

# Innovation for forgotten Indians – How corporate world can improve their lives



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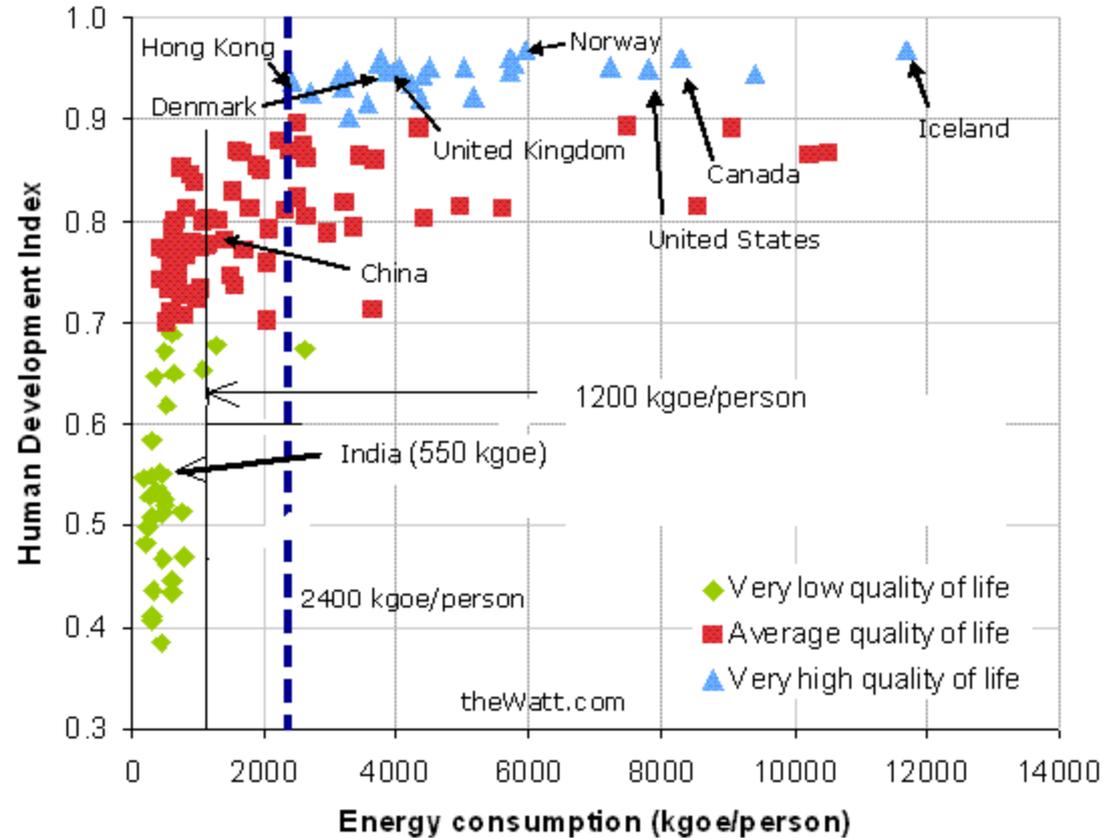
# Problems of rural poor

- ❑ In India 75 million households ( ~ 300 million people) have no electricity (2011 census).
- ❑ Around 60% of rural population live in miserable conditions. Sad state even 68 years after independence.
- ❑ Mostly use kerosene for lighting in polluting lanterns and more than 200 million tons/yr of biomass for cooking in inefficient, primitive and smoky stoves. Use unclean drinking water.
- ❑ According to WHO around 600,000 deaths/yr because of indoor air pollution and 1.5 million because of polluted drinking water in India alone.
- ❑ Modern technology has not touched their lives. Other India has aspirations of sending man to the moon and Mars and becoming economic power.
- ❑ Around 400 million people in rural areas survive on less than Rs 100/day.



# Energy vs HDI

- US energy consumption  $\sim 335$  GJ/person per year
- India  $\sim 35$  GJ/p-yr.
- Rural India  $\sim 3-4$  GJ/person-yr.
- Need yearly 50GJ/person.
- Provision of increased energy from local sources as challenge for engineers.



# Rural scenario....

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- ❑ Rural poor are not sub human beings. They have the same number of neurons as rest of us and aspire to have good quality of life.
- ❑ They cannot wait indefinitely for trickle down goods and services.
- ❑ Mass media has fueled their aspirations which can be fulfilled with affordable technology and services.
- ❑ How to provide goods and services which improve their quality of life is the biggest challenge for engineers and scientists. Need for affordable innovations.
- ❑ Provision of affordable energy from local resources can provide these services and increase wealth in rural areas.
- ❑ Energy innovations needed in;
  - Household sector (decent living)
  - Farming sector (decent livelihood)

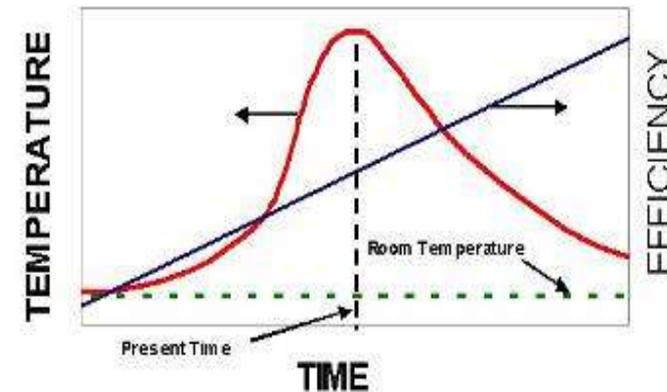
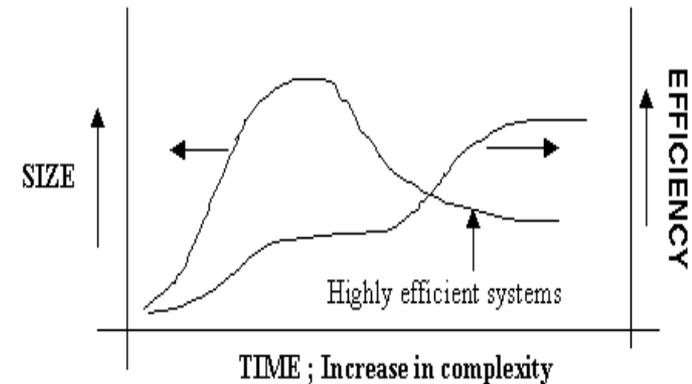
# Innovations for rural households

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- Mantra for development; Improving the lives of rural poor – one household at a time.
- Need:
  - Excellent light (>3000 lm); solar lanterns < 600 lm.
  - Very clean cooking fuel (liquid or gaseous fuel preferred because of ease of control and high energy density)
  - A small refrigerator for storing milk and vegetables
  - Clean drinking water
  - A very efficient fan (maximization of m<sup>3</sup> air/W)
  - Electric motor bikes for mobility
  - Availability of wholesome food; rural restaurants?
- Provision of affordable grid electricity in rural India is a distant dream. Innovations needed in providing above services without it. Need decentralized grids.
- Efficiency increases when energy sources match end needs. Decentralized energy production needed.

# Strategy for rural innovations

- ❑ High technology needed for rural development. Need to maximize efficiency. Frugal innovations?
- ❑ It allows maximum extraction of materials and energy from dilute locally available resources, like solar, biomass, wind.
- ❑ Hallmark of evolution: size reduction; increased efficiency; **room temperature processes;** equilibrium with surroundings and robustness.



# Strategy.....

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- ❑ This is how nature has evolved. Biomimicry as mantra for design. Most of our designs are following this route. Cell phones, power plants, etc.
- ❑ Societies as Prigogine's dissipative structures. Decentralized high tech energy solutions  $\Rightarrow$  softer and sustainable decentralized societies .
- ❑ Third industrial revolution (3D printing/additive manufacturing) is following natural systems. Can usher in Gandhian concept of self-sufficient rural areas.

# Rural huts



**Even during daytime there is darkness in huts**



# NARI Multifuel LANSTOVE™

- ◆ One device produces excellent light (200-300 W bulb), cooks a complete meal for family of 4-5 and **makes 10 liters of water potable.**
- ◆ **Runs on kerosene and diesel. 1500 W capacity.**
- ◆ Tested in 25 un-electrified huts ( for one year in 2013). Excellent response.
- ◆ Lanstove is as easy to use and clean as LPG.
- ◆ **3-5 times more efficient than electric cooking and lighting. LCA analysis.**
- ◆ Present cost Rs. 10,000/- . In mass production expected Rs. 4000/- . Women ready to pay Rs. 20-30/day.
- ◆ Excellent combustion in lanstove. CO <3-4 ppm and particulate emissions (15-20  $\mu\text{g}/\text{m}^3$  ) much less than WHO standards.
- ◆ **All fuels are dirty. Excellent combustion makes them clean. Kerosene or diesel is not an issue. Its affordable availability is.**

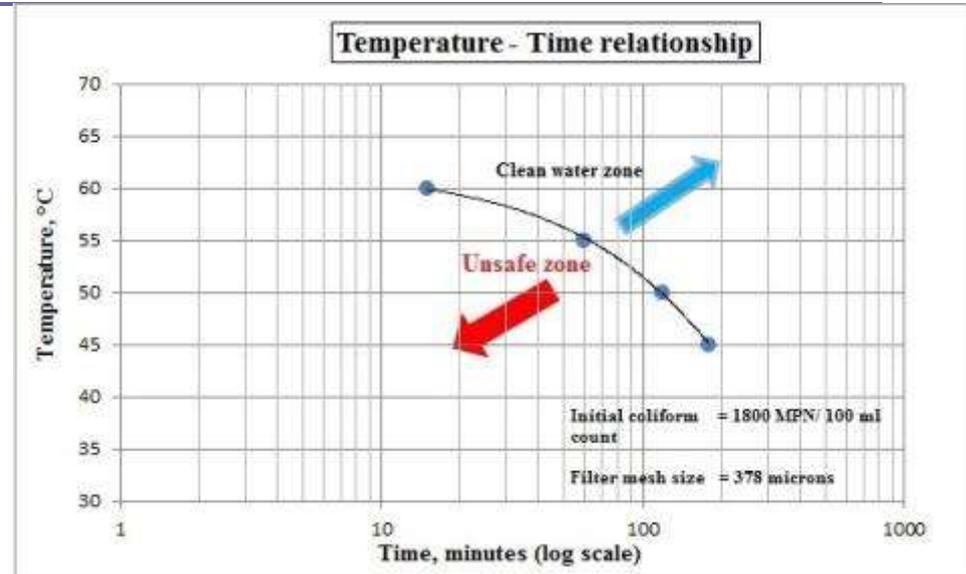


Lanstove



# NARI solar water purifier

- A simple water cleaning technology. Filtering dirty water through 4 layered sari cloth and heating to 60-65° C.
- Cleans 12-15 liters/day.
- Cost < Rs. 3000/- in volumes.
- Need to develop a solar powered water utility for a village; 30,000 l/day capacity.
- In conjunction with absorption refrigeration unit, could provide ~ 5 kg of ice per household. Need to develop such a unit.
- Estimated cost of purified water ~ 30 p/ liter.



# Challenges for rural households.....

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- ❑ Need cell phone charger with lanstove.
- ❑ Development of heat powered small absorption refrigerators. Market of 70-100 million.
- ❑ Need for heat reflecting glass.
- ❑ Need very high efficiency fan. Max  $m^3$  air/W.
- ❑ Development of electric two wheeler.
- ❑ Availability of kerosene and diesel for rural poor is a major issue.
- ❑ Conversion of agricultural residue into kerosene or diesel type fuel. Making these fuels soot-less.
- ❑ Wholesome food for rural poor. India has the most malnourished population in the world.

# Wholesome food availability?

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- ❑ More than anything else rural poor need better food. Concept of rural restaurants.
- ❑ Tremendous pollution in rural households.
- ❑ Need utensils and fuel to cook. Costs money.
- ❑ After a hard day in the field the woman is in no shape or mood to cook. Very tiring and unpleasant chore.
- ❑ Very poor nutrition. Daily rations are bought from PDS shops. If not available they tend to eat less.
- ❑ Poor eating and hence rapid aging and poor physical and **mental health** including those of children.
- ❑ Best medical care for rural poor is to provide them with good food.
- ❑ Creation of clean rural restaurants. Based on McDonald model. Regular ones but for BPL families subsidized meal. Use of UID card for meal purchase.

# Rural restaurants (solution)

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- ❑ Has a potential for producing 20 million jobs. Can be a large rural industry. Fit for public-private partnership. Part of CSR activity?
- ❑ Will also help reduce energy/kg for cooked food. May facilitate use of renewable energy. Biogas, producer gas, efficient wood fired stoves.
- ❑ Poverty to my mind is not an absence of material goods but not getting **enough wholesome food**. **We are what we eat!**
- ❑ Cooking is a luxury for rich and upper middle class. For rural and urban poor it is a chore and a misery. Hence subsidized meals in rural restaurants is a welcome step for these people.
- ❑ A small beginning made in Chennai where quite a few such restaurants have started working with huge success and demand.

# Farming Sector (decent livelihoods)

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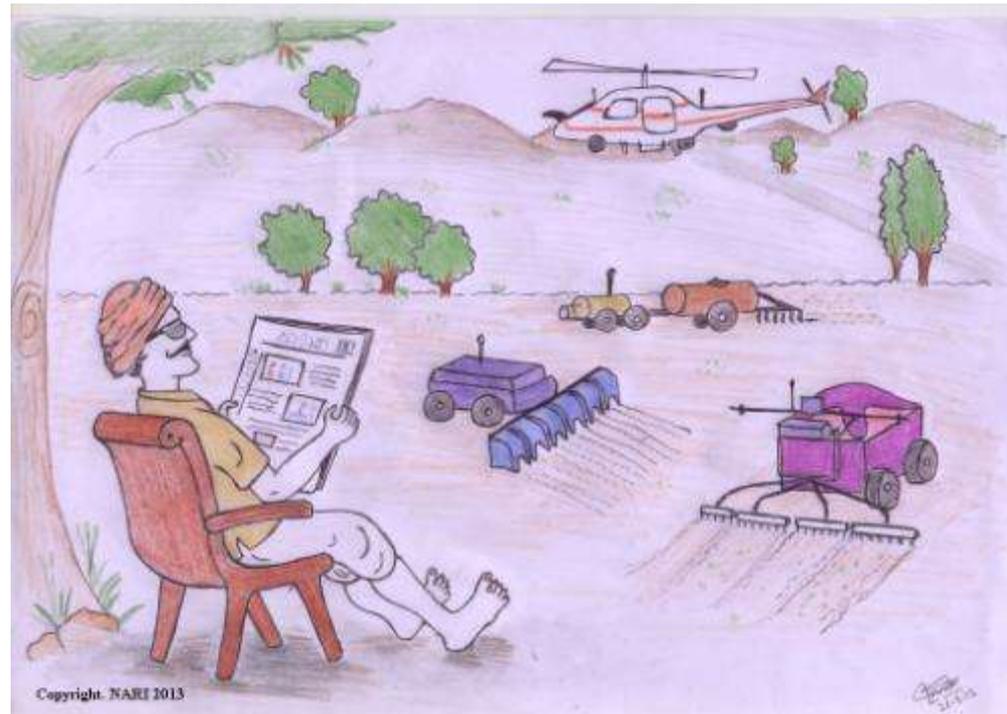
- Around 55% of India's population involved in farming. In US it is < 4%.
- Small farm holdings. 80% of Indian farms < 2ha.
- Only 30% of farms are irrigated. Shortage of irrigation water. Also very low productivity. ~ 33% of world's standards.
- 50% farmers are in debt. Large scale farmers suicides.
- Farming is presently non-remunerative. Hence farms are being sold and labor is not available.
- Need for highly mechanized farms – precision farming. Will lead to higher productivity.
- Great challenge for engineers to develop robots for small farms; weeding, harvesting, sowing etc.
- Presently working with Mahindra on this.

# Farming sector .....

## Challenges:

- Affordable drip irrigation.
- Cheap drones.
- Camera on drones for disease and stress identification.
- Robots for planting, weeding and harvesting.
- Farm machines to run on farm-derived fuel. Either liquid or electric.
- Leasing equipment model.
- Venture funds needed for agricultural technology development.

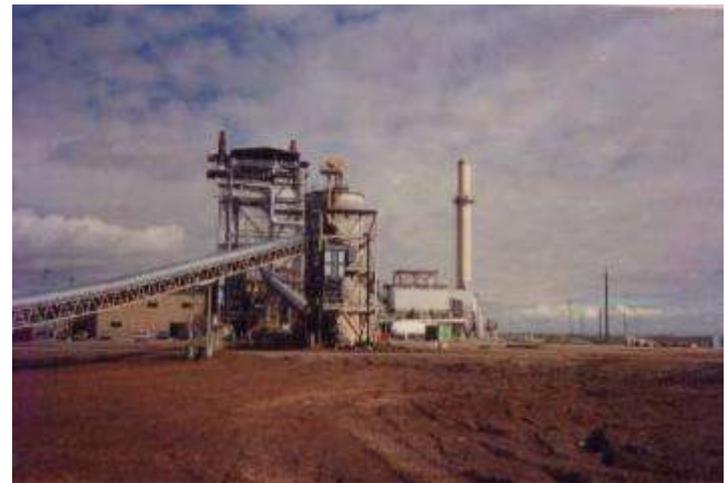
My dream!



Farmers to become breeders

# Farming sector ....

- ❑ India produces ~ 800-1200 million tons of agri. residues per year. 60-75% of farm produce is residues. Mostly burned in fields .
- ❑ Theoretically these residues can produce **156 b l/yr of ethanol** which is 42% of India's oil demand in 2012; or **80% of oil demand** via pyrolysis oil; or 80,000 MW of electric power which is ~ 50% of presently installed capacity.
- ❑ Energy from farming can be Rs. 2 lakh crores/yr industry and can bring in tremendous wealth to rural India.
- ❑ With precision agriculture and increased productivity of farm; more residues.

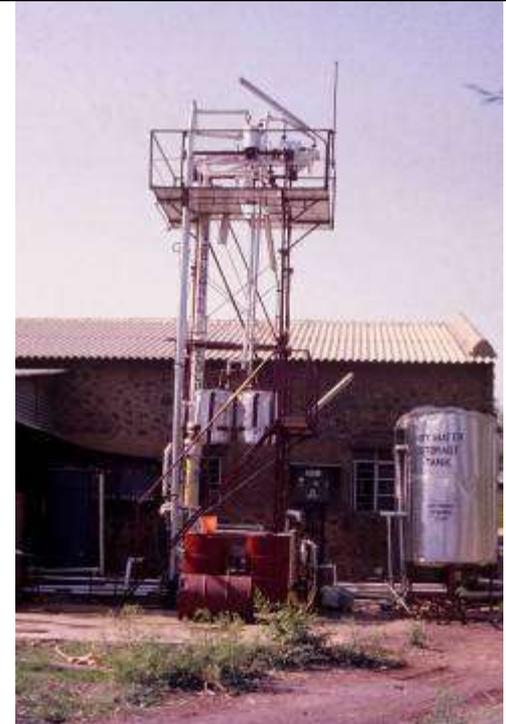


# NARI technologies

## (ethanol from sweet sorghum)



[Solar distillation plant](#). Set up in 1987



- 50 lpd 95%(v/v) ethanol.
- 1<sup>st</sup> in the world

### Solar detoxification of dist. waste

- 200 lpd plant
- Photocatalyst
- T ↑ 0-90% in 2 days.



# NARI technologies (Power generation)

## Sugarcane leaves gasifier

- 0.5 MW<sub>th</sub>
- Thermal applications
- Set up in 1997



## NARI Taluka plan became a national policy

- Adopted by MNRE in 1996
- More than 100 power plants setup



# NARI technologies (Mobility issues)

- [Electric cycle rickshaws](#). Work started in 1995.
- Present e-rickshaw design could be traced to our work.
- 2 dozen rickshaws sold in US, Canada, Europe.
- Austria based Energy Globe Award.



ELECSHA



MAPRA



Electric trikes for handicapped persons

# Agriculture

## □ Sweet Sorghum

- Introduced in India in 1970s by NARI.
- Alcohol/syrup, grain and fodder.



## □ Safflower

- 50% of all released varieties from NARI
- Petals, seed, charcoal and cut flowers



## □ AHD

- FecB gene for twinning of sheep.
- CSIR award

## □ Precision agriculture



# Final thoughts

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- Purpose of life is to achieve happiness. All our efforts are geared towards that goal.
- Giving back to society produces satisfaction and happiness. It also gives purpose to life.
- Helping bottom of pyramid population to improve their lives is giving back to society.
- It should be done without greed for profits.
- If done actively all our lives; will make us better human beings.
- Will also help us live sustainably.
- Need for NGO corporate partnership.
- Story

# Thank you

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## □ Useful sites:

- [www.nariphaltan.org](http://www.nariphaltan.org)
- [www.nariphaltan.org/writings.htm](http://www.nariphaltan.org/writings.htm)
- [www.nariphaltan.org/roi.pdf](http://www.nariphaltan.org/roi.pdf) (Romance of Innovation book)
- [www.nariphaltan.org/precisionagriculture.pdf](http://www.nariphaltan.org/precisionagriculture.pdf)
  
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Photos of talk (next page)

**Anantha Sharma (Vice President and Center Leader) giving a memento to AKR**



**AKR's talk**

