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for Rural India

World Celebrates Second International Day of Yoga

The world on 21st June, 2016 celebrated the second International Day of Yoga. From Times Square in New York to the Opera House in Sydney, celebrations for Yoga Day spanned the globe, effectively showcasing India's soft power.

"Practicing yoga can help raise awareness of our role as consumers of the planet's resources and as individuals with a duty to respect and live in peace with our neighbours," said Ban Ki-moon, the UN Secretary-General.

Celebrations took place all over India. In Delhi, the President Shri. Pranab Mukherjee conducted a Yoga class at the Rashtrapati Bhavan and Prime Minister Shri. Narendra Modi led approximately 30,000 participants in a mass Yoga demonstration in Chandigarh.

Addressing participants at the event, the PM said, "We are disconnected from ourselves in today's times. Yoga helps us reconnect with ourselves." He appreciated the fact that people from all parts of the country and from all sections of the society had come together to support the idea of International Day of Yoga.

The Prime Minister said that the International Day of Yoga is a day linked to good health, and it has become a mass movement and Yoga provides health assurance with zero budget. He emphasized that Yoga is not about what one will get, but it is about what one can give up.

The Prime Minister called for focus in the next one year, on how to mitigate diabetes through Yoga. He said that to honour those who are working to popularize Yoga, two awards will be instituted, one at the national level, and the other at the international level.



The Prime Minister, Shri Narendra Modi performing Yoga with other participants at the Capitol Complex, Chandigarh on the occasion of the second International Day of Yoga on June 21, 2016



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Kurukshetra seeks to carry the message of Rural Development to all people. It serves as a forum for free, frank and serious discussion on the problems of Rural Development with special focus on Rural Uplift.

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Editorial

Mahatma Gandhi had said, "India lives in her villages". Even today, after decades of rapid urbanisation, around 70 per cent of Indians live in villages. Agriculture still employs half of the labour force. With these statistics, it is obvious that India can not develop without developing its villages. Various Government schemes such as *Deendayal Upadhyaya Gram Jyoti Yojana* (for rural electrification), *Pradhan Mantri Gram Sadak Yojana*, Rurban Mission are focused on rural development. Effective implementation of these schemes would depend on the efficiency of our administrative machinery at ground level, but one more factor that can make or mar the government efforts is availability of right technology for rural needs. For example, providing roof top solar panels in a hilly village where grid connected power supply can not be extended.

In fact, our self sufficiency in production of foodgrains today is the result of technological interventions made in the agriculture in sixties, popularly known as 'green revolution'. Use of modern scientific tools and techniques increased agricultural productivity manifold. Today, we are among the top producers of milk, wheat, rice and sugarcane. Latest remote sensing technologies have made the resource mapping and planning very effective in agriculture and forestry.

However, it needs to be emphasised that we need to preserve and harness our traditional knowledge in agriculture while adopting modern technology. For example, many localised techniques of water conservation and distribution exist in several parts of our country. This needs to be preserved and promoted as they are cost effective, use locally available construction materials and are environment friendly. At the same time, latest technologies like laser land leveling, drip and sprinkler irrigation need to be brought to these villages so as to improve water efficiency and reduce wastage of this precious resource.

Other than agriculture, technology is significantly impacting all other aspects of rural life. With increased teledensity, ICT (Information, Communication & Technology) is making rapid inroads in rural India, revolutionising the connectivity and information flow. This has opened a plethora of opportunities. Now ICT is being leveraged to plug leakages in the public distribution system and for better targeting of subsidies by way of Aadhar linked direct benefit transfers. It is used in tele-medicine, online study courses, e-Payments and what not. e-Technology can be effectively leveraged to fulfill the information needs of the rural populace such as providing weather and market related information. It can also be a good platform for online marketing of the artifacts produced by village artisans.

But, one challenge in exploiting these ICT tools remain reliable supply of power. For this, we need to look at unconventional sources of energy as grid connected supply is not always available in villages. Developing and popularising renewable energy technologies for rural needs is important. Other than solar, wind and small hydro, generating electricity from biomass and waste will considerably solve rural India's energy woes.

One thing also needs to be emphasised here, that developing suitable technology does not always mean cutting edge research in an advanced laboratory. Low cost technological solutions to day-to-day problems may, many times, come from a semi-literate farmers as well. This is what we call as innovation or '*jugaad*'. These innovations and innovators need to be encouraged in every possible way. At the same time it is important to nourish rural entrepreneurship so that low cost solutions to meet the rural needs can be developed and marketed effectively. For this all, attention needs to be given to improve education of science and technology in rural India.

In the end, we will have to see overall impact of science & technology on rural society. We will have to weigh the pros and cons of the new technology and make the right choices keeping in mind the social and environmental impacts. A rational decision on the technologies for sustainable development will only be able to take our villages, and hence India, forward. □

RATIONAL USE OF SCIENCE & TECHNOLOGY: KEY TO DEVELOPMENT OF RURAL INDIA

Manish Mohan Gore

There is no controversy in saying that the duo of science and technology paves the way for the development of a country. Aligned with this stand, recently governments and policy makers have started emphasising the introduction of such S&T devices, products suitable to geographical location, environment and social fabric. One step ahead, idea of innovation is taking shape in everyone's mind. An autonomous organisation of the Department of Science & Technology, Government of India namely National Innovation Foundation, Ahmedabad is nurturing our grass-root innovators to complement the above.

If we consider science, technology and innovation as the three wheels of a vehicle which is called development, then scientific temper would be the fourth significant wheel. **Scientific temper is in fact a thinking process whereby a person takes rational decisions in his/her daily life through analysis.** If people are devoid of such temperament, they will not be able to play their logical role in the development process. On the contrary, final development shall not be sustainable if a society of scientifically tempered people ignores human emotions, human rights, environment and animal welfare. Therefore, a balance between scientific temper and positive mentality having good value system in the background is needed for the sustainable development. We would not accept development at the cost of environment or inhumanity. Taking cognisance of such components should be an essential part of the policy making in respect of any technology intervention.

Let's continue the above discussion in context of rural development of our country. As we can notice, science is at play in almost all walks of our life. It is around us as well as within us. The word 'Science' is derived from a Latin word 'Scientia' which means 'to know'. We may consolidate science as a tool or device to know or disclose the processes/rules of nature. Scientists when observe nature and experiment, they understand the processes of nature. In this perspective, science is synonymous of

nature. The earth attracts every material and this is a natural law. English physicist and mathematician Sir Isaac Newton (1642-1726) first observed the falling of apples from tree and later explained it in the law of gravitation. Scientists attempt to remove ambiguities about various laws of nature and make world aware about it. **When we utilise these natural laws to facilitate our lives, that facet of science is called 'technology'.** We are witness to several applications of science and technology in our daily life. Technology has revolutionised the present era and brought new dawn in the sectors of agriculture, irrigation, energy, health, education, communication, business, transportation and employment.

From rich past towards progressive future

India has a rich past. In early times, human society had progressed with their common sense, innovations, and indigenous techniques. Indus valley civilization is a prominent example of our glorious history. The remains of Mohenjodaro and techniques used for water conservation and sewage systems in Harappa civilization are witness to the scientific and rational thinking of their inhabitants. Similar proofs about usage of advanced technology can be traced during medieval period in the form of rust-less iron pillar at Delhi, architecture of the Taj Mahal and monuments in southern part of the country. The world has witnessed remarkable scientific and technological achievements of the modern India in various fields including agriculture, health, defence etc. **Science and Technology for upliftment of Rural India**

Nearly 70 per cent of the country's population lives in rural areas. Thus, the development of rural India shall reflect development of the whole country. For this to happen, an intensive focus on conservation of natural resources and use of sustainable technologies will have to become a prerequisite. In our villages, millions still cook using fossil fuels in earthen wares. Their exposure to smoke causes serious health hazards. The present government has launched a new initiative of providing LPG

connections to poor people. The users who can afford LPG at market price may give up the subsidy on their gas connections and help provide clean fuel to a BPL family.

Dr. Harsh Vardhan, Union Minister for Science and Technology has launched an equipment called 'Solar Dome' in April 2016. The device will help illuminate houses of people living in rural areas where electricity has not reached. The photovoltaic cells in this device, store sunlight and can provide light for 8 to 10 hours. Such innovative methods of alternative/renewable energy will allow the people to do their routine work during night hours. This will also prove to be a boon to the school going children who can complete their assignments and save their eyes from the impact of dim light of candle or lantern.

A number of new and innovative techniques have been developed in the field of construction. Low cost and environment friendly building materials and designs are being used. Structural Engineering Research Centre (SERC), Chennai and Central Building Research Institute (CBRI), Roorkee, are premier research institutions under CSIR umbrella, doing commendable R&D work in the field of building technology. CBRI has developed Fluorogypsum Plaster that is imperishable in the rain and can sustain in rain for long. Portable C-brick machine is such a low-cost technology which uses sand, fly ash and cement to build durable and good quality bricks. This can substantially reduce the cost of construction and go a long way in meeting demand of *pucca* houses especially in rural areas. In addition, these institutions have contributed in developing sustainable and efficient building technologies such as earthquake resistant structures, use of rice husk in making wood etc. Such sustainable and low-cost technologies are not only in the interest of rural population but affordable to them also.

Health of rural public plays a crucial role in rural development. Primary Health Centres (PHC) and Community Health Centres (CHC) have been established to address health issues of rural areas. Unfortunately, these centres are facing shortage of doctors and pharmacists/nurses. Modern medical technologies and their specialists are also lacking there. Due to lack of medical facilities, most of the rural population have to take recourse to nearby

city hospitals. If PHCs and CHCs are well equipped with essential and modern medical technologies and facilities, health care in rural India could be better.

Science and technology have contributed significantly in promoting agriculture in our country over the decades. Agriculture Information System (AIS) plays a vital role in ensuring the reach of agriculture related information to farmers. Through different Information Processing Tools monitoring, we are able to know the situation of natural resources and environmental impact such as analysis of environment deterioration, soil erosion, deforestation, etc.



Since last one year, DD Kisan Channel is providing dedicated programmes on agriculture. Facebook, Twitter and Whatsapp have caused wider promotion of this channel among urban and rural India. Content of the channel and its presentation are also innovative. Therefore this channel is gaining popularity. *Vigyan Prasar*, an autonomous organisation of Department of Science and Technology, Government of India is engaged in public outreach for S&T communication. In rural areas, this organisation organises street plays, puppet shows and science exhibitions.

Also towards education, S&T is playing a great role. Online education system has become a boon for those students who cannot attend school on regular basis. Indira Gandhi National Open University (IGNOU) and Uttar Pradesh Rajarshi Tandon Open University (UPRTOU) are providing online education to under graduate and post graduate courses to both urban and rural students through online information technologies. National Institute of Open Schooling (NIOS) is a national organisation under Ministry of Human Resource Development. It provides online

education to student upto 12thstandard. Students of country's rural and remote areas are the target for NIOS. Different vocational and life skill related educational programmes have also been introduced at various centres of NIOS.

The National Informatics Centre (NIC) was established by the Department of Electronics in 1975. NIC is based on the nationwide satellite communication network. It has developed District Information System (DISNIC) in each district of the country. A large number of training and information transfer programmes have been taking place through this system. This helps in making available valuable information for district and rural development.

Government Schemes for Rural Development

Prime Minister Shri. Narendra Modi has launched '**Lab to Land**' scheme in 2014. The objective of this scheme is to increase agricultural production along with the rational use of water. For this, the PM has coined a mantra '**per drop more crop**'. He has motivated agricultural scientists for the use of scientific technologies to help raise the agricultural production. In this scheme, the stress is given on a logical combination of traditional knowledge system and new technology. Ground water level is going down in different parts of the country and this situation is alarming. Such schemes can motivate people to conserve water.

On 25 July 2015, the Prime Minister invited about 6000 scientists functioning at the various centres and institutes of the Indian Council of Agriculture Research (ICAR) and over 15,000 scientists working with state agricultural universities under a programme called **Mera Gaon Mera Gaurav**. The scheme envisages scientists to select villages and remain in touch with the selected villages and provide information to the farmers on technical and other related aspects through personal visits or on telephone.

The centre has announced '**Digital Literacy Mission Scheme**' in the Union Budget 2016-17. Under this scheme, government will cover around six crore additional households in the next three years' time period. Digital literacy is defined as the knowledge to handle digital devices such as computers, smartphones and internet.

Inculcation of Scientific Temper in public: Basis of robust Future and Rural Development

Gautam Buddha said,"Do not believe in anything simply because you have heard it. Do

not believe in anything because it is spoken and rumoured by many. Do not believe in anything simply because it is found written in your religious books. Do not believe in anything merely on the authority of teachers and elders. Do not believe in traditions because they have been handed down for many generations. But after observation and analysis, when you find that anything agrees with reason and is conducive to the good and benefit of one and all, then accept it and live up to it."

This statement should not be misconstrued as a call for indifference or a flippant attitude. If we carefully observe and analyse the above statement of Buddha, we can find a scientific temper or rational thinking that Buddha has highlighted. Such temperament causes positive attitudinal changes among public. They then, give up following things blindly. They start questioning, reasoning and reach to a rational conclusion.

From the Governments and policy makers, citizens expect non-discrimination between urban and rural development. Weaker, deprived and tribal communities must be brought into the mainstream of societal development.

The utility of S&T will be paramount in achieving aim of rural development as it is most important and effective tool for ensuring poverty alleviation, food security, life skilling, and educating masses. But only scientific and rational outlook can help us determine whether a technology is in harmony with nature or not. Else it may adversely affect our natural resources, flora and fauna. Only on inculcating this rational and logical thinking, we will be able to achieve the goal of sustainable development. One must remember that survival of human beings is linked with the survival of living organisms and environment.

Technologies should be used in a sustainable manner and only to the extent they do not interfere with the nature and ecosystem. The key to a developed and prosperous village lies in the sensible and rational usage of technologies which are in harmony with nature.

(The author is Associated with Vigyan Prasar, an autonomous institute of Department of Science & Technology, Govt. of India)

COMBINING TRADITIONAL WISDOM WITH MODERN RESEARCH

Mayanglambam Ojit Kumar Singh

Can hunger be eliminated from our homes, villages, states, countries or the world in our lifetime? How can we increase the production to satisfy the ever increasing starvation of the expanding population in a contracting and fragmenting fields and environment?

The most central idea to the approaches of increasing productivity for a secured and healthy society today is the strong feeling with conviction that know-how or knowledge must be brought to the people and places that need it the most. And it is in this context that combining conventional and contemporary science with the local wisdom and traditional ecological knowledge comes into picture to face the challenges posed by the increasing demand of food, both in terms of quantity and quality.

Finding and paving the ways for the collaborative works between established and the local remote knowledge together can feed starving and non-nutritious world. As we know that the researchers and the technical experts who create new knowledge and methods must execute and implement their findings by the local farmers hence, maximum collaborations between these two stakeholders to bridge the theories and practices is of paramount importance.

According to Food and Agricultural Organisation (FAO), good nutrition is the first defense against disease and the only source of energy to live and be active. Inadequate production of food accompanied by the nutritionally deficient agricultural produces is affecting the generation of youngsters. This lowers their learning capacities and compromises with their future with no compensation starting a positive feedback mechanism of poverty and malnutrition with an apocalyptic consequence on both - individuals and nations. Hence, the increase in production of food without compromising the nutrient contents is the single most important theme of most of the developmental programmes of all the countries. The right to adequate food is universal and good nutrition is essential for all. The impending and emerging challenges of climate change, uneven

economic growth, inter and intra-generational disparities and biased technological growth are shaping the present food production which needs to be seen and scrutinised critically.

Key Facts

793 million people suffer from chronic hunger.

161 million children under the age of five are stunted.

3.4 million people die each year due to overweight and obesity.

The cost of malnutrition is of about 3.5 trillion USD per year

Source: Food and Agriculture Organization (FAO)

According to the World Food Summit in 1996, it was expressed that "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".

Ensuring a life with dignity cannot be exercised among the people who are in empty lifeless fields. To make the people healthy we need to make our fields healthy and productive. This is even more important in the context of India. India is the world's second most populous country, and it has the largest number of farmers and rural population. Subsidies and food distribution programmes may increase production and consumption, but they absorb a large share of national finances that could alternatively be spent on essential public goods and services, such as health, education and the development of rural infrastructure. Increasing the productivity shall surely lead to higher domestic consumption and larger export besides, serving many other purposes.

How will we increase the agricultural productivity without compromising the nutrient values, soil fertility, and environmental issue. The marriage between the modern technological means and local adoption of the technologies and vice versa for a sustainable harvesting of the peaceful, equitable and profitable increase in agricultural productivity

must be our motto and objective. Some of the very practicable collaborative works which can fuel the growth of modern research without undermining the local needs and cultural acceptance must be based on local centric objectives and resources. Some of the possible ways and the already successful stories are briefly discussed here as under with respect to the increase productivity of agricultural produces. The availability of sufficient quantities of food of appropriate quality is the guiding spirit of the nations today. Increase in productivity shall surely help in providing food to all besides, allowing the diversification of employment and livelihood activities.

Scientific techniques becoming a part of local knowledge vs. productivity:

Harnessing the scientific development for the local welfare needs is the major objective of our scientific goals and the main work of the institutions of the government. Some of the interesting scientific techniques which have the potential to revolutionise the agricultural activities on the rural fronts are as follows.

1. Vermiculture: (The use of earthworms for composting organic residues)

Benefits of Vermicomposting

- Produces natural organic fertiliser
- Simple activity that can be done by anyone
- Minimal cost and requires very little space
- Good for the environment
- Fun, safe, and educational experience
- Not related to any zoonotic disease
- Reduces the release of green house gases like methane



*Picture: Close up of Worm Culture
(Source: FAO)*

Vermiculture is a method by which organic farm waste is converted to nutrient-rich fertiliser in a small shed so that it can be applied to crop fields and horticultural establishments. By ensuring proper methods taught to local farmers, villagers and the farmers can be encouraged to produce the vermicompost which is the product of composting using earthworms. Vermicast, also called as worm castings, worm humus or worm manure, is the end-product of the breakdown of organic matter by an earthworm. Wormcastings have been shown to contain reduced levels of contaminants and a higher saturation of nutrients than do organic materials before vermicomposting. Vermicompost is truly an excellent nutrient - rich organic, water soluble fertilisers and soil-conditioners. If properly developed, it enables the local farmers to develop skills to harvest this product which can easily become the backbone of the sustainable organic farmings of the villagers and the country at large. Earthworms which are also commonly considered to be the first farmers of the world for its habit of churning the soil and making it more porous are not alien for the local habitants. Our scientists must maximise the use of technique like vermiculture to not only increase the fertility but also to pave new ways to organically increase the yield of the products without enduring environmental degradation and pollution due to many harmful modern practices of predatory agriculture.

There is a growing realisation that vermicomposting also provides growth enhancing hormones that plants need for their growth and development. Many of the horticultural products grown using vermin-compost are also found to be having better keeping quality.

The process of vermin-composting or vermiculture is a simple technique. This process of composting crop residues using earthworm consists of spreading the agricultural wastes and cow dung in layers as 1.5m wide and nearly 0.9m high beds of required length. Earthworms are introduced in between the layers at the rate of around 350 or 400 worms per m³ of bed volume. These beds are maintained at about 40-50 per cent moisture content and a temperature of 20 to 30°C by sprinkling water over the beds. The earthworms consume the biodegradable matter and give out a part of the matter as excreta or nutrient rich manure called vermin-

castings. One worm which weighs 0.5 to 0.6 grams can consume almost equal to its body weight producing casts of about the same weight in a day. If one million worms exist in an acre, the casts that they produce in the same area are reported to be about 500 kg a day per acre that is nearly 200 tonnes of manure a year. According to NABARD (National Bank for Agriculture and Rural Development), the cost of the production of this compost works out to about Rs.1.5 per kg. It is quite profitable to sell the compost even at the maximum price of Rs.2.5 per kg.

Central and state governments must look into this method of availing the much needed organic manures making the present non-availability of organic manure as a thing of the past. To make the earthworm available, research centres should work on the better varieties of the earthworms and the specific requirements, according to the places or the field sites. Universities must be the centres of training and spreading awareness of such an achievable goal of producing the organic manures in cost-effective and successful manner. If the research centres put effective efforts, the governments may help in making the earthworms and the necessary infrastructures available at the subsidised rates whenever necessary.

Seed banks for banking the local variety of seeds Vs. Productivity: Meeting the world's food needs through better conservation of crop diversity

A seed bank stores seeds to keep them viable. It helps to preserve genetic diversity which the plant breeders need to increase yield, disease resistance, drought tolerance, nutritional quality, etc of plants used in agriculture. Many plants that were used centuries ago by humans are used less frequently now and seed banks offer a way to preserve that historical and cultural value. Seed banks are considered seed libraries and contain valuable information about evolved strategies to combat plant stress or produce novel products.

Seed banks maintain stocks of foundation and certified seeds of different crops and varieties which can be utilised for such contingent requirements such as during natural calamities like floods, droughts, etc. By maintaining the traditional varieties, opportunities shall be opened for the breeders and the crop scientists to find novel genes and traits.

Traditional varieties that have evolved in an area shall be providing the buffer against damage that may fall on the modern high yielding varieties.

Established in 1995, the Millennium Seed Bank Project (MSBP) is an international partnership for the conservation through seed storage of research quantities of endangered, endemic and useful. number of are world's plant species are under the threat of genetic erosion leading to loss and that seed banks are a cost-effective means of countering some of threats. Deforestation affects these daily lives of millions of people. The starting material for reforestation is, primarily, seed and it is also the most useful material for the conservation of species. Developing seed banks for the crop plants and trees shall provide a beautiful synergistic platform to help each other.

Making the seed banks accessible, besides providing the awareness to the local farmers, shall surely help them in developing newer varieties and at the same time shall also provide them with another opportunity for the growing of the traditional variety. Such acts shall surely help in conserving the biodiversity of the areas and also help them adapt to the change which is brought by the global climate change. Today more than seven million samples of seeds, tissues and other plant-propagating materials from food crops, along with their wild relatives, are safeguarded in about 1,750 gene banks. Such seed banks, if managed properly, shall surely help to preserve genetic diversity and make it available to breeders and other scientists, who can then use it to develop and share improved varieties, including those adapted to particular agro-ecological conditions.

Ren Wang, FAO Assistant Director-General said, "As the world's population grows and continues to face a wide range of climate, environmental and other challenges, maintaining a healthy variety of seeds and other plant genetic resources for the benefit of people in all countries will be essential in keeping agricultural and food systems sustainable and resilient, generation after generation".

Seed banks are the modern temples that help in bridging the past and the future by ensuring the continued availability of plant genetic resources for research and for breeding new varieties that meet the consumers continually evolving needs and a

changing climate. They will surely improve the adaptive capacity of the local farmers and the people alike. Gene bank will revolutionise the agricultural productivity, this time, by integrating with the biodiversity not away from it. More than 200,000 varieties of paddy were known to be cultivated extensively at one time in our country. Drought-resistant and highly nutritious scented millets were also once a popular crop as they were cultivable in the poor soil. If conserved, it will surely manage to come out with 200,000 different ways to increase and conserve crops and their productivity.

Traditional knowledge is the product of the biocultural adaptation of the local and indigenous people. Farmers have wealth of knowledge. Rather than imposing and dictating methods and information on farmers, it is important to learn from them and at the same time find ways to communicate and make long lasting relations. The farmers' fields are grounds for discovering a dynamic living laboratory of tremendous biological diversity sustained primarily by small-scale farming communities.

Upgrading the quality of farmer-saved seed, providing the financial assistance for distribution of certified seed for the production of quality seeds and for the training on seed production and technology to the farmers is a much needed work of today. In this regard, progress has been, made through programmes like the seed village scheme. Without good seeds the survival of rural households is endangered. Diversity is the best and the cheapest form of pest control.

Our traditional cropping methods in many agricultural societies have been based largely or solely on the crop rotation patterns maintaining the diversity of the area. This method of agriculture has been acting as the adaptive gene throughout our culture. Doing agriculture by maintaining the diversity is the best way to honour the earth.

Institutional development Vs. Productivity: a-IDEA for fostering innovation and entrepreneurship in Agriculture

Well-funded and determined institution tries to come out with the proper solution of relevant issues. In this regards mention should be made of the a-IDEA. A-IDEA is a technology business incubator. This is the initiative by ICAR-National

Academy of Agricultural Research Management (ICAR-NAARM, GOI) with the support of Department of Science and Technology for fostering innovation and entrepreneurship in agriculture in India. One of the most appreciable objectives of the institution is the provisioning of the access of knowledge and the network support services in innovation and entrepreneurship in agriculture. It is indeed the "Interactions Not the Combat that allows coexistence and evolution".

Conclusion:

Domestic agriculture production is a priority to attain future food security and self sufficiency goals. Collaborative programmes are underway to share valuable knowledge with local farmers everywhere. Local growers and the farmers are provided a series of demonstrations throughout growing seasons and to educate them on effective hybrid rice farming techniques, besides, arming them with the much needed know-how on proper seed selection, soil healthmanagement,pestcontrol,waterconservation, harvesting and post harvesting practices. Such programmes in order to be sustainable and efficient must also incorporate the local knowledge that has been already embedded in the existing geography.

The results of any of the programmes and the policy may not be getting crowned with success so quickly but the journey must be memorable, meaningful and enjoyable. And this will be achieved if we work inclusively by incorporating the diverse ways and norms of the places, likes and dislikes of the places and the levels of education, awareness and inquisitiveness of the farmers, growers besides, all the stakeholders. Today increase in productivity while compromising the soil fertility and the biodiversity shall not be sustainable. And achieving the targets of food security by incorporating the biodiversity and local increase in the organic biofertiliser is the sure way to achieve the sustainable development goals.

Let's remember "Once in a Journey Always in a Journey". Our growth model and fruits of the same shall be an everlasting journey of peace, prosperity, meaningfulness and indeed a truly enjoyable one.

(Author is Assistant Professor in Zoology Department, Ramjas College, Delhi University and Research Fellow at School of Human Ecology, Ambedkar University Delhi)

ROLE OF ICT IN RURAL INDIA

Vishwadeep Singh

On the fateful morning of 13th October 2013, a severe cyclonic storm 'Phailin' hit the Odisha coast near Gopalpur. However, it was not the first time that people of Odisha were facing the wrath of the nature. Devastating cyclone of 1999 had left more than 15000 dead and lakhs of people homeless. In contrast, fatalities due to 'Phailin' were a mere 45, mainly due to uprooting of trees.

This miraculous turnaround, no doubt, was the result of meticulous planning on the part of government with effective evacuation and relief measures. But, one thing that played most important role in saving loss of life and property was – Information and Communication Technology (ICT).

ICT tools enabled *Meteorological* Department to know precise location of the cyclone in the Bay of Bengal and give accurate forecast. Further these tools helped the government and district administration to coordinate their in-house efforts and disseminate important information to the public in real time. Radio and mobile messages were used extensively. This specially helped the rural and remote areas of the state as the people were able to prepare for the cyclone before hand and give a distress call when needed.

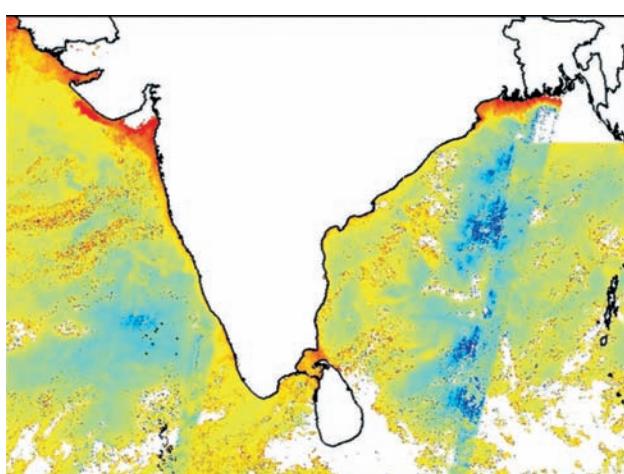
Other than such emergency situations, ICT can contribute immensely to the rural life in India through all such possible applications of ICT as follows:

Resource Mapping

India is vast with abundant natural resources available across the length and the breadth of the country. Some of these resources like water are vital for agriculture. Remote sensing technology can be leveraged for their effective management. Using data from satellites, government agencies and institutions can plan their effective utilisation such as watershed management and development of fisheries.

Following Chlorophyll Image of Indian coastline retrieved from Oceansat-2 Satellite Data, helped increase in fish catch by two-three times. Chlorophyll is a substance found in the leaves of green trees where photosynthesis takes place. In ocean, there are phytoplankton, also known as microalgae, which are similar to terrestrial plants as they contain chlorophyll and require sunlight in order to live and grow. These phytoplankton are food for small fish which in turn are food for bigger fish. This way, if we come to know the exact amount of the phytoplankton at any place, we can predict the fish number in that area.

About 70 lakh people living along the Indian coastline, spanning over 7516 km, are depending on fishing for their livelihood. Locating and catching fish is always a challenging task. A hand held GPS device can help fishermen navigate in the sea. They can go out further from the coast without fear of getting lost, increasing their catch manifold. Earlier, when a fisherman had a good catch, would find it difficult locating the exact spot the next day. This was time consuming, but now, equipped with GPS, he can locate and record all favourable spots and get there the next day without any hassle. Also, often reports of fishermen being arrested by neighbouring countries are received when they inadvertently enter their territorial waters. Solution is a GPS-enabled device, which will alert the fishermen as and when they are about to enter



Chlorophyll Image retrieved from Oceansat-2 Satellite Data

a foreign territory. An app 'Fisher Friend' gives fishermen alerts on weather, potential fishing zones and maritime boundaries.

ICT for Agriculture

One of the challenges for farmers in rural India is their lack of access to market information. This creates an imbalance in bargaining power with urban buyers which are big companies that have the resources and information to influence the market. Other than market information, a farmer needs to know about weather on a day to day basis, about new technologies and various government schemes for farmer welfare. With the use of ICT, this information asymmetry can be solved effectively.

Up till now in India among various media, radio, television, literature and newspapers are certainly most utilised by the extension workers to transfer agricultural technology to the huge illiterate and literate segments of the rural populace. But this approach has some major drawbacks one, there is limited scope to get feedback from farmers and second it is not demand driven. One farmer may require information about new rice variety, but radio and newspaper may be giving information about sugarcane. These anomalies can be effectively solved by using IT tools. Through these, we can give exact information that a farmer might be looking for without any delay. Also it can be a two-way process using interactive tools and farmers' opinions and queries would reach the desired officers within seconds.

The Government is actively promoting use of ICT to reach the farmers. Some of the initiatives are described as below:

- i) **Kisan Vikas Kendras** (KVK) form the backbone of information and technology dissemination in India. At present, around 630 KVKs are in operation whereas several new ones are being established. These KVKs work as a link between scientific community and the Indian farmer by demonstrating new technology at district level. The present Government has asked KVKs to use more and more ICT tools in their work to reach the remotest farmer. Generous funding is being provided for this.
- ii) **Mera Gaon Mera Gaurav** is a scheme in which Agri-Scientists would go to villages and help

farmers adopt new technologies. Again, ICT can be very effective in this. Scientists can form WhatsApp and facebook groups with youth of the villages and interact with them more frequently.

- iii) The Government is working on linking all agricultural colleges of India through IT. This way there would be more interaction among the academics so that any good technology developed anywhere would reach other parts without much delay.
- iv) Easy access to internet is a problem in India, especially in rural hinterland. In many villages network coverage is poor. Further, not everybody can afford a laptop or smart phone in rural India. The problem of connectivity would be largely solved by connecting all Gram Panchayats through cable broadband under **Digital India Initiative**. Also **Common Service Centres** in villages will make sure that even the poorest have access to the affordable internet services.
- v) **Kisan Call Centre** is an expert advisory system. The farmers need to call the toll free number 1800-180-1551 to seek expert advice on different matters related to agriculture and allied sectors.

mKisan Portal

It (<http://mkisan.gov.in>) is an effort to provide information to the farmer at the single place. We know that **internet penetration in the countryside is still abysmally low, therefore, mobile messaging can be the most effective tool. So an SMS service on this portal was also launched on July 16, 2013 by the President of India.**

This mKisan SMS Portal for farmers enables all Central and State government organisations in agriculture and allied sectors to give information/services/advisories to farmers through SMS in their language, preference is given to agricultural practices and location. Semi-literate and illiterate farmers have also been targeted to be reached through voice messages.

In addition to above, various farming related apps can be downloaded from mKisan portal. E.g.-

- i) **Kisan Suvidha** - it is an omnibus mobile app developed to help farmers by providing relevant

information to them quickly. This app has following information-

- information on weather of current day and next 5 days,
 - market prices,
 - agro advisories,
 - plant protection,
 - Integrated Pest Management (IPM) practices
- ii) **Pusa Krishi:** The app will provide farmers with information related to new varieties of crops developed by Indian Council of Agriculture Research (ICAR), resource conserving cultivation practices as well as farm machinery.
- iii) **Bhuvan Hailstorm App:** A mobile app has been developed to capture crop loss ocewel due to hailstorm. Agriculture Officer will go to the field with mobile or tablet loaded with this mobile app. The captured data will automatically be plotted to Bhuvan Portal and analysis can be done easily. This will reduce the delays in the payment of compensation to the farmers.
- iv) Crop Insurance App— It will provide all the information about government crop insurance scheme. It can be used to calculate the Insurance Premium for notified crops based on area, coverage amount and loan amount in case of loanee farmer.
- v) AgriMarket- This mobile app can be used to get the market price of crops in the markets within 50 km of the device's location. There is another option to get price of any market and any crop in case person does not want to use GPS location.
- vi) **Pashu Poshan-** With its help balanced ration is formulated while optimising the cost considering animal profile, i.e. cattle or buffalo, age, milk production, milk fat, and feeding regime etc. and milk producers are advised to adjust the quantity of locally available feed ingredients offered to their animals along with mineral mixture.

ICT in Dairy Sector

Emphasizing on the ‘White Revolution’, in his budget speech, Union Finance Minister made an allocation of Rs 850 crore for four programmes — *Pashudhan Sanjeevani*, *Nakul Swasthya Patra*, *e-Pashudhan Haat*, and National Genomics Centre.

Here lies the scope to utilise IT for dairy development. *Nakul Swasthya Patra* is a ‘health card’ that can help the dairy farmer to keep a record of his livestock, as well as ready information on the age and dates on which he should get his animals vaccinated and inseminated. The card would keep track of the veterinarian who has given the medicine, vaccination, artificial insemination and genetic background of the bull or semen used. On the other hand *e-Pashudhan Haat* wants to create an online platform to buy and sell cattle.

It is a known fact that farmers depend on informal channels such as friends and relatives to buy and sell their cattle. Therefore, a need for a virtual livestock market was long felt. ‘Health Card’ of an animal integrated with *e-Pashudhan Haat*, can help farmers in buying the desired cattle. This can be associated with *Pashu Posahn* app also.

Also, farmers would be able to keep the past record of their cattle e.g. health, fertility, production, etc. This way, many concepts of genetics and breeding could be encouraged to develop dairy sector.

Another area for IT application in dairying can be automatic milking systems which are computer controlled stand alone systems that milk the dairy cattle without human labour involved.

ICT for Effective Implementation of Welfare Schemes

Every year, government spends billions on the welfare of the poor. As around two-third of the total population and large number of the poor reside in rural areas, most of these welfare schemes are targeted at the rural populations. Use of ICT can improve the efficacy of these schemes, plug leakages and eradicate corruption. Some examples are described as follows:

- i) ICT will be used in *Pradhan Mantri Fasal Bima Yojana* in a big way. In this, a farmer will have to send the photo of his damaged crop to authorities on net. Then the government will also access damage through satellite imagery of the field. After that insurance claim will be directly transferred to farmers' account. Thus delays and corruption in payment of claims would not be

there. This scheme has the potential to change the way farmers' look at crop insurance.

- ii) The Government is investing a lot in irrigation through *Pradhan Mantri Krishi Sinchai Yojana*. IT can be used here also for **Smart Agriculture** by measuring soil moisture through and then automatically supplying water through drip irrigation.
- iii) Leakages in **Public Distribution System** can be plugged by connecting the ration shop through internet and using biometric authentication system of beneficiary.
- iv) Through **Direct Benefit Transfers**, the government is trying to give subsidy directly in the bank account of the beneficiary. This has effectively stopped black marketing of subsidised LPG cylinders.

ICT in Rural Education and Skill Training

Thanks to the relentless efforts by the government and schemes like mid day meal, India has achieved universal enrollment at primary level. But one worrying fact is that learning outcomes of enrolled children are very abysmal. Attention needs to be focused on this now. Using ICT tools in education can help improve the learning among the kids e.g. through projector and computer, teachers can make children understand complex concepts easily. But problem here would be to train the teachers in use of ICT tools so that their attitude towards teaching may be changed.

The Government is promoting use of ICT through *Rashtriya Madhyamik Shiksha Abhiyan*. Under this following steps are being taken-

- The establishment of smart schools, which shall be technology demonstrators.
- Provision for engagement of an exclusive teacher for ICT, training all teachers in use of ICT.
- Development of e-Content.
- National Award for teachers using ICT in schools in the teaching learning process.

Also a project called *e Basta* is conceived under **Digital India Initiative** to make school books accessible in digital form as e-Books to be read and used on tablets and laptops.

Further, ICT can be used in skilling rural youth under various Government skilling programmes e.g. Skill India, *PM Kaushal Vikas Yojana*.

ICT for Rural Health Sector

Healthcare is the right of every individual but lack of quality infrastructure, dearth of qualified medical functionaries, and non-access to basic medicines makes it difficult for the poor to access Medicare. There are few Primary Health Centres in villages and many of them do not have doctors as no one wants to be posted in remote rural areas. This can be solved effectively through **Telemedicine** in which a doctor sitting in a city can interact with the patient in the remote village and prescribe medication. This is not only cheap but also convenient and less time consuming.

Also apps like '*MeraDoctor*' are launched by private sector which offers WhatsApp-like chat sessions between patients and licensed doctors to answer questions.

Government has also adopted ICT in health by issuing biometric smartcards to the beneficiaries under *Rastriya Swasthya Bima Suraksha Yojana*.

ICT for Marketing Needs in Rural India

ICT in rural areas will provide unique opportunities to producers of rural products, agriculture/agro-processing products, rural handicrafts etc. to have direct access to markets. It can also be used to promote Village and heritage tourism. Many artifacts are made by the women in the villages which can be sold online to outer world.

One important reform undertaken by the Government in the field of agri-marketing is **National Agriculture Market**. It is a well-defined plan to integrate the *mandis* through internet. It enables a farmer to sell his produce anywhere in India depending on the highest price which means a trader in Mumbai can buy a farmer's produce kept in a *mandi* of Delhi.

Conclusion

Thus we see that ICT has immense potential. If this potential is leveraged effectively, it can uplift the lives of the rural masses in a big way by bridging the cultural gap between different parts of the country.

(Author is an IT Expert)



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FARMERS' FRIENDLY NUCLEAR ENERGY BASED TECHNOLOGIES

Nimish Kapoor

Energy is essential for the survival and growth of modern human civilisation. All available sources of energy, therefore, must be optimally developed and deployed to meet the short as well as long term energy needs of our country. Nuclear energy and related technologies are the safest options that can be used in diversified fields of agriculture and health for peaceful purposes. Many misconceptions and rumours are associated with the nuclear energy based technologies, like nuclear energy fosters nuclear weapons, nuclear radiation is deadly and nuclear reactors are not safe for human-beings and environment etc. This technological awareness gap of understanding nuclear energy and its applications is the most challenging area in India today. India faces formidable challenges in meeting its energy needs and providing adequate energy of desired quality to consumers in a sustainable manner at a reasonable cost.

Nuclear energy based technologies can play a bigger role offering sustainable solution to not only global energy problems, but also food safety and better farming practices. Agriculture is one of the important sectors under the peaceful uses of nuclear energy having major societal impact. Nuclear technologies are applied to minimize wastage of agricultural produces and at the same time it helps in increasing crop yield and thus adds to food security.

The hot and humid climate of India is quite favourable for the growth of numerous insects and microorganisms that destroy stored crops and cause spoilage of food every year. Spoilage

can also occur due to chemical and physiological changes in stored foods. Sea-foods, meat and poultry may carry harmful microbes and parasitic organisms that cause illnesses associated with their consumption. Various methods of food preservation are in practice in the country which are costly and not farmers' friendly such as sun drying, pickling, fermentation and more energy consuming techniques such as refrigeration, freezing and canning. Each of these methods has its merits and limitations.

India's nuclear scientists are involved in a broad based research programme of agriculture and biotechnology for food safety through nuclear radiation (known as radiation processing of food or food irradiation), developing high yielding and early maturing crop varieties with better nutritional quality and wider ecological adaptability using mutation breeding. As many as forty crop varieties have been developed and released so far for commercial cultivation in different agro-climatic zone of India. The other important applications of nuclear technology in agriculture are studies on fertilizer use efficiency, control of insect pests through sterile insect technique, monitoring



Breeder seed plot of Trombay groundnut variety

of pesticide residues and preservation of agricultural produce. Farmer friendly soil organic carbon detection kit for the analysis of soil organic carbon on field has been developed with nuclear radiation technology.

Radiation processing of food or food irradiation is the process of exposing food to ionizing radiation in order to destroy microorganisms like bacteria or insects that might be present in the food.

Food irradiation involves exposure of food to short wave radiation energy to achieve a specific purpose such as extension of shelf-life, inhibits the insect infestation and elimination of food borne pathogens and parasites. In comparison with heat or chemical treatment, food irradiation is considered a more effective and appropriate technology to destroy food borne pathogens. It offers a number of advantages to producers, processors, retailers and consumers. This effort is aimed to reduce the waste of food grains in India because of worms and pests. According to United Nations, India is also home to over 194 million people suffering from hunger. Approximately, 38 per cent of India's food grains go waste in storage. Most of the agricultural produce gets wiped out by insects and pests. This means country's farmers produce food grains to feed all hungry population, and some surplus too, but still, 194 million people go hungry. The proportion of food wastage can be reduced by nuclear energy based food irradiation.

The irradiation process involves passing of food through a radiation field allowing the food to absorb desired radiation energy. The food itself never comes in contact with the radioactive material. Food irradiation is like an X-ray, it doesn't remain in the body. So it is a safe process and do not induce any radioactivity in foods. Moreover, it increases the shelf life of the product like in onions, potatoes, mangoes and other fruits and vegetables. It inhibits the sprouts and also delays their ripening. It decontaminates the microbes in food products by making it safe and the availability



of food for long time is also assured by this process. At present, all food products, except milk and milk products, are allowed to be irradiated. Large-scale irradiation takes place in medical and food sectors. Medical kits are sterilised using radiation facilities. Many ready-to-eat food items, too, are irradiated to increase their shelf lives. Research has proven that the properties of food items do not change during the irradiation and they are safe for consumption. Traditionally, in India food grains are exposed to sunlight for long hours during summer to kill all pests but irradiation facilities do this work in few seconds.

Government institutions involved in nuclear agriculture and biotechnology are preparing to establish a big network of food irradiation facilities across the country. At present, India has 21 irradiation centres where food grains, fruits, ready-to-eat food, mutton and chicken are also being irradiated. They are all under strict regulation of the Atomic Energy Regulatory Board. The Joint Expert Committee of the Food and Agriculture Organization (FAO), World Health Organization (WHO), and International Atomic Energy Agency (IAEA), in 1980 concluded that irradiation does not induce special nutritional problems in food.

Mutation breeding is other important application of nuclear radiation. In this process seeds are exposed to nuclear radiation in order to generate better varieties with desirable traits, which are known as mutants. Plants created using mutation breeding or mutagenesis are called mutagenic plants or mutagenic seeds. Bhabha Atomic Research Centre and Indian Council of

Agriculture Research have various research programmes in food and agriculture involving genetic improvement of crops through mutation breeding. The major emphasis in mutation breeding programmes is on oilseeds and pulse crops for higher productivity, resistance to biotic/abiotic stress and quality improvement.

Scientist at BARC has developed more than 200 plant varieties of grains, fruits and vegetables through nuclear radiation based mutations encompassing different crops including oilseeds like groundnut, mustard, sunflower, linseed, pulses like pigeonpea, moong, urad and cowpea; cereals like rice and wheat; other crops like soya bean and jatropha for bio-diesel. These varieties are endowed with improved characters such as early and higher yield, large seed size along with resistance to biotic stresses like insects, heavy metals etc. and abiotic stresses like shortage of water, drought, salinity etc. Mutation breeding in wheat and *sesbania* crops is also being carried out. Benefits of high-yielding ability of groundnut varieties by harvesting record groundnut yields in many parts of the country have been realized by farming communities. By cultivating the mutant varieties, groundnut productivity in major groundnut states like, Gujarat, Andhra Pradesh, Maharashtra, Karnataka, Orissa and Rajasthan has been increased. A drought tolerant variety, **TG-37A** has rekindled groundnut cultivation in desert areas of Rajasthan state. Large seed varieties like **TPG-41** and **TLG-45** benefited many farmers, traders and exporters by virtue of their earliness in ripening, moderate seed dormancy and superior productivity. According to the scientists involved in mutation breeding, the deployment and dissemination of crop technology and large scale production of breeder seeds of these varieties are being undertaken in collaboration with central and state governmental institutions, seed corporations and NGOs. The societal impacts of these varieties are reflected in terms of enhanced productivity, popularity and extensive cultivation with financial benefits to farmers.



The sterile insect technique (SIT) is one of the major applications of nuclear radiation technology in which male insects are made sterile. Females that mate with a sterile male produce no offspring, thus reducing the next generation's population. Repeated release of sterile males can diminish small populations, although success with dense target populations has not been demonstrated. The technique has successfully been used to eradicate the screw-worm fly. Many successes controlled species of fruit flies, most particularly the Mediterranean fruit fly (*Ceratitis capitata*) and the Mexican fruit fly (*Anastrepha ludens*). Sterile insect technique for the management of red palm weevil and potato tuber moth insects and bioinsecticidal formulations based on *bacillus thuringiensis* and *Bacillus sphaericus* for the control of mosquito larvae have been developed.

The applications of nuclear energy are bringing forth revolutionary changes in human life and life expectancy by contributing in food security, healing and wellness. Misperception, that nuclear power poses a unique and enormous threat to public health and environment, is out of proportion, and is actually undermining the public interest. The only answer to the misinformed and mis-communicated society is lack of awareness. Public understanding on the issues like nuclear energy and nuclear technologies is required to develop a knowledge based society.

(Author is working as Sr. Scientist in Vigyan Prasar (under DST, Government of India) & is involved in science communication activities)

Low Cost Micro Solar Dome Surya Jyoti to lit rural homes

Union Minister for Science & Technology and Earth Sciences, Dr. Harsh Vardhan, recently launched the Low Cost and Environment-friendly solar lighting device, which would prove to be a boon for the urban and rural households in the country that do not have reliable access to electricity. The device has been developed under the aegis of the Department of Science & Technology.



Describing the salient features of the device, the Minister said that the potential users of this device are 10 million households. He said that according to preliminary estimates, if this technology is adopted in 10 million households only, it has the potential of saving 1750 million units of energy. It would also lead to an emission reduction of about 12.5 million ton of CO₂ equivalent, hence giving a fillip to the mission of 'Clean India, Green India'. The manufacturing process, being labour-intensive, would also generate huge job opportunities in the economy.

Dr. Harsh Vardhan, while explaining the working of the device, said that the Micro Solar Dome captures sunlight through a transparent semi-spherical upper dome and concentrates it inside a dark room. The light passes through a sun-tube having a thin layer of highly reflective coating on the inner wall of the passage. It also contains a lower dome having a shutter at the bottom that can be closed if light is not required in the daytime. It is leak proof and works for almost 16 hours daily i.e. throughout the day and 4 hours after sunset.

The Minister said that the Photo-Voltaic Integrated Micro Solar Dome costs about Rs. 1200 and the Non Photo-Voltaic version around Rs. 500. These cost figures are expected to get further reduced to Rs. 900 and Rs. 400 respectively post the scaling-up of the manufacturing process and future linkages with the subsidies under various schemes of the Ministries of Urban Development, Rural Development and Ministry of New and Renewable Energy.

The Minister of State for Science and Technology and Earth Sciences, Shri Y.S. Choudhary said that this technology would lead to the saving of fossil fuels to a great extent as 1 unit of energy saved is equivalent to 3 units of energy generated. He envisaged the corporate sector to play its role under their Corporate Social Responsibilities Schemes for the manufacturing process to scale up. He said that incubation centres are being brought up under the 'Start up India, Stand up India' programme which would encourage entrepreneurship in the solar sector to make commercialization of the device viable.

According to a TERI University test report, the illumination level of the light during mid-day goes as high as a 15W LED bulb. Extensive Testing of the device for select parameters has been completed at IIT Bombay, TERI University and Indian Institute of Engineering Science and Technology (IIEST), Kolkata. Field trials have been conducted and 300 Micro Solar Domes are being installed in the slums of Delhi, Mumbai, Kolkata, and Bengaluru.

INDIA'S STRIVE FOR TECHNOLOGY INTERVENTION TO PROMOTE RURAL ECONOMY

Ratnajyoti Dutta

India's endeavour to raise rural income will depend on how effectively measures can be put in place to reduce the cost of cultivation. Prime Minister Shri Narendra Modi has set a target to double farmers' income by 2022. This target can be achieved by a wider technological intervention to cut the input cost in the farm sector to ensure better returns to farmers for their produce.

The Government has already started giving thrust to usher in a second green revolution with a special focus on the North Eastern region. The first Green Revolution took place in the sixties through traditional approach of sustained focus on higher production. But the next green revolution has to be based on perpetual higher production through the minimising cost of cultivation by a wider application of all forms of technologies including remote sensing and mobile based applications.

India's farm dependent rural economy has been trying hard to raise productivity for a long time now in an attempt to ensure food security to its huge population. An elevated status of a developed nation would be viable, only if farming activities in rural areas become sustainable, to feed the country's growing population.

Prime Minister's commitment to promote a "per drop, more crop" approach to farming promises better use of scarce water, while flagship scheme like 'Soil Health Card' aims at managing nutrient related issues at micro level with a focus on the core issue of how to raise existing level of productivity at a farmer's level, achieving higher productivity.

Thrust on greater use of remote sensing techniques aims at reduction in the cost of production and crop losses so that farmers are assured of higher returns as against traditional methods of farming. Using remote analysis to assess soil moisture and crop development has the potential to cut input costs and raise yield levels.

Farmers would be able to access advisories on their mobile phones to help them to choose seed varieties, apply the right fertilisers or time irrigation 'shots'. All these would be made possible under the satellite-aided farming techniques, experts said.

Information about soil moisture level in a field can help a farmer to choose a crop that is suitable at that level; better fix the ideal fertiliser mix given the cultivable land's soil type. Based on satellite feeds, one can assess vegetation cover at a field level, and

help determine how a crop is growing and whether it has been attacked by pests or needs more water.

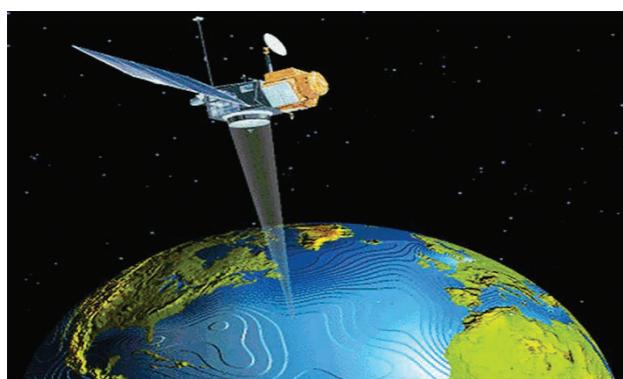
"Personalised farm advisories on mobiles with the help of remote sensing techniques can be a vital component in minimising farming costs as the country is still to develop the ideal network of weather observatories," said N.Chattopadhyay, Deputy Director General, India Meteorological Department (IMD).

In fact, the remote sensing based farming approach aims to promote 'precision' farming methods pioneered in North America that use geo-location technology to help farmers to micro-manage exactly how much seed, fertiliser or pesticides they need to apply over their piece of lands. In countries like the United States, Canada and Mexico unmanned aerial vehicles, popularly known as drones, are in use to overfly farms to map soil and crop with precision.

Experts said such an analysis can empower farmers on a near real-time basis to take decisions, right from the start of choosing seed varieties to adopt strategies to mitigate crop losses, before or after at the time of natural disasters like drought, floods or even in cases of pests attacks.

"Remote sensing technique can minimise the loss due to pest attacks by 20-30 percent, up to 60 percent in case of a drought while the loss minimisation could be as high as 100 percent in case of accurate prediction of a flood due to high intensity of rainfall in a particular area," said B.C. Barah, a New Delhi-based agriculture economist.

The Government at Centre has urged states to use remote sensing extensively to benefit farmers, most of whom plough a tiny piece of land. The country has also geared up to use satellite-based crop forecasts to develop insurance for farmers.



Experts like Chattopadhyay said the remote sensing technology would increase the agricultural production by monitoring the climatic factors at high-resolution scale, even up to a few meters, which results in improvement in the agricultural productivity.

The technology provides the synoptic overview of the current agriculture situation. The information available for monitoring pest and disease, drought and flood conditions along with the remedies to the farming community before the situation turns into a disaster affecting the crop yield and productivity.

"At present, there is no sensible soil moisture network exists on a national scale and remote sensing technique can fill this vacuum by providing information on soil moisture condition for irrigation scheduling," said Chattopadhyay .

Remote sensing methods can be integrated with crop growth models, statistical models to estimate better result in a spatial format.

But challenges would be to develop bias free meteorological/agro-meteorological information with usage at a local scale to raise farm output for the country's huge rural population in the days ahead.

Technology Thrust

The government has initiated a host of measure to empower rural population through technology intervention. In the beginning of this year, the government had launched a remote sensing based insurance scheme, aimed at empowering the farming community. The scheme 'Pradhan Mantri Fasal Bima Yojana' will require a uniform premium of only 2 percent to be paid by farmers for all Kharif (summer) crops and 1.5 percent for all Rabi (winter) crops. For the first time, thrust has been accorded to satellite technology to facilitate accurate assessment and speedy settlement of claims.

Under the launched scheme, use of technology has been encouraged in the farm insurance scheme, smartphones will be used to capture and upload data of crop cutting to reduce the delays in claim payment to farmers.

Indian farmers also receive customised weather-based advisories on mobiles. Farm ministry runs dedicated weather information based services at various stages of farming. These services, including Kishan Portal, empower country's 11.34 million farmers covering 633 districts of 23 states.

Rural awareness programmes are run on a regular basis through multi-media platforms, most popular being state-run All India Radio's dedicated programmes on farming in local languages.

Ministry of rural development has been collaborating with the ministry of agriculture to distribute advisories and rain gauges for rainfall

monitoring on a pilot basis involving around 25 village bodies (Panchayats).

The government's commitment to bring stability in price mechanism has been visible with its attempt to electronically integrate nearly 250 wholesale markets in the country by September 2016. An electronic integration will ensure free movement of farm produces from one market area to another, minimising supply-side uncertainties associated with price mechanism in rural India.

Electronically integrated markets will offer a common marketplace by providing a platform for real-time prices at a national level for all stakeholders involved in the rural supply chain for farm produce.

Such an initiative would provide farm producers wider access to markets, save them from levies charged by multiple markets and ensure agricultural commodities to consumers at reasonable prices. The farm ministry plans to develop a national e-platform for market integration covering 585 wholesale markets by March 2018.

The centre has urged states to introduce the e-market platform within their territories so that farmers can sell harvest in any of the connected markets. The Department of Agriculture will provide free software and help in customization of the software to suit the requirements of the states.

The Centre has set aside 1.75 billion rupees for providing software needed for the market integration project with each market receiving three million rupees. Markets from Gujarat, Maharashtra, Telangana, Jharkhand, and Chhattisgarh have already received the approval for the financial assistance in the first phase.

For promoting digital connectivity, the government is running two dedicated portals, which aims to serve as a "One Stop Shop" for all the farmers to access information on agricultural activities. The portals provide information about a package of practices, crop and seed varieties, common pests, dealer network for seeds, fertilisers, and pesticides, machinery and tools, agro-met advisories, credit and insurance, rain-fed areas.

Two mobile apps were unveiled recently as part of the government's sustained focus to promote the use of information technologies to benefit of farmers. Mobile app 'Crop Insurance' helps farmers find out details about insurance cover available in their area. This application helps to calculate the insurance premium for notified crops, coverage amount and loan amount in case of a loaned farmer. AgriMarket Mobile, the second app, can be used by farmers to get market prices of crops in wholesale markets within 50 km radius of the device.

(The author is a New Delhi-based journalist)

RENEWABLE ENERGY: MAKING A DIFFERENCE

Dr. Rina Mukherji

As I write this, the Delhi government has announced its intention to turn Delhi into a green-powered city in the next decade.

Delhi, of course, will not be the first city to embark on a green journey. Pune was one of the first Indian cities to do so, through incentivisation of rooftop solar heating systems. Today, the Pune Municipal Corporation is one of the foremost profit-making bodies, thanks to its Waste to Energy projects, which have not only made it save on power, but enabled it to make a neat profit out of its leftover slurry being sold as fertiliser.

The Government at centre has been focussing on Renewable Energy. The Government declared its intention to achieve 1.75 lakh MW of renewable power by 2022. Of this, one lakh MW was to be achieved through Solar power, while the rest was to be done through other renewable sources. Of this, 40,000 MW is to be achieved through rooftop panels.

The Smart Cities Mission has made the harnessing of renewable energy as one of the important factors in selecting cities for retrofitting them into smart urban centres.

The Government has been actively encouraging the replacement of old air-conditioners with energy-efficient machinery; and the mandatory setting up of rooftop panels over all government buildings to that end.

However, more than urban India, it is rural India that can be transformed through Renewable Energy.

In a country where vast topographical differences make it difficult for the grid to be extended to many remote regions, renewable sources of energy can bring in the real change in people's lives, and hence, development.

Solar Power

India being a tropical country, solar power can easily be used off-grid to light up villages in

the remote interiors, and islands off the mainland, where logistical problems make it near-impossible to extend the power to.

For those familiar with urban India, it is difficult to imagine living without the basic necessities of running water, toilets or electricity. However, for the people in the Indian Sundarbans, life is a daily struggle. Tiger attacks are not unheard of, and kerosene lanterns are the only lights that can provide succour after sunset.

At the *Debipur Karunamoyee Balika Vidyayan* Government Girls School, 610 girls and lady teachers, in addition to three para (assistant) teachers had to make do with just three toilets. The toilets lacked running water. Hence, water had to be carried from the single tubewell or the waterbody in the premises as and when someone used the toilet. "It was an ordeal, since the girls would often avoid flushing the place after use." The facilities had to be shared with the girls in the accompanying hostel, making matters even more difficult.

In 2010, solar power brought in a new era.

Baikunthapur Tarun Sangha (BTS) came forth to provide solar lanterns to the day-scholars and installed solar panels for lighting the school building and hostel. A solar pump was also provided to pump and store water overhead for the existing toilets. Additionally, 10 latrines and two urinals were built and equipped with lights and running water, through technical expertise from Geetanjali Solar. Currently, the students use a water filter, which runs on solar power, with the help of an inverter.

BTS also runs a private, government-aided free primary school at Baikunthapur which has digitised its premises using solar power. This school, which was started in 1980 in a thatched cottage belonging to the current Assistant Secretary- Haradhan Sahu, is now housed in a two-storey building put up with funds from an NGO,

Asha for Education, and the Irish Embassy. Solar power enables BTS to run computers on its school premises, as also the lights and fans here.

Since healthcare is negligible in these parts, BTS set up a maternity healthcare facility with funds from the Irish Embassy. Fully equipped with operation theatres, beds, testing equipment and ambulances, the facility uses running water and lights with help of solar power. Unfortunately, since all medical equipments run on AC power, no operations can be performed. Only children delivered normally can be catered to here; along with the occasional medical camp.

Even as government agencies demur on electrifying the remotest corners of India, Melinda Foundation has been using micro-grids to electrify India's Maoist-affected interiors and the remote islands of the Indian Sundarbans. Keen to bring electricity into the homes of the bottom 20 per cent Indians, Melinda Foundation has gone on to create group accounts and hence, secure loans for electrifying every home through solar power. The homes are electrified through decentralised micro-grid, and can use the power generated for three light bulbs and a plug point to charge their mobiles. 'They can use DC fans, but cannot run ceiling fans using the micro-grid,' explains Colonel Vijay Bhaskar of Melinda Foundation. In the initial years, Melinda retains an engineer at the site to train a villager for maintenance purposes, after which, 'the community maintains it'. Similarly, 65 microgrids in the tribal districts of East Singhbhum, Gumla, and Simdega of Jharkhand have managed to light up several homes. In hilly Purulia in West Bengal, 18 villages have been lit up using microgrids catering to clusters of 10 homes or so.

Melinda also uses larger grids catering to 2500 families to help in agricultural tasks. "For this, we give a pre-paid meter, and own the grids. The instalments are paid in 10 years, as per a long-term plan. The larger grids are meant for irrigation pumps, and threshing. 'Since water needs to be pumped for the Rabi crop only October onwards, the excess power generated can be used when idle.' Larger grids, though, are meant for the comparatively better-off, 'when farmers reach a certain level of well-being'.

However, running microgrids is tough, Col Bhaskar concedes. "We need to maintain a

warehouse on every island, and keep distilled water available for the batteries."

Lack of transport infrastructure makes most rural areas of West Bengal impossible to travel to. The Sundarbans is particularly difficult to travel to, notwithstanding their proximity to Kolkata. Not only are the islands tough to travel to, even parts contiguous to the mainland take at least 5 hours to reach. The only means of communication here are the van-rickshaws, which are made of a plank of wood, fixed on a rickshaw. Most often, the rickshaw is powered by an engine which uses a mixture of naptha, used engine oil and kerosene. The resulting mixture spews toxic fumes which are a major source of pollution. Herein, using solar-powered vehicles can prove a boon for transport, even as do away with the pollution caused by the rickety van-rickshaws. A recent pilot project by Melinda Foundation, along with the Ministry of New & Renewable Energy to replace 3000 van rickshaws proved immensely popular.

Onergy, a business venture modelled in the manner of a social enterprise, has concentrated on arranging microfinance through banks and other institutions for people in backward regions. It has not only managed to get rural homes –especially in the poverty-stricken Sundarbans, lit up with solar power, but managed to help farmers in agriculturally-rich districts in West Bengal with solar-powered cold storage facilities for their crops. Of late, students in rural areas are also getting familiar with computers at district knowledge centres which are powered by solar energy.

Along the Jharkhand – Odisha border, forest villages along the Dalma hills would be plunged into darkness immediately after dusk. The difficult terrain, and dense forests had kept them deprived of the advantages of the power grid. This is where solar power has made a difference. In Sidmakudar village, solar power now lights up the village thoroughfare, and homes are lit up with solar power. Biogas made out of animal waste has also made cooking easier for the women, who no longer have to suffer from indoor air pollution.

Wind Power

Wind power is another huge success story, especially in Karnataka and Tamil Nadu, where miles

of wind-farms dot the rural landscape, and produce enough power in a decentralised power to be fed into the power grid.

In high altitude regions such as Himachal Pradesh, people have to grope in the dark during winter if there is heavy snowfall, in spite of regular power connectivity. However, in these high altitudes, the skies remain bright and clear all through the year, and a steady wind is generally guaranteed. Hybrid solar –cum-wind power systems have proved a boon in these high altitude villages, which, as and when disruptions occur in the regular power supply, switch over to renewable energy.

Other Renewable Sources of Energy

Wind and solar power may be better known sources of renewable power; but there are several other sources that should not be lost sight of. In a primarily agricultural country like India, agricultural waste can prove an important source of energy. Rice husk and biomass have proven to be useful sources of renewable energy.

Recent focus on bio-methanation from organic – and particularly animal waste is a welcome step in this regard. Methane is major greenhouse gas that is emitted from landfills and animal waste. Methane is a major cause of global warming when it escapes into the atmosphere. Treating organic and animal waste to generate electricity can not only help bring down greenhouse emissions, but help meet our energy needs in a green, sustainable manner.

In Tamil Nadu, sewage from public toilets built under the Swacch Bharat programme is being used for bio-methanation. The fuel so yielded is used for cooking, while the leftover slurry is used as fertiliser.

Suitability of Small Hydro, Biofuels and Biogas

There was some interest generated in the past on small hydro projects. But here, it should be pointed out, hydro projects-whether small or big-can never be reliable in an era of climate change. Years of drought and erratic rain have left nearly all reservoirs empty; in such a scenario, hardly any hydropower can be generated.

Wind energy too, is fine if generated on a small scale. But when wind farms are set up on large



tracts of land, those who part with land can never be happy. Especially since, in rural India, land spells livelihood. Those displaced from their lands are deprived of their livelihoods, identity and homes.

Biofuels too come with a rider. When biofuel is derived from molasses and sugarcane bagasse, which are by-products of the sugar manufacturing process in industry, it entails increasing the acreage under sugarcane cultivation. Sugarcane being a water-guzzling crop which feeds on large amounts of groundwater, is already suspect in these times of climate change and water scarcity. Hence, it is hardly wise to fall back on biofuels as a source of energy for the nation. The planting of *Jatropha* on wastelands has also been challenged by many activists, since it entails depriving communities of the village commons, which are often used by communities to grow vegetables, greens and the like.

This leaves us with only biogas derived from bio-methanation of organic waste as an alternative, reliable source of energy, besides solar power.

An Important Post-script

In all this, one must never forget that India can never become self-sufficient in energy unless new and efficient technologies are adopted. New, clean technologies today have ensured that coal-driven power is no longer as polluting as old, polluting coal-fired plants which need to be replaced by newer, cleaner ones; in the same manner that power-guzzling electronic goods ought to be phased out for efficient BEE certified models.

(Author is a senior journalist and writes on environment and climatic issues)



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WASTE TO ENERGY: SOME TECHNICAL SOLUTIONS

Dr. K. Baby

Every year, about 55 million ton of municipal solid waste (MSW) and 38 billion liters of sewage are generated in the urban areas of India. In addition, large quantities of solid and liquid wastes are generated by industries. Waste generation in India is expected to increase rapidly in the future. As more people migrate to urban areas and as incomes increase, consumption levels are likely to rise, as are rates of waste generation. It is estimated that the amount of waste generated in India will increase at a per capita rate of approximately 1-1.33 per cent annually. This has significant impacts on the amount of land that is and will be needed for disposal, economic costs of collecting and transporting waste, and the environmental consequences of increased MSW generation levels.

India is a rapidly growing economy which needs energy to meet its growth objectives in a sustainable manner. The Indian economy faces significant challenges in terms of meeting its energy needs in the coming decade. The increasing energy requirements coupled with a slower than expected increase in domestic fuel production has meant that the extent of imports in energy mix is growing rapidly. India is among the top five Green-house-gas (GHG) emitters globally. According to the Union Budget, India is projected to be the fastest growing large economy globally with an expected real GDP growth rate of 7.4 per cent. This economic growth and rising population have strained the limited ability of resources to generate consumptive outputs and sustain life-supporting functions. Another implication of this economic growth is the increasing use of energy in the country. Coal continues to remain the dominant fuel in the total energy production with

a share of 65 per cent. The situation of energy access in India needs much attention. India's electrification rate is reported to be at 75 per cent, which indicates that one-fourth of the population still lacks access to electricity. Also about 815 million people rely on traditional biomass for cooking, which is approximately 66 per cent of India's total population. Human development is considered the principal reason as well as the result of sustainable development. India's growing energy deficit is making the central and state governments become keen on alternative and renewable energy sources. Waste to energy is one of these, and it is garnering increasing attention from both the central and state governments.

Renewable Energy

Renewable energy in India comes under the purview of the Ministry of New and Renewable Energy. India was the first country in the world to set

up a ministry of non-conventional energy resources, in early 1980s. India's cumulative grid interactive or grid tied renewable energy capacity (excluding large hydro) has reached 33.8 GW, of which 66 per cent comes from wind, while solar PV contributed nearly 4.59 per cent along with biomass and small hydro power of the renewable energy installed capacity in India.

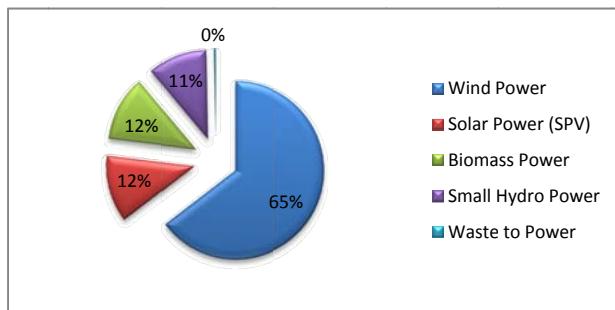


Waste to Energy

Total Renewable Energy Installed Capacity in India (2015)

Source	Total Installed Capacity (MW)
Wind Power	24,759.32
Solar Power (SPV)	4,684.74
Biomass Power (Biomass & Gasification and Bagasse Cogeneration)	4,550.55
Small Hydro Power	4,161.90
Waste to Power	127.08
Total	38,283.59

Source: Ministry of New and Renewable Energy 2015



Waste to Energy

Every year, about 55 million tonnes of municipal solid waste (MSW) and 38 billion liters of sewage are generated in the urban areas of India. In addition, large quantities of solid and liquid wastes are generated by industries. Waste generation in India is expected to increase rapidly in the future. As more people migrate to urban areas and as incomes increase, consumption levels are likely to rise, as are rates of waste generation. It is estimated that the amount of waste generated in India will increase at a per capita rate of approximately 1-1.33 per cent annually. This has significant impacts on the amount of land that is and will be needed for disposal, economic costs of collecting and transporting waste, and the environmental consequences of increased MSW generation levels. India has had a long involvement with anaerobic digestion and biogas technologies. Waste water treatment plants in the country have been established which produce renewable energy from sewage gas; however there is significant untapped potential. Also, wastes from the distillery sector are on some sites converted into biogas to run in a gas engine to generate onsite power.

Importance of Waste to Energy

Most wastes that are generated, find their way into land and water bodies without proper treatment, causing severe water pollution. They also emit greenhouse gases like methane and carbon dioxide, and add to air pollution. Any organic waste from urban and rural areas and industries is a resource due to its ability to get degraded, resulting in energy generation. The problems caused by solid and liquid wastes can be significantly mitigated through the adoption of environment-friendly waste-to-energy technologies that will allow treatment and processing of wastes before their disposal. These measures would reduce the quantity of wastes, generate a substantial quantity of energy from them, and greatly reduce environmental pollution.

Types of Waste

Waste can be broadly classified into

- Urban Waste
- Industrial waste
- Biomass Waste
- Biomedical waste

Energy from Waste- Technologies

Energy can be recovered from the organic fraction of waste (biodegradable as well as non-biodegradable) through thermal, thermo-chemical, biochemical and electrochemical methods.

- (i) **Thermal Conversion:** The process involves thermal degradation of waste under high temperature. In this complete oxidation of the waste occurs under high temperature. **The major technological option under this category is incineration.** But incineration has been losing attention these days because of its emission characteristics.
- (ii) **Thermo-chemical conversion:** This process entails high temperature driven decomposition of organic matter to produce either heat energy or fuel oil or gas. They are useful for wastes containing high percentage of organic non-biodegradable matter and low moisture content. **The main technological options under this category include Pyrolysis and Gasification.** The products of these processes (producer gas, exhaust gases etc) can be used purely as heat energy or further processed chemically, to produce a range of end products.

(iii) **Bio-chemical conversion:** This process is based on enzymatic decomposition of organic matter by microbial action to produce methane gas, and alcohol etc. This process, on the other hand, is preferred for wastes having high percentage of organic, bio-degradable (putrescible) matter and high level of moisture/ water content, which aids microbial activity. **The major technological options under this category are anaerobic digestion (bio-methanation) and fermentation.**

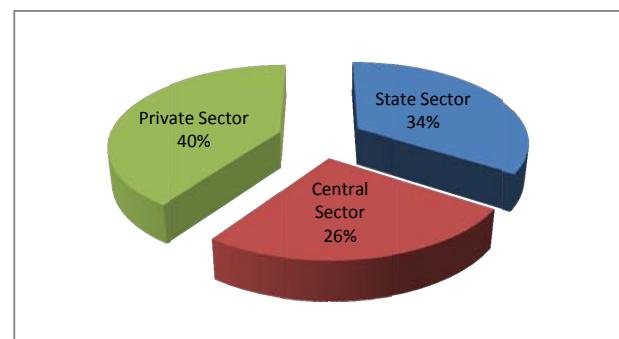
(iv) **Electrochemical conversion:** Electrochemical conversion in the context of waste to energy refers typically to microbial fuel cells (MFC). These systems are developed to trap the energy from wastes, where the reduction-oxidation machinery of immobilized microbial cells is catalytically exploited, for the accelerated transfer of electrons from organic wastes, to generate electricity and bio-hydrogen gas

Electricity Generation Performance

The electricity generation target for the year 2015-2016 was fixed as 1137.5 Billion Unit (BU). i.e. growth of around 8.47 per cent over actual generation of 1048.673 for the previous year (2014-2015). The generation during (2014-15) was 1048.673 BU as compared to 967.150 BU generated during April- March 2014, representing a growth of about 8.43 per cent.

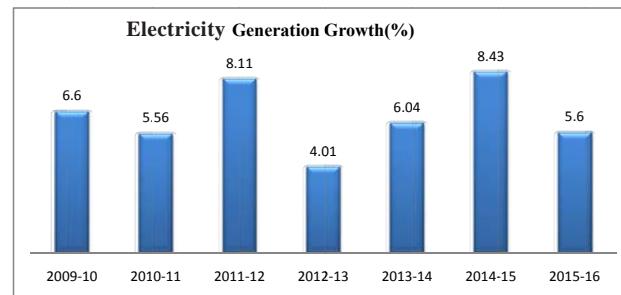
Why Waste to Energy

Most wastes that are generated find their way into land and water bodies without proper treatment, causing severe water and air pollution. The problems caused by solid and liquid wastes can be significantly mitigated through the adoption of environment-friendly waste to energy technologies that will allow treatment and processing of wastes before their disposal. The environmental benefits



of waste to energy, as an alternative to disposing of waste in landfills, are clear and compelling. Waste to energy generates clean, reliable energy from a renewable fuel source, thus reducing dependence on fossil fuels, the combustion of which is a major contributor to GHG emissions. These measures would reduce the quantity of wastes, generate a substantial quantity of energy from them, and greatly reduce pollution of water and air, thereby offering a number of social and economic benefits that cannot easily be quantified. In addition to energy generation, waste-to-energy can fetch significant monetary benefits. Some of the strategic and financial benefits from waste-to-energy business are:

- **Profitability** - If the right technology is employed with optimal processes and all components of waste are used to derive value, waste to energy could be a profitable business. When government incentives are factored in, the attractiveness of the business increases further.
- **Government Incentives** - The government of India already provides significant incentives for waste to energy projects, in the form of capital subsidies and feed in tariffs. With concerns on climate change, waste management and sanitation on the increase (result of this increasing concern is the newly formed ministry exclusively for Drinking Water and Sanitation), the government incentives for this sector is only set to increase in future.
- **Related Opportunities** - Success in municipal solid waste management could lead to opportunities in other waste such as sewage waste, industrial waste and hazardous waste. Depending on the technology/route used for energy recovery, eco-friendly and “green” co-products such as charcoal, compost, nutrient rich digestate (a fertiliser) or bio-oil can be obtained. These co-product opportunities will enable the enterprise to expand into these related products, demand for which are increasing all the time.



- **Emerging Opportunities** - With distributed waste management and waste to energy becoming important priorities, opportunities exist for companies to provide support services like turnkey solutions. In addition, waste to energy opportunities exist not just in India but all over the world. Thus, there could be significant international expansion possibilities for Indian companies, especially expansion into other Asian countries.

Current Waste-to-Energy Installed Capacity

Grid-Interactive Power	(Capacities In MW)	Contribution (per cent)
Waste to Power		
Urban	20.20	27.4
Industrial	53.46	72.6
Total	73.66	100
Waste to Energy		
Urban	3.50	4.6
Industrial	72.30	95.4
Total	75.8	100

Source: MNRE, 2015

Major Constraints Faced by the Indian Waste to Energy Sector

The growth of this sector has been affected on account of the following limitations:

- Waste-to-Energy is still a new concept in the country.
- Most of the proven and commercial technologies in respect of urban wastes are required to be imported.
- The costs of the projects especially based on biomethanation technology are high as critical equipment for a project is required to be imported.
- In view of low level of compliance of MSW Rules 2000 by the Municipal Corporations/ Urban Local Bodies, segregated municipal solid waste is generally not available at the plant site, which may lead to non-availability of waste-to-energy plants.
- Lack of financial resources with Municipal Corporations/Urban Local Bodies.
- Lack of conducive policy guidelines from State Governments in respect of allotment of land, supply of garbage and power purchase / evacuation facilities.

Indian Government Support for Waste to Energy

The Indian Government has recognised waste to energy as a renewable technology and supports it through various subsidies and incentives. The Ministry of New and Renewable Energy (MNRE) is actively promoting all the technology options available for energy recovery from urban and industrial wastes. MNRE is also promoting the research on waste to energy by providing financial support for R&D projects on cost sharing basis in accordance with the R&D Policy of the MNRE. In addition to that, MNRE also provides financial support for projects involving applied R&D and studies on resource assessment, technology up-gradation and performance evaluation. A number of key statistics, such as the value of recyclables, the amount of environmental pollution from waste sources, and the quantity of industrial waste generated, need to be computed to gain a better understanding of this sector. In terms of research related to waste to energy, detailed analysis of costs and available funding is needed. **Solid Waste Management (SWM) is a crucial component of Swachch Bharat Mission.** In a significant step towards generating power from garbage under the Swachch Bharat Mission, six waste-to-energy plants with installed capacity of about 74 MW will be commissioned next year including two in the national capital.

Conclusion

A clear trend observed during India's recent waste crisis is that the outbreak of epidemics and public protests around happening in the biggest cities of their respective regions. When looking at converging factors such as improving public health, the scale of the problem and the time at hand, there is no confusion about WtE being the solution. Waste to energy (WtE) is expected to be a major option for many Indian cities. While self-reporting and regulating emissions is a must, WtE will become the right choice for India when it becomes more inclusive with increased public understanding.

(Author is Asst. Professor Department of Economics Govt. College, Chittur, Kerala)

RURAL WATER NEEDS: CHALLENGES AND NEO-TRADITIONAL SOLUTIONS

Rudresh Kumar Sugam

India receives an average annual rainfall of around 1100 mm, but there is a huge regional and temporal variation in the distribution of rainfall. The country receives more than 80 per cent of the rainfall within June to September. The unequal spatial distribution could be easily observed by the fact that the Brahmaputra and Barak basin, with only 7.3 per cent of the geographical area and 4.2 per cent of the country's population, have 31 per cent of the annual water resources. Further the utilisable water resources are only 28 per cent (1123 Billion Cubic Meter) of the total available water resources in India (4000 BCM).

The per capita water storage in India is quite low (209 m^3), as compared to countries such as Australia (3223 m^3) and USA (2192 m^3). The other form of water storage structures is comparatively small and dispersed, both natural and manmade, such as lakes, ponds, tanks etc. Due to extreme pressure of urbanisation related pollution, increasing land costs and dependence on centralised systems, these water bodies are in abysmal state in India.

Groundwater (GW) which is currently the lifeline of India, supports more than 60 per cent irrigation and 85 per cent drinking water requirements in rural areas, is depleting at an unprecedented rate. Overall, India in real sense is mining groundwater and is way ahead, in terms of total groundwater withdrawal, of various countries.

Poor water quality limits the usability and has detrimental impact on health. Currently, as per a CPCB report of 2014, 302 river stretches on 275 rivers (out of 445 rivers being monitored) across the country have got polluted due to discharge of both municipal and industrial waste water over the years. As stated earlier the wetlands and traditional water bodies are in abysmal state, in Meerut district of Uttar Pradesh 50 per cent of the ponds studied by CEEW had dissolved oxygen concentration below 5mg/l and 93 per cent had turbidity value beyond recommended levels, both a matter of serious

concern. GW quality is also suffering due to pollution and natural factors, majorly high concentration of arsenic and fluoride is limiting use of GW at several places in India.

Estimated Demands

If we see sector-wise consumption of water, currently irrigation consumes more than 80 per cent of the total water resources in India. Moreover, with increasing demand from other sectors the water stress would further aggravate (see figure 2 below).

Vulnerable Agriculture Sector - Climate Change - Frequent droughts and high intensity floods are adding to the complications

Findings of the fifth assessment report of the IPCC says that human influence has been the dominant cause of the observed warming since the mid-20th century. Asian region as a whole experienced the climate-related disasters in the world and suffered the second highest proportion (almost 30 per cent) of total global economic losses. Researchers at Stanford University analysed 60 years (1951-2011) of Indian Monsoonal trends. They found, through a comprehensive statistical analysis of precipitation, that: (i) peak-season precipitation has decreased over the core monsoon region and daily-scale precipitation variability has increased; (ii) frequency of dry spells and the intensity of wet spells has increased; (iii) 1981-2011 had more than twice as many years with three or more dry spells as compared to 1951-1980, and the dry spell frequency shows an increase by 27 per cent.

All these findings are supportive of increased flood and drought incidences that we are already observing in India. A data released by Central Water Commission in April, 2016 shows that this year most of the reservoirs have lower levels than the last 10 years average.

Rural Water and Sanitation Sector

Rural regions in India, which primarily have agricultural and domestic water requirements,

suffer from many challenges such as lack of water supply infrastructure, inadequate sanitation facilities, insufficient irrigation facilities etc.

Only 18 per cent, and that is restricted to few States only, of the rural households in India receive treated water supply. However, more than half of the households rely on GW sources and many of these households face negative health impacts due to poor GW quality. Status of sanitation is even worse as nearly 70 per cent of the households have no latrine facility, leading to high scale open defecation.

Traditional Water Solutions

Historically, communities in India managed water and had their unique mechanism of fighting climate extremes. Due to different topography and agro-climatic conditions, various regions in India had different structures to utilise and conserve water. Broadly, these practices could be classified into following three categories:

Obstructing/diverting the flow of stream/river: In this practice the natural flow of the stream/river is obstructed and water is stored by using gully bunds/check dams/gabion structures etc. Prominently built in hilly regions, these structures in addition to water conservation and groundwater recharge, also act as soil trap.

Storage in wells/step wells/below ground level storage structure: Mainly used to meet domestic water requirements, such structures could be found in western arid regions of India. The step-wells traps rainwater and because of no direct exposure to sunlight and surface temperatures it reduces evaporation losses. These were treated as auspicious at temples in Gujarat and Rajasthan.

Collection and use of rainwater on surface: Commonly found across India, these structures are constructed in the flow of seasonal stream or the excess runoff is diverted into this. Some examples of such structures include *nadis*, *kundis*, *talabs*, *jaldhar*, *farm ponds* etc. The bottom of surface is generally pervious but it could be made impervious using plastic sheets to prevent GW recharge.

In addition to construction of these structures, community were involved in regular maintenance

work thus ensuring longevity of water bodies, without any government/external support.

Modern Technologies

Traditional systems cannot be neglected as they have advanced after centuries of trial and error on field. That said, definitely there is a necessity to modify some of the practices such as flood irrigation, tilling etc. which are not resources efficient. Also, with advancement in technologies better options are available.

Agriculture Water Solutions

Modern agriculture practices such as use of chemical fertilisers, tractors, pesticides, High Yielding Varieties (HYVs) etc., evolved as a solution to low productivity and for meeting higher food demands. These interventions radically increased the production levels but had negative consequences as well. The way out is to rectify the mistakes and come up with integrated and innovative solutions. Some of the water efficient practices have been briefly discussed below:

Micro Irrigation Systems - Micro irrigation systems such as drip, sprinkler etc., have high water saving potential. For example, drip irrigation provides an irrigation efficiency of more than 90 per cent, whereas the current irrigation efficiency in India is in the range of 50 per cent -70 per cent. It also promises to enhance yield and reduce fertiliser use thus saving input cost and increasing income at the same time.

Laser Land Levelling - Laser levelling is a precision land levelling technique, it smoothes the land surface (± 2 cm) using laser equipped drag buckets. The benefits it brings are: smoother soil surface, reduced water and time requirements for irrigation, improved uniformity in water distribution and reduction in fertiliser inputs. However, it has high input costs and requires regular fields.

Conservation Agriculture – The principles of Conservation Agriculture are minimum disturbance to the soil (through tillage); maintain permanent organic cover on the soil; and adopt diversified cropping/ agro forestry systems. It promises to reduce water for irrigation by improving soil moisture and water intake rate. It also reduces run off and erosion, decreases pollution, and enhances groundwater recharge.

Understanding of Soil Moisture - One could save huge quantity of water and energy by knowing when and how much water is required by a crop. Use of tensiometers (typically a sealed, water-filled tube with a ceramic porous cup and a vacuum gauge at the top) could be really helpful in providing estimates of soil moisture.

System of Crop Intensification (SCI)/ Alternative Wetting and Drying (AWD) – Innovative cropping practices such as SCI is yielding good results on ground. It has been tested on rice which is the major crop of India. SCI involves changes in the way soil, water and nutrients are managed. It achieves these benefits by reducing competition amongst crop by providing them sufficient space, use of organic fertilisers and AWD instead of flood irrigation.

Access to Energy – Rural regions in several states in India have sufficient water but do not have access to energy which limits the access to water. While government is working on connecting every village with electric supply, solar powered pumps could be used in such places to meet the irrigation water needs.

Domestic Water Solutions

In addition to water harvesting, water quality testing and infrastructure development for water supply would be necessary initiatives to provide clean, safe and affordable water to rural households. The choice of treatment technologies would be largely determined by the quality of raw water and nature of demand. A few of the water treatment technologies/methods are discussed below:

Slow sand filters (SSF) – SSF is one of the most recommended method of water treatment for rural areas. If designed properly, it purifies the water efficiently by reducing turbidity and bacterial contamination and it does not require high skilled labour for operation and maintenance.

Chlorination – Disinfection using chlorine has been a common practice in various water supply systems. Being a strong oxidant, chlorine is used to remove taste and odour, as well as biological contamination. It can be used for community water supply system as well as at the individual household level.

Solar Disinfection (SODIS) - The SODIS method utilises solar energy for water disinfection at household level. A clean and transparent PET plastic bottle (preferably below two litres) is filled with water and kept in direct sunlight for six hours during noon on sunny days and two days if the sky is more than 50 per cent clouded. It has no chemical and external energy requirements thus making it an affordable choice. As reported, it removes 99.9 per cent of micro-organisms. The major limitations are that the raw water should not have turbidity more than 30 NTU and there is sufficient sunlight available.

Integrated Solutions

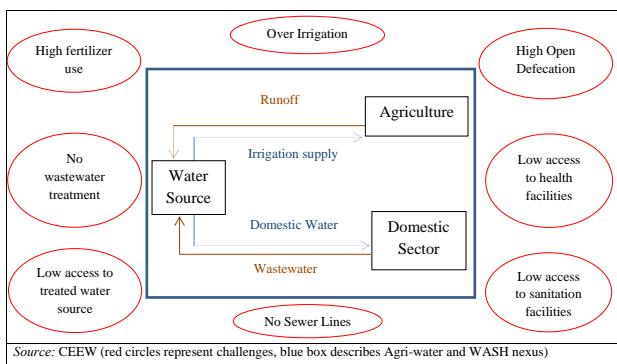
Agriculture and domestic water needs are met by same/different water sources and runoff from such uses pollutes these water sources. Also, sanitation related water pollution is very high. **Figure 4** highlights the nexus between agriculture and the domestic sector in an Indian rural set up. Therefore, an integrated solution is required for managing water, waste water, sanitation and agriculture water. Treatment and reuse of wastewater would be essential to meet the increasing water demands and reduce water related health diseases.

Current Government Programmes/Mission addressing rural water needs:

Following are the major Indian government schemes which could be leveraged to alleviate the water problems in rural areas:

- 1) National Rural Drinking Water Programme (NRDWP) (2009) – Ministry of Drinking Water and Sanitation (MoDWS)
- 2) National Rural Drinking Water Quality Monitoring & Surveillance Programme (NRDWQM&S) (2005) - MoDWS,
- 3) Jalmanai(2008) - MoDWS
- 4) Swachh Bharat Mission (Gramin) (2014) – MoDWS
- 5) Provision of Urban Amenities in Rural Areas (PURA) (2003) -Ministry of Rural Development (MoRD)
- 6) National Rurban Mission (NRuM) (2015) –
- 7) Pradhan Mantri Krishi Sinchai Yojna (PMKSY) (2015) – Ministry of Agriculture and Farmer Welfare

Figure 4: Agri-water and WASH Nexus in a Typical Indian Rural set-up



- 8) National Project on Aquifer Management (NAQUIM) – Ministry of Water Resources
- 9) Integrated Watershed Management Programme (IWMP) (2009) – Ministry of Land Resources

Policy Recommendations

Different States in India face completely different water related challenges and thus “one size fits all” approach would not be applicable. Major policy reforms in regard to rural water management are discussed below:

- i) **Better Data:** The first and foremost step is to develop better data, on water quality and quantity, and a robust hydrological information system for developing precise information about the resource availability and planning accordingly.
- ii) **Basin/Sub-basin Level Water Management** – As advocated by experts and also being realised by the people working on ground, integrated water resources management is only possible at a larger scale as the resources supply and use are interconnected. Several basins are inter-State thus it would require the riparian States to come to a consensus, which is a complex process and would take time. Therefore, water management at sub-basin level should be initiated.
- iii) **Water Source Improvement:** Currently, as per a CPCB report 2014, 302 river stretches on 275 rivers across the country have got polluted due to discharge of both municipal and industrial waste water over the years. Also, the ground water quantity and quality is degrading at unprecedented rate which needs an immediate response.

iv) **Open Defecation Free** – Open defecation related water contamination is high and it has other negative health impacts as well. Therefore, sanitation management would be a crucial element of achieving water security.

v) **Supply and Access Augmentation:** On the supply side, wastewater reuse and recycling and rain water harvesting should be encouraged across the country without further delay. On the access front, households and farms with poor access to water should be targeted on priority. The government should also look into decentralised solutions for topographies which are difficult to be connected to centralised systems.

vi) **Demand Side Management:** Water use efficiency across sectors is poor in India as compared to available best practices. Government will have to come up with innovative policies, incentives and subsidies, for increased adoption of water efficient practices in the agriculture sector.

vii) **Capacity Building:** Capacity building of institutions involved in water resources management would encourage informed decisions. It would also trigger more interactions between such institutions, which is currently not so frequent.

viii) **Institutional and Legislative Reforms:** Water is segregated amongst so many institutions that the accountability is difficult to be defined. There is no umbrella agency that controls the governance of the water sector. We would definitely need such bodies as well as better legislations for controlling ground water extraction and pollution.

ix) **Revival of Traditional Wisdom:** The first and most important initiative to preserve traditional knowledge is the documentation of traditional customs and practices. It is essential to acknowledge and recognise the knowledge and contribution of indigenous communities. None of the suggested interventions could work without collective effort. Thus, collective effort should be directed towards reviving traditional systems by making people understand the long term benefits and the necessity of their participation.

(Author is Senior Programme Lead, Council on Energy, Environment and Water, New Delhi)

TECH INNOVATIONS: CHANGING INDIAN AGRI SECTOR

Dibakar Lenka

The share of agriculture and allied sector in Gross Domestic Product (GDP) was 51.9 per cent in 1950-51. It has come down to 13.7 per cent in recent years. That contribution is quite low for a sector that employs about 50 per cent of the country's population. We also need to make better use of scarce factors of production such as land, light and logistics for an increasingly urban population.

Present farming and agricultural operations are far different from those few decades ago. This is because of advancement in science and technology. Sensor systems, appropriate devices, machines, and information technology has changed the face of farming and status of farmers. Now the progressive farmers routinely use sophisticated technologies such as temperature and moisture sensors, aerial images, GPS technology and robots. These advanced devices and precision agriculture has made the agriculture a business. Besides earning profit, efficiency, safety, and environment issues are taken care of.

The share of agriculture and allied sector in Gross Domestic Product (GDP) was 51.9 per cent in 1950-51. It has come down to 13.7 per cent in recent years. That contribution is quite low for a sector that employs about 50 per cent of the country's population. However, this is mainly due to the farmers' inability to generate sufficient income from their farming and meet their debt obligations. The use of innovations in the field of agriculture science and its adoption by quick motivation will definitely change and break the vicious circle of poverty of farmers.

Importance of Agricultural Technology

The challenges of growing enough food to feed the growing population have built huge pressure in the century. We have to arrange food for 1.25 billion people with limited agricultural land and resources. We also need to make better use of scarce factors of production such as land, light and logistics for an increasingly urban population. We also need to ensure zero-waste and low-energy technologies for sustainable and less harmful effect to the environment.

Action taken

In the Budget 2016-17, Rs 412 crore has been allocated for organic farming, Rs 850 crore for animal husbandry, cattle and livestock breeding and Rs 35,984 crore has been allocated for farm sector developments, excluding research and development grant to agricultural universities. Dedicated efforts of scientists and engineers have contributed a lot and are intensely working to make their "lab to land" program successful for use of technical innovations in farms for national interest.

Lot of innovations visible in this area:

- a) Innovation of agricultural devices, sensors, and systems
- b) Applied researches have been made to deploy technologies economically and with minimal disruption for convenient and quick adoption by farmer community.
- c) Assistance for use of new technologies

Consequently, farmers no longer have to apply water, fertilizers, and pesticides across entire fields manually. Instead, they can use the optimum quantities required and target specific areas. Even an individual plant can be treated differently.

Besides, robotic technologies enable reliable monitoring and management of air, water quality and other factors of production. It also gives producers an excellent opportunity of control over plant and animal production, processing, distribution, and storage

In turn the producers, consumers and economy will be benefited:

1. Increase in productivity in turn keeps food prices down

2. Decline in use of water, fertilizer, and pesticides, so that cost pushed inflation can be reined
3. Reduced adverse impact on environment
4. Increased worker safety

Robotic technology with artificial intelligence benefits the farmers for:

1. Greater efficiencies and lower prices
2. Safer growing conditions and safer foods
3. Reduced environmental and ecological impact

Benefits of Technology to Small and Marginal Farmers

More than 85 per cent of farmers are classified as small and marginal group. They operate in 44.5 per cent of cultivable area with average holding size of 0.9 ha. Most of these farms are family-owned. Such farmers are confronted with considerable challenges, such as increased movement of young mass into cities, an aging population in rural, farm fragmentation, and changing weather patterns.

Family and small farms are vital to our economy. Not only do they support the competitiveness and sustainability of rural and farm economies, they serve to:

1. Protect and enhance natural resources and the environment
2. Provide a ground for the development of new activities and create market.
3. Maintain rural populations and prevent urban migration

In particular, focus for those segments should be more of motivational and result base for adoption of alternative advance technologies:

1. Increase confidence, production, and profits for small farm communities
2. Develop new and improved practices to reduce production costs
3. Establish research and demonstration plots to adopt technologies and best practices for real field use.
4. Ensure that all farmers have equal access to development programs and services

5. Ensure that farmers are knowledgeable about:
 - a) Planning for entire holding
 - b) Planning for crop selection, rotation, mixed cropping and mixed farming
 - c) Risk management by adopting mixed farming
 - d) Market demand opportunities for better return.

Organic Agriculture

Organic farmers, livestock owners, and food processors use agricultural methods intended to preserve the environment. Government restricts the use of certain conventional inputs such as synthetic fertilizers and pesticides. The organic sector is one of the fastest growing agricultural segments. Organic farming benefits by preserving soil health.

Organic farming involves practices that:

- 1) Maintain and improve fertility, biodiversity, and reduce soil erosion
- 2) Reduce the risks of environmental, human and livestock damage.
- 3) Fine-tune farm practices of local conditions and meet the requirement of local market.

Government support in this field includes:

- 1) Facilitating development of organic production, breeding, and processing methods
- 2) Evaluating potential economic benefits to producers and processors
- 3) Exploring international trade opportunities for organically grown and processed products
- 4) Determining distinct quality of organic commodities
- 5) Identifying marketing and policy framing for expansion of organic agriculture

Startups came up for farmers with innovative adoptable solutions.

Vertical Farming is an adoptable solution where land resource is very scarce and rampant urbanization puts a threat to land availability for agriculture. In this technique critical elements of farming such as temperature, light and heat are regulated. Plants of different depth of root

zone and shoot zone (canopy management) are efficiently managed in a single patch of land. Vertical Farming is promising because it requires displaceable soil, and can save space and energy—and improve crop yield. It takes advantage of the vertical space rather than turning over expanded land. Advanced greenhouse technology for hydroponics or aeroponics crops can be raised by environmental control that regulates temperature, humidity and light. Vegetables, fruits and other crops can be grown throughout the year. This technique can also be utilised for urban agriculture and roof top cultivation.



Skymet is one of the largest weather monitoring and agricultural risks solutions company of the country. They measure, predict, and minimize climate risk to agriculture, thereby limiting losses incurred due to weather abrasions. This website forecast weather information, suggests for crop insurance and related risk management. Weather forecast can help farmers for preparing against possible hazards to farming and help them to take befitting preventive measures. They claim to be accurate in their prediction.

Frontal Rain Technologies is accessible through computer and mobile devices. It is useful for firms dealing in commodities like groceries, basmati rice, seeds, cattle feed, sea food, dairy products and edible oil. The website creates a scope for demand and supply of agricultural products on the cloud. Rain+ solution helps companies at different stages of the value chain, starting from sowing, growing, processing, logistics, wholesale and retail trade and exports.

Digital Green is a non-profit making international development organization. The company focuses on imparting training to the farmers through the method of '**seeing is believing**'. The company prepares and exhibits short videos where they record problems and achievements, share different ways of solutions and highlight

success stories as community group engagement to improve lives of rural masses.

This technology shows the rural masses through videos, the way of behavioral changes by bringing together researchers, development practitioners, and rural communities. They are imparted with the value of preservation and protection of environment for healthy life.

Agrostar provides genuine agricultural inputs to the farmers at their doorstep. It is a Pune-based m-commerce platform, directly linked to the farmers. AgroStar helps farmers to procure agricultural inputs such as seeds, plant nutrition, plant protection and agriculture equipments by simply giving a missed call on the company's toll free number, 1800 or through their mobile app to prevent hardship of unavailability of products. Substandard and spurious agricultural inputs can be easily avoided.

Ekgaoon Technologies is an IT based network integrator. It provides a technology platform to the farmers with provision of range of services. They provide financial counseling, guide for agricultural input availabilities and provision of government assistance etc. They have mobile banking platform for delivery of financial services. It also provides information and counseling of credit, savings, remittance, insurance, investment and mortgage etc at the door step and information regarding microfinance institutions available in the locality. They also provide local language base agriculture advisory services to the mobile users through

interactive voice response system (IVRS). They also provide web based information on weather, market, price, soil health management etc.

Biochar based organic Soil Amendment Technology (BIOSAT) is a technology base solution to soil additive and amendment. It is made off of different organic nutrients. The product restores soil fertility, reduces carbon emissions, maintains the health of topsoil and increases productivity. This reduces the use of chemical fertilizers. It ensures enhanced productivity with optimum use of resources.

Besides being expensive, the use of toxic pesticides for control of pests contaminates water bodies meant for use of human and animals. Scientists have developed environment-friendly plant protection methods after much research on products. It supports organic farming with minimum expenditure. This is pheromone base pest control method which is quite popular now a day. This pest control traps have artificially synthesized smell attractant that attracts and traps harmful pests. Before eating the crops, the pests are trapped and are killed. This is a sticky sheet, known as **Barrix** (hormone base pest control trap). It uses bright yellow and blue colored recyclable sheets of wavelengths between 500 nm to 600 nm. At least 19 high-risk pests are trapped and are killed.

MITRA (Machines, Information, Technology, Resources for Agriculture), is a set up, aims to improve mechanization at horticulture farms with the use of highly effective farm equipments. These are created through Research and Development and launched after rigorous field trials. They have developed Air blast sprayers. It is very useful for fruits and vegetables crops. It is also effectively utilized for grapes and pomegranates. The sprayers are used to spray hormones that help the growth of crops. It considerable reduces the expenditure on manual labour and is less time-consuming.

CropIn Technology Solutions offers information on a cloud-based platform through mobile base application. It is known as 'Smart Farms'. It allows companies to track status of the crops around the country. It helps companies to

remotely monitor farms, interact with farmers and make every crop traceable and visible. It also helps farmers in adopting advance farm practices and improves productivity by providing high yield methods and productivity forecasts. This technology solutions startup invented by a software engineer, it provides smart and safe food supply for consumers around the world by considering agriculture as a business.

Eruvaka Technology is a unique way to measure and control water health. Poor knowledge of water health sometime put the fish farmers in a great loss due to rampant and mass death of fishes and damage of aquaculture produces. An organization of Andhra Pradesh encourages farmers in a mission mode for use of this technology in aquaculture for control of water health to save farmers from big risk

It is solar-powered floating equipment that measures oxygen level, temperature and pH range of water and suggests conduciveness of aquaculture and possible remedies. This is very crucial for the growth and survival of fishes. The information collected by the equipment are uploaded on the cloud and transmitted to individual farmers through mobile app, SMS, tele-call or the internet. Farmers can rectify the water body by remotely controlled equipment such as aerators and feeders.

Conclusion

It is high time for us to rethink the role of knowledge, science and technology in achieving equitable and sustainable development in rural sector. The focus must be on the needs of small and marginal farmers who are of great need for the same. This means improving rural livelihoods, empowering farm communities with weapons of technologies for sustainable natural resources, enhancing multiple benefits provided by ecosystems, considering biodiversity, and providing fair market access for farm products along with availability of factors of agricultural production are essential emerging needs of present time.

(Author is Chief Manager, Union Bank of India and faculty at Staff Training Centre, Bhubaneswar)

TECHNOLOGY FOR INFORMATION AND MARKETING NEEDS OF RURAL INDIA

Dr. Shri Nath Sahai

Throughout the third world, technologically improved form of communication is the need of the hour, for social, economic and political development. Focusing on the prevailing 'communication gap', the UNESCO and UNICEF also emphasized on this subject, to help rural development.

In India, the continuous and constant flow of information, through modern technology, to rural masses is the sine qua non for lifting up their life and living; as also their social status.

Presently, large part of rural India is in worrisome condition. About 30 per cent families are landless and nearly 51 percent work as daily-wage-labour. The economic condition of people here is so low that 75 per cent families are bound to manage their living within five thousand rupees per month.

When crops fails with poor rains, number of people engaged on farms get reduced, which eventually brings down the wages too. The increase of wages as one-off measure, in crisis year, proves only a temporary relief.

Infrastructure for health is deficient in villages e.g. for malnutrition, sanitation, drinking water.

Data Explosion: We are living today, in the Information Age. More and more information has been reaching us than in the past. The amount of information that is added to the internet in a month today, compares equal to the stack of the Library of Congress of US – the largest library of the world.

Thus, technology has since made sweeping presence, affecting our life and living. It has infact, bestowed an opportunity to achieve economic and social betterment; if properly harnessed.

Digitalization of India: The government announced its keen resolve to its functioning by increasing use of digital technology with the motto of minimum government, maximum governance.

But challenges to it are many – huge amount of investments are needed to connect every Indians

to internet. Issues like call drops, poor network, net neutrality, privacy and infrastructure, investments from the private sector have to be addressed.

India's Aadhar Programme has a leeway to mitigate any leakage that occurs in the supply system and commercial transactions. Today this Aadhar, is a model for many countries. The digital technology has undoubtedly great potentials for transformation of all sections of society in India.

Tackling the problems: The commanding and ascending connectivity that technology gives, facilitates our reach nationally and globally. In this age of globalization, such facility is of a prime help to acquire new knowledge and initiative to strengthen economic and social enterprises; especially in rural context, where villages are still short of such information for sake of their agricultural farming, cultivation, water harvesting, micro-irrigation, proper and useful manuring and overall protecting their land-health with unknown extra exploitation.

More we gain electronic access to the Information and Communication Technology (ICT) and that goes down to the villages, more we are empowered to achieve our target of inclusive growth. It helps our rural people to fulfill their wants and desires and ensure eventually, better life and living.

e-Governance: The aim of e-Governance under the National e-Governance Programme is reaching out to villages in the shortest time, with minimum cost and maximum transparency. The whole domain of work culture is changed; eliminating the entity of the middle man.

In Uttar Pradesh, number of rural programmes, have been brought under e-Governance ambit which makes the public services available at the threshhold of the village. Such centres are called *Suvidha Kendras*. Here important documents, land records of villages etc. are made available, supplied with great ease and in a transparent manner.

Making villages prosperous : Villages were very close to Mahatma Gandhi's heart. Gandhi Ji

said - India lives in villages. That, India can prosper only when our villages grow, progress and become prosperous. To empower the rural India, all the villages of the country should be connected with broadband .

China has done it : China has transformed its villages through rural e-commerce programme. It has created Taobao villages. Taobao village is an assemblage, group of rural e-tailers. Here, certain village households, may be around 10 to 15 per cent, join together and engage themselves to work in e-commerce. They set-up online shops. Starting from 20 such villages in 2013 to 211 in 2014, their number has been increasing continuously, covering more than 70,000 rural producers of the villages.

Chinese e-commerce villages manufacture goods of urban interests as well. This increases the output of the village industries.

Dongfeng, the first Taobao village in china, started manufacturing low cost furniture, with the help of cheap local timber and cheap labour available in the area. Its production being quite competitive, cost-wise, received huge supply orders within short span of time. Another Taobao village that started with the 'bread making' soon became a specialised company for gear manufacturing and sleeping bags. This company reached the annual sale of over 8 million dollars, outdoing the other brands in the field. Thus e-commerce has renewed and reconstructed the villages in China.

India can draw a leaf from China, since our villages have limited production, infrastructure is lacking and the purchasing power is low here. We can start with small target. Like China, we too have the benefits of possessing cheap rural labour, which would make the production cost lower and competitive. This exercise requires, of course, a well-knit marketing network and a better financial running and management. The connectivity, easy linkage with industrial villages – transportable roads and adequate electrification, are the prerequisites.

Right back from Gandhian era, India has always claimed to give credit to the village industry (but with little real care). The Khadi and Village Industries Commission (KVIC) was set up to manage *Khadi Gramodhyog* shops and market its products through the state-wide networking. Being planned and executed through Government agencies, the results

have not been encouraging, despite Government subsidies made available. On the other hand, small village-work like preparation of *Lijjat papad*, started with small base, transformed into industry, as it is executed, managed and run by village women groups. Swaminathans Anklesaria Aiyar says "The ethos of KVIC is Gandhian, not commercial."

Rural artisans, currently engaged in their traditional occupation and trade do not get full price of their produce, items and often fail to meet even the production cost, less said about the profits and benefits. Middlemen's system need be eliminated to link the producer with consumer and to provide the benefits direct to both.

State of agriculture in India is not encouraging. Nearly 65 per cent of the village is engaged in farming. But this sector, so high in number, contributes to merely 15 per cent of the GDP. And this contribution is getting reduced gradually. This shows how grievous is the condition of our *kisans* (farmers). To amend and ameliorate conditions of the farmers, Government has introduced 'Kisan Channel and Portal' to apprise and abreast them of the various programmes and development of their interest currently introduced, the e-banking, as also present trend of the market, pricing of various products and the oncoming climatic conditions. They are informed about the modern agricultural techniques for better irrigation, tubewell, harvesting, health care and credit facilities. People living in villages need to develop their full capacity to interact and interplay with the huge and widespread environment and the great resources lying before them (provided by Nature), to reshape and enrich themselves. To this end, media, in its various forms like Radio, Television, Computer and print, can be of great help to provide information.

Skill India Mission: In India, just 2.2 per cent persons of age group 15 to 59 years received formal vocational training against 8.6 per cent of this group that received non-formal vocational training. This means, about 90 per cent persons did not receive any kind of vocational training here.

Passing down the hereditary skills, self and on-the-job-learning, are still very common in village community. This, in fact, produces here the skilled work-force, even more than the training institutions. Driving and motor-mechanic training are found more

preferred by 22.3 per cent males. And about 32.2 percent rural males take to textile work. There is dire need to make the work force in India technically skilled in their respective areas of vocations and occupations.

Nearly 25 crore people are engaged in work in different areas in India and about 1.2 crore people add to it every year. As such there is a need to skill about 31 crore people in the next five years here. While the degrees granted by Engineering colleges are not of much help to securing the jobs, only 12-month course of intensive training and skill development, prove to be of greater help for self-employment or working in organisation. The present Government of India has embarked on an ambitious target of imparting vocational skills to 42 crore workers, drawn mostly from villages, by 2022. The target is praiseworthy, though challenging.

The young generation of the villages is largely looking for job outside, maybe civil jobs in Government and private sectors, leaving out its traditional occupation. This situation has resulted in creating a big army of unemployed youths in the villages. Solution lies in creating small-scale rural industries, to do the low-cost manufacturing. And these industries should be given access to proper roads and electricity. The rural *Hathakartha Udyog* (Handloom industry) and such textile units, house construction provide much jobs. Several village institutions are being reconstructed today, to lend their proper support and services to the rural India. Village Panchayats, patterned on the grandiose idea of Gandhi Ji as a system to liberate the rural masses, are being strengthened and reinforced to address the village-issues properly.

Libraries as Information Hub: To disseminate information and the relevant documents to villagers, a network of libraries is being set up, in *Chaupal* premises. These libraries also help the neo-literates maintaining their post-literacy by reading newspapers and drawing interesting books, literature and other reading materials from these libraries.

With the spread of adult literacy, the base of Rural Press (newspapers) is increasing. Newspaper, besides giving information, takes up the cause of the village at the right door.

So, the mass media fit into the National Communication Policy for transmission of



information and educational and cultural messages. They carry message from Government to people and people to Government – the two-way-participation. Prime Minister's current programme, *Man Ki Baat* speaking live on AIR, is an apt application of the two-way awareness and understanding of the masses. The two-way understanding is non-elitist concept that helps reaching out even to the unheard, downtrodden ones - the poor, illiterates yet possessing valuable knowledge and wisdom to offer, one can learn from. Gandhi Ji himself did this everyday. He created "low-cost mass communication system with mass participation." The AIR makes it, by reaching out the largest audience living in far-flung, remote places.

Apperance of New Gadgets: Technology has since made inroads in the lives of villagers. This is transforming the rural India; bringing in radical changes in life and the living-style. Their demands and daily needs are getting altered drastically. Also, people are strengthening their economic-base, eventually raising their social status. The socio-economic gap between the city and village is slowly receding- 'Maharaja marriages' are being performed, celebrated in the villages also (though very less in number,) where the bride-groom lands by helicopter in the village, for his marriage. As such, the very face of the Indian village is changing now with the use of newly arrived gadgets in the market.

However, with all said above (development of villages), there exists still considerable section of rural population that is yet groaning in poverty, living in deplorable state of wants and have-nots; and looking for help and care for upliftment, all-along. Technology is certainly helping in reaching them.

(Author is an academic and writes in national and International Journals)

SCIENCE AND TECHNOLOGY EDUCATION IN RURAL INDIA

JP Pandey

Science and Technology (S&T) has changed the whole spectrum of modern life. Implications can be observed in every walk of our day to day life. There is necessity of harnessing Science and Technology in transforming Rural India. Though its importance had long been recognised and that too as early as 1935, when **Gandhi ji initiated a movement called "Science for People"** at the all India Village Industries Association.

During the post-Independence scenario, Rural India was marginalised by the main stream scientific and technological establishment. Basically, need of higher and middle class was catered but large chunk of folks were left to sojourn from the path of scientific and technological development. It is said that India lives in villages. Around 70 per cent of population still lives in villages. Advanced institutions of Education turned their attention to this area in the 1970s. The most well-known of these efforts was from the Indian Institute of Science with its programme for the application of Science and Technology in the rural areas known by its acronym ASTRA (Application of Science and Technology in Rural Areas). ASTRA, recently renamed as Centre for Sustainable Technologies was based on a model of science-technology interactions in a 'dual society' like India with affluent few elites amidst a large economically deprived majority, living primarily in rural areas. The model showed that *inter-alia* an extension centre and a mission-oriented programme would be required to develop technologies to address the normally ignored needs of the rural population. Science and Technology Policy also envisages it as an economic perspective. Technological progress is crucial determinant of economic growth, which is vital for the welfare of people of Rural India.

The Information and Communication Technologies also played an important role in Rural Development. The Empowerment of rural communities is crucial for the development of the rural region. Bringing the people of the rural region to the mainstream of the digital technologies and enable them to access and adopt modern technologies is a major concern now. Rural Development implies both, the economic development of the people and greater social transformation using electronic

governance (e-Governance). To provide rural people with better prospects and opportunities for economic and agricultural development along with marketing management, increased participation of rural people in usage and adoption of information and communication technologies (ICTs) is envisaged. Information related to commodity prices, transportation, agricultural practices, weathers, etc, are crucial to farmers. Information and communication technology can provide such information easily and instantaneously, benefitting the farmers.

Significance

If India has to transform into a developed nation, growth of Rural India has to be put on track through the use of Science and Technology. As 58 per cent of the workforce and nearly 70 per cent of population continue to depend on agriculture and allied sectors, there is an immense opportunity of growth in this area. Food grain production increased from about 45 million tonne in 1951–52 to over 252 million tonne in 2014–15. Productivity of major cereals increased from 700 kg per hectare in 1961–62 to over 2981 kg per hectare by 2014–15. There is still scope of improvement of per hectare production in the country as it is less than per hectare production of developed countries. The revolutions in agriculture, health and education witnessed during the last century were mostly the products of public research supported by government and philanthropic institutions. Progress in production with regard to crops, milk, eggs and fish, improvement in health status, growth in access to electric power and drinking water for India's rural population over the post-Independence period is the result of the proactive role played by the State in promoting research and development. This research has contributed the technologies crucial for a breakthrough in production and promotion of people's access to basic facilities.

Present Situation

The presence of Science and Technology in rural area is noticeable. Farmers and artisan are using the S&T in every sphere but education, awareness and research need to be proliferated more. Only few

percentage of farmers avail the facility of soil testing. Use of fertilizers, pesticides is also not done as per the prescribed norms and standards. Krishi channels and help-line numbers have been introduced to enhance the awareness but extensive efforts need to be done. Scientific temperament needs to be infused. Farmers and artisans use Science and Technology in their activities but many a time it is not in proper way. Research and Development (R&D) work and budget are not up to the mark. In India, only 0.82 per cent of GDP was allotted for R&D in 2011-12, however, in USA 2.77 per cent and in China 1.79 per cent of GDP were allotted for R&D during the same period.

Efforts to Promote the Use of S&T

The Government is continuously making efforts to promote the use of Science and Technology in Rural India. Present NDA regime has started Skill India movement, which basically aims for providing Skill education to youth. Skill can be enhanced by use of science and technology. The Labs under the Council of Scientific & Industrial Research (CSIR) System especially Response Rate Limiting (RRL) network are established for developing technologies for rural application i.e. to meet technological needs of rural production and function. The specialised Labs, like Central Leather Research Institute (CLRI), Central Glass and Ceramic Research Institute (CGCRI) deal with the need of rural or semi-rural producers. The Technology Development Research and Training Centres under KVIC (Khadi and Village Industries Commission) and State Khadi Board and Institutions such as the Indian Institute for Handloom Technology are primarily in rural non-farm sector and rural industries under household, tiny and small sector are engaged in the value addition activities.

District Industries Centres (DICS) were set up to provide financial and technological support including training and to coordinate their activities with KVIB (Khadi and Village Industries Board) and State Small Scale Industries Corporations. However, success has been limited because of lack of concerted efforts. Indian Council of Agricultural Research (ICAR) has developed a national grid comprising 46 Institutes including four deemed universities, four National bureaus, 81 All India Coordinated Research Projects (AICRP), 31 State Agricultural Universities and Central Agricultural university at Imphal.

The university system in States set up with support from UGC and the State governments is also equipped with the capacity for basic, applied and

adaptive research. Every State has a departmental network for each development activity, basically geared to motivate and assist 'the stakeholders' to adopt technology innovations, processes and practices of various types. Various schemes are launched by Centre and State governments based on strong technological contents. Introduction of innovation in areas such as housing, have been done so far, however, more and more research will improve the tools, techniques and facilities for the betterment in the respective fields. Non-Governmental Organisations (NGOs) are also playing pivotal role in this regards.

Challenges

There are numerous challenges before accentuating the use of S&T in Rural India.

1. Various agencies are involved in R&D work but the cost of maintaining this technology transfer is very high.
2. Awareness level is very poor, which needs to be increased through regular campaigns and training programmes. Mobile phones, Televisions and social networking sites can be instrumental in spreading the awareness.
3. The crux of the problem is that it had worked like this only in respect of some technologies and produced isolated pockets of success i.e. green and white revolution in some parts of the country. Green revolution yielded results in States like Punjab not in eastern UP and Bihar similarly, white revolution was a mega success in Gujarat, not in many other States. Due to lack of creative synergy at cutting edge level, Rural India has not been able to reap the full benefits of S&T it deserves.
4. Due to lack of linkage with industries, the S&T work in Rural India is badly affected. Even Tenth Plan documented that "lack of linkage with industry has resulted in R&D being largely academic in nature with very few applications; commercialisation and patenting.
5. Lack of integration of S&T system in developmental activities and no S&T based planning and distributions of responsibility amongst nodal implementing agencies are the major challenges.

Solution

Considering the challenges for implementing the S&T for Rural India, following measures can be taken:

1. Centrally funded Agencies like the District Rural Development Agencies (DRDA) set up in every District for carrying out poverty alleviation programme should be provided with S&T back up to look into the technology aspects of developmental and anti-poverty programmes. It should identify technology gaps and make appropriate choice or even to draw up an R&D proposal as per their needs.
2. A partnership should be forged with S&T institutions and civil society to assess the need and popularise the usage of S&T in various rural economic activities
3. IT means should be used to increase the awareness and disseminate the information regarding the benefits of S&T in promoting rural areas as economic activities centres.
4. Need based R&D work should be promoted. As in Uttrakhand, research for eco-system balancing, preventing wild fire, innovation in wood craft and water conservation should be promoted, however, in Punjab food processing and cold chain storage related innovations are required to be taken in bigger way. The objective is to technologically empower the communities to assess their problems and participate in the process of making ‘choice of technologies’ in the specific areas. For this, consultative Group of Local Science and Technological institutions comprising concerned departmental officials and Science and Technology capable NGOs may be formed. One of the S&T institutions may be selected as the nodal agency. In line with the concept of Mother NGO, a lead Science and technology NGO may be selected to take up various functions.
5. Conduct a survey of S&T needs and gaps, sector wise, especially non-farm sector and identify areas for entrepreneurship development.
6. Select field NGOs who could be trained and supported to develop competency in S&T intervention and to act as incubators for enterprise growth. Arrange training for NGO partners in project activities in the area.
7. Scientific Departments and the autonomy granted to the Departments and Institutions like the existing coordination arrangements at the central level have their own rationale and are not amenable to change. At the State level, the Science and Technology Council should be

restructured to function as the Science and Technology Advisory Group (STAG) responsible for integrating Science and Technology inputs from all S&T institutions located in the State by making them ‘partners in development. In smaller States, STAG may be constituted for the Region with appropriate changes. STAG will be formed on a partnership mode to cover all sectors and identify technologies developed already for dissemination and prioritise research work with emphasis on problems ‘emerging’ from the field.

10. There are many entrepreneurs and researchers doing technological advancements of tools and processes at local levels. Efforts should be made to identify such innovations and to make them commercially viable. Local science and technical institutions should be asked to take up such projects in co-ordination with the experts from field.

Demands (backed by purchasing power) must be distinguished from wants (defined by human needs). In a “dual society” such as India, with few affluent elites amidst a large economically deprived majority living primarily in rural areas, the technology development system ignores the wants of the rural masses because they are not backed by purchasing power and emphasises the demands of those (elite) sections of society that have the purchasing power. The first step in the development of technology for the underprivileged rural masses consists, therefore, of the identification of their felt needs. This identification is best done, not from a remote/ alien environment, but through direct contact and “learning from the people”. The felt needs, thus identified, must then be translated into technical challenges. These technical challenges must excite technical personnel and motivate them to come up with solutions that are appropriate in the rural context.

Science and Technology has the power to bring about the changes in Rural India. Thus, harnessing S&T is the key to transform Rural India as a growth engine through improvement of livelihood, employment generation, environment prediction and ecological security. As a basis of socio- economic development, it may be enhanced at all levels. Today, we need concerted efforts to device user-friendly S&T solution for transforming Rural India.

(Author is IRPS Officer, Principal Oak Grove School, Jharipani, Mussoorie)

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EFFECTS OF SCIENCE AND TECHNOLOGY ON RURAL SOCIETY

Sunil Kumar, Neeraja

Humans and technology go hand in hand. They are inseparable twins. Since the dawn of human inception, since Darwin's chimpanzees, both have been travelling together. From the cave dwelling *Homo-sapiens* (primitive man) of yesterdays to the present day sophisticated space dwelling *Robo-sapiens* (tech-supported humans), the technology always stood by them.

The other side of the truth is that many a times the same technology turned from boon to bane. Fire, which made the life easy and saved humans from the wild animals, engulfed their huts and burned many a cities. In this article we would discuss these varied effects of technology on rural society in India.

Agriculture

The farmer feeds the society. He/she has grown grains for the mankind with his/her plough and bullocks and depended on the mercy of rain gods for centuries. But now he has embraced the tractor and cultivator instead of plough and bullocks. He has developed the irrigation system. This has increased production of foodgrains from 45 million tonnes in 1951-52 to 252 million tonnes by 2001-02. Infamous Bengal famine of 1940s had then become the part of tragic folksongs in India but not anymore.

The use of technology in agriculture has also resulted in the cultivation of genetic crops which can grow fast and they can be resistant to many pests and diseases. But GM cotton is also blamed for large number of farm suicides in Vidarbha region of Maharashtra thus wreaking many families.

Culture

Prolonged habits of a community are its culture. Human beings develop some habits out of their needs or compulsions of their physical environment. In due course, they become rituals and customs of that particular society and soon take the shape of their culture. Irony is that the same society feels helpless after few hundred years to change those habits created by their ancestors. Whether out of inertia or fear, they are unable to change or add new habits which are no more of any relevance or

importance for the society. They become taboos and rigid laws.

But the science and technology has helped loosen this cultural rigidity. Printing press made books affordable and available to the villagers. This ushered in new ideas. Advent of print and electronic media further broadened the world view of the rural people. Due to newspapers, radio, television and internet, the old and diehard taboos are fading away and the society is once again becoming open and liberal. The effect of sorcery and witch craft has reduced. Earlier many diseases were seen as the impact of ghosts and ancestral anger and people, instead of going to a doctor, were often cheated by some lunatic *sadhus*, who brainwashed them and claimed to cure with some celestial powers.

Internet and television has also affected the dressing sense of the people in rural communities. Dress of a person is one of the most visible signs of his culture. Traditionally, every region of India has had its own unique dress depending on climatic and historical factors. But in today's internet connected world and online marketing, dressing sense all over India is overwhelmingly influenced by western fashion. Now jeans and T-shirts have become universal and traditional dresses are mainly kept for special occasions such as marriages or festivals.

Also, because of industrialization youth are migrating to cities, leaving behind the old parents lonely. Old age homes are on rise. Care and respect towards senior citizens have declined. Nuclear families have increased and joint family system is breaking down causing the emotional backlash resulting in suicides, depression, drug abuse etc.

Cast

The main thing that caused oppression of *dalits* for millennia was – land. In villages, farming land has been the sole source of livelihood and production. But distribution of this land has been uneven with *dalits* almost left out. With no land, *dalit* communities had no option but to work as labourer for land owning communities. That is how their exploitation became

institutionalised and permanent. But the progress in science and technology brought industrialisation. With their millions of jobs, industries provided an alternative source of livelihood. This gave *dalits* much needed option to break free from the subjugation of land owning casts as the village landlord is no more their sole 'bread giver'. Now they can go and work in a factory. For factory owner, cast is immaterial. For him skill and productivity of the worker matters the most. Thus industries have provided much needed equalizer among the casts. This has reflected into improved socio-economic conditions of *dalit* communities. Thus technology has demolished the monopoly of the few.

Another aspect of castism in India was that *dalits* were forced into manual scavenging. Law was made against it but still the practice continued. Now technology has offered the solution by way of sanitary latrines and waste management technologies thus eliminating the need of manual scavenging.

Women Empowerment

Woman is born equal but opposite to men. But history made woman slave and weak (*abla*). For centuries she lived in a state of oppression and negligence. She was kidnapped, raped, butchered during the wars and conflicts. Society gave her low status than her cousin man. Her birth was seen inauspicious in the family. She was killed in the womb or after birth silently. After marriage, she was just on the mercy of her husband and in-laws.

If we think about the origin of this inequality then we zero in around one factor – man's superior muscle power. It appears that due to his physical strength, primitive man was in a better position than woman in hunting wild animals and fighting the rival tribes. This some way or other gave rise to male supremacy in primitive society which was further accentuated by various social norms in later periods. But today technology has made man's superior physical strength redundant. Machines have empowered women to do any arduous work with ease. But entrenched social prejudices and biases remain. Again here, technology is helping break these stereotypes by bringing new ideas through TV, cinema, and social media. In a way we can say that women empowerment that we are witnessing today would not have been possible in the absence of certain technological breakthroughs.

Today, inter caste marriage and love marriages are on rise constructing a very new cosmopolitan society. Practice of '*sati*' is abolished and the medieval traditions such as veil and dowry are being challenged everyday on the media platforms.

Transportation

Earlier connectivity was the biggest issue for villagers. Their mode of transportation were slow bullock carts, mules or boats. *Kuchcha* roads would become unusable in rainy season. Technology has improved this. Now villages are well connected by roads and rail lines. It has provided mobility for people and goods and thus has spurred economic activity there. The tiresome journeys of miles on foot or by bullock-carts to meet their relatives and procuring and selling their crops in the towns have become the things of past. Now cycles, tractors, bikes are the norm of the day.

But this fast transport has impacted rural social life in other ways too. Earlier a guest would come and stay for days. There were some particular occasions when some particular guest would arrive e.g. a son-in-law will visit his in-laws in rainy month of *saavan* on *Rakshabandhan*. There, he would stay for some days and interact with villagers and other visiting son-in-laws. Thus his social contacts would be established far and wide. These interactions were a great way of socialising in earlier times. But in today's fast world, a son-in-law will hardly go to his wife's place on *Rakshabandhan*, and there too, he would hardly stay for a day or two. Thus old social processes of rural society are giving way to tech driven socialising processes which are significantly different from old ones and often lack a personal touch.

Communication

The greatest visible impact of technology on villages, in recent times, has been on the communication system. Electronic media like radio, television, internet and social media have improved the information flow to rural society. These media can be used to persuade, entertain and inform the society. Cinema and TV serials have inspired the women for equal participation in the male dominant activities like sports, literature, driving etc. Earlier, every village in India had its own unique identity. Its residents identified themselves with their village. Reputation or disreputation of the prospective

groom's village used to be an important factor in the decision making of a girl's father. But, communication and transportation technology is rapidly fading the unique and distinct identity of Indian villages. Now these villages appear more of a homogenous entity with much similarity.

At individual level, communication has empowered the common villager by being his/her voice but it has also taken toll on his peaceful and leisure life with the inflow of mobiles and internet. Social media has helped village communities connect with outer world. This has benefitted them in many ways but socially it is throwing up many challenges. The technology, that was designed to bridge distances and facilitate communication, is ironically creating distances. In villages, the youth are turning into prisoners of Facebook wall and WhatsApp chats. They have hardly any time for their actual friends and families face to face, but are crazy for their perhaps un-existing virtual friends. Four members of a family may be sitting in one room but all may be busy with their own mobiles not bothering about each other. Empathy and sympathy are replaced by selfies and Facebook likes. Instead of helping an accident victim, recording video in mobile and uploading instantly, has become more important.

Education

Science and technology has improved education and learning process. Visual education, by way of using computers and projectors, has proved to be a better method of teaching and learning. So government is promoting the use of ICT (Information & Communication Technology) tools in education. Online courses have opened boundaries for so many in the rural areas.

Through technology, Indian education is spreading far and wide but at the same time, we can see a moral degradation in our education system. The much revered **Guru-Shishya** (teacher-pupil) tradition has been replaced by **client-tutor** trend. Though, more than technology, it has increased commercialisation of education that is responsible for this state of affairs. But technology has been an enabler in this. Second problem created by technology is information overload. Today's children know much more than what their parents knew at that age. This causes issues in upbringing and understanding between different generations.

Health

Greatest misery of people in old times used to be untimely deaths of family members due to various reasons. With the advancement of medical science most of the fatal diseases have been either cured or contained. Medical facilities in rural areas have improved significantly, though they still lack far behind compared to urban areas. Further technological innovations like telemedicine would significantly bridge this gap in near future. This has overall positive impact on the health of rural people, increasing their life expectancy.

Thus, the technology has reduced the tragedies and lessened the pain. But it has had its side effects on the health as well. Over dependency on the machines and vehicles has turned the strong and stout villagers into the easy living fellows. They are no more known for their figures and physique. While the grandmothers used to get up early in the morning and did the entire household chores, today the females sleep till late and depend on technology for everything- be it churning of milk or fetching the water. Hence, Life style diseases like hypertension, depression, obesity, diabetes are no more limited to urban centers but affecting rural masses on a large scale.

Environment

Traditional Indian life is closely related to nature. One reason is that rural economy is still predominantly dependent on agriculture which in turn depends on monsoon and good weather. That is why Indian festivals, songs, rituals are associated with nature in some way or other.

But with the advent of new technologies to clean the forests, dam the rivers, hunt the animals...., a commercial and consumerist approach towards nature has been gaining ground. This has prompted unmindful exploitation of the natural resources causing pollution, environmental degradation and ever increasing man-animal conflicts.

With this analysis, it can be concluded that science and technology has made an impact on human beings. It has been the best friend of human-being through the history when used wisely, but turned the worst foe whenever misused.

(Authors write on social and environmental issues)



OPERATION MALYUDDH – REALISING THE DREAM OF ODF HARDA

Harda is a district in Madhya Pradesh in central India which has come up with many innovations to promote sanitation.

Literally meaning ‘war against impurity’, Operation *Malyuddh* started off as an experiment to engage communities and create an Open Defecation Free (ODF) environment in villages by shifting the onus to people of the village. Gradually, it turned into a more institutionalised campaign involving every possible stakeholder and making them change agents in the behaviour change process. A monotonous act of toilet construction metamorphosed into an interesting and evolving campaign with several innovations, some of which are listed below:

- Branding the campaign with a name, logo, theme song and local brand ambassadors.
- Training of motivators, hired by a unique three-step elimination process of group discussion, interview and a physical fitness-cum-punctuality test; selection was based not on educational qualification but on discipline, perseverance and communication skills
- Motivators hired on a result oriented incentive system (Rs.15000/- per Gram Panchayat and 250/- per day) where the result is attainment of ODF status and not the number of toilets, thereby totally avoiding financial risk. Sustainability is taken care of by making provisions of top-up after six months (Rs.5000/-) and one year (Rs.5000/-) of ODF status attainment. The per-day honorarium was restricted to 90 days (optimal follow up duration, according to research).
- Each resident of the District is a stakeholder to the behaviour-change drive; so more than 4000 people were oriented in an in-house triggering module; all those triggered, like religious leaders, caste and community association leaders, health, revenue, cooperative, dairy and ICDS workers, judiciary, police and forest officials, held power in various capacities to trigger large sub-groups.
- Bar association announced concession in advocate fees to clients from ODF villages. Doctors advocated the use of toilets in the medical prescription of their patients. Private school owners started counseling sessions for encouraging their students’ parents to own a toilet in their home for better attendance of their kids. Cooperative societies that distribute food grains through fair-price shops started advising their customers to own toilets first and then come to collect their month’s ration. Religious leaders started propagating the importance of ODF in their sermons.
- An affidavit was signed by all government and semi-government employees that they would use toilets and were informed of the various sections under which Open Defecation is a crime under existing legal statutes. *Yoga Day*, *Teachers Day*, *Students Day*, *Diwali*, *Rakshabandhan*, *Senior Citizens’ Day*, *Women’s Day*, *Children’s Day*, *Drug Addiction Eradication Day*, *Gandhi Jayanti*, *Independence Day* and *Republic Day* were all given the ‘cleanliness’ angle to spread the message of ODF Harda and *Malyuddh*.
- All types of technical options in toilet construction like pre-cast RCC, in-situ cast block, traditional brick, fly-ash, advanced air fried blocks, etc. were encouraged and no single model was emphasised upon. All possible toilet models were displayed in a Wat-San (Water and Sanitation) Park in the *Zila Parishad* office.
- ‘Cluster Attack’ and ‘Zero Days’ were organised for large-scale toilet construction to provide all villages with the needed number of toilets in a limited span of time.
- ‘Diaspora’, a social networking website and ‘Sendspace’, a file sharing website were used to obtain payment sheets in MS-Excel format



from *Gram Panchayats* and ensure timely release of payments to constructed toilets.

- ODF attainment was celebrated by the villagers during 'Swachhta Utsav' when they took a 'Walk of Pride' to visit the now-clean ex-open defecation spots of their village, rewarded the vigilance team members, honoured the new-toilet owners, burnt the symbol and vestige of Open Defecation from the village in a 'Lota Jalao' (Lota - water holder for open defecation) and ended with a signature campaign and unveiling the cleanliness rules of the village including the penal provisions and sanctions against any future defaulters.
- In order to encourage self-constructed toilets rather than panchayat-built toilets, a *Bhai Number One* campaign was launched on the occasion of *Rakshabandhan* festival, which rewarded more than 500 brothers who safeguarded their sisters by gifting them a toilet before tying a '*Rakhi*'. It also encouraged them to share a 'Selfie with Sister' in front of their newly constructed toilet; the Honourable

Prime Minister of India mentioned this initiative in his monthly address to the Nation – *Mann ki Baat*

- To promote sustainability, upon request of the District administration, *Sahayog Private Dairy* has been procuring milk from ODF villages at 25 paise extra per litre under the 'Holy-cow-incentive-scheme' because in ODF villages, the cattle are not in contact with open human faeces.
- ODF Olympics were organised at Village, Block and District level to encourage and reward the villagers and volunteers from ODF villages only. More than 1100 participants of age groups 10 to 60+ participated in 20 categories of events such as *Kabaddi*, *Kho-Kho*, three-legged race, sack race, slow cycle race, sit-up and push-up counts, etc. The fun and frolic was missed by non-ODF villagers. Even National and State level players from non-ODF villages were disqualified from participation in ODF Olympics
- 'Swachh Kitchen-Sundar Kitchen' (Clean Kitchen-Beautiful Kitchen) competition is being organised among kitchen sheds of Self-Help Groups, which are engaged in preparing Mid-Day –Meals in schools situated in ODF villages.
- 'Raddi se Samriddhi' (Waste to Wealth) programme was an experiment to make soft toys stuffed with sanitised shredded non-biodegradable waste like plastic bags, wrappers, etc; More than 35 women were trained in the trade. 'Kooda se kalakriti' (Trash to Art) exhibition-cum-sales is an opportunity for school and college students and artisans to display the various showpieces and arts made out of waste products which can become a source of livelihood.

(Courtesy: Ministry of Drinking Water & Sanitation)

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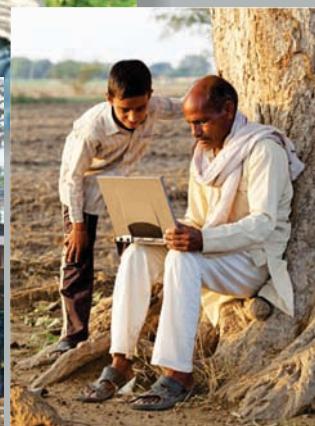
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