

# Romance of Innovation – Engineering a better world

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Talk at UF, July 2015

# Outline

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- Romance of Innovation as a path to happiness
- Why become an engineer?
- My story
- Challenges and possible solutions for bottom of pyramid
  - Household sector
  - Farming sector
- How you can make a better world?

# Happiness through innovation

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- ❑ All of us work to maximize our happiness.
- ❑ Fame and money gives it to some.
- ❑ Creating something wonderful, inventing and innovating also gives happiness.
- ❑ To do something meaningful in one's life and give back to society brings great joy and happiness.
- ❑ Planning should start when you are students.
- ❑ Happiness is a state of mind.
- ❑ Innovation is like yoga. To reach the goal all the roadblocks and pinpricks become inconsequential.
- ❑ It is the romance of innovation!
- ❑ Engineers always innovate

# Why become an engineer?

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- ❑ Modern civilization is defined by engineering
- ❑ Engineers create the world and therefore are cool
- ❑ We create technologies to help people
- ❑ Hence by nature engineers are empathetic people – we try to help mankind
- ❑ By doing so we also help ourselves – giving back to society gives us happiness and joy
- ❑ World is interconnected – everything we do affects every part of the world
- ❑ Use your knowledge to help poor of the world – in order to do so you have to be focused
- ❑ Have ***passion*** and ***compassion***

# My life story

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- ❑ IITK to US in 1974 and back in 1981 to rural Maharashtra. Journey written in a book. [www.nariphaltan.org/usexp.pdf](http://www.nariphaltan.org/usexp.pdf)
- ❑ Returned to India because of arrogance. Will change India. India changed me!
- ❑ Challenges of working in rural Maharashtra. Written in the new book "Romance of Innovation". [www.nariphaltan.org/roi.pdf](http://www.nariphaltan.org/roi.pdf)
- ❑ Freely available on internet.

# My life story .....

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- ❑ Mantra for working in rural environment –Junoon!
- ❑ Junoon means passion, romance, seized of an idea, etc.
- ❑ Junoon is a focused activity. Need to be cultivated from childhood.
- ❑ Junoon is helped by
  - Concentration
  - Meditation
  - Curiosity
  - Picking up interesting projects
- ❑ Junoon helps ward off pressures from family and peers.
- ❑ Greatly focused mind helps getting the right priorities of life. Helps in becoming spiritual.
- ❑ Genesis of happiness, tranquility and sustainability.

# Challenges

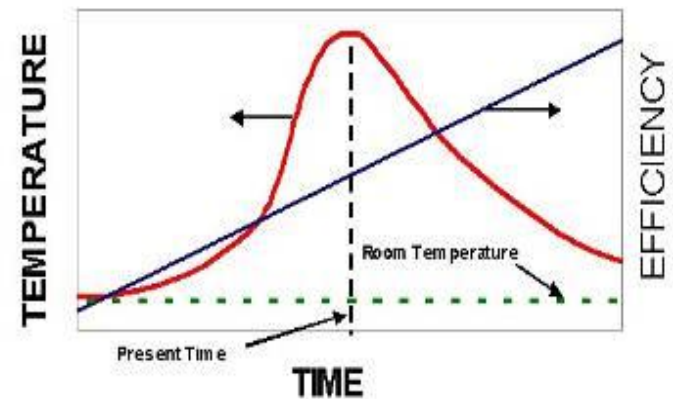
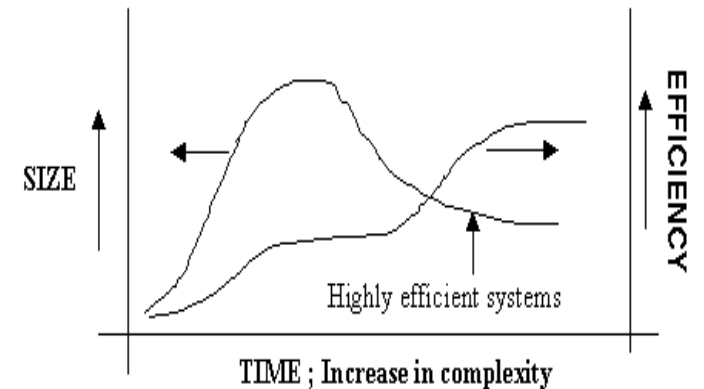
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- ❑ Hardly any electricity, cook on biomass stoves, no clean drinking water, lack toilets and very few avenues for gainful employment.
- ❑ Rural poor in India are some of the most malnourished in the world. Need for **rural restaurants?**
- ❑ 30% of the world's poorest live in India.
- ❑ Modern technology has not touched their lives.



# Strategy of rural development

- ❑ 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. Biomimicry as mantra for design.
- ❑ Our designs are following this route. Cell phones, power plants, etc.
- ❑ Societies as Prigogine's dissipative structures.





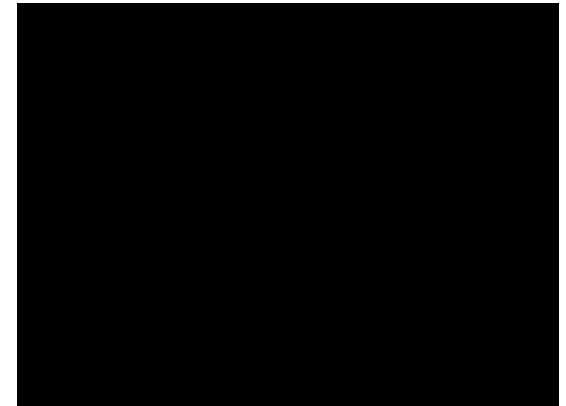
# What needs to be done?

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- ❑ Improve quality of life for rural poor; one hut at a time. Need 1220 kWh/yr electricity for fans, lights, refrigerator and transport; and 260 kg/yr LPG. Can put them in the bracket of middle class.
- ❑ Provide excellent rural livelihoods via high-tech farming.
- ❑ Need the best engineers to be engaged in rural development.

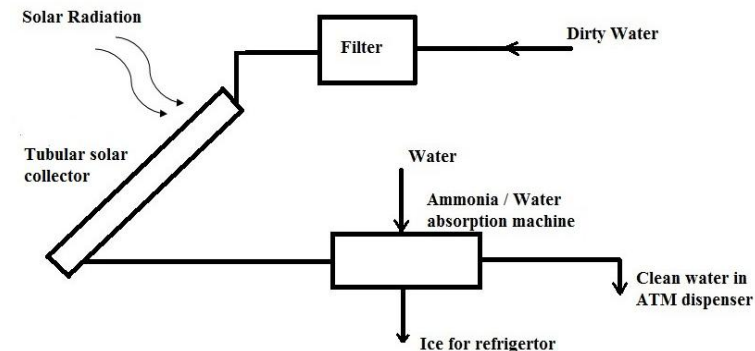
# Lighting up lives - one hut at a time

- NARI's lanstove.
  - Provides excellent light ~ 3000 lumens.
  - Cooks a complete meal for a family of 5. Produces 10 liters of potable water. Runs on kerosene and diesel.
  - No smoke, no smell and particulates < WHO standards. Tested in 22 huts in 5 villages near Phaltan. As clean as LPG.
  - LCA on lanstove shows it is 5 times better than electric cooking and lighting.
  - Problems of kerosene availability; diesel as fuel ?
- **Challenges**
  - Heat-opaque glass needed
  - TE unit to charge cell phone and run an efficient fan. 10-15 W
  - Need an efficient fan. Max  $\text{m}^3/\text{W}$
  - Agricultural residues to liquid fuels.



# Potable water and refrigeration

- ❑ Filtering dirty water through 4 layers of cotton sari and heating it to  $60^{\circ}\text{C}$  for 10-15 minutes or  $45^{\circ}\text{C}$  for three hours inactivates all coliforms.
- ❑ Use of solar tubular water heaters. 99.5% times water temp  $> 50^{\circ}\text{C}$ .
- ❑ Hot water can also be used to produce ice for refrigerators via  $\text{NH}_3/\text{H}_2\text{O}$  or other absorption system.
- ❑ **Challenge**
  - Low cost solar powered refrigeration unit; efficient abs/ref pairs needed.
  - Low cost ATM for water and ice.
  - Efficient ice box as refrigerator.



$T_w > 60^{\circ}\text{C}$  For 10-15 Min.

# Ethanol from sweet sorghum



## Solar detoxification of dist. waste

- 200 lpd plant
- Photocatalyst
- $T \uparrow$  0-90% in 2 days.



Solar distillation plant. Set up in 1987



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

# 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



# Mobility issues.

- [Electric cycle rickshaws.](#)

Work started in 1995.

- 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



# Rural livelihoods

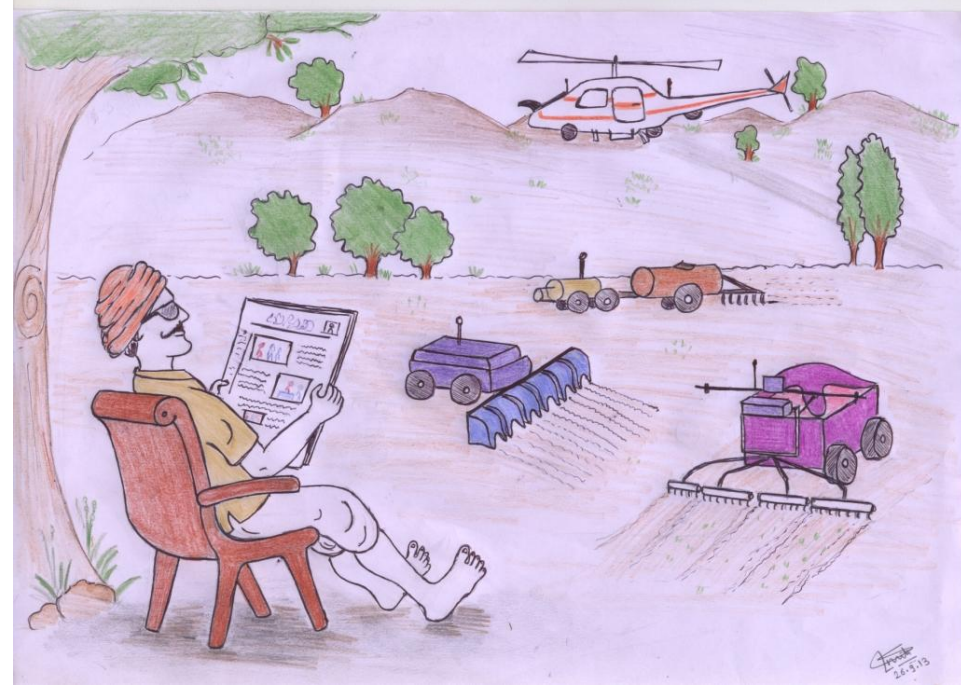
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- ❑ 80% of rural population involved in farming.
- ❑ 80% of farms in India < 2 ha size.
- ❑ Farm productivity in India lowest in the world and ~ 33% of the world's best.
- ❑ Farming is non-remunerative and farmers children do not want to farm. Farmers' suicides.
- ❑ Large areas of farmland are being sold to builders.
- ❑ Precision farming(PF) for small farms can increase productivity and make farming glamorous.
- ❑ Precise and timely input to the crop. Robots-based.
- ❑ 3-D based manufacturing in rural areas.
- ❑ Great challenge for engineers and scientists.



# Precision farming

- ❑ My dream for Indian farmer!
- ❑ **Challenges:**
  - Cheap drones.
  - Camera for disease and stress identification.
  - Robots for planting, weeding and harvesting.
  - Farm machines to run on farm-derived fuel.
  - Venture funds needed for agricultural technology development.
  - Leasing equipment model.



Farmer should become a breeder

# Best brains for rural development

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- ❑ Need interns for 1-2 years in rural NGOs like NARI.
- ❑ Need to get rural poverty in the DNA of smart kids.
- ❑ Will help rural areas when they become corporate honchos.
- ❑ Helping rural poor through technology is the best use of technical education.
- ❑ Give 2 days/month (3% of your time only) for society work. Develop a Junoon for society work.
- ❑ **Teach the romance of innovation to rural kids. NARI conducts short courses.**
- ❑ Mantra of world development – Spirituality with High Technology.
- ❑ Spirituality reduces greed and high tech helps in efficient use of resources.

# Challenge for engineers

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- ❑ Develop household devices to remove drudgery
  - Efficient lighting and cooking technology; clean water; efficient fans; refrigeration
  - Efficient T/E devices to run on chulhas; charging of smart phones
- ❑ Develop technologies for precision farming
  - Autonomous small farm machines. Drones, weed removers, planters, harvesters etc.
  - Electric and air-powered motorcycles for rural transport.
  - Fuel for farm machines from agricultural residues.
- ❑ Become technology managers

# Thank you

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## □ Useful sites:

- [www.nariphaltan.org](http://www.nariphaltan.org) (Institute site)
- [www.nariphaltan.org/roi.pdf](http://www.nariphaltan.org/roi.pdf) (Romance book)
- [www.nariphaltan.org/writings.htm](http://www.nariphaltan.org/writings.htm) (My writings)
- [www.nariphaltan.org/precisionagriculture.pdf](http://www.nariphaltan.org/precisionagriculture.pdf) (Article on precision agriculture)
- [www.nariphaltan.org/watersterilization.pdf](http://www.nariphaltan.org/watersterilization.pdf) (water sterilization paper)

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