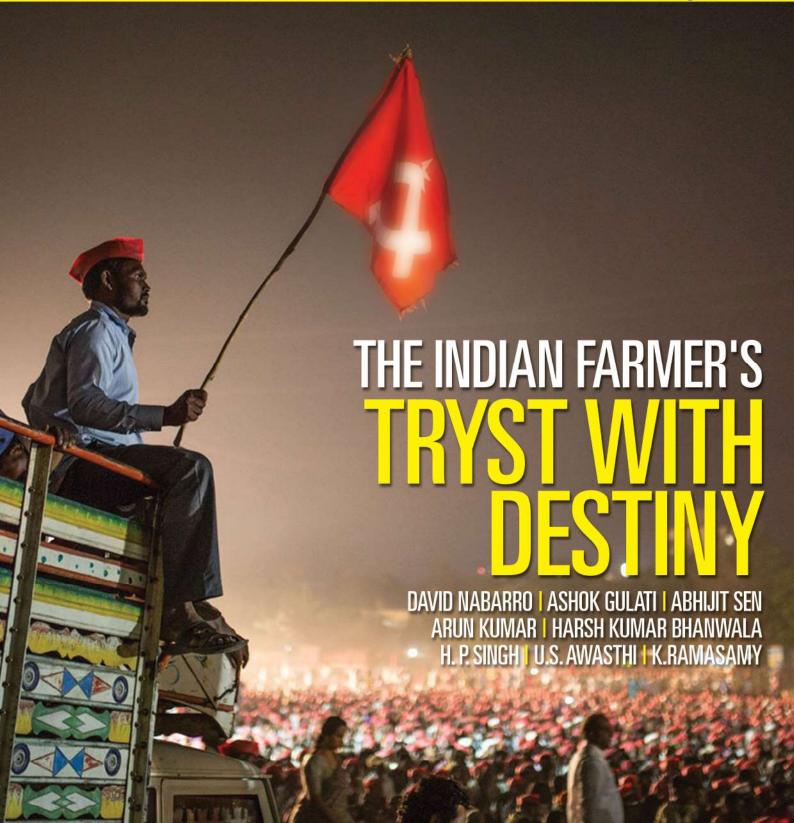
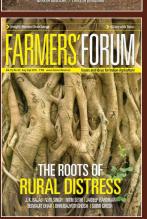
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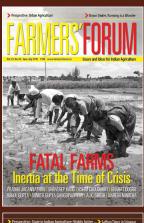






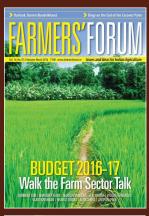






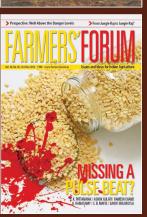


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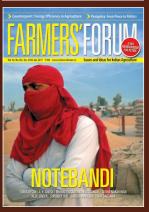














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Farm Landscapes: **Embittered Present: Futile Future**

ever before in the history of mankind have the landless seemed to be better off than marginal and small landowning classes. Farmers, emotionally attached to their lands, continue to try, unsuccessfully, to make a living from their meagre holdings while those with no land have little to hold them back from moving to other professions or migrating in hope of better opportunities. The pent-up frustration thus caused has erupted in more farmer agitations across India in last four years than in the preceding decades.

The current times are reminiscent of when Mahatma Gandhi returned from South Africa in 1916 to launch the Champaran Satyagraha. Along with the Kheda Satyagraha in Gujarat, such farmers' uprisings got channelized into beginning the Indian Independence movement and the current turmoil may well signify the beginning of yet another momentous change that may affect Prime Minister Narendra Modi's larger-than-life image, created by clever marketing, sloganeering, social media and advertising spend, raising hopes of millions of people across rural India.

Having won an unexpectedly massive mandate the Prime Minister started off with a huge advantage over the government that his

dispensation replaced. Though he inherited a declining farm economy, he was blessed with very low petroleum prices that led to several lakh crores of savings accruing to the exchequer and the nation too was ready to believe and follow the new leader, even on a path of thorns that he set.

Not since Indira Gandhi has India had a Prime Minister as bold and authoritative as Narendra Modi. The former created Bangladesh out of east Pakistan, nationalized banks, put an end to privy purses but also imposed the Emergency. Narendra Modi announced demonetization that took 80 per cent of the currency out of circulation in the beginning of the sowing season and followed up with a poorlyimplemented GST. The double whammy, entirely human induced, accompanied the twin mammoth shocks of a back-to-back drought and very low international commodity prices.

This vicious concoction destroyed hopes of millions and dented Mr Modi's infallible image as

NARENDRA MODI'S **DEMONETIZATION** TOOK 80 PER **CENT OF THE CURRENCY OUT OF CIRCULATION IN** THE BEGINNING OF THE SOWING SEASON, **FOLLOWED** BY A POORLY-**IMPLEMENTED GST**

EDITORIAL

TAKING FOR
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well. The two-year drought led to a production shortfall and high commodity prices. When farmers responded to market signals of high prices of pulses and oilseeds, production jumped up, while the country kept importing pulses and edible oil at zero import duty. It took the combined force of cabinet minister, Nitin Gadkari, CEA to PM, Arvind Subramanian and Niti Aayog member, Ramesh Chand, to literally coerce the establishment to stop import of pulses and to take other remedial measures. These came too late as large segments in the countryside went over the edge.

Trying to salvage the situation after the Mandsaur calamity, the Nashik-Mumbai march and other agitations cropping elsewhere, sent the government on a panic mode; it over-reacted and committed a bigger political blunder by announcing higher minimum support prices (MSPs) earlier this year. The methodology to calculate the MSP was contentious but even that would not have become an issue had the farmers been able to sell their crops at the promised price. Unfortunately, and irrespective of how ever much one may so want, neither this nor the next government can purchase all the crop produced, for which MSPs are announced.

Meanwhile, the Prime Minister seems to have been isolated from the cacophony of discontent by a party leadership afraid to tell him the truth, aided and abetted by fumbling opposition, which seems to have given the office of the Prime Minister a high dose of dopamine that kept it out of touch with ground realities. Wary of inflation that had battered UPA II and propelled BJP to power in 2014, the government prioritized keeping inflation low for consumers and, by design, farmers became the primary inflation mitigation tool and scapegoats.

The Pradhan Mantri Fasal Bima Yojana, electronic trading portal eNam, soil health cards, model Model Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017 and a slew of other schemes have failed to deliver. As commodity prices fell, agriculture inputs became more expensive and decimated farmer incomes. Doubling farm incomes has become a dark and cruel joke cynically repeated for the administration's own benefit. The National Forest Policy 2018 has been a dampener for tribal farmer rights and those living on the margins. Consequently, the largest migration in human history is underway, from rural areas to urban areas. The silent migration is resulting in devastating socioeconomic consequences.

While the government wisely retreated from its stated position by continuing with the Mahatma Gandhi National Rural Employment Guarantee Act, it was forced to abort the land acquisition bill. At other times, government actions have had unintended positive consequences; reducing urea bag size from 50kg to 45kg has brought about a 10 per cent fall per acre consumption because the farmer measures the input by the

bag not weight. The department, however, deludes itself into believing that the introduction of neem coating of urea has led to the improvement.

Yetanother dimension is added to the farm sector woes with agriculture being a state subject. When states are not able to perform, the central government gets the blame. Not that the government is otherwise without blame; policies for farmers are made by the central government without consulting the state governments or even the beneficiaries, the farmers. Therefore, central government policies look good on paper but cannot be implemented; there is a basic design flaw because policy-makers lack the capacity to make informed decisions. In days to come, the signing of the international Regional Comprehensive Economic Partnership trade treaty, without taking opinion of the states and farmer interests into consideration, will spell the death knell for the community.

After the 14th Finance commission, there is a 42 per cent fund devolution to the states and it would be unfair to blame Narendra Modi for reduced





allocations for agriculture programmes. The state governments are supposed to utilize the increased resource allocations as they prioritize their agriculture needs, which they do not. Accepting the 7th Pay Commission recommendations was a gigantic blunder too. It strained central government finances and even the states will be compelled to accept it. After salaries and pensions have been paid, the states will have no spare resources for development or for even tapping into central government programmes like RKVY and ATMA, which require sharing of costs.

For all his well-intentioned plans to improve farmer livelihoods, the Prime Minister's failure may well be attributed to over-reliance on the bureaucracy. Even as farmer suicides take place without let or hindrance, the government hides figures. A broken promises like the ₹15 lakh in every bank account is not only what haunts the BJP, the unkept promise of providing two crore off farm-jobs and the total lack of livelihood prospects for the farmer's children are the more serious let downs. Over the decades the ruling party has honed its tactics to blame others for existing problems. This is not an option anymore as the BJP is in power in the centre and in several states.

Taking for granted the disunited farmers and making the blunder of believing them to be of little electoral significance may prove costly for more reasons than one. If the Congress makes substantial gains in the state elections, an all-India farm loan waiver may well be on the cards because there is nothing left to promise or deliver but that will not resolve anything; it will not eliminate the root cause of the sustained indebtedness. That no one is conscious of this makes the future frightening in terms of the total vacuum of farmer leadership within the top hierarchy of all large political parties today.

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Ajay Vir Jakhar

Editor twitter: @ajayvirjakhar blog: www.ajayvirjakhar.com

LETTERS

To the Editor

Futility Everywhere

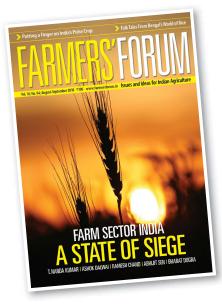
Sir, Apropos of your editorial "Will Someone Tell the PM?" (Farmers' Forum, August-September 2018), you are right that the policy-making and policy-driving officials supporting the Prime Minister's regime lack the capacity to make wiser decisions or even figure out options. The outcome is an Indian farm sector that is bleeding slowly; as if being prepared for ritual halal or kosher diet. The government will have to suffer for this in the forthcoming elections. In the meantime though the farmer is being pushed to excrutiating levels of stress. What is worse, however, is that "no one can be held accountable for the aggravated problem on every farm, courtesy the very structure of the policy-making ecosystem". What hope do we have for farmers in India?

Neeraj Yadav

New Delhi

'Vision' at Last

The work done by Punjab State Farmers' and the Farm Workers' Commission in preparing the "Draft Punjab State Farmers' Policy", as published in your report, Punjab State Farmers' Policy; **New Positioning: From** farm to the farmer (Farmers' Forum, August-September 2018), is commendable. I hope the Punjab government understands the exemplary work done and has a serious discussion around it and adopts it. The state needs such visionary measures and certainly the Punjab



Water Use Efficiency

T. Nanda Kumar's point about Punjab using the maximum irrigation water per kilo to produce rice in Breaking Nexus; Changing Minds (Farmers' Forum, August-September 2018) and its implications must be taken aboard when driving policy in the state. Water use efficiency must be the cornerstone of efforts to revive agriculture in Punjab.

Manish Chaturvedi

Hardoi, Uttar Pradesh

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provides free access
to all editions for
a comprehensive
understanding of Indian
farmer concerns

farmer will be benefited if the government adopts the positions stated in the draft report.

Kuldeep Sharma

Amritsar, Punjab

Shocker Over Pulses

The article "Putting a finger on India's pulse crop" by Bharat Dogra (Farmers' Forum, August-September 2018) is shocking in terms of the grim statistics that it presents. How can a leading green revolution state like Punjab allow the area under pulses to decline from 13.4 per cent in 1966-67 to just three per cent in 1982-83. This is a monumental decline in just 16 years and it would need strenuous efforts by government and strong policy measures to restore the balance. The country and the state should extend all support to its pulse farmers.

Suresh Kumar

Dehradun, Uttarakhand

Vanishing Farmers

"India raises curtains on the farmers' long march', featuring Paranjoy Guha Thakurta in conversation with P. Sainath (Farmers' Forum, August-September 2018) laid bare many critical details. However, there is nothing more serious than the story of the vanishing farmer that the interview presents. Between the 1991 census and the 2011 census there was a loss of 15 million farmers. As Sainath underscores, farmers have been quitting the profession "at the rate of more than 2,000 a day; every 24 hours there are 2,000 fewer farmers".

Priyanka Mahapatra

Cuttuck, Orissa



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MAKING FOOD SYSTEMS MORK

A Farmers' Forum Report

"There is a crisis of confidence amongst the farmers, not only in India but amongst farmers across the world; across all continents. The farmers' infinite optimism is now tempered with fear but, as a farmers' organization, the Bharat Krishak Samaj believes – to borrow from the words of Frodo in Lord of the Rings – there are some good things in the world that are worth fighting for; our farmers' prosperity is amongst them" – Ajay Vir Jakhar; setting the ball rolling on the two-day "Food Systems Dialogues" on October 25 and 26, 2018, at the Kamaladevi Complex, First Floor, India International Centre, New Delhi.

iscussions on agriculture in India have remained focused on the farm and not on farm issues that stem from farming activities. Policies too are obviously never made on the farm, with counter-productive impact on the farmer. There is, therefore, need to change the narrative. The Food Systems Dialogues is all about bringing about that change and the Bharat Krishak Samaj (BKS) started the dialogue in India in the inspiring presence of David Nabarro, winner of the 2018, World Food Prize and strategic director, Skills, Systems & Synergies for Sustainable Development (4SD). David Nabarro won the award along with Lawrence Haddad, executive director of the Global Alliance for Improved Nutrition.

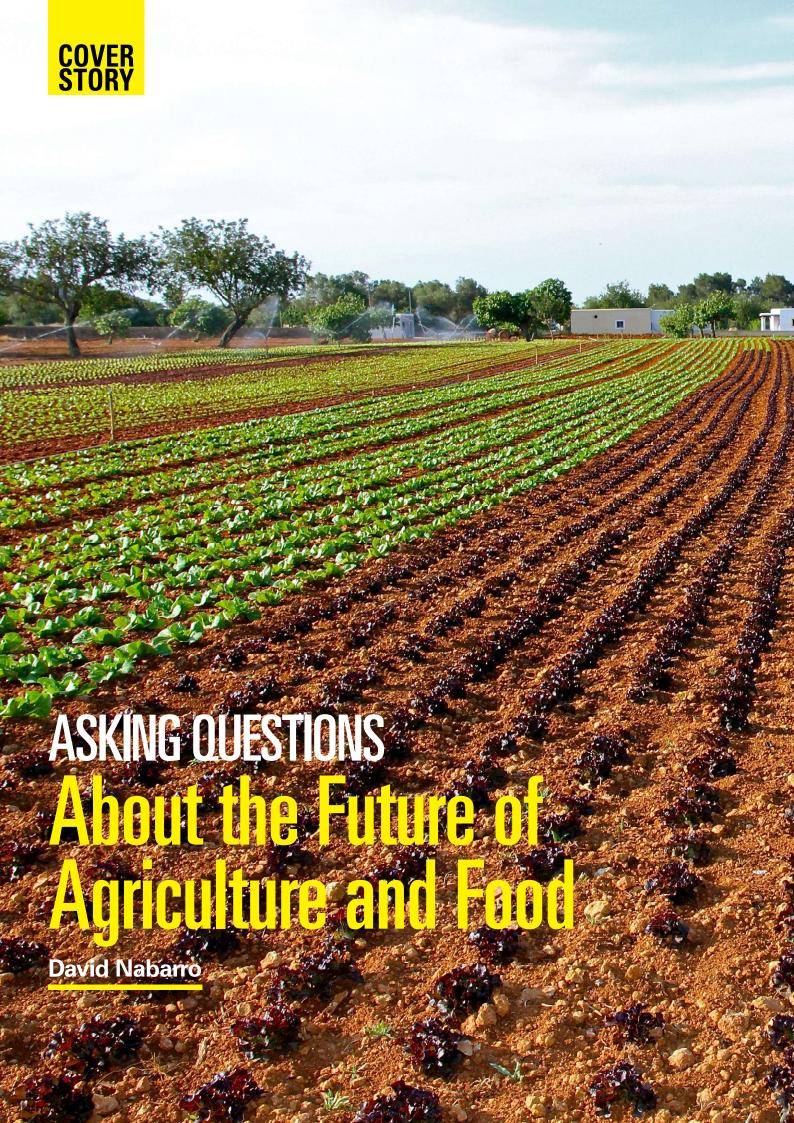
The World Food Prize was founded in 1986 by the Nobel Peace Prize winner, Norman E. Borlaug, and is the foremost international award for individuals who have advanced the cause of human development by improving the quality, quantity or availability of food in the world. "David Nabarro is a fascinating, inspiring and a magical curator and organizer and has focused on transforming food and health systems so that they work for the people and the planet", said Ajay Vir Jakhar.

Farming is about people who actually farm and the BKS serves its constituents without aligning itself to any political conviction though it has very strong policy preferences while being a-political. The BKS also has a heavy ideological endowment from the environment and circumstances in which it functions in villages. The Bharat Krishak Samaj currently has three convictions in mind. "First, we know that what is happening is wrong. Second, people should know about it. Third, we will speak about it. We will not keep quiet about it", the BKS chairman said.

Speakers at the multi-session dialogue included Ashok Gulati, Infosys chair professor for agriculture, Indian Council for Research on International Economic Relations; Abhijit Sen, former member, Planning Commission; Arun Kumar, Malcolm S. Adiseshiah Chair Professor, Institute of Social Sciences; Harsh Kumar Bhanwala, chairman, Nabard; Ramesh Chand, member, Niti Aayog; H.P. Singh, founder/ Confederation chairman. of Horticulture Associations of India; K. Ramasamy, vicechancellor, Tamil Nadu Agricultural University; Anil Jain, CEO, Jain Irrigation Systems Ltd; Ashish Bahuguna, former chairman, Food Safety and Standards Authority of India; Avik Saha, general secretary, Swaraj Abhiyan and national convenor, Jai Kisan Andolan; C.D. Mayee, former chairman, Agricultural Scientists Recruitment Board; Devinder Sharma, food policy analyst; Kavitha Kuruganti, convener, Asha; Kiranjeet Jhunir, farmer activist, Punjab; Neelkanth Mishra, managing director and Credit Suisse India economistand strategist; Paranjoy Guha Thakurta, senior journalist; and Purvi Mehta, senior advisor and head of agriculture (South Asia), Bill & Melinda Gates Foundation. Siraj Hussain, former secretary, Union Ministry of Agriculture and

T. Nanda Kumar, former secretary Union Food & Agriculture Ministry, moderated the discussions.

^{*} The speeches of Avik Saha, C.D. Mayee, Devinder Sharma, Kavitha Kuruganti, Kiranjeet Jhunir, Neelkanth Mishra and Purvi Mehta, will be published in the December 2018-January 2019 issue of *Farmers' Forum*.





he Indian subcontinent is where I have learnt most of what I have in my head and heart about how people live and how life works. I spent five years working in the region when I was younger in Nepal, West Bengal, Orissa and Gujarat. Hopefully, by returning



DAVID NABARROWinner 2018,
World Food Prize

here, I will be able to build on the impressions and understanding that I gained when I was in the region as a young medical officer and development professional. I would like to acknowledge and thank the people and officials, civil society activists and scientists from this country and the region for everything that I have learnt.

The World Food Prize this year came my direction and to Lawrence Haddad because the World Food Prize jury decided that they wanted to highlight the issue of human nutrition. They wanted to show the importance of the links between food systems and human nutrition and the absolute challenge that is faced all over the world in trying to make sure that food systems really do contribute to the well being of people.

There are one billion people who are still hungry and food insecure and the numbers are rising after having been on the decline for about 10 years. The fundamental cause of this is the on-going wars, particularly in Africa, which is unfortunately leading to large numbers of people, particularly children and women, being undernourished and food insecure. In another major problem, there are between one and two billion people experiencing health challenges because they are just not eating diets that are good for their well being. Globally today, 25 per cent of deaths result from dietary causes with a world-wide epidemic of Type II

diabetes and increase in levels of cardio vascular disease; two challenges that are unfortunately directly related to what people are eating.

Most commentators in the health sector are asking what is wrong with the food systems that are providing food that seems to be associated with

high levels of illness and what can be done to food systems to



make them more healthy and nutritious. There is also the agriculture community saying that there is a crisis in farming, with the increase in number of farmers who find that their livelihoods are unsustainable, leading them into situations of really severe distress. Unfortunately, a large number of farmers are actually taking their own lives in India because the situation for them is so bad.

Agriculture is facing a third challenge vis-à-vis the relationship between farming and the environment that does not always seem to be in equilibrium. As even the Indian experience shows, there are places with extreme shortage of water with aquifers emptying or becoming damaged by the presence of heavy metals. Elsewhere, the top soil is getting undermined and forest areas are getting reduced along with other big environmental challenges.

The fourth concern is that agriculture and land use changes account for about 35 per cent of green house gas emissions at this time. These taken together indicate that the entire



The entire area of agriculture and food systems will need quite a radical rethinking about where things will be headed over the next 10 years

area of agriculture and food systems will need quite a radical rethinking about where things will be headed over the next 10 years. That is why a group of organizations, each of which is international in its approach – the World Economic Forum, the World Business Council on sustainable Development, EAT (a non-profit founded by the Stordalen Foundation, Stockholm Resilience Centre and the Wellcome Trust to catalyze a food system transformation) and Food and Land Use Coalition – came together to encourage dialogues in as many venues as possible and to start asking tough questions about the future of agriculture and food.

The dialogues are taking place internationally, in Stockholm, in New York and will also be organized in Poland; and at the climate conventions; in Bangkok at a meeting organized by the International Food Policy Research Institute

and the Food and Agriculture Organization. They are taking place regionally in Europe and Africa and will increasingly be held in South East Asia. India is having the first of the series of the food systems dialogues organized by the Bharat Krishak Samaj that will provide an opportunity to debate, as openly as possible, the options ahead for the future of agriculture and food.

Quiet often there are strong differences of opinion and there are groups that find it very hard to talk together because their positions are so divergent. These dialogues provide secure venues for people with divergent issues to come together and talk without fear of being quoted outside. The one underlying principle is that everyone gets a chance to speak without fear that his/her position will be taken out and put out on the social media or any other venue that can cause trouble.



David Nabarro: Uniting people and organizations to solve global health issues

David Nabarro's inspirational global leadership in combating hunger and under-nutrition positioned this issue as central to the global food security and development dialogue, closing the gap among nutritionists, public health practitioners, agricultural scientists, policymakers, humanitarians and major donor institutions. Through his work in the UN, he unified the disjointed development efforts of these and other public and private sector organizations to successfully confront food insecurity and maternal and child malnutrition in Africa, South Asia and Latin America.





In 2008, the UN secretary-general, Ban Ki-moon asked Nabarro to head the newly-created UN High Level Task Force on Global Food Security in response to the food price crisis. Two years later, he was also appointed as co-ordinator of the new Scaling Up Nutrition (SUN) Movement. In these twin roles, he brought together a broad group of stakeholders around nutrition and food

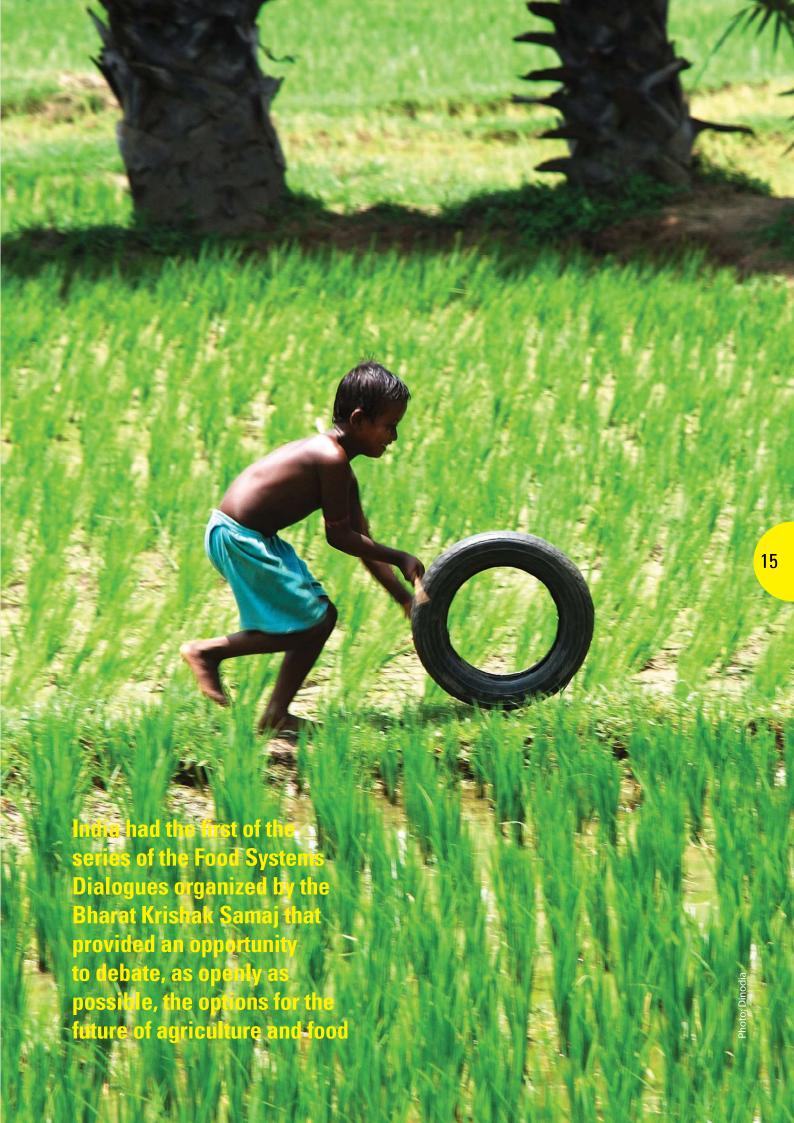
security at the national, regional and global levels that included the leaders of dozens of countries suffering from high rates of malnutrition, the heads of UN agencies, representatives from donor groups and members of civil society organizations. As a result, agriculture and food went from being a low priority issue to mainstream.

The SUN Movement, with Nabarro at the helm, headed a concerted effort to reduce childhood under-nutrition and stunting in the first 1,000 days of life, from pregnancy to two years of age. Under Nabarro's direction, SUN implemented a multi-sectoral, multi-level and multi-stakeholder approach to reduce child under-nutrition and support future economic growth. Never before has the economic and humanitarian costs of under-nutrition for the children, their families and their countries been as clear to the global community.

In 2014, when the SUN Movement was strong and making a significant impact in reducing child stunting, Nabarro was asked to take over as the Special Envoy on Ebola and co-ordinate the UN's response to the Ebola outbreak in Africa. When he stepped down as SUN's co-ordinator to take up this new mission, 50 countries encompassing 83 million stunted children had joined the SUN movement and endorsed nutrition-related laws and policies. The SUN framework and strategies that Nabarro established continue to mobilize political leaders in developing countries to improve the nutritional status of millions of mothers and young children.

When the Ebola crisis subsided, Nabarro assumed a new role as the UN secretary-general's special adviser on Sustainable Development and Climate Change and continued to serve as the special representative for Food Security and Nutrition. He retired from the UN in June 2017 but continues to serve on SUN's high-level lead group. By end 2017, 59 countries and three Indian states had joined SUN. Many, like Myanmar and Nigeria, reported a significant decline in the number of stunted children. Globally, the number of children under five who are too short for their age has decreased from 165 million in 2012 to 155 million in 2017.

Nabarro works toward food and nutrition related goals through teaching at the Imperial College's Institute of Global Health Innovation and through 4SD, a social enterprise with a focus on partnering and integrated action that he started to support those implementing the 2030 Agenda for Sustainable Development.





he Indian food landscape has farmers as producers who have, over the past 40 years, seen their average holdings shrink to 1.1 hectare, with 87 per cent of the farmers working on less than two hectares. The challenge lies in connecting the small farmer at one end of the value chain to the other, which is consolidating and scaling up in size. Food has to be moved all the way from the farmer's field to the consumer's plate. The small individual surpluses per farm have to be linked with the retailing industry,

Connecting the two ends of the value chain with fragmented production at one end and upscaling retailers at the other is a challenge that demands innovation. It is a challenge to policy-makers and

the processing sector, which wants large quantities

and symmetrical things.



ASHOK GULATI Chairman, Commission for Agriculture Costs and Prices

academics studying the food systems around the world. The India story has moved on from the ship-to-mouth stage in the sixties to one where the country can reasonably feed itself and have a marginal surplus for export. Many argue though that, given the prevailing massive malnutrition and hunger, it would be a misnomer to call the exported surplus a real surplus.

Ensuring farmer prosperity and linking of the farmers to this value chain demands

crop differentiation – the grain sector, the meat sector, the fruits and vegetables sector or other combinations of crops – because the value chains differ from sector to sector. In Maharashtra, protesting milk farmers recently spilt milk on the roads because they were not getting a fair price. Some weeks back, India's largest tomato mandi in



In the dairy sector, especially in the co-operative space, Amul, for example, claims that it ensures that the farmer gets between 75-85% of what the consumer pays

Kolar saw farmers selling tomatoes at ₹5 to ₹6 a kilo while in Delhi it was retailing for ₹30.

Even taking into account transportation and other costs, fruit and vegetable farmers get, on an average, one third, one fourth and, sometimes, no more than one fifth the retail price. When bumper harvest prices crash, the farmer gets a fifth of what the consumer pays. Yet, in the dairy sector, especially in the co-operative space, Amul, for example, claims that it ensures that the farmer gets between 75 per cent and 85 per cent of what the consumer pays.

Thus there is one value chain giving the

producer between 75 per cent and 80 per cent of the consumer spend and another that offers no more than one fifth at times. The grains sector value chain falls somewhere in between. Historically, heavy intervention by the government in wheat and rice has seen between 60 per cent and 70 per cent of what the consumer pays going to the farmer. To go back in time, India's milk sector had experienced monopsonistic practices when the British insisted that only Paulson, a private player, supply milk in Mumbai because the local milk was not considered safe. Paulson connected with the Kerala and Gujarat farmers and, using its



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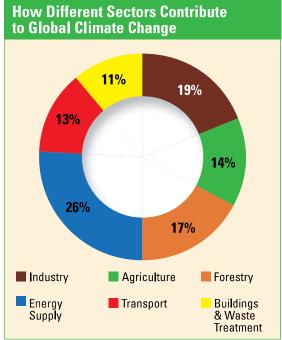


monopsonistic powers, ensured that the farmer was literally being squeezed out. The farmers then went to Sardar Patel, who led a successful agitation of the milk farmers in 1942-46 and ultimately asked them to make their own co-operative and stop supplying milk to Paulson.

Their 15-day strike ensured that Paulson did not get the milk to supply to Bombay and it became the turning point in the history of milk value chain in this country. The milk co-operatives came in and the first co-operative was registered in Kheda in 1946.

Today, courtesy that value chain development over a period of time, through Operation Flood and Atal Bihari Vajpayee delicensing the milk sector, India is the largest producer of milk at 177 million tonnes. USA is the second largest player, way behind at 95/96 million tonnes, while China produces some 45 million tonnes or so. Its value chain not only delivers the bulk of the consumer's rupee to the producer but is inclusive as well. A country like India cannot just talk of competitiveness without inclusiveness because of the small holders. The real innovation is remaining competitive but inclusive. The small holders have to be put together.

The third issue is to ensure sustainability. There are questions about water table and water quality; there is soil degradation; rice production needs 5,000 litres of water per kilogram of rice and that is being extracted from the Punjab and Haryana belt, where the water table is going down by 70



Source: C.D. Mayee, Presentation on Climate Change



cms a year. This is not sustainable and the need is for technologies that use half the water and still get higher productivity and to change the behaviour of the farmers. That will need ending the policy of free power and free everything. That is where the challenge is.

Yet, it can be done and these questions of comparative value chain, inclusive value chain and sustainable value chains - in terms of both environment and finances, so as not to become a drag on the exchequer for permanent subsidies - should be explored. Self-sustaining business models should be worked out and scaled up. This competitive-inclusive sustainability, leading to scalability, must be informed by financing, which is the critical factor and lubricates the value chain. The source of the finance is the problematic part. In the Kolar fruit and vegetable space, between 90 per cent and 95 per cent of the farmers borrow from commission agents, who charge a huge commission for a 2-3 minute auction, officially at between six per cent and eight per cent and unofficially as much as between 10 per cent and 12 per cent.



Between 2000 and 2016-17, in different commodities and states, Indian farmers were taxed implicitly, through restrictive trade policies, about 14 per cent per annum on an average

Even at the Azadpur or Mumbai's Vashi markets, the minimum legal commission is six per cent for a three-minute, zero-risk procedure. Someone else is selling the farmer's produce; somebody else is buying; and the farmer is squeezed in between. If farmers are to prosper, they have to be linked to the market through agri-marketing reform. Indeed, farmers have to deal with too many controls. In an exercise conducted with the OECD a couple of years back, it was established that between year 2000 and 2016-17, in different commodities and in different states, Indian farmers had been taxed implicitly through restrictive trade policies to the tune of about 14 per cent per annum on an average.

When prices go up, a control is imposed; when there is an uneven movement in prices, control is imposed; the Essential Commodities Act imposes restrictions and the entire agriculture policy regime has been largely pro-consumer while implicitly working against the farmer. Restrictions may be needed if, for instance, there is a dramatic jump of 40 per cent in prices, but even these ought to be reviewed after a couple of months. Instead, restrictions are applied and then forgotten about for four years. Thus price implicitly acts as a tax on the farmer courtesy the price policy followed.

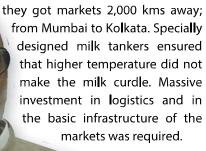
The agriculture regime in India will need to change from farm to fork to plate to plough through demand-driven systems. What the consumer demands internationally and domestically, which city demands what type of commodities, what type of colour or what type of nutrition will increasingly determine what will be produced and the information linkages will have to be provided to the farmer in a reversal of the system. The messages will go through the big retailers or others though there is considerable debate on the big box retailers versus the mom and pop stores, which may be somewhat misplaced.



The white revolution did not come just by making cooperatives; the milk had to be collected and investments made in bulk coolers so that milk could travel far and wide

The two sides can be duct-taped together with one serving as the hub and others could be spokes with the system entirely upgraded through massive investments in infrastructure. The white revolution is a prime example. It did not come just by making co-operatives; the milk had to be collected and investments made in bulk coolers. When the co-operatives started producing more

than the local market could consume,



Similar investments are needed in tomatoes, for instance, but who will make this investment? Will it be the government, the private sector or a publicprivate partnership, with clear rules of the game? Such structural and institutional reforms are needed to progress from the Essential Commodities Act mindset. Why can people not buy directly from the farmers instead of going through the mandi? Why do commission agents get such hefty commissions? Why not sever this relationship between the credit market and the output market, which are inter ocked? That is where the commission agents gain the dominating power to extract from the producers and become rich while the farmers remain poor. These institutional reforms are essential to get the markets right. These infrastructural investments are needed to be able to secure a higher percentage of the consumer's price for the farmers.

The government is trying to increase the prosperity of farmers through a cost plus pricing or 50 per cent margin over cost, A2+Fl, which

is paid out cost and family labour. Basically, this does not include the imputed rental on the land or owned capital, which indicates a typical supply side pricing and ignores the demand side.







hould Indian agriculture or its food systems continue to stay, as the Constitution of India willed it, a state subject or be shifted to the concurrent list? There are discussions on the many hindrances that emanate with agriculture remaining a state subject and questions asked about why the centre does not



ABHIJIT SEN Economist and Former Member, Planning Commission

take it over either directly or through the concurrent list? I believe that agriculture, health, education and all such work better in a more decentralized setting than in a more centralized setting, barring exceptions.

To approach the question from the other side; that there is something fundamentally wrong with agriculture being a state subject, it is interesting to note that the seventh schedule of the Constitution of India – with some 100+ subjects in the central list, around 60 in the state list and around 50-60 in the concurrent list – says, under the very last item on the central list, that any item not in the part 2 and 3 belongs to the central list.

Thus simply by changing the name, something can be brought under the central list. Unlike in similar lists and similar designations of subjects in, say the Constitution of the United States or that of most other federal states, if the centre brings the law on India's concurrent list – which is in between so that both the state and centre can make laws – and if at any point that law conflicts with some existing state law, the central law trumps the state law. That, of course, also means that the bias, if any, in the Constitution, is in favour of the centre. Thus anything that is missing is the centre's list and anything that can get into the concurrent list is effectively under the centre.

Standards in medicine, in education, in weights and measures, whatever they are, they come under the central list. Without standards one cannot move far on many things



Under these circumstances – and given my personal bias – one is beginning with a bias in favour of the centre. When does the states versus centre issue become most vocal? It is very vocal is in the agricultural context and this has to do with markets. There is often a demand that agricultural marketing should be in the concurrent list. An organized corporate system wants a system of laws that it can understand; it does not want too many players and it wants a single law. Additionally, there are issues with states having their own taxes, which can distort the market because of differential taxes. There has been much debate around this but, at the end of the day, despite the model law, nothing much has happened.

Pursuing the centre versus state theme in agriculture may actually mean looking at the wrong design issue rather than the issue that needs to be looked at. In agricultural marketing, even without the word appearing anywhere, trade in certain agricultural products including foodgrain, oil seeds and cotton, is already under the concurrent list. The







question then is that if, despite this, the system has not achieved what those in favour of inclusion in the concurrent list would have wished for, something else must be happening. It is not the Constitution; it is, in fact, a political issue and one would do well not to stir the hornet's nest too much.

However, it is clear that the Constitution did see merit in certain things being in the central list and one critical area that the Constitution puts in the central list is 'Standards'. Standards in medicine, in education, in weights and measures, whatever they are, they come under the central list and without standards one cannot move far on many things. All the debate around opening up markets – of spot markets to ride on the fact that there is the future markets being on the central list whereas the agricultural markets are not – overlooks the simple fact that there are virtually no grading standards for agricultural commodities.

How does someone trade miles away on an agricultural commodity without a grading standard? This is entirely in the central list and there is nothing

that prevents grading standards from being instituted except for the lack of will to take that route and to think about it. The same goes for health and education. There is talk about malnutrition and growing evidence that what is often sold as healthy food is hugely unhealthy. The stuff comes in packets, looks nice, looks crunchy; claims to have built in proteins; often that it is not even fried, it is roasted; Kohli eats it; and is supposed to be healthy but there is not enough evidence, there is enough reason to seek evidence on how healthy these things in fact are.

More than the centre-state issue, there are other important things, particularly with regard to sustainability, which should be debated. Forests used to be in the original state list but an amendment of the Constitution in the seventies brought it under the concurrent list. However, land and water continue to be on the state list. The question is whether they should be left there or shifted elsewhere. There are tremendous problems with inter-state rivers and disputes between states. The courts have gone into them but have not been able to do a thing. Land and water should remain a state subject because without land and water there is very little geographic meaning to the state.

The centre is needed to keep the standards movement going and have standards that are compatible nationwide; to have the knowledge flowing without barriers; there are problems given that there are so many languages. These are things that need to be pursued instead of playing up the whole centre-state issue too much.



Food Sustainability IN A RAPIDLY CHANGING WORLD

Arun Kumar

t is time to overhaul India's development paradigm, which is the basic cause of the contradictions amongst the various policy goals, to address the multiple challenges facing the country as it seeks achieve sustainable food systems. India's policies have further marginalized the marginal, including agriculture and rural areas. There are now two circles of growth, one comprising the organized sector; the other, the unorganized sector, both diverging

substantially from each other and causing problems of inadequate demand and a slowdown in the economy.

The economy has suffered two big shocks in the last two years in the shape of demonetization and GST, both hurting the unorganized sector unambiguously, with the forced digitization of the economy adding its woes. The demand from the unorganized sector has gone down and this demand shortage has led to low farm gate prices even though consumer prices have not dropped. Thus the gap between the price paid and the price received by farmers has increased, which is at the root of the problem. The terms of trade should be analysed in this context because farmers' incomes depend on the pricing mechanism.

In the non-agricultural sectors, there is mark-up pricing with a ratchet effect. Price can be fixed oligopolistically and monopolistically but that is not so in the case of agriculture prices where producers have to take what they get. This difference in the pricing mechanism is very important. There is a big gap between what the farmer gets and what the consumer pays. If agricultural prices are not remunerative, there arises the need for government intervention, to exercise policy options like public distribution or procurement policies or price fixation via the Costs and Agricultural Prices Commission (CACP).

Technology has also become the big disruptor. There is a mismatch between the retail level – wherelargeorganized sector distributers (including e-commerce firms) are coming in to deliver to the end user – and the producer level, where there is prevalence of small scale structures. The former is abletosqueezethelatterwithad verseconsequences for the farmers.

India has followed top-down policies since Independence, which has led to growing inequality. The Indian elite has wanted to copy western



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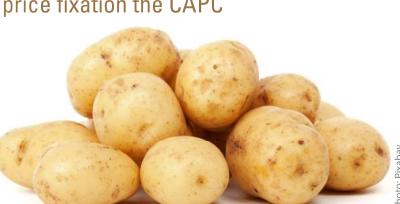
modernity and cornered resources leaving little for the non-elite, including the rural areas and farmers. Thus, resources have been pre-empted by the organized sector, leaving very little for the unorganized sector, which is impacting its well-being.

Investment patterns in the economy even a decade ago showed that 80 per cent of it went to the organized sector that accounted for seven per cent of the employment; the remaining 20 per cent went to the unorganized sector that employs 93 per

cent of the work force. Today, agriculture engages 45 per cent of the work force but hardly gets 10 per cent of the investment. This big mismatch, in the investment pattern between the agriculture and non-agriculture sectors and between the organized sector and the unorganized sector, results in a large disparity and consequent problems.

Technology is leading to big disruption with the rise of artificial intelligence as well, which will widen the gap between the organized and unorganized sectors. Artificial intelligence has hardly enhanced agricultural technology but is helping in production and distribution in the organized sector. The rise of e-commerce and other structures like aggregators in various other services (taxis and hotels) are examples of the ongoing disruption. This is likely to lead to problems, for example, in employment generation.

If farm prices are not remunerative, there is need for government intervention with policy options like public distribution or procurement policies or price fixation the CAPC



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Photo: Pixab

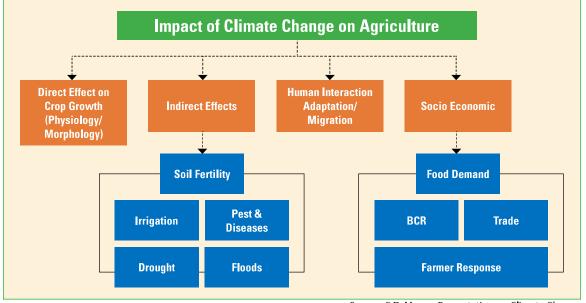
Another issue that must be flagged is the nature of the black economy in India. The black economy currently is 62 per cent of the gross domestic product (GDP). The bulk of that is concentrated in the services sector and not in the agriculture sector. If 62 per cent is added to the GDP, the services sector that accounts for 57 per cent of the white economy would account for 77 per cent of the enlarged economy. Agriculture that accounts for between 14 per cent and 15 per cent of the GDP, would come to around nine per cent of the GDP. Thus, the gap between agriculture and non-agriculture increases further if the black economy is taken into account.

The black economy also leads to policy failures because the government is unable to raise enough resources and the way they are spent results in waste. Fiscal policies, for instance, face two problems. If 62 per cent of the GDP is black, tax collection is less by around 24 per cent of the GDP. This results in shortage of resources with the government. Whenever more allocation is demanded from the government for education, for instance, it says it does not have the resources and its fiscal deficit is already high. Had it collected taxes from the black economy, the budget would have had a fiscal surplus rather than a six per cent deficit. The resource shortage is entirely a result of the black economy.

Rajiv Gandhi said in 1988 that only 15 paise of every rupee spent by the centre reaches the beneficiary. If that be the case, neither agricultural policy nor other policies, like education or health, can achieve their targets. This results in a setback to development and to poor social infrastructure. India has never spent more than 3.9 per cent of







Source: C.D. Mayee, Presentation on Climate Change



The bulk of the black income is generated in the organized and not in the unorganized sector, where most incomes are below the taxable limit

the GDP on public education while it should have spent six per cent, like the South East Asian countries did; some even spent 10 per cent.

The black economy amounts to digging holes and filling them. When one person digs a hole during the day and fills it up at night it implies that the next morning there is zero output but two incomes. This is activity without productivity. A large part of the black economy is like that; activity but no productivity. A road built with insufficient targets washed away by the rain and the investment in it does not yield the productivity it should.

This means huge wastage of resources and low investment productivity.

The incremental capital-output ratio rises as a result. The black economy also lowers the investment rate in the economy. These two factors together lower the rate of growth. It has been shown that India has lost on an average five per cent growth rate since the mid-seventies on account of the large black economy.

Moreover, the bulk of the black income is generated in the organized sector and not in the unorganized sector where most of the incomes



Sustainability has little meaning in terms of a year or five. It has to be over a long time span and must include issues of inequity, environment and instability in society

are below the taxable limit. So, the government's moves towards formalization are not going to help check the black economy. Further, because black incomes are concentrated in the three per cent of the population, inequality rises even more. As already argued, the sectoral gap between services and agriculture increases because of the black economy.

The next crucial issue to consider is sustainability, which has a time dimension. Is one talking of five or hundred or thousand years? Sustainability has little meaning in terms of one year or five years. It has to be over a long time span and must include issues of inequity, environment, instability in society and the development paradigm that is needed. There can be no sustainability in an unstable society. If inequity and instability rise, there can be no sustainability.

Social instability regrettably is very high in India and it is rising because of inequality as the Oxfam and the World Inequality Reports state. One per cent of India has 70 per cent of India's wealth. If

black incomes are included, one per cent will have 85 per cent of the wealth. Further, one per cent has 22 per cent income and if black income is included, that one per cent will have 40 per cent of the income.

High income and the wealth disparities result in greater instability and alienation in society. One very important aspect of all this is that there are 90 tax havens. They are a part of the global financial architecture that enables the rich and the corrupt to siphon out funds from the country resulting in shortage of capital for investment. A poor country is exporting capital. There is Base Erosion and Profit Shifting (BEPS)¹ that Obama complained about because of which the USA lost \$100 billion of taxes. However, the rich countries are beneficiaries of this flight of capital since much of these funds are funneled back to them. India is losing large amount of resources because of this but it is a net loser.

The financial architecture and more particularly BEPS allows 'Wall Street' to dominate over the

¹ Base erosion and profit shifting or BEPS refers to corporate tax planning strategies used by multinationals to "shift" profits from higher-tax jurisdictions to lower-tax jurisdictions, thus "eroding" the "tax-base" of the higher-tax jurisdictions.







'Main Street'. The world of finance rules over the main production structures, whether agriculture or industry. For example, when AlG (the largest insurance company in the world) was failing, the American government gave it \$350 billion within three months. When General Motors wanted \$25 billion, the American government did not give it that sum even though General Motors employed twice as many as did AlG.

The world of finance is able to dominate since global capital movements are very large and use loopholes to escape taxes. Thus, they can make nations states give them concessions. These global financial movements have strengthened capital and weakened labour because labour lacks mobility.

What all this has resulted in is marketization, which means penetration of market principles into various social institutions and this has led to growing consumerism. Consumerism has diverted attention away from the real issues of society, like environmental degradation and growing disparities. Today, consumerism can be said to have become the new opium of the masses. This leads to unsustainable policies, which have led to a rightward drift in society because the real issues are not in the focus. Issues of migration and such others have become very critical globally. These issues are being used in various countries by the

right wing to create a paranoia and divert attention from the real issues.

How does one use technology to address these issues? Facing the challenge of technology will require continuous upgrading of skills and high-qualityeducationthat will enable peopletoup grade themselves, whether in agriculture or in any other sphere. However, with privatization of education and rising costs, access to education has declined.

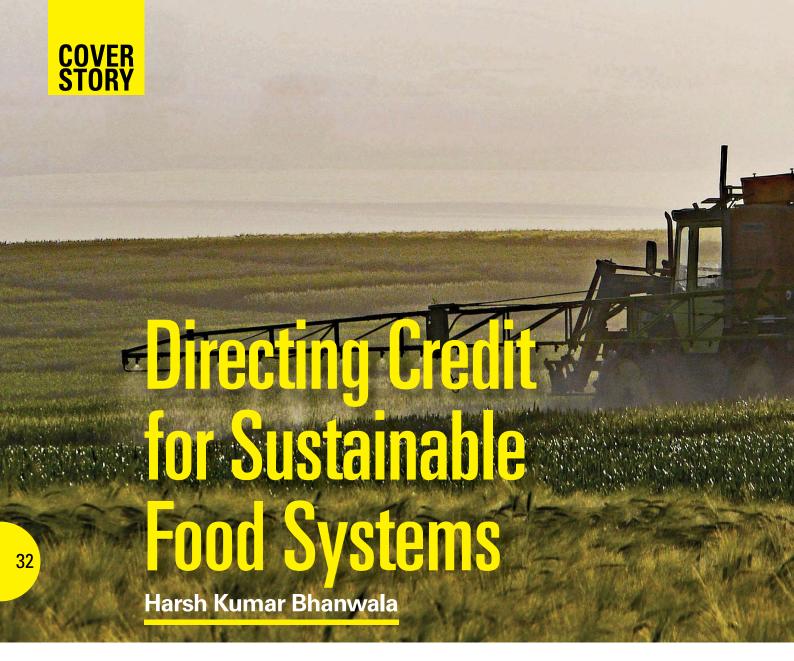
When the access to education declines, large numbers of people become outliers. Annual Survey of Education Reports (ASER) suggest that 50 per cent of the children in the Class V cannot read or write or do Class II level mathematics. Formally they are in Class V but effectively they are not even in the Class II and most of them drop out.

Under these circumstances, one is assured of a 50 per cent poverty in India for the next 50 years till these children go out of the job market. That too only if we start improving our education standards starting today. Not only should more people get education but the content is crucial as well, if India is to empower itself to use new technology and, especially, artificial intelligence. India's expenditure on public education has to rise dramatically and academic institutions must be nurtured. Instead, at present, institutions are under attack and getting destroyed. This undermines the ability to provide world-class education to all.

All of the factors discussed here impact overall development and that ties up with creation of sustainable food systems, which must be a long-term plan; not a five-year or a 20-year plan. An appropriate development paradigm that would reverse the ongoing marginalization of the unorganized sector, including agriculture in rural areas, is required. It would need to tackle the black economy and policy failure to achieve a sustainable long-term policy. The challenge of technology and marginalization need to be addressed through education, without which nothing can change. Poor quality of education and marketization have led to growing alienation in society.

To consider another aspect, people are talking about driverless cars and driverless trucks. These can displace millions of people from drivers' jobs. Electric cars will mean that petrol pumps and repair shops will become redundant and that the auto industry will undergo major changes. This example shows how automation will lead to large changes in the nature of jobs. This has the potential of increasing social inequity. All this has to be addressed if one wants sustainability in spite of marketization and consumerism.





griculture has changed dramaticallyfromtheyesteryears with huge implications for food systems. Indians today produce differently, consume differently, the market laws are different, the availability of infrastructure is different, weather conditions are different and they in turn determine the infrastructural requirements of various kinds.

There are also some striking similarities. The presence of a large number of small and marginal farmers across all regions; between 82 per cent and 87 per cent in many states and even 90 per cent in others. There is also an uniform absence of technology – except for a few north Indian states, Andhra Pradesh and some southern states that have plantations – or use of old technology, be it in the form of seeds or farm implements or the form of storage or any such others.

The similarities extend to the lack of resources for any meaningful development to be taken up.



HARSH KUMAR BHANWALA Chairman, Nabard

The allocation of resources in the form of budgets is largely consumed by the revenue expenditure of many departments or by efforts to maintain an existing system; not only the manpower but others things as well.

There is, however, the advent of new communication technology and aspiration levels are rising. People want a better quality of life and more diverse income

sources but there are not enough opportunities for the youth in rural areas. They are looking for employment because opportunities for selfemployment are few and even job opportunities are shrinking across the country.

The Nabard is concerned about making funds available upfront and organizing small and marginal farmers in various forms. India's production systems are small while the marketing systems or systems that depend on the production system are being monopolized by larger players, with



Without sustainable farming, there would be large-scale unemployment even if disguised with serious implications for the law and order situation, as one has seen in certain areas

technology helping further monopolies. In such a scenario, small farmers who account for 85 per cent of the farmers but own merely 45 of the land while contributing 50 per cent of the production, need someone to look after their interests. Without them there would be, first, large-scale unemployment even if disguised and that would have serious implications for the law and order situation, as one has seen in certain areas.

Second, there could be a threat to food security. India has encountered periods of scarcity and surplus even in the fully-grown system where everybody participates. Prices have soared for certain vegetables primarily because of a production shortfall or even distribution problems. The Nabard is, therefore, working with state

governments and the centre on what can be done for the small farmers to ensure their participation in the production system. Nothing can be achieved with everyone's support and through more efficient systems with regard to resource allocation, production system and such others.

The third disturbing phenomenon is the increasing oral leasing, which means some are acquiring others' lands to cultivate informally. The Nabard's All Indian Financial Inclusion Survey, (Nafis) shows that it is as high as 40 per cent in some states. The lowest is 10 per cent. This can be remedied by changing the law but there is something to be done on the organizational front, with small farmers coming together. There is a very successful programme in India, the Self help





Uniting to help each other

Under the Self Help Group (SHG) Bank Linkage Programme, banks can open savings accounts for Self-Help Groups, which are registered/ unregistered entities with a membership of 15 to 20 members from very low-income families, usually women. They mobilize savings from members and use the pooled funds to give loans to the needy members. Under this programme, banks provide loans to the SHGs against group guarantee and the quantum of loan could be several times the deposits placed by such SHGs with the banks. Banks consider entire credit requirements of SHG members, namely, (a) income-generation activities, (b) social needs like housing, education, marriage and such others and (c) debt swapping.

Group (SHG) Bank Linkage Programme, where small, underprivileged people, save little things, not "saving" per se but more by way of thrift, with which they are doing business worth about ₹100,000 crores.

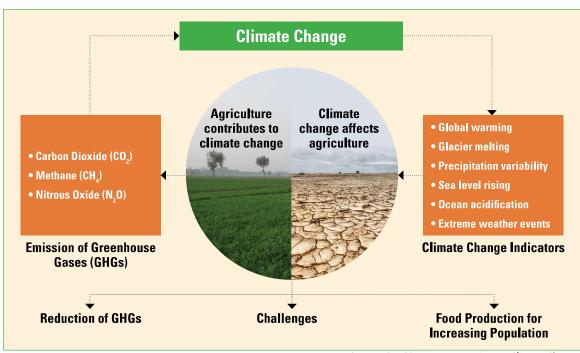
The circulation of money within the group, the savings that they keep with the banks and the kind of money that goes from banks to this initiative has a multiplier effect on individual savings. This should be built upon without becoming consumption-oriented as has been the past experience. Small farmers should be brought together to pool in their resources in terms of land, in terms of labour, their

enterprise taken on board and organized in terms of farmers' producers organization.

Regrettably, despite scattered successes there is no integrated action though two or three agencies, the state government, the Nabard, the small farmers agribusiness consortium are involved. It needs an anchor organization like the National Dairy Development Board (NDDB) to mobilize small farmers. It should be large enough to have outreach into the villages and to state governments because agriculture is state subject.

Many schemes get implemented under the NDDB because it has the financial muscle and outreach right from the village to the state and there should be more such. The country requires at least 50,000 farmer producer organizations where farmers come together primarily for an economic activity and create a scale large enough to tilt the balance in favour of the farmers compared to other larger entities. The scale has to be somewhere around 500,000 farmers who work around some economic activity, be it custom hiring, be it marketing of produce, commodity specific, multi-commodity and other such things. Organization and finance should be focused upon simultaneously.

As has been discussed with the Reserve Bank of India and other entities, there should be a separate priority sector target for small and marginal farmers. Since 2015 it has become compulsory and this should be closely monitored. Where the credit goes is very important when ₹1,100,000 crore is flowing to agriculture. Even gold loans have been



Source: C.D. Mayee, Presentation on Climate Change





There should be a wholistic approach to encourage efficient food systems to come up locally, sub-nationally or integrated across the country. Farmers must integrate their resources

declared as agriculture activity and one does not now know what part of the credit is going into the food credit system; how much the food chains are getting out of these funds; or what is the real sector linkage of this credit flow. How much is going for apple or for sugarcane or for milk cows?

There should be fair estimates and a wholistic approach to encourage efficient food systems to come up locally, sub-nationally or integrated across the country. Farmers must integrate their resource and invest together even without forming NPOs. Oral leasing and such phenomenon defeat the purpose of empowering the farmer and creating necessary infrastructure on the basis of what is needed.

The Nabard's Nafis survey shows that only five per cent goes for farm mechanization. Precision irrigation or solarization or electricalization of tube wells and such others will account for much less. The focus must change to investment credit and on small farmers creating groups that, even if not geared around economic activity, can have members issuing guarantees for each other for availing of the credit that requires a surety against which a loan can be made. This is one way to overcome the problem.

Warehousingschemesarealsoadisappointment. Organized bill discounting figures are on the decline for the last 2-3 years. Storage systems with seamless interaction between investment



Currently produce comes small lot sizes and farmers complain that the required trading lot sizes are too large. To secure their participation, the system must be modified

made and market demands an entirely different set of standards. Currently, produce comes small lot sizes and farmers complain that the required trading lot sizes are too large for them. To secure the farmer's participation in a vibrant food system, the scheme has to change from the standard ones for larger exchanges and warehouses or storage godowns, to help farmers to ensure better storage capacity utilization.

The other problem is the lack of investment in warehouses after the subsidy scheme of the Ministry of Agriculture was withdrawn. Only governments have been investing for the last two to three years and individual investment in warehousing is significantly lower in rural areas

post subsidy withdrawal. Investments must also take place in farmer's field for mechanization, for electrification, for the internet of things and for storage.

A vibrant and sustainability food system takes time to build and some states are making some arrangements to support their food system but even one episode, be it climate related or economy related, throws them out of kilter. Climate change events regularly impact the small farmers, who are the backbone of any food system in the country. Climate funding requires a different thinking altogether; it is mostly government-led now but the off take from even what is sanctioned is too small.



The Nabard is the national implementing entity for the National Adaptation Fund (NAF) as well as for Green Climate Fund (GCF). It is difficult and time-consuming to get funds from the GCF and there are few effective implementing agencies for the NAF, save for what resides with the state governments. There is need to focus on climate impact mitigation and adaptation in a significant manner with carefully designed schemes that can be understood and taken up by farmers without the help of external agencies.

Unless farmers understand climate change in their own terms and how it impacts them personally, there can be no sustainability in the food system. There must be people's involvement with farmers undertaking some activities for mitigation or adaptation. There is also discussion around launching funds to handle specific problem.

Primarily though, credit has been pushed at the individual level but off-farm investments have not

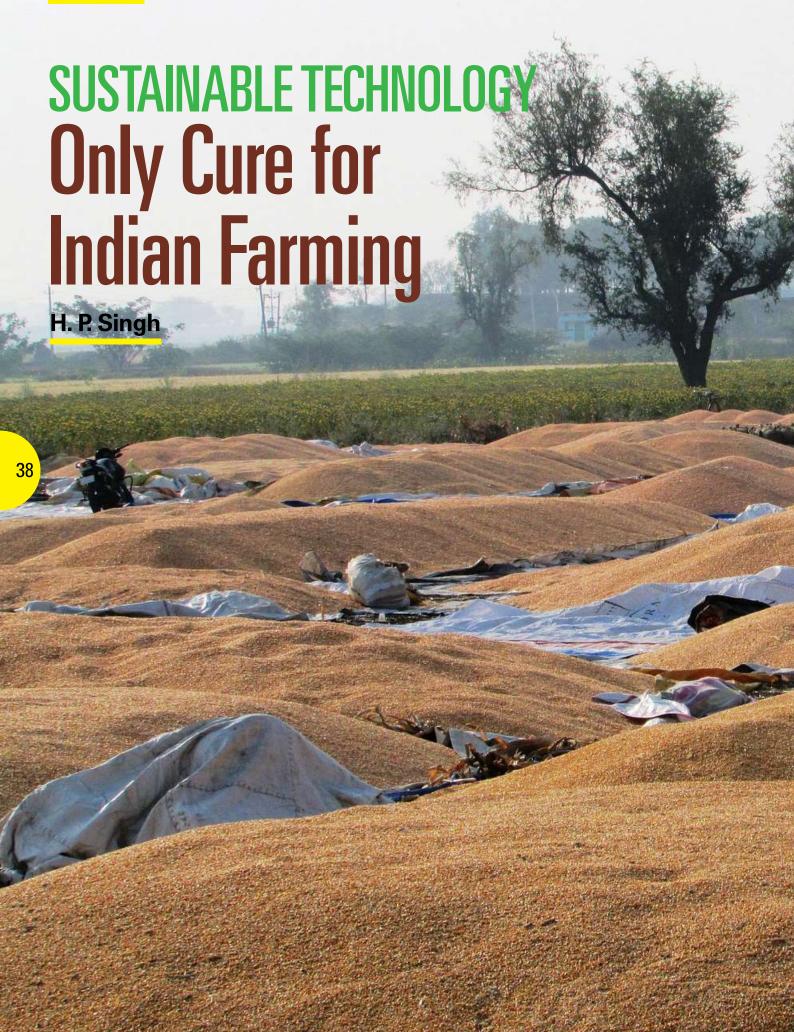
kept pace. Off-farm infrastructure financing is important as in milk processing, whereby India has become the largest producer of the milk. However there is no capacity to process the milk; no major investment has taken place after Operation Flood; certainly not in the co-operative sector and only some in the private sector. This, with larger production and inadequate consumption, has prompted farmers to come to the streets to throw their milk to protest low prices while the lean season suffers from a scarcity of milk.

This underscores the need for processing capacities and Nabard has launched funds to make money available upfront. There is need for massive infrastructure investment on pending infrastructure projects and long-term irrigation funds that Nabard is creating. Happily, 18 of these 99 projects are technically complete, though some command area investments are still required. However, there must be efficient use of water along with this. Otherwise such wasteful utilization of the long-term irrigation fund will hamper its extension to a larger area.

There are various such funds, a fisheries fund, a market infrastructure fund, a warehouse fund of ₹10,000 crore whereby Nabard provides upfront money for expeditious completion of the projects that could be repaid slowly over the next 10 years or so, rather than slow investments over the next 10 years. Food systems need these critical supports.

Finally, food systems or the value chains today mostly work around fast foods; venture capitalist focus on faster delivery and logistics but not on solving the problems for the farmers of the food sector per se. There is need to create larger accelerators, incubators, incubation funds to impact on the entire area of agriculture or on food systems and not just fast cooking or fast delivery. The investment should be focused equally on sub-national and the local food system as well. There is enough opportunity for somebody to cook for local taste and provide quality standards even at a local level. Funding must be motivated by such requirements to genuinely nurture efficiency in agriculture and make the system sustainable as well.

Siraj Hussain: Last year agriculture credit was ₹10,000,00 crore of which some ₹6.5 lakh crore went to crop loans. Where has the remaining ₹3.5 lakh crores gone? I have been trying to get some information without success.





griculture is changing in India and much has happened in this space. In the 1950s, my great father had three sons and one acre of land got divided into three and they had three sons each and the land was further divided by three. The question is notabout the land getting divided but whether the farmer's lot has improved? Has the per unit



Founder/Chairman, Confederation of Horticulture Associations of India

realization improved with use of technology?

I was in Jalgaon recently meeting some 500 farmers; people who could not afford a bicycle 30 years ago now own vehicles. That is the impact of technology for the banana growers, pomegranate growers and even vegetable growers. However, while change has taken place there is dissatisfaction amongst farmers; there is distress sale too.

One has talked of commissions paid and marketing solution for decades but there is no genuine solution. Farmers ask for markets before they start producing. Markets are required for progress to take place; to sell what one produces but it is not just limited to the market. The entire value chain must be managed.

Again, this is not just about value addition in some part of the chain but about managing the whole, especially post WTO. This involves profits being shared from the top end to the bottom; from the first link of the value chain in the early stage of production till it reaches the consumer. A farmer producing a variety that is not in demand will not get value.

Such value chain management extends to production system management, irrigation system management and fertilizer system management as well and if these lead to productivity enhancements, the farmer gets a better income. In the banana business, the farmer would get not more than 15-20 tonnes in 18 months but, with tissue culture and other technology, it is possible to get bananas every month. For every acre, the income is upwards of ₹2.5 lakh.

Technology has helped pomegranate growers to go to dry and arid areas and, with production systems management, completely change their circumstances by earning more than ₹3 lakh per acre of the land. There is the technology and people are adopting it though there is resistance.

There is a massive problem with water and the problem is going to be critical by 2025. In certain places action has been taken and there have been changes in irrigation systems and, virtually, there has been total revolution of irrigation through solar plants or the micro irrigation systems. One international company serves the agriculture space exclusively. It has an excellent project in Karnataka called Ramdhan that talks of 'source to root'.

One has been talking about saving water because India's irrigation efficiency is only 30 per cent but it can improve to 80 per cent if one uses sprinklers and as high as 95 per cent with micro irrigation, especially with drip system. That is the kind of water than can be saved. If one adds fertilizer to this there will be a 50 per cent reduction in fertilizer use. The system is called fertigation and it has led to productivity enhancement.

This has gradually picked up; a start was made with row crops like mango, citrus and grapes. Then came bananas and now, in Maharashtra and many other places, a large number of vegetables have come under micro irrigation system because that is building incomes for the farmers. For the past decade we have argued the case for micro irrigation for rice.

Producing one kg of rice requires 4,000-5,000 litres of water but there is technology to produce better rice using just 1,000 litres of water through the micro irrigation system. Data demonstrates that this is possible though the initial cost is high and many clients in Haryana, Punjab are taking to this cropping system, which will be a reality in due course.

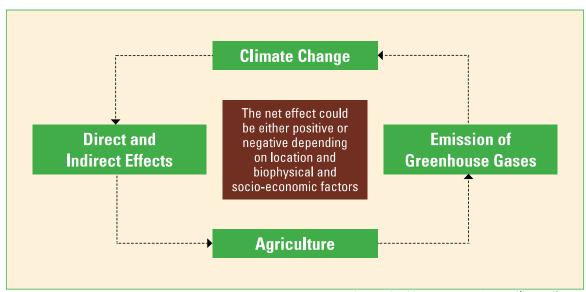
Earlier, when one talked of micro systems

even scientists thought that it was a foolish idea. The government realized the value when, for the first time in 1991, micro irrigation was launched and many lessons were learnt and changes made. In 2002, when there was drought across the country, Prime Minister Atal Bihari Vajpayee, announced a task force for micro irrigation, chaired by Chandrababu Naidu, of which I was member secretary.

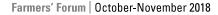
The Nabard chairman, M. S. Swaminathan and three or four ministers were on the committee that went across the country, had discussions with all the stakeholders and submitted a report categorically saying that if Indian agriculture had to be saved, at least 70 million hectares had to be brought under micro irrigation. An investment plan was also given. Has the investment come in accordingly? No.

Nabard has allocated funds but no one has actually worked on this. That is essential as the system needs technical support because under micro irrigation the benefit comes not come only from the micro irrigation per se but from a total system management. The variety of crop, the manner of production, marketing and the whole system must be managed for the full benefits of micro irrigation to accrue. Mismanagement will ruin the crop and support has to be consistent and not on a piecemeal basis.

In some states like Maharashtra, Andhra Pradesh and Gujarat, the farmers have become pro-active for they realize that without proper systems management they cannot grow the crop. For assuring a sustainable food system, there has to be a value chain management starting from



Source: C.D. Mayee, Presentation on Climate Change





the selection of the site of production. This is important because mere production of rice and wheat will not lead to food security. There must be diversification.

Ionce had to explain to the government that food security could not be achieved without focusing on horticulture and nutrition security before the horticulture mission was launched. Today, farmers are aware of the mission and its schemes; they even know the problems but, overall, the success of the horticulture mission is reflected in the way it has enhanced the fruits of the green revolution.

In the 1950s horticulture accounted for 25 million tons and food for 50 million tons. Horticulture was focused upon only after 1998-99 when I became the Commissioner of Horticulture. Today food production is 285 million tons and horticulture has touched 307 million tons. In two years it is going to be 360 million tons though the demand for horticulture produce will be more than 560 million tons by 2050.

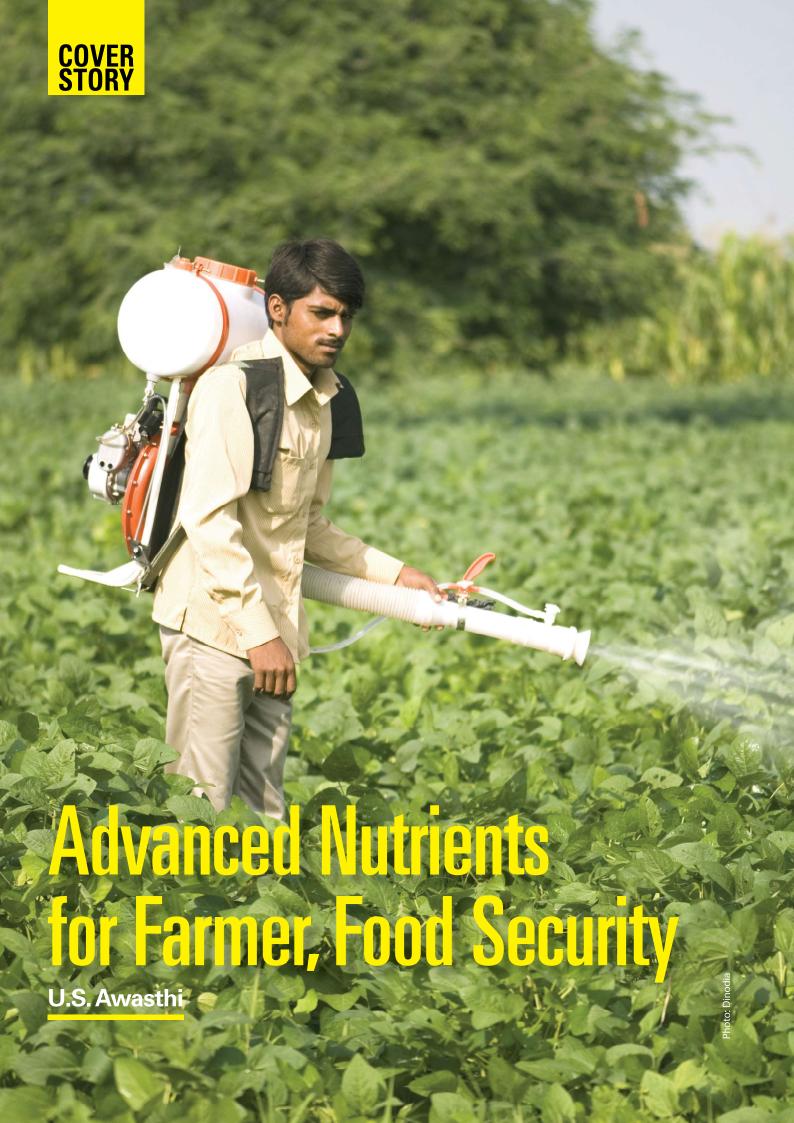
The answer lies in technology and the future is going see nearly completely environmentally-controlled agriculture and that will lead to better productivity. If one acre grows 400 tons

The future is going to see nearly completely environmentally-controlled agriculture and that will lead to better productivity

of tomato, why should another grow only 50 tons? If one wants to ensure sustainable food systems not only must there be investment for infrastructure creation but skills have to be upgraded as well.

Indian labour is believed to be cheap but it is very costly because of the low output. My son-in-law is associated with a big programme of pipelines being laid in Andhra but the plumbers had to come from China. The whole problem is around skills. In the Netherlands 30 acres of land under green house are being managed by only 10 people.

There is need to build scales, build efficiency and make investments for micro irrigation. If this is done Indian agriculture will come up and provide leadership to the world.



hen we talk of fertilizer, we talk of food security. Policy makers in the post-Independence period were still reeling from the horrors of the Bengal famine and for a long time thereafter the country faced food shortages, moving into the PL 480 era that



U.S. AWASTHIManaging
Director, IFFC0

was a ship-to-mouth situation. Understandably, they were only concerned about enhancing food security. That was why the Fertlizer Corporation of India was created. All policies were centered around food security because the policy makers realized its importance for the country to retain its independence.

Then came the green revolution with its hybrid seed accompanied by the need for fertilizers. Even today a large sum of money is given as subsidy for fertilizer; as much as two per cent of India's gross domestic product. IFFCO is one of the country's largest fertilizer companies but is farmer owned, which is why the company is always beside the farmer.

From 1965, when the nutrient application was 0.7 million ton, nutrient application has increased to 26.6 million ton in 2017-18 with corresponding rise in India's food production. This shows the co-relation between food security and nutrient application. India today is a food exporter, under-nourishment in the country has fallen from 22 per cent to 14.8 per cent. The absolute number is larger because the population has grown.

India's food priorities have also changed. Urbanization and dietary transitions are being felt in India across states and per capita foodgrain consumption is declining while consumption of fruit and vegetables is increasing. Expenses on cereal have practically become half in both rural and urban India. Cereal consumption is down from 24 per cent to 12 per cent for rural India and from 14 per cent to seven per cent for urban India. Since the last decade, the per capita consumption of fruit has increased by 21 per cent, of vegetables by 14 per cent, of milk by 11 per cent, of meat, egg and fish by 23 per cent.

During our childhood, there were practically no non-vegeterians; egg was consumed by very few people; milk consumption was limited even though households bred animals. Their yield was so low that



In 1995-96, the average farm size was 1.41-1.15 hectare. By 2020 it will be 0.32 hectare. This means that systems need to be redesigned with room for nutrients

it was practically impossible to breed them. Fruits were a rarety: a saying in Hindi goes: "ek anaar 100 beemar";foronepomegranatethereare 100 patients. Today there is plenty of fruit across the country; villages have fruit sellers and growers.

Agriculture too has changed, keeping food consumption patterns and India's dietary preferences in mind, in an unprecedented manner. However, the farmer did not get an adequate return and landholdings were marginalized. In 1995-96, the average farm size was 1.41 hectare to 1.15 hectare. By 2020 it will be 0.32 hectare. This means that systems need to be designed, keeping in mind nutrient and agriculture management considerations, to take care of marginal farmers, who will be in the majority. This makes it a matter of serious concern around the very sustainability of the marginal farmers with climate change impacting agriculture very adversely.



Sudden rains, hailstorm, changes in the weather pattern, the global warming and their effect on the soil, the declining yield along with problems such as burning of crops in Punjab, which is forced by the reduced time available between crops, plague Indian farming today. The farmer has only 15 days in which he has to plant the second cycle of his wheat after cutting paddy. So there is need for area-specific incentives to grow what is needed and to grow it cheaper. Growing paddy in Punjab is not cheap; growing paddy in Himachal is not cheaper.

The impact of climate change needs to be researched at the university level because around 150, out of 648 districts in India, are in the highly vulnerable category due to climate change. The Economic Survey 2017-18 says that climate change would lower farmer incomes by 12 per cent annually on an average. In unirrigated areas farmers could lose up to 18 per cent, if policies do not adapt to climate change. Management of fertilizer apart, managing climate change is a very critical concern today.

Nutrient use efficiency is equally important because overall nutrient efficiency promotes optimum and balanced use of fertilizer. The government of India has issued about 100 million soil health cards and farmers who understand them can make use of them. IFFCO too undertakes some 100,000 soil surveys and majority of villagers have soil health cards; an input recommendation is given. Direct Benefits Transfer of fertilizer subsidy through the POS machine is one step by which the government can change the subsidy pattern from being industry centric to being farmer centric. If that happens, farmers will be empowered to better manage nutrients and soil.

One of the biggest problems in India is the excessive use of urea, which mines the good nutrients from the soil and uses it in its growth,

The impact of climate change needs to be researched at the university level because around 150, out of 648 districts in India, are in the highly vulnerable category due to climate change



not necessarily in the yield. The need to record the buyer's name and the reduction in size of the bag from 50 kgs to 45 kgs have had an impact and urea consumption that seems to have declined by six per cent to seven per cent.

The other important step is for policy to balance the prices of N, P and K. The budget amount can remain same but it must address nutrient management given that India is a water-starved country; water is misused and not properly recycled. Linking per drop to more crop and giving har khet ko paani (water to every village) will mean using drip irrigation and judicious use of water and charging heavily for excessive use.

While irrigation coverage with micro irrigation has increased from 3.35 million hectare to 4.36 million hectare, there is about 50 million hectare of irrigated land and 145 million of





IFFCO has taken a small step towards an Indian Co-operative Digital Platform with 25 million farmers members, which is continuously disseminating data and knowledge, with very good response

IFFCO is also doing research on Nano technology at the Tarafdar IFFCO Nano Laboratory; J.C. Tarafdar being the godfather for nano fertilizers. IFFCO is in the process of patenting its nano fertilizers. It has developed five nano fertilizers, boron, nitrogen, phosphate, potassium and zinc that can bring down phospatic fertilizer use to 10 per cent. Such measures will help reduce the impact of global warming.

The other noteworthy development is that data is emerging as the new oil and India has many institutions, laboratories and universities to do research. A lot of data is generated but there are no artificial intelligence tools whereby that data can be mined and shared with the farmers. Managing this lacuna will revolutionize the system of generating and sharing information and knowledge with the farmer. By 2020, 73 per cent of India's population will comprise internet users; the data can be effectively used and the information shared.

IFFCO has taken a small step towards an Indian Cooperative Digital Platform with 25 million farmers members, which is continuously disseminating data and knowledge, with very good response. There is also IFFCO Yuva, which provides training for digital skill development and many young boys and girls are very keen to learn about modern agricultural practices; how to run their tractors and repair tractors and agricultural implements; how to save water; how to sell the products. These are things that they are trying to understand.

What India needs is a precise system for imparting knowledge through data. Disruptive technology, use of nano, bio fertilizers; reduction in cost of fertilizer or the cost of cultivation; providing farmers with tools to reduce their working hours; providing them with support by way of marketing knowledge are initiatives that will empower the farmer. If these are done, the fertilizer industry and farmers can continue to support each other.•

land. This means that not even 10 per cent is covered through drip irrigation, which is the mostimportantaspectofwatermanagementand needs a very strong push.

Emerging disruptive technologies like precision farming can also increase production by 10 per cent but this will need serious investment by the states because farmers cannot own drones, sensors or wireless connectivity. It would be very useful if these services are provided by the states or by their agencies as a part of technology development and infrastructure development. Biotechnology and nano fertilizers are other aspects of technology that should be encouraged. IFFCO has increased biotechnology production 16 times and can give complete advisory on how to reduce the use of chemical fertilizer by 30 per cent and cost by at least 20 per cent by using biotechnology.



mongst the greatest environmenta**l** challenges facing the world are climate change and weather variability. Seasonal change profoundly affects the balance of life in ecosystems and essential human activities, including agriculture and irrigation; weather variability and climate change impact agricultural productivity that is regulated by prevailing weather and climate through temperature, rainfall, relative humidity, light intensity and such other factors.

In India's southern states, for instance, an increase in the frequency of heavy rainfall events had a negative impact on grain production and the region's economy. In north India, various weather stresses and their impacts have been found on the wheat crop. The exposure was to a 5°C increase in temperature at sowing stage and a 1-2°C increase in mean temperature at reproductive stage in the



K.RAMASAMY Vice-Chancellor, Tamil Nadu Agricultural University

wheat crop. This exposure caused a delay in the duration of wheat crop by seven days that in turn reduced the yield by 5q/ha, according to a study.

Indian agriculture is highly prone to the risks due to climate change caused by increase in the concentration of atmospheric Greenhouse Gases (GHGs) such as carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Climate change can affect agriculture through direct and indirect effects on the crops,

soils, livestock and pests. Development of technologies for adaptation and mitigation and their fast uptake at by farmers are essential for climate change management.

Potential adaptation strategies include developing cultivars tolerant to heat and salinity stressandresistanttofloodanddrought, modifying crop management practices, improving water management, adopting newfarmtechniques such



Many ecosystem services on which crop production depends are affected by climate change, including pollination, biological control and nutrient cycling

as resource conserving technologies (RCTs), crop diversification, improving pest management, better weather forecasts and crop insurance and harnessing the indigenous technical knowledge of farmers.

- Many ecosystem services on which crop production depends are affected by climate change, including pollination, biological control and nutrient cycling.
- Greater intra-varietal diversity may be needed to cope with unpredictable extreme climate events.
- Climate change may increase the importance of plant species that have previously been underutilized or considered to be of minor importance.

Climate during effect in India 2002-2014

- 2002 Drought
- 2003 20-day heat wave in Andhra Pradesh
- March 2004 and January 2005 –
 Abnormal temperature
- 2005 Floods in Mumbai
- 2006 Floods in Arid Rajasthan and Andhra Pradesh, drought in the north-east
- 2009 Severe all-India severe drought
- 2010 One of the warmest ears; Ladakh floods
- 2012 Drought in Haryana, Gujarat, Karnataka
- 2013 Uttarakhand flash floods
- · 2014 J&K floods

The predicted effects of climate change include a trend toward higher temperatures over the coming decades. In the tropics and subtropics, in particular, rising temperatures will present significant problems for livestock production. Heat stress affects animals in many ways with production and fertility declining and death rates increasing. High temperatures also increase animals' water requirements and reduce their appetites and feed intakes.

Climate change thus presents several challenges both to the practical tasks of keeping animals alive, healthy and productive and to the task of ensuring that livestock diversity is maintained over the longer term. Animal genetic resource diversity has generally not fared well as a result of these changes. Also there is a lack of adequate policies supporting the sustainable use, development and conservation of these resources.

Traditional crop varieties and livestock breeds are frequently overlooked in efforts to improve crop and livestock production. However, such varieties have often been developed in harsh production environments and have characteristics that allow them to thrive in severe or variable conditions. Climate change underlines the importance of having crops and animals that are well-adapted to the environments in which they are raised and of retaining the diversity necessary to adapt production systems to future changes.

The potential advantages of species, varieties and

Farmers perception of climate change issues

- Changes in number of rainy days/season
- · Changes in amount of rainfall
- · Changes in distribution of rainfall
- · Changes in the onset of monsoon
- Changes in number of hot days during summer season
- · Changes in day temperature
- Greater number of dry spells
- · Hot winds during summer
- More pest and disease incidence
- Occurrence of new pests and diseases
- Conversion of minor pest into major pest
- · Change in cropping pattern
- Increased weed growth
- · Loss of soil nutrients
- Reduced crop yield
- · Adversely affected income
- · Increased cost of cultivation



breeds that have previously been underutilized or discarded in favour of high-producing but less environmentally-adapted equivalents should always be taken into consideration when planning interventions. Attention should be paid to the potential risks involved in attempting to raise non-adapted livestock or crops in harsh or variable environments, particularly if the production inputs needed to raise them successfully are difficult for farmers or livestock keepers to obtain or afford.

Breeding programmes for crops and livestock should pay more attention to traits that increase resilience rather than focus exclusively on maximizing yields. They should look at the contributions that biodiversity for food and agriculture as a whole makes to food security,



Breeding programmes must develop strategies for specific crops and regions, targeting varieties that will be relevant to the challenges facing farmers 10 to 15 years in the future

livelihoods and environmental health, as well as to the sustainability, resilience and adaptability of production systems.

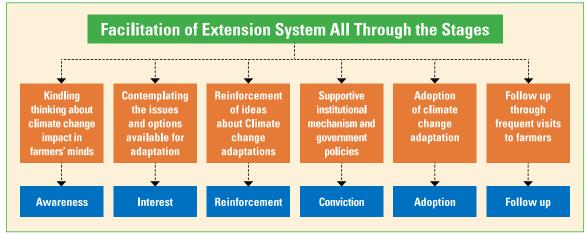
Breeding programmes will need to develop strategies for specific crops and regions, targeting the development of varieties that will be relevant to the challenges facing farmers 10 to 15 years into the future. Breeders will need to identify genetic resources with traits that can be used to develop varieties that will be able to thrive in extreme climatic conditions. There is a need to develop

screening methods that can be used to identify the physiological basis of tolerance to such stresses.

Global reports also indicate a loss of 10 per cent to 40 per cent in crop production by 2100 with greater loss is expected in Rabi. Every 1°C increase in temperature reduces wheat production by 4-5 million tons and the loss can be reduced to 1-2 million tons if farmers plant in time. Increasing temperature would also increase fertilizer requirement for the same production targets and result in higher emissions.







Source: C.D. Mayee, Presentation on Climate Change

Researchers have been trying to find pragmatic solutions to the threat of climate change on agricultural growth. Farmers have been trying to mitigate this phenomenon through several climate changeadaptations (Seebox Some farmer responses to climate change through adaptation measures).

Though, adaptation measures are followed by individual farmers, many measures require community action that could be strengthened

Some farmer responses to climate change through adaptation measures

(Vivekanantha, 2016)

- Selection of crop According to the availability of water and foreseeing a dry spell or drought.
- Selection of short duration/climate specific variety/pest and disease resistant/ drought tolerant variety; Adoption of Swarna sub 1 a flood tolerant variety by farmers of the Cauvery delta by replacing the ruling paddy variety BPT 5204.
- Direct sowing by farmers of Muthupettai and Thiruthuraipoondi villages of Thiruvarur district, increasingly adopting direct seeded rice instead of transplanted rice.
- Changing the date of planting/transplanting as farmers have done, based on weather forecasting and indigenous wisdom.
- Formation of farm pond and water conservation structures (In Ramanathapuram and Sivagangai districts, farmers very successfully went for dry seeding of rice and during the critical stage of the crop, if the rain is not received in time they could save the crop using the water from the farm pond).
- Summer ploughing is widely practiced.

by revitalizing the link between farmers and the extension system. The link will be strengthened only when the extension workers get rid of the monotonous way of delivering inputs. They should try to follow the extension principles in letter and spirit to transform farmer lives.

Conducting participatory workshops and facilitating farmers brainstorming sessions and answering the following questions would go a long way in solving the problems of farmers related to climate change. The questions could be around the following issues:

- 1. Did they really feel climate variability? If so, they should be asked to explain climate change as they perceive it.
- 2. What issues have they faced due to climate variability?
- 3. What indigenous adaptation measures do they follow?
- 4. Is there any constraint in following such adaptation measures?
- 5. Do they need any technology to overcome the extreme climate events?

Instead of directly implementing climate resilient interventions, the extension system could conduct exercises outlined here and prepare farmers to think and align themselves with extension system. Behavioral change among farmers is the core objective of extension. Hence, the extension system should try to address the issues pertaining to change in the behaviour towards climate change.

This means that extension workers should go step by step and be with the farmers as they travel from awareness to sustainable adoption of technologies through the judicious combination of traditional and modern information and communication technology tools.



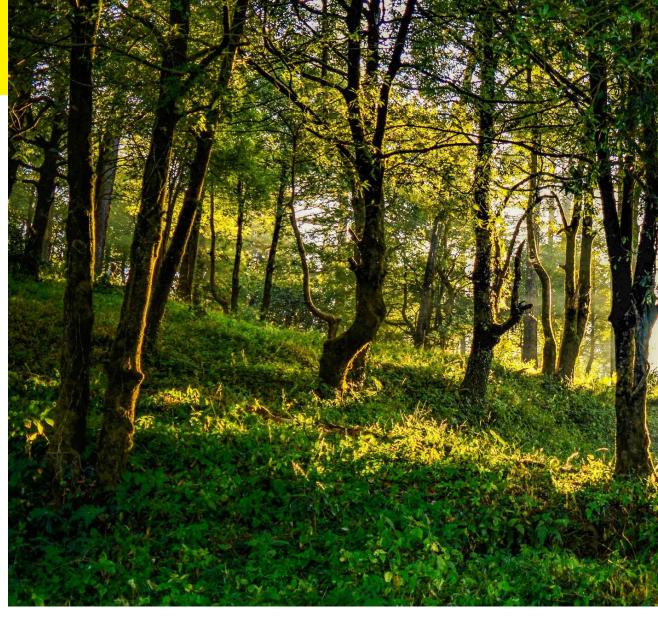
Missing Links in Farm Extension

The following strategies may be considered for a realistic link between the extension system and farmers.

- 1. A specialized extension approach focusing on climate change and mitigation.
- 2. Women extension workers being appointed to improve womens' participation in combating climate change.
- Capacity building of scientists and other stakeholders in climate resilient agriculture research and application.
- 4. Most climate change adaptation requires collective action. Hence, the extension system must revitalize its group extension strategies. Example, determining the sowing date for a crop, adopting a plant protection practice.
- 5. The farmer collectives need to be sensitized by the extension workers about climate variability and the adaptation measures and emerging issues in climate change.
- 6. Strategies to be devised for farmer-farmer learning, farmers' networks on adaptation techniques.
- 7. The mode of reaching the farmers needs to be changed in line with the development in ICT:
 Utility of Social Networks, WhatsApp, SMS and

- Crop insurance is an important adaptation mechanism for which the extension workers need to familiarize the farmers and motivate them to enroll themselves.
- Location specific tailor-made climate change adaptation measures could be documented and up-scaled by the extension system.
- 10. Village level contingency plans containing integrated information on agriculture and allied sectors on technological interventions to combat climate change should be developed.
- Duplication of interventions may be avoided and the extension system should converge all schemes for wider reach.
- 12. The extension personnel may be given free hand to work for which the reporting work needs to be minimized. An enabling environment is needed for the extension workers to pay more visits to field and follow up the visits.
- 13. A database on the impact of climate change in agriculture and evaluation of its impact in various locations would help in devising appropriate strategies to combat climate change.
- 14. Monitoring and evaluation mechanisms to be strengthened exclusively for climate change projects.
- 15. Need-based irrigation methods have to be developed for each crop, based on micro situation and the information disseminated.



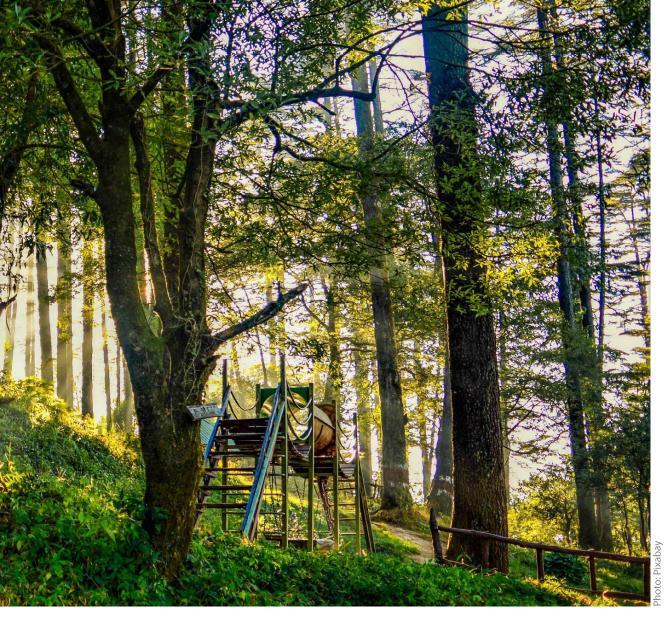


The government's schemes and programmes for promoting sustainable agriculture practices include.

- National Mission on Sustainable Agriculture that aims to enhance food security and protect resources such as land, water, biodiversity and genetics;
- National Initiative on Climate Resilient Agriculture, whose four main modules include natural resource management, improving crop production, livestock and fisheries and institutional interventions;
- National Agro Forestry Policy designed to protect and stabilize ecosystems and promote resilient cropping and farming systems to minimize the risk during extreme climatic events;
- Soil Health Card Scheme to improve soil health;
- National Food Security Mission to increase production and productivity of wheat, rice and pulses on a sustainable basis so as to ensure food security of the country;
- Mission for Integrated Development of Horticulture to enhance horticulture production, augment the income of farmers and strengthen food security

 National Mission on Agricultural Extension and Technology to make the extension system farmer-driven and farmer-accountable by way of new institutional arrangements for technology dissemination being implemented to cover major aspects of farming.

The Tamil Nadu Agricultural University is implementing various national initiatives/ interventions to combat climate change in agriculture. One such project implemented through Krishi Vigyan Kendras is the National Initiative on Climate Resilient Agriculture (Nicra). In the Thiruvarur district, farmers replaced a local variety in paddy (BPT 5204, Co 43 and ADT 50) that was not tolerant to flood with CR1009SUB1 at the Nicra-adopted Rayapuram village. This improved version of CR 1009 with Sub 1 gene conferred submergence tolerance without hindering growth and the work was undertaken at IRRI, Philippines. The variety has given a mean grain yield of 6,278 kg/ha in 155 days with moderate resistance to blast and brown plant hopper. In 2016-17, the cultivable



Drought tolerant finger millet variety ML 365 with ICM practices was demonstrated in Dharmapuri district, which yielded 21q/ha as against 17q/ha in traditional varieties

area under CR109 Sub 1 and Swarna Sub 1 has increased to 250 acres.

Climate resilient interventions in KVK and Nicra Project at KVK Dharmpuri district include:

- Drought tolerant finger millet variety ML 365 with ICM practices was demonstrated in Dharmapuri district which yielded 21q/ha as against 17q/ha in traditional varieties.
- Demonstration of Bengalgram variety JAKI 9218 with ICM practices recorded higher yield, realized higher net return and benefit cost compared to farmers practice. About 26 per cent of Bengal gram growers stared cultivating this variety.
- Other demonstrations include: demonstration of in-situ composting of sugarcane trashes in ratoon sugarcane using TNAU Biomineralizer that conserves soil moisture, soil nutrients and enhancedsoilorganiccarboncontenttherebysoil

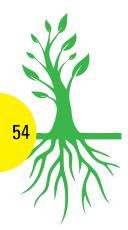
fertility. Demonstration of PPFM use to mitigate drought in rain-fed cotton increased the number of bolls per plant by 20 per cent and cotton yield by 13.8 per cent compared to farmers practice and without the use of any spray.

Finally, there is the question of natural resource management that includes in-situ moisture conservation, water harvesting and recycling of supplemented irrigation, improved drainage in flood prone area, artificial ground water recharge and such others through certain interventions. Six farm ponds and one check dam were constructed and two drainage channels desilted, resulting in water harvesting and ground water recharge.

A Nicra scheme in Nicra villages has popularized the drought-tolerant paddy variety, Anna (R), shortduration paddy variety CO(R) and biotic stress-







Biointensive pest management approaches

(Vivekanantha, 2016)

- Seed treatment with Pseudomonas fluorescens and Trichoderma viride.
- Soil application biocontrol agents for the management of rot and wilt diseases in turmeric, tomato, tuberose and melons.
- Demonstration of Trichogramma chilonis, Acerophagus papayae and Chrysopa Spp. to manage insect pests.
- Use of entomopathogenic nematode for the management of subterranean insects in brinjal and sugarcane.
- Use of pheromone traps and yellow sticky traps in vegetables for the management of caterpillars and sucking pests.
- Use of aggregation pheromone traps for the management of fruiflies in mango and cucurbits.

Ecological pest management approaches

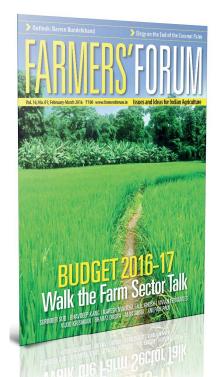
- Growing a combination of flower crops around the bunds.
- The chronology should be based on the height and flower initiation period.
- Blackgram, greengram, cowpea, sesame, mustard, sunflower, chrysanthemum, sunhemp and such others are the preferred crops in the border preferably before transplanting.
- These crops will attract natural enemies and also restrict pest movement.

tolerant variety, NLR 34449. PPFM spray along with supplemented irrigation using mini portable sprinkler during terminal stress helped avoid the occurence of terminal stress on crops. Additionally, theharvestedrainwaterinthefarmpond/community pond was effectively utilized at critical stages of crop growth to avoid economic losses.

Drought-prone areas suffer insufficient and uneven distribution of rainfall that affect crop growth and yield, resulting in frequent crop failure, low yield and non-adoption of drought tolerant varieties and such others. Interventions include popularization of drought-tolerant and short-duration paddy varieties; popularizing salt-tolerant paddy varieties; popularizing high-yielding paddy varieties, creating awareness on crop diversification and value addition in millets.

It is important that the extension approach be integrated, comprehensive, intensive and location specific. The location specific technology development, testing adaptation and demonstration with the participation of farmers and other stakeholders by KVKs are ideal for combating climate change in agriculture. This extension model has to be adopted on a large scale by the extension machinery to effectively deal with climate change.









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