Renewables: Energizing Rural India

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FARMERS' FORUM

Vol. 17; No. 02; April-May 2017 ₹100 www.farmersforum.in

Issues and Ideas for Indian Agriculture

TIME TO REBOOT THE FARM SECTOR

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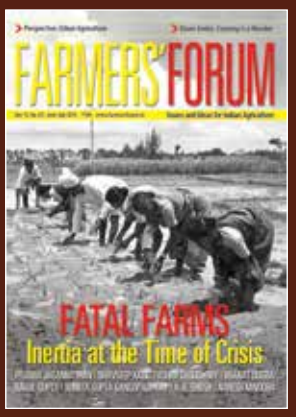

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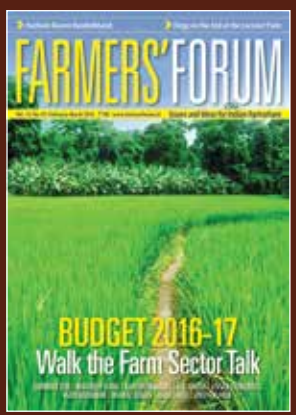

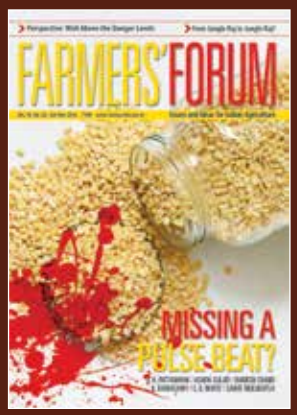

Volume 17; No. 01;
April-May 2017
RNI No. DELENG/2001/5526

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© PealiDezine
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Owner
Bharat Krishak Samaj

Published at
Bharat Krishak Samaj,
A-1, Nizamuddin West,
New Delhi 110013

Printed at
3A Graphics, 305, Durga Chambers,
1333, D.B. Gupta Road, Karol Bagh,
New Delhi 110 005

Cover Photo
Pixabay

Fertilizing Farm Sector Woes

Agnotology is the name of the game. Stanford historian Robert Proctor coined this remarkable term to describe a state of affairs where ignorance is so deliberately and effectively induced into discourse that indisputable facts do not win arguments. This is how the hapless Indian farmer feels about the government strategy with fertilizer subsidy.

The goings on in the fertilizer industry are reminiscent of the classic tobacco industry response to the cancer-causing charges – that were levelled against it since 1954 – with the current "Direct Benefit Transfer of Fertilizer Subsidy" plot. This is being piloted on the specious plea that it will generate point of sale farmer traceability, stop leakages and ensure timely payments to the industry.

An excellent notion but this is hardly illustrative of what obtains in real life, where DBT emerges as a mechanism to transfer benefits exclusively to the industry. Realizing the enormous opportunity in fertilizer DBT, such large international fertilizer companies as Yara International have started to buy Indian urea plants to get a toehold into the lucrative market.

The fertilizer subsidy DBT pilot project in 17 districts is a well planned deception; like the proverbial Trojan horse, ushered into the countryside to secure the farmer's buy in. The pilot is misleading as it does not incorporate all the draconian measures that will eventually be a part of the full roll out. Ultimately, DBT will allow the industry to price fertilizers at will and the burden of collecting the subsidy, now with the government, will be transferred to the farmers.

The DBT ploy is very similar to what happened with the U.S. sugar industry in 1960, when it paid off scientists and academics to delink sugar and heart disease by diverting attention to saturated fat.

The fertilizer price has two components; the fixed retail price and the variable subsidy component. Today, irrespective of international urea price fluctuations, the farmers can buy a bag of urea at a fixed cost of ₹284. With the DBT regime, the arrangement will be turned on its head. The cost of urea bag will become variable while the subsidy component will be constant.

THE DBT OF FERTILIZER SUBSIDY CAN BE GOOD IF TWEAKED TO PROTECT FARMER SUPPORT

In 2008, the international urea price breached $500 per tonne mark. In India though, the urea retail price was ₹239 per bag. International prices, about half currently, are perking up. Should the international price rise to 2008 levels in the DBT regime, the farmer could have to shell out ₹1,200 per bag.

A perfect analogy to explain the final version of DBT of fertilizer subsidy regime is the LPG gas

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cylinder cost borne by the consumers. Before the DBT on LPG, consumers paid ₹450 for the gas cylinder. After the regime change, the gas cylinder price has risen to ₹805. The consumer purchases the cylinder at full cost first and is reimbursed the subsidy component, if applicable.

Currently, farmers just pay the subsidized retail price and take home the bag of urea. In the new regime, the farmer will have to register for the subsidy with land documents (difficult to procure) and pay the full price upfront with a future reimbursement of subsidy. This implies a capital expenditure that will increase the farmer's credit requirement by a third for no fault of his. The most common cause of farmer suicides remains credit.

Tim Harford's 'distort, dispute, distract' idea in 'The problem with facts" may well have been based on the Indian DBT drama. First the fertilizer industry appeared to engage, next it sowed doubt around prioritizing farmer needs over fertilizer industry profitability and, in the third stage, employing its enormous resources, it is using amenable experts to undermine farmers' concerns and the genuine experts.

The new DBT regime will also limit the quantity of subsidized fertilizer that a farmer will be allowed to purchase. Wheat, rice, potatoes, pulses or millets and such others require different nutrients in varying quantities, depending on soil and crop selection. The policy negates this and reverts to the old bureaucratic generalization of Indian agriculture that has failed the nation repeatedly. Things get worse for a 100 million tenant farmers who currently buy subsidized fertilizers. In the new regime, this category will not be entitled to subsidized fertilizers because land records will not reflect their names.

The DBT of fertilizer subsidy can be good if tweaked to protect farmer support. Farmers, with their backs to the wall, have no option but to pray for parliamentary guarantee of safeguards because mere words are not legally binding. For the farmers this is absolute betrayal, especially because the issue of livelihood is no longer the primary concern of even farmer fertilizer co-operatives. The last bulwarks of farmer hope and resistance against the international fertilizer mafia have fallen.

The government's grand vision for a 'New India' is at variance with its narrow economic policies. Officials only wish to rein in the fertilizer subsidy expenditure. The number of economists advising the government has reached an affliction point and, sadly, 'doubling farmer income' is becoming a parody against the establishment. The disempowered farmer's voice is being drowned in the din generated by the fertilizer industry and the small farmers are in danger of getting even more deeply trapped by their circumstances. ●

THE NUMBER OF ECONOMISTS ADVISING THE GOVERNMENT HAS REACHED AN AFFLICTION POINT AND, SADLY, 'DOUBLING FARMER INCOME' IS BECOMING A PARODY AGAINST THE ESTABLISHMENT

Ajay Vir Jakhar
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Photo: Prabir K. Patra

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To the Editor

The true cost of food

Sir,- Apropos of your editorial, Fatal forecasting and the farm sector (*Farmers' Forum* February-March 2017), you are entirely right that the policies made by nations, including India, are out of sync with stated government objectives, leading to such systems failure. This is especially so when policies need to impact on a vast country like India with such varied agro-climatic zones. This certainly makes the Indian challenge more daunting than that in much of the developed world. You are right in demanding urgency to set things right and to give the country a new matrix to measure growth and security with a greater focus on food security. As you say, "the most important investment should be made in calculating the true cost of food. Without knowing the true cost of food, policymakers cannot make informed choices and investments".

Dhananjay Singh
Ranchi, Jharkhand

Death in numbers

Devinder Sharma's piece, Managing India's serial deaths: anatomy of farm suicides, (*Farmers' Forum* February-March 2017), focuses on and reflects the true picture of farmer suicides with facts and figures. It is important to repeat his numbers: between 1995 and 2015, a period of 21 years, a total of 3,18,528 farmers have committed suicide. In the agriculturally prosperous Punjab, 96 per cent of the rural households have incomes lower than the expenses. That gives the game away, no matter how hard the administration tries to hide facts. Please try to include such articles in every issue of your esteemed magazine.

Rajender Dondiyal
Una, Himachal Pradesh

Cure for sure

I applaud the members of Jan Swasthya Sahyog for visiting the homes of the patients in remote villages to understand the predisposing causes of their illnesses. (Diagnosing the wider cause of rural disease; *Farmers' Forum* February-March 2017), Effective treatment can only take place if the socio-psychological background of the afflicted is understood. How many doctors try to get that understanding? May India be blessed with many more such initiatives.

Sandip Patel
Gandhinagar, Gujarat

***Farmers' Forum* website www.farmersforum.in is now up and running. Log in to check out all the earlier issues.**

Demon without teeth

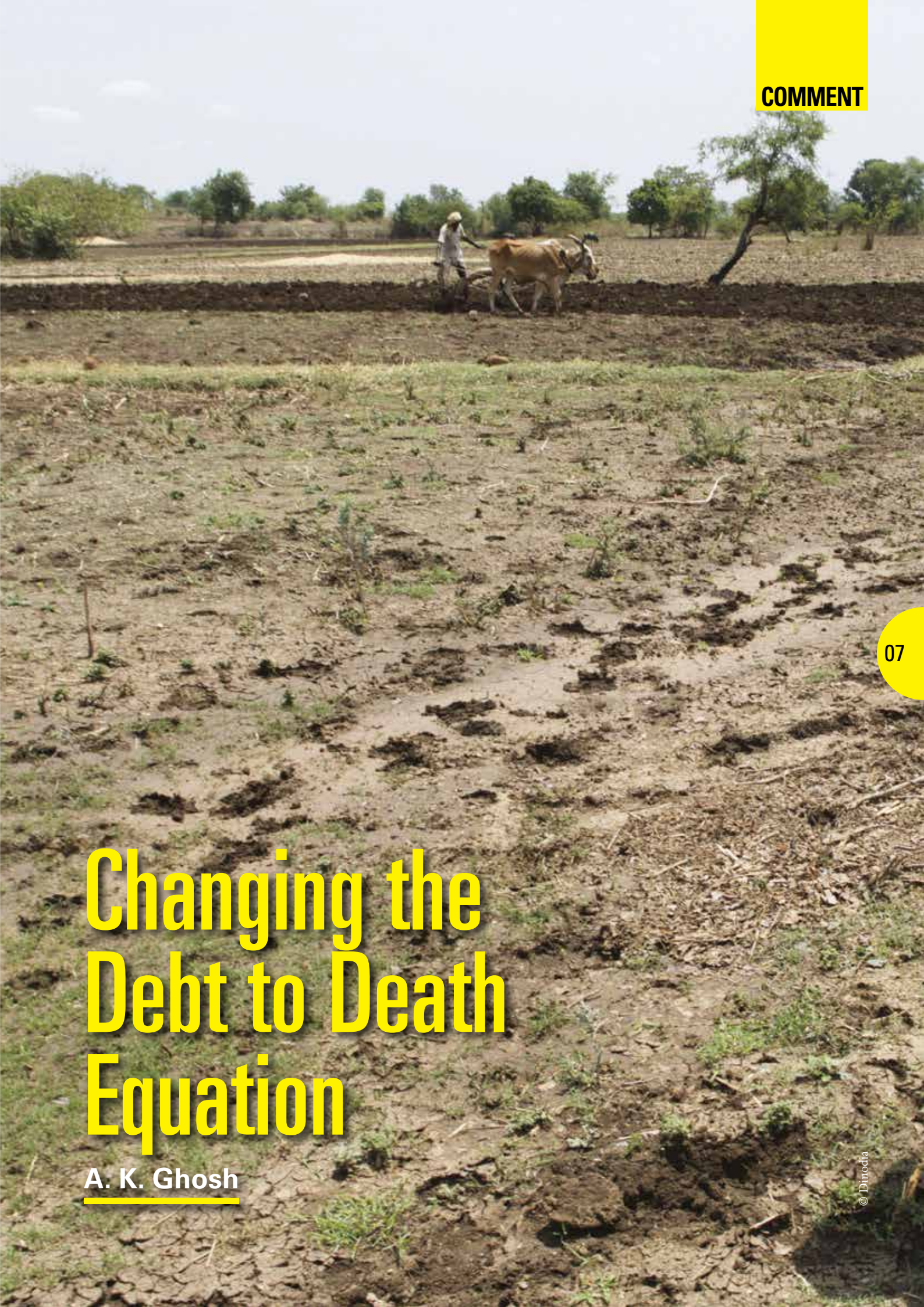
Subir Das correctly focusses on the impact of demonetization on farm economy in "Demystifying demonetization farm produce, poultry and plantations" (*Farmers' Forum* February-March 2017). He is right in that the demonetization order, having come in the midst of the winter sowing season, the first impact was on farmers, who were left without cash even to buy seeds. The preliminary data on horticulture and pisciculture, both integral parts of the farming space, is just as scary. The full negative impact of demonetization is yet to be calculated though it quite clear that its desired impact on black money is anyone's guess. Demonetization turns out to be quite inconsequential then, save for the farm sector hardship.

Amit Kumar
New Delhi

Insights into disease

I read with keen interest the Jan Swasthya Sahyog report, Diagnosing the wider cause of rural disease, (*Farmers' Forum* February-March 2017). It is only because of the commitment of some caring individuals that the poor and the dispossessed find some relief. The aim is not just to cure disease but also to prevent disease in this case. My salute to this remarkable group.

Sulochana Saini
Bareilly, Uttar Pradesh



Changing the Debt to Death Equation

A. K. Ghosh

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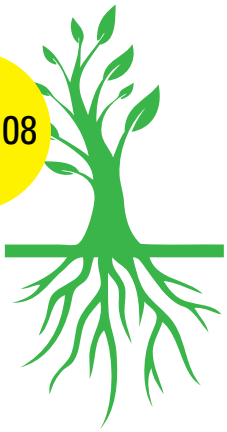
Two April 2017 reports have caught popular attention: 'Waiver won't help small farmers: few took bank loans over hassles'; and 'Crop Insurance drives non-life biz, Industry grows 32 per cent in FY17, touches ₹1.0 lakh crore for the first time'[1]; both from the Times of India. The burden of the song is that the bulk of the farmers depend on money lenders and not banks for their credit needs.

Data from Uttar Pradesh reveals that while 28 per cent farmers may feel comfortable with banks and co-operatives, an overwhelming 72 per cent, the indigent farmer, must go to the local mahajan. Banks are for the big and 93 per cent of medium and big farmers, with five acres or more land holding, depends on banks and co-operatives, while only a meagre seven per cent of the moneyed class goes to moneylenders. This is a telling commentary on India's success with banking for the masses as the smaller farmers, with small holdings, can hardly expect banks to be accommodative of their needs.



Data from U. P. reveals that while 28 per cent farmers may feel comfortable with banks and co-operatives, an overwhelming 72 per cent, the indigent farmer, must go to the local mahajan

The U.P. example works for other Indian states as well. The U.P. government has announced a waiver of ₹1,00,000 of bank loans taken by farmers, something that other states have not done. The Madras High Court directed the Tamil Nadu government to waive farmer loans in April, 2017. The Maharashtra government is also reportedly under pressure to do so while Punjab has set up a commission to draft a roadmap (ToI, April 26, 2017).

Agricultural loans and the farmer's inability to repay often lead to farmer suicides and, therefore, the need for crop insurance (see *Farmers' Forum* Vol. 15, No.3. page 57-62). The Indian prime minister has made out a case for it, proposing it to ease the farmer's woes should crops fail[2]. The Supreme Court of India, hearing a public interest litigation, filed by the Citizens Resource and Action Initiative, observed that a farm distress situation can arise from a variety of reasons, flood, drought or debt and it asked banks to consider the possibility of farmers becoming unable to pay back under such circumstances. The crop insurance scheme announced in 2015 should address the entire scenario realistically. The point is that there is hardly, ever, a quick response to distress.

This situation is seemingly changing over the past year with premium collection by insurance companies increasing to ₹1.27 lakh crore during 2016-17, against ₹96,276 crore in FY 2015-16; a growth of 32 per cent. Of this nearly 16 per cent came from crop insurance. Crop loss claims are expected to comprise 75 per cent of the premium; such crop damage has been witnessed in Karnataka and Tamil Nadu.

The situation has arisen in the first year of crop insurance, where farmers pay only two per cent points of the sum insured as premium with the rest to be paid by the government. In 2014-15, the actual loan availed of was ₹6,000 crore, which more than doubled to ₹13,000 in 2015-16; with a budget allocation of ₹15,000 crore (Ghosh, A.K., 2016).

The issue at stake here is the need for continuous surveillance of the distribution of farmer loans and the coverage of crop insurance at a huge subsidy of 98 per cent in a country where even good policies get converted into scams. Financial misappropriations of public funds get reflected in the huge debt burden borne by public sectors bank in India.

Providing for hassle free loans to farmers at low rate of interest — at a maximum of eight per cent against the 24 per cent interest charged by moneylenders — is essential given that India has a record of a farmer committing suicide every 12 hours because of the inability to repay loans on account of drought or flood or soil salinization.

Cynically, there is the flip side of the picture in which farmers are driven to committing suicide,

1 April 12, 2017 and April 14, 2017, Times of India
2 Times of India, March 04, 2017

even during good weather with bumper yields, because of poor procurement by the government at minimum support price. When potato production peaked, price plummeted to ₹2 a kilo at the place of production and there was no help by way of warehousing facilities that the farmer could use as he waited for prices to pick up.

Yet, even during this low-price season, consumers in cities paid four times the price. Essentially this suggests a massive gap in the system that can possibly be breached by farmers' co-operatives operating directly from the field to the urban/peri-urban market, cutting out the chain of middlemen. This suggestion has been in the public domain for a long time.

One awaits the response to the question raised by the Supreme Court on how to check farmers' distress. The last date for the response is supposed to be June 3, 2017! All one has so far heard is the strong opposition from Arvind Subramanian, the government's chief economic advisor, to the waiver of farmer loans, on the plea that it will have serious adverse impact on India's GDP driving it down by at least two per cent (ToI, April 26, 2017).

Arvind Subramanian would do well to profile the farmers who need the waiver and explain why are they unable to pay. He would do even better to profile those who cannot access the banks for loans and say why. That would make for a more complete understanding to the farm sector financing riddle in India. •

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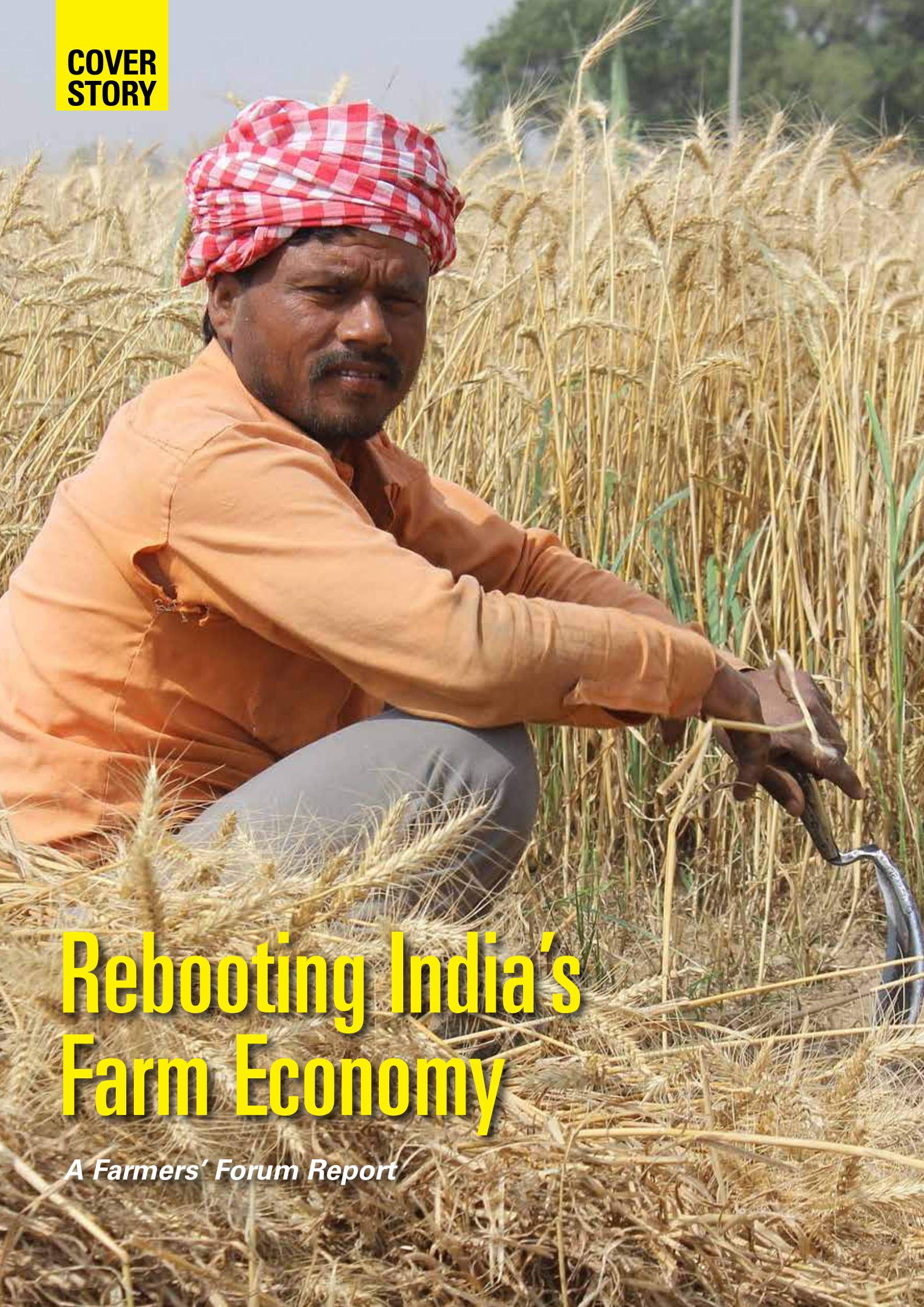


Rebooting India's Farm Economy

A Farmers' Forum Report

Photo: Pixabay

"The government will continue to work closely with the farmers and the people in the rural areas to improve their life and environment. This is a non-negotiable agenda for our government".

— Arun Jaitley in Parliament

Energy is as central to agriculture as it is to industry; a fact often ignored by planners and possibly overlooked by the farmers themselves. The farm sector is thus often left to fend for itself for its energy needs or provided intermittent energy, often from sources that are second rate or poorly maintained. In any event, power for the farm sector is often treated as a matter of charity and not as a critical input that any government should ensure. This is true not just for India but for most developing countries even though India is trying to ensure 24x7 power for all rural households (see *Figure 1*).

Given the known difficulties around cost of providing the standard electricity fare and the environmental cost of such energy production, renewables have gained popularity as a concept. Admittedly, renewable energy and electricity would have to be placed on a firm footing if they are to capture more value from agriculture but there are working models that can be followed.

Globally, record levels of renewable energy capacity were created in 2016 at a cost almost a quarter lower than in the previous year, thanks to the plunging cost of renewables, says a recent report from UN Environment. Investment in renewables capacity was roughly double that in fossil fuels and the cost of offshore wind power fell by around a third since 2012 – far faster than expected.

Figures from the International Energy Agency show that the switch to renewables has been one main reason for greenhouse gas emissions staying flat in 2016 even though the global economy grew by 3.1 per cent. There is more inspirational news from home. Visit an initiative on the transformational impact of basic energy even in a poorly performing village courtesy Desi Power's operations in village Baharbari, district Araria, Bihar. It was here that Desi Power established a

biomass-based power plant through a co-operative (19 members in September 2016) in 2001 with the Indian Institute of Science, Bangalore, supporting it by training three or four locals to operate the gasifier plant. The co-operative owns water pumps and paddy mills.

Significantly, Desi Power employed women to operate their grids. In 2007 and 2008, the company expanded its operations into two other villages in the district and created a feedstock calendar, shared with the community, to manage feedstock. Nearly 70 per cent of the operational revenue is reinvested in the villages as salaries and payment for feedstock. The benefits have been remarkable.

- Farm productivity picked up courtesy low-cost irrigation and the villagers, hitherto selling paddy at low price, now sell hulled rice as there is an electric-powered rice huller in the village.
- Commercial activity has received a fillip and some 25 shops have opened, ranging from an agricultural input supplier to shops that provide daily groceries and computer parts.
- The operations in Baharbai evolved from providing power for productive uses to household-level electrification.
- It is cited as a case study by the International Crops Research Institute for the Semi-Arid Tropics (Icrisat) in its Technical Report 7, based on a Workshop on Energy and Agriculture for Smart Villages, published in September 2016, on Energy and agriculture for smart villages in India.[1]

Globally, on an average, the agriculture sector generates around 30 per cent of the GDP and provides work for 65 per cent of the workforce and some 2.5 billion people come from primarily agri-based families. Specifically, South and East Asia are the largest contributors to the world's agri-basket, producing about 40 per cent of the world's cereals and meat and almost 60 per cent of vegetable oils, mostly palm, in 2013-15. Yet farm sector electrification remains a distant dream globally.

Even in India, despite the talk about rural electrification most villages are poorly served and the government promises to complete electrification of 18,452 villages by May 2017 and take electricity to every village by December 2018 (Ministry of Power projections, June 16-17, Goa)[2].

The Deen Dayal Upadhyaya Gram Jyoti Yojana (DDUGJY) was initiated to ensure rapid electrification, feeder separation and strengthening of rural distribution infrastructure. A budgetary allocation of ₹4,843 crore has been made for electrification of rural areas under the DDUGJY in 2017-18. The agenda is 24x7 power for all rural households, an excellent initiative, numerous flaws at the implementation stage notwithstanding.

The Hindu[3] reported some failings of the programme, citing specific cases:

- Haldu Khata in Uttar Pradesh was declared electrified by the state on November 6, 2015. During a visit by GVAs on January 1, 2016, no works of grid extension were found in the village. As an interim arrangement, the village stands electrified with solar power.
- Dimatala in Assam was declared electrified by the state on September 27, 2015. This was confirmed Gram Vidyut Abhiyantas (GVAs). A follow-up visit on January 18, 2016, by GVAs found that the distribution transformer was damaged. The state was directed to take corrective action.
- Kadam Jheriya in Chhattisgarh was incorrectly declared electrified by the state on October 9, 2015 and this was confirmed by GVAs. Dimatala in Assam and Buknari in Bihar are similarly misclassified as electrified villages in government books.
- Pagara Buzurg in Madhya Pradesh was declared electrified on September 28, 2015 and was confirmed through a GVA visit. However, a GVA visit on March 22, 2016 revealed that existing infrastructure has been stolen; this remains the responsibility of the state.

The farm sector is left to fend for itself for its energy needs or provided intermittent energy, often from sources that are second rate or poorly maintained

1 http://e4sv.org/wp-content/uploads/2017/01/Energy-and-Agriculture-for-Smart-Villages-in-India.compressed.pdf
2 www.ddugjy.gov.in/mis/portal/latest_news_pdf.jsp?NEWS_NO=88
3 http://www.thehindu.com/opinion/op-ed/Providing-transparency-in-rural-electrification/article14179883.ece

Photo: Pixabay

Figure 1: 24 x 7 Power for all Rural Households

- Panalomali, Kusadangar, Patyetapali in Odisha and Sunwara in Madhya Pradesh were declared electrified by the states on November 27, 2015; December 4, 2015; November 12, 2015; and September 28, 2015 respectively. GVAs have recorded these as uninhabited villages but the state governments have not declared them so.
- Birni in Jharkhand was declared electrified by the state on October 15, 2015. A GVA visit on March 23, 2016 confirmed that village works are complete but line charging is not. It is being expedited.

As far as the power ministry is concerned, it has established 100 per cent access to electricity in 3,702 villages; the distribution transformer capacity and infrastructure capability is designed keeping 500 watts as the load per household; the status and progress on access to households now being captured in 'GARV'.

The Rural Electrification Corporation has been entrusted to associate with discoms to create a dedicated web-enabled platform for village-wise assessment and planning by discoms that will


Photo: Pixabay

further build a database of all sanctioned villages (UEV and IEV); identify completed villages; capture details of available infrastructure and those yet to be completed along with details of existing and proposed infrastructure; and finally assess village-wise status of household electrification and adequacy of infrastructure. While all this is sweet music to rural ears, there is many a slip between the cup and the lip and there are miles to travel before last mile connectivity for all is achieved.

The good news is that awareness of these problems has led to a special drive to provide last mile connectivity and release of service connections, especially to above the poverty line households. Discoms have been asked to organize campaigns/camps in rural areas for on the spot release of connections at a cost payable over instalments with states asked to chip in with connections at a concessional cost.

The Icristat's Technical Report 7 (September 2016), on Energy and agriculture for smart villages

Figure 2: Access to Electricity – Village Electrification

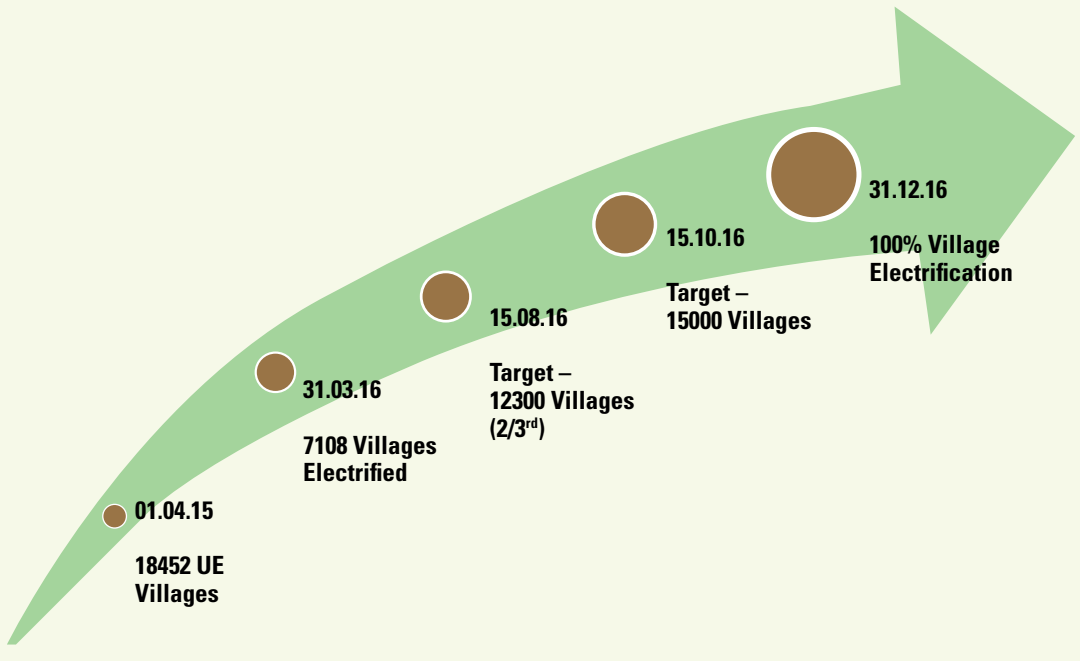
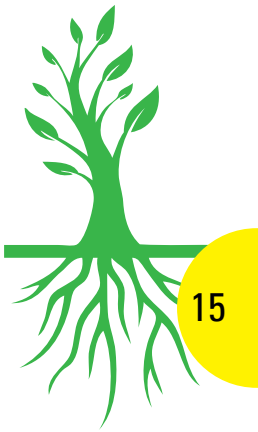


Table 1: Possible power systems and their economics

Technology	Generation capacity (kW)	Energy sources	Services Available	Estimated economic cost
Pico-power systems	0.001 – 0.01	Hydro, wind, solar	Lighting, radio communication reception, two-way mobile communication	US$ 10 – 100
Stand-alone home systems	0.01 – 1	Hydro, wind, solar	Same as above plus additional lighting and communication, television, fans, limited motive and heat power	US$ 75 – 1,000
Mini-grids	1 – 1000	Hydro, wind, solar, biomass, diesel, hybrid combinations	Same as above plus enhanced motive and heat power and ability to power community-based services	Medium-large capital cost, low marginal cost to end-user
Regional grid connection	1000 – 1000000	Gas, hydro, wind, solar PV, biomass	Assuming high quality of connection, same as above up to a full range of electric power appliances, commercial and industrial applications	Medium-large capital cost, low marginal cost to end-user

South and East Asia are the largest contributors to the world's agri-basket, producing about 40 per cent of the world's cereals and meat... Yet farm sector electrification remains a distant dream



in India talks of government data claiming 96.7 per cent villages electrified but emphasizes that supply is erratic with frequent outages and that only a small proportion of houses are actually connected. Consequently, rural consumers spend around $2.5 billion per annum on kerosene, almost 840 million people in India use solid biomass to meet their cooking and heating requirements in traditional cookstoves amidst great indoor pollution that contributes to a high number of premature deaths and environmental degradation through the loss of biodiversity and deforestation.

The mini-grid model that Desi Power has adopted merits consideration with supporting policies tailored for compatibility with models in use. There could be mini-grids with local generation in areas where the national grid is absent and the private mini-grid operator installs the distribution network. They could also be mini-grids where the national grid exists and mini-grid operators have their own generation facilities but use the existing electricity distribution infrastructure.

Solar-powered water pumps provide an excellent alternative to diesel powered pumps in particular. Energy to drive water pumps constitutes about 30 per cent of the total input cost for a farmer. Indian farmers draw more than 212 million mega-litres from the ground each year to irrigate about 35 million hectares. Studies estimate India's potential for solar PV water pumps for irrigation to 70 million pump sets.

"Solar pumps can substantially improve the financial health of State Electricity Board (SEB) by reducing subsidized power to farmers and eliminating incremental capital expense to connect

The Mini-Grid

The availability and eligibility of mini-grid operators for central or state subsidies varies. The anchor load based model is still in its nascency. Mini-grid enterprises have to struggle to provide reliable supply to the anchor, especially mobile phone towers during peak hours of consumption. Effective demand management during off-peak hours is also extremely important to improve load utilization. Access to finance is another major challenge facing mini-grid enterprises, especially those that aim to take a cluster approach and serve multiple off-grid villages. The centre has funded states for grid extension, subsidized capital targeted at private companies that have demonstrated proof of concept can help them expand their presence in rural areas. Using anchor loads to develop a long-term revenue stream can also help these firms access private capital and contribute to their expansion helping them achieve scale.

– Icrisat Technical Report 7

farms to grid which is estimated to be ₹1.7 lakh per connection", according to Vikas Dwara, Managing Director, Investment Banking, YES Bank.[4] While the upfront capital cost of solar powered pumps is higher than traditional pumps, a lucrative payback economics of three to five years is possible given the high operating cost for diesel pumps.

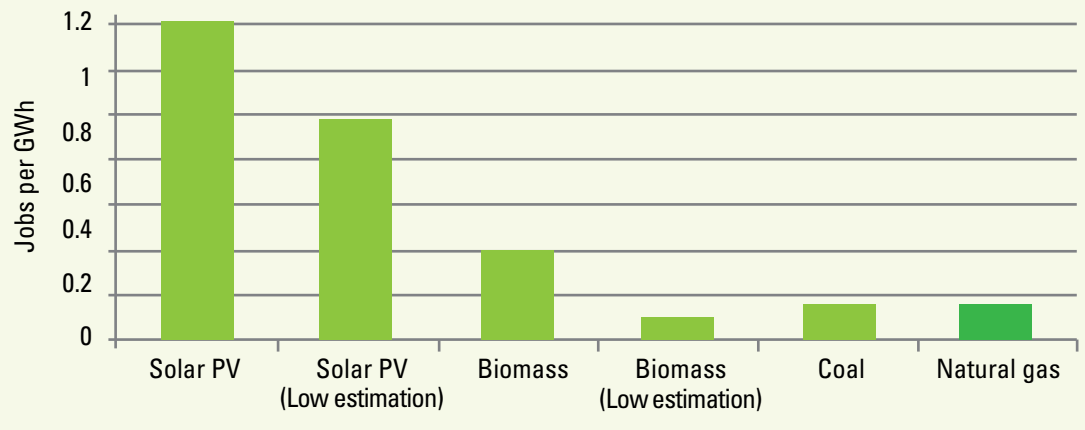
What are the market opportunities that people living off-grid can expect out of renewables? For one, they can possibly empower villages to board the energy escalator and convert their daily work (see *Table 1*) into income-generating enterprises by adding value to agricultural products. There has been great value addition through power-enabled enterprises as diverse as rural tourism — catching up in India — or food processing, much of which is renewables based. Besides, there are solar powered irrigation systems, technology to reduce harvest losses, post-harvesting processing. There are some 10 million diesel pumpsets in India that can be replaced by solar photovoltaic pumpsets.

Renewables can even power heating and cooling systems and kick start MSMEs in the food

Photo: Pixabay

Government data claims that 96.7 per cent villages are electrified. However, the supply is erratic with frequent outages and only a small proportion of houses are actually connected

Figure 3: Estimated jobs created per GWh



Source: Icrisat Technical Report 7

4 http://www.thehindubusinessline.com/news/variety/renewable-energy-best-bet-for-farm-sector/article7322489.ece

preparation, processing, extraction, refining, and preserving. Tea plantation can use renewables for their processes. Grain mills, rural bakeries and ICT-based services can power themselves with renewables and provide an alternative livelihood option for women as well.

In India, more than 60 per cent of all employed women work in agriculture while in rural areas the percentage is as high as 84 with average take-home earnings at about two-thirds of men's wages for the same work. Often they go unpaid and with up to 75 per cent of such women being illiterate, the odds against them increase.

Icrisat itself has launched a customized low-cost mobile phone and a tablet, the GreenPHABLET powered by the GreenSIM that allows for real-

The Sure Shot

Sakhi Unique Rural Enterprise (SURE) is about women empowerment through entrepreneurship building and networking at the grassroots. A training and development organization, it works in 13 districts in four states, promoting the use of clean energy products and solutions. Rural women entrepreneurs are encouraged to undertake micro-businesses and are provided with training, technical support and access to technology, nance, and markets. Women are able to have more effective interactions with potential customers due to their place in the community as "one of their own". The initiative tries to improve access to clean energy solutions such as smokeless cookstoves, biomass pellets, biogas, solar lamps and other socially relevant solutions that are provided at affordable prices through an effective network.

– Icrisat Technical Report 7

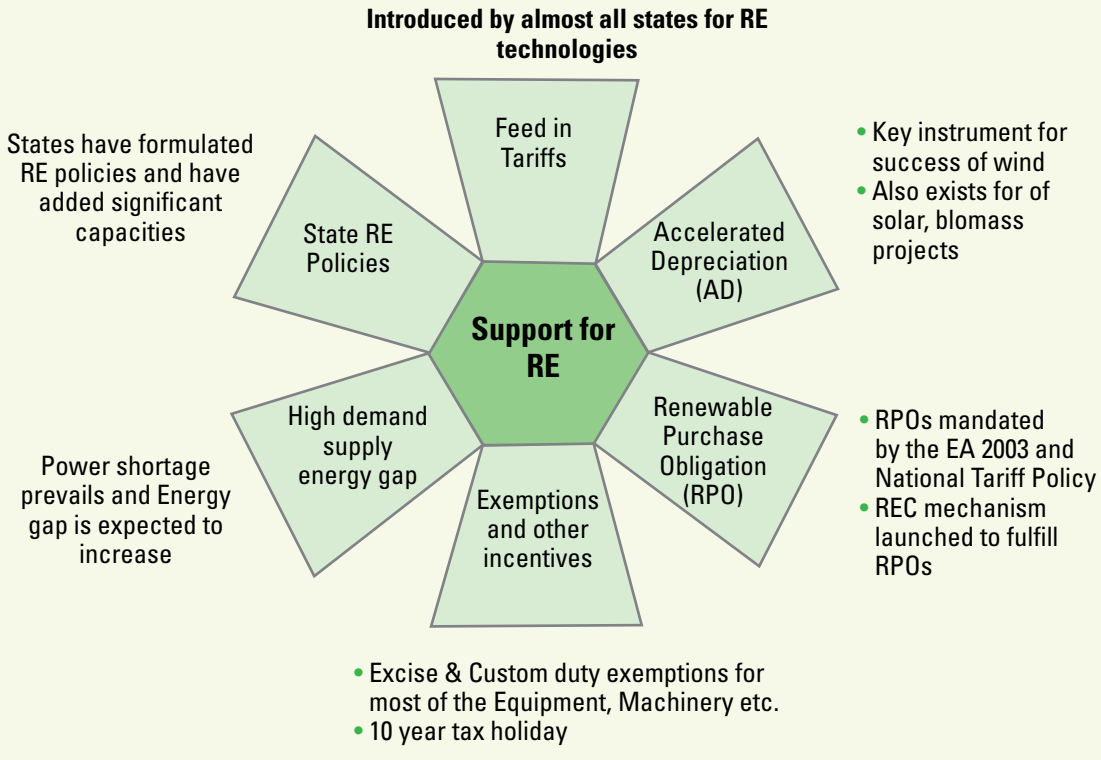
time information sharing between farmers and researchers and helps them improve crop productivity. For researchers, it presents the chance to collect accurate and real-time field data. The GreenPhablet enables information to be delivered precisely to smallholders as per their individual requirement. It also helps them with information regarding input prices and helps achieve better returns in the market.

There is also the Reuters Mobile Light (RML), "a mobile information service RM, has helped farmers in rural India access agricultural advice, local weather forecasts, and market price updates. RML has a network of 300 agricultural experts as well as content developers who are responsible for providing real time and personalized information to farmers. Information on prices from 1,300 markets is available to farmers, covering 450 crop varieties", says the Icrisat report. The case for renewables is made stronger by the decline in real terms in its tariff over the years even as fossil fuel fed generation has become more expensive. Solar tariff, in particular, has fallen in nominal terms from ₹15 per kWh in 2009 to ₹5 per kWh in 2015, courtesy a fall in module prices and improvement in capacity utilization factor.

The U.N. paper on falling prices of renewables, published in conjunction with Frankfurt School-

Photo: Pixabay

Figure 4: Support Mechanism for Renewable Power in India



GEF National Workshop in India, MNRE 13 April, 2015

Wind, solar and other renewables added 138.5 gw to global power capacity in 2016; up eight per cent from 2015; roughly equal to that of the world's 16 largest facilities combined

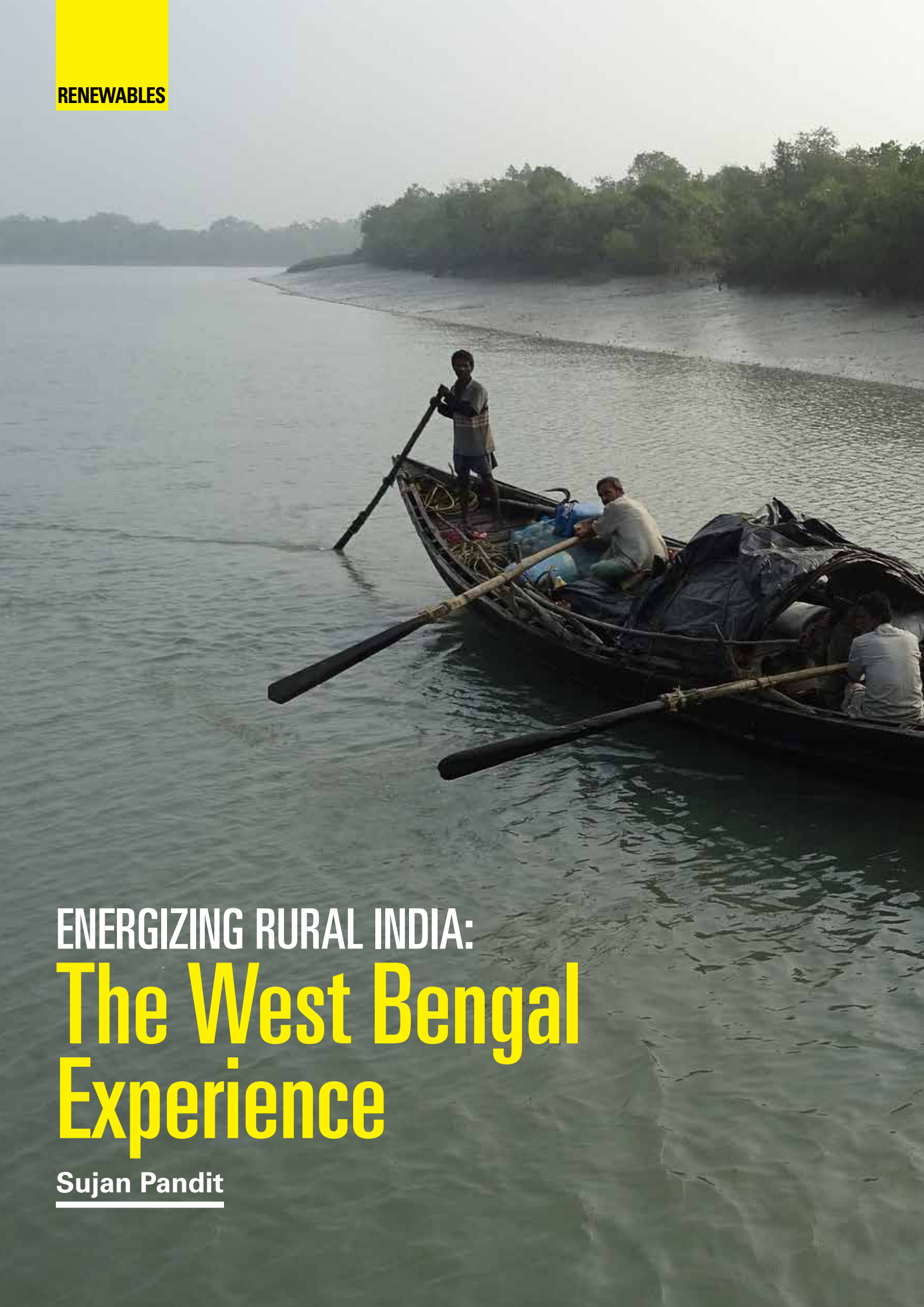
UNEP Collaborating Centre and Bloomberg New Energy Finance was co-authored by Ulf Moslener, who told BBC News: "Things are heading the right way, and the learning and technical costs of renewables have done a large part of their job. But investments are not yet there to meet the structural change agreed in Paris".

There is more to the evolving renewables story because one is looking at a future where the farmer can produce his own energy; become energy self-reliant: biomass, geothermal, hydroelectric, solar, and wind power can produce electricity for heating, lighting and fuel for use on the farm. Solar powered electric fences[5] protect farms from marauding animals to solar irrigation. (See Betna and Joka experiences recorded by ONnergy.)

These comprise a SPV unit as a source of power, an energizer that produces high voltage impulses (8kv) emitted at intervals of 0.9 to 1.2 seconds, along with a 12V battery. The impulse carries 10 mA of current and delivers a shock lasting for a fraction of a second. The batteries can be recharged using readymade solar fence chargers. Battery operated solar fences may cost from ₹45,000 to ₹50,000 per acre though there are cheaper versions at ₹10,000 to ₹25,000 per acre that use local materials.

Meanwhile, the U.N. report finds that wind, solar and other renewables added 138.5 gigawatts to global power capacity in 2016 - up eight per cent from 2015; adding capacity roughly equal to that of the world's 16 largest existing power producing facilities combined. Clearly it is time for Indian farming to reboot itself on renewable power. ●

5 https://ag.umass.edu/crops-dairy-livestock-equine/fact-sheets/renewable-energy-production-on-farms



ENERGIZING RURAL INDIA: The West Bengal Experience

Sujan Pandit

Photo: Pixabay

SUJAN PANDIT
is Member, Governing Body, WBREDA

Renewable energy is aggressively promoted as a solution to some major problems facing the world today. Growing awareness of the adverse impacts of carbon-based fossil fuels, both in terms of affecting the earth's energy balance (climate change and global warming) and in increasing air pollution, have tilted the scale in favour of the renewables — solar, wind, hydro or any such. They come across as a panacea to massive and seemingly intractable problems as they help avoid both the aforementioned effects.

The other use for modern, renewable energy sources that attracts less attention is in providing electricity and high quality heating and cooking resources and even for farming activity to remote areas that are either difficult or extremely expensive to connect to the main transmission grid. These isolated pockets of what is essentially rural India are best served by renewable energy.

West Bengal has been a pioneer in providing electricity to remote regions using modern, renewable sources of energy. The problems faced by the state are common to other Indian states with one crucial difference. Most Indian states are power deficient and often employ renewable energy to bridge the deficiency but West Bengal is power surplus. Though reliant on fossil fuels like coal, it has sufficient generating capacity to meet its peak demand needs. Power failures, if any, are on account of cable or transmission failure and not due to a shortage in electricity generation.

If West Bengal employs renewable energy it is to meet its carbon emissions reduction commitments or to provide power to those isolated pockets that are beyond the reach (for economic or geographical reasons) of the electricity transmission grid. The only challenge to electrifying 100 per cent of the villages and hamlets in West Bengal is on account of the topography of some regions in the state.

There are three main regions that still have villages and hamlets that are unelectrified:

1. The remoter villages and hamlets of the Sundarbans (mainly in the South 24 Paraganas)
2. The chawr regions on the India-Bangladesh border in Cooch Bihar, Malda, Murshidabad and Nadia districts.
3. The remoter villages and hamlets of the Darjeeling Hills, mainly on the Nepal-Sikkim border.

What are their problems? How does one resolve them? What lessons can one draw for the rest of the country?

The Sunderbans

The Sundarbans, the Gangetic delta region near the Bay of Bengal, are the world's largest mangrove forest and crisscrossed by very broad rivers; some many kilometers wide. It is extremely difficult and expensive to build and maintain a transmission grid that connects these far flung islands of the Sundarbans, some of which are sparsely inhabited.

Most inhabitants of the regions are extremely poor and rely on traditional energy sources like kerosene lanterns and firewood for their lighting and cooking needs. However, over the past two decades, the situation has been changing and solar power systems, provided by government agencies like the West Bengal Renewable Energy Development Agency (WBREDA) or non-profit organizations like the Ram Krishna Mission, WWF and such others, have changed the ways the people meet their lighting and cooling (fan) needs. The lighting needs, from modern renewable energy sources, for these people are provided in three main ways:

1. From power generated and provided through a decentralized, distributed grid (DDG) or micro-grid: Each of these plants have a solar photo-voltaic (SPV) capacity of between 25 kW and 120 kW or biomass gasifier capacity between 200kW and 500kW and through a micro-grid provide limited amounts of electricity (usually three to five light or fan points for five/six hours a day) to around 200-300 families in the vicinity of these plants.
2. Solar Home Lighting systems (SHLS) that usually consist of a solar panel (with a capacity between 20W and 120W), a battery and an inverter. Panels are usually placed on the roof of houses and provide a limited amount of electricity to the inhabitants of that house.

Renewable energy can provide electricity and high quality heating and cooking resources and even for farming in remote areas, difficult or expensive to connect to the main grid

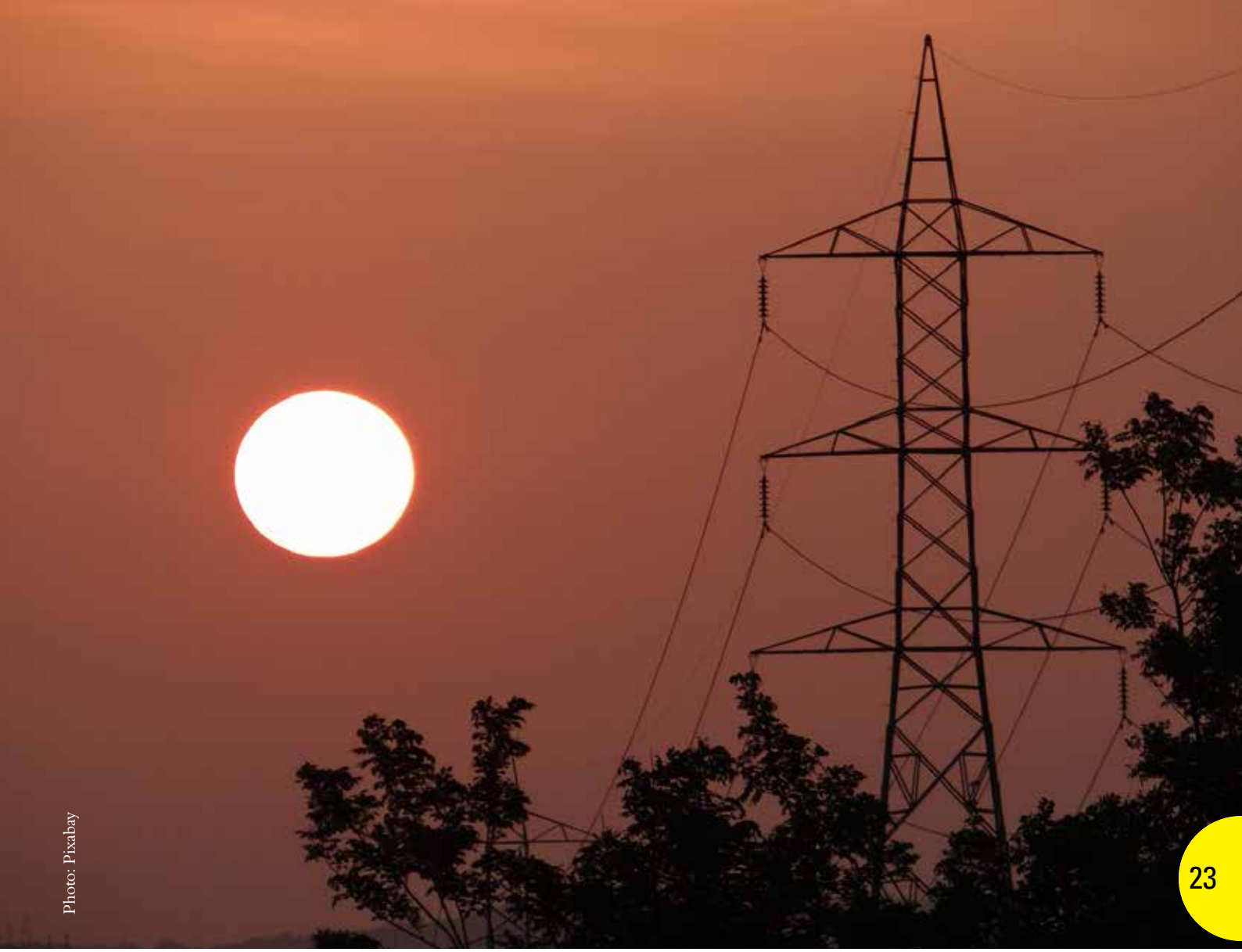


Photo: Pixabay

3. Solar Lanterns: similar to kerosene lanterns in shape but with a small solar panel on the top. If kept out in the sun during the day, they generate enough electricity to meet the lighting needs of these people during the hours of darkness. The main advantage is their low cost.

For fuels to cook, there is still almost total reliance on firewood. In a few places there are biogas plants that generate sufficient methane to light modern stoves.

Chawrs on the River Padma

The chawrs consist of small villages and hamlets on the Gangetic riverine region that forms the boundary between India and Bangladesh. Though maps of this region show wide rivers (the Padma in particular) forming the boundary, this is true only in the monsoon season. During the rest of the year, the region is devoid of trees and swirling with sand and dust; in practical terms a desert. A few villages and hamlets on the slightly higher reaches of this dusty plain. Given the changing nature of the terrain on account of shifts in the river flows, building large transmission grids to provide electricity to the peripatetic inhabitants of this region is a futile exercise.

The inhabitants of the chawrs are even more indigent than those in the Sundarbans. Given their itinerant ways of moving between India and Bangladesh and adopting smuggling as a livelihood,

The Solar Power Footprint

Without reliable energy services, farmers and agribusinesses in developing countries are less able to increase food production and engage in value-added processing. New technologies, such as solar food dryers and solar water irrigation, allow farmers living off-grid to replace expensive diesel generators with cheaper and cleaner technologies. This segment of the energy access market is still in the early stages of development but much progress is being made … with companies that offer modern energy solutions to boost productivity and economic growth.

— Energy4Agriculture

the government has paid little attention to meeting their energy needs. Unlike the Sunderbans, which have numerous government backed renewable energy projects and related initiatives, here they are conspicuous by their absence save for solar street lights and home lighting systems in a few villages; privately financed initiatives by charitable institutions and NGOs of this region, like the various Ram Krishna Missions in these districts. Copious quantities of dust everywhere makes the maintenance of solar panels difficult.

Darjeeling Hills

Some villages of north Bengal and the Darjeeling Hills that also lack electrification on account of their high altitude and remoteness, though efforts are now underway to connect them to the grid and the central government has been funding the Gorkhaland Territorial Administration (GTA) to carry out this task.

There are some differences between the Darjeeling Hills and the other two regions: the Darjeeling Hill regions have an alpine climate and hence the need is for heating, especially water heating. Here SPV is less effective due to a perennially thick cloud cover and poor insolation while micro-hydro or mini-hydro is a more suitable energy source.

Many villages near the Nepal or Sikkim border also remain unelectrified, especially villages in or near the Singalila National Park and the Neora Valley National Park. Some of the guest houses and trekker's huts in the Singalila National Park have solar panels on their roof along with a solar home lighting system) to light their guest rooms and recharge the trekker's mobile phones. This is done despite the poor insolation and electricity generation capabilities, mainly because electricity is at such a premium here that guest houses can charge trekkers and guests between ₹50 and ₹100 to recharge their mobiles phones.

Dhotre is an example of an unelectrified village (as of June 2014) at an altitude of over 8,500 feet and on the road to the 51 MW Ramam Hydel Power Station, owned and run by WBSEDCL.

Due to high rainfall and poor insolation levels, mini-and micro-hydro plants are found in the hills, especially in the tea gardens.

Problems faced by the DDG Model in Rural Bengal

Ever since the setting up of the WBREDA in the mid-1990s, West Bengal has pioneered electricity for remote regions using modern, renewable sources of energy. Sundarbans, where a large number of small power plants with a cumulative DDG electricity capacity over 1 MW were installed in the 1990s and the 2000s, were benefitted the most.

However, the entire DDG system in West Bengal began to face severe problems over time. They

Incentivizing Solar Power

The centre's Solar Mission has a subsidy scheme to help farmers procure solar irrigation systems being implemented by the Nabard. It offers a 30 per cent to 40 per cent capital subsidy linked to bank financing from a rural or commercial bank with a five-year tenure. Switch ON with support from ONergy Solar, amongst others is building appropriate financing models for small and marginal farmers to participate in the scheme. Informal Joint Liability Groups of 4-10 individuals are being formed to avail of bank loans for solar irrigation against a mutual guarantee. The JLG pays the bank EMI based on their land holding and water usage.

ONergy Solar (Punam Energy Pvt. Ltd) identifies water entrepreneurs replacing their diesel pumpsets with solar irrigation systems. The water entrepreneur sells water on a hourly or a contractual basis to a farmer group, the revenue goes into the loan repayment for the irrigation systems.

Photo: Pixabay

The DDG system in West Bengal faced severe problems that were two fold in nature. The first arose from the sharply rising expectations; the second from the problems of maintenance

were two fold in nature: the first set of problems arose from the sharply rising expectations; the second from the problems of maintenance. Today many decentralized micro-grid electricity distribution systems set up in the Sundarbans over the past 15 years are in a state of disuse. One reason is that grid connectivity has been extended to these regions, most notably in the Sagar Island. The more important reason is the poor running and maintenance of these decentralized micro-grid electricity distribution systems that led to their collapse.

The administrative set up for the day-to-day running and billing of the electricity distribution network has also been deficient, leading to their eventual breakdown. Typically, sometime after setting up the decentralized micro-grid electricity distribution systems in an unelectrified village, WBREDA would hand over managerial control for the day-to-day running and billing to the local panchayat or local electricity distribution co-operatives. Despite the best of intentions, the people employed by the panchayats or co-operatives often lacked the technical knowledge to run the system smoothly. This was in contrast to the grid-connected villages served by WBSEDCL that had a cadre of well trained personnel to handle day-to-day problems.

The problems faced by panchayats and co-operatives often leads to a vicious downward death spiral that discredits the entire system. While the inhabitants would initially be grateful for receiving any electricity, with the passage of time their demands for electricity would increase rapidly. This would often lead to illegal hooking and unauthorized consumption of electricity, putting the system under strain and lead to frequent breakdowns in the distribution system.

As the energy storage system was lead-acid battery based, even a 25 kW SPV power plant would require hundreds of batteries to store the generated electricity.

- First, maintaining so many batteries in working condition is a challenge.
- Second, if problems occurred with the electronic components of the BoS, the local operators would not be in a position to repair them. Though technically the equipment was to be maintained by the equipment providers as part of their service contract, in practice it would take considerable time before the problem was resolved.

All this meant that the villagers received electricity intermittently and were reluctant to pay their monthly electricity bills. Consumer were charged a flat monthly rate, determined by the number of electricity points in their house and not on the number of unit of electricity consumed in a month (as is the practice for professionally run electricity distribution companies with metered electricity consumption).

The non-payment of bills meant a cash flow problem at the panchayats and co-operatives that could not pay the monthly wages to the operators. This, in turn, demoralized the operators who looked for other sources of work and income and only notionally remained as power plant operators. The condition of the equipment worsened, power outages become almost permanent giving consumers more justifications for not paying their bills.

Decentralized micro-grids also got a bad reputation because they provided electricity for only five to six hours a day while the centralized grid connected electricity supply was available 24/7. A feeling has grown that RE electricity supply is for the boys while real men have grid connected electricity. Therefore, unelectrified villages and regions began to clamour for the grid extended to their regions and their wishes were often satisfied even if the costs of extending the grid exceeded the net present value of future revenues from electricity billings.

Photo: Pixabay

Decentralized micro-grids provided electricity for five to six hours a day while centralized grid connected electricity supply was available 24/7, giving rise to the feeling that RE electricity was for boys while men had grid connected power

Resolving the problem has been made easier by the rapidly falling costs of SPV panels that makes it possible to satisfy the rising expectations without necessarily making uneconomical centralized grid extensions. For example, a 25kW capacity solar micro-grid power plant set up in the Sundarbans a decade or more ago would provide five to six hours of power a day to around 250 households living in the vicinity of the plant.

Had the capacity had been increased from 25kW to 100 kW, it would have been possible to provide these 250 households living near the plant with 24 hours of power. The reason this was not done was because solar panels were very expensive 10 to 15 years ago and providing a continuous power supply using SPV technology would be prohibitively expensive. The economics of SPV technology have changed dramatically over this time period.

There still exists a role for setting up of DDG systems in West Bengal where some villages and

The Sun Pump

- **Pay Back in 3-5 years:** Replacing diesel pumps makes economic sense
- **Savings:** No recurring energy costs
- **Long life:** Works for more than 25 years
- **More reliable:** Simple and assured operation and water output
- **Convenient:** Saves time and labour
- **Robust and hardy:** Almost no maintenance
- **Free power:** After paying bank loan, free power for irrigation
- **Improves lifestyle:** By enhancing income
- **Water efficient:** Used for sprinkler irrigation, tube wells,water lifting
- **Remote monitoring:** Pump operations can be monitored remotely on a real time basis.

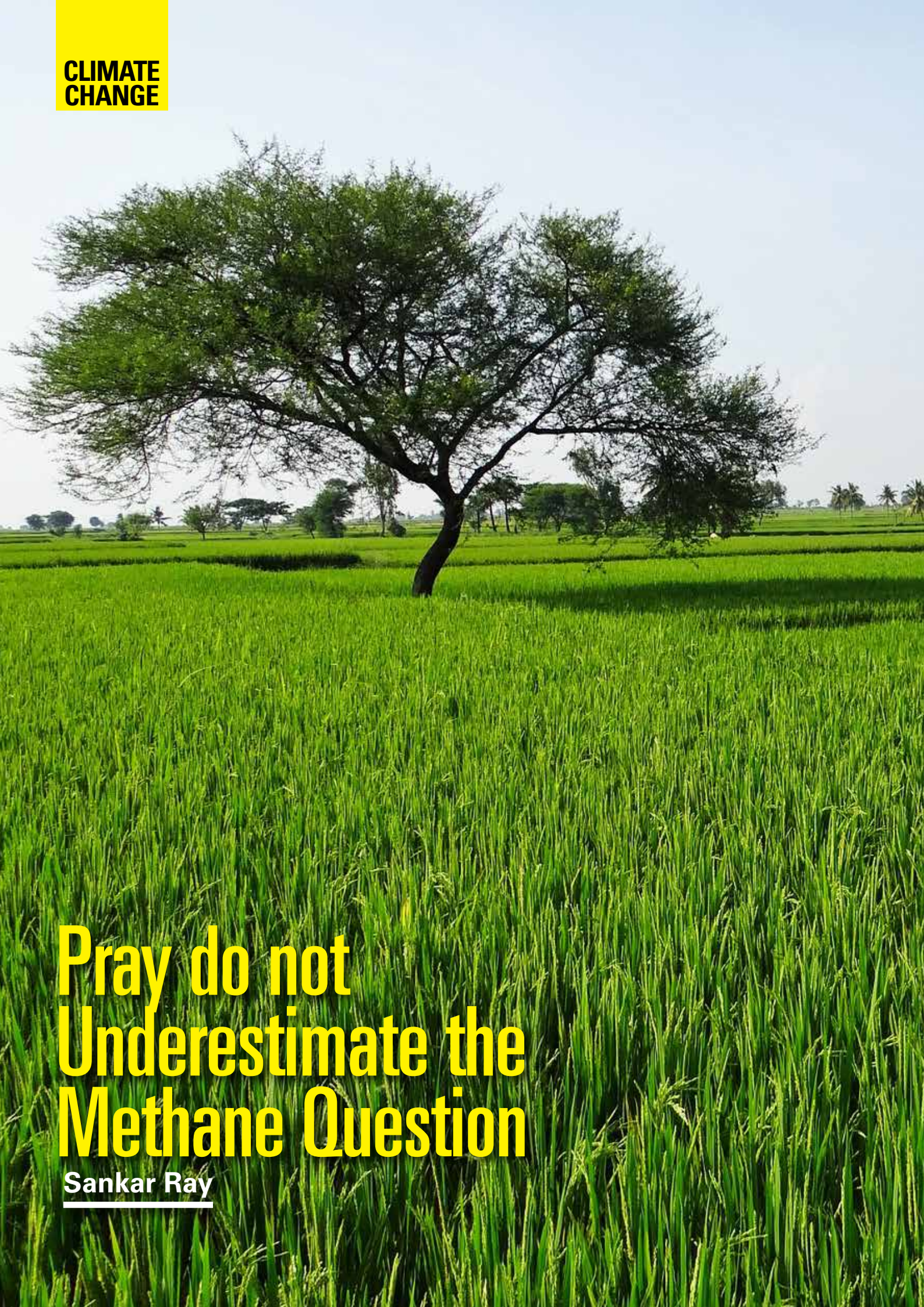
ONergy Solar (The company has installed over 250 solar pumps for irrigation, water purification, drinking water, sanitation and water supply; impacting more than 250 village communities and more than 5,000 farmers/households.)

hamlets are not connected to the centralized electricity grid. This is a niche area where renewable energy entrepreneurs can play a useful role by setting up renewable energy power plants and selling metered electricity through a micro-grid. Providing a continuous supply of electricity on a 24-by-7 basis will help remove the stigma of DDG electricity of not being as reliable as that from the grid.

Renewable energy entrepreneurs can set up a renewable energy DDG power plant at a fraction of the cost of a fossil fuel power plant. There are many central government subsidies, provided through the Ministry of New and Renewable Energy (MNRE) for such schemes, reducing the initial capital outlays.

What is critical is sound local knowledge since success or failure of such a venture depends on the ability of the entrepreneur to make accurate billings based on electricity consumption, preventing hooking or the illegal consumption of electricity and making quick and timely repairs for any faults that may occur. ●

CLIMATE CHANGE



Pray do not Underestimate the Methane Question

Sankar Ray

Photo: Prabir K. Patra

SANKAR RAY
is a veteran journalist

The big debate in the farming sector is about climate change proofing agriculture. Indian agriculture is particularly vulnerable to climate change and future proofing India's food security would mean addressing Indian farming's exposure to global and domestic environmental change and building capacity to manage its onslaught. An even more fundamental question is about how Indian agriculture itself is contributing to climate change. Is the only danger from CO_2 emissions or are there other potent threats?

Consider rice, amongst India's most widely grown crops. Rice varieties are known to affect greenhouse gas emissions, especially methane. "The physiology of rice plants regulates methane emissions by making available sources of methanogenic substrates through carbon in the roots, including exudates, and also by transporting CH_4 emissions through the aerenchyma.[1] *Several studies have confirmed variations in the emission levels of different rice cultivars". How serious is the issue?*

Prabir K. Patra, winner of the **MSJ Horiuchi Award (2016)**, speaks to **Sankar Ray**, for Farmers' Forum, on the methane-farming connect.

Sankar Ray (SR): ***Is the threat from methane potentially much greater than that from CO_2?***

Prabir K. Patra (PP): Methane (CH_4) is one of the most important short-lived climate forcers (SLCFs) along with tropospheric ozone and black carbon, according to the United Nations Environment Programme. Reducing their emissions could improve public health, reduce losses in crop-yield and slow the rate of near-term climate change (UNEP 2011). Methane has duel role in the earth's atmosphere:

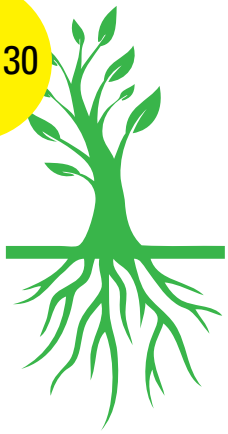
1) A very strong greenhouse gas, with global warming potential (GWP) of 23 over 100 years (IPCC). GWP is a measure of heat (earth's outgoing radiation) trapped by 1 kg of CH_4 relative to the heat trapped by 1 kg of carbon dioxide.
2) It takes part in tropospheric chemistry, leading to ozone production. Since methane reacts with hydroxyl (OH) and other radicals, it has a residence time of only 10 years once emitted to the atmosphere (unlike that of CO_2, which is

1 Boateng et al., 2017; http://www.mdpi.com/2077-0472/7/1/7

chemically inert in troposphere and thus resides longer than 100 years in atmosphere). This means if CH_4 emissions are reduced today, we will reap the benefits in 10 year, but benefits of CO_2 emission reduction today will be seen after 100 years.

The shorter lifetime of CH_4 makes it attractive for policymaking because by reducing a smaller amount of CH_4 we make greater and quicker impact on global warming (— 23 times compared to CO_2). Many methane sources owe themselves to mismanagements of waste, quality of feeds to the livestocks and such others. So the quality of life of every citizen improves when we take measures for reducing CH_4 emissions by improved management practices.

SR: ***Do we tend to underestimate the methane question?***
PP: In the science community CH_4 means a lot of opportunity but I agree with you that methane is not often discussed in some of the important fora. That is probably because methane concentration is only about 1.8 ppm today compared to about 400 ppm of CO_2. For the scientific community, prediction of year-to-year variability in CH_4 concentrations has also remained as one of the most challenging.



Methane is not often discussed in some important fora probably methane concentration is only about 1.8 ppm today compared to about 400 ppm of CO_2

In our paper (Patra et al., Biogeoscience, 2013) we showed that when we weigh CH_4 emissions with the global warming potential, CH_4 radiative forcing become higher than that from all fossil-fuel CO_2 emissions from the South Asia region. We estimated average CH_4 emissions of 37 Tg-C/yr and best estimate of CO_2 emissions of 297 Tg-C/yr (1Tg = 1trillion g), which means the net global warming effect of CH4 emission from South Asia (37 x 23 = 851 TgC/yr in CO_2-equivalent) is way greater than the fossil fuel CO_2 emission.

SR: ***Agreed that the atmosphere is under threat but is there any reason to panic?***
PP: I think there are reasons to panic, considering our future generations. I am worried about the high level of air pollution in India and the South Asia region in general – as I said CH_4 plays a role in air pollution chemistry. We do not want to get this worse. There are many kind of illness just due to poor air quality (respiratory, cardiovascular...). This can be achieved by educating people that everyone can live better and at the same time reduce greenhouse gases emission. For example, (a) driving well-maintained vehicles on the road reduces CO_2 emissions, reduces air pollution, (b) Reduction of CO_2 emission and air pollution can also be achieved by proper driving of vehicle, say lane driving, smooth transition of speed.

On the longer time scale, the effects of greenhouse gases on regional climate change is lesser known but the earth system with high global warming is likely to be irreversible. It is always better to keep our living (environmental) conditions as close to the natural state as possible. A warmer world (which is guaranteed as greenhouse gases continue to increase in atmosphere) is definitely not desirable for Indians – we already invest so much on air conditioning.

SR: ***What are the main threats facing Indian farming today from the climate change perspective?***
PP: Several studies have shown growing-season mean temperature and precipitation are very important for crop yield. For example, if there is an increase in temperature during the winter months, the yield of wheat is affected and we all know the control of rainfall on rice yield. There are also studies that air pollution, such as high ozone (O3) level reduce productivity of many crops, such as wheat, soybean and rice.

SR: ***In what manner is Indian agriculture itself contributing to this threat?***
PP: Methane (CH_4), which is a precursor of ozone production, is emitted from rice cultivation, enteric fermentation (ruminants), manure and waste management. So it is clear that emission of CH_4 has a negative feedback on crop yield. Nitrous oxide (N_2O) is another strong greenhouse gas that emits from our agricultural system. With the advent of measurement and modelling, we are now able to estimate and verify emissions of CH_4 from different parts of the globe (Patra et al., J. Meteorol. Soc. Jpn., 2016). The South Asia region is one of the hottest spot in the world as far as emission of CH_4 is concerned. Further investment in research

Photo: Prabir K. Patra

is needed for clear separation of different emission sectors so that effective policy decisions by the national government can be taken.

SR: ***What are the policy changes that the government of India should be considering to mitigate these threats?***

PP: One of our studies (funded by the Ministry of Environment, Japan) is now looking into emission reduction potential of CH_4 by changing agricultural practices, such as selection of rice cultivars, continuous flooding vs intermittent flooding, application of fertilizers. Apparently, the intermittent flooding method has been implemented in many areas of Japan and China in order to reduce CH_4 emissions from paddy fields. In fact, this method can also save water by a large margin but is possible to implement without risking the crop damage but can only be envisioned when highly secured irrigation facility is available.

SR: ***What policies should India and the world keep in mind to drive change?***

PP: Carbon dioxide plays the major role in global warming and methane has the second largest contribution to the global warming due to anthropogenic emissions. As mentioned earlier, a couple of factors make emission reduction of methane is the most attractive option for reducing impact of global warming and air (ozone) pollution. Apparently, any effort toward reduction of CO_2 and CH_4 emissions improves the living conditions of Indian citizens through direct reduction in air quality and preservation of water resources, and contributes to the global effort in mitigation of climate change. ●

***Prabir K. Patra**, an atmospheric physicist of global repute, is senior scientist at the Department of Environmental Geochemical Cycle Research, Yokohama, Japan Agency for Marine-Earth Science and Technology (JAMSTEC) and formerly head of international research project on climate change at the Frontier Research Centre for Global Change. His research paper has been published in many peer-reviewed journals, including Nature.*

Changing Landscape; Innovative Rural Workspace

Asish Biswas

Women engaged in Ari embroidery.

Photo courtesy: Craft Resource Center

In the late seventies, an Oriya teenager, Baburam Biswal from Bhadrak, came to Kolkata in search of a livelihood. Through the extensive Oriya network in the city, he was placed as an apprentice to a senior plumber. Over the next several years, he worked at his job and explored the city and its many attractions.

ASISH BISWAS
is a development consultant working on national and international projects

In one of the many multi storied buildings of south Kolkata that his senior worked in, there was the temporary vacancy for a lift man. Fed up with his low-paying job, Baburam managed to wriggle his way into the office of the building co-operative's manager. After suitable entreaties and assurances of future loyalty, the much coveted job of a temporary lift man was his.

With no place to stay of his own, enterprising Baburam found local accommodation with an upper middle class family close to his place of work. The deal was that he would be an errand boy and make chappatis for dinner between six and 10 pm, as he worked a morning shift. His lunch and dinner would be covered by the family and he would also get some financial compensation.

Every year Baburam went back to his village for his month-long holiday when he bought agricultural land after addressing the immediate priorities of his house and homestead. A decade and a half later, Baburam had acquired substantial rural holdings and had returned to his village as a rich man by local standards. However, the plot was falling apart.

Like most Odiyas from the coastal areas, Baburam grew lots of rice. Most of it was low grade, meant for home consumption and weekly market (haat) sales. The more expensive varieties were used on special household occasions. The surplus again found its way to the local markets. This, in itself, was counterproductive: it occupied precious farm land, used vast amounts of water, consumed an inordinate amount of human resource and blocked money for three or four months as input costs.

Yes, seasonal vegetables and fish were also raised. Both were largely consumed at home and there was hardly anything left for commercial sales. Being a Vaishnav, livestock was not raised for slaughter and chicken was especially taboo.

As a lift man, Baburam was unemployable in a rural setting. As a plumber, jobs were rare enough in his area. The occasional assignments that he got from wealthy neighbours were hardly remunerative. The possible saving grace was the then proposed construction of a new port in the district. Baburam Biswal was eyeing future possibilities as a plumber in the proposed port.

Globalization and India's consequent "success story" changed millennia old farm and labour patterns. There was a sharp spike in the migration into urban areas in the last two decades. Add the glitter of city lights and mass media (television, films and free Jio sims) pushing urban attractions into rural spaces; sprinkle a dash of cash at the day's end and the recipe for migration to urban India was complete. It would be interesting to compare the number of rural-based Hindi movies today as compared to the seventies and the early eighties.

The Indian farming landscape has some self-farmed farm plots, getting subdivided and fragmented, and inherited plots, left unattended and fallow or grabbed by neighbours

The Indian farming landscape meanwhile had some self-farmed farm plots that were getting subdivided and fragmented on the one hand and, on the other, inherited farm plots that were either left unattended and fallow or quietly grabbed by neighbours and siblings. This could also be the opening of an opportunity — albeit unintended — of having slightly larger farm plot size whereby agriculture could become somewhat more economically sustainable.


Pottery makers at Khurja.


Fringing stoles in Varanasi.

Some two million shift from rural to urban areas annually and 22 million have migrated since 2001, driving the spectre of rural unemployment and urban slums

The Ayurved Opportunity

Bangalore-based Foundation for the Revitalization of Local Health Traditions, ran a herbal project that secured large scale participation by village women in its production and processing. People took easily to this inexpensive yet equally effective alternative, which they had seen earlier generations rely on. If this could be scaled up and necessary compliances adhered to, this could be an additional source of income for many millions of families across this country. Over the years, certain designated small towns or villages could become hubs for seasonal ayurvedic fairs and centres of knowledge management.

Factor in that Indian farm plots are growing smaller as they keep getting divided among children with the passing of each patriarch. Thus, consolidation of family and community farm plots for operations would probably mean more and efficient agriculture, if suitable mechanization was promoted. It would also mean displacement of labour that would have to be suitably absorbed or else it will migrate to urban centres.

Some two million people shift from rural to urban areas annually and some 22 million people have migrated from rural to urban areas since 2001. It is this mass that drives the spectre of rural unemployment and urban slums. It is also a challenge in rural India that could be converted into an opportunity if there was diversified training provided to the rural youth in particular to help them access opportunities that the new socio-economic trends are throwing up.

Consider just a few areas of obvious but emerging opportunities; the growing market for herbals and ayurveda, for instance (see box). This has huge scope for additional income and employment generation. It requires little land, limited inputs, some technical support in drying/processing and strong market linkages. Globally the herbal product market is $80 billion with an annual growth rate of seven per cent that is expected to reach $6 trillion by 2050. The Indian market is estimated at ₹4,205 crores with

Weaving woollen stoles in Kashmir.

Photos courtesy: Craft Resource Center

possible export of Ayurvedic drugs and allied herbal products projected at ₹440 crores and the total earning potential by 2020 estimated at ₹7,000 crores.

This is an opportunity that is waiting to be seized and there are many such. To convert traditional farm practices and products, a large cadre of "field agents" would need to be identified, trained and deployed to act as counsellors to farmer groups. Progressive farmers need to be identified and sent to farmer field schools for training and capacity building and have to be mentored to "take the plunge".

There are proven opportunities in post-harvest processing. Many youth in rural eastern Maharashtra invest in small cold storages. There they stock up on the soya crop after the harvest when the price is around ₹7/8 a kilo and release it during off season, when it commands a sizeable premium.

Huge opportunities may be seized in the ongoing shift in the non-vegetarian eating patterns. The day is not far off when a certain class of English speaking Indians will be eating escargots – the rural poor already eat "geNdri". Follow that up with turkey, guinea fowl, quail, emu – happening in more upmarket restaurants — as are Norwegian salmon. Crocs and kangaroos could also follow. There is now a huge scope for rural employment here along with corresponding profits.

If a part of the reasonably educated rural farm labour could be diverted to Village Level Operations and Maintenance (VLOM) of community assets like hand pumps, panchayat roads, renewable energy units, which could

Home Stays for Rural India

Any form of tourism highlighting rural life, art, culture or heritage, at rural sites, thereby supporting the host (local) community socially, economically as well as enabling interaction among the guests (tourists) and the hosts for a more enriching experience, is rural tourism. This is happening in rural sites of Darjeeling Hills with the concept of home stay empowering the rural economy.

Rural tourism's greatest potential benefit is its ability to generate money, which translates into numerous economic opportunities for locals and their communities beginning with jobs within the tourism sector and outside of it. Tourism development means more income and profits for tourism-related business.

The economic multiplier model suggests that if local income from tourist expenditures is spent within local area, an increase in local income and jobs will follow, helping both individual homestay owners and the host communities. This results in increased economic stability and provides various social benefits other members of rural communities, the extent of which hinges on the level of involvement from the community itself. The formation of rural home stays in small villages has also supported the opening of others in the same area.

Besides, small enterprises formed to accommodate the needs of various home stays are helping refuel the local tourist industry. Female home stay owners recognized how their home stays were contributing to the local economy and the promotion of their village as a tourist destination "I found only those home stays that had been in operation for an extended period of time were able to make a significant social contribution to their community. At present many home stay were being opened in different parts of rural areas for tourist purposes and the through which it is helping in sustaining the development of the area as well as the source of livelihood of economically deprived population".

— Sourced from Rural Tourism for Sustaining Rural Livelihoods in Darjeeling Hills, Dr Sherap Bhutia.

Photos courtesy: Craft Resource Center

generate power for both domestic needs and agro based industries, the shelf life of various agro products would multiply manifold.

Consider the economy of Darjeeling district in West Bengal that is being transformed by a state government supported village tourism initiative with home stay facilities being offered by villagers. Training institutes for people who would anchor homestays and those who would work as guides in the same estate are also being set up. (See box Homestays for rural India)

Considering that India is spread over a huge geo climatic range, opportunities could be endless and varied. India could out produce France in asparagus, New Zealand in kiwi fruit and the Germans in pork, to look at a few areas. India could extend the milk production experience that made it the world largest milk producer to fish or other animals.

A mission approach would be the way to go. If Operation Flood gave India the edge in milk production; a possible Operation Oink could make it a serious competitor to China in pork production. A parallel Operation Scales could promote breeding and growing of aquarium fish – a growing opportunity for rural women to collectively earn extra money.

Barefoot College, amongst many others, is doing just that. Canning, processing of products like jams, sauces, pickles, butter, local cheese (Bandel and paneer are the only two registered Indian cheeses now), sausages, bacon, which some enterprising Goans must be doing. They do so all over Europe and this is something that could be done by village level groups after suitable training. Most of these would require rudimentary machinery which, in turn, would require regular upkeep and maintenance and lead to more opportunities.

This entire value chain would generate jobs and profits at every level. Apart from the direct

Labour-intensive weaving: the Ikat technique; Siripuram village, Telengana.

Local women working on jewellery, Moradabad.

Large scale conversion to livestock farming would require an attendant para vet cadre and a cold chain for vaccines. These need specialized training

opportunities, there would be an enormous scope in training people in the maintenance of support services – servicing of cold storages, trucks, bikes, cell phones, solar panels and wind turbines, rural data bank computers (for prices/online bookings, inventories and weather updates), training in packaging, processing and such others. Large scale conversion to livestock farming would require an attendant para vet cadre and a cold chain for vaccines. All these need specialized training.

Apart from these services and potentially new jobs, the self employment possibilities of support services would create a new value chain. Transport would be one area of opportunity. From those narrow, winding household paths, the brick laid pavements to the red "murram" rural roads and finally, the tar top roads that lead to highways and cities, would need a range of transportation. From head loads to bicycles, cycle vans to cannibalized scooter engine driven vans, TATA Ace micro trucks to 3 axle Leylands; they would all require drivers, cleaners, loaders and, of course, service crews.

With a quantum increase of livestock, what happens to their waste? Could that be used for micro energy generation units and vermicompost? Both these activities would require training, follow up and regular monitoring. This, in itself, would create and sustain another cadre of specialized trainers. All this would simultaneously require huge numbers of sales and marketing personnel. Rural insurance requirements would go through the roof. Are there enough trained personnel as insurance agents, assessors, accountants and such others?

Mumbai is a city synonymous with glamour and wealth. Yet, 61 per cent of that city lives below the poverty line. A good question here would be why? The obvious answer is to provide cheap labour to Bombay's factories. Now, with Make in India, the scenario will probably get worse.

It is this scenario that should be focused on alongside the spectre of rural unemployment. ●

EXEMPLAR

TOWARDS THE RIGHT 'DISHA'

Integrating Social Reform with Livelihood Improvement

Bharat Dogra


महिला हिंसा नहीं सहेंगे
महिला होगी जब किसान देश बनेगा तब महान।

Rope-making artisans, from farming families in the Shivalik hill region, were badly handicapped. They needed the bhabar grass growing in Shivalik belt for making ropes used for weaving cots and other furniture like chairs and morahs. As in many other artisanal fields, middlemen/ traders procured the raw material cheap and fleeced artisans for the grass.

BHARAT DOGRA
Senior journalist, specializing in the farm sector

The exploitation would have continued had not a local social organization, Disha, intervened. It bought grass and distributed it amongst the rope makers. The vested interests did not relent. They sabotaged this effort by setting the stored grass on fire. Disha was not to be dissuaded. In collaboration with Vikalp, another grassroots institution, it formed an organization of rope artisans, which could then directly access cheaper raw material and free the craftspersons from the middleman's clutches.

Livelihood improvement in the farm sector and social reform are recognized as critical to rural development but are generally taken up in separate silos. Disha, based in western Uttar Pradesh, integrates enhancement of rural livelihoods with its many-faceted initiatives for social reform.

"When the guiding aim is all-round welfare of people, clearly our efforts to reduce liquor consumption are as important as improvement of agriculture; efforts to promote gender equality are as important as setting up self-help groups to promote savings and small enterprises. Progress in one contributes to progress in the other", says Jahnvi Tiwari, a leading Disha activist.

A related aspect of this approach has been giving top priority to the weaker sections: small workers and farm workers as well as artisans. Again, within this section, there is greater emphasis on enhancing and supporting the rights of and leadership opportunities for women. Due to such clear priorities, a broad-based front of small and marginal farmers has been created with thousands of members, in Disha's core working area. This has also created a strong platform for its social reform efforts, based on social equality, gender justice and communal harmony, which are Disha's core values.

Disha started about 35 years back in the Sarsawa and Sadhaula Qadim blocks of Saharanpur district but, with the passage of time, while retaining its original base, Disha's work spread to several other parts of western Uttar Pradesh and the neighbouring state of Uttarakhand. The core values continue to guide all efforts.

How were the women organized into self-help groups in the initial years? These groups started with very small savings that increased over time to a level from where they could be leveraged by the women to borrow. They borrowed not only to meet family contingencies but also to enhance livelihood opportunities by setting up small shops, leasing in land or buying a buffalo. These groups were linked to banks to enhance their capacity to provide credit.

As the groups set up by Disha were not isolated efforts, integrated as they were with a much wider socio-econmic mobilization, they became well known for their efficient functioning. Recovery of loans was exceptionally good and even Nabard awarded Disha for this. The groups met regularly and took up other matters of common interest and welfare as well.

Eventually Disha's work was integrated with the wider micro finance movement and spread to new areas. There were questions about Disha's ability to succeed in the new areas where it did not have the long experience of social mobilization, which was a strength in its core area. Disha made special efforts to make the expansion work.

K. N. Tiwari, founder co-ordinator of Disha, says that isolated business ventures are not desirable for the organization that always tries to link its work with wider welfare objectives. The expansion phase was progressing well till it faced its first major disruption by way of demonetization and related factors. People hope to overcome the crisis and carry on with their work smoothly.

In areas where more specific agriculture-related improvement work was taken up, separate farmer groups were set up in addition to self-help groups. These efforts around a crop diversification project showed how incomes could increase and agriculture become more sustainable if a carefully selected but more diverse range of crops is grown. Organic farming practices, reduction of dependence on agri-chemicals and cost decreasing methods were also emphasized as a part of this initiative.

Around the same time Disha conducted two studies.

- One, on the growing problems of farmers and the worsening agro-ecological crisis, conducted over a few villages.
- Two, on the impact of climate change on mango orchards.

Much before the GM crop debate became a big issue in India, Disha was the local host for an international conference on GM crops that warned about their hazards

The findings showed the need for eco-friendly farming. Thus, much before the GM crop debate became a big issue in India, Disha was the local host for an international conference on GM crops that warned about their hazards. Experts from several countries participated in this conferences and the proceedings, published as a book, provided a timely warning.

Disha also distributed land for cultivation among dalit landless households, reaching out to the weakest sections. Later, when the administration tried to take back some of this land, Disha acted with alacrity and, with the help of Vikalp, it obtained stay orders so that land remained with dalit cultivators who had toiled hard to make the land cultivable in the first place. It was this Disha-Vikalp combine that had rescued the rope-makers of Shivalik from the throes of the middlemen as well.

As its activities expanded to Uttarakhand, Disha initiated efforts to help artisans in Tehri Garhwal district. Here Disha helped in the rehabilitation of earthquake victims, amongst others. In the Yamuna Khadar area, where hundreds of farmers faced ruin due to chronic water-logging of their land, Disha initiated a campaign on their behalf that, over time, resulted in effective government action for providing relief to them.

Dishas's focus on women was steadfast as it secured better participation of women in all its activities and provided them leadership opportunities for all their initiatives. At one critical point of time, when farm workers were demanding higher wages, Disha and the locals emphasized the demands of women workers first as they were paid much less than their male counterparts, though they worked just as hard. This struggle was a very difficult one but eventually succeeded in getting a significant wage increase for women workers.

The emphasis on women empowerment became evident during the various panchayati raj elections and town area committee elections for urbanizing villages. Disha campaigned for free and fair elections so that honest candidates had better chances of winning. Alongside, it emphasized and worked for the emergence of effective women leaders, particularly women from weaker sections.

Whenever women, elected to leadership roles in panchayati raj institutions, needed any help in more effective governance, Disha extended all help. In Sultanpur, Chilkana village, for example, people fondly remember the very helpful role played by

The leadership role for women led to more emphasis on anti-liquor efforts in Disha's work though this was not related to the assigned project work. It was prioritized by women members

two elected representatives, Suraiya Begum and Rajjo, who in turn were helped by Disha activists so that their work could progress well.

When an elected woman representative, Zeenat, was humiliated by fundamentalists for contesting an election, women activists of Disha took the lead in opposing this, even though they were brutally beaten up for this protest.

The leadership role given to women also led to more emphasis being given to anti-liquor efforts in Disha's work. Even though this work was not related to the assigned project work for Disha, it was prioritized by women members in particular, who could better understand the increased difficulties and problems of women from villages where liquor vends had been opened, leading to increased consumption there.

This meant a reduction in the already meagre family incomes for meeting basic needs, increased domestic violence and the gathering of anti-social elements near liquor vends that endangered women's safety. Matters came to a head in Pather village of Saharanpur district where these problems had increased alarmingly.

Women of this village took the lead in demanding the removal of the liquor vend located here and started a sit-in protest dharna. Disha put its full weight behind the villagers with women playing the most important role. This turned out to be a much more difficult task than was anticipated as the liquor contractor was a politically very well connected and was willing to spend a lot of money to retain this vend.

Days passed into weeks but the demand was not accepted. Villagers with little resources were finding it difficult to continue the dharna. Women, who played an important role in the dharna were facing hostility, even within their own families, generally from male members. Even the administration pressured Disha to discontinue its support to the anti-liquor movement.

Disha took them on headlong; the administration as well as the goons. This brought out the firm resolve of the women — who had an important say in decision making — to determinedly continue the struggle. The situation became graver as the police cracked down brutally on a protest organized by anti-liquor movement activists in Saharanpur. Several women were injured seriously and had to be hospitalized. All seemed to be lost but the dharna continued.

Meanwhile, the movement caught the attention of the governor of Uttar Pradesh who reportedly intervened personally and ensured that the liquor vend was removed. There was a spontaneous celebration in Pather village as women danced and halwais (sweet sellers) distributed sweets free of cost.

A determined group of women and activists showed that they would not be deterred by intimidation and repression and Disha's remarkable courage to withstand multiple pressures and continued support for the anti-liquor effort was established. The episode also brought to focus the importance given by Disha to the wider agenda of social change, reform and the need for equality at all levels.

Disha is particularly opposed to discrimination against the dalits. Some senior members recall how difficult it was to break old traditions and change mindsets. It was initially difficult even for the dalit families to fully accept the idea of equality for their own members. Over time, such thinking was changed as people were convinced of the need to have social equality at all levels. This had a wider impact in the villages where Disha activists worked.

Communal harmony has also been central to Disha's philosophy and working; its area of operations largely having a mixed population of Hindus and Muslims. Disha has consistently worked to promote good relationships between the two communities. It organizes Eid and Holi celebrations with members of both communities coming for joint celebration. Disha activists belong to both communities and work together with mutual trust and co-operation. Leading by example, they have a wider impact on other villagers.

When Disha started working in Sultanpur, Chilkana, the rural society here was broadly divided between the Pandit and Mir factions. The weakest sections had little by way of an independent identity. While striving to maintain good relations with all sections, Disha encouraged a broad alliance of small and marginal farmers, landless workers and other weaker sections, carving out an important role for women.

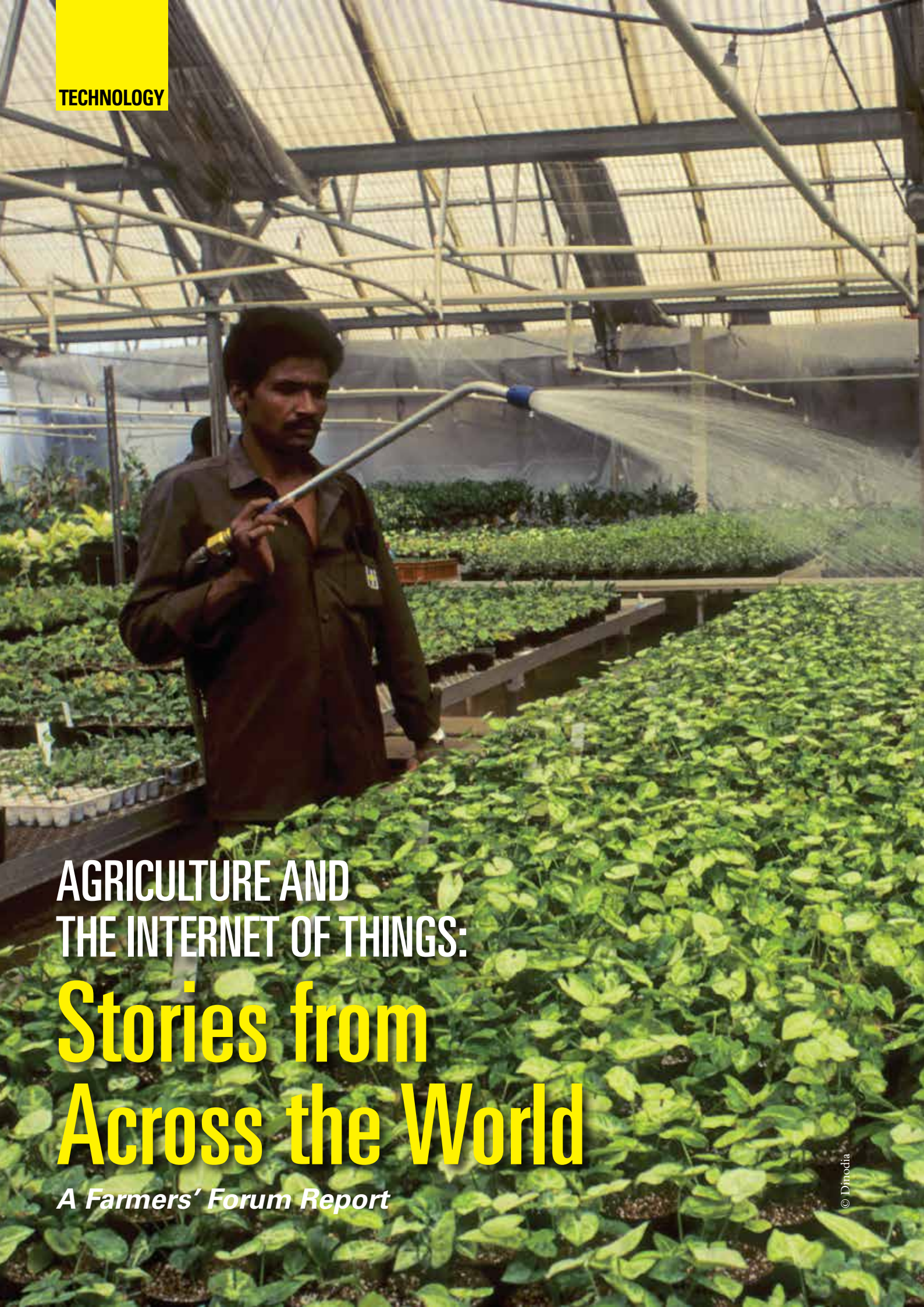
The upshot was that the majority of people belonging to these sections developed a sense of independent identity, based on solidarity and shared interests while keeping away discrimination and segregation. While it was not possible to change all discriminatory attitudes in a few years, some important steps have certainly been taken towards social equality. Such social equality is very important as base work for the success of justice-linked development work.

When this is neglected and only the 'development' aspects of projects are given priority, their success, vis-a-vis the sense of justice that they should instil in communities, remains hamstrung because no focused efforts are first made to create a foundation of social equality. This is why Disha's work has been significant in terms of multi-faceted learning experiences.

Three Disha women activists were returning tired and thirsty from a bus journey to a remote village and wanted a cold drink. They did not have the money to buy three and purchased one cold drink with three straws. As they sat sipping the drink together, an elderly person remarked that one of them was Brahmin, one was Dalit and one was Muslim.

She nodded in appreciation: "Yes Disha certainly shows the direction for creating a new society based on equality and harmony". ●

TECHNOLOGY



AGRICULTURE AND THE INTERNET OF THINGS: Stories from Across the World

A Farmers' Forum Report

Spread over a diverse agro-climatic regime, Indian agriculture covers 157.35 million hectares — the second largest quantum of land under agriculture for any country in the world — with rapid advances in food production and an increasingly diverse crop basket. There is a rub though.

Much is fundamentally wrong with the sector, led by a rapid loss of soil fertility courtesy excessive use of chemical fertilizers. Given the domestic (and global) focus on food security, agriculture should emerge as the most important segment of economic activity and receive the attention of the best technological resources. Indeed some progress has been made (see Ibef infographic Evolution of agriculture in India)

Global estimates for food required to feed every mouth suggest that production will need to go up 70 per cent in 2050 from the numbers in 2006, says the U.N. Food and Agriculture Organization. That is easier said than done. India too seeks to step up foodgrain output from 253.16 million tonnes in 2016 to 280.6 million tonnes by 2020-21.

Yet there are areas of concern everywhere, from soil, fertilizers and pesticides, inadequate monitoring of livestock, disease prediction, inadequate water for farming and irrigation, poor storage capacities (like water tanks) and many such. The issue is to produce enough food and at a lower cost on the one hand while the farmer must receive adequate remuneration to continue to stay in agriculture on the other.

Globally, all farming roads are turning towards the internet of things (IoT) and things are slowly but surely turning that way in India as well. Notwithstanding the relatively basic use of technology in Indian farming, innovation in use of technology is hardly recent; indeed the culture of using implements that was spawned by the need to make farming easier, though it began with simple hand-held tools, is nothing new for the country. Globally, the Industrial Revolution led to import of higher technology into agricultural practices beginning with the cotton gin; the 1800s brought in grain elevators, then came the chemical fertilizers, first as a blessing, which went on to becoming a curse in India thanks to injudicious and over use. Then came the early gas-powered tractor.

Currently, India is amongst the largest manufacturers of farm equipment such as tractors, harvesters and tillers, accounting for nearly one-third of the overall tractor production, globally, with the tractor production in the country estimated to increase from 0.57 million units in 2016 and reach to 16 million units by 2030. The government has allocated $223 million to set up a farm machinery bank to distribute farm machinery and tools to farmers in various states in 2016.

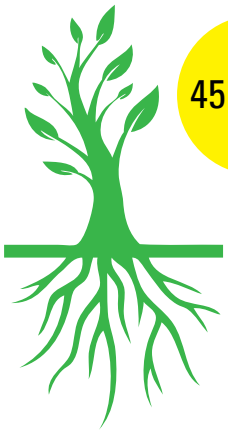
Under the Digital India movement, things need to be fast forwarded to getting IoT to serve Indian farmers better. Globally, farmers have been using satellites to design cropping plans from the 1990s. "The IoT is set to push the future of farming to the next level"[1].

Not just in countries using advanced farming technology; India's own Indian Space Research Organization's (Isro) Indian Remote Sensing programme has focused on the farmer.

The first remote sensing based pilot project carried out to identify coconut root-wilt disease in Kerala in 1970, led the development of Indian Remote Sensing (IRS) satellites. "These IRS satellites have been the workhorse for several applications - encompassing the various sectors such as agriculture, land and water resources, forestry, environment, natural disasters, urban planning and infrastructure development, rural development, and forecasting of potential fishing zones", says Isro.

The Natural Resources Management System (NNRMS) networks with central and state governments, private sectors, academia and non-government organizations to enable the integration of remote sensing, contemporary technologies and conventional practices for management of natural resources. Such platforms to support the farmer have been developed by other global technology

Global estimates for food required to feed every mouth suggest that production will need to go up 70 per cent in 2050 from the numbers in 2006



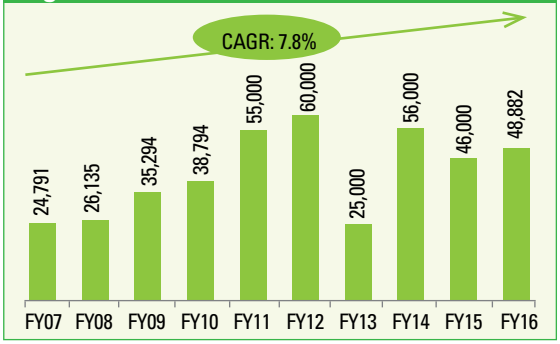
1 http://www.businessinsider.com/internet-of-things-smart-agriculture-2016-10?IR=T

firms as well (See box *ThingWorx*). The possibilities are endless.

Consider India's tractor space, where sales increased from 0.35 million units in FY07 to 0.57 million units in FY16, witnessing growth at a CAGR of 5.5 per cent. John Deere (a global player in the farming equipment space) is connecting its tractors to the internet to display data about farmers' crop yields. Alongside it is developing self-driving tractors to free up the farmer's time for other tasks and increase efficiency.

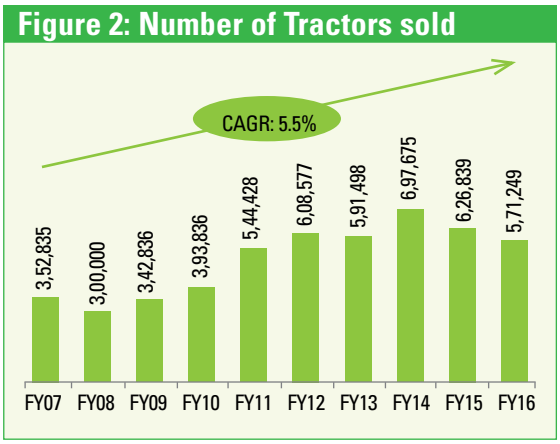
The idea of marrying the internet with farm mechanization programmes is catching up. Tiller sales in India increased at a CAGR of 7.8 per cent to 48,882 units over 2007-16 and the government has set up a number of farm machinery training and testing institutes to train farmers on the operation and maintenance of agricultural equipment. On the anvil is a National Mission on Agricultural Mechanization (NMAM) to spread the benefits of mechanization, especially amongst small and marginal farmers. The aim should be to inject a dose of IoT to convert mechanization into precision farming, using satellite imagery and allied technology to capture relevant data to make enough and affordable food for all and to so with environmental sustainability.

Figure 1: Number of Tillers sold



Source: Department of Agriculture and Cooperation, A report of 'Indian Tractor Industry' by ICRA, TechSci Research DAC - Dept. of Agriculture and Cooperation

Figure 2: Number of Tractors sold



Source: Department of Agriculture and Cooperation State of Indian Agricutlure 2013-14, ICRA,, A report of 'Farm Machanization in India;, TechSci Research

ThingWorx

The ThingWorx IoT Platform helps collect and manage vast quantities of data from sensors, cloud services such as weather or maps, connected equipment and existing systems and support the quick building and bringing to market new innovative IoT applications at 10 times the speed of other approaches with the platform's rapid application development environment and drag and drop mashup builder. It also helps leverage big data and analytics to provide new insights and recommendations to aid in better decision-making and empowers farmers to visualize data and take action on insights and recommendations

This is clearly not a charity project; there is a challenge and a business opportunity given that India has 20 agri-climatic regions — with all 15 major climates in the world to be found here — and its farming accomplishments are considerable. India is the largest producer of spices, pulses, milk, tea, cashew and jute; the second largest producer of wheat, rice, fruits and vegetables, sugarcane, cotton and oilseeds; second in global production of fruits and vegetables; largest producer of mango and banana; and has the highest productivity of grapes in the world.

Thanks to these achievements, agriculture services have attracted cumulative FDI of $1,869.37 million from April 2000 to December 2016 while agricultural machinery fetched $445.96 million. The Ibef reports that 52 countries have signed MoUs/Agreements and there are 63 partnerships with other countries. These are aimed at providing improved agricultural facilities in areas such as R & D, capacity building,

Agriculture services have attracted cumulative FDI of $1,869.37 million from April 2000 to December 2016 while agricultural machinery fetched $445.96 million

© Dinodia

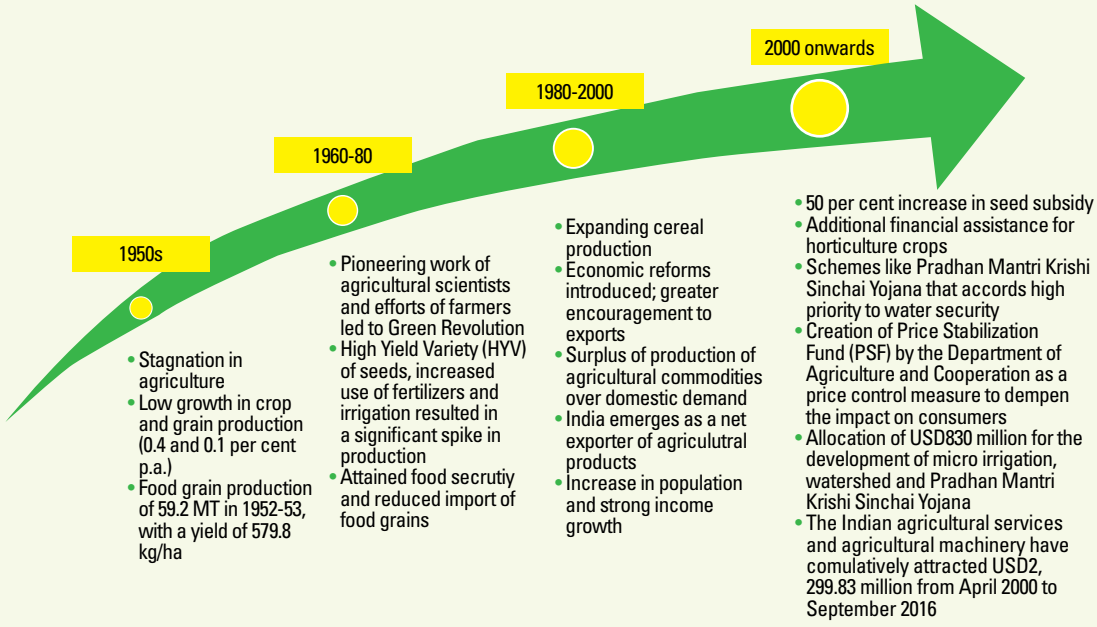
germ-plasm exchange, post-harvest management, value addition in food processing, plant protection, animal husbandry, dairy and fisheries and in shoring up bilateral ties between partners.

Clearly the challenge of feeding the world must be addressed by dealing with factors militating against food production, including climate change and the self-inflicted damages caused by intensive farming practices. Thus the demand for injecting smart thinking into farming.

Beecham Research, a global IoT research company, emphasizes that: "Smart Farming is not just for large farms and research centres but is starting to impact small and medium-sized farms"[2].

The global farming industry has been receptive to such IoT driven technical innovation and it is

Figure 3: Evolution of Agriculture in India



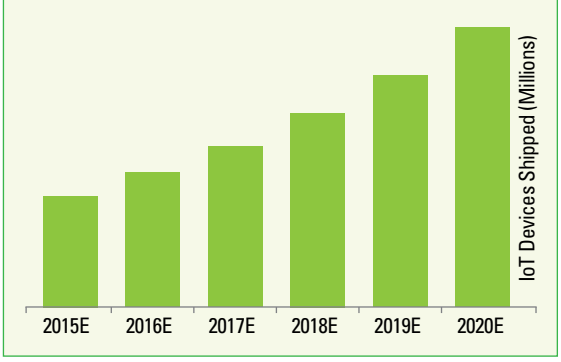
Source: Ministry of External Affairs, RBI, Ministry of Agriculture, TechSci Research

India's turn now. In 2014, Cambridge-based sensor and monitoring firm General Alert (GA) teamed up with IoT specialist 1248 to see if the company's Geras IoT database could improve livestock welfare (See box *Farming with Data*).

The database stores billions of readings on environmental data such as temperature, humidity, drinking-water flow, feeding rates and CO^2 concentration, as well as ammonia and pH levels.

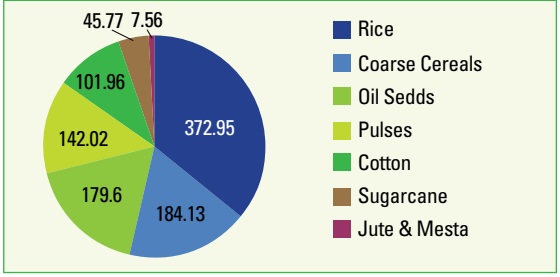
For crop farming, smart farming means preparing the soil, planting and harvesting at precisely the best time; while for livestock farming it includes monitoring the condition of animals to provide the right type of intervention at the right time.

Figure 4: Estimated Agricultural IoT Device Shipments (Global)



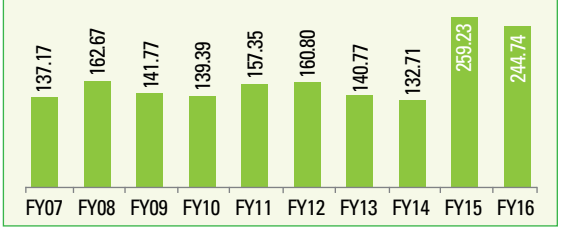
Source: BI Intelligence

Figure 5: Area sown in FY17 (lakh hectare)

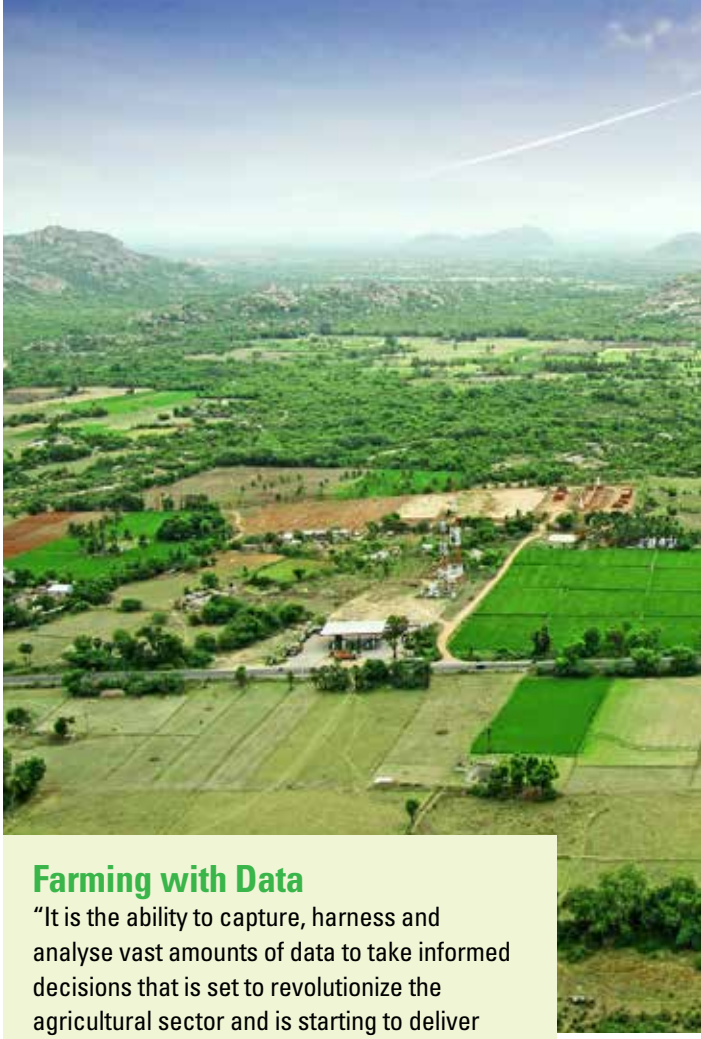


Note: FY171 - Data till September 2016
Source: Ministry of Finance, Ministry of Agriculture, TechSci Research

Figure 6: GDP by value added - size of agriculture and allied activities (US$ billion)



Note: GDP-gross Domestic Product, MOSPI-Ministry of Statistics and Programme implementation FY16-Advance Estimates
Source: Ministry of Agriculture, Print Release, RBI, TechSci Research



Farming with Data

"It is the ability to capture, harness and analyse vast amounts of data to take informed decisions that is set to revolutionize the agricultural sector and is starting to deliver tangible benefits and measurable return on investment for farms of all types and sizes. For crop farming, smart farming means preparing the soil, planting and harvesting at precisely the best time; while for livestock farming it includes monitoring the condition of animals to provide the right type of intervention at the right time".

— Beecham Research

Precision agriculture is sometimes known as 'smart farming', an umbrella term for easier comparison with other machine to machine (M2M) based implementations and is based on sensor technologies the use of which is well established in other industries. For all M2M implementations, depending on the type of farming involved, IT systems gather and collate data for farmers and growers; special sensors collect data regarding soil and crop behaviour, animal conduct, machine status, storage tank and outbuildings status emanating from remote sites. This is forwarded to IT systems for tracking and analytics. The results from the analytics are noted and used to respond to what is happening in the field by taking the most appropriate future decisions and actions[3].

2 Enabling The Smart Agriculture Revolution - The Future of Farming through the IoT Perspective
3 Enabling the smart agriculture revolution; The future of farming through the IoT; Beecham Research

Photo: Pixabay

Sensors, electronics and communications technologies have reached a price point that is making it possible to deploy IoT systems

1248 (See box *Smart Sensors*) offers a range of expert services and off-the-shelf products to help companies connect their devices to the internet and rapidly build scalable IoT solutions. The company is also playing a leading role in creating the Hypercat open standard to enable IoT applications and services to work together automatically, as part of a project funded by the U.K. government's Technology Strategy Board.

The good news, as Chris Dodge, IT Director at General Alert, says is that "Sensors, electronics and communications technologies have reached a price point that is making it possible to deploy IoT systems that deliver real commercial benefit and Geras is a core building block of our solution. We are already working closely with veterinary, agricultural research and farm management companies and looking to expand the range of applications".

BI Intelligence, Business Insider's premium research service, predicts that IoT device

Smart Sensors

General Alert (GA), a pioneer in the use of sensors and monitoring technology on farms, works with (IoT) specialist 1248 to improve the welfare of pigs, poultry and other livestock and provide early warning of transmitted diseases. GA uses 1248's new Geras IoT database and publishing solution to collect data from multiple sensors including temperature, drinking water flow and animal feed rate, humidity, CO2 concentration, ammonia and pH. GA even uses in-vivo RFID and temperature tags planted in pigs, effectively turning a pig into a 'thing' on the Internet of Things.

This is the first time agricultural environments and the behaviour of animals are being measured on this scale and in such detail, to manage productivity, health and wellbeing and improve operational efficiency. By monitoring on a national and international level, the technology will be able to provide early warning of diseases such as foot-and-mouth, which can cause devastating livestock and financial loss.

The GA system uses a very large number of sensors, each collecting thousands or millions of readings via the mobile phone network or internet, which need to be stored and queried to provide meaningful and useful information. For example, a change in drinking behaviour could indicate illness or source of animal stress that can be resolved quickly.

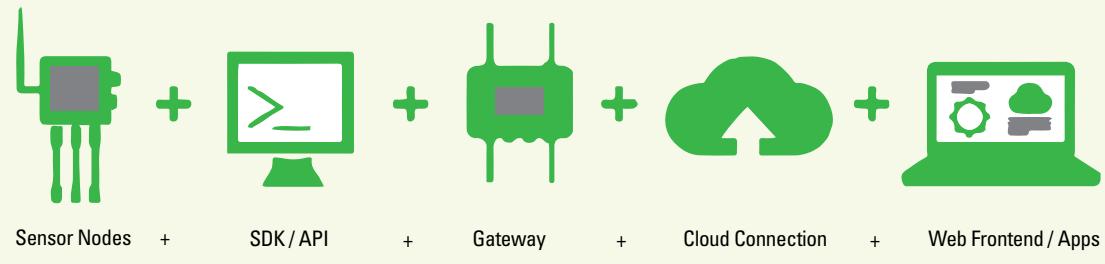
"Rising global population and standards of living are increasing the pressure on food-animal production, which leads to an increased requirement to manage animal productivity, health and wellbeing effectively", says Chris Dodge, IT Director at General Alert.

Geras is a generic, scalable IoT service – a piece of infrastructure which solves a common IoT problem based on open standards. It accepts data trickling in from many devices, stores it and then allows applications to quickly answer high-level questions from it. "Geras is designed to allow companies like General Alert to focus on what they do best – in this case, developing and deploying livestock technology," said Pilgrim Beart, CEO at 1248.

"Companies looking to rapidly harness the opportunities presented by the Internet of Things need to partner with experienced providers who understand how to build scalable architectures and are committed to open standards."

—http://www.general-alert.com

Figure 7: Value Chain Illustrating Data Colletion from Sensor Nodes & Analysis Chain to Web based Decision Support System



Source: Enabling the smart agriculture revolution; The future of farming through the IoT; Beecham Research

IoT device installations in the agriculture world will increase from 30 million in 2015 to 75 million in 2020, for a compound annual growth rate of 20 per cent

installations in the agriculture world will increase from 30 million in 2015 to 75 million in 2020, for a compound annual growth rate of 20 per cent. The U.S. currently leads the world in IoT smart agriculture, as it produces 7,340 kgs of cereal (wheat, rice, maize, barley and such others) per hectare (2.5 acres) of farmland, compared to the global average of 3,851 kgs of cereal per hectare.

This efficiency is expected to improve as farms get connected. OnFarm, which makes a connected farm IoT platform, expects the average farm to generate an average of 4.1 million data points per day in 2050, up from 1,90,000 in 2014. Its studies discovered that for the average farm, yield rose by 1.75 per cent, energy costs dropped $7 to $13 per acre and water use for irrigation fell by eight per cent. This is something that should interest Indian farmers.

Given all of the potential benefits of these IoT applications in agriculture, it is understandable that farmers are increasingly turning to agricultural drones and satellites for the future of farming. Not that India is quite ready to use drones for agriculture mapping given the basic inconsistencies in land documentation. There are other usable technologies though.

Vodafone's India experience bears testimony to the IoT's India potential, thanks to the Indian mobile phone phenomenon. The company believes that small-scale farmers in emerging markets could benefit to the tune of billions of dollars if they had better access to mobile connectivity. The 2015 report, Connected Farming in India, produced by Accenture Strategy, said that 70 million Indian farmers could be taking in $9bn between them by the year 2020 if more attention was paid to mobile services.

The report identified six mobile services that could be instrumental in boosting farming incomes in the developing world – not just in India[4]:

- Agricultural information services, such as weather forecasting, and apps giving advice on when to harvest, along with crop husbandry techniques to enhance yields, could increase incomes by an estimated $89 a year.
- Mobile receipt services to allow transparency in commodity supply chains, would boost incomes by improving efficiency and giving farmers a means to fight fraud.
- Mobile wallet services for payments and loans – such as Vodafone's M-Pesa service, which is already available in India – could give farmers access to micro-finance and easy and transparent electronic payment systems, which may enhance incomes by nearly $700 in some cases.
- Field auditing could enable auditors monitoring quality, sustainable practice and certification compliance to eliminate paper records and adopt electronic reporting, again enhancing efficiency.
- Local supply chain services would allow smaller producers to transact fairly with local co-operatives.
- Smartphone-enabled services would provide better functionality and richer sources of information than is currently possible using basic feature phone SMS and voice services. Here the emphasis would need to be on advanced and affordable smartphones and the network to back them up.

4 http://www.computerweekly.com/news/4500246900/Vodafone-reveals-six-mobile-services-to-help-developing-world-farmers

Seeding Smartness

iPads from John Deere, an iPad app, has nine mapping layers that track what is happening in the field. Users can set, for example, how many seeds are planted per acre and precisely how far apart they are planted. A mapping layer called singulation shows groups of up to 10 seeds (the number distributed in 20 millisec) and shows on the iPad exactly where they are located and whether they are spaced properly, seed-by-seed.

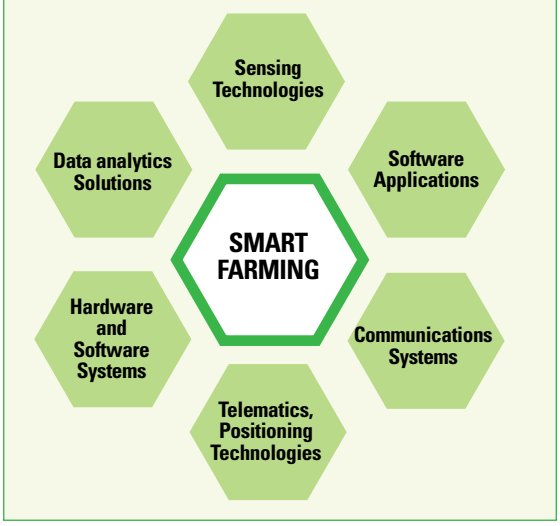
Another IoT add-on for a row unit (which puts the seed in the ground) is a sensor that measures the pressure being exerted on each seed as it is planted. Farmers want to change this pressure depending on how soft the soil that they are planting on is. Based on the readings, managers can adjust the pressure and the spacing. That way the seeds are set at the optimal depth and distance apart for successful growth.

— John Deere

© Dinodia

Probably the most interesting thought comes from John Deere on the internet of manure, which addresses chemical sprays for crops that lead to environmental hazards. John Deere is offering manure constituent sensing. Manure is highly in demand and well-used in farming as a natural, organic fertilizer but variations in its make-up and consistency mean that can deliver highly variable results.

Figure 8: Smart Farming



Source: Beechame Research

By mounting sensors on the applicator that can deliver 4,000 readings per second, farmers can now measure nitrogen, phosphorous, potassium, ammonium, dry matter and volume accurately, while spraying their fields. Says Christoph Wigger, of John Deere: "When the manure is very light, the sensors will guide the speed of the tractor and decelerate it so that it gives more. When it is heavier, it speeds up".

This means that users can achieve site-specific nutrient target levels on the go, while saving money on bought-in mineral fertilizers. The other key use case for sensor networks in farming is to detect the presence of environmentally-protected areas on a farmer's land, such as watercourses that must not be polluted with chemicals. When there is a spray boom, the GPS picture shows the sprayer exactly where it is and automatically shuts off some of the nozzles so that one stays back to protect the water.

There will be some 22.5 billion IoT devices in 2021, up from 6.6 billion in 2016. There will be $4.8 trillion in aggregate IoT investment between 2016 and 2021. How will India leverage this massive opportunity to address its challenges is the question. ●

TECHNOLOGY

Intelligent Cloud; Increasing Yields The Icrisat-Microsoft Experiment

A Farmers' Forum Report

The contrast could not have been more spectacular; nor the results. Perched at one end of the spectrum was G. Chinnavenkateswarlu, a farmer from Bairavanikunta village, Andhra Pradesh. Chinnavenkateswarlu had sown groundnut on three acres of land that he owns. This was on June 25, 2016. The crop was impressive. Not surprising, because at the other end were scientists from the International Crops Research Institute for the Semi-Arid Tropics (Icrisat) and Microsoft.

Chinnavenkateswarlu's was a special sowing for it was based on the recommendations provided to him by the Icrisat."My crops were harvested on October 28, 2016 and the yield was about 1.35 tonne per hectare. Advisories provided for land preparation, sowing and need-based plant protection proved to be very useful to me", says Chinnavenkateswarlu.

This Andhra farmer was a part of the pilot project launched by Icrisat and Microsoft to test a new sowing application for farmers combined with a personalized village advisory dashboard in the state. The results showed a 30 per cent higher average yield per hectare. Around 175 smallholder farmers have seen such productivity hikes.

A pilot project launched by Icrisat and Microsoft tested a new sowing application for farmers combined with a personalized village advisory dashboard in Andhra Pradesh

Icrisat had adopted Microsoft's Cortana Intelligence Suite including machine learning (ability of computers to learn without being specifically programmed) and Power BI or Business Intelligence, to empower farmers and government officials with technology. The idea was also to promote digital farming practices in the state. The Personalized Village Advisory Dashboard has been especially developed to enable officials of the Andhra Pradesh Primary Sector Mission (APPSM) to better manage programmes of scale.

The sowing app was developed to help farmers achieve optimal harvests by advising them on the best time to sow, depending on weather conditions, soil and other indicators. The pilot was implemented in Devanakonda Mandal in Kurnool district and the advisory applied only to the groundnut crop.

This was made possible through a partnership between the Icrisat, Microsoft and the Andhra Pradesh government. The pioneering digital tools were released as part of the Andhra Pradesh Primary Sector Mission also known as Rythu Kosam.

Using powerful BI tools, this dashboard provides important insights around soil health, fertilizer recommendations and seven-day weather forecasts derived from the world's best available weather observations systems and global forecast models. This data is then downscaled for the highest possible accuracy at the village level, to transform how small holder farmers tackle climate change to drive effective decision-making for their crops.

During the pilot, farmers were sent 10 sowing advisories starting June 10, 2016 via SMS in Telugu, comprising essential information such as sowing recommendation, seed treatment, optimum sowing depth, preventive weed management, land preparation, farm yard manure application, recommendation on harvesting, shade drying of harvested pods, storage and such others. Going

forward, when combined with other data collected from the Rythu Kosam project, rich datasets can be processed to build other predictive models for the farmers.

The sowing application utilized powerful artificial intelligence to interface with weather forecasting models provided by USA based aWhere Inc. that collects more than "seven billion data points across the planet each day to create unprecedented visibility and insight for the agricultural earth". Extensive data, including rainfall over the last 45 years as well as 10 years of groundnut sowing progress data for Kurnool district, was brought to bear on this pilot. This data was then downscaled to build predictability and guide farmers to pick the ideal sowing week.

For Anil Bhansali, Managing Director, Microsoft India (R&D) Pvt. Ltd, the outcome was proof of the efficiencies that cloud technology can bring to Indian agriculture, helping farmers economically by improving agricultural productivity. "The applicability of the Intelligent cloud is a significant start for digital agriculture and we hope more governments and stakeholders come forward to reap benefits of this innovation", he said. Microsoft believes that success of the pilot suggests that adopting these technological solutions will help deliver sustainable solutions to smallholder farmers.

Farming Intelligence

"aWhere uses the term agricultural intelligence to convey the critical intersection of location and time in agricultural initiatives. aWhere combines location based and information technologies, allowing users to visualize their data across location and time, enabling local to global evidence-based decision making. This is agricultural intelligence."

— aWhere Co-Founder, Dr John Corbett

C.Madhusudhana, President, Chaitanya Youth Association and Watershed Community Association of Devanakonda says: "Registered farmers did the sowing in the last week of June and managed the crop as per the weather-based advisories provided by Icrisat and Microsoft throughout the crop-growing period. Farmers who sowed in the first week of June got meagre yields due to a long dry spell in August; while registered farmers who sowed in the last week of June and the first week of July and followed advisories got better yields and are out of loss. Many more farmers are showing interest to register their mobile phone numbers for receiving the advisories".

Dr David Bergvinson, Director General, Icrisat is happy with the outcome too. "We are excited about the results that have emerged from the use of the Sowing Application and Personalized Village Advisory Dashboard. We look forward to continuing our partnership with Microsoft to enhance incomes and improve the lives of small holder farmers and give a boost to our digital agriculture initiative in a big way".

Icrisat provides technical backend support to Rythu Kosam, which seeks to place Andhra Pradesh amongst the best three performing states by 2022. This technical input involves the establishment of pilot sites of learning in 13 districts of 10,000 hectares each and upgrading soil analysis laboratories. It also involves technical support for planning and adopting an inclusive market-oriented development (IMOD) strategy to benefit smallholder farmers through public-private partnerships; and promoting private investments in the state. ●

Koraput is Globally Important Agriculture Heritage Site

A Farmers' Forum Report

The regional biodiversity here is quite mind-boggling though it is reputed to be amongst the primary centres of origin of rice. The cultivated diversity recorded includes about 340 landraces of paddy, eight species of minor millets, nine species of pulses and many such. New crops have been introduced too: high-yielding paddy and cash crops like sugarcane, cotton and sunflower and improved vegetable varieties.

This is the Koraput belt of Orissa, amongst the most breathtakingly beautiful regions of the country; amongst the most naturally endowed with minerals, forests and fertility and amongst the poorest in the land.

It is also where the tribal population has sustained traditional farming systems and has conserved the rich floristic diversity consisting of about 2,500 species of flowering plants belonging to angiosperms. This is the land that has received the Globally Important Agriculture Heritage Site from the Food and Agriculture Organization (FAO).

The assault to the region comes from years of neglect by the administration and massive deforestation and mining. These have led to the increasing rate of loss of genetic diversity that dropped from 1,800 rice landraces in the 1960s to 350 in the 1990s. The area, therefore, makes an excellent case for ecosystem approach to agricultural biodiversity conservation and management.

This is where the M. S. Swaminathan Research Foundation (MSSRF), a non-profit NGO trust, has been working since 1998, and has attempted to recognize community conservation and mainstream it into poverty reduction and enhancement of livelihood security with poverty. The foundation develops and promotes strategies for economic growth that directly target increased employment of poor women in rural areas. Today, Koraput is district declared a Globally Important Agriculture Heritage Site by the FAO[1].

The foundation has sought to enhance livelihood security with poverty reduction with the programme empowering people with technical inputs for integrated natural resource management particularly of the rich genetic diversity of rice for poverty reduction. The initiative has helped impart and evolve techniques for quality seed selection and for new 'formal' methods of cultivation to maintain soil fertility and increase crop productivity. The process started with a focus on enhancing the utility of people-preferred landraces

1 http://www.fao.org/giahs/giahsaroundtheworld/designated-sites/asia-and-the-pacific/koraput-traditional-agriculture/en/

Photos: pragatikoraput.org

Preserving Agrobiodiversity

Integrated to its environment, traditional local communities' cultivation has remained sustainable. Preserving the agrobiodiversity including cultivated and wild plants but also the traditional knowledge farmers had played a great role. That is why, forest preservation is a result of the human management.

Looking at the water resources management, agriculture is mostly rain fed. Small streams are used for irrigation. Recently some areas in the region have irrigation facilities originating from a major river has changed the traditional agricultural practices.

Due to the current threats toward forest and agrobiodiversity, recognizing this GIAHS would aim to enable rural families to derive economic benefit from their past and present contributions to conservation of genetic resources.

—FAO

(LR) of rice through simple, easily adoptable plant breeding techniques, says the foundation.

As is wont in regions where indigenous populations practice farming and dominate culture, Koraput's traditional systems have been linked to age old customs that have helped them conserve regional biodiversity through an in-situ conservation, which has "sustainably managed the forest preserving endemic species" as well.

What is not so well with the system is the failure of the farming and scientific communities in the country to appreciate the "public good value deeply interlinked with the lifestyles, cultural value from local communities that needs to be recognized and valorized as custodian and owner". This is what the Swaminathan Foundation is seeking to set right.

More important than recognition is the need for the community to be helped to achieve food and livelihood security. Clearly, what the indigenous people grow is not enough to meet their needs and food falls critically short. Rice accounts for half the cultivated land and maize, millet, green and black gram for the rest. The forests are kind and offer roots, tamarind, tamarind seeds, leaves, jackfruit, seeds and mango stones. The tribals have learnt to manage with these.

The Swaminathan Foundation says that the average income of a household comes from agriculture, poultry and employment is agricultural. "To supplement their income and sustain their livelihood, local communities depend on forest produce for fuel wood, material for construction of their houses, agricultural implements, timber and medicinal herbs. The tribal population depends on the low value non timber forest produces for their subsistence".

What are the local knowledge systems and adapted technologies? Essentially, the tribals understand small scale fields integrated to the land forest management. In the hill forests they use the slash and burn system and put their indigenous knowledge to good use to run viability tests for seeds before sowing, maintain the soil fertility and conserve the landraces of rice and other crops.

Their knowledge of forest species is also remarkable as they know what species to consume and what to use for fodder and firewood and what to use for medicines. They are masters of more than 1,200 medicinal plant species that are locally available in this area and the tribal knowledge enhances India's healing system significantly.

The foundation has conducted exhaustive studies to understand the religious aspects of the Sabara tribe of Koraput. Magico-religious beliefs about agriculture and food collection are significant for the Saharas. The Bondos too have complex magico-religious rites in seed conservation, fertility and production. The entire combination

Tribals integrate land-forest management. In the hill forests they use the slash and burn system and use traditional knowledge to run viability tests for seeds; maintain fertility...

Sacred Groves

"Strongly linked as a cultural trait, sacred grove is an effective method of preserving plant genetic resources. It is a biological heritage as well as social mechanism by which a forest patch is protected. The sacred grove has religious significance since it is believed that the vegetation is under the protection of their local deities. Even today we find forest patches left to local deities as a traditional custom".

— FAO

Photo: pragatikoraput.org

of circumstances has led to the belt being given the Food and Agriculture Organization's Globally Important Agriculture Heritage Site.

Excellent support for the work in the Jeypore tract has come from the state government that donated five hectares (12.5 acres) of land to set up the "Biju Patnaik Medicinal Plants Garden and Conservation Centre". It is here that the foundation has launched the biodiversity programme in 1998, and where it undertakes:

- Collection, conservation and documentation of landraces and local varieties of rice, finger millet, little millet, pulses, tubers and vegetables
- Capitalization of important landraces for livelihood of rural communities
- Conservation, multiplication and use of locally important medicinal plants used by the tribal communities

The programme covers three blocks in Koraput, Kundra, Boipariguda and Jeypore. The Jeypore tract of Odisha is a secondary centre of origin of Asian cultivated rice (Oryza sativa L.) and it is considered as the primary centre of origin of 'aus' ecotype of rice. Before the introduction of high-yielding rice varieties in the mid sixties, a large number of landraces were being cultivated in the Jeypore tract.

With the advent of high yielding varieties (HYV) and intensive campaigning by the Department of Agriculture, Government of Odisha to introduce and popularize them, the tribal farm families have progressively given up cultivation of their traditional varieties and have opted for the modern rice varieties. This has resulted in the loss of genetic diversity of rice in this tract.

This promoted efforts to revitalize and conserve the valuable genetic resource materials not only of rice but also millets, pulses and other important crops both in-situ and ex-situ involving the farming communities of the Koraput district. Documentation, characterization and popularization of rice landraces were taken up on a priority basis through Participatory Conservation System (PCS) and cluster approach through diversity blocks, the foundation says.

Some of the selected varieties were evaluated through Participatory Varietal Selection that enabled to narrow down the varieties to a few like Kalajeera, Machhakanta and Haladichudi, which were multiplied and grown on large scale and then promoted. Accessions in the ex-situ gene banks are deposited by farming communities, who had evolved and conserved these materials at their personal cost, with trusteeship entrusted with the MSSRF[2].

So far, 140 rice landraces, 19 finger millets, 2 little millets, 14 pulses, 13 tuber crops, and 30 vegetable varieties have been conserved. Also, 19 package of practice modules were introduced for yield enhancement which was well adopted by farming communities. A dozen village seed banks were established to make available the seeds during periods of scarcity. Usually, 25 per cent of seeds are reserved in the bank for use by the farmers to overcome the early drought and flash floods, if any.

Traditional varieties are generally low-yielding for many reasons such as impure seeds, lack of seed treatment, inadequate FYM application, moisture stress, lack of knowledge on improved cultivation practices, improper water management, lack of use of modern agricultural implements and climatic variation. To address these problems two appropriate technologies were tested in farmers' fields accompanied by proper training and demonstration. ●

Intervention

A modified SRI technology was tested in 11 operational villages in 32.8 ha with Machhakanta, Kalajeera and Haladichudi landraces. Training/demonstrations were conducted in a cluster approach for seed treatment, nursery raising, planting, weeding, seed selection and water management

2 http://www.mssrf.org/?q=content/biju-patnaik-medicinal-plants-garden-and-research-centre-jeypore-koraput-odisha

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