Romance of Innovation – R&D in Rural Setting[1]

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Good afternoon fellow Padma Awardees, ladies, and gentlemen,

I must really thank Shri. Om Birla ji the Hon'ble Speaker of Lok Sabha for inviting me to address the Hon'ble members of Parliament. I am deeply honored to do so. I am also thankful to the PRIDE secretariat for providing the logistics.

I am really thankful to the Prime Minister Shri. Modi ji for giving me Padma Shri last year. He plucked me out of oblivion and thus helped me to share some of my experiences with wider audiences like these.

I am going to first tell you briefly about our work and then its possible implications for helping develop *Atmanirbhar Bharat* that our Prime Minister Shri. Modi ji talks about. The PPT of the talk is at the end of this document.

Our Institute NARI

I run a small rural NGO called Nimbkar Agricultural Research Institute in Phaltan Taluka (District Satara). I and my wife Dr. Nandini Nimbkar – both Ph.D.'s from a well-known U.S. University left a lucrative career in United States in 1981 and in a fit of madness and arrogance came to rural Maharashtra. Madness that I wanted to do something for rural India and arrogance that with my knowledge and experience in renewable energy acquired in US, I will change India. India is a very ancient country and a society and how foolish I was to think about changing it. India did not

[1] Presentation made to Hon'ble Members of Parliament, 27 January 2023

change – it changed me. Living and working in rural India taught me humility, sustainability, and spirituality. In the process I also learnt an interesting lesson. If you want to do something different you have to be foolish and arrogant as I was!

Thus, to lot of my peers I have been a failure because with so much of education and opportunity I left U.S. to work in rural India and hardly made any money. But I feel that I have lived a fruitful and emotionally satisfying life that is far more precious than making a lot of money. That is in itself a fascinating story and I have written a book about it detailing my journey from IIT Kanpur, where I got my B.Tech, to USA and back to rural India.

Since 1981 we have been doing interesting work in trying to utilize the best tools of science and technology for rural development.

There are many firsts to our credit, and they are listed in our website www.nariphaltan.org. and, in my book "Romance of Innovation". https://nariphaltan.org/roi.pdf. I will highlight few of the notable ones.

1. Our energy self-sufficient Taluka plan in 1990s, which became a National Policy and was run by MNRE has resulted in setting up biomass-based power plants totaling 2500 MW. The idea of Taluka Self Sufficiency came from my dear friend the economist Dr. V. M. Dandekar in early 1980s. In 1981 when I came to Phaltan I saw large scale sugarcane leaves being burnt in western Maharashtra as a part of the waste disposal problem. Not only this burning produced pollution but I felt that it was a waste of good energy source. Besides sugarcane leaves, other agricultural residues were also being burnt. We mapped all the residues of Phaltan taluka and prepared a plan showing that agricultural residues of a taluka can run a biomass-based power plant to supply all its energy needs. Based upon this thesis MNRE did the biomass mapping of all Talukas in the country. NARI also developed leafy biomass gasifier to use these residues for small energy systems.

2. I come from Lucknow (was born and raised there) and was always troubled by the plight of poor rickshaw pullers. Hence decided to do something about it. So, in mid-1990s we started the work of electrifying rickshaws. This was the first such attempt anywhere in the world for producing e-rickshaws. Our work on developing electric rickshaws in late 1990s has led to its development and deployment. Thus ~15-20 lakh electric rickshaws run on the road in India. 83% of total electric mobility use in India is by these e–rickshaws. Many videos and stories on our work have been published in mass media. We also extended our work on e-mobility to develop small farm machines running on batteries.

3. When we came back from U.S. to Phaltan in 1981 the electricity situation in Phaltan was bad. So very often I used kerosene lanterns at night in our house. This made me start thinking on how to improve them. We therefore embarked on a program – the first in the world of improving kerosene lanterns. Later, we combined lanterns with cooking stoves to produce a device called lanstove.

   Besides improving the lanterns, we also looked at alternative fuel to kerosene that could be produced in India. This led us to pioneer the program of producing ethanol from sweet sorghum – a multipurpose crop and using it to run lanterns and stoves. Our work on ethanol for cooking and lighting has been adopted on a much bigger scale in Africa and Latin America.

   Our work on ethanol from sweet sorghum which we did in early 1980s is also known world over and many distilleries around the world produce ethanol from sweet sorghum. Our sweet sorghum variety Madhura is very well known and is also used for producing syrup. We are the sole suppliers of sweet sorghum syrup in India.

4. Our improved cooking and lighting program for un-electrified huts near Phaltan also resulted in understanding the food needs for rural poor.

This program of rural restaurants that we developed in 2012 helped in initiating Amma Unavagam in TN and also resulted in Shiv Bhojan program of Maharashtra. Presently about 10 lakh meals are served daily under these schemes. Other states are also planning to take it up.

5. In the past our research work on cotton, sweet sorghum, safflower have benefitted farmers all of over the country. All our work is at our website; www.nariphaltan.org. Similarly, our work on sheep and goat improvement is well-known all-over India.

6. Our latest project is on providing clean drinking water to rural schools. Thus, we want to harvest rainwater and purify it using our unique solar energy technology. Not only it will supply clean drinking water to school children but will also help them learn about solar energy, rainwater harvesting and water analysis. With hands-on approach this is the best way for them to learn science and technology. I feel Government of India can facilitate this program through the Jal Shakti Abhiyan of rainwater harvesting.

7. The above are some examples of frugal innovations. Frugal innovations are those in which one gets more from less for the benefit of maximum people. But the real frugal innovation has been in doing R&D in rural setting on a shoestring budget. Thus, all the R&D at NARI in renewable energy in the last 40 years has been done in less than Rs. 10 crores. I feel that to do excellent R&D one does not need a lot of money. What is needed is deep thinking and passion for problem solving. This results in some very innovative solutions.

   I have written about these innovations in details in my book "Romance of Innovation – A human interest story of doing R&D in rural setting". It is freely available on the internet.

Future work

Having spent more than 40 years staying and working in rural India I have learned few lessons that I would like to share with you, and which may have implications on how to make this country great. They are.

1. One of the biggest lessons we learned is that ***we need excellent and dedicated people on the ground for rural development***. I therefore feel that some of our brightest and most talented scientists and engineers are needed to solve the complex technological problems of rural India using local resources, materials, and workforce. Somehow our brightest students do not engage with rural problems and so it is really a great challenge for all of us to make them interested in it.

   One of the best ways do it is to make bright engineers and scientists exposed to farming practices and given courses in agriculture. Besides they should be inspired to spend time (6 months to 1 year) doing internship with rural based S&T organizations. When one stays and works in these areas for a longer time then one understands the problems better and I feel that intelligent and smart people can think about them and can produce out-of-box solutions to solve them.

   For this we need to create a ***vibrant S&T infrastructure for rural areas*** and strengthen the existing rural based R&D Institutes. That will include increased funding in IITs, NITs, etc. for high tech R&D which will provide solutions for rural India; provision of excellent fellowships to students from top engineering colleges to spend a year or two in developing technologies and solutions for these areas; and ***creating venture funds to help agritech startups.***

   Recipe for success world over has been to get the best people involved in the project and provide them with adequate funding. They can then solve any problem in the world. This methodology should also be used for rural development.

2. The second lesson that we learned is the ***need to develop unique technological solutions for rural problems.*** We have unique rural problems which nobody will solve except us. So, we need our own solutions. Presently most of our products are made for urban areas and then they trickle down and get transported to rural areas.

   We need to make the goods and solutions in or near the rural markets rather than shipping them through thousands of kilometers at enormous cost. This will require very innovative use of local decentralized energy sources like solar, wind and biomass together with locally available materials to produce the final products. In this process very innovative technological solutions like 3D printing, artificial intelligence, etc. could be used.

   The wealth of the country comes from its land and the most important commodity is food. After all we need to eat food rather than nuts and bolts or software. With growing population, we need to create food security. Thus, by helping the farmers we can create wealth in rural areas.

   Also, we cannot simply import farming technological systems from abroad because the farms in U.S. and Europe are huge and hence those systems are not suitable for small holdings (< 1 ha) of Indian farmers. Scaling down these technologies may help but will tax the best engineering brains.

   I think a better solution is to develop unique technologies and solutions for small farms. This will be a right step in creating *Atmanirbhar Bharat* which the Prime Minister is stressing upon. Small and efficient farm machines for plowing, seeding, pesticide application, harvesting, weed removal are needed. Hence development of these machines which will be electric powered, drone based and helped by AI technologies will be

useful. This will require very strong and ***excellent synergy between top educational institutes, S&T NGOs, and corporate world.***

3. The last and most important lesson that we have learned is to ***reduce our greed*** and become sustainable in our personal life. Then only we can create a sustainable India. As Gandhi ji said we should practice what we preach so if we want to be Vishwaguru then we should practice sustainability ourselves.

   I feel greed can be reduced by practicing spirituality. Spirituality is concerned with the matters of spirit. When we think deeply and for a long time about anything whether it is an idea or an object then the brain has a tendency of focusing on it like a laser and in that process the object vanishes from the vision field and only its germ or the spirit remains. This is called *Sanyam* in Patanjali Yoga Sutras and results in complete knowledge of that idea or object. This is the process by which all great discoveries of the world have been made.

   It is this deep thinking on anything which makes our brain very powerful; makes us spiritual, removes our insecurities and gives us a sense of peace and happiness. It also gives us a proper perspective on what is important in life.

   Another consequence of becoming spiritual is that one becomes fearless and the desire to impress others is reduced. It also reduces our desire to control the events and the narrative, and this can lead to a more tolerant and happy society. It also helps us to give back to society.

   Spirituality helps us live a sustainable lifestyle since one uses goods and services to fulfill ones needs and not to show off! This can help us reduce our energy and resource consumption and by judicious and efficient use of technology we can live a sustainable and emotionally satisfying life. I have tried to live such a life for the past 35 years.

I therefore believe that the mantra of India's and world's development should be "Technology guided by Spirituality can produce Happiness and Sustainability". Spirituality allows us to curb our greed and with technology it can make our lives better. This is the lesson that I have been teaching youngsters in all my lectures and interaction.

I have been writing on these issues for the last 20 years and have published more than 200 articles in Times of India (Speaking Tree), Thrive Global, Huffington Post and South Asia Monitor and two books on this subject.

I strongly feel that if we use the ancient Indian philosophical thought with the modern technology then this could lead to a new paradigm of development for creating a sustainable and emotionally satisfying world. ***India can then give a new thought to the world and can rightly become a Vishwaguru.***

I again thank the Lok Sabha Secretariat for giving me this opportunity to present my views before the Hon'ble members.

HOME

January 2023

The PPT presentation is given below.

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Anil K Rajvanshi, Padma Shri Awardee 2022

Director

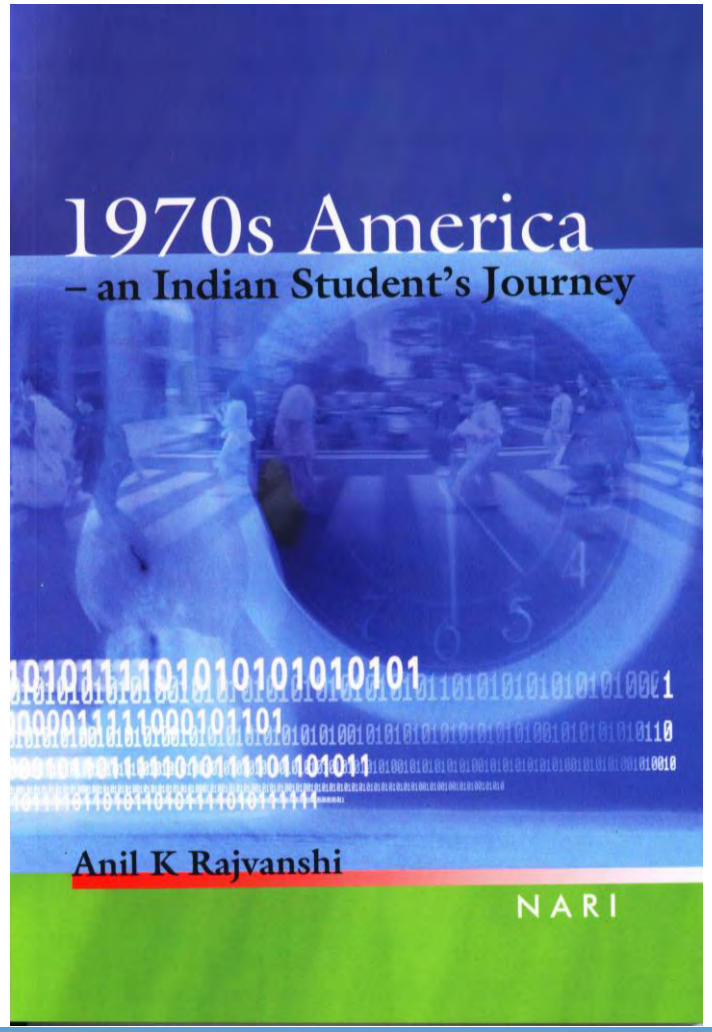
Nimbkar Agricultural Research Institute (NARI)

Phaltan, Maharashtra www.nariphaltan.org

(Presentation made to Lok Sabha Secretariat. 27 January 2023)

Our Institute NARI

- Registered as a trust and started in 1968 by Mr. B.V.Nimbkar, 2006 Padma Shri Awardee.
- Develop technologies for sustainable development.
- R&D in Agriculture, Renewable Energy, AH & Sustainable Development.
- Try to use best tools of S&T for solving rural problems. Focus on technology development. Extension work.
- Total staff of 25 with 7 scientists and technologists. Working on shoestring budget.
- Funding from GOI and other agencies.
- Details on our website www.nariphaltan.org

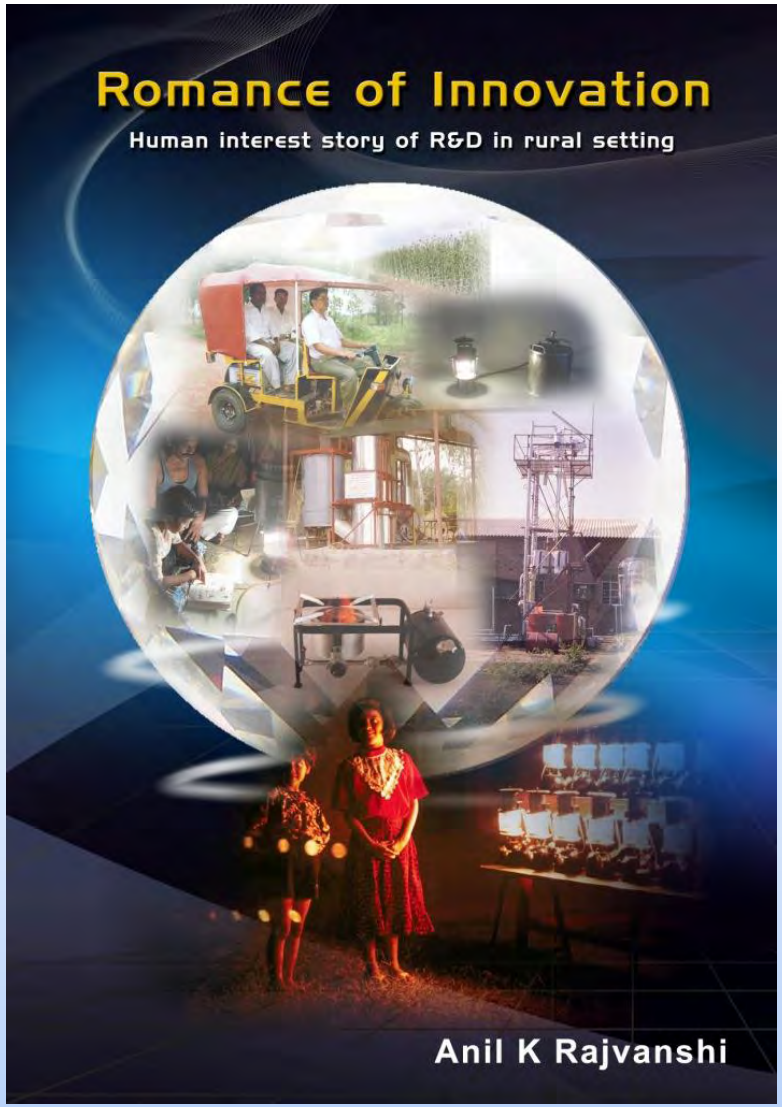


US Journey Book

https://nariphaltan.org/usexpwithphotos.pdf

Romance of innovation

https://nariphaltan.org/roi.pdf



Biomass power

- More than 100 million tons/yr. of agricultural residues are burnt in the fields in India.
- Create huge pollution and are also waste of good energy source.
- Taluka power plants 5-15 MW capacity. National policy run by MNRE. ~2500 MW biomass power plants installed.
- Biomass map of each taluka developed.
- NARI also developed multi-fuel low density biomass gasifier (0.5 MW_{th} capacity) for industrial applications.
- Gasifier can run on loose leafy biomass like sugarcane leaves and bagasse, sweet sorghum stalks and bagasse, safflower stalks, etc.

1996

E-rickshaws and e-farm machines

- Pioneered e-Rickshaws in mid 1990s. Today lakhs of these rickshaws are on Indian roads providing employment to weaker sections of society.
- E- farm machines for research plots.

E-trike for handicapped persons

Battery powered safflower thresher

Ethanol and syrup from Sweet Sorghum

Introduced in India by NARI in late 1970s

Pilot plant for solar distillation of ethanol from sweet sorghum 1987

Lanstove

Madhura SS syrup

Mechanized SS syrup production facility set up at NARI.

Rural restaurants concept

- After a hard day in the field the woman is in no shape or mood to cook. Very tiring and unpleasant chore.
- Wood based chulha produces tremendous pollution in rural households.
- Very poor nutrition. Daily rations are bought from PDS shops. If unavailable, they tend to eat less.
- Poor eating and hence rapid aging and poor physical and mental health.
- Creation of rural restaurants. Regular ones but for BPL families subsidized meal at Rs.10 per person. Use of UID card for meal purchase. www.nariphaltan.org/ruralrestaurants.pdf
- Good CSR activity.
- Developed in 2012. Helped initiate Amma Unavagam in TN and Shiv Bhojan in Maharashtra. Other states are also thinking of introducing it.

Agriculture

- Safflower
  - Till 2017 ~ 25% of all released varieties came from NARI.
  - Petals, seed, vegetable, charcoal from residues. Whole plant approach.
- AHD (started in 1990)
  - FecB gene for twinning of sheep.
  - Goat improvement.
- Precision agriculture and hydroponics

NARI safflower variety

Solar powered safflower petal collector

Low-cost hydroponics

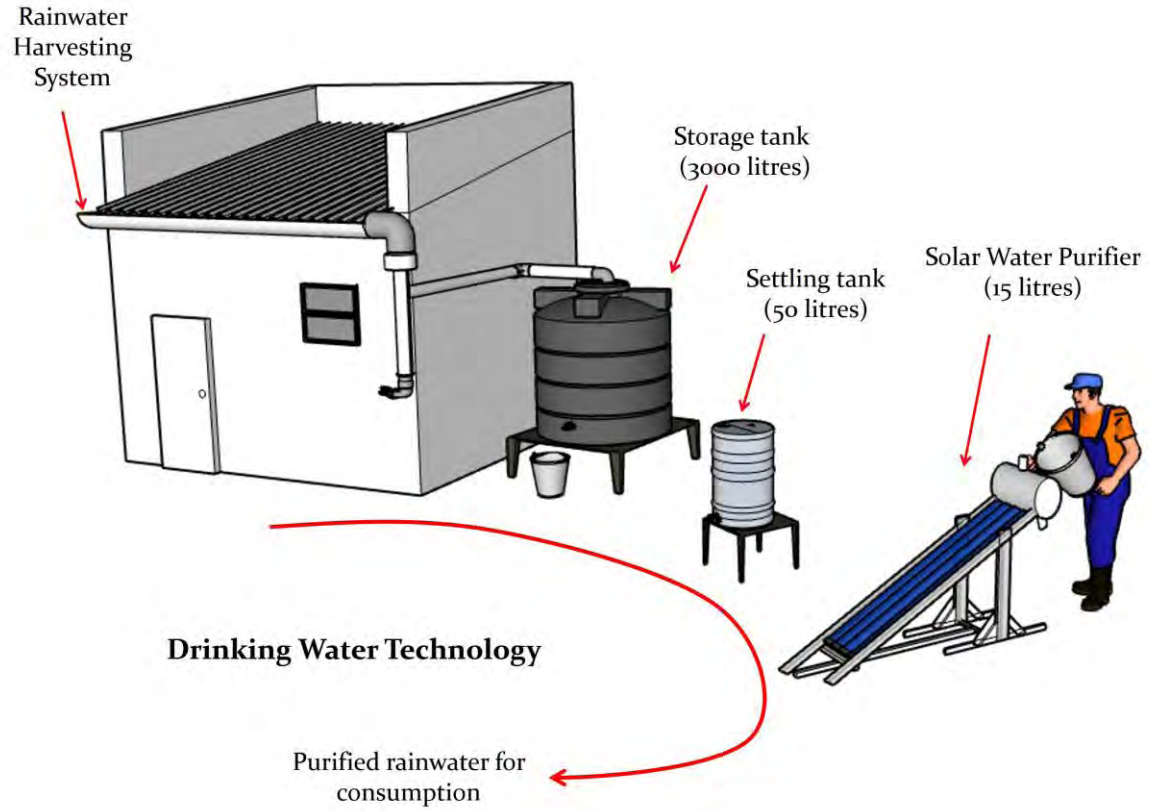
Sheep breeding

Safflower plant

Clean drinking water for rural schools

- Solar water purifier.
  - Rainwater harvesting.
  - Storage of water in food grade tanks
  - Using solar energy for removing all E.coli.
  - Will also be used to educate children in solar energy, water cleaning and rainwater harvesting.
  - Best way for them to learn about hands-on work in science and technology.
- All our energy work written in “Romance of Innovation”

www.nariphaltan.org/roi.pdf



Future Work; Lesson 1 (*people*)

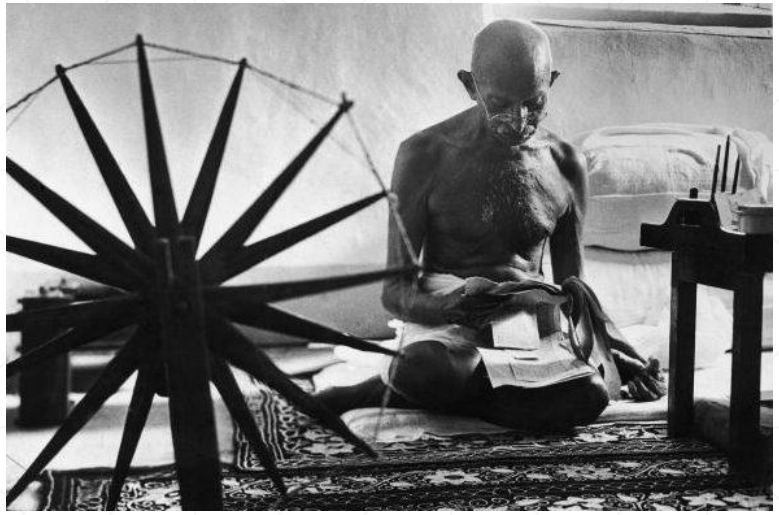
- Need excellent and dedicated people on the ground for rural development.
- Need brightest scientists and technologists for creating rural technologies. Also need for them to stay for longer period in rural areas. Can be helped by providing them with adequate funding.
- Need to make farming glamorous and a worthy vocation so best people are attracted to it.
- Creation of vibrant S&T infrastructure for high tech rural projects in IITs, NITs, etc. and collaboration with corporate world.
- Recipe of success. Get best people and fund them adequately. Liberal funding for agritech startups.

Future Work; Lesson 2 (*Excellent technologies*)

- Need to develop unique technologies for rural problems.
- All technological solutions developed for urban problems which trickle down to rural areas.
- Use local resources and energies using high tech like 3D printing, AI, etc. to produce excellent solutions.
- Small e-machines for small farms.
- Biggest challenge in rural areas is to improve farming and increase farmer's remunerations.
- Synergy between IITs, NGOs and corporate sector for high-tech R&D for rural areas.
- Need heavy R&D funding for providing rural solutions.

Future Work; Lesson 3 (*reduce greed*)

- Need to reduce our greed and become sustainable in our personal life.
- Rural goods and services should be made available at affordable cost.
- Spirituality helps in reducing our greed, removes fear, reduces desire to control and helps us live a sustainable lifestyle. Spirituality is not religion.
- One can live sustainably and in an emotionally satisfying way. I have lived such a lifestyle for last 35 years in rural Maharashtra.
- Possible Mantra of India's development: *Technology guided by Spirituality can lead to Happiness and Sustainability.* Can help India become Vishwaguru.



Gandhi ji produced highest quality of thought in least energy and resource usage.

Thank you

- www.nariphaltan.org
- www.nariphaltan.org/writings.htm (all my writings, talks, podcasts, videos, books, etc.)

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