DEALING WITH UNCERTAINTIES

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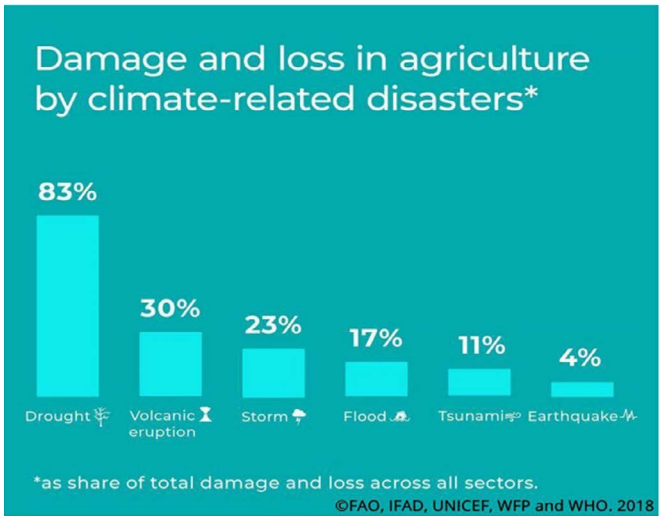
NATURAL DISASTERS AND EXTENSION & ADVISORY SERVICES (EAS): LESSONS FOR BETTER PREPAREDNESS

Natural disasters, calamities and unforeseen events make farming and farmer lives vulnerable. These events lead to severe loss, crop damage, and human and livestock fatalities, which in turn, cause grave stress to them and their livelihoods. Mahesh Chander reflects here on the roles and responsibilities of Extension and Advisory Service professionals before, during, and after natural disasters, with particular emphasis on the livestock sector.

We often hear news stories on floods, cyclones, hurricanes, tornadoes, hailstorms, landslides, fires, droughts, tsunamis, earthquakes, volcanic eruptions, etc. All these events are characterised as disasters (Box1). According to FAO (2015), of all natural hazards, floods, droughts and tropical storms affect the agriculture sector most, showing the severe impact of climate-related disasters. Drought causes more than 80 percent of the damage in the agriculture sector, especially on livestock and crop production. Tsunamis and storms cause much damage in the fisheries subsector, while floods and cyclones are responsible for most of the economic loss with regard to forestry. Disaster risk reduction and climate change adaptation are closely intertwined, and in agriculture they should be addressed in an integrated manner (FAO 2018).

No one disaster is exactly the same as another, therefore impact and consequences vary from region to region and community to community. In developing countries, the agriculture sector attracts about 22 percent of the total damage and loss caused by natural hazards. In developing countries alone, these disasters have brought about US$ 550 billion in estimated damage and affected 2 billion people. Such disasters often undermine overall national economic growth and development goals, and agriculture sector growth and sustainable sector development in particular (FAO 2015). Alongside humans, their shelters, their livelihoods, including crops and livestock, all suffer damage and loss in varying degrees due to any of these disasters. Therefore there is critical need to prepare ourselves to deal effectively with such events in terms of reduction, preparedness, response and recovery from its harmful effects.



In India, during 2001 to 2015, 33,291 human deaths were reported against 12,58,353 cattle heads lost, 1,97,35,686 houses damaged, and 581.50 lakh hectares of cropped area affected (GOI 2016). Farmers, including livestock owners, suffer during disasters in multiple ways.

Box 1: Disasters

A disaster is a serious disruption, occurring over a relatively short time, in the functioning of a community or a society, involving widespread human, material, economic or environmental loss and impact, which exceeds the ability of the affected community or society to cope using its own resources. The World Health Organization defines disaster as 'any occurrence that causes damage, economic destruction, loss of human life and deterioration in health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community or area' (WHO, 2007). It is an event, concentrated in time and space, which causes social, economic, cultural and political devastation, which affects both individuals and communities.

Between 2003 and 2013, disasters triggered by natural hazards caused US$ 1.5 trillion in economic damage worldwide (FAO 2015). Disasters significantly impede progress towards sustainable development and must be prevented or mitigated in order to achieve the Sustainable Development Goals by 2030. Countries at lower levels of human development, in particular, having higher levels of poverty, are likely to suffer especially large socioeconomic setbacks as a consequence of disasters. For example, an estimated 94 percent of the human population killed by disasters between 1975 and 2000 were from low or lower-middle income groups (UNISDR 2008). Disasters challenge efforts to reduce poverty, undermining sustainable development, so it calls for our active involvement in efforts to tackle these disasters.

Box 2: Disasters in the Asia-Pacific Region

The Asia-Pacific Region is particularly susceptible to all the major types of natural disasters. Over the 10-year period ranging from 2005 to 2014, 426,991 lives were lost in the region as a consequence of natural hazards, 52 percent of the global total. An estimated 1.4 billion people were affected by natural hazard events, representing 85 percent of the global total. Reported direct physical losses reached over $0.7 trillion, equivalent to an average US$ 198 million loss per day. The region accounted for 49 percent of total global losses over the same period, far higher than the region's share in global gross domestic product. Asia and the Pacific now face a collective average annual loss of $157 billion as a consequence of natural hazards. *Source: Benson, 2016*

Ideally, EAS being responsible for serving the farming community should be the primary stakeholders in helping out farming communities during disasters. It is well known that many developing countries, including India, are not always well prepared to deal with disasters. Lack of a well-developed disaster management plan leads to considerable loss of human life, animal life and property, which could be avoided if the necessary mechanisms were in place. A lot needs to be done to improve the situation, particularly with regard to livestock. Can we as extension professionals, contribute meaningfully to better climate change and disaster management so as to minimize farmer suffering?

Livestock & Disasters: An Overview

Disasters not only cause loss of life, damage to environment and properties, but have immediate and progressive impact on animals as well, resulting in animal deaths, suffering and economic losses. A large number of animals, including poultry, is affected during disasters such as drought, cyclones, earthquakes, landslides, floods, and ensuing epidemics. For instance, "in the recent floods in Kerala as many as 1.76 crore poultry, 46,000 cows and 20,000 goats were washed away. Officials of the Kerala Agriculture Department said the department was able to rescue at least 50,000 cattle and house them in relief shelters across eight districts. "These cattle had been left behind by their fleeing owners when the water levels rose. There is also widespread fear about a breakout of communicable cattle diseases. There is a huge scarcity of roughage, including straw and green fodder," said officials (Kumar 2018). A holistic approach along with collective efforts is required to address the issues of animal disaster management more effectively. This may contribute greatly towards avoiding or minimizing animal suffering, save many animal lives and the livelihood of millions of people through protection of animals in disasters.

My Personal experience

While reviewing various types of natural disasters and their impact on livestock, we outlined different preparedness, response, recovery, and mitigation strategies as well as the roles of different agencies, including veterinarians (Sen & Chander 2003). We also conducted an ex post facto study (Ganguli 2004 and Ganguli and Chander 2007) during 2002-03, using the super cyclone that struck the Indian state of Orissa in October 1999 as a case. This case study could help us understand the impact of natural disasters on livestock farmers in general, and the preparedness, response and recovery with respect to livestock management under disaster situations in particular.

The super cyclone affected the human and livestock population, causing 4.41 lakh livestock mortality against 9,885 human deaths. The preparedness, response and rehabilitation mechanisms primarily focused on human beings, but inadequate attention to livestock management in such a situation led to heavy losses. Moreover it delayed and caused poor recovery from livestock-

related damages. The total loss arising from cyclone-related damage to livestock could have been reduced with better preparedness, timely response and well-designed rehabilitation efforts. The authors, based on their findings, argued a case for better attention to livestock during natural disasters, such as cyclones, since the majority of Indian small, marginal and landless livestock farmers depend heavily on livestock – and it is often the only livelihood source for them.

The welfare measures in the wake of disasters mainly concentrate on human beings with little thought given to livestock, thus causing maximum casualty in animals leading to huge economic loss for livestock farmers. For instance, cyclonic storm *'Phailin'* which hit the coastal belt of Orissa in 2013, resulted in extensive damage not only to human life and property but it also had high impact on livestock farmers as well. These farmers faced several problems with sheltering, feeding, and treatment of animals as well as marketing of milk and other products, disposal of carcasses, restocking of animals, etc. The study undertaken on *Phailin* (Sunita Bara & Ganguli 2016) revealed that the preparedness, response and recovery mechanism were inadequate, resulting in poor recovery of losses for livestock farmers in the affected area. It concluded that considering the contribution of livestock to local and national economy and the dependence of poor farmers on livestock for their livelihood, the preparedness, response and recovery mechanism should be given greater attention – both by the government as well as NGOs – so as to minimize the economic, social and psychological loss to livestock farmers from natural disasters.

In 2013, I attended a two-day National Conference on Animal Disaster Management[1] with the theme 'Animals matter in disasters', organized by Federation of Indian Chambers of Commerce and Industry (FICCI) in association with National Disaster Management Authority (NDMA) and World Society for the Protection of Animals (WSPA) at New Delhi, India, that highlighted the importance and relevance of animal disaster management. The conference suggested establishing 'veterinary emergency response units' all over the country in order to minimize the loss of livestock as well as to reduce the economic impact on livestock farmers. This conference emphasised that the preparedness culture is to be inculcated in animal disaster management through awareness, effective information sharing, appropriate education and efficient communication.

In June 2013, the North Indian state of Uttarakhand witnessed the country's worst natural disaster since the tsunami of 2004. A multi-day cloudburst caused devastating floods and landslides leading to much sufferings and loss, including more than 5,700 people presumed dead. Among several agencies that joined in response and relief operations, the Indian Council of Agriculture Research (ICAR) too took some proactive steps in analysing the disastrous situation that affected agriculture and allied sectors. I represented the Indian Veterinary Research Institute (IVRI) at the workshop held at the Central Soil and Water Conservation Research & Training Institute, Dehradun, on 1-2 August 2013, wherein, an action plan[2]was drafted for the agriculture sector in the state under the leadership of Dr S Ayyappan, the then Director General, ICAR.[3] As an outcome of this workshop, IVRI brought out a 'Status Paper on natural disaster in Uttarakhand: Strategy and Action Plan on relief measures for livestock'.[4] This status paper details the measures and actions required to be taken up by stakeholders in the livestock sector in terms of preparedness, response, recovery and mitigation strategies in such natural calamities.

I also happened to be part of the IVRI team that surveyed tsunami-affected areas in Tamil Nadu, Kerala and Andaman& Nicobar Islands to assess the economic losses in livestock, and strategies for their improvement. We saw that the small scale farmers who had reared goats, pigs and poultry lost their animals in large numbers, which adversely affected their livelihood. Swift action could have protected animals during these disasters, thus not only preventing their suffering but also helping protect the livelihoods of the people who depend on them. Animal protection starts with people, so it is essential to arm animal owners and communities in vulnerable regions with specialised training so that they are ready and able to protect their animals in an emergency. Appreciably, some agencies in India are now conducting emergency disaster drills for preparing communities to protect animal lives, and thereby local livelihoods.[5]

[1] *https://www.unisdr.org/we/inform/events/32047*

[2] https://drive.google.com/file/d/1T6sUUlboXk4Gz0IdJ3lCM-QHgCdJAnbC/view

[3] http://www.cswcrtiweb.org/Vision%20&%20Newsletter/NEWSLETTER/2013/OCT/Newsletter.pdf

[4] https://drive.google.com/file/d/1Xrx7MdBysMpDmiNpkuOqKDgwxJXWSy0S/view

[5] https://businesswireindia.com/news/news-details/emergency-disaster-drill-tamil-nadu-preparing-communities-protect-animal-lives-local-livelihoods-/44638

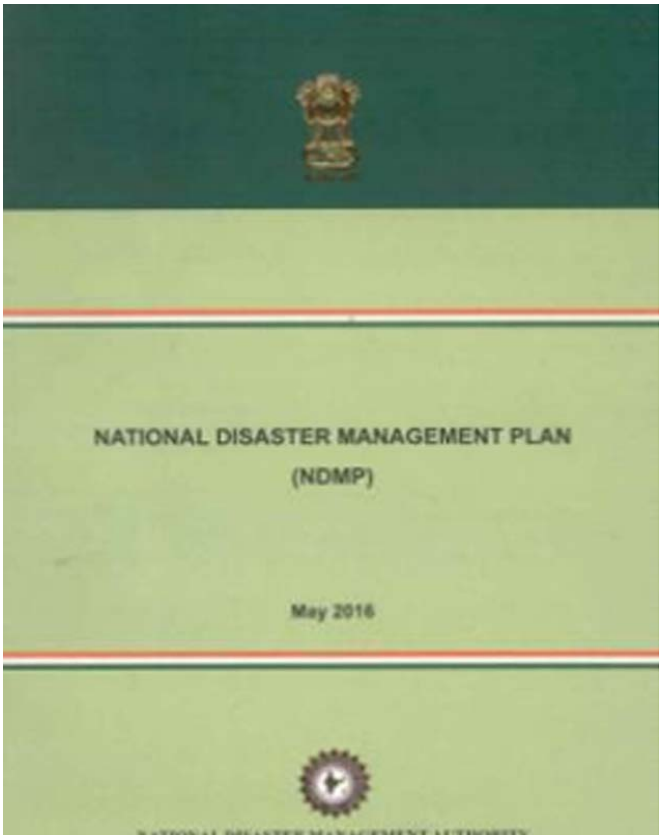
Lessons

Lessons from these disasters demonstrate that national governments, aid agencies, and international/non-governmental organizations (I/NGOs) are effective primarily at distributing short-term products (e.g., food packages and tarpaulin) to cities (Chapagain and Raizada 2017). Such products are inexpensive, simple to procure, and easily quantifiable for donors. Unfortunately, the literature suggests that many national governments and foreign NGOs are ineffective at assisting rural farmers in both the short- and long-term. Given that the global community is somewhat effective at distributing short-term products, Chapagain and Raizada (2017) have suggested that a similar strategy should be developed for rural areas, but focusing on products that can assist farm households.

To minimise the gap in knowledge of effective products that can target such households after a disaster, they proposed an emergency sustainable agriculture kit (eSAK) framework[6] for disaster relief in rural areas. The eSAK involves a comprehensive list of products that can be combined into packages to address the needs of shelter, hunger, first aid, seeds, preservation of indigenous crop varieties, and post-disaster labour shortages. The EAS can work out strategies elucidating their roles in different types of disasters and emergencies, which will not only help reduce the stress and sufferings of farmers but also improve the visibility of the profession in the eyes of the public at large.

Livestock Disaster Management: Some Key Initiatives

On 3 March 2016, the National Institute of Disaster Management (NIDM), World Animal Protection and Policy Perspectives Foundation (PPF) together with Department of Animal Husbandry, Dairying & Fisheries (DADF), Ministry of Agriculture & Farmers Welfare, Government of India,reached the landmark of integrating animals into the National Disaster Management Plan of India.[7] The plan ensures, for the first time, that animals will be included in disaster preparations, potentially saving millions of animal lives and building the resilience of the communities that depend on them. With the launch of the National Disaster Management Plan 2016,[8] India has also aligned its National Plan with the Sendai Framework for Disaster Risk Reduction 2015-2030,[9] of which India is a signatory.



Disasters: What EAS could do?

To discuss issues of development in the area of disaster management in agriculture, the National Academy of Agricultural Sciences (NAAS), India, organized a one-day brain-storming session on 27 February, 2004. The role of the Government of India, International agencies, Non-governmental organisations, Panchayati Raj institutions including those in education and training within disaster management, were deliberated upon (NAAS 2004). A number of recommendations emerged at this session, some of these have been studied since then. The role of disaster management education and training was emphasized in planning and implementation of disaster management strategies. The workshop recommended that education should be designed so as to provide comprehensive knowledge on different types of hazards, disaster management techniques, and impediments in the way of disaster reduction, and should directly address community needs.

[6] *https://link.springer.com/article/10.1186/s40066-017-0116-6*

[7] *https://www.worldanimalprotection.org.in/news/india-launches-first-national-disaster-management-plan-animals*

[8] *https://ndma.gov.in/images/policyplan/dmplan/National%20Disaster%20Management%20Plan%20May%202016.pdf*

[9] *https://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf*

Often response to disasters is addressed by the local and state development administration, including designated disaster management authorities. But this does not mean other organizations have no responsibility or can't do anything in disaster situations. Extension is one among a few other organizations that is well positioned to assist affected communities with long-term disaster recovery. Recovery programming falls well within Extension's wheel house; it can provide swift response to local needs with research-based educational outreach and direct engagement, often accomplished through synergistic work with community partners. Extension's engagement in disaster preparedness and recovery benefits communities because no other entity has the geographic distribution, access to research-based practices, local credibility, capacity, and mission to address the depth and breadth of community needs after such events. Additionally, the goodwill and relationships forged during such trials can go on to facilitate extension programming in an area long after recovery is complete (Kerr, Sanders, Moulton & Gafney 2018).

Given that it is embedded in communities, and has programming visibility, along with existing partnerships, Extension can be a valued, trusted, and effective participant in community-based recovery efforts. In the time of a disaster, a state's Extension Service has the opportunity to be a local beacon of recovery while working side-by-side with others in the community. Serving in this way helps Extension Service grow stronger (Boteler 2007; Cathey, Coreil, Schexnayder & White 2007). Moreover, citizens trust Extension as a credible source of locally relevant information and appreciate Extension's effective connections with other organizations (Eighmy, Hall, Sahr, Gebeke, & Hvidsten 2012). As trusted members of the communities they serve, Extension professionals are strongly positioned to share mitigation and adaptation strategies with their clients (Prokopy et al. 2015).The major strengths of Extension are the dedicated Extension personnel and the Extension model that includes partnerships, state-wide networks of offices, and a unique focus on assessing human and community needs (Cathey, Coreil, Schexnayder & White 2007). Extension staff may consider becoming members of the local emergency preparedness teams and work toward establishing Extension as a valuable resource before, during, and after a disaster (Washburn 2006).

Considering the importance of disaster management, one compulsory non-credit course entitled 'Disaster Management' was introduced in 2009 by ICAR at the Master's level of agricultural education in Indian universities. This course aims to: introduce learners to the key concepts and practices of natural disaster management; equip them to conduct a thorough assessment of hazards, and risks vulnerability; and build capacity to deal with disasters. Many would argue that such courses are important not only in agriculture but across all disciplines so that all citizens are ready to face, or assist others, as and when required. In Veterinary Education too, such a course would help develop capacities of veterinarians to handle emergencies better.

EAS can join disaster management agencies to contribute in:

i. Understanding disaster risk, enhancing disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation and reconstruction, and strengthening disaster risk governance to manage disaster risk better;

ii. Training and education on disaster risk reduction, including the use of existing training and education mechanisms and peer learning;

iii. Promoting the incorporation of disaster risk knowledge, including disaster prevention, mitigation, preparedness, response, recovery and rehabilitation, into formal and non-formal education, as well as in professional education and training;

iv. Promoting national strategies to strengthen public education and awareness in disaster risk reduction, including disaster risk information and knowledge, through campaigns, social media and community mobilization, taking into account specific audiences and their needs;

v. Enhancing collaboration among people at the local level to disseminate disaster risk information through the involvement of community-based organizations and non-governmental organizations.

The EAS can disseminate tailored climate forecasts prepared by meteorological agencies to support farmers' seasonal needs through mobile phones, information centres, community radio, etc., and thus help farmers protect themselves from climate shocks and changes. These advisories, however, have to be context specific and relevant to local situations since generalized messages often prove to be wrong, leading to lack of confidence in them by farmers. RAS can also motivate farmers by enabling them to buy index-based insurance giving them a measure of protection in the event of extreme weather. In this new paradigm,

insurance pay-outs are pegged to easily-measured environmental conditions, or an 'index', that is closely related to agricultural production losses. Possible indices include rainfall, yields, or vegetation levels measured by satellites. When an index exceeds a certain threshold, farmers receive a fast, efficient pay-out, in some cases delivered via mobile phones.[10]

In recent times, the instances of social media use in emergency situations, such as disasters, are increasingly being noticed (Box 3). Social media can act as one potential disaster management tool. A social media platform, such as Twitter, combines human efforts and machine computation to process highly accurate tags and labels for subsets of micro tweets. It coordinates the role of humans and smart-technology to work together and improve disaster response efforts (Anbalagan and Valliyammai 2016).

Box 3: Social Media and Natural Disasters

Those who experienced heavy rain/flash flood in Chennai in the first week of December 2015, also, saw the power of social media in such a crisis situation (Pradnya 2015). Again, the Andhra Pradesh Chief Minister Mr M Chandrababu Naidu used social media and technology to steer the relief work in Vizag which was hit by the devastating cyclone Hudhud in 2014 (Naidu 2014). The use of social networks started right after the city was struck by the cyclone. People started sharing pictures of affected areas on social media, prompting the government to come forward and speed up relief measures. The pictures submitted by the people on social media were collected by the AP government's crowdsourcing project and sent to the National Remote Sensing Centre for geo-tagging locations and putting them on the satellite map to directly identify them. The government, with the help of NRSC, also launched an Android app for a crowdsourcing project where people could upload photos from their smartphones. The Android app had more than 3000 downloads. Mr Naidu also directed NRSC to use GIS, GPS, and remote sensing technologies to spot the damage and put them on the satellite through geo-tagging.

Extension functionaries should have knowledge and skills on the subject of social media and its uses, including the current tools, methods, and models to properly make use of social media for crisis communication. Extensionists need to be equipped with capacities onthe use of social media tools, such as Facebook, WhatsApp, Twitter, Youtube, etc. They need to learn and master skills to disseminate information and monitor, track, measure, and analyse social media traffic. Extensionists should be able to use social media as a method to identify warning signs when a crisis is developing, so that they can communicate with stakeholders on handling disasters. Livestock owners may need advisories of various kinds related to feeding, housing and health of their livestock. Creation of awareness for disaster reduction is a felt need for improving preparedness among communities. A good communication network is required to keep all the agencies involved in a state of preparedness in order to manage the disaster as efficiently as possible (Gnanasekaran 2018). In recent times, WhatsApp has become very popular among farmers to share information on farming practices (Chander 2016), which could be even more useful during natural calamities.

We can look for successful initiatives taken around the world, where extension personnel are well integrated with disaster management efforts. Extension has gained ground in helping communities prepare and recover from disasters in the USA.For instance, the Extension Disaster Education Network (EDEN), created in 1994, is a collaborative multi-state effort by Extension Services across the USA to help extension personnel facilitate preparedness and response services for citizens. Land-grant institutions across the United States and its territories are members of this organization, with each institution appointing EDEN representatives. The EDEN website[11] serves as a disaster-related resources portal for extension personnel to share with their clientele to help them prepare for, and stay safe during, and then recover from disasters. Several disaster-related educational programs are available through EDEN.

[10] *https://ccafs.cgiar.org/themes/index-based-insurance#.U6A2hPm1a-0*

[11] http://eden.lsu.edu

One example is the Family Preparedness training, a classroom program developed to teach families and individuals how to make family disaster kits, develop a family disaster plan, and be informed about and prepared for various disasters. These resources should be used to help organizations and government fill some of the family- and child-oriented gaps in state and local disaster plans (Black 2012). EDEN has opened the door for extension personnel to work in the emergency management field, since extension through the resources available from EDEN can serve their stakeholders in times of need (Koch 1999). The Extension Disaster Education Network links land-grant institutions with disaster management. The efforts of EDEN representatives have provided the necessary 'foot in the door' attribute needed to work in the field and it serves as a portal for disaster-focused resources.

Way Forward

To sum up, Extension's engagement with disaster management efforts can effectively contribute by:

- Increasing literacy among extension professionals in every sector on potential regional impacts and adaptation strategies with regard to climate change. This is key to producing high-quality relevant programs for addressing climate-related risks. Given the urgency of addressing climate-related issues and the range of climate-related perspectives among extension professionals, thoughtfully designing programs to build climate literacy across and within climate-perspective groups are a critical path forward (Clifford& Monroe 2018). EAS need to develop capacities so that extension professionals can assist effectively in all stages of disaster management, viz., preparedness, response, recovery, and mitigation. EAS can promote disaster resilient practices among farmers, facilitate rural / local agriculture innovation systems to mitigate disaster, and educate farmers on standard operating procedures (SOPs) to get post-disaster relief services and in-kind materials. EAS can also scout around for relief materials, aid and other contributions, through corporate social responsibility (CSR). To revive human and livestock habitats, health and agriculture, EAS can train and facilitate the people – involving faculties, scientists including students of agricultural research and academic institutions, and other stakeholder institutions.
- EAS could be of great help in disseminating correct information about safe places, rescue operations, ways to safeguard people and animals, first-aid methods, and in-kind relief material distribution places, through authorised institutions using personal communication, public address system, mass media, social media, flyers, and other appropriate mass media to people. Also, developing simple extension literature, such as 'Do's & Don'ts' during disasters could be a big help to affected communities.
- Extension is uniquely positioned to assist with community disaster preparedness, mitigation, and response efforts; so this needs to be outlined in the National Preparedness Goal. We need to document examples of Extension's involvement in disaster management and its contributions in the many aspects of community emergency preparedness.

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DEMONETISATION AND AGRICULTURE: LESSONS FOR EXTENSION AND ADVISORY SERVICES

The recent demonetization exercise by the Indian Government has impacted farmers adversely, at least in the 'short run'. At the same time, has it also opened up new possibilities of digitizing money handling in the agricultural value chain? Arun Balamatti explores these issues in this blog.

In 2016, the Indian government decided to recall all 500 and 1000 rupee notes, the two biggest denominations in its currency system; these notes accounted for 86 per cent of the country's circulating cash. With little warning, India's Prime Minister Narendra Modi, announced to the citizenry on November 8, that those notes were worthless, effective immediately – and they had until the end of the year to deposit or exchange them for newly introduced 2000 rupee and 500 rupee bills. In his address, the Prime Minister cited multiple justifications, including (a) eliminating black money; (b) reducing the prevalence of counterfeit currency, which is allegedly used to fund terrorism against India itself; and (c) curbing corruption and criminal activity of various kinds that have been facilitated by the 500 and 1000 rupee notes. Although none of these reasons have much to do with agriculture, the sector seems to have been impacted rather harshly.

Effect of Demonetization on Agriculture

Transactions in the Indian agriculture sector are heavily dependent on cash and were adversely affected by the 'demo' of 500 and 1,000 rupee notes. Due to scarcity of the new banknotes, many farmers had insufficient cash to purchase seeds, fertilisers and pesticides needed for Rabi crops usually sown around mid-November.

Box 1: Demonetisation

Demonetisation ('demo') is essentially a financial tool used by the government for specific reasons. 'Demonetization' is defined as the act of stripping a currency unit of its status as legal tender. It occurs whenever there is a change of national currency; the current form or forms of money is pulled from circulation and retired, often to be replaced with new notes or coins and sometimes, a country completely replaces the old currency with new currency. There are multiple reasons why nations demonetize their local units of currency and these include, combating inflation, corruption and crime (counterfeiting, tax evasion); discouraging a cash-dependent economy and facilitating trade.

Source: Investopedia (2017)

The demonetization came at a time that coincided with the end of the Kharif season (harvesting) and the beginning of Rabi (sowing). Therefore, the effect of demonetization hit all the farmers, those who were selling their produce and those who were about to buy seeds, fertilizers and other inputs.

The 'demo' led to unavailability of cash to pay for food products. The reduction in demand that arose in turn, led to a crash in the crop prices. Farmers were unable to recover even

the transportation costs from their fields to the market, due to the low prices offered. The prices dropped as low as 50 paise per kilo for tomatoes and onions. This forced the farmers across the country to dump their products in desperation. Some farmers resorted to burying unsold vegetables. Agricultural produce such as vegetables, food grains, sugarcane, milk and eggs were dumped on roads. Some farmers dumped their produce in protest against the government. Farmers and their unions conducted protest rallies in Gujarat, Amritsar and Muzaffarnagar against the 'demo' as well as against restrictions imposed by the Reserve Bank of India on district cooperative central banks, which were ordered not to accept or exchange the demonetised banknotes.

The predictions, prophecies and volatile sentiments were laden with anxiety, caution, frustration as well as optimism with one common 'caveat'; demonetization would cause short term discomfort but bring benefits in the long term. The varied perceptions on 'demo' were largely in the form of informed as well as ill-informed opinions on what might happen rather than certainty of such effects.

Shepard (2017), writing for Forbes, describes the impact of demonetization thus far: Modi's demonetization initiative caused a sudden breakdown in India's commercial ecosystem. Trade across all facets of the economy was disrupted, and cash-centric sectors like agriculture, fishing, and the voluminous informal market were virtually shut down, with many businesses and livelihoods going under completely—not to mention the economic impact of millions of people standing in line for hours to exchange or deposit cancelled banknotes rather than working or doing business.

Shaffer (2017) quoting Faraz Syed, an associate economist at Moody's Analytics, pointed to a reason that demonetization might lay less of a cold hand than expected on the economy. Syed said, "Because of demonetization, while lending rates have come down, bank deposits have increased; if those lower lending rates can be translated into higher investment, then there's certainly going to be less risk from demonetization."

Bansal (2017) wrote, after demonetization, only the agriculture sector showed some positive improvement while the manufacturing and service sector both crashed down and these are likely to affect the whole Indian market in 2017 also. Discussing the impact of demonetization on agriculture sector, Bansal said, there are short-term and long-term impacts of demonetization on different sectors of economy. Agriculture sector typically sees high cash transactions and therefore near-term impact could be seen till liquidity is infused in the rural areas. As farmers face a temporary shortage of cash in hand, it could lead to a delay in payment, which in turn would hurt the related companies in the short term. As liquidity eases and cashless transactions gain acceptance, the fundamentals would be driven by the longer-term drivers of normal monsoons and positive traction in acreage. Presenting the findings of his study of impact of demonetization on agriculture, he noted the following -

Agricultural growth in India contracted by 0.2 per cent in 2014-15 and grew no more than 1.2 per cent in 2015-16, largely because of back-to-back droughts. It was expected to grow at 4 per cent this year, but due to demonetization, this forecast has not materialized as farmers are running out of cash to buy seeds, fertilizer, equipments and pay wages to workers, commission to agents, etc. Because of cash shortage, the daily supply from the transport system has also suffered, which has resulted in 25 to 50 per cent reduction in sales. The main reasons being,

- Farmers are not well educated and are not aware of how to make use of the E-Payment System; a recent study by RBI shows that 78 per cent of the population do not use internet of which almost 80 to 85 per cent are farmers.
- In most villages a proper banking system has not been developed and hence villagers needed to go to the cities for exchanging the old notes.

However, there is some light at the end of the tunnel if one were to believe what Srinivas (2016) says, "It is a myth that farmers refuse to accept cheque payment. Small dairy farmers in Andhra Pradesh accept cheques. Sugarcane farmers accept cheques from sugar factories. Moong farmers are accepting cheques from government procurement agencies. Apple farmers accept cheques from large buyers. Potato contract farmers accept cheques from food companies. Maize farmers in Nabrangpur, Odisha's poorest district and coconut farmers in Karnataka took cheques from state agencies. The list is growing."

In Karnataka and Andhra Pradesh, which have adopted the Rashtriya eMarket Services-run Unified Markets Platform, produce worth Rs39,000 crore has been sold with cheque payment in the last four years. The 250 *mandis* in 10 states that have adopted the electronic National Agricultural Market (eNAM) platform for sale of primary produce are designed for cheque payment. So far, 1.60 lakh farmers, 46,000 traders and 26,000

commission agents have been registered on the e-NAM platform.

Food Corporation of India tried but failed to pay Punjab and Haryana farmers by cheque for wheat, only because the powerful commission agents want to first deduct the loan repayment amounts. Direct benefit transfer for seeds has been a success even among the small and marginal farmers of Uttar Pradesh. Moreover, of the seven crore Kisan Credit Cards issued in India, more than one crore are ATM-enabled debit cards. Farmers accept insurance and disaster relief cheques. So to portray the farmer as a Luddite is both unfair and untrue.

Chand and Singh (2016) have looked into the possible effect of demonetization on agriculture in a more comprehensive way (Box 2).

Box 2: Potential impact of demonetisation on agriculture

Demonetization can affect agriculture directly in four ways. These include area sown, crop pattern, productivity and market.

Effect on Sown Area: According to the tentative estimate of area sown up to 11 November, at the start of demonetization, Rabi sowing was completed on 14.6 million ha area which was 5.7 per cent lower than the normal crop coverage. The gap between area sown this year and normal area steadily declined almost every week since the announcement of demonetization. During the week ending 30 December, 2016, net sown area under Rabi crops exceeded the normal area by 2.77 per cent and area sown last year by 6.86 per cent. There was a delay of 1-2 weeks in sowing this year in the beginning of Rabi season, but it picked up pace subsequently. Normally, Rabi sowing is completed on 88 per cent area by 30 December. This year (2016) it has been completed in more than 91 per cent area. The data on progress of sowing of Rabi crops clearly indicate that, at the country level, there is absolutely no adverse effect of demonetization as far as sowing of major crops is concerned.

Crop-wise effect: The progress in area sown remained uneven across regions and crops. Wheat, which accounts for 47 per cent of total area under the reported Rabi crops, showed a big shortfall of 41 per cent in area at the time of demonetization. The gap declined to less than 1per cent by mid-December, 2016 and crossed normal area by 2.12 per cent by the end of December. Compared to the corresponding period last year, wheat has been sown in 7.7 per cent greater area. Area under pulses and oilseeds is higher than normal for the corresponding period by 11.2 and 1.7 per cent, respectively. The shortfall in area is reported for Rabi rice and course cereals. This shortfall is much smaller (6.6 lakh ha) compared to the gain in area under wheat, pulses and oilseeds (22.3 lakh ha) resulting in net increase in area under Rabi by 15.7 lakh ha over normal area and 37.4 lakh ha over last year.

Among major Rabi crops growing states, overall shortfall in sown area is about 20 per cent in Tamil Nadu and Karnataka and 8 per cent in Gujarat and Andhra Pradesh. Similarly, Jammu & Kashmir and Himachal Pradesh also show major deficit in Rabi sowing. Largest shortfall is seen in Kerala. All other major states indicate small to large increase in crop sown area this year over normal area. Even Uttar Pradesh, which was persistently showing shortfall in area, has reached higher than normal figure.

Effect on Productivity: Farmers use cash to buy quality seed, fertilizers, chemicals, diesel and to hire labour and machinery. More than 7 per cent seed used for Rabi crops are self-produced while the rest is purchased from public sector agencies, research institutes and private sources. Sale of seed this year by public institutions is reported to be much lower than normal sales. This can have small impact on productivity.

The major impact on productivity is going to happen due to change in use of fertilizer. According to the Ministry of Agriculture source, fertilizer off-take during the current Rabi season (till 21 December 2016) was lower than the fertilizer off-take in the corresponding period, during 2014-15 and 2015-16 by 7.47 per cent and 7 per cent. If fertilizer use at farm level faces the similar shortfall as reported in fertilizer sales at first point, it will affect productivity. It is estimated that current shortfall in fertilizer consumption if it persists till the end of Rabi season, which constitutes half of annual agricultural output, can result in 1.05 per cent decline in crop output and 0.75 per cent decline in agricultural output.

Effect on Prices: No effect of demonetization was seen on prices of major crops like paddy, soybean, and maize in the month of November and their wholesale prices in Agricultural Produce Market Committee (APMC) mandis of the country were around 3 per cent higher in November as compared to the month of October. While the prices of maize and soybean fell in the month of December, paddy prices ruled higher than previous two months and also as compared to last year. There might be some delays in payment to the farmers due to cash crunch but that is a temporary phenomenon.

The perishables, vegetables and fruits, in most markets and states, showed a drop in market arrival as well as in prices, post demonetization. Wholesale prices of banana, apple, tomato and cabbage in the month of November in the APMC mandis of the country, taken together, were 3.80, 3.86, 8.47 and 5.6 per cent lower, compared to the month of October, respectively. These changes indicate that income of producers of perishable commodities suffered due to fall in prices in the month of November. Seasonal glut and bumper

crops seem to be the major reasons for crash in vegetable prices in the month of December 2016 in some states.

Effect on Output Growth: The situation prevailing at the end of December 2016 implies that Rabi crop output will increase by 6.02 per cent over last year, due to higher area sown. Lower use of fertilizer, as observed from the first point sale, can cause 1.06 per cent decline in output during Rabi season. These two factors put together, imply that Rabi output in 2016-17 could be 4.96 per cent higher than in 2015-16. Lower sale of quality seeds due to cash crunch can also affect growth but this impact is expected to be small.

The growth rate in farmers' income is projected to be slightly lower, due to drop in prices of perishables during the months of November and December. The net effect of fall in prices on the farmers' income, is estimated to be -0.26 per cent. Factoring this change, farmers' income in year 2016-17 is projected to witness increase of 5.8 per cent in real terms. The above discussion shows that growth story of agriculture is intact as demonetization is found to cause small and insignificant effect on growth of output, as well as on farmers' income. Agriculture, which is the largest informal sector in Indian economy, has shown strong resilience to the effects of demonetization.

Source: Chand and Singh (2016)

Renu Kohli (2016), an economist, predicts, "Production in 2016-17 could drop if sowed acreage (Rabi) reduces for want of enough seeds, on time to exploit the adequate soil moisture. Yields could fall from late sowing and subsequent exposure to rough spring weather, the lack of sufficient or timely application of fertilizers, pesticides, etc. Farm labour, vital for this period, is reported to be unpaid as farmers have no cash. Many of them are reported to be returning from some northern parts to homes in Uttar Pradesh and Bihar. Labour shortages and wage-spikes may follow with a lag.

In a complete contrast to the fears of economic slowdown, expressed by both critics as well as supporters of the demonetization idea, the government's demonetization program barely dented India's economic momentum in Q3 FY 2016, according to recently released data by the Ministry of Statistics and Programme Implementation (MOSPI). GDP expanded a healthy 7 per cent annually in the October to December period, below the 7.4 percent expansion reported in the previous quarter, but nearly a full percentage point above market expectations (Bouzanis, 2017).

Here is the latest critique on 'demo' by Langa and Sriram (2017), who wrote in The Hindu, "In addition to low prices, what has aggravated the situation is the Central government's demonetisation move late last year that has adversely hit the rural and agrarian economy". They go on to add, "Note bandi has almost finished us in the rural areas. Even after selling our produce, we don't get money in our hands for at least two-three weeks and sometimes even a month," quoting Lalchand Mali, a farmer from Barkheda Panth. While the critics, during the early days of 'demo' were saying the cash crunch could lead to reduced investments on seeds, fertilizers etc., and hence reduced production, the criticism is now directed at bumper crops, causing market gluts and price crash.

The delayed payments could be hurting farmers when they sell their produce, but the same authors, Langa and Sriram (2017), in the same article, seem to contradict themselves by saying, "From a persisting cash crunch due to demonetisation to a price free fall because of a bumper produce, it's a big bag of woes for farmers in Madhya Pradesh and Maharashtra. Agricultural expert Devinder Sharma, on the other hand, doesn't blame it on 'demo', but says, "Over the years, the government has deliberately impoverished the agriculture sector. Our economic policymakers are pushing people in agriculture to cities to get cheaper labor for industrial infrastructure and to keep food prices low so inflation does not increase (Firstpost, 2017)".

As it always happens with every ambitious policy, more so with a policy causing an impact of the magnitude that 'demo' has caused, there will be fierce criticism as well as appreciations, depending upon which side of the fence one wants to choose. But reality is that, there is a need for preparing the farmers to live in the 'post demonetization era'.

Lessons for Extension and Advisory Services

Extension and Advisory Services (EAS) have a crucial role to play in helping farmers deal with challenges of all sorts, including those that have emerged due to demonetisation.

Discussing post 'demo' ways of handling agricultural transactions in a workshop with the farmers, the author could experience the real and the perceived problems that could challenge the pace at which the digital economy starts rolling. It is not just the shortage of small currencies, power cuts and server breakdowns; rather, there is a huge psychological barrier and cultural baggage to deal with before the cash-dependent working class starts using banks, credit-debit cards, e-wallets and so on (Box 3). It is not a comfortable feeling at all, going to the bank in the first place,

the farmers may not say it but it is no secret - the ignominy they face from the banking staff, more so if they happen to be illiterate, poor and ill-clad.

The farmers are now fearing handling large monies, when they are selling their produce in the wake of limits on daily/ weekly transactions; they do not understand it is legitimate money earned out of their farming, for they are clueless on making black money from white; they do not feel comfortable going to banks with wads of currency; they fear their privacy is compromised the moment they deposit the money into bank accounts; culturally, they are used to keeping out their financial transactions from their friends, neighbours and relatives.

Box 3: Behavioural change to adapt to demonetisation

As the demonetization campaign progressed, its narrative gradually transitioned from being a measure to fight corruption, to one to modernize a large swath of India's economy. Prior to this campaign, most of the country was firmly entrenched in the cash economy and there was very little incentive to break the generations-old habits, get bank accounts and go financially digital. But temporarily removing the society's access to cash, pushed millions of people onto India's formal economic grid by all out fiat, wrote Shepard (2017) and he quoted another author Monishankar Prasad, "The unbanked and informal economy is hard hit. The poor do not have the access to structural and cultural resources to adapt to shock doctrine economics. The poor were taken totally off guard and the banking infrastructure in the hinterland is rather limited. The tech class has poor exposure to critical social theory in order to understand the impact on the ground. There is an empathy deficit".

While farmers could benefit from the ICT tools like Loop Mobile App introduced by digital GREEN in Bihar, (digital GREEN 2017), wherein aggregators come in to help farmers sell their produce in markets that offer best price. Srinivas (2016) wrote, "To convince agri-input agents and other merchants, the government should make it easier and cheaper for them to adopt card payment and mobile wallets on a trial basis. Shopkeepers should be educated about how they can expand business by moving from 'cash only' to 'cash and card', because it attracts more customers. Those customers also spend more because they are not hampered by lack of cash. Once village retailers accept digital payments, rural customers will follow. Exactly the way mobile wallets picked up with Ola and Uber. Economists call it the network effect." Srinivas went on to write, "Once the agricultural value chain adopts electronic payments and cleans up its books to align itself with the financial supply chain, benefits will follow. The biggest will be the inflow of private and banking capital, which is waiting to power agricultural growth, and social impact capital to improve rural lives".

That underscores the need for improving farmers' financial literacy, which the EAS haven't addressed so far. EAS will have to target not only farmers, but all other actors in the agricultural value chain not only in terms of educating everyone on the information and skill requirements related to digital transactions but also on how each stakeholder forms a link in the chain, to help farmers adapt to the new situation.

The banking staff and the government machinery need to be taught to be empathetic and courteous and not merely work on simplification of procedures and reducing paperwork. Similarly the banking and government servants, should enhance the capacities of small traders, commission agents, and whole set of operators at regulated markets etc., as this is of equal importance to complete at least one cycle of digital transactions. Rural infrastructure, especially power and internet services have to get far better than what they are at the moment before digital economy picks up trust from the cash-dependent communities. Without this, not only the banking services but also the delivery of information and technology through ICTs are likely to take the hit.

Way Forward

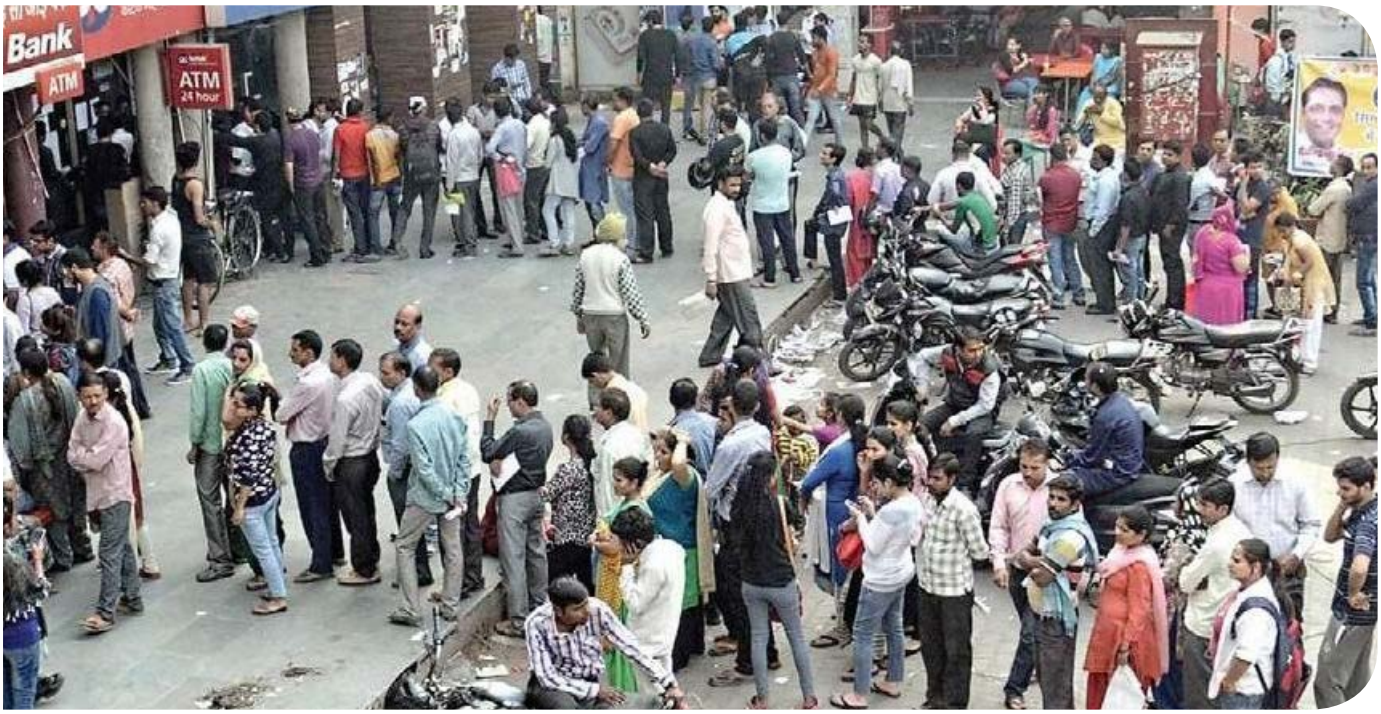
Results of the latest elections in 5 states, particularly Uttar Pradesh, seem to have silenced the critics of demonetization; ironically, the political triumph of the ruling government, more so in this state of Uttar Pradesh, has reinforced the positive economic indicators of Q3 of FY 2016-17.

It is true that the small and marginal farmers who

sell off their produce in the village itself are hurt by the 'demo'. Similarly, value chains with minimal processing and direct consumer sales such as fruits and vegetables are hit. Most fresh produce are sold by small hawkers and vegetable mongers in the streets of India. Since they take payment in cash and buy their wares from the *mandi* in cash, their business is down.

Visible difference will come if the government uses 'demo' to persuade two intermediaries in the value chain — the traders and the village shopkeepers — to adopt electronic payments. All the APMC markets are regulated by the state governments and are used by larger traders. They should be made cash-free. Cash is an inefficient medium of exchange. The World Bank estimates that the Indian government can save one per cent of the GDP annually from digitising current cash-based subsidies alone. Farmers, traders, processors and retailers will never again blindly trust cash. That makes it the perfect opportunity to prise open closed minds and introduce new payment habits in this otherwise opaque part of the economy (Srinivas, 2016).

EAS have an urgent and important role to play in enhancing the capacities of farmers and other stakeholders in the agricultural value chain to adapt to digital transactions. But to do this effectively, the capacities of EAS providers need to be enhanced, especially on the implications as well as opportunities emerging on account of 'demo'. Apparently the agenda or the mandate of EAS should also be broadened to include this topic at the very top of the priority list.



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INSTITUTIONAL CHANGE AND ADAPTATION TO CLIMATE CHANGE

Agricultural extension system has been slow to adapt and communicate climate science to farmers, as there is still limited institutional priority accorded in processing and communicating the scientific knowledge, opines Hemant R Ojha.

Adapting agriculture to climate change has now become a matter of widespread concern among scientific community and policy actors in South Asia. Recent studies have documented various aspects of climate change impacts on agro-ecological and hydrological systems and how it will impact the wider socio-economic system. Along with the growing number of analysis of the meteorological data, farmers' perceptions of climate related risks and their responses are also being documented. However, there is still little knowledge on how the key actors in agricultural systems - the farmers, service providers and regulators - perceive, learn and respond to diverse impacts of climatic change and variability on agro-ecological systems.

Southasia Institute of Advanced Studies (SIAS), Nepal and its India (Centre for Research on Innovation and Science Policy) and Bangladesh (Flood Hazard Research Centre) based partners collaborated with the CGIAR program on Climate Change, Agriculture and Food Security (CCAFS) to study what innovations and challenges exist in the Indo-Gangetic Plains (IGP). We collected evidence from 15 sites in Nepal, India and Bangladesh. One of the questions we looked at was - how and to what extent the different stakeholders (both state and non-state), are helping farmers to adapt to climate risks. The study blended qualitative and quantitative methods – combining case studies with survey research methods. A range of qualitative tools were used, including focus group, key informant survey, interactive field observation, semi-structured interviews and others.

Findings

The study confirms that farmers in the IGP have experienced diverse forms of climatic change in the recent years. This increasing exposure to climate risk is also supported by available scientific evidence. This study identifies diverse adaptive and innovative responses to such climatic shocks that have emerged at individual farms and community levels.

Climate Adaptive Innovation Threads

When farmers have access to services and information, they have resorted to more climate adaptive and innovative practices – such as changing cropping patterns, containing climate induced risks, improving common lands management, and adopting technological options that have become available in the recent years. We have identified 10 different types of what we called *adaptive innovation threads* - involving creative responses to risks as well as opportunities in the changing socio-economic context of South Asia.

While farmers, local communities and locally based NGOs are catalyzing a wide range of adaptive innovations, more established agricultural institutions are yet to be ready to learn from these innovative practices, much less scale up through needed institutional and policy change. On the contrary, farmers' ability to engage in innovative practice is substantially shaped and determined by the stakeholders operating at local and meso levels, whose efforts are in turn affected by state governments and national policy. It is therefore important to see farmer innovation capacity in relation to wider institutional capacity in agricultural system to generate and translate scientific information, offer institutional and technological development advice, and broker resilient change at across multiple scales.

Communicating Climate Science

Strong gaps exist between predicted level of climate change and the actual adaptive actions among both the farmers and other locally based agriculture stakeholders, suggesting the deficit of processes and institutions to facilitate adaptive innovations. By and large, climate science data still remains within the research institutions, not readily accessible to agricultural actors. Agricultural extension system, which is largely within government, is also slow to adapt and communicate climate science to farmers, as there is still limited institutional priority accorded in processing and communicating the scientific knowledge.

In particular, this study shows that the role of NGOs, local governments, agricultural extension and communication agencies, technology service providers are all important, whose capacity is in turn contingent upon the assistance of international organizations, research agencies, government subsidies and funding, and overall policy environment at state and national levels. Despite information revolution and universal acceptance of participatory strategy in management and policy, channels of communication and interactions between farmers and these agencies are weak, often top-down, driven by an orientation to upward accountability, and having scale bias (with a tendency to plan and act at higher scales than farmers would meaningfully benefit). As farmers are the ones who experience the effect of climate change before other service delivery organizations, it is crucial for other stakeholders to be more democratic and interactive with farmers while formulating strategies for adaptation at district and sub-national levels.

Need for Institutional Change

The dominant narrative of adaptation emerging within the discourse of climate policy appears to 'target' farmers, but fails to appreciate the crucial need to adapt institutions at higher scales of agricultural governance. There is now an urgent need to transform agricultural institutions, not only because farmers' capacity to adapt is determined by the responsive and accountable regulatory and service providing institutions, but also because it is through these institutions that the short term and farm level adaptation actions of farmers could be integrated with the large scale agricultural landscape management and adaptation. The current adaptation narrative has a tendency to leave the burden of innovation to farmers, while overlooking the massive restructuring needs of external institutions, including extension. This is also related to a question of how farmers' contributions of environmental and public goods – in terms of enhancing food security, soil conservation, agro-biodiversity management - are compensated in a fairer way.

Way Forward

Given the uncertainty around the future effects of climate change on agriculture, compounded by fluctuating market trends of agricultural commodities, questions persist as to how agricultural actors will be able to integrate 'a comprehensive and dynamic policy approach, covering a range of scales and issues, from individual farmer awareness to the establishment of more efficient markets. The evidence from South Asia now clearly shows that the 'unfinished" agenda of green revolution has now met with a new imperative of adaptation.

In order to consider such issues in adaptation planning and policy process, we need to consider 'adaptive innovation' thinking, integrating both adaptation and innovation in a single work package. This view can offer a new conceptual tool to understand how agricultural system can adapt to climate risks on the one hand, and improve production and equitable benefit sharing, on the other. The adaptive innovation thinking also needs to recognize cross-scale and inter-sectoral processes of extension, learning and communication.

Both adaptation and innovation happen in particular institutional context, and therefore it is now time to think more fundamentally about how institutional structures change and become part of adaptive innovation dynamics. Those who aim to catalyze adaptive innovation must identify and act upon actionable opportunities for reshaping institutional boundaries and nurturing innovative agency for climate-smart agriculture in the developing countries.

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FARMERS' SUICIDES IN INDIA: TRENDS, RISK FACTORS AND PREVENTION

Increasing farm distress and the resulting farmer suicides are areas that need urgent attention. A key aspect of any suicide prevention strategy is our ability to understand the suicide process and manage the predisposing, protective, and precipitating factors so as to prevent these suicides. Extension services should play a crucial role in preventing farmers' suicides – by assisting them to fathom the stress and suicide process, identifying vulnerable groups, providing telephonic advice and counselling, and creating community-based institutions that can educate and help farmers, argue P Sethuraman Sivakumar and P Venkatesan here.

Despite its substantial presence and contribution to rural livelihoods, Indian agriculture faces several challenges. These include: shrinking size of landholdings, unstable markets, erratic climatic conditions, and a gradual decline in the availability and productivity of natural resources, which has currently led to a distress-like situation, which adversely affect the farmers. Farmers' suicides (Box 1) are becoming a major socioeconomic issue in India, leading to farmers' agitations and political debates. Farmers' suicides result in immeasurable social, psychological, and economic costs to families and rural communities (Lovelock and Cryer 2009). At the family level, farmers' suicides have caused breaks in children's education, development of anxiety and stress disorders in family members, reduction in household income in the Vidarbha region of Maharashtra (Kale et al. 2014), and in Punjab it has led to reduction in the size of operational holdings, loss of dairy animals, and significant yield reduction in high value crops (Singh and Singh 2016).

Agriculture as a Stressful Occupation

Agriculture is considered as a stressful occupation (Keating 1987), operated in complex, diverse and risk-prone environments. It also makes farmers vulnerable to physical, biological, chemical, mechanical, and psychological hazards (Gerrard 1998; Fraser et al. 2005).The National Safety Council, USA, sited agriculture as one of the leading occupations producing high stress among farmers (National Safety Council 2016) while farming was identified as the fourth highest risk occupational group in the UK (Kelly et al. 1995). Studies in the USA (US Dept. of Labor 1999), Canada (Pickett et al. 1999), and Australia (Fragar and Franklin 2000) have identified farming as one of the most dangerous industries (Gerrard 1998; McCurdy and Carroll 2000), and as being associated with high rates of stress (Simkinet al. 1998). Research studies conducted in several countries indicated that farmers are more vulnerable to stress and other psychological hazards which lead to suicide (Box 2).

Agriculture is a risky and stressful occupation mainly due to the following factors:

1. **Multiple Uncertainties -** Farmers are subject to the uncertainties of climate and other natural forces, unstable market conditions, changing consumer demands, fluctuating interest rates, and changing global agricultural conditions and policies.

2. **Diverse working conditions -** Farmers work for long hours in physically demanding environments under a range of varying light and weather conditions (McCurdy and Carroll

Box 1: Farmer Suicides in India

Official estimates indicate that over 11,000 farmers are committing suicide every year, which is 11.2% of all suicides reported in India (National Crime Records Bureau 2015). The United Nations Commission on Sustainable Development (UNCSD) indicates that one farmer committed suicide every 32 minutes in India between 1997 and 2005. The details of farmers' suicides in recent years (2015, 2016) as compared with 2001 is displayed in Table 1.

Table 1: Farmers' suicides in India

No	State	Total No. of farmers' suicides			
		2001	2015	2016	% Change between 2001- 2016
1	Punjab	45	124	271	502.22
2	Haryana	145	162	250	72.41
3	Karnataka	2505	1569	2079	-17.01
4	Gujarat	594	301	408	-31.31
5	Madhya Pradesh	1372	1290	1321	-3.72
6	Telangana	0.00*	1400	645	-
7	Maharashtra	3536	4291	3661	3.54
8	Andhra Pradesh	1509**	916	804	-46.72
9	Chhattisgarh	1452	954	682	-53.03
10	Other states	5257	1595	1249	-76.24
	Total	16415	12602	11370	-30.73

Analysis of data presented in Table 1 indicates that farmer suicides are decreasing over the years, but showing an increasing trend in a few states like Punjab, Haryana and Maharashtra. Among the farmer suicide deaths reported in 2016, nearly one-third of these deaths were reported from Maharashtra (3661), followed by Karnataka (2,079), and Madhya Pradesh (1,321), as per data shown (The Hindu Business Line 2018). These states, together with Chhattisgarh, Andhra Pradesh and Telangana, have over 80% of the farmer suicides reported from India.

**Data not available for 2001; **Data for undivided Andhra Pradesh.*
Source: National Crime Records Bureau, 2001; 2015; The Hindu Business Line, 2018.

2000),with work practices involving high health risks including chronic exposure to pesticides and other chemicals (Von Essen and McCurdy 1998; Rautiainenet al. 2005) along with handling heavy farm machinery.

3. **Multiple work roles -** Farmers also hold multiple work roles in farms, households and off-farm responsibilities that are performed with limited time, resources and energy.

Box 2: Suicides: Are farmers at a higher risk globally?

Farmers' suicides are reported as socio-economic problems in several countries, including Australia (Fragaret al. 2008; Andersen et al. 2010; Perceval et al. 2018), Brazil (Meneghelet al. 2004), Canada (Pickett et al. 1998), China (Law and Liu 2008), France (Bossardet al. 2016), New Zealand (Gallagher et al. 2007; Walker 2012; Beautrais 2018), Switzerland (The Local Ch 2018), UK (Charlton 1995; Thomas et al. 2003; Johnswire 2018), Japan (Nishimura et al. 2004), and USA (Kposawa 1999; Ivanova 2018).

There is growing evidence that farming is an occupation with a higher risk for suicide than other occupations (Milner et al. 2013). Two studies conducted among farmers of UK (Gregoire 2002; Thomas et al. 2003) found that the suicide rate among farmers was higher than in other occupational groups. Field survey revealed that the feeling of hopelessness in present life was two-and-a-half times higher among farmers than non-farmers. The suicide rate for Australia's male farmers is about double the general male population, sitting at 32.2 compared with 16.6 per 10,000 (Bryant 2018). Analysis of farmer suicides in Australia indicated that agricultural labourers and farmers/farm managers were identified as having higher suicide rates than those in other occupational groups (Fragaret al. 2008; Kennedy et al. 2014). Similarly, the New Zealand farmers engaged in crop farming, fisheries, and forestry had higher suicide rates than those in other occupations (Gallagher et al. 2007). In the UK, during the period 1993-2008, the relative suicide rate among farmers was 1.5-2.5 times higher than among the non-farming population (Hounsomeet al. 2012). Farmer suicides are about 11% of the total suicides reported in India (National Crime Records Bureau 2015). The study conducted by University of Bern among 1.8 million Swiss men aged 35 to 74, estimated that farmers are 37% more likely than other men in rural communities to commit suicide (The Local Ch 2018). Similar trends were observed in China too (Law and Liu 2008). A recent study conducted by the Centers for Disease Control and Prevention (CDC), USA, found that workers in farming and related industries have the highest rate of suicide at 84.5 per 1,00,000 as compared to those in other occupations (McIntosh 2016).

These factors make farmers vulnerable to hazards and mental problems such as high levels of stress (Booth and Lloyd 2000), depression and anxiety (Eisner et al. 1998), diseases like heart and artery disease, hypertension, ulcers, and nervous disorders (Fetsch 2018; Grant et al. 2009), physical injury and suicide (Booth et al. 2000; Page and Fragar 2002).

Socioeconomic Risk Factors and Processes associated with Farmers' Suicides

Considering the nature of agriculture as a stressful occupation associated with high vulnerability of farmers to physical and psychological hazards, the suicidal behaviour of farmers need to be assessed. Several studies indicate that the suicidal behaviour of farmers is a context-based phenomenon caused through interplay of multiple biological, psychological, family, social, cultural, and environmental factors (Moskoset al. 2004; Bridge et al. 2006; Consoliet al. 2013). These factors are largely influenced by country-specific production trends, demographic shifts, trade reforms and policy changes. The macro-level trends in Indian agriculture which influence farmers' conditions are as follows:

Suicide is the act of intentionally ending one's own life (Nock et al. 2008), which isessentially an outcome of harmful psychological processes. Suicide is seen as an extreme end to a continuum of psychological stress, distress, and tragedy for individuals, their families and communities (Boulanger et al. 1999). The suicidal process has several interlinked factors and events, such as a pre-disposition to risk or stress factors, onset of stress, poor coping ability of such individuals to manage stress, vulnerability of individuals to psychological hazards, occurrence of precipitating factors which trigger suicidal ideation (thoughts), which then leads to inhibition due to protective factors or suicide guided by facilitating factors.

Based on a critical review of studies conducted on farmers' suicide in different countries, a suicide model is proposed (Figure 1) integrating various predisposing, protective and precipitative factors of farmer suicides into the popular Clinical presentation of suicidal behaviour model (Shaffer and Pfeffer2001) and the Model of stress, distress, and psychiatric illness (Terluinet al. 2004). The proposed suicide model presents a sequential view of various factors or events leading to a farmer's suicide. The various suicide factors depicted in the model are compiled from various studies conducted in India and abroad.

According to the Farmers Suicide Model (Figure 1), stress is the major reason that makesfarmers vulnerable, leading to suicide. Various predisposing factors affect farmers in the long-term and create stress in them. Prolonged stress makes them vulnerable to physical and psychological hazards like depression. The vulnerable group of farmers are affected by unexpected precipitating factors, which influence their decision to commit suicide; it also depends upon the absence of protective factors.

Box 3: Unfavourable trends causing stress to Indian farmers and agriculture

• **Predominantly smallholder farming**

Small and marginal farmers play a significant role in the Indian agriculture setup. In 2015-16, the population of small and marginal farmers was estimated as 126 million, who owned 86.21% of total landholdings representing 47.34% of the total agricultural area in the country (Govt. of India 2018). As the average landholding of small and marginal farmers is just 0.6 ha, maximising productivity of farming through input intensive agricultural technologies is a tedious task. The smallness of the holding straightaway denies the farmers the benefits of mechanization, modern irrigation, and other investment-based technological improvements. As a result, productivity is suboptimal leading to agrarian distress.

• **Indebtedness**

Farmers' prolonged indebtedness and shrinking ability to repay loans are predominant factors that create farmer distress in India. A NABARD survey indicates that the Incidence of Indebtedness (IOI), which is a proportion of households having outstanding debt on the date of the survey, was 52.5% and 42.8% for agricultural and non-agricultural households, respectively (NABARD 2018). The average amount of outstanding debt for indebted agricultural households was INR 1,04,602 in 2018, which was higher than the outstanding debt for indebted non-agricultural households (debt – INR 76,731).

• **Reduction in agricultural income**

Data from2015-2016show that the rural sector earned INR 8,059 as net household income during 2015-16 from cultivation, livestock, non-farm sector activities, and wages/salaries (NABARD 2018). The highest portion of the net monthly income was from wage labour (both farm and non-farm - INR 3,504), followed by government or private service jobs (INR 1,906), and agriculture (INR 1,832). For agricultural households, which accounted for 48% of rural households, the share of average income from cultivation and livestock farming was about 43%, with the remaining 57% of income coming from non-agricultural sources (NABARD 2018).

Factors

(i) Predisposition to risk factors

Predisposing factors are those conditions or situations that increase the likelihood of farmersuicides. Predisposing factors induce long-term psychological stress in farmers which make them vulnerable to suicide. The predisposing factors associated with farmers' suicide include: genetic and biological factors, social and demographic factors, family characteristics and childhood experiences, socio-economic factors, presence of diagnosable mental disorders like depression and mood disorders, along with alcohol and substance abuse; psychological factors such as egoistic tendencies, impulsivity/ aggressiveness, loss of control/stoicism; previous suicide attempts and presence of multiple stressful life events, long work hours, conflicting roles of work and family, pooraccess to health care services, social isolation and lack of social support; regulatory and industry factors beyond the farmer's control; and prolonged periods of climate variability with heat stress and drought (Fig. 1).

(ii) Precipitating factors

Precipitating factors are stressful events that can trigger a suicidal crisis in a vulnerable person. These factors cause or trigger the onset of a disorder, illness, accident, or behavioural response. A few precipitating factors which trigger farmers' suicide are: sudden crop failure, high job demands, breakdown in family relationships, current financial hardship, prolonged illness and pain, failure in business/politics, hopelessness, fall in social reputation, non-realization of expected market price, and unexpected disaster or sudden climatic change (Fig. 1).

(iii) Protective factors

Protective factors are those that decrease the probability of an outcome in the presence of elevated risk. Some of the protective factors which prevent farmers' suicides include: family and social support, social resources, religious beliefs, peer support, personality traits, coping skills, and a sense of belonging (Fig 1).

Processes

Psychological stress

The psychological stress refers to the emotional and physiological reactions experienced when an individual confronts a situation in which the demands go beyond their coping resources. It is created due to occurrence of unexpected stressful situations.

Distress

Distress is an aversive, negative state in which the coping and adaptation processes fail to return an

organism to physiological and/or psychological homeostasis (Carstens and Mober2000).

Coping

Coping is the sum of cognitive and behavioural response of individuals to stress, which are constantly changing, that aim to handle particular demands, whether internal or external, that are viewed as taxing or demanding (Lazarus and Folkman 1984).

Vulnerability

Vulnerability refers to the inability of a person to withstand the effects of a hostile environment. It indicates physical and psychological deterioration including stress/distress conditions.

Suicidal ideation/suicidal thoughts

Suicidal ideation is thinking about or having an unusual preoccupation with suicide. Hopelessness, mood swings, anxiety, emotional pain and depression are a few symptoms of suicidal ideation.

Facilitation

The suicide facilitation factors include easy access to suicide methods, acceptance of suicidal behaviour, isolation, impulse, and evading treatment.

These factors and processes together determine a farmer's decision to commit suicide.

Suicide Risk Assessment Approaches

Farmers' suicides are caused by a complex interplay of various factors and occur at different stages of their life. An important aspect in preventing farmers' suicides is identification of the vulnerable population in advance, and helping them overcome their psychological stress.

Suicide risk assessment refers to the establishment of a clinical judgment of suicide risk in the near future, based on the weighing of a very large mass of available clinical detail (Pokorny 1983). Risk assessment is carried out in a systematic, disciplined way by qualified professionals.

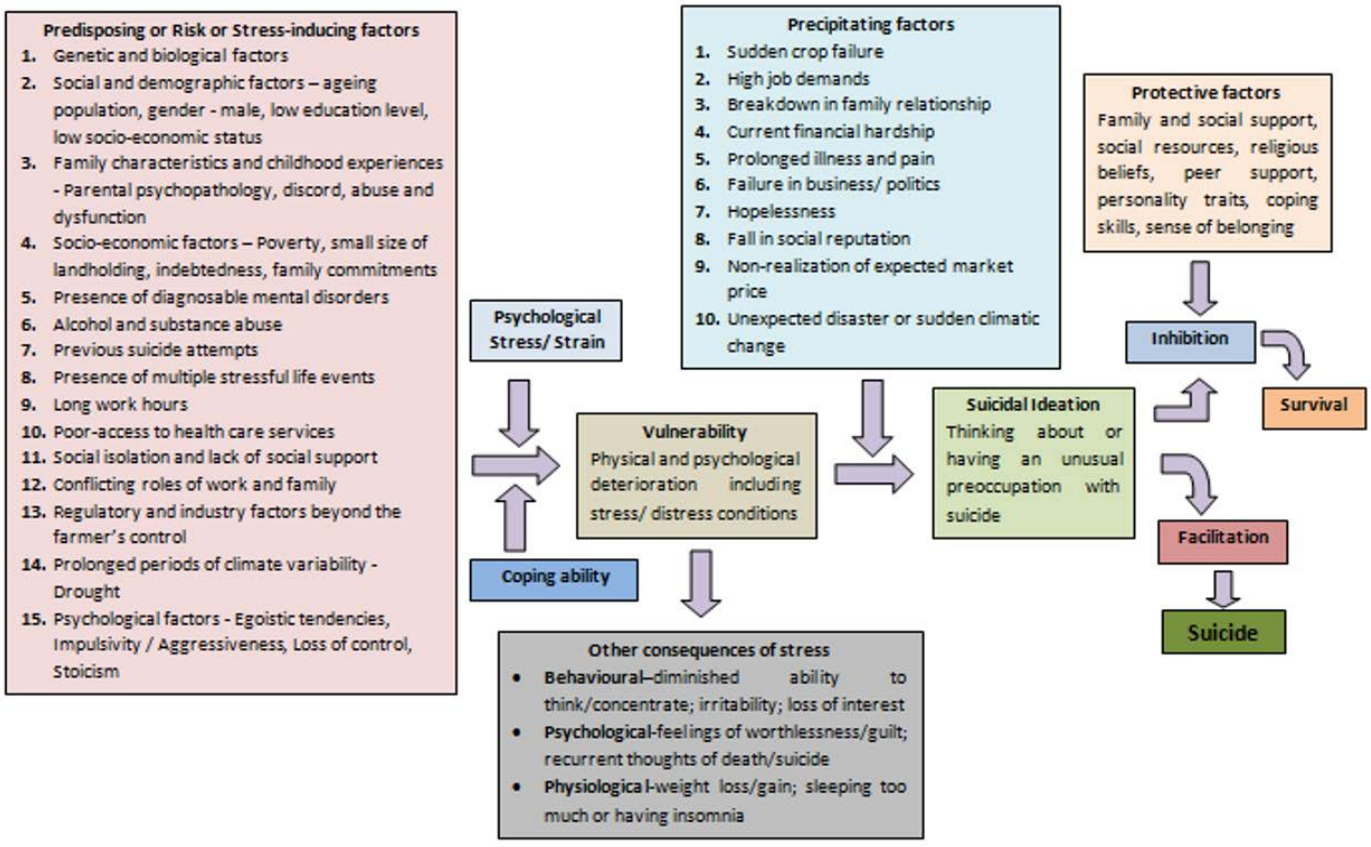

Fig. 1: Farmer's Suicide Model

Adapted from:

National Crime Records Bureau (2015); Behere and Behere (2008); Bhise and Behere (2016); Kureshi and Somasundarm (2018); Dandekar and Bhattacharya (2017); Anneshi and Gowda (2015); Macharia (2015); Mohanty and Shroff (2004); Mohanty (2013); Meeta and Rajivlochan (2002); Judd et al. (2006); Tonna et al (2009); Judd et al. (2006); Hossain et al. (2008); Fraser et al. (2005); Mc Shane et al. (2016); Hanigan et al. (2012); Kunde et al. (2017); Manjunatha and Ramappa (2017); Sher (2006); Boergers et al. (1998); Eskin et al. (2007); M. T. Y. Lee et al. (2006); Wild et al. (2004); World Health Organisation (2018); Hawton et al. (1998); Judd et al. (2006); Ramesh and Madhavi (2009)

The assessment of suicide risk is based on identification and appraisal of warning signs, along with predisposing and protective factors that are present. Several methods, instruments and diagnostic tools are developed to assess farmers' stress factors, coping behaviour, vulnerability to suicide, and suicide ideation. A few resources are available to support the suicide risk assessment process, including clinical guides (Jacobs 1999; Rudd et al.2004) and best practice guidelines (American Psychiatric Association 2003; Heisel andFlett 2006; Registered Nurses' Association of Ontario 2009). A few suicide risk assessment scales and methods are displayed in Table 2.

Table 2: Farmers' suicide risk assessment scales and methods

No.	Name of the scale/ method	Responsibilities	Source
1	Beck's Scale for Suicide Ideation	A 19-item rating scale measures active and passive suicidal desire as well as suicidal preparation.	Beck et al. (1988)
2	The Modified Scale for Suicidal Ideation	This scale measures the presence or absence of suicide ideation and the degree of severity of suicidal ideas. The time frame is from the point of interview and the previous 48 hours.	Miller et al. (1986)
3	Hospital Anxiety and Depression Scale (HADS)	To determine the levels of anxiety and depression that a person is experiencing.	Zigmond and Snaith (1983)
4	Kessler Psychological Distress Scale	A 10-item measure of general distress during the previous 4 weeks.	Kessler et al. (2002)
5	Farm Stress Inventory	A 61-page inventory measures farm stress in six dimensions, i.e., 1. Financial; 2. Weather; 3. Work overload; 4. Social; 5. Hassles; 6. Worry.	Walker and Walker (1995)
6	Edinburgh Farming Stress Inventory	Assessing farm-related stress In six dimensions, i.e., 1) Farming bureaucracy; 2) Financial issues; 3) Uncontrollable natural forces; 4) Time pressures; 5) Personal farm hazards; and 6) Geographical isolation.	Dearyet al. (1997)
7	The General Health Questionnaire (GHQ-12)	Screening device for detecting various sources of distress and other minor psychiatric disorders in the general population and within community or non-psychiatric clinical settings.	Goldberg (1972)
8	The Farm Stress Survey	A 28-item Likert-type summated rating scale measures farm stress in five dimensions, i.e.,1) economics;2) geographic isolation;3) time pressure;4) climatic conditions; and 5) hazardous working conditions.	Eberhardt and Pooyan (1990)
9	Farm/Ranch Stress Inventory	A 28-item scale which measures farm stress in three dimensions – farm-related factors, financial factors and social factors.	Kearney et al. (2014)
10	Stress Vulnerability Scale	A 20-item Likert-type summated rating scale, measures the individual's vulnerability to stress, that is, how much a person is prone to physical and psychological stress.	Miller and Smith (1985)
11	Scale to measure resilience in relation to farmers' life (RFL-Scale)	A summated rating scale which measures Resilience - degree to which farmers can bounce back in relation to their life after a national calamity.	Lalet al. (2014)
12	Psychological or verbal autopsy	It is a retrospective reconstruction of the life history of a suicide victim, which involves the examination of physical, psychological and environmental details of the victim's life in order to more accurately determine the mode of death and get a better knowledge of the death process and the victim's role in hastening or affecting his own death.	Behere and Behere (2008); Bhise andBehere (2016); Gajalakshmi and Peto (1997).

Conducting a farmer's suicide risk assessment, either for research or extension purposes, is a tricky process. It is important to pursue the following guidelines while conducting afarmer's risk assessment:

- The farmers' suicide risk assessment process involves collecting sensitive information from human subjects and this call for approval from Institute Ethics Committees. It is important to follow the ethical guidelines laid out by the Indian Council of Medical Research (ICMR) (2017) to avoid problems in the future.
- Many assessment scales are copyrighted and involve costs in procuring and using them. Unauthorised use of assessment scales or other measure will invite legal issues.
- It is essential for researchers to undergo formal training before conducting a suicide risk assessment. It is a specialised process which needs deeper/sensitive understanding of the entire suicide process.
- Many suicide risk assessment scales or measures are standardised and have adequate reliability and validity across cultures. The suicide risk assessment is conducted by a psychiatrist, registered psychologists, or people who are adequately trained for this purpose. Indiscriminate use of these measures by unqualified persons will attract legal issues.
- When a researcher is interested in developing a scale or measure to determine any aspect related to farmers' suicides, it is essential to study all available measures or scales which have already been standardised. Developing a measure or scale for assessing risk factors of suicide is a complicated process as it requires Ethical Committee approval, and needs to be carried out under the supervision of a psychiatrist or a registered psychologist.

Extension Strategies for Prevention of Farmers' Suicides

Considering the magnitude and negative consequences of farmer suicides, many countries have opened up specialised services for preventing suicides. The extension services in USA, Australia and New Zealand provide stress management services to farmers. They provide the following services for reducing farm stress:

Information and campaigns on managing farm stress

This service is aimed at educating farmers about farm stress – its sources, identifying the symptoms, and measures to cope with stress. They provide links to various distress and suicide-related services in the county/state/country. The extension services also conduct campaigns to educate farmers about stress management and suicide prevention.

Suicide prevention hotline

This service provides opportunities for farmers to discuss their farm-related problems, which induce stress, and get advice through telephone or one-to-one counselling. The Iowa Concern programme of Iowa State University Extension and Outreach (https://www.extension.iastate.edu/iowaconcern/) provides stress counselling, telephonic advice on stress-related queries, managing legal issues of farmers and helping them to cope with stress in crisis situations.

Agricultural mediation services

Here the extension agency voluntarily acts as a third party insolving farm-related disputes outside the legal process. This service greatly reduces the stress involved in conflict resolution among farmers. For example, The Kansas Agricultural Mediation Services of Kansas State University Extension (Web: https://www.ksre.k-state.edu/kams/services/mediation/index.html)helps farmers to solve disputes in a peaceful manner. Likewise, the K-State Farm Analyst programme provides educational services to farm families to manage their finances and business planning.

Capacity building on crisis, risk and stress management and suicide prevention

Several extension services in USA, Australia, New Zealand, and in Europe conduct capacity building programmes for various clientele in managing stress and preventing suicides. Various academic and continuous education programmes are offered to many stakeholders for farm stress management and suicide prevention.

Single window system for farmers' health management

Under this system, the specialised agencies created for farmers' health management provide integrated services to farmers including counselling, stress and suicide-related education, capacity building, conducting workshops on stress and suicide prevention, conducting research on farmers'health and safety, and offering certificate courses on farmer health to develop a workforce for grassroots interventions. The National Centre for Farmers Health, Australia (https://www.farmerhealth.org.au/) and Farmstrong programme of New Zealand (https://farmstrong.co.nz/) are a few examples of this approach. Some farmers' federations likeVictorian Farmers Federation, Australia (https://www.vff.org.au/), also provide integrated services for farm stress management.

Community-based suicide prevention programme

Community-based suicide prevention programmes are aimed to help communities to create interventions/projects to reduce farm stress and prevent self-destructive behaviours and conditions that lead to suicide, and to increase individual, family, and community health. These programmes offer grants, subsidies and bursaries to create infrastructure and facilities to develop competencies in farm stress management and suicide prevention on a community level. They also provide peer support services and counselling services for the community.

The Vidarbha Stress and Health Programme (VISHRAM) in Vidarbha region of Maharashtra, India, (http://www.sangath.in/vishram/), the Alaska Suicide Prevention Programme, United States of America (http://dhss.alaska.gov/dbh/Pages/Prevention/programs/suicideprevention/default.aspx) and Project Utshah, an initiative of the Department of Agricultural Journalism, Punjab Agricultural University (PAU), Ludhiana, under National Agricultural Science Fund (NASF) of Indian Council of Agricultural Research (ICAR), New Delhi, are a few examples of community-based intervention models for preventing farmer suicides.

Way Forward

Farmers' suicides are increasingly becoming a public health crisis in India. As agriculture is a relatively stressful occupation managed predominantly by small and marginal farmers with smaller operational holdings, stress factors both at the macro and micro levels have a severe impact on farmers' health. Suicide is not a discrete event caused by a sudden tragedy; it is rather an outcome of long-term accumulation of various stresses over a period of time. A key aspect of any suicide prevention strategy is our ability to understand the suicide process and manipulate the predisposing, protective, and precipitating factors so as to prevent the suicide. As a field-oriented profession directed towards farm households, extension services play a crucial role in preventing farmer suicides – by assisting farmers in understanding the stress and suicide process, identifying vulnerable groups, providing telephonic advice and counselling, creating community-based institutions to educate and help farmers, along with policy changes to help vulnerable groups. To conclude, these are a few strategies for preventing farmers' suicides in India.

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LEARNING FROM THE KERALA FLOODS OF 2018: HOW EXTENSION AND ADVISORY SERVICES COULD SUPPORT FARMERS TO DEAL WITH NATURAL CALAMITIES

The unprecedented floods of August 2018 adversely affected Kerala's agriculture.
Rema K Nair, in this blog, reflects on how extension services came forward to support farmers to deal with the flood damage to crops, and how it is currently supporting farmers to deal with its long-lasting impacts.

Kerala witnessed an unprecedented flood last August that critically affected the lives of people belonging to every walk of life. It goes without saying that farmers were the most affected as their houses and livelihoods were completely lost. It is estimated that an area of around 57,000 ha with standing crops of various types were lost in the deluge. Apart from the loss of machinery, farming implements, harvested and stored produce and damage to warehouses, irrigation channels etc., the incalculable loss of top soil and soil nutrients, are almost always overlooked.

Kerala floods: August 2018

With the exception of 1924 and 1961, in the last 118 years Kerala received the highest amount of rainfall in 2018. From May to August the State received rainfall that was 53% higher than normal, and all dams were almost full at that time. The incessant rains in catchment areas of the dams turned the situation into a nightmare. Kerala received a rainfall of 254.2 mm in just three days in mid-August. All these factors together created the greatest catastrophe in the history of Kerala. Landslides and cloudbursts were reported from several districts. The floodwater receded only after one week. Lots of silt, sand and other debris got deposited in many of the fields and in some places it was not possible to clear such fields manually.

Impact on Farms

Crops worth more than INR 5600 crore were lost, affecting around 400,000 farmers. Approximately 150,000 ha of cropped land was affected. In August most of the flooded fields remained inundated for eight to ten days. The weight of 1 m3 of water is around 1 ton, and this water remained above the soil to a height of about 2 to 2.5 m. That means around 2 to 2.5 tons of mass exerted pressure over the soil making it compact. This made the soil impervious to air, and under anaerobic conditions the respiration of roots was affected. Plants, therefore, failed to take up water, and as a result once the floodwater receded the crops appeared to have completely dried up.

The nutrient status of the deposited soil varied from place to place. Nutrients, such as nitrates, and potash, along with micronutrients were washed off from the topsoil, especially from places at a high altitude. Some of these were partially deposited near banks and the rest had washed away into the sea. Under anaerobic conditions mostly pathogenic microbes flourish, whereas beneficial microbes, such as Vesicular Arbuscular Mycorrhiza (VAM) and Trichoderma, cannot survive. Gases such as nitrous oxide methane, and carbon dioxide, which are

produced under flood conditions, accelerate the decay of roots. Anaerobes make use of these gases and grow. Most of the soils in Kerala are acidic. The post-flood analysis of soil has confirmed that acidity has increased several folds. This further creates problems in nutrient assimilation by soils. Loss of soil micro flora and macro flora, like earthworms, ants, etc., is a very serious problem that needs to be addressed urgently.

Box 2: Impact of the flood on crops

Rice being a semi-aquatic plant could survive inundation, especially during the vegetative phase. However, crops at the flowering stage were seriously affected. The grains were partially filled and the appearance and acceptability of the grains were affected.

The major commercially important varieties of bananas, such as *Nendran* and *Poovan*, were completely destroyed. It is to be noted that varieties of *Palayankodan* and *Njalipoovan* survived the flood. But spices like ginger, turmeric, and pepper could not withstand the flood, and all vegetables were completely lost. Nutmeg seedlings below 5 years failed to survive, whereas older plants could be saved with proper care.

Coconut seedlings were lost in the flood but adult palms were generally unaffected. The impact of flood on all perennial crops and trees are yet to be completely understood. There are chances of occurrence of new diseases. It is to be noted that the root disease of coconut was first noticed in Kerala at *Erattupetta* after a major flood.

Incidence of pests was another major problem. Post floods, attack of *Spodoptera* (Armyworm) was seen severely on all crops, like paddy, vegetables, and banana. Timely scientific intervention successfully controlled the attack. *Alternanthera spp, Cyperus,* and other grassy weeds are seen growing wild in many places. A change in weed flora was also noticed.

Extension's Response to the Floods

Dealing with the damage

Our first concern was how to protect the lives of farmers from a likely epidemic of leptospirosis, a distinct possibility due to a rise in the rodent population as a result of floods. The immediate response of the extension staff, especially of the State's Department of Agriculture, was to inform farmers on the need to take doxycycline as advised by the Health Department.

Flood debris were removed by the farmers themselves. In places where the quantity of debris was too high, farmers were given assistance to the tune of INR 12,500 per ha. In several places, government agencies like Kudumbashree (http://www.kudumbashree.org/) were engaged in de-silting activities. Support from schemes such as MGNREGS were also used to implement these activities.

On a war footing extension functionaries visited each and every farmer to assess crop loss. This helped the farmers to get government aid at the earliest. During the visits individual farmers were given instructions on how to save their remaining crops, and how to get income from their fields.

Farmers were advised to plough the topsoil so as to open up the soil's pores and allow the soil to breathe. This was essential to prevent the formation of hard impermeable aggregates that could affect soil aeration further. The silt and clay that was deposited above the topsoil was broken down by the farmers and mixed with the soil.

As regaining soil health was vital to restart agriculture, soil test campaigns were conducted in almost all panchayats to know the nutrient status of soil. In several places water-soluble nutrients, such as potash, calcium and magnesium, got dissolved and leached into the water. Soil acidity had increased considerably in most of the soils. Dolomite, gypsum, slaked lime and other soil ameliorants were supplied to farmers at a subsidised rate to regain soil health.

Farmers were encouraged to enrich the microbial activity in soil by ploughing in lots of green matter, farmyard manure and compost. Adding paddy husk was also adopted by farmers as this too can help in improving soil aeration. Moreover it adds to the silica content of the soil.

Beneficial microbes like Trichoderma, and VAM, were supplied to farmers to enhance the population of helpful microbes in soils that can aid in root growth and nutrient uptake. On-farm multiplication of VAM and Trichoderma was taken

up as a front line demonstration in progressive farmers' fields. These microbes help in control of soil-borne pathogens as well.

Cultivation of cover crops, especially leguminous crops, is promoted wherever possible as it will help in adding more organic matter to the soil and thus improve soil aeration and moisture retention as well as nitrogen fixation. Seeds of these crops were supplied to farmers.

Farmers were advised to allow the growth of naturally occurring weeds as they have a deep root system that can improve soil porosity. They were also encouraged to adopt mulching of soil with organic matter, such as dried leaf and crop residues as this helps in moisture retention, ensure soil porosity, and improve microbial activity.

Short duration vegetable crops particularly amaranthus and cucurbits – can help the farmer to get some income immediately after the flood. So seeds and seedlings of these crops were supplied to farmers free of cost.

Extension staff convened campaigns under the title Punarjani (meaning 'rebirth') on the worst affected farmer fields to clear the debris, and add soil ameliorants. Seeds and seedlings were planted in these fields by extension staff.

Building Resilience

The Department of Agriculture Development & Farmers' Welfare (Kerala) had launched a crop insurance programme a few years back. But farmers were reluctant to spend the initial premium even though it was nominal. But the floods have changed their attitude. Farmers currently recognize the importance of insurance as these types of unpredictable calamities and crop damage are likely to increase due to changing climate. Wide publicity is currently being given to the crop insurance scheme so that farmers can take up agriculture confidently. More farmers are currently approaching the extension staff to help get their crops insured.

Under the leadership of the Agricultural Technology Management Agency (ATMA), farm schools, farm field schools, capacity-building meetings, kisan gosthis were conducted in all panchayats to popularize scientific intervention in agriculture and allied fields. Apart from this, since a lot of nutrients were lost in floodwater, we are carefully assessing nutrient deficiency symptoms.

Crops like pepper, nutmeg, and other spices need a comprehensive package for rejuvenation. Perennial crops also need periodical surveillance given the incidence of new pests and disease. Under the crop health programme, extension staff are deployed to keep a vigil on the occurrence of pests and diseases.

Farmers are also being encouraged to take up additional activities, such as fisheries, animal husbandry, and value addition so as to ensure a steady income.

Way Forward

Despite this staggering calamity agriculture continues to be the biggest employment generating sector in Kerala even today. So the revival of this primary sector is vital in rebuilding Kerala in the post-flood scenario. This would necessitate more coordinated efforts from the Kerala Agricultural University and the State Department of Agriculture Development and Farmers Welfare. The greatest challenge facing the extension community is how to cope with the unpredictable situations that will continue to develop as a result of climate change.

It's high time that we shift to crops that demand less water and have high water use efficiency. Moreover, wetlands and paddy lands play the most important role in containing floodwaters. Deforestation in the hills and unscientific cultivation of soil-eroding crops on slopes have to be checked in order to increase the soil binding capacity and water retention. Simultaneously, the remaining wetlands and paddy fields have to be preserved through flood reservoirs that can avert loss to people and their belongings. Stringent action has to be taken against those who violate existing wetland preservation laws.

The crop insurance scheme has to be revamped to suit each agroecological zone. Agroecological zones – coastal, plains, hilly —have to be

differentiated based on their its soil and climatic characters. Based on the special features of each agroecological zone suitable crops and cultivars are to be identified. An integrated farm-based approach will be helpful in increasing farmers' incomes and reducing the associated risks instead of a crop-based approach that's being adopted now. Certain varieties of spices, such as pepper, nutmeg, ginger and turmeric, showed significant abilities to withstand adversities. Studies have to be conducted to identify and multiply these varieties.

Disaster risk reduction has to be included in the curriculum, not only in agriculture but in allied sectors as well, as we envisage a change in climate that would trigger cyclones and storms more often. Training is to be imparted to extension officials using national level training agencies, like the National Institute of Agricultural Extension Management (MANAGE), and it has to be ensured that the knowledge imparted through such trainings percolate down to target groups.

Agriculture should be the main focus of efforts at rebuilding Kerala as the floods have proved beyond doubt that food is the most important commodity for human survival. "Annadatha Sukhibhava". Therefore, society has a grave responsibility to ensure the well-being of the farming community.