Innovations for Rural Poor [1]

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Good morning ladies and gentlemen,

I am delighted and deeply honored to give this keynote at INAE-organized International Conference on Innovation. I must thank Dr. Mashelkar for suggesting my name and Dr. Zarabi and his colleagues at INAE for inviting me.

Since yesterday we all have heard many speakers talking about innovation in various fields. My talk will focus on innovations for rural poor. But for us to do so we must first understand the problems of rural poor.

Consider the following:

1. Sixty five percent of our population is rural-based. And 60% of this population (~ 400 million) has nearly non-existent electricity. Nearly 50,000 villages have never seen electricity. It is a sad state of affairs even 65 years after independence.

2. In poor rural households they mostly use kerosene in polluting lanterns for lighting and use 180-200 million tons/year of biomass in inefficient, primitive and smoky stoves. Besides there is no provision of clean drinking water.

3. In rural India around 300,000 deaths/year take place because of indoor air pollution and another 1.5 million deaths due to diarrhea-related cases.

4. Around 400 million people in rural areas survive on less than Rs. 40/day. With increased electronic mass media exposure (cell phones, T.V. etc.) they aspire to a

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better quality of life. This aspiration is the driving force for urban migration and rise of Maoism in the country.

5. Energy is the basis of life. Lack of it produces economic stagnation and social upheavals. Energy situation in rural areas is really alarming with per capita electricity consumption of just 96 kWhr/year. Even average per capita consumption of Indians is only 18 GJ/year as compared to 350 GJ/person-year for U.S. citizens.

6. Human Development Index (HDI) is directly proportional to the energy consumption. In India it is 0.55 with per capita energy consumption of 18 GJ/year. With energy consumption of 50-60 GJ/year HDI can be raised to 0.8 (equivalent to European lifestyle of 1970s) and is a doable goal.

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 infrastructure which has resulted in unavailability of adequate energy in rural areas.

Strategy for Rural Development

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.

I therefore believe that innovations in technology are needed and that sophisticated technology is needed to convert efficiently the locally available resources and materials into useful products. These innovations are also called frugal innovations in which one can achieve much more from fewer resources and materials. 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. Some of our designs and technologies are following this route. For example, computer chips, cell phones, 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'.

I also believe that the Mantra for rural development should be **"Improve quality of life for rural poor – one household at a time".**

Thus the major effort should be for providing basic amenities for rural households. This includes excellent light, very clean and easy to use fuel for cooking and clean potable water. Besides innovation is needed in providing a very energy-efficient fan (maximizing air flow; m^3/W) for comfort cooling and a tiny refrigerator for keeping small amount of milk and vegetables. With provision of these amenities the quality of life of rural poor can make a quantum jump.

We will show with few examples how some of these innovations can take place.

Lanstove™

A good example of a frugal innovation (achieve more with less) is the concept of Lanstove developed by our Institute. It simultaneously provides excellent light (equivalent to that from 250-300 W electric bulb), cooks a complete meal for a family of 4-5 people and boils 10 liters of water. In one shot it provides a very high quality end-product of lighting, cooking and clean potable water. For an unelectrified household

this is a unique invention. Lanstove has been tested in about 50 huts and 25 units have been distributed to the rural households which had never seen electricity.

The Lanstove™ runs on kerosene and is clean and as easy to light and run as LPG. Tests reveal that the CO levels are less than 4 ppm even after 4 hours of use and the particulate levels are also within WHO standards. Efforts are on to put a small thermoelectric element in the Lanstove for charging cell phones. Similarly R&D has also started on using the heat from Lanstove to drive an absorption chilling unit for a very small refrigerator.

In working with the rural poor it also became evident that just with better cooking technology their diet will not improve and improved nutrition needs a different effort. Most of the rural poor are landless laborers who come home in the evening very tired after working in the fields and farms and have to cook on most primitive and polluting cook stoves. They cook and eat whatever is available from Public Distribution Shops (PDS)-which most of the times do not have adequate rations.

Hence a concept of rural restaurants has been developed. These restaurants will be similar to regular ones but for people below poverty line (BPL) they will provide meals at subsidized rates. These citizens will pay only Rs. 10 per meal and the rest, which is expected to be quite small, will come as a part of Government subsidy. **The buying of meals could be facilitated by the use of UID (Aadhar) card by rural poor.**

The rural poor will get more nutritive and tasty food by eating in these restaurants. Besides the time saved can be used for resting and other gainful activities like teaching children. Since the food will not be cooked in huts, this strategy will result in less pollution in rural households. This will be beneficial for their health. Besides, women's chores will be reduced drastically.

Cooking food in these restaurants will also result in much more efficient use of energy since energy/kg of food cooked in households is greater than that in restaurants.

Large-scale employment generation in rural areas may result because of this activity. With an average norm of 30 people employed/a 100-chair restaurant, this program has the potential of generating about 20 million jobs permanently in rural areas. Besides the infrastructure development in setting up restaurants and establishing the food chain etc will help the local farmers and will generate huge amount of wealth in these areas.

In the long run this strategy may provide better food security for rural poor than the existing one which is based on cheap food availability in PDS – a system which is prone to corruption and leakage.

Besides the above innovations another major innovation needed is in increasing the productive employment and purchasing power of rural poor. NREGA has given money to them without increasing their or the nation's productivity. I think energy from agriculture can provide it.

Energy from Agriculture

India produces close to 800-1000 million tons of agricultural residues per year. Most of these residues are burnt in the fields to solve the waste disposal problem though a part of them also go as fertilizer and animal feed. Burning of residues not only creates tremendous air pollution but is a waste of an important energy source. There is enough scientific data available that shows that the biomass residue burning in Indian sub-continent is creating a huge brown cloud which is modifying the weather over India.

These agricultural residues can theoretically produce about 150 billion liters of ethanol per year via lignocellulosic conversion. This can take care of about 50% of India's oil demand. Similarly if we take the pyrolysis oil route then these residues can provide around 80% of India's diesel demand. Pyrolysis oil is produced by rapid heating of biomass to 600-700^{0}C and quenching the smoke rapidly to produce oil. This oil with suitable modifications is very close to diesel in characteristics. Both these technologies are near maturation and quite a number of plants are being set up the world over for pyrolysis oil and ethanol production from agricultural residues.

Alternatively if these residues are burnt in the biomass-based power plants they can produce close to 80,000 MW of electricity which is nearly 50% of India's total installed capacity. Biomass power plant technology is very well developed and produces around 60,000 MW of electric power around the world. In India there are close to 91 plants with capacities of 6-10 MW each and total installed capacity of about 500 MW. Our Institute was the principal author of this policy which was initiated by DNES (now MNRE) in 1996.

Besides producing energy these residues (with enough R&D) can also contribute to the organic fertilizer industry. Thus the use of residues from present agriculture can substantially ease India's present energy crisis and can be a Rs. 2 lakh crore/year industry. At the same time this can also produce about 50 million jobs in rural areas. With increasing crop production to feed our burgeoning population more agricultural residues will be produced which can further help in energy and fertilizer production.

Farming for energy therefore can create huge wealth in rural areas and lead to prosperous India.

However, for this to happen two things are necessary. Firstly farmers need to be compensated properly for the agricultural residues.

It is a peculiar aspect of farming that only 25-40% of its produce fetches money and the rest 60-75% are agricultural residues which have to be discarded. No industry can run on such norms where 3/4th of its produce is not sold and in fact discarded. Yet for farming we accept these norms.

When agricultural residues are capable of producing very high quality energy like liquid fuels and electricity, they should be given a very good price. Our estimates show that with proper pricing of these residues (Rs. 3000/ton) a farmer can easily earn between Rs. 5000 to Rs. 7000/acre/season by selling them for energy production.

Any marginal farmer can produce agricultural residues even if the main crop fails. The income from these residues can give him benefits even in the case of distress sale of his crop and this is the best hedge against farmers' suicides. I also feel that unless and until the farmer gets remuneration from his entire produce, farming will never become

economically viable. This is an aspect of farming which should be understood by policy planners.

The second aspect of farming is the need for sophisticated science and technology inputs in it. Presently most of the agriculture in India still exists in stone ages. There is very little mechanization and ancient agronomic practices are used. The problem has also been compounded by the fact that because of land reforms in India the land holdings have reduced thereby restricting the use of existing large farm machines. In fact this farm size reduction could be a boon in disguise since it can fuel innovations in precision agriculture and small farm machinery. This can reduce inputs and increase productivity of farms.

Other issues

Recently some very innovative technologies like 3D printing – where a computer design can be made into a three dimensional product layer by layer using a special printer, are being developed. This technology is presently very costly and is mostly used to make plastic goods. Nevertheless the technology is progressing so rapidly that it is a matter of time before small objects made of any material could be produced using 3D printers.

This technology has far reaching consequences for rural areas where it can be envisaged that small manufacturing shops will manufacture items of use economically and on as-and-when-needed basis from the locally available raw materials. This perhaps could be a forerunner of self-sufficient dream villages that Mahatma Gandhi always talked about.

However more than these technologies the most important innovation needed for improving the life of rural population should be in governance. All the good efforts by technologists, planners and government are of no use if the benefits do not reach the bottom of pyramid population.

The poor have waited long enough for 65 years! The numbers are on their side and the rise of Maoism, strife and general unrest in the country is caused by the chasm between expectations and reality.

I think one of the solutions could be to sensitize the bright young scientists, engineers and managers to the plight of rural people. This can happen if they spend some time in rural areas and work with rural NGOs. Observing the poverty first hand can fire the bright minds to come up with innovative ideas. Besides this exposure to rural poverty will also help these youngsters to become frugal and nudge them to live a more sustainable lifestyle!

Finally I will end this talk by telling you a story, a tale from our ancient scriptures, the *Puranas*. It is the 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 replies, "When the first glimmer of light across the sky reveals the fronds of 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 mountaintops of the Himalayas, that is when the night ends and the dawn begins".

The sage says, "No, my sons, when two travelers 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 we scientists, technologists and planners help light up the lives of rural population through technology and resources, then it will bring in the dawn of a new and prosperous India.

Thank you.

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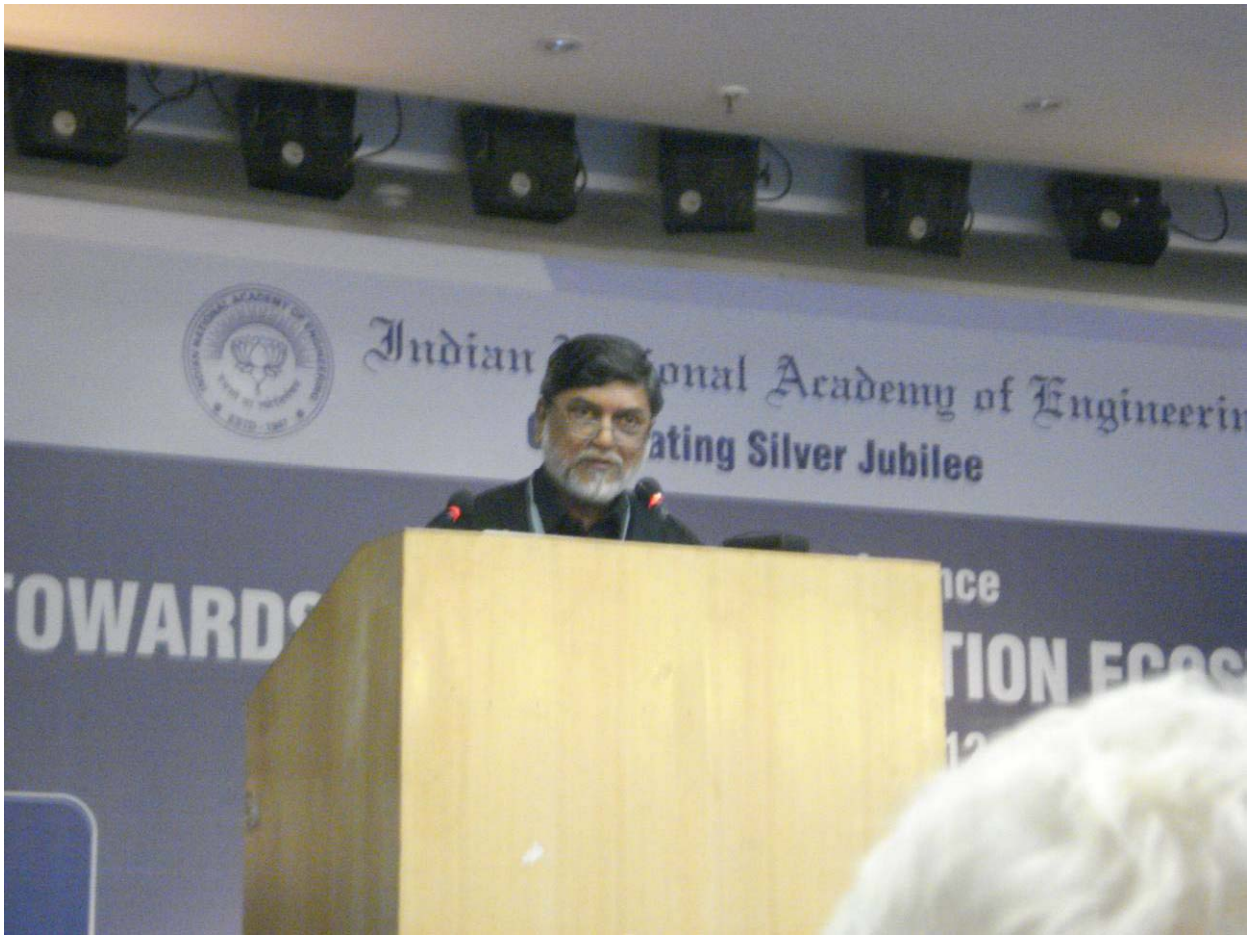

Dr. Anil K Rajvanshi delivering his talk at INAE, 21st September 2012

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