustainable.

(The writer is a recipient of the Jamnalal Bajaj Award and director, Nimbkar Agricultural Research Institute, Phaltan)



Anil Rajvanshi with the model of the proposed Sustainable Development Centre at Phaltan in Satara.

Simplify! Simplify!

American philosopher Henry David Thoreau's timeless message

The mass of men live lives of quiet desperation. What is called resignation is confirmed desperation. But it is a characteristic of wisdom not to do desperate things.

We live meanly, like ants. Our life is frittered away by detail. An honest man has hardly need to count more than his ten fingers, or in extreme cases he may add his ten toes, and lump the rest.

We live meanly, like ants. Our life is frittered away by detail

Simplicity, simplicity, simplicity! I say, let your affairs be as two or three, and not a hundred or a thousand; instead of a million, count half a dozen, and keep your account on your thumbnail.



Simplify, simplify. Instead of three meals a day, if it be necessary eat but one; instead of a hundred dishes, five; and reduce other things in proportion.

Why should we live with such hurry and waste of life? Let us spend one day as deliberately as Nature, and not be thrown off the track by every nutshell and mosquito's wing that falls on the rails. Let us rise early, and fast or break fast gently and without perturbation; let company come and company go, let the bells ring and the children cry. Why should we knock under and go with the stream? If the bell rings, why run?

Let us settle ourselves, and work and wedge our feet downward through the mud and slush of opinion, and prejudice, and tradition, and delusion, and appearance, till we come to a hard bottom and rocks in place, which we can call reality, and say, This is, and no mistake.

Why should we be in such desperate haste to succeed and in such desperate enterprises? If a man does not keep pace with his companions, perhaps it is because he hears a different drummer. Let him step to the music he hears, however measured or far away.

India's safflower passion may open new markets

The GRDC-sponsored 7th Annual International Safflower Conference was told there is the potential for Australian farmers to fill supply shortfalls in the large and growing safflower market in India.

BY KELLIE PENFOLD



■ Mumbai-based health, hair and skin care company Marico Ltd is like many rapidly growing businesses in India. Turning over US$477 million annually it is enjoying annual growth of 25 per cent, riding the wave of the cashed-up Indian consumer.

Nitin Kathuria, the buying manager at Marico, negotiates with traders to buy safflower seed for oil, which is packaged and sold as Saffola into a market moving from bulk oils to packaged products. The trend towards supermarkets in India means customers are able, for the first time, to pick and choose products off the shelf, rather than buy at markets or direct from processors, such as the numerous safflower oil crushers in rural towns.

Speaking at the conference at Wagga Wagga, NSW, Mr Kathuria said that increasing pressures on land and rising input costs – particularly that of labour – meant Indian safflower production may not meet future domestic demand.

"It is still considered a minor crop in India and is grown as a rain-fed mixed crop with sorghum or wheat," he said. "It follows the monsoon crop, usually soybean, in the dry season."

The average yield of a safflower crop in India is 650 kilograms a hectare and it costs the farmer $184 a hectare to grow, returning an average profit of $174/ha.

The main reasons for low productivity, according to Mr Kathuria, are poor quality seed, small land holdings, poor crop management and inadequate irrigation.

Dr Nandini Nimbkar from the Nimbkar Agricultural Research Institute (NARI) in Maharashtra, India, explained that R&D at NARI seeks to lift the profitability of the Indian-grown safflower by breeding new varieties, providing agronomic guidance and adding value by creating a market for the flowers as a health food and as a natural dyeing agent.



PHOTO: KELLIE PENFOLD

Nandini Nimbkar, president of the Nimbkar Agricultural Research Institute (NARI) in Maharashtra, India, told the conference of research work to encourage Indian farmers to stick with safflowers.

PHOTO: BRAD COLLIS



PHOTO: KELLIE PENFOLD



Nitin Kathuria from health food and personal care products company Marico, based in Mumbai, India, where sales are growing by 25 per cent a year.

Half the area sown to safflower in the world each year is in India (364,000ha), equating to 27 per cent of world production.

Dr Nimbkar said the challenges facing growers are the low oil content of Indian safflower (about 30 per cent compared with nearly 45 per cent in Australian and US varieties), a fluctuating market caused by rapid consumer switching to cheaper oils such as palm oil in response to price increases, and susceptibility to pests and diseases.

She said economics have had the greatest impact on production over the past eight years. While production costs (mainly labour) have risen by 24 per cent, the market price for safflower in India has increased by 100 per cent.

In addition to oil, the market for safflower flowers has begun to bloom, particularly in China. NARI has also been test-marketing the flowers as a herbal tea.

The flowers are worth up to 400 rupees a kilogram, as opposed to 20 rupees/kg for seed. The constraining factor has been that the traditional varieties are spiny, making them difficult to harvest by hand. NARI has now developed a vacuum handpiece that allows workers to suck the flowers from the inflorescences.

Spiny and non-spiny varieties, such as NARI-38, which achieved a yield of more than 2t/ha in trials in 2007, have recently been released. NARI has also established fertiliser regimes for optimum yield, and trials have shown irrigation can lift yields by up to 45 per cent.

"However, irrigation brings with it other challenges such as disease, particularly if watered post-flowering," Dr Nimbkar said. "And yield loss to aphids can be as high as 74 per cent." □

More information: Marico Ltd, www.marico.com; Nimbkar Agricultural Research Institute, http://nariphaltan.virtualave.net

BIOTECHNOLOGY NEEDED TO SUSTAIN OILSEED SUPPLIES

■ Although global oilseed supply has increased from 382 to 418 million tonnes in the past five years, that pattern may not continue into the future, according to Lorin DeBonte, the assistant vice-president of R&D and technical director of specialty oils for the US-based Cargill, Incorporated.

To provide some consistency for oilseed growers – in a time of climate change – biotechnology and genetic modification could provide the answers, Dr DeBonte said.

"In the next five years, to remove some of this threat, we need yield gains of 20 to 30 per cent and this is where genomics can be of tremendous assistance. And at the same time we need to be good environmental stewards," he added.

"The use of plant biotechnology can increase tolerance to drought and extreme temperatures, minimising production risk in oilseed supply."

The world oilseed market is dominated by four major crops – palm (38 per cent), soybean (28 per cent), canola (15 per cent) and sunflower (nine per cent). Thirty-three per cent of all oilseeds come from South America, 22 per cent from the US, 14 per cent from China and one per cent from Australia.

The greatest growth has been in palm oil production, with 1.3 million hectares dedicated to new plantations – mainly in Indonesia and Malaysia – in the past three years. Palm nuts yield 5,000 litres of oil per hectare, as opposed to canola which yields 1,000L/ha.

However, Dr DeBonte said that with soybean production for human consumption in decline due to biodiesel demand, demand for canola oil could increase, which could, in turn, increase demand for safflower oil.

"You can't build growth in safflower, you have to create a market which pulls it, just as happened with canola," he said.

"Twenty years ago I remember trying to get people to grow one acre of high-oleic canola for Cargill. Today we buy the production of 1.4 million acres. Creating a market is a struggle, but if you stay at it, it will happen."

The oilseed supply threats listed by Dr DeBonte included:

- depletion of productive soils;
- a failure to develop crops with higher protein or oil content;
- biofuel demand;
- increased disease and pest pressure due to intensive agriculture;
- narrowing genetic diversity; and
- climate change. □

More information: www.cargill.com



Cargill assistant vice-president, technical director specialty oils, Dr Lorin DeBonte, spoke at the International Safflower Conference.
PHOTO: KELLIE PENFOLD

KINGOWER SUNFLOWER GROSS MARGIN 2008	
Expenses	Actual ($/ha)
Pre-plant fallow weed control	35
Treated seed	65
In-crop insect control	34
Harvest	64
Income	
Harvest Income (hectare contract on-farm)	675
TOTAL	$477/ha

The gross margin above does not include fuel and labour costs.

Sunflower gross margins compared extremely well to other dryland crops in the Central Highlands this season.

The gross margins local summary (Table 1) assumes average conditions, does not include labour or fuel costs, and provides long-term average yields. It is also assumes that farmers are harvesting their own crops, with the exception of corn and cotton.

Economic benefit from growing sunflowers

At the current price, sunflowers provide very competitive returns when compared to high yielding grain crops.

Reliability and robustness of sunflowers

"Our first irrigation crop," points out Alicia Dunbar, "was seed sunflowers in 1999, a Pioneer trial, and they were absolutely terrific. Prior to TSV, sunflower was always a main summer crop at Kingower. Even when yields were lower, we found there was a better potential gross margin than grains." ■

ALICIA'S TAKE HOME MESSAGES

- Sunflowers provide an important option for summer and spring dryland plantings.
- We aim to manage TSV damage to five per cent of total crop as an acceptable loss.
- Sunflowers are a low input crop which can provide superior returns to high yielding grain crops.
- Be aware of contract conditions (eg. NACMA standards) and also be aware of who the contracts are actually with – keep a 1.0 to 2.5 kg sample bag of each and every load taken away, so you can seek independent quality assessments if needed.

Safflower breeding and future challenges

By Hans-Henning Mündel

Genetic improvement in safflower has aimed at improving yield, oil and other agronomic characteristics, including resistance to diseases, insects and abiotic stresses. It has relied on exploiting the existing variability in commercial cultivars and land races, and to a limited extent also on crosses with closely related species, *Carthamus oxyacanthus* and *Carthamus lanatus*.

India is the major producer of safflower and for decades, safflower research in India was in the hands of individual government centres or agricultural universities, as well as private sector research such as at Maharasthra Hybrid Seeds (Mahyco) at Jalgaon and the Nimbkar Agricultural Research Institute (NARI) at Phaltan in Maharashtra State.

Using mass-selection at Niphad, in the former Bombay State, the first commercial safflower, N-630 was released in 1942. At Annigeri, in 1969, A-1 was released following a pedigree breeding method.

The All India Coordinated Research Project on Oilseeds (AICORPO) included safflower projects from 1972. Aside from developing high yielding cultivars for the diverse regions growing safflower, these programs have developed a wide range of plant types, including appressed, semi-compact and spreading. Over 18 high-yielding cultivars and four hybrids of regional and multi-regional importance, have been released.

Safflower yields in India averaged less than 200 kg per hectare in the years just preceding this coordination. By the 1990s, countrywide yields ranged from 500 to 650 kg per hectare. Cultivar improvement has been a major contributing factor to these increased yields. But oil content has remained constant, around 28–30 per cent, with only an occasional cultivar reaching to 35 per cent oil.

To facilitate the introduction of safflower in non-traditional areas, A.R. Sawant, at the Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV) in Indore, bred high-yielding spineless safflower, JSI-7, released in 1990. He was assisted for some years by the International Development Research Centre (IDRC) from Canada.

A decade later, the spineless NARI-6 was released by NARI, providing a dual income to farmers, as the florets can easily be collected from non-spiny safflower after the crop matures and is sold for food and textile dye.



Hans-Henning Mündel delivering his keynote address.

Spreading safflower worldwide

Decades of studies at UC–Davis, by international graduate students and local technicians, under the mentorship of Paulden Knowles, spread safflower knowledge worldwide. Paulden worked out the cytotaxonomic relationships among not only most of the safflower species but also between these species and their wild relatives.

His interests ranged from the breeding, genetics, cytogenetics, to the germplasm conservation of safflower. The widely-used USDA World Collection owes most of its safflower lines to Paulden's collecting efforts from the 1950s to 1970s.

Three alleles at one locus were found to govern the levels of linoleic and oleic acid, with the intermediate levels being temperature sensitive in the 1960s. Starting with the release of UC-1 from Knowles program, high oleic cultivars were developed around the world – for example, S-317 from SeedTech in California and Rinconada in Spain.

Working in Arizona, Dave Rubis released 'Gila', in 1958. This was an F3-derived cultivar which showed wide global adaptability. Gila became popular in Mexico, Australia and Argentina for much of the next three decades. Gila was reputed to have been grown in more countries and covered more area than any other single cultivar. It has been incorporated in many future cultivars by crossing and backcrossing, in numerous countries.

Disease resistances

A series of cultivars was released with resistance to alternaria leaf blight (caused by the fungus *Alternaria carthami*. Cultivars such as Girard were developed by mass-selection of resistant plants from crossing of existing cultivars in a disease nursery initiated in the early 1960s from fields naturally infested with a multitude of diseases in Sidney, Montana, US.

This produced cultivars with improved field resistance to several diseases.

In Canada, Saffire was developed at Lethbridge, Alberta, by mass-selection from a bulk derived from selections from India, having good field resistance to head rot, caused by *Sclerotinia sclerotiorum*. This cultivar is almost the only safflower cultivar currently grown in Canada, as a high quality (solid white) birdseed.

As infection with safflower rust (caused by *Puccinia carthami* Cda) at the seedling stage can cause serious yield reduction in warm soils, five improved safflower lines (PCA, PCM-1, PCM-2, PCN, and PCOy) have been developed, each carrying a different dominant gene for rust resistance.

Biotechnological advances

Safflower has become the focus for several innovative biotechnological endeavours including the production of insulin by SemBioSys in Canada and Unusual Fatty Acids by CSIRO, Plant Industry in Australia.

SemBioSys' system involves the genetic attachment of commercially viable target proteins to oleosin, the primary protein coating the oil-containing vesicles (oilbodies) of the seed. While the range of products being developed by SemBioSys are on the S-317 background, newer, more disease resistant will be needed in the future to facilitate this 'molecular farming' over a range of agro-ecological niches.

With the development of protocols for genetic transformation of safflower based on callus-mediated regeneration of seedling explants in India, major contributions towards the use of biotech in safflower breeding can be expected there, specifically, the development of transgenic cultivars with resistance to aphids and herbicides, as well as cultivars with tocopherol content with improvements in both antioxidant activity and vitamin E content.



Nandini Nimbkar who is the president of the Nimbkar Agricultural Research Institute based at Phaltan, India, inspecting safflower plots in India.

Development of safflower hybrids

Advancements have been underway in both the US and India in producing safflower hybrids. Barney Hill, working for Cargill at the time, initiated a safflower hybrid program in 1972. This system for the development of cytoplasmic male sterile lines relies on the use of the wild safflower, *C. oxyacanthus* as female and the domestic safflower, *C.tinctorius* as restorers of CMS and as recurrent males.

His Safftech Hybrid Safflower is linked with the Montana-based Safflower Technologies International, with Jerry Bergman and group, in the production of birdseed safflower hybrids.

It is expected that this partnership will produce high oil hybrids (well above 40 per cent) which can be globally commercialised over the next few years.

In India, a Maharasthra private seed company, MAHYCO, has not only developed the male sterility maintainer genotype for the sterile cytoplasm but has also developed and is commercialising the first Cytoplasmic Male Sterile-based safflower hybrid in India, MRSA-521, expressing high wilt resistance.

It is expected that hybrid seed will be made available much more cheaply compared to the seed of Genetic Male Sterility-based hybrids in safflower. This should lead to the rapid expansion of the hybrid safflower area in India.

This is an edited version of a keynote address given by Dr Hans Henning Mündel at the 7th International Safflower Conference, November3–6, 2008.
Copies of the proceedings are available from www.australianoilseeds.com ■

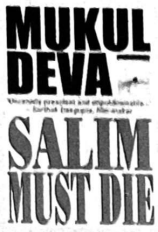
FUTURE CHALLENGES

To continue to deliver new and improved cultivars for the global safflower industry it will be important to:

- Continue to develop cultivars from promising germplasm;
- Fully utilise the world collection;
- Further study and expand the medicinal uses of safflower; the use of biotechnology for pharmaceutical purposes could greatly assist such expansion;
- Integrate the latest biotechnology advances into safflower breeding programs; and,
- Develop robust hybrid systems to increase the productivity of safflower.

Between hatred and death

India's "only military writer" **Mukul Deva** launched his latest book *Salim Must Die* in Pune yesterday. The thriller has a fictional ex-brigadier of Pakistan's ISI called Murad Salim whose only aim is to strike against the "*kafirs*." Between Salim's plot and death of thousands of innocent people stands India's special FORCE 22 that acts under the Indian Prime Minister.



TOPPERS NOW

FICTION

1. **The Associates,** John Grisham ..... Rs 230
2. **The White Tiger,** Aravind Adiga ..... Rs 395
3. **Thanks for the Memories,** Cecilia Ahern ..... Rs 250
4. **True Dummy,** Ashish Jaiswal ..... Rs 195
5. **The Story of My Assassins,** Tarun J Tejpal ..... Rs 495

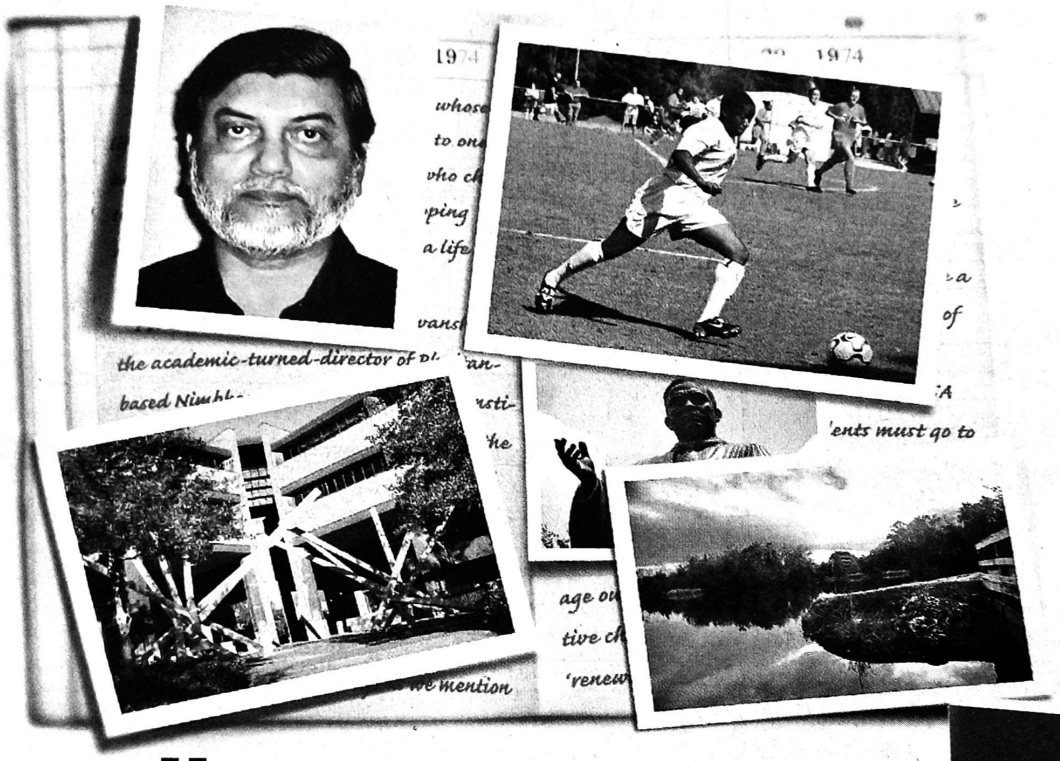
NON FICTION

1. **The Choice,** Eliyahu M Goldratt ..... Rs 295
2. **Leadership in the Era of Economic Uncertainty,** Ram Charan ..... Rs 375
3. **Oneness With One Life,** Eckhart Tolle ..... Rs 450
4. **Imagining India,** Nandan Nilekani ..... Rs 699
5. **Hot Flat and Crowded,** Thomas L Friedman ..... Rs 595

(Bestsellers list courtesy: Crossword. Ph: 26059600)

CLOSER LOOK

Imaging: Manish Choure



Recalling a journey

Anil K Rajvanshi's memoir about his student days in the USA is aimed to inspire the young Indians to serve the nation, finds **Biswadip Mitra**

As the USA gets a new President, whose life can be the source of inspiration to one and all, we turn to one among us who chose to dedicate his expertise for developing rural India, rather than enjoying a life of luxury in the USA.

For decades now, Dr Anil K Rajvanshi, the academic-turned-director of Phaltan-based Nimbkar Agricultural Research Institute (NARI) has been "interacting with the students in India's vast rural settings and encouraging them to utilise their entrepreneurial potentials." One such mode of communication has been through written words. "Ideas keep evolving and I tell them through my writings," he says as we mention one of his much-acclaimed works, *1970s America — an Indian Student's Journey*.

"Encouragement can do wonders. In a country like India, where millions struggle everyday just to survive, a little guidance and assistance from the experts can make a lot of difference, particularly to the lives of youngsters," he says. "I chose to write the book, detailing my experiences in the USA because I believe Indian students must go to that country if they want to enhance their skills. But, more importantly exposure to the American way of learning will encourage our youngsters to bring about the positive changes in rural India," the expert of 'renewable energy' and 'sustainable rural development' adds. "Exchange of thoughts is essential for advancement."

After graduating from the Indian Institute of Technology, Kanpur, in 1974, Rajvanshi went to the University of Florida in the USA to pursue his dreams. "In the book I have described the preparations I undertook to go there, the campus life there, marriage and the rest. I had to depend on my memories and as I began writing, it became like a process of self-discovery," he says.

Written lucidly, the book has several humourous anecdotes like Rajvanshi's effort to cook an Indian meal for his Romanian roommate in Florida. "The *pulao* I cooked had too much of *mirchi* and my roommate had a tough time," the writer reminisces with a hearty laughter. "In a country like USA, where one needs to be self-reliant, such experiences help an individual to learn. If I have to compare in a broader perspective, our villages too must be self-sufficient. The youngsters need to take the lead," he elaborates.

How did he develop the habit of writing, we ask. "In the IIT, they taught humanities and I realised that such discourses help to explore one's inner self. You could say, there's a spiritual angle to it," he says. Possibly, that's why Rajvanshi is also known for his writings on spirituality.

Rajvanshi then recalls how different India has been in the 1970s. "My brother got his scooter from the quota of H Bahuguna, the then chief minister of Uttar Pradesh. With liberalisation and globalisation, things have become better," he says, adding, for an Indian student it is often difficult to leave the lure of American life. "I hope my book encourages them to come back to India and serve this country. We too can be one among the best," he affirms.

features@sakaaltimes.com



STUDENT GANDHI

In his autobiography *The Story of My Experiments with Truth*, **Mahatma Gandhi** described his days as a law student in England. The first person narrative includes several funny anecdotes like Gandhiji's efforts to follow the ways of English gentlemen. After getting himself the English clothes, tall black hat and typical English haircut, he felt the need for learning how to dance. "*I decided to take dancing lessons at a class and paid down £3 as fees for a term. I must have taken about six lessons in three weeks. But it was beyond me...*" he writes in the book.

When that effort failed, Gandhiji bought a violin and also took elocution lessons — all for getting accepted in the English society. These endeavours continued till the truth prevailed upon him that it is India which is his home and not England.

WB shows interest in NARI stove

TIMES NEWS NETWORK

Times of India - 24/05/2009

Pune: The World Bank (WB) has shown interest in an innovative cooking stove developed by Phaltan-based Nimbkar Agricultural Research Institute (NARI). This stove runs on low-grade alcohol (country liquor) and produces light and heat.

This information was given by Anil Rajvanshi, director and honorary secretary of NARI, while delivering the B D Tilak memorial lecture on 'Energy: R&D for rural development', at the National Chemical Laboratory here on Friday.

"The stove, developed by NARI, has been tested successfully. The World Bank has appreciated the idea of using low-grade alcohol as a domestic fuel and has asked the institute to share the findings of the test," Rajvanshi said.

Since the WB is keen on conducting some more tests, it has asked NARI to send the stove, a cylinder, a suitable pressure cooker and low-grade alcohol, along with the readings of the tests conducted by NARI to the US, Rajvanshi said, adding, "However, NARI has requested WB officials to visit Phaltan as all the required equipment is ready and tests are already underway here."

Rajvanshi said that though the light produced from the stove has moderate brightness, it also generates significant heat, which can be utilised for cooking. The stove could be a boon for villages that have zero or little availability of electricity.

"Kerosene-operated stoves are not good for the environment, but this stove does not have this shortcoming," Rajvanshi stated. Unlike the conventional stove or electricity-operated stoves or those that run on biomass, the stove developed by NARI is efficient, eco-friendly, safe and easy to handle, he said.

Rajvanshi, however, added that the quality of low-grade-alcohol, which depends on the raw material used for producing it, is the only worrying factor for the project was. "As the material used for making alcohol varies, the chemical composition also differs with each batch of alcohol. We need to solve this problem," Rajvanshi said.

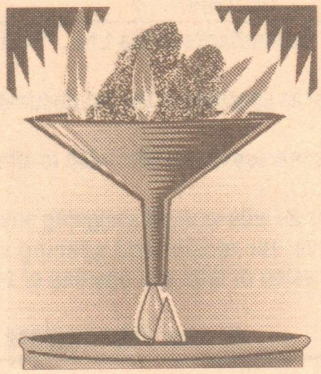
He also emphasised on the need for combined effort by the government, private sector companies, research institutes and non-governmental organisations to find some solutions on problems in rural areas. "Biomass and bagasse-based power generation equipment have huge potential in rural areas. There is a lot of scope for research and development and this can only be achieved when, both the private and public sectors join hands," he said.

Go for ethanol

Times of India - 09/06/2009

By ANIL K RAJVANSHI

Sixty per cent of rural India lives in utter poverty, with no electricity. Rural India uses 180 million tonnes of biomass every year for cooking, creating indoor pollution and health hazards. The WHO estimates that 1.5 million deaths per year are caused by pollution from chulha smoke. Making available locally grown clean and renewable cooking and lighting fuel can improve the quality of rural life. Liquid fuels are far superior to solid fuels for cooking because of their clean combustion, higher energy density and existing supply chain convenience. Ethanol is one of the best as it is an excellent substitute for kerosene and burns better, with no particulate output or unpleasant smell. Its combustion is almost as clean as that of LPG.



Ethanol can be produced from any sugary or starchy material and is presently produced world over from sugarcane and corn. However, as the ethanol economy grows, there is a need to produce it from a crop, which uses much less water than sugarcane and also produces food. Sweet-stalk sorghum (jowar) is one such crop. Its earhead produces grain, which can be used for making bread; its sweet stem has nearly the same amount of sugar as in sugarcane and hence the juice can be fermented and used for ethanol production. The bagasse, left after juice extraction, together with leaves is excellent fodder for animals. So from the same piece of land one can get food, fuel and fodder. Besides, sweet sorghum uses nearly 50 per cent less water than sugarcane to produce the same amount of sugar. It is a four-month crop so farmers can grow two crops per year from the same piece of land. Also the energy output/input ratio of producing ethanol from sweet sorghum is very positive.

The Nimbkar Agricultural Research Institute (NARI) introduced sweet-stalk sorghum in India in late 1960s and has developed the technology for its production and usage as a cooking and lighting fuel. An efficient ethanol cooking stove running on 50 per cent ethanol-water mixture has been developed. This mixture, which can be distilled efficiently in a rudimentary rural distillation unit, is safe and less flammable fuel than pure ethanol. The stove works just like an LPG stove with high and low flame settings. Field-testing shows that rural users like this stove.

NARI has also developed a lantern running on ethanol. It burns cleanly without smoke or smell. The ethanol lantern produces light equivalent to that from a 100W bulb. Presently the government is propagating solar lanterns running on PV cells. They use compact fluorescent lamps costing over Rs 2,000, producing light equivalent to that of a 40W incandescent bulb. This light is not sufficient for children's reading or for doing household work. The CFL lanterns are only twice as efficient as ethanol lanterns when we consider the power plant-to-light efficiency. With a little more R&D, we could make ethanol-based lanterns more efficient than electric lighting. In the absence of grid electricity to most rural areas, liquid fuel lanterns running on ethanol provide an attractive alternative.

To facilitate the use of ethanol for rural households the government should remove excise duty. The cost of ethanol from sweet sorghum after excise duty removal can be as low as Rs 10-14 per litre. The use of ethanol for rural applications will also create great wealth in rural areas in terms of growing crops and producing ethanol from them. It is estimated that the industry to produce ethanol for such purposes for rural areas can be of the order of Rs 2,00,000 crore a year and can make the ethanol economy 100 times bigger than the present one based on automobile consumption only.

Another unique way in which ethanol can be used for lighting in rural areas is via electricity generation through two-wheelers. For this, existing two-wheelers need to be converted to a hybrid vehicle where the small internal combustion engine running efficiently on ethanol or petrol charges the battery to run the electric motor system. When the vehicle is not running the system can act like a power plant producing electric power. Every two-wheeler can potentially become a mobile power plant.

The writer is director, NARI.

NARI'S AWARD WINNING LANTERN

In a tough competition with five prominent nominees the Indian research institute NARI (Nimbkar Agricultural Research Institute), won the Globe Sustainability Research Award 2009.

TEXT BY SHEETAL M PHOTOGRAPHS COURTESY NARI

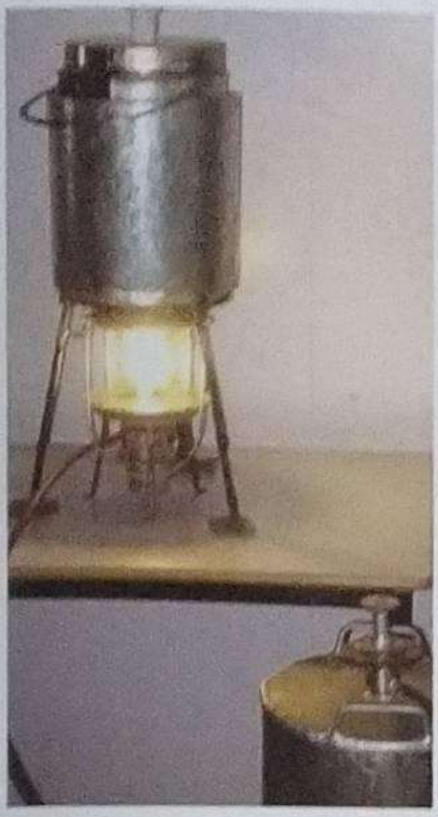
SUSTAINABILITY if practised from the heart and soul can certainly fetch results in a positive and appreciable way and that is exactly how NARI (Nimbkar Agricultural Research Institute) won the Globe Sustainability Research Award 2009 for its lantern cum stove called the Lanstove. This honour was awarded to NARI's representative director Anil Rajvanshi, by H.R.H crown princess Victoria of Sweden, at a ceremony in the winter garden of the Grand Hotel in Stockholm on June 3rd 2009.

The award winning Lanstove is an extremely efficient dual purpose system. It is a pressurised lantern with rare-earth mantle lighting which also doubles up as a cooking stove. This unique lantern which not only illuminates but also acts as a cooking device runs on a low concentration [50% (w/w)] ethanol-water mixture. The 50% ethanol-water mixture is less flammable than pure ethanol, making it safe to handle and hence ideal for household cooking purposes. It burns very cleanly and therefore is environmental friendly as well.



Mr. Anil Kumar Rajvanshi (Director, NARI)

The Globe Award originated in 2007 in Sweden and was founded by the interna-





tional business network and marketplace Globe Forum with the aim to support and encourage successful and innovative CSR (Corporate Social Responsibility) work. The Globe Award 2009 acknowledges prominent researchers, innovators, cities and companies from all parts of the world within four categories, Sustainability Research, Sustainability Innovation, Sustainable City and Sustainability Reporting.

The goal of the Globe Sustainability Research Award, this year was to discover and encourage researchers and research institutes prominent in sustainability research. The jury for the Sustainability Research Award was chaired by Mohan Munasinghe, Nobel Peace Prize Laureate 2007 and Vice Chairman of the UN Intergovernmental Panel on Climate Change. Jury members were Dr. Mona Makram-Ebeld, former member of the Egyptian Parliament and Professor of political science at the American University, Cairo Egypt; Frederick C. Dubee, Senior Adviser, United Nations Global Compact Program, working extensively in China and Asia, and Tommy Borglund, Head of CSR services at Hallvarsson & Halvarsson Sweden.

"The Globe Sustainability Research Award jury analyses and judges several criteria, including originality, practicality, and contributions to humanity through economic gains, social development and environmental protection." said, Mr. Mohan Munasinghe, Chairman of the Globe Sustainability Research Award jury. Talking more about NARI Mr. Mohan said, "The Nimbkar Agricultural Research Institute (NARI) project on development of a low grade ethanol filled cylinder, which provides energy to produce a high quality light output in lanterns, as well as clean fuel for cooking systems, was the outstanding example of sustainability research, based on these criteria."

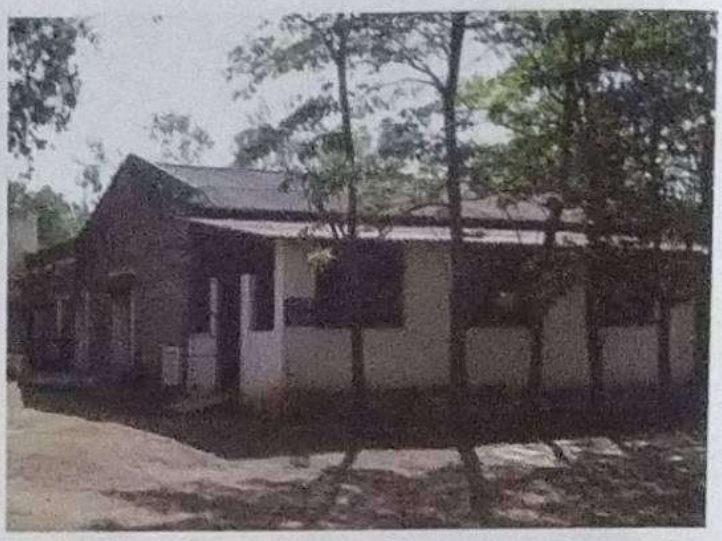
On receiving the prestigious award Mr. Rajvanshi said, "We are delighted to receive this prestigious international award at the hands of HRH Crown Princess Victoria. This award recognises and confirms NARI's philosophy that high tech solutions based on local resources can be developed appropriately by a rural organization to solve the basic problems of the people residing in such areas of the world."

NARI, (www.nariphaltan.org) is an NGO and a non-profit research and development institute. It was established in 1968 by Mr. B.V. Nimbkar who remained its first president till 1990. Since then Dr. Nandini Nimbkar is the permanent president. The institute undertakes research and development in agriculture, renewable energy, animal

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The lanstove, winner of the Globe Sustainability Research Award 2009.

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An electronic rickshaw by NARI - A sustainable transport option.





husbandry and sustainable development. It is situated in the rural town of Phaltan in Maharashtra state. Phaltan is about 100 km from Pune and 300 km south-east of Mumbai. The Institute actively collaborates with researchers in other organizations and institutes such as NFCL, NCL, BARC, TIFR and BAIF, UF (USA) and UNE (Australia).

One of the main categories in the product portfolio of NARI is renewable energy in which they have talked about their sustainable products and systems. Its solar powered ethanol distillation plant which was set up in 1980s at their campus was capable of distilling 50 l/day of 94% (v/v) ethanol from NARI's Madhura sweet sorghum hybrid. The solar collector area was 38 sq. m. About 70% of the energy for distillation came from solar energy. A solar detoxification pilot plant was also set up to treat distillery effluent at the NARI campus. It could clean 200 litres of diluted distillery waste in two days. The photo catalyst chemical used could be recycled and the waste water had 90% transmittance and hence was fit for discharge in waterways. Additionally, NARI has developed a biomass gasifier for loose agricultural residues like sugarcane leaves which are the major pollutants of air.

NARI has also developed technologies for a green, pollution free sustainable transport system for developing countries. The institute has manufactured pedal rickshaws, motor assisted pedal rickshaws and electric rickshaws; all of which have been exported to Europe and America. NARI can transfer their technologies under license to any interested party.

Mr. Rajvanshi the director of NARI and the originator of the Lanstove concept has over 30 years of experience in the field of renewable energy, r&d and rural development. He has a B.Tech degree in mechanical engineering from IIT Kanpur and has a Ph.D. from the University of Florida, USA. He left a very lucrative career in the US to come back and settle down in rural India. He is the author of the national policy on Energy Self Sufficient Talukas, which was run by MNES, New Delhi. In 1998, he was inducted in the U.S. based Solar Hall of Fame. He was also awarded the prestigious Jamnalal Bajaj Award for rural development in 2001. In 2004 his work on the electric cycle rickshaw was awarded the Energy Globe Award (also called the Oscars of Energy). He has authored and co-authored 135 publications in various national and international journals including 35 editorial articles on sustainable development and spirituality in some of the major newspapers and magazines of India.

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The solar detox pilot plant located at the NARI Institute.

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The institute is situated in the rural town of Phaltan, Maharashtra.

Anil K. Rajvanshi

Director of the Nimbkar Agricultural Research Institute (NARI)

Invention of LanStove

Dr. Rajvanshi was the recent recipient of The Globe Sustainability Research Award in Sweden which was given to him for NARI's originality, practicality, and contributions to humanity through economic gains, social development and environmental protection.

What made you choose such a career?

After doing my B.Tech and M.Tech in Mechanical Engineering from IIT Kanpur I went to the US in 1974 to do my Ph.D. in Solar Energy from the University of Florida (UF), Gainesville. After graduation, I taught for another two and a half years at UF. I decided to come back to rural India in 1981 after spending seven years in the US. In those days hardly any IITian ever came back from the US let alone went to rural India. There were many factors that contributed to this decision – my desire to do something useful in renewable energy for rural areas; to do something meaningful in my life; to do something on my own rather than being an employee, and also my arrogance that I could make a difference in rural India. Whether I achieved any or all of these goals is still debatable but the experience has been enriching. Most of these things including my US experiences as a student are written up in my recently released auto biography entitled "1970s America – an Indian Student's Journey" (www.nariphaltan.org/usexp.pdf).

What is NARI's work in renewable energy?

NARI (Nimbkar Agricultural Research Institute) is a NGO in India situated in the rural town of Phaltan in Maharashtra state having a small staff of about 40 people. It was set up in 1968 to do R&D in agriculture. In 1981, when I joined NARI on my return from the US, it started work in renewable energy. Since 1990 it has also been working in animal husbandry. NARI's mission is to use the best tools of science and technology to solve rural problems. In agriculture it has done pioneering work in breeding high yielding varieties of safflower and sweet sorghum. In animal husbandry it has developed high meat yielding sheep and goats. The details of the Institute are at: www.nariphaltan.org

Though small, NARI has done pioneering research work in renewable energy. It was the first to develop sweet sorghum for ethanol production and to set up the world's first pilot plant for solar distillation of ethanol. It pioneered the development of biomass gasifiers that run on loose leafy matter like sugarcane leaves. It also started the work on electric cycle rickshaws. In the early 1990s, NARI originated the concept of energy self-sufficient talukas. This became a national policy and was implemented by the Ministry of New and Renewable Energy (MNRE). This concept later morphed into PURA (Provision of urban Utilities in Rural Areas). Most recently NARI has pioneered the development of cooking and lighting devices running on low grade ethanol. As a result NARI, represented by Dr. Rajvanshi, was awarded the Globe Award 2009 in Stockholm, Sweden in June 2009.



NARI's LanStove provides light and heat for cooking

What was NARI's contribution in developing this technology?

The greatest challenge in developing a low grade ethanol lanstove was to first evaporate the ethanol/water mixture and then to combust it completely so that no Carbon Monoxide emissions would take place. This required very sophisticated heat and mass transfer calculations and device configuration. The flue gases from the lanstove were used to provide a very efficient cook stove by utilizing the principle of a heat pipe. Thus this lanstove could simultaneously produce light and heat for cooking a complete meat for up to six people. The details are given at www.nariphaltan.org/lanstove.pdf



Nature Conservation + Spirituality = Sustainability



Anil K Rajvanshi
Director
Nimbkar Agricultural Research Institute (NARI)

Introduction

One of the sad effects of progress is destruction of nature. Large-scale deforestation, pollution of air, introduction of toxic chemicals in rivers and oceans and general march of our present technological progress is depleting biodiversity. American heritage dictionary defines nature as "The order, disposition and essence of all entities composing the physical universe" or in essence the biosphere. Some critics of environmental movements contend that if some living species do get annihilated due to our activities still we are part of nature. They also contend that our technological march is an evolutionary process, which automatically allows reduction of biodiversity. Their argument may carry weightage if our technological progress is environmentally sustainable but at present we do not understand all the natural forces surrounding us and hence we are not working in tune with them. Eventually we may, but till that time we need to conserve nature and biodiversity. Hence we should be concerned about nature's destruction for if we destroy nature we will loose valuable genetic information and with that a possible mechanism to evolve efficiently and sustainably.

How Nature Helps Us

Nature provides us direct benefits and without it we will not be able to survive. Majority of medicines presently in use and all our foods are

derived from plants and animals. The cost of over-the-counter drugs from plants alone has been estimated to be about US$ 84 billion worldwide[1]. Yet a tiny fraction of biodiversity has been utilized in the allopathic medicines. Similarly in 1997 an international team of economists and environmental scientists came out with a figure of US$ 33 trillion for all ecosystem services provided by natural systems to humanity free of charge. This amount was more than twice the total GDP of the world[2]. Ecosystem services include regulation of the atmosphere and climate; purification and retention of fresh water; formation and enrichment of soil; nutrient cycling; detoxification and recirculation of waste; pollination of crops and the production of lumber, fodder and biomass fuel. Even if by magic we get the necessary technology and this much money to provide these services, the physical task will be nearly impossible to accomplish it thereby proving the superiority of natural systems over manmade ones.

Besides providing ecosystem utilities, nature also provides us knowledge for our future science and technology. Nature had billions of years of head start and hence it has evolved through infinite permutations and combinations of designs. Since our brain is a product of natural evolution and earth time, it can be conjectured that we cannot think more than what already exists in nature. Thus the fastest way for us to progress is to copy nature. For if we destroy nature we will be robbed of the design template for our further development.

There are large numbers of examples where we have benefited from copying nature. Presently the new mantra in the design world is to mimic nature. Thus better fluid dynamic foils by mimicking dolphin swimming; better insulation by studying polar bear's fur; betterdesign of helicopter by observing bumble bee flying and better light bulb by understanding the firefly luminescence etc. are among innumerable examples that are being researched all over the world. In fact there is hardly any modern invention which does not have its counterpart in nature. Sometimes we do not have the necessary tools to probe nature to find out how it works and thus foolishly think that we have superior technology.

Our ability to feed the world will also come from copying the natural genetic manipulation of the species. Thus the modern tools of biotechnology and genetic engineering will be used in producing higher yielding crops which use minimum of inputs of chemical fertilizers and pesticides. Our ability to mimic the natural process at molecular levels (nanotechnology is a prime example) has just started and we are still scratching the surface. Out of 10 to 100 million species on this planet earth, we have only discovered about 1.5 to 1.8 million[1]. Just to duplicate the complexity of biological life and interactions of organisms will take millions of years to perfect. Hence the best thing we can do is to copy the natural designs, live in harmony with nature and evolve with it.

Since we have evolved with other life forms our brains are wired to enjoy the beauty of nature. No manmade systems can compete with the joy and well being we feel in observing the infinite variations of nature's display year round. There are large numbers of studies all over the world which have shown that subjects recover rapidly from physical stress when they are exposed to pleasing natural environmental conditions[1].

Similarly walking in forest under a thick tree cover is a very pleasing and emotionally satisfying experience. Besides it appears that trees might act as antennas for Universal Thought. Gautam Buddha got his enlightenment under a Banyan tree and so did the great Indian sage Ramkrishna who used to meditate at night under a similar tree. The forest cover provides balm to our eyes, green lung to our planet and inspiration to our soul. This could have been the basis of sacred groves around temples. Thus nature is very important for our emotional and intellectual evolution and well being.

Conservation of Nature for Sustainable Living

Yet the fact remains that we are destroying nature with our wasteful lifestyles and our burgeoning population. We use natural resources very inefficiently since we want to change things rapidly possibly within our lifetimes. Because of our technological superiority we are changing the natural tapestry, have started playing God, and have this arrogance to change everything in one lifetime. Besides, we still do not understand the complexity and beautiful designs of the natural systems. As we evolve in our science and technologies we will understand nature's wonders and may become more tuned to it. Thus rather than exploiting resources like oil and gas which took millions of years to produce, we will produce innovative renewable energy technologies with cycle times of 10-15 years. This may include fuel cells powered by liquid fuels from biomass; efficient biomass based power systems, solar and wind energy units[3]. Research world over does point towards this strategy.

Our present lifestyle is untenable. Estimates are that, at present level of technology, for all the world's population to have wasteful lifestyle of U.S. will require about 4 more planet earth[1]. Obviously it has to change so that it becomes sustainable and more emotionally rewarding.

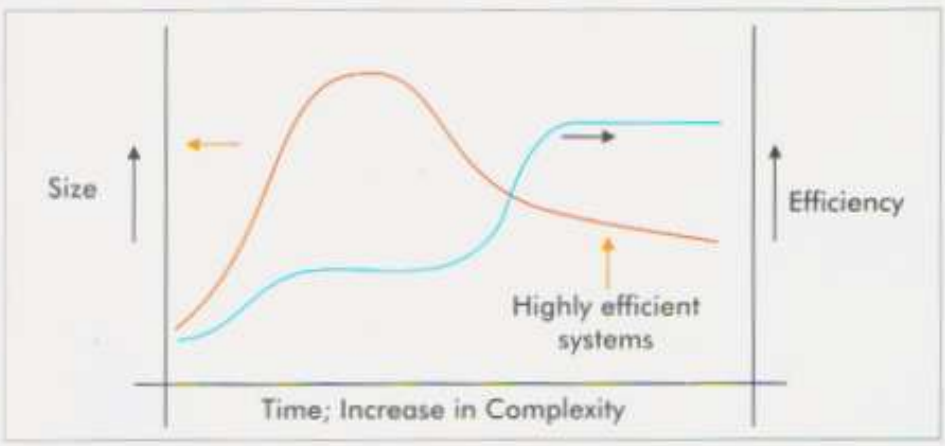
The new lifestyle can be based on decentralised development. A hallmark of evolution of a system is its size reduction; increase in its complexity; increased efficiency of materials and energy transfer through it; and dynamic equilibrium of system with forces surrounding it. As systems evolve they become extremely efficient energy and materials transformers. Just as dinosaurs became extinct and were replaced by human beings and other small and highly evolved compact life forms, our big and sometimes ugly cities will be replaced by smaller more compact rural communities. All design evolution process follows the size reduction as depicted in figure below.

Our technological designs are also doing that. Thus our computers, phones, power plants etc. are becoming more efficient, complex and compact. Similarly our energy production systems will also become smaller and more efficient to take advantage of locally available diffuse natural resources like solar, wind and biomass.

It is quite possible that the evolutionary model for our society could be compact and rural based. It will be driven by very advanced technologies so that it will be able to feed and create for its inhabitants goods and services from the raw materials available to it in its geographical area. With the availability of internet, desktop manufacturing, small renewable energy powerpacks, genetically modified food and other advanced technologies being researched in laboratories all around the world, it will be possible to have a sustainable development.

In fact sustainable development can be defined as a process in which we use recyclable materials, resources and energy for our needs in an extremely efficient and environmentally sound manner. This process can be facilitated by advancement in technology.

A recent study done in India showed that for a community size of Taluka (equivalent to a county in U.S.) all its energy demand of electricity, liquid and gaseous fuels could be met by judicious use of locally available biomass resources. With provision of large-scale employment generation, Taluka model can provide critical mass for sustainable development[4].



Spirituality and Sustainability

However all the development models will become untenable if we do not put a cap on our greed for materials, resources and energy. Present economic models are based on increased consumption and encourage greed. Ever increasing choices available to an average person fuel the greed impulse since the fear of missing out is very high. Spirituality can help in keeping our greed for materials and resources in check and sustainable development can only take place when we use the resources for our needs and not for our greed as Mahatma Gandhi once said.

Spirituality is the state of mind that makes it understand that the Truth is beyond the barriers of worldliness, caste, creed, race or geographical boundaries. It is universal in nature and a great spiritual thought is a cause of celebration for the whole mankind. It connects us to Universal Consciousness and gives a certain perspective in life. As a person progresses on the path of spirituality his or her priorities in life change. The focus of life shifts more towards getting personal happiness through mental peace and is less on material needs and desires and more towards sustainability. Recent examples of Mahatma Gandhi and Einstein have shown that with very few needs and living very simple lives they were able to produce the highest quality of thought.

Spirituality also helps us have a compassionate view of nature and as we evolve spiritually, we become more tuned to it which helps us in preserving it. Besides it helps us live in harmony with each other and enables

everybody to work together for the common good. Also in all religions the respect for nature is preached and the maxim of simple living and high thinking is ingrained.

Nevertheless the clock on technology cannot be turned back. It is an evolutionary process and as we advance technologically we also become more spiritual, since technology helps us in doing things more efficiently and thus our needs are satisfied with less quantity of materials and energy. This allows us to think and reflect on higher things in life. Eventually we will follow nature where all the processes are carried out extremely efficiently with few materials, in minimum number of steps and at room temperatures[5]. Thus a combination of high technology together with spiritual growth will be a new paradigm of sustainable development.

How can we do it?

A change in mindset is necessary for sustainable growth. The best way to do it is to teach children in schools and colleges about wonders of nature and limitations of natural resources of the world. The awe that the children will feel on knowing that nature has nearly all the answers to the design problems we are trying to solve will produce in them respect and love for it. Besides, the knowledge that our world resources are finite and we need to husband them carefully, will help instill in them frugal habits. This early training can have a tremendous impact on an impressionable brain and will help create a generation of responsible citizens. In this process the role of women needs to be brought to the mainstream specially in developing world. They constitute 50% of the race and can tremendously influence the children. A program where all the scientists from the major labs are required to teach part-time in schools and colleges will also be a step in the right direction.

There is also a need for international cooperation on development of sustainable and environmentally sound technologies. 3 billion people who live below the poverty line in developing countries need to be brought into the mainstream of progress. Their aspirations for the good life have been fuelled by electronic mass media. If they remain in a state of poverty the destruction of nature will continue to take place, since developing countries are following the same nature destroying pattern of developed countries half a century ago.

Equitable international cooperation in technology and resource transfer will allow the developing countries to leapfrog into modern age and help in environment improvement. The ensuing economic and social development will also help reduce the social strife in the world.

Though we human beings have changed the tapestry of nature and produced problems facing our planet, yet we have this innate ability to take corrective actions once the information and knowledge is available to us. Thus the fear of greenhouse gases, genetically modified foods, animal and human cloning can be allayed by continuously evolving technological and social interventions. The upsurge of movements around the world in the renewable energy and environmental fields attests to this fact.

Nevertheless there is a need to create a spiritual movement so that march towards sustainability is holistically driven. Hence it is the responsibility of all of us scientists and technologists to inform the citizens about these issues in a sustained and responsible manner. This will help educate the politicians, policy makers, corporate world and environmental pressure groups so that we evolve towards sustainable living.



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Dr. Anil K. Rajvanshi has more than 25 years of experience in renewable energy R&D and rural development. He did his B.Tech and M.Tech in Mechanical Engineering from Indian Institute of Technology (IIT) Kanpur in 1972 and 1974 respectively. He received his Ph.D. in Mech. Engg. from University of Florida, Gainesville, USA in 1979 under solar energy pioneer Dr. Eric Farber. He was on the faculty of University of Florida (Dept. of Mechanical Engineering) for 2 years before returning to India in 1981 to run his own rural NGO – NARI in Phaltan, Maharashtra.

NARI has done pioneering work in agriculture, renewable energy and sustainable development areas specially those affecting rural population. Dr. Rajvanshi has devoted the last 25 years at NARI to apply sophisticated science and technology to solve the problems faced by the rural people in the areas of energy, water, pollution and income generation, broadly based on renewable energy in environmentally sound ways.

Consequently very innovative technologies have been developed at NARI. They include ethanol from sweet sorghum, solar distillation plant for ethanol, very efficient lanterns for rural lighting, low concentration ethanol stoves and lanterns, biomass gasifiers and electric cycle rickshaws, among others.

Dr. Rajvanshi has written extensively on his work on rural self-sufficiency and has attracted the attention of the print and visual media worldwide. He has 132 publications and 7 patents to his credit. He has been inducted into several prominent committees of the government of India at the national and state level. He is the principal author of the Govt. of India national policy on Energy Self Sufficient Talukas.

For his pioneering work, Anil has received a number of prestigious national and international awards, such as Jamnalal Bajaj Award, induction to the U.S. based Solar Hall of Fame, Energy Globe Award, Federation of Indian Chambers of Commerce and Industries (FICCI) Annual Award, and Sweden based Globe Award, among others. He has been a featured speaker at many prominent conferences and forums, both in India and U.S. and lectures regularly on the issues of sustainability and rural development.

Besides his engineering work he is also involved in studies of human consciousness and the interaction of spirituality and technology. His writings on these issues have appeared regularly in Times of India in Speaking Tree column. He is an author of a book entitled, "Nature of Human Thought", which tries to bring about a synthesis of ancient Indian Yogic thought and modern cosmology and brain research. The book contains many essays on spirituality and technology and reflects his belief that sustainability and spirituality go hand in hand. Recently he has also penned his memoirs of his US student days in a new book entitled "1970s America – An Indian Student's Journey".

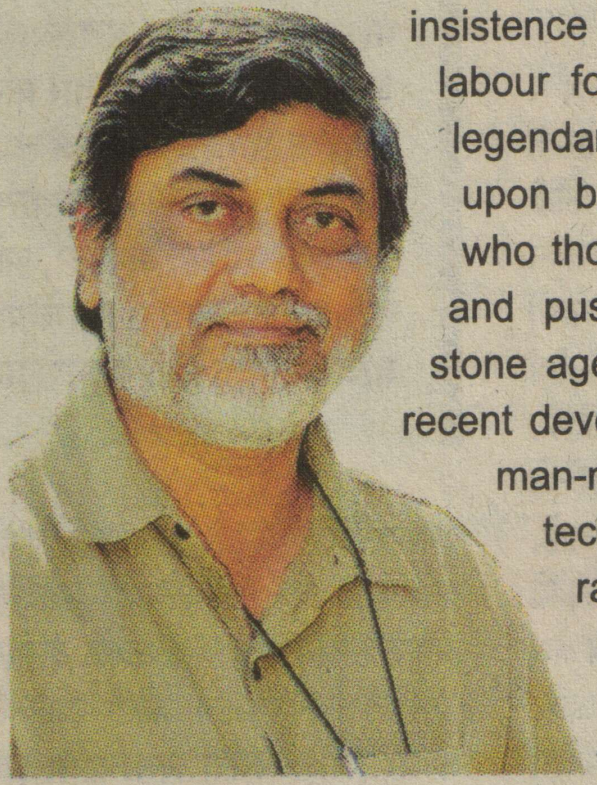
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FT My Inspiration

Anil Rajvanshi

Timeless Inspirator

As a spiritual being and a visionary, Gandhiji was far ahead of his times. For example, he was an energy conservator par excellence. He lives in his ashrams without electricity or any modern amenities. His insistence on use of self / human labour for majority of needs was legendary and was usually frowned upon by his closest colleagues who thought it was anti-progress and pushing India back to the stone ages. Nevertheless with the recent development of sophisticated man-machine interface technologies like free play radios, human powered electricity producing units for laptops, cell phones, etc, the use of self / human labour may be able to solve the twin problems of obesity and energy!



Gandhiji believed in all-inclusive growth and felt that India can only become a great nation when its teeming and impoverished rural masses become better off. He therefore focused on rural development for last 30 years of his life and felt intuitively that future of India is in decentralized rural development. This vision which he stated in 1920's is even more valid today after almost 100 years.

In order for this to happen, creation of wealth and employment should take place in rural areas. I believe this is possible when agriculture provides both energy and food security for India in an economically viable manner. It is the land that provides the wealth of the country -a message that Gandhiji always gave regarding rural development.

(Excerpted from "Timeless Inspirator -Reliving Gandhi", a book conceptualized and edited by scientist Dr. Raghunath Mashelkar and published by Sakal Papers Ltd.)

DNA - Pune - 24/02/2011

'Lanstove' warms hearths, lights up lives of rural poor

DNA
india posi+ive

Bhagyashree Kulthe PUNE

Here is an innovation that has brought smiles on the faces of rural poor, besides helping in environment conservation. Called 'Lanstove', it's a lantern-cum-stove that lights up a small room while cooking food, a boon for lakhs of India's poor living without electricity.

Developed by IIT-Kanpur and University of Florida alumnus, Anil Rajvanshi, who heads the Nimbkar Agricultural Research Institute (Nari) in Phaltan, Satara district, four months ago, Lanstove runs on kerosene and produces illumination equivalent to that of a 300-Watt bulb.

The flame is lit with the flip of a valve and the unit also includes a pressure cooker based on heat pipe principle. Without smoke or smell of kerosene, Lanstove provides light and cooks a complete meal for a family of five in about 2 hours. The cooker can be used for cooking rice, dal and vegetables.

Speaking to *DNA*, Rajvanshi said Lanstove runs for six hours on a litre of kerosene. "Our tests confirmed that the carbon dioxide level generated while using Lanstove is very low as compared to that produced by *chulhas* (traditional wood-fired mud stoves)."

A recipient of the Jamnalal Bajaj award for use of science and technology for rural development, Rajvanshi said solar lamps are expensive and cannot carry out the dual function of lighting. Nari had bagged Sweden's Global Award in 2009 for developing Lanstove that runs on an ethanol-water mix.

Nari carried out about 28 tests among the poor people in villages around Phaltan like Nimbhore, Garpirwadi and Vadzal.

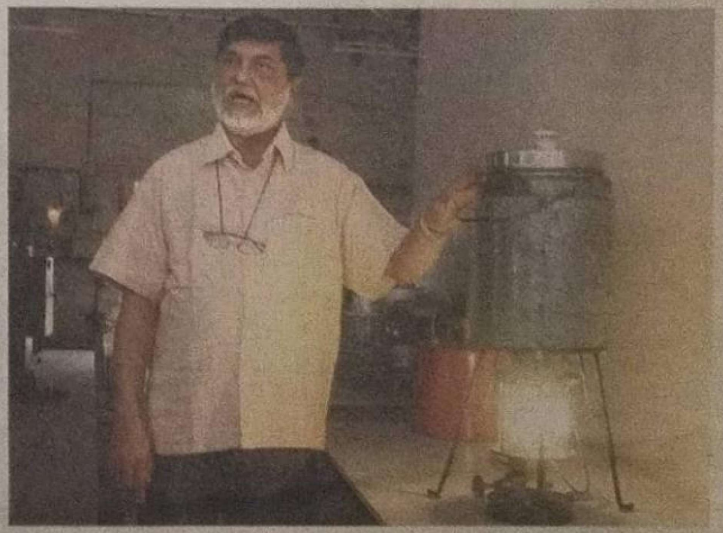
Sunita Mohite, a villager told *DNA*, "While I cooked on Lanstove, children complete their homework. Otherwise they never touched the books after 6 pm." Electricity has not touched the lives of the Mohites for nearly four decades. The children were delighted to see their small hut lit up by Lanstove.

Sunita's mother-in-law, Indubai Mohite, was happy that the *chulha* smoke is now a thing of the past. It has not only relieved Sunita of watering eyes but has saved them the effort of collecting firewood.

A carpenter, Arun Adsul, said now he could continue with his work while his wife Kalpana was cooking. "Otherwise I have to pack up at 6 pm," he said.

Villagers Lata Jadhav and Bharati Ranavre said Lanstove does not require pumping. They were happy that the device helps save time and they could now make *bhakri* after cooking vegetables in the cooker.

Nari has applied for funds from the ministry of science and technology for manufacturing 100 units of Lanstove. "If manufactured on a commercial scale, the device could cost under Rs3,000 and villagers could pay in installments," he said.



Director of Nimbkar Agricultural Research Institute, Anil Rajvanshi with the Lanstove —Sanket Deshpande DNA

HT, LKO - 26/02/2012

Let's promote motorised rickshaws: NARI director



Dhiraj Dolwani being given the social entrepreneurship award.

HT Correspondent
lkoreportersdesk@hindusntatimes.com

LUCKNOW: Pedal rickshaws are supposed to be the best pollution-free mode of transportation. But now we need to promote the motorised version in order to make the job less tedious for the rickshawpullers, said Anil K Rajvanshi, director and honorary secretary of Nimbkar Agricultural Research Institute (NARI).

He said this while delivering keynote address at the northern region HR summit on 'Striving for Change through Social Entrepreneurship' held on Saturday. "The little technology could trigger a big change and also bring a humane touch in the life of the rickshawpullers," he added.

He had even made a model of motor driven pedal rickshaw and floated the idea. But none came forward, he rued.

Organised by Lucknow chapter of National HRD Network, the summit was aimed at bringing change through social entrepreneurship. "Priced at ₹35,000, the three-speed gear fitted motored pedal rickshaw would make life easy for rickshaw-pullers. They will just have to switch on the motor when the road is tough," he said.

Rajvanshi said: "India cannot progress without rural development. With 65% of country's population residing in rural India, their interest needs to be protected. Promoting social entrepreneurship in rural area is a must. Gandhiji was the biggest social entrepreneur and thus, the corporate world must cut on their profitability and give something back to the society."

Dhiraj Dolwani, who runs BPO in rural area and is also a recipient of social entrepreneurship award has set up BPOs in rural Uttarakhand, trained locals and gave them employment. "It is a myth that rural youth cannot match the potential of urban youth. This I can say from my own experience," he said.


NARI

Radhika Raje Haresh Patel

THE DRIVING FORCE A repatriate engineer, Anil Rajvanshi has become a messiah in rural Maharashtra through his eco-friendly innovations

"My father called me an idiot because I refused the Green Card to the US!" Anil Rajvanshi's conversations are punctuated with anecdotes that combine wit and wisdom. Even as he conjures up a joke, he amuses, inspires and motivates all at the same time. He claims he has attained this state of mental peace—"*man ki shanti*", as he calls it—after several turbulent life experiences. The repatriate has been working tirelessly towards giving Maharashtra's rural residents a better life than their privileged urban-half by spearheading sustainable development projects and innovations in and around Phaltan in Satara district.

Born and raised in Lucknow, Rajvanshi went to S T Francis School and later completed his B Tech and M Tech degrees from IIT-Kanpur. His quest for knowledge took him to the US where, at the University of Florida, he pursued his doctorate in mechanical engineering, specialising in solar energy. It was during these days that he met Nandini Nimbkar, who he later married. "I went to the same university exactly six months after him and within a few months we were friends," she recalls. "It was surprising to see how much we had in common."

Developing an interest in imparting knowledge, he stayed back at the University of Florida to teach for two-and-a-half years before an inner voice goaded him to return to India. "I gave it all up to come back and work for rural development. My arrogance and belief that I could change my country brought me back," says the 62 year-old, as he goes down memory lane.

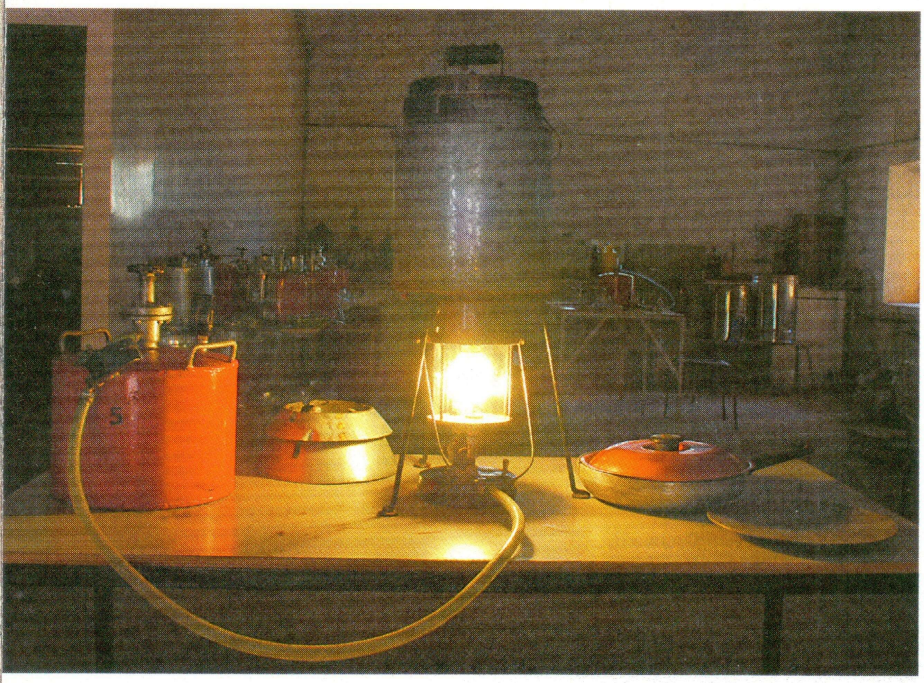
However, it was not an easy homecoming. To begin with, he had to face the negative response of his family, as he had "chosen to decline fast-track citizenship in the US". "Why should I be a citizen of another country when the country I was born in is good enough?" asks Rajvanshi, filled with pride, for the sake of which he and Nandini even refused to have children in the US. Today, blessed with two daughters Noorie and Madhura, Rajvanshi says, "I wanted my kids to be Indians." In 1981, he bid adieu to the US and landed here to join hands with Nimbkar Agricultural Research Institute (NARI), which was founded by his in-laws in Phaltan in 1968. "I supported him...I had the same plans as well. We both understood each other. This being my hometown, it was much easier for me to adjust but he took a while," says Nandini.

The whole family is dedicated to the cause. While Rajvanshi heads the institute, Nandini is the president and his sister-in-law oversees the animal husbandry department. "We are a bunch of mad people," jokes Rajvanshi. NARI has been a major stepping stone for Rajvanshi as it gave him an outlet for his dreams. This non-profit research and development institute was established by B V Nimbkar, his father-in-law, who was the first president of NARI till Nandini took over. Since its establishment, NARI has been involved in agricultural research, sustainable development, renewable energy and animal husbandry. With a recent Globe Sustainability Research Award from Sweden to its credit, the institute is touching new heights. Vijendra Singh, who has been working with NARI since 1991 and is a witness to Rajvanshi's journey, says, "He is a great person; his main aim is to support the poor. He genuinely loves the people here and is always supportive of new ideas and gets into the minutest details of each and every project."

To prove the adage 'change begins at home', Rajvanshi conceptualised and designed an

RAJVANSHI RECENTLY INVENTED LANSTOVE, A LANTERN-CUM-STOVE THAT COOKS WHILE SERVING AS A LANTERN. ACCORDING TO HIM, THIS IS, BY FAR, HIS BEST INVENTION. "WHY SHOULDN'T THESE PEOPLE GET THE LUXURIES LIKE PEOPLE FROM THE CITIES? WE ALL SHOULD HAVE EQUAL LIVES." THESE ETHANOL LANTERNS HAVE BEEN DISTRIBUTED TO LOCALS AT A PRICE OF RS 20 ON A TRIAL BASIS

environment-friendly house for himself in 1984. The 16-inch walls keep the house cool during summers and warm during winters. The house is additionally cooled by laying gunny sacks on the roof and spraying them with water, a simple application of science and thermal energy. "We don't need air-conditioning in our house," he boasts. The house is surrounded by acres of greenery and has been widely used for his research work.





Calling for more and more people to work towards green ideas, Rajvanshi believes that today's youth have a very important role to play. He is dismayed at what they term as success. "A car, a big house and a huge salary are not successes according to me. Youngsters should stop thinking on these lines. This shallow thinking will only make them fret over clothes and bags. I had just two shirts and two pants but I thought I was the king of the world." Another thought that bothers him is the lack of good role models for developing minds. To guide tomorrow's leaders, Rajvanshi meets them regularly. "Speaking to youth is my passion; shaping their lives means shaping the future of the country."

Uplift at the grassroots is another cause close to his heart. Just like his father who quit his professorial job at Allahabad University to fight against the British during the struggle for freedom, the desire to bring about a change has remained in Rajvanshi's genes. He recently invented Lanstove, a lantern-cum-stove that cooks while serving as a lantern. According to him, this is, by far, his best invention. "Why shouldn't these people get the luxuries like people from the cities? We all should have equal lives." These ethanol-based lanterns have been distributed to locals at a price of Rs 20 on a trial basis. Hoping for a positive response, Rajvanshi says, "Lanstove promises light in homes that have been in the dark for 50-60 years." The innovation received a Globe Forum Award in Sweden recently.

Another feather in his cap is the biomass gasifier that utilises agricultural waste from sugarcane factories in and around Phaltan. Earlier, this waste was burnt, causing air pollution and production of greenhouse gases. With this patented innovation, the entire natural residue gets turned into heat and is being used for rural business. Another of Rajvanshi's



inventions is an electric rickshaw—ELECSHA—which has gained a lot of popularity among locals as an eco-friendly substitute to pedal-pushed rickshaws. To help pedal easily on roads and slopes, ELECSHA runs for about two hours or up to 60 km with a single battery charge.

As we are left wondering if he is a geek, Rajvanshi slowly unfolds his spiritual side. He has written extensively on topics like mental happiness, technology and spirituality as well as personal evolution on his blog *speakingtree.com*. "We must do what makes us happy but be considerate to others as well," he says. His last book, *Nature of Human Thought* (2010), presents a unique perspective on human thought and its production through modern science. So who is he really—a scientist or a saint? He laughs this off and proclaims, "I am just a zoo animal!"

While Rajvanshi's innovations and ideals are improving people's lifestyles in the surrounding rural areas, he still reminisces about the days when there was no school nearby for his daughters. "My wife started the first school in Phaltan. With my daughters, grew the grades in school." So it didn't come as a surprise when their younger daughter Madhura showed an interest in giving up her botany education to become a teacher in the same school. Indeed, Phaltan has this family to thank for many of its firsts. "When I moved here in 1981, I had to walk for miles to go to another city to make an international call," recalls Rajvanshi. He kept writing letters to the government asking for a telephone booth in the area and didn't rest till one was set up in his village.

With so much to his credit, it doesn't come as a surprise that he is an ardent fan of Einstein and many other great inventors. "It's a boon to be able to change people's lives," he says, sounding like Shah Rukh Khan in *Swades* and Aamir Khan in *3 Idiots* and reinforcing the fact that our films are, in fact, based on reality.

ROTARY CLUB OF PUNE UNIVERSITY
R.I. DIST. 3131
MAHARASHTRA STATE, INDIA.

TODAY

March 2013

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PRESIDENT'S MESSAGE



Dear Friends,

You all are aware that our club was **HOST** for the President Elect Training Seminar at Mahabaleshwar between 1st to 3rd March 13. Our PETS committee did wonderful job at Mahabaleshwar. All those who attended PETS were delighted, enjoyed and thrilled with hospitality given by all our members. I have circulated email sent by DGE Dr. Deepak and IPDG Mohan praising our club and its members for the excellent job done. This shows again team spirit amongst our members. Of course we can not forget the efforts taken by Rtn. Abhay and his district team. Without their involvement and support the success would have not possible. I personally feel proud of having PETS committee members such as Abhay, Ajit, Kshama, Jagdish, Shruti, Dileep, Shobhana, Satish, Rohini, Dilip, Shobha, Ravi, Sujata, Satish, Neeta, Vinay, Meeta, Jayant, Anjali, Jitendra, Dr. Jyotsna, Rekha and Sanjay.

In the last month Rubella Vaccination for 297 girls of RMP School and 110 girls of ZP School Urse carried out. Thanks to Rtn. Dr. Preeti Kale who single handedly gave vaccination to 297 girls, of course assisted and supported by Rtn. Anita, Shobhana, Sujata, Kshama, Rekha and Kumudini.

On 24th Feb, we immunized 891 children on the occasion of polio NID. First time Rtn. Jitendra, Dr. Jyostna and Kshama Upasani were involved in this drive. After completing their job they were thrilled with the experience and committed to carry out same job in the next NID without giving any excuses. Thanks to Rtn. Vinay and Meeta shouldering the responsibility of Chairmanship of POILO committee for more than 15 years. As usual Rtns. Dileep, Shobhana, Kshama Gangoli, Shruti, Arvind, Vibha, Dilip Chitre, and Rekha were part of NID team.

We have given one more RDEP at ZP School Godumbre, Tal. Maval. Dist. Pune. So far we have installed RDEP in 7 schools this year against targeted of 10. We have given Rubella Vaccine to 407 girls against targeted 1000. Hopefully we will complete the balance within next one month time.

In last month, Rtn. Aniruddha Ranjekar, one more family, is joined in the family of RCPU. I am sure, with having Rotary background he will be an asset to our club. I wish him all the best.

-Rtn. Pradip Patil

EDITORIAL



Dear Fellow Rotarians & Anns,

In Rotary, March is the **"Literacy Month"**. In 1985, Rotary declared basic literacy to be a pre-condition to the development of Peace. Some literacy projects are Early childhood literacy and Primary education, Adult literacy programmes, Literacy and Women. Literacy Month encourages the club and district to focus on literacy in their service projects. Many Rotary clubs use to teach reading and writing during literacy projects. We can get the tools for projects promoting youth and adult literacy.

Rotary worldwide is very focused on literacy goals. Simple reading skills can have an effect on person's entire life as well as the world. I think literacy can be defined as the ability to read and write, the ability to use printed and written information to function in society, to achieve one's goals, to develop one's knowledge and potential. In order to develop this ability one must not only be able to recognize letters and words but also make inferences, draw conclusions, understand the cause, other higher level skills. In short, it's not just the ability of read and write but also understand and use and apply what you read and to communicate effectively in writing. Our DGE has offered good scholarship through ***"Shyamchi Aai"*** programme which will help reduce illiteracy. Illiteracy causes crime, poverty and mortality. Illiteracy doesn't just affect those who are illiterate but also it affects our community, nation and the whole world.

In today's world illiteracy also gets extended with computer illiteracy. We all must educate all anns which will help them succeed in all kinds of computer applications. Even our District's major tool **RDEP (Rotary Distance Education Program)** which will help a lot to eradicate computer illiteracy. We all should come together to eradicate nation's illiteracy by forming various Ineract, Earlyact and Rotaract clubs. We must provide them Career Guidance programs, leadership development workshops which will help in their personality development.

-Rtn. Sujata Kulkarni

On the occasion of "National Science Day" an article submitted by Rtn. Dileep Paranjpye

LANSTOVE —
A Kerosene Lantern cum Stove for Rural Areas

As we know, kerosene is a commonly used fuel in rural areas for cooking as well as for lighting by burning it in lanterns. Although subsidized by the government as the 'poor man's fuel' its use has its own problems like smoke, pollution, spillage and wastage, shortage etc.

Anil K Rajvanshi, a winner of the Distinguished Alumnus Award from IIT, Kanpur, and the Director of Nimbalkar Agricultural Research Institute, Phaltan, has created a combination of a lantern and stove, which works on kerosene. Named KeroLanStove or Lanstove, this device is a boon to the users who can get sufficient light for the family, especially children, to do their school reading. At the same time, it generates heat so that household cooking can be carried out without hindrance. Extracts from literature on lanstove are printed below:

What is lanstove? : Lanstove is a kerosene-fueled device which produces high intensity light and simultaneously cooks a complete meal for a family of 5.

Who has developed it? : Nimbkar Agricultural Research Institute in Phaltan, Maharashtra. They own the intellectual property rights of lanstove. The word lanstove has also been coined by NARI.

Attributes of lanstove:

Sr. No	It	Attributes
1	Unit	The unit consists of lanstove; novel cooker with insulated jacket; and pressurized (2-3 atm pressure) 9 liter kerosene cylinder. Items made of mild steel and stainless steel.
2	Light output	3000-3200 lumens from thermoluminescent mantle used in Petromax lamps. Existing hurricane lantern produces 65-70 lumens.
3	Efficacy of lantern	1.5-2.6 lumen / Watt
4	Efficiency of stove	40-45% (water boiling tests)
5	Heat output	1400-1600 Watt (Approx. 1.5KW)
6	Kerosene consumption	1.7-2.5 grams per minute
7	What it does	Provides excellent light; cooks complete meals for a family of 5; and boils 5 liter of water for drinking.
8	Cooking – Rice, dal and vegetables	Via very efficient steam cooker with 3 or 4 pots. The cooker works on the principle of heat pipe.
	Cooking – Chapatti / bhakari	On griddle (tava) put over the lanstove.
9	Water boiling	5 liters of water is boiled in 30 -35 minutes.
10	Expected usage	4 hours at night and 2 hours in the morning.
11	Pollution parameters	- No smoke, smell or burning in eyes. - CO levels less han 3 ppm even after 3-4 hours of working in a very small enclosed room. - 2.5 and 10 microns particulate emissions less than WHO standards.
12	Controls	A valve controls the light output and hence heat from the lanstove. Some more R&D needed in it.
13	Field testing	50 huts in villages around Phaltan. Given in 25 huts for long term testing.

Comments of women using lanstove (16 households) :



- Lanstove cooking is much faster than that with woodstove.

- Very bright light. Since no supervision is required during steam cooking, can do other household work like sewing, cleaning grain etc. and is also helpful for children to study.

- Very easy to light and use it. No smell or soot unlike in regular kerosene lanterns or stoves.

-Very good for small businesses which can produce handicraft items in the light.

- Very tasty food since no overcooking or burning. Slow steam cooking.



- Chapatti or bhakari can also be conveniently cooked on lanstove.

- Will be willing to buy this stove if the price is between Rs.1,000-3,000/-

- Liked the water boiling aspect of the stove. In the morning it is used for heating bath water.

- Works just like LPG stove since no pumping is needed other than that required to pressurize the cylinder (done once a week) and it is easy to control the flame.

- The lanstove is safe to handle and does not involve risks of fire outbreak as is the case with regular kerosene lanterns, pressurized kerosene stoves and conventional chulhas.



- The use of lanstove can eliminate the physical exertion in collecting wood/biomass. The time saved can be used to relax at home or doing other work.

- The bright light of lanstove makes us feel secure and comfortable, as we stay in an isolated area.

Economics :

1. Cost of lanstove : Present cost (for 2-3 pieces) is Rs. 6,000-7,000/- (US$ 120 - 140). This cost is estimated to come down drastically in mass production.

2. Kerosene used : 0.8 liters/day (6 hours use; 4 at night and 2 in the morning)

3. Running cost : Rs. 375/month (PDS kerosene @ Rs. 13 per litre)

Rs. 920/month (open market kerosene @ Rs. 40 per litre)

Technical and Design Issues

Industrial designers needed to improve the look of lanstove and reduce the cost.

General comments:

To the best of NARI's knowledge this is the first time anywhere in the world where one device provides simultaneously light and complete cooking energy needs for a family of four or five. Also because of the excellent combustion in lanstove, kerosene becomes a very clean fuel for rural households – almost equivalent to LPG.

The lanstove, therefore, has the ability to immediately improve the quality of life for bottom of the pyramid people in rural and urban areas. With the existing kerosene consumption of India, lanstove can drastically improve the quality of life of 180 million people.

On per unit energy basis lanstove is 3 times more efficient than electricity-based lighting and cooking. This is because 70% of energy is lost as heat in electricity production and 20% are transmission and distribution losses. Together with these losses are added the efficiencies of electric lighting and cooking devices, thereby making lanstove much more efficient than electricity based systems.

Extensive user trials are being conducted by NARI and once the apparatus is fully developed, it will certainly prove to be a boon for the rural homes.

How NRIs can Help in Poverty Alleviation

Sophisticated and cutting edge technology is needed to find a solution to the energy problem and NRIs have a role to play in facilitating technology transfer and ultimately alleviate poverty.



ANIL K. RAJVANSHI was born and raised in Lucknow. He completed his M.Tech. from IIT Kanpur and his Ph.D. in mechanical engineering (with specialization in solar energy) from the University of Florida, U.S.A. He taught at the University of Florida for two and half years before returning to India in 1981 to join Nimbkar Agricultural Research Institute (NARI) as its Director at Phaltan, Maharashtra. Dr. Rajvanshi serves on many prestigious committees of the Central and the States Government. In 2001, he received the prestigious Jamnalal Bajaj Award for the use of science and technology in rural development. His work also received the prestigious Energy Globe award in 2004.

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EVEN AFTER 60 years of independence, a large part of the rural population in India still uses archaic technology such as inefficient kerosene lanterns for light, and primitive and biomass cook stoves for cooking. It seems that modern technology has yet not touched their lives, and creation of wealth is a desperate need.

Non-resident Indians (NRIs) can help in creating a better quality of life for the rural people by bringing in technology and leveraging their knowledge, technology and financial resources. While it is necessary to improve all aspects of rural life to improve the quality of life of the rural populace, this article would focus on energy alone, specifically on the production of liquid fuel and electricity – two important fuels of modern life.

One strategy to create wealth in rural areas through energy solutions is to tie up agriculture and the energy industry. According to experts, on an average, only 25-40% of agricultural produce is food, while the rest is agricultural residue. Residues can produce electricity (via biomass-based power plants), ethanol fuel (via enzymatic hydrolysis process), and diesel (via high temperature pyrolysis route). Any marginal farm can produce agricultural residues even if the main food crop is not very successful. On an average, a farmer can get an extra income of Rs. 2000-4000/acre from the residues alone if they are used for producing energy. This income can give him benefits even in case of a distress sale of his crop.

Today, about 600 million tons/year of agricultural residues are produced in India. Most of these are burnt in the fields as a solution to the waste disposal problem. Theoretically, these residues can produce 80,000 MW of electric power year round via biomass based power plants. This is nearly 60% of the total installed electricity capacity of India. Part of these agricultural residues can also be used via the methane (biogas) route to produce fertilizer for the crops and gaseous fuel to run rural transport, irrigation pump sets, or as cooking gas.

Similarly, agricultural residues can be used to produce diesel via fast pyrolysis process. The production of liquid fuels and electricity from residues will require an investment of about Rs. 160,000 Crores. However, in return it will bring about 10 times more money to rural areas in terms of revenues from energy generation. Besides, it can potentially create almost 120 million extra jobs in these areas.

Sophisticated and cutting edge technology is needed for converting agricultural residues to ethanol. For producing electricity, there is a need to look at technologies that convert agricultural residues to electricity very efficiently, and NRIs can bring some of the most efficient power plants to India.

In 1974, I started my Ph.D. in Solar Energy under Dr. Erich Farber. Dr. Farber had come from Germany during the last days of World War II and then worked in U.S; he was very well recognized in the scientific community. He told me that nearly all the German scientists who came to U.S. came with very few material things, but with all their knowledge, which was used by U.S. military and the Government for the betterment of the country.

Both finance and knowledge are required in poverty alleviation for India, and the NRIs can contribute greatly by providing their knowledge and skills. They can further make their interventions more effective by:

- Tying up with local rural based NGOs and financial institutions for financing,
- Educating the corporate sector and having technological tie ups with them,
- Influencing multilateral agencies like the World Bank, IMF, UN agencies and even governments of western countries to help in rural development.

Rickshaws in Europe, lanterns in US

From Kalyan Ray
DH News Service

NEW DELHI, July 19

In a unusual reverse flow of technology day to day items like kerosene lantern and cycle rickshaws - typical of India and the developing world - are getting acceptance in the advanced world in the last few months, thanks to the efforts of a group of Indian scientists in Pune.

The rickshaws and lanterns, improved upon by Nimbarkar Agriculture Research Institute (NARI), are now serving people in London, Germany and California.

In the first step four rickshaws have been sent to Europe while two lanterns are aiding a communication engineer in California.

NARI has developed a series of improved cycle rickshaws ranging from improved pedal rickshaw, motor driven rickshaw and a completely battery-driven one.

But those which have gone to Europe are a pedalled version that has a five-speed gear, back wheel brakes, short chains, lower aerodynamic drag and better suspension.

This type of rickshaws, each costing Rs 7000, has potential as a pollution-free leisure mode of vehicle for use inside large campuses, NARI director Anil Rajvanshi told Deccan Herald on the sidelines of a CII-organised biotech conference. Rickshaws are in fact a preferred mode of transportation in Oxford and Cambridge University campuses.

The institute will soon introduce these rickshaws in Pune University and in the process of negotiating with Rickshaw-puller associations and cooperative societies in states like Andhra Pradesh, Bihar and Uttar Pradesh to introduce the rickshaws there.

In a similar manner, the researchers have improved the common lantern into a bright 100-watt light source in case of load-shedding - a frequent malady in India and other countries in the developing world.

UNIQUE LANTERNS: Costing Rs 300, the unique lanterns consume 40 per cent less fuel, can run on kerosene, diesel and alcohol, do not require cleaning and can double up as a makeshift stove in case of emergency.

The luminosity of the petromax-sized lanterns is equivalent to 100-watt electric bulbs and more efficient that lanterns made by foreign companies, Dr Rajvanshi said, adding that the US engineer who bought those two lantern saw the product on the net and communicated directly to the institute which has not started marketing the lanterns commercially.

Power from cane leaves

Sugarcane leaves, millions of tonnes of which go waste in India every year, can be used to generate power, save diesel and produce enough heat to run jaggery units.

Production of power via loose leafy biomass is a unique technology report scientists from the Nimbkar Agricultural Research Institute (NARI) at Phaltan in Maharashtra. NARI scientists have initiated a project to gasify loose sugarcane leaves to generate electricity in the 10-15 kilo Watts (kW) range.

Tests on a 15-kilo-Volt-Ampere diesel genset powered by a sugarcane leaves gasifier showed that 70-90 per cent diesel substitution could be achieved with 5 kilo Watts load.

The NARI gasifier, which is non-polluting and safe, also produces char which is 15-28 per cent of the fuel. The char boosts the overall efficiency of the system to 80-85 per cent and when mixed with a suitable binder it forms an excellent briquetting fuel for cooking purposes.

In India alone, about 430 million tonnes of crop residues are produced every year, out of which 330 million tonnes are used as feed or fodder and the remaining 100 million tonnes simply disposed of by burning in open fields.

Scientists chopped Sugarcane leaves (five cms-long) and sun-dried them. They also designed a gasifier-powered diesel generator set, comprising a gasifier, a cooling-cum-cleaning system and 15 kVA diesel engine generator.

The biomass and air are fed from the top and ash and char continuously removed from the bottom into a water seal. The gasifier is an open top unit, without any neck or constriction, and has an inner steel cylinder and an outer jacket.

To deal with the problem of tar formation in the gasifier, the NARI team has designed an elaborate but effective cooling and cleaning system. Another problem with the unit is the total contaminants in the gas which finally comes out is far in excess of the maximum recommended levels. It is also 10-20 times higher than that obtained in wood gasifiers. To overcome this hurdle the scientists passed the gas through a safety filter system which was cleaned with a solvent every 10-20 hours.

Following long-term studies, the team is considering replacing the stainless steel lining of the inner cylinder with a ceramic lining.

The studies also show that the NARI type gasifier systems with very few or no controls are more suitable for steady and uniform loads such as pumpsets, rather than for applications involving transient or cyclic loading patterns such a crushers and threshers. — PTI

Alternative source of jaggery

Those with a sweet tooth may find an ally in sweet sorghum, a crop widely grown in parts of peninsular India and emerging as an alternative source of jaggery for making candy and confectionaries, reports PTI.

Scientists in Maharashtra have devised for the first time in the country a complete protocol for making jaggery a table-variety syrup from sweet sorghum.

The Nimbkar Agricultural Research Institute at Phaltan has set up a pilot plant of 100-kg capacity, and its scientists say that with sweet sorghum as the raw material, jaggery making can become a year-round occupation instead of a seasonal one as in the case of sugarcane.

NARI's project report was submitted recently to the Council for Advancement of People's Action and Rural Technology. The findings may not only offer an alternative source for jaggery but also reduce diversion of sugarcane for making jaggery instead of sugar.

Jaggery and khandsari production is a Rs 30,000-million industry in India and provides employment to about 2.5 million people, says NARI director, Dr Anil K. Rajvanshi.

About 40% of the total sugarcane production in India is diverted to make jaggery in spite of inefficient manufacturing techniques that lead to revenue losses for many farmers, he said.

Farmers still prefer to make jaggery for a variety of reasons. For one, they get instant cash after selling jaggery in the open market, whereas if they give their cane to sugar factories they get money only in instalments and sometimes, after two to three years.

With several regions in India, especially Maharashtra, facing a labour problem of cane cutters, many small-and medium-scale farmes cannot get their cane cut in time and hence receive a reduced price for dry canes.

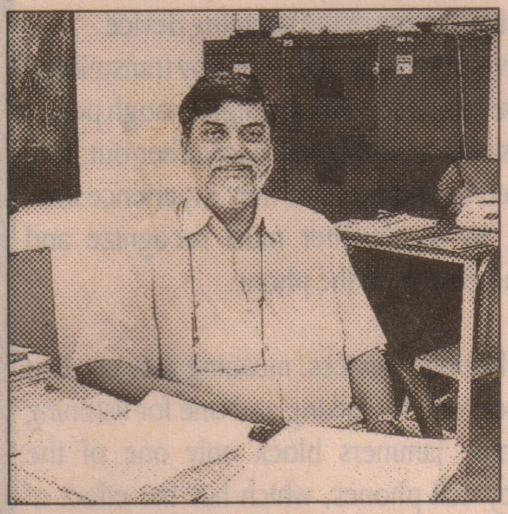
Times of India - 30/10/2007

Nari goes to China

UNDP Invites Rajvanshi To Share Insights on Rural Energy

TIMES NEWS NETWORK

Pune: Phaltan-based Nimbkar Agricultural Research Institute's (Nari) director Anil Rajvanshi has been invited by the United Nations Development Programme (UNDP) to share his thoughts on rural energy development with the Chinese government.



THE CHOSEN ONE: Anil Rajvanshi

Nari, under Rajvanshi, has pioneered work related to development of renewable energy technologies for rural areas, and the Chinese government has expressed a desire to learn from these experiences.

A statement released by Nari, said the government of China was in the process of preparing a national energy law, and rural energy issues figured prominently in it.

Though China has managed to achieve a lot in the overall development of its urban areas, the rural areas on the other hand have by and large remained neglected, leading to discontent and frustration in the rural population.

The statement said the Chinese government was preparing the energy plan on a massive scale, to develop the impoverished rural areas. "Lack of energy is one of the main reasons for this poverty, and hence the energy law," the statement said.

As a part of this effort, the government of China is organising an international symposium in November, in the field of rural energy, in order to learn from the experiences of various international experts.

Rajvanshi is one of the six experts, and the only Indian, to be invited for the symposium. Other experts, scheduled to speak at the symposium, are from Brazil, United States, Europe and Africa.

Besides giving a talk on Nari's efforts, Rajvanshi will also visit some of the Chinese rural energy projects.