UNDERSTANDING FARMER LED INNOVATIONS FOR PROFITABLE FARMING AND LEARNING EXPERIENCES

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ABSTRACT

Farmer-led innovations are evolving under specific agro-climatic and socio-economic conditions and such innovations should be widely adopted and sustained. The farmers identified a number of traditional crops and developed varieties with enhanced productivity and better quality through selection. Farmers also developed low cost processing technologies for value addition, increased shelf-life, and better marketability of various farm products. In addition, a number of farm implements and tools were also designed and manufactured by the farmers to increase operational efficiency and productivity. Women farmers have equally contributed in germplasm conservation and postharvest and value addition enhancing the farm income. The identity of farmer innovators as those who have developed or are testing new ways of land husbandry that combine production with conservation is well established. Such innovations may be simple or sophisticated structural designs in the integrated production systems. The innovation may be an on-going experiment, or already proven and effective. As such, farmers' innovation is a practice started and later improved by a farmer on her/his own initiative (problem oriented), without any external influence. Indian farmers are continuously improving available technologies for more efficient and cost effective farming over the generations. Promotion of farmers' innovations is also a priority agenda item of the government in the form of various programmes

Key words: Farmer led innovations, social networking, Entrepreneurship development, convergence, Income generation

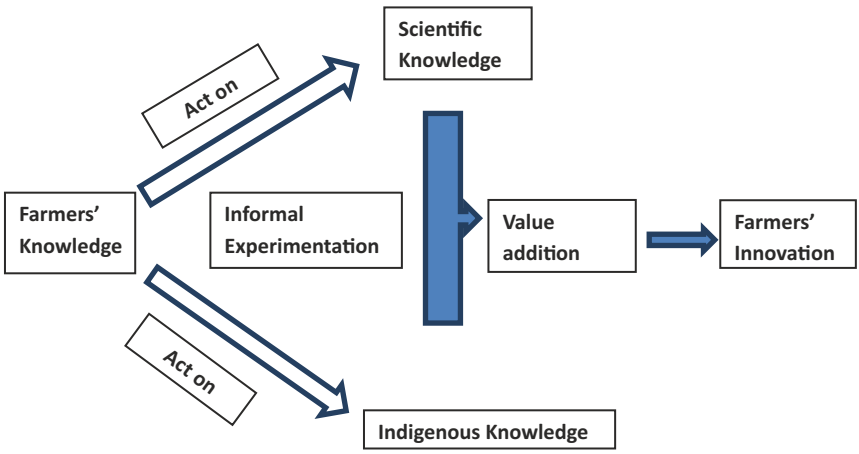
In July 1987, some 50 social and natural science scientists met at the *Institute of Development Studies(IDS) of the University of Sussex*, UK, for a workshop on 'Farmers and Agricultural Research: Complementary Methods', later more generally known as the 'Farmer First' workshop. That workshop brought together experiences from a diverse range of individuals and organisations and marked a key moment in the development of approaches to farmer participation in agricultural research and extension. The importance of traditional knowledge for the protection of biodiversity and the achievement of sustainable development started slowly being recognized internationally (Gadgil *et*

al, 1993). The motivating factor for developing innovation has always been curiosity followed by increased production in addition to the reduced cost of production (Bayer, 2013). The sustainability of livelihoods becomes a function of how men and women use asset portfolios on both a short- and long-term basis (Krantz, 2001). SRI was a 'farmer-first' innovation from the outset, truly farmer-centered in the experimentation and evaluation undertaken by Fr. Henri de Laulanié (1993, 2003) and it has been farmer-participatory in its further development. This reporting on farmer innovation reflects the fact that SRI is still a work in progress. Chapters of this story have been written in over two dozen countries already, through the efforts of NGO workers, researchers, teachers, administrators, and other motivated individuals (Uphoff, 2009). Tripps (2006) study of low external input technology (LEIT) showed that there are relatively few examples where LEIT projects have led to a significant amount of independent experimentation, while farmers' experimental capacities got strengthened. Similarly, Sambodo (2007) mentioned that farmers' decision rules can be distinguished according to their perceptions and attitudes, to their belief that they have the power to deal with problems and opportunities, as well as to the extent of socio-cultural influences. The innovators in general share certain distinctive characteristics like opportunism, tend to be *curious, proud and willing to take risks,* and they pick up ideas from here and there, *they respond to recognition* (Gupta, 1998); they have latent skills and enthusiasm (Segeross, 1996), and triggered to innovate by various factors including *problem solving and accidental or even playful discoveries* (Roling, 1996) whereas the farm innovators *depend on the land; pick up piecemeal advice and blend with their own experience; focus on intensification and integration of resources; typically concerned with resource management; demonstrate pride in their own achievements, driven by a financial motive as well as a general concern with production, stimuli to innovation are travel outside the area, and information from various sources (*Critchley and Mosenene,1996).

Gamut of Farmers' Innovation

The significance of farmers' innovation however ranges from being useful only to the individual farmer to a wider range of farmers. Innovation involves the interaction of individuals and organizations possessing different types of knowledge within a particular social, political, policy, economic, and institutional context (World Bank 2006). Important dimension of the concept of "farmer innovation" is that it embraces not only technological innovation, but also new ways of managing livelihood in general (networking, communication, institution building, information management, marketing, planning, accessing resources, etc). As a conceptual understanding platform, Prolinnova-

Ethiopia (2004) adopted the following schematic presentation to explain the conceptual framework of farmer innovation:



Local innovations have been extended in different scales. However, 70 percent of local innovations were extended beyond the village and 30 % were confined only in village. The effectiveness of local innovation was reflected through its area of coverage. Farming community has developed a number of valuable innovations, and has proved potential through the application of these innovations in fellow farmers' fields (ICAR, 2010). As far as the impact of farmer led innovation is concerned, increased production has been the major outcome of most of the farmers' innovations followed by increased satisfaction and knowledge (Tambo, 2014). Another important area of impact of farmer led innovations may be farmers' capacity to continue the process of innovation to address other challenges through strengthening individual capacities, such as confidence, knowledge and to handle experimentation and innovation (Wettasinha et al. 2014). Social networking of farm innovators has proved to be potential to construct knowledge. On the other hand, the farm innovators require certain distinguishing capacities like foreseeing institutional requirements and linkages, comparative financial impact and success analysis ability in addition to analyse projected demand and required changes in socio cultural and infrastructural domain. FLIs having additional advantage over conventional innovations to tackle second generations' problems require different set of capacities on the part of farm innovators to scale their innovations in addition to be innovative, learning institutes for which are yet to be come into existence. (Nain et al, 2018). Farmer-Led Agricultural Innovation for Resilience (FLAIR) has achieved tremendous success in introducing SRI to a large number of small-scale farmers. In Cambodia and Vietnam, SRI adopters experienced

significant positive impacts on food security and income with a coarse calculation giving a 13-fold return on investment (Pommier, 2014). Innovative ways to increase production, improve organisation, or reduce dependence on external inputs, farmer innovations were found having significant potential to improve the quality of life for farming families in Malawi and reduce their impact on the environment. The farmer led innovations are driven by a range of interlinked factors: economic factors (the inability to afford external inputs or grow enough food to be food secure), environmental factors (the need to adapt to climate fluctuations or restore infertile soils which cannot be rested due to small landholdings), social factors(migration, HIV/AIDS, and scarce labour availability), cultural factors (need to use certain plants for ritual and other purposes), and political factors (availability of subsidized fertilizers and seeds as a form of political patronage by a neopatrimonial state (FAO, 2012)). Squire (1998) reported that it is the Attitude of Traditional Farmers which determines the fate of farmer-led innovations. He found that Traditional farmers are more Lean towards the usefulness of Technical Assistants in receiving Agricultural Technology from them rather than nurturing innovations of their own experiences. These Traditional Farmers were the Heads of 150 households in Botswana.

Key initiatives

The technological and institutional innovations are not two different departments of the same system, but it is often very common to see instances where technological innovations causing institutional changes or institutional innovation stimulating technological innovations. At international level, to develop mechanisms for local innovations to find their way into the formal research and development system, the Participatory Adaptation and Diffusion of Technologies for Rice-Based systems project initiated several activities to encourage their national partners to document, validate and disseminate local knowledge and innovations. This IFAD- funded project is coordinated by the African Rice Center (WARDA). The first phase of the project was implemented from 2000 to 2003 in Ghana, Guinea, The Gambia and cote d' Ivore. The Farm level Applied Research Methods for Eastern and South Africa (FARMESA) is a regional collaborative institute operating in five countries including Kenya, Tanzania, Uganda, Zambia and Zimbabwe with associate countries including Botswana, Malawi, Mozambique and South Africa. African Highlands Initiative (AHI) in traduced numerous technologies to improve and enhance land productivity in a sustainable way within the intensive land-use systems of the highlands in eastern and central Africa while maintaining the quality of the natural resource base during 1998-99, where farmers modified some elements of the technologies in different ways and sometimes opposing some of

researchers methodologies in their fields according to their experiences with locally available alternatives resulting in a formal survey to trace such innovations and search out the motivating factors for innovation and its effects on adoption (Lyamchai *et al* 2005). The common activities for PROLINNOVA (Promoting Local Innovation) global programme are identification and documentation of local innovation, capacity building of different stakeholders, validation, promotion and up scaling of innovation which supports in livelihood of resource poor and low resource farmers. PROLLINNOVA Cambodia started up action research on so-called Local Innovation Support Funds (LISFs) in 2007 where farmers were given flexibility and independence in doing their own research relevant to local problems and conditions and facilitated the sharing of such innovations and experiences through a workshop. Promotion of farmer innovation and experimentation in Ethiopia (PROFIEET) Later named as PROLINNOVA-Ethiopia worked on the process and products of local innovation-based partnership between farmers, the formally trained researchers/experts, the private sector, policy people, extension workers and other factors". The global community of practices included 16 countries mainly from Africa, Latin, America and Asia (PRROLINOVA-Ethiopia, 2006). Promoting Farmer Innovation (PFI) was the key activity of a project in East Africa upto 2001. The methodology and early results of PFI sought to use local farmer innovation in the field of land husbandry as a stimulus to more appropriate research and extension systems in semiarid and marginal areas which led to documentation of selected innovations as one of the products. International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) in northern Malawi stressed and worked for convergence between informal innovation and formal research and development systems (Olivia, 2012).

In Indian context, NIF (National Innovation foundation) took up the mission of making India innovative (documenting, adding value, protecting the intellectual property rights of the contemporary unaided technological innovators, as well as of outstanding traditional knowledge holders) and a creative society since 2000 with the active support of Department of Science and Technology, Government of India. In this, it supplements the work done by the Honey Bee network over the years. The NIF seeks to create an innovation-driven society by giving awards to outstanding grassroots innovators, helping transform those innovations that have economic potential into products that can be commercially produced (either by the innovator himself or through licensing of the innovation to another commercial enterprise), and linking grassroots innovators to the formal science and technology system to get inputs to improve upon innovations wherever necessary and create a new model of innovation-driven entrepreneurship. To support individual innovators, the

Technopreneur Promotion Programme (TePP) has been used to provide capital to several of the individual innovators. To support the commercialization activities of the NIF, the government created a Micro Venture and Innovation Fund of about $ 1million (to be operated by the NIF with the involvement of the Small Industries Development Bank of India) in 2002 and these funds are being used to scale-up innovations and facilitate the creation of viable enterprises. The Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI), a global NGO based in India was set up in 1993 to provide support to the honey bee network and to enhance global networking and do research on problems related to diffusion and protection of grassroots innovations. Grass Roots Innovation Augmentation Network (GIAN), Gujarat set up in 1997 is involved in documentation and validation of farmer innovations. It provides small amounts of funding for prototype development, links innovators to science and technology institutions, and identifies commercial enterprises interested in licensing product technologies from the grassroots innovators. ICAR organised a National farm innovators meet at JSS Krishi Vigyan Kendra, Suttur, Mysore District, Karnataka and published Farm Innovators 2010. Intellectual Property and Technology Management cell (IP&TM) of ICAR oversees all matters related to intellectual properties and technology transfer/commercialization of new ideas. It is maintaining data base of successful innovative farmers for better dissemination. ICARs Zonal Technology Management and Business Planning and Development units (ZTM & BPD) main objective is to protect Intellectual Property Rights, showcasing, transferring and commercializing the ICAR institutes innovations. They also act as Agri Business incubator to Incubate new startup businesses. Almost all the State Agricultural Universities, state departments, KVKs, ATMAs are documenting the farmer led innovations at district level and recognizing them through kisanmelas, exhibitions, seminars, conferences etc. (ICAR report 2015). Technology Information, Forecasting and Assessment Council (TIFAC) set up in 1988 under the Department of Science & Technology to look ahead in technologies, assess the technology trajectories, and support technology innovation by network actions in selected technology areas of national importance is providing the technical and financial support in the form of filing patents, extending post patent support for technology refinement and marketing to upscale through various programmes. Protection of Plant Varieties and Farmers Rights Authority (PPV&FRA) set up in 2005, is involved in documentation, indexing and cataloguing of farmers' varieties. National Bank for Agriculture and Rural Development (NABARD) set up a separate fund titled "Farm Innovation and Promotion Fund" (FIPF) to encourage specifically the innovations in the farm sector. The Fund has been created in NABARD with an initial corpus of 5 crores and it was

operational with effect from 1 April 2005. It was initiated mainly to provide support on the analogy of venture capital for innovative ideas – technological and managerial (like supply chain management) in farm sector for further development (NABARD report 2010).National Research Development Corporation (NRDC) was established in 1953 is recognizing a large repository of wide range of technologies spread over almost all areas of industries, viz. Agriculture and Agro-processing, Chemicals including Pesticides, Drugs and Pharmaceuticals, Bio Technology, Metallurgy, Electronics etc. It has licensed the indigenous technology to more than 4800 entrepreneurs and helped to establish a large number of small and medium scale industries. (NRDC annual report 2015).

Learning exchange through social networking

The growing importance of knowledge has led to the concept of knowledge management which is the process of capturing, developing, sharing, and effectively using knowledge. Extension manages knowledge in an agricultural innovation system to support the progress of farmers. In general, the uses of information technology communications tools support knowledge sharing (Eid and Nuhu, 2011). The SECI (Socialization, Externalization, Combination, Internalization) model is a knowledge management model that explains how the different forms of knowledge are transferred or combined in an organisation. Social network or negotiation communication model considers information overload or fatigue which implies different approach for different issues and facilitative knowledge exchange (interactive partnership to share knowledge and experiences for decision making). Low-cost information and communication technology (ICT) tools possess the ability to deliver timely, relevant, and actionable information to farmers at lower costs than traditional extension services (Aker, 2011, Cole and Fernando, 2012).

Social media has proved to be an important platform for pluralistic extension, bringing together all the actors in Agriculture Information System (AIS) and making them shareholders in development (Naruka *et al*, 2017). Study on social interactions between online communities in online learning through mobile device, has found social presence to be a principal factor influencing motivations to engage in social interactions for constructing and sharing knowledge (Cheung *et al*, 2008). Comparison of the use of blogs and Facebook for supporting knowledge management activities of creation, sharing, and application found that both tools generally support knowledge management but Facebook has more capabilities and potential than blogs in support of knowledge sharing.

Farmer led innovations (FLIs) having advantage to tackle second generations' problems require different set of capacities on the part of farm innovators to scale their innovations in addition to be innovative (Nain *et al*, 2018). It can empower individual farmer and rural communities, strengthens link between farmers, extension worker and researcher in such a way that farmer experimentation directs the research agenda and the participatory technology development ensures sustainability of technology. Provision of comparative experiences through knowledge management systems, conflict management approaches, facilitation of multi stakeholder negotiations, building alliances with private sector, marketers and NGOs need to be stressed upon. Farmers need to initiate group action in production process, the mechanism for better remuneration need to be ensured for the extra efforts and the institutional arrangements for networking of stakeholders need to be devised to translate the challenges into opportunities. In order to enhance awareness of the innovative capacities of the farmers, to identify farmer-led innovations having potential to be adopted for larger impact and to share the experiences of farmers-led innovations in the field of agriculture and allied sector and to set the ground for networking of farm innovators, research institute and agricultural marketing agencies for dissemination of farmers' innovations as well as institutional innovations among larger population.

Entrepreneurship development through Farmer led innovation

There is proven nexus of entrepreneurship and innovation for sustainable development and need of the day is to encourage 'entrepreneurial agriculture for human development and maximum farm profits'. Innovativeness has been found to be critical in entrepreneurial behavior. Farm Innovators could effectively become consultants and entrepreneurs leading to off- farm income generation options after getting training and support in certain distinguishing capacities like foreseeing institutional requirements and linkages, comparative financial impact and success analysis ability in addition to analyze projected demand and required changes in socio cultural and infrastructural domain (Nain *et al.,* 2018). On other hand according to social network theory, entrepreneurs' social ties influence their recognition of entrepreneurial opportunities and entrepreneurial pursuits (Hills *et al*., 1997). The development of a rural entrepreneurial support system necessitates creating a supportive environment, or social networking, to flourish in an entrepreneurial climate through building partnerships (Dabson *et al*, 2003). Developing partnerships includes the coordinated efforts of central government, local governments, municipalities, academies and non-governmental organizations to help spur the entrepreneurial activity of that region (Kulawczuk, 1998). Partnership with institutions, academies and various

organizations encourage rural community development and strengthen institutional support structures and well-built relations between the government and the private sector in new enterprise development in rural provinces. The strength of infrastructure development plays a crucial role in rural entrepreneurship development (FAO documents, 1997). Infrastructure development is highly correlated with the level of entrepreneurial activity across different countries (Zacharakis et al., 1999). Since basic infrastructure development and availability of financing (Kulawczuk, 1998) are necessary for any entrepreneurial venture, it is assumed that a country's rate of the development of the national framework conditions may be a crucial link between a variety of other social, intellectual and environmental dimensions and rural opportunity recognition in a country. There is no proper appreciation of farmers as actors in the innovation system, little information provided about different sources of knowledge involved, or the flow of knowledge and little attention to long-term impacts on livelihoods (Brigidletty *et al*., 2012). Institutionalization of any farmer led innovation being a complex process requires capacity strengthening and change in individuals as well as change in organizations. Fuentes *et al.* (2013) suggested that private players should assist in the commercialization of farmer-led innovations. Farmers should play a key role in planning the process of scaling out in their area to develop ownership and commitment to improving livelihoods. Supporting organizations need to facilitate the scaling out process beyond short term research or development projects. In some studies, FLI is equated with Family Farm Innovations. Guy Faure et al (2013) conducted their study in Francophone African countries and found that Learning Experiences gained in family farms are instrumental in making farm innovations sustainable. Their further research on Governance Mechanism and Capacity Building issues reveated that most often Producers Organizations play central role in scaling up of family farm innovations. Extension Workers were found a low key due to lack of training in family farm systems.

IARI experiences

In order to develop the model for making farming a business venture and replicating farmers' innovations, an action research study was conducted and the farmer led innovations identified, documented for their scalability and the action interventions were initiated in three NCR Delhi villages namely *Fatehpur Biloch (Faridabad), Manjhawali (Faridabad) and Swamika (Palwal.* These villages were selected purposively for action interventions being predominantly engaged in agriculture and having scope of agripreneurship development due to their proximity to National capital of Delhi. At first stage, 135 farmers and farm women (45 from each village) were identified to analyse the perceived determinants

for maximizing farm income and capacity building needs in agripreneurship development. On the basis of need analysis, action interventions were identified and at this stage 110 farmers and farm women were involved on the basis of their interests and motivations. Pre training and post training data on entrepreneurial competencies as suggested by McClelland, 1969 was collected from 110 farmers and farm women trained on various aspects of entrepreneurship development. In order to understand the backward and forward linkages, 30 farmers each (a total of 120 farmers) cultivating tomato, cauliflower, tuberose and gladiolus were interviewed and the perceived linkages were mapped on three point continuum from poor linkage, fair and good linkages. The price spread (the difference between the price received by the growers and the price paid by the consumers)for four farm products namely tuberose, gladiolus, cauliflower and tomato was calculated with standard procedures and the estimate of producer's share in consumer rupee was performed. To test the scalability of the farmer led innovations, a test was standardized consisting of seven broad parameters namely; credibility, complexity, testability, observability of results, relevancy, relative advantage over existing practices and sustainable source of funding with suitable modifications in scaling up toolkit. The data for analysis of scalability of the innovation were collected from 60 farmers (20 from each village) from project locations. Simple statistical tools averages, percentage, mean score, weighted mean score were employed to accomplish the different objectives of the study.

On the basis of analysis of the successful cases and the action interventions undertaken a framework for agri- entrepreneurship and farmers' innovation dynamics has been conceptualized. The agri-entreprise development for maximizing farm profitability was found to be interplay of entrepreneurial competencies, entrepreneurial climate, and farmers' innovations. It was found that the competencies like opportunity recognition, drive for excellence, quality concern ,moderate risk taking behaviour , innovativeness and business orientation in presence of suitable climate like networking, infrastructure , government priority and financial backstopping lead to experimentation not only for technological innovation, but also new ways of managing livelihood in general (networking, communication, institution building, information management, marketing, planning, accessing resources, etc). The innovations which were economically viable and found sustainable source of funding were able to translate into entrepreneurial ventures having higher income and profits. Social networking of farm innovators has proved to be potential to construct knowledge. On the other hand to maximize the income, the farms required certain distinguishing capacities like foreseeing institutional requirements and linkages,

comparative financial impact and success analysis ability in addition to analyse projected demand and required changes in socio cultural and infrastructural domain. The results were in conformity with Singh *et al*, 2014 and Singh *et al.,* 2016, whereas it was inferred that individual motivations and aspirations trigger entrepreneurship and the competencies along with best practices (innovations) and convergence and synergistic linkage play sequential role for enterprise success.

Summing up

Diminishing returns from Agriculture have put the whole rural economy under severe stress which paved the way to accelerate the diversification of rural livelihoods in order to have adequate viable and sustainable means and opportunities. Institutional mechanism and human mobilization for networking and resource optimization, collectivization, technologies and methodologies of secondary agriculture are the keys for maximizing farm income. Human resources base in rural ecosystem in general is lacking in social processes of group and enterprise management skills along with marketing and communication skills. The capacity building interventions not only have the potential for changing entrepreneurial competencies but broadening the horizon of the participants to launch their own income generating activities. The backward and forward linkages in the form of advisory services, input supply, marketing of the produce, financial backstopping and the support and convergence of various stakeholders like banks, NGOs, research institution, state line department may bring positive impact in the form of initiation of income generating activities out of their own innovations. Screening for scalability of farmers' innovations and efforts for their institutionalization pre- requires creation of platform for exchange of information and experiences, developing and disseminating theme-based knowledge products and undertake analysis of partner institutions to assess their potential as participants and building capacity of partner institutions. The framework for agri-entreprise development for maximizing farm profitability may be conceived as the function of entrepreneurial competencies, entrepreneurial climate, and farmers' innovations. To encourage Entrepreneurial Agriculture for Human Development and maximum farm profits, farmers need to harness all their skills so that they will be able to withstand harsh conditions which are as a result of environmental changes or social compulsion driven. Agricultural productivity is believed to be enhanced by the incorporation of strategic entrepreneurship skills. Also, farmer led innovations generated for

immediate problem solving or creative application have helped in optimizing farm profits and managing agricultural activities conveniently. Innovativeness has been found to be critical in entrepreneurial behaviour.

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INDIAN FARMING IS DEFYING THE LAWS OF ECONOMICS, AND PAYING FOR IT

Average farmers' income is low, yet their produce is priced out of the market. Crop productivity is abysmal by global standards but higher produce often leads to distress sales. Leaning on govt support at every level — from sowing to sale — Indian agriculture has moved away from value-creating enterprise to vote-catching opportunity

1 Average profit from farming is low and falling

Average monthly income (in ₹) for kharif season — 2015-16

Based on average land holding size of Indian farmers which is 1.08 hectares

2 Access to govt procurement is limited to a few states

Government purchase of wheat under MSP as % of total sales during 2018-19

99% of wheat is purchased from these 5 states

3 High price-low income paradox

With small farms and low mechanisation, Indian agriculture is labour intensive. This means high labour costs and low yields. Developed countries give output subsidy to keep prices globally competitive and protect consumers from food inflation. In India, government purchases some crops at minimum support price (MSP), which is based on input cost. But even the MSP is higher than international prices for most crops

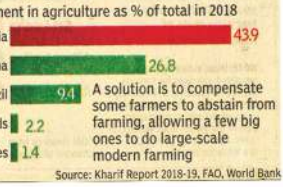
4 The only lasting solution is higher productivity...

Yield of major crops in kg per hectare

	India's highest	World's highest
Rice	3,974 Punjab	6,932 China
Maize	7,010 Tamil Nadu	10,960 US
Pulses	931 Gujarat	5,540 Australia
Soybean	831 Madhya Pradesh	3,501 US

5 Productivity will rise if fewer Indians depend on farming

Employment in agriculture as % of total in 2018



A solution is to compensate some farmers to abstain from farming, allowing a few big ones to do large-scale modern farming

Source: Kharif Report 2018-19, FAO, World Bank

...and the bar for productivity is even higher for horticulture

Difference in agri yields — **India** vs **Netherlands*** (yields in kg/ha)

*Netherlands does precision farming that needs very little soil, sunshine, water and pesticides