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## **PRESIDENTIAL ADDRESS**

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### **Has Indian Agriculture Become Crowded and Risky? Status, Implications and the Way Forward\***

**P.K. Joshi†**

*Honorable dignitaries, distinguished delegates and members of the Indian Society of Agricultural Economics*

I am deeply humbled and extremely honored to be here today. First, I would like to express my sincere thanks to the members of the Indian Society of Agricultural Economics for electing me the Conference President for 2014. I am not sure if I deserve this recognition but I certainly feel that this recognition is due to those who have inspired me and worked with me during the last four decades. And on this occasion, I would like to remember the late Dr. S.L. Shah and late Dr. Dayanatha Jha, who shaped my professional career and remain my role models. I received enormous support and continuous encouragement from Dr Katar Singh, Dr. Praduman Kumar and Dr. D.K. Marothia, as well as many friends, colleagues, and my parents and family. It has been a tremendous learning experience for me to witness the leadership roles played by the late Dr. M.L. Dantwala, late Dr. V M Dandekar, Dr. A. Vaidyanathan, Dr. S.S. Johl and Dr. C. Ramasamy in strengthening society and its activities. I am indeed indebted to all of them.

For the last four decades, I have been working in the areas of impact assessment, technology policy, land degradation, watershed management, and markets and institutions. However, during the last decade I have been focused more on better understanding the problems and opportunities of smallholder agriculture, diversification of agriculture towards high-value commodities, institutional innovations in production and marketing systems, and climate change. This has made me wonder whether smallholder agriculture is becoming unviable, particularly given the threat of climate change. Hence I would like to speak on the subject “Has Indian Agriculture Become Crowded and Risky? Status, Implications and the Way Forward.”

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## I

## BACKGROUND

Indian agriculture has seen a steady transformation from subsistence to semi-commercial and commercial mode. Following a phase of stagnation and agrarian distress due to heavy indebtedness of farmers, frequent droughts and floods, and an uncertain global economic environment, Indian agriculture has been in the path of revival due to policies and programs aimed to accelerate the pace of agricultural growth. At the macro level, investment in agriculture has increased—from 12 per cent in 2005-06 to the current 21 per cent of the agricultural gross domestic product (GDP). Consequently, agricultural growth peaked at 4 per cent during the eleventh Five Year Plan, and foodgrain production reached a record level of 264.38 million tonnes in 2013-14. Higher crop productivity driven by technological change has been the main source of higher foodgrain production. Agricultural exports have increased and terms of trade turned in favour of agriculture. Contrary to past trends, a larger share of incremental gains in agricultural growth was attributed to non-cereal commodities (horticulture, dairy, poultry etc.) and non-Green Revolution areas.

Yet there are concerns about the growing number of landless labourers and smallholder farmers - smallholder farmers being defined as those owning less than 2 hectares (ha) - given the slow decline in dependency on agriculture and agriculture's rapidly diminishing share in GDP. This share declined to about 13.7 per cent in 2012-13, when the sector still had employed about 51 per cent of the workforce. Apparently, a large proportion of the population is dependent on agriculture for food and income. Though literature is replete with instances of smallholder farmers being efficient in production, their increasing number and shrinking farm size raise questions about their viability and sustainability. Globally too, smallholders have regained attention due to their growing numbers and significant contribution to food production. The United Nations has declared 2014 to be the "Year of Family Farms," which globally account for about 85 per cent of farm holdings. These farms provide livelihood opportunities to about 2.5 billion people across the world; 84 per cent belong to the category of smallholders (Lowder *et al.*, 2014). Available estimates show that about 87 per cent of the world's 450 million smallholders are in Asia and the Pacific region (IFPRI 2007; Thapa and Gaiha, 2014). China and India together account for about two-third of smallholders, with those in India contributing about 50 per cent of total agricultural output (Thapa and Gaiha, 2014).

Lately developing countries, including India, have been promoting smallholder farmers on the pretext of "small is beautiful". There is certainly no denying their greater efficiency than larger farms, but their viability and sustainable is now being debated (Chand *et al.*, 2011). Issues that raise concern center around the disadvantages they face: economies of scale and inadequate access to information, services, and markets (Joshi *et al.*, 2007; Joshi and Dev, 2014). Moreover, it is being argued that the efficiency advantage they face is evaporating with development,

rising per capita incomes, migration of workers from agriculture, rising rural wages, and cheap capital compared to land and labour (Hazell and Rahman, 2014), and increasing climate risks (IPCC, 2014a).

This paper hypothesises that agriculture is being crowded by the growing number of smallholders and facing tremendous climate change risks, thereby leading to their being trapped in a vicious cycle of food insecurity and poverty. A better understanding of crowding and climatic risks is necessary to assess smallholder agriculture's advantages and disadvantages. This paper is an attempt to provide such an understanding. It broadly covers (1) the status of crowded agriculture and climatic risks in agriculture with special reference to smallholders; (2) the implications of this status; (3) opportunities for smallholders given a market-driven economy and changing climate; and (4) an action plan to reduce crowding in agriculture to make smallholders viable and sustainable.

Accordingly, the paper is divided into six sections. After this background section, the second section reviews the extent and nature of crowding in agriculture and its implications. It is followed by the section elaborating climatic risk in agriculture and its implications to smallholders. The fourth section illustrates the tale of Bihar and Odisha, the two states that are most crowded and at greatest risk from climate change. It is followed by a section on listing possible opportunities for smallholder agriculture. The sixth section provides a road map for solving the problem of crowded and climatically threatened agriculture, which is followed by a section on conclusion.

## II

### CROWDING OF INDIAN AGRICULTURE AND ITS IMPLICATIONS

Lack of alternative employment opportunities and diversion of agricultural land to non-agricultural purposes has led to overcrowding of agriculture. During the last three decades, number of landless labourers and the land owners have doubled from 141 million in 1980-81 to 282 million in 2010-11. During this period, nearly 50 million landholdings were added, from about 88 million in 1980-81 to 138 million in 2010-11. However, the same period saw a decline in operated area by about 4 million ha. During the same period, 91 million landless labourers were added, from 53 million in 1981 to 144 million in 2011. The net sown area remained stagnant around 140 million ha since 1970-71, and consequently the per capita net cultivated land declined from 0.26 ha in 1971 to 0.11 ha in 2011. Also, the land/man ratio declined from 0.90 ha per agricultural worker in 1972-73 to 0.68 ha per worker in 2009-10 (Bhalla, 2014). Such trends point towards the tremendous pressure on land, with significant negative impacts on land and labour productivity (Bhalla, 2014). The literature contains instances of how the present situation has adversely affected the viability and sustainability of smallholder agriculture and led to agrarian distress (Deshpande and Arora, 2011).

### *Crowding Patterns*

During the last three decades, the number of smallholder farmers increased by 77 per cent from about 66 million in 1980-81 to 117 million in 2010-11. They now account for about 85 per cent of all the landholdings in India, compared to 75 per cent in 1980-81 (Table 1). Though their number is significantly higher, they controlled only 45 per cent of the total operated area in 2010-11 compared to a mere 22 per cent in 1980-81.<sup>1</sup> Conservative estimates show that if the current trend remains unchecked, India will have more than 155 million smallholders by 2020-21, controlling about 51 per cent of the total operated area. Coming to the medium and large holdings, their share has declined during the last three decades from 26 per cent in 1980-81 to 15 per cent in 2010-11. It is important to remember that 56 per cent of the total operated area is still cultivated by medium and large farmers, meaning very few farmers are cultivating significantly larger areas.

TABLE 1. LAND HOLDINGS AND OPERATED AREA IN INDIA, BY FARM GROUP

Size group (1)	Holdings (per cent)		Operated area (per cent)		Size of holding (ha)	
	1980-81 (2)	2010-11 (3)	1980-81 (4)	2010-11 (5)	1980-81 (6)	2010-11 (7)
Small	74	85	26	45	0.65	0.61
Medium	23	14	51	45	4.05	3.61
Large	2	1	23	11	17.41	17.38
All India	100 (88.9)	100 (138.3)	100 (163.8)	100 (159.6)	1.84	1.15

*Source:* Government of India, *Agricultural Census*, Department of Agriculture and Cooperation, New Delhi (various issues).

*Note:* Figures in parentheses are total holdings (in million), and operated area (in million ha).

On an average, the size of landholding in India declined from 1.84 ha in 1980-81 to 1.15 ha in 2010-11. The average size of landholding of a smallholder is 0.61 ha compared to 3.61 ha for a medium farmer and 17.38 ha for a large farmer. Further disaggregating the smallholders, the share of marginal farmers (those holding less than 1 ha in the category of smallholders) in total holdings has increased significantly from 56 per cent in 1980-81 to 63 per cent in 2010-2011; however they control only about 22 per cent of the area, with an average size of just 0.39 ha.

A state-level disaggregation of landholdings provides useful insights into the nature and structure of occupational patterns (Table 2 and Figures 1 and 2). There is a large variation in the operating area of smallholders across the states. By and large, they are concentrated in areas with low urbanisation, high poverty, and more risky production and marketing environments which offer meagre non-farm employment opportunities.

In 2010-11, the share of smallholders in total holdings was equal to or more than 95 per cent in the states of Bihar, Daman & Diu, Jammu & Kashmir, Kerala, Tripura, and West Bengal (Table 3). Their share in total operated area ranged between 73 per

TABLE 2. SMALLHOLDER LANDHOLDINGS, OPERATED AREA, AND AVERAGE HOLDING SIZE, BY STATE

State (1)	Smallholdings (per cent)		Operated area (per cent)		Size of holding (ha)	
	1980-81 (2)	2010-11 (3)	1980-81 (4)	2010-11 (5)	1980-81 (6)	2010-11 (7)
Andaman & Nicobar*	55	58	22	25	0.81	0.78
Andhra Pradesh**	73	86	29	55	0.75	0.69
Arunachal Pradesh*	32	35	9	9	0.99	0.95
Assam	82	86	43	49	0.71	0.63
Bihar	87	97	42	76	0.47	0.31
Chhattisgarh*	76	80	34	42	0.73	0.71
Dadra & Nagar Haveli*	80	82	43	47	0.80	0.79
Daman & Diu*	95	98	66	76	0.41	0.29
Delhi*	74	73	33	34	0.68	0.67
Goa*	92	89	47	51	0.43	0.66
Gujarat	46	66	13	30	0.97	0.91
Himachal Pradesh	77	88	35	54	0.70	0.61
Haryana	51	67	13	22	0.92	0.75
Jammu & Kashmir	87	95	54	73	0.61	0.47
Jharkhand	73	84	43	43	0.73	0.59
Karnataka	59	76	19	40	0.89	0.81
Kerala	96	98	64	76	0.29	0.17
Laccadive Islands*	93	90	77	70	0.23	0.21
Madhya Pradesh	52	71	12	34	0.82	0.85
Maharashtra	52	78	16	45	0.90	0.83
Manipur	83	83	60	60	0.89	0.82
Meghalaya	65	76	33	43	0.89	0.77
Mizoram*	82	87	61	65	0.93	0.85
Nagaland	26	15	4	2	1.03	0.98
Odisha	74	92	38	70	0.82	0.80
Pondicherry*	92	93	55	63	0.42	0.44
Punjab	39	34	10	9	1.01	1.03
Rajasthan	49	58	10	16	0.87	0.85
Sikkim	70	76	28	35	0.79	0.65
Tamil Nadu	87	92	47	61	0.58	0.53
Tripura	89	96	59	76	0.71	0.39
Uttar Pradesh	87	92	48	65	0.56	0.53
Uttaranchal*	88	91	55	64	0.99	0.63
West Bengal	89	96	60	81	0.64	0.65
All India	75	85	26	45	0.64	0.61

Source: Government of India, *Agricultural Census*, Department of Agriculture and Cooperation, New Delhi (various issues).

Note: \* represents data for 2001 under column 1981. \*\* includes Telangana.

TABLE 3. SMALLHOLDER SHARES OF TOTAL LANDHOLDINGS IN DIFFERENT STATES, 2010-1

Share of smallholders (per cent) (1)	States (2)
> 95	Kerala, Daman & Diu, Bihar, Tripura, West Bengal and Jammu & Kashmir
90 – 95	Pondicherry, Tamil Nadu, Uttar Pradesh, Odisha, Uttaranchal, Lakshadweep
80 – 90	Goa, Himachal Pradesh, Mizoram, Assam, Andhra Pradesh*, Jharkhand, Manipur, Dadra & Nagar Haveli, Chhattisgarh
70 – 80	Maharashtra, Sikkim, Meghalaya, Karnataka, Delhi, Madhya Pradesh
60 – 70	Haryana, Gujarat
50 – 60	Andaman & Nicobar, Rajasthan
< 50	Arunachal Pradesh, Punjab, Nagaland

\* includes Telangana.

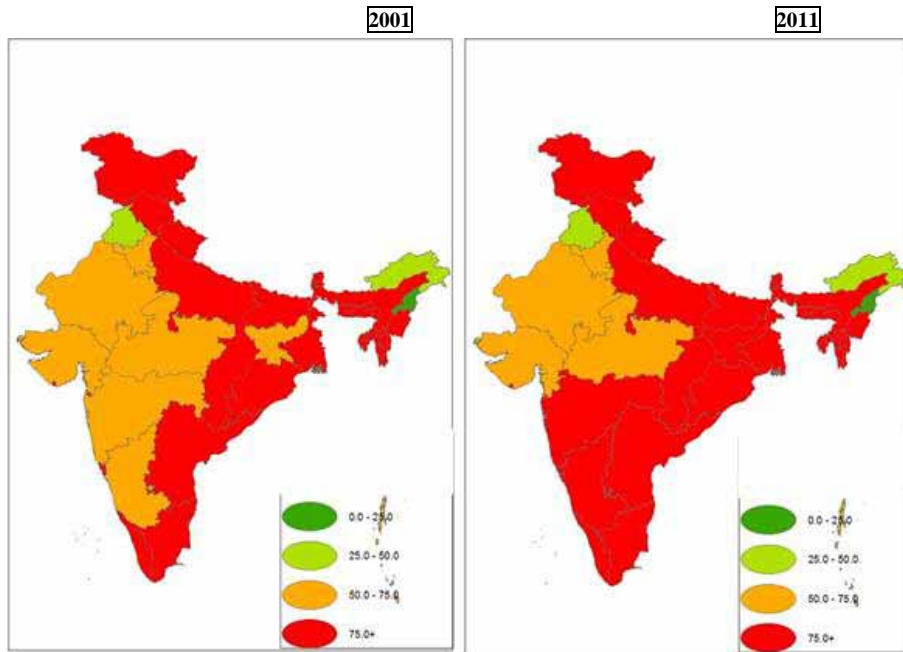


Figure 1. Share of Smallholders in Total Holdings Across States in 2001 and 2011 (per cent).

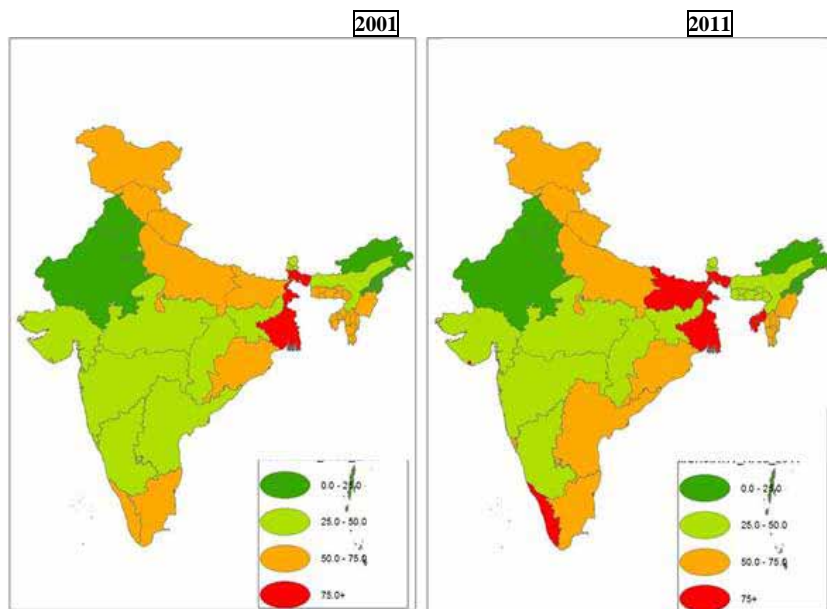


Figure 2. Share of Smallholders in Total Operated Area Across States in 2001 and 2011 (per cent)

cent and 81 per cent. It is important to note that only 2 per cent of medium and large holdings in Kerala and 3 per cent in Bihar each control 24 per cent of operated area. In contrast, Arunachal Pradesh, Punjab, and Nagaland have 35 per cent or less land holdings belonging to smallholders.

The average landholding size of smallholders is as low as 0.17 ha in Kerala, 0.21 ha in Lakshadweep Islands, 0.29 ha in Daman & Diu, and about 0.31 ha in Bihar. It is less than 0.70 ha in more than half the states in India. Despite the profusion of tiny landholdings, the number and operated area of smallholders is rising. The largest increase in the share of smallholders was observed in Maharashtra (15 per cent), Gujarat (14 per cent), and Odisha (12 per cent) in 2010-11 compared to 1980-81. The share of smallholders in operated area increased by 19 per cent in Andhra Pradesh, 23 per cent in Odisha, and 24 per cent in Bihar. These disturbing trends are not conducive to extracting smallholders from the clutches of poverty and making them viable and sustainable. Since their basic need is food, a majority of them rely on a cereal-based production system (mainly rice, wheat, and millets) for income and food security (Joshi *et al.*, 2007). Can the tiny landholdings of smallholders enable them to produce enough food for their own family consumption as well as to generate sufficient marketable surplus to meet other essential expenses? Corrective land policies and creating more job opportunities outside agriculture are solutions to these problems.

A contrasting scenario can be seen in Punjab and Goa, where the share of smallholders declined between 1990-91 and 2010-11.<sup>2</sup> Sikkim, Delhi, Lakshadweep and Meghalaya too witnessed a decline in the number of smallholders and also showed a decline in the share of area operated by smallholders. These trends are an indication that the smallholders may either be expanding their own areas by moving upward, or selling land to other farm categories, or selling the land and moving out of agriculture, possibly in search of alternative options to ensure food and income security.

More disturbing trends are widening land inequalities. At the national level, the Gini concentration ratio increased from 0.21 in 1995-96 to 0.31 in 2010-11. In states like Bihar, Uttar Pradesh and West Bengal, the ratios were much higher and increased over time.<sup>3</sup> Declining landholding size and widening land inequalities may have several socio-economic and political implications and adversely affect all welfare schemes and agricultural development programs. It is often debated whether there should be uniform or differentiated policies for different categories of farmers in order to attain the goal of higher, sustainable and inclusive agricultural growth. Evidently, a uniform policy biased in favour of any category may drag down the process of agricultural development.



## III

## IMPLICATIONS OF CROWDED AGRICULTURE

There is a profusion of smallholders in rainfed and marginal areas. They operate in a high-risk environment, confronted by frequent droughts, floods, and other eventualities. Their yield levels are way below that of favourable and better endowed areas. They produce marginal quantities of heterogeneous products with the multiple goals of increasing food production, maximising incomes, and minimising risks. Most of these smallholders operate at subsistence level with small marketable surpluses. In a highly competitive and globalised market, this group of farmers faces numerous challenges. This section discusses a few of the key challenges they face.

*Soil and Water Health*

Crowding in agriculture puts pressure on natural resources, especially soil and water, worsening the production environment. Absence of appropriate institutional arrangements in managing natural resources lead to deterioration of soil and water resources (Marothia 2003, 2009). Deterioration in soil and water quality has been reported to generate adverse effects on agriculture's production potential. Declining landholding further compounds the problems of smallholders. More than 57 per cent of the total reporting area in India is characterised as degraded land as against 17 per cent at the global level (NAAS, 2009). In fact, nearly 120.72 million ha of land in the country is degraded due to soil erosion and about 8.4 million ha has soil salinity and water-logging problems (ICAR, 2011). It is estimated that India is losing nearly 0.8 million tonnes of nitrogen, 1.8 million tonnes of phosphorus, and 26.3 million tonnes of potassium annually, with deteriorating soil health (ICAR, 2011).

Soil health has deteriorated due to disproportionate use of inorganic fertilisers and less application of organic manure (Chand and Pandey, 2008). In 2006-07, the average fertiliser application by smallholders was as high as 180 kg per gross fertilised area while that of farm yard manure (FYM) was about 4.88 tonnes per gross fertilised area. The FYM application has declined by 26 per cent during the last 15 years and reduced the organic carbon in the soils.<sup>4</sup> The partial factor productivity of fertilisers during the last three and a half decades showed a sharp declining trend from 48 kg foodgrains/kg NPK in 1970-71 to 10 kg foodgrains/kg NPK in 2007-08 (NAAS, 2009). On-farm experiments further reveal that current fertiliser management patterns are depleting carbon and micronutrient availability adversely affecting agricultural production and income, and ruining soil health and water quality. Smallholders are more vulnerable to such adverse effects due to disproportionate fertiliser use. Higher subsidies on nitrogenous fertiliser induce greater urea use compared to phosphorous, potash, and other micronutrients (like manganese, zinc, and boron). The fertiliser subsidy is also thinly distributed to smallholders due to their large number. On a per holding basis, smallholder farmers

get about 14 times less fertiliser subsidy than what large farmers get.<sup>5</sup> Recently introduced “Soil Health Card Scheme,” if implemented effectively, will play an important role in saving inorganic fertiliser and improving soil health, which would eventually reduce the fertiliser subsidy burden to a large extent.

Similarly, the steeply plunging water-table in most of the irrigated areas and deteriorating water quality due to leaching of salts and other pollutants is a major concern (ICAR, 2011). The green revolution belt is now exhibiting second-generation problems owing to over-exploitation and mismanagement of soil and water resources (NAAS, 2009). Increasing level of fluoride and nitrate pollution are adversely affecting groundwater quality and yields.

### *Markets and Value Chains*

India’s agri-food marketing system has undergone changes and is offering new opportunities. Some of the changes are (1) product differentiation at the food industry level, post-farm level, or both (Reardon and Timmer, 2005); (2) rapidly developing rural-urban value chains encompassing the majority of food commodities (Das Gupta *et al.*, 2010a; 2010b); (3) organisational changes like consolidation in the processing and organised retailing sector (Bhavani *et al.*, 2006); (4) emergence of organised retail or supermarkets (Hu *et al.*, 2004, Neven and Reardon, 2004; Reardon and Gulati, 2008); (5) institutional changes such as contract farming and farmer producer organisations (Regmi and Gelhar, 2001, Reardon and Farina, 2002); and (6) policy changes to attract the private sector in agri-food value chains and ensure food safety standards.

The nature and speed of market transformation varies across geographical areas and commodities. How are the smallholders in backward areas participating in this transformation? It is argued that with changing agricultural marketing chains, smallholders have to compete in the market. This is demanding in terms of quality and food safety (Hazell and Rahman, 2014). Hence smallholders in backward areas face the risk of being left behind in this process.

While there are several government programmes to boost agricultural production, efforts are lacking in developing markets and improving efficiencies of value chains for agricultural commodities. Punjab, Haryana, Western Uttar Pradesh, and coastal Andhra Pradesh have relatively well developed markets. Local markets in most of the smallholder-dominated areas are unorganised, thin, and fragmented.

The second generation of marketing reforms in the mid-1990s had the aim of “getting institutions right” through an indirect transformational role for the government. These reforms included expanding wholesale infrastructure and amending private wholesale regulations. The reforms have had very limited impact, however. For example, the Model Marketing Act, which was expected to pave the way for organised marketing and processing, has been only partially adopted by state governments.

Indian agriculture is also seeing the emergence of commercialisation, regardless of farm size and market development. Though the marketable surplus of all commodities has increased (Table 4) for all farm categories, smallholders encounter four key marketing constraints in comparison to large farmers (Delgado, 1999; Escobal *et al.*, 2000; Joshi *et al.*, 2007):

- Relatively lower marketable surplus.
- Lower bargaining power in influencing output prices.
- Higher transaction costs.
- Greater price volatility, especially of perishable commodities.
- Underdeveloped markets in smallholder-dominated areas.

These factors escalate production and marketing risks considerably and are often devastating for smallholders.

TABLE 4. MARKETABLE SURPLUS OF MAJOR CROPS IN INDIA

Crop (1)	<i>(per cent)</i>		
	1999-2000 (2)	2005-2006 (3)	2011-2012 (4)
Rice	61.7	71.2	77.2
Wheat	56.5	54.9	70.0
Maize	67.3	80.0	83.3
Pigeon pea	63.5	77.8	81.5
Chickpea	71.8	94.0	85.3
Cotton	83.8	94.1	98.4
Onion	98.5	82.9*	75.4
Potato	47.6	80.7	77.4

*Source:* Government of India (2012c), *Agricultural Statistics at a Glance*, Ministry of Agriculture, New Delhi.

\*Refers to 2004-05.

Studies have shown that the share of output marketed is less than that for medium and large farmers (Borate *et al.*, 2011; Grover *et al.*, 2012; Reardon *et al.*, 2012; Sarkar *et al.*, 2012; Tuteja, 2013).<sup>6</sup> The lower share and volume of marketable surplus and heterogeneous products are a disadvantage to smallholders due to high transaction costs and lack of bargaining power. In the case of perishable commodities such as potato, onion, and fruits and vegetables, smallholders are deprived of cold storage facilities (Basu and Dinda, 2003; Singh and Ahmad, 2008), leading to high post-harvest losses and preventing them from taking advantage of higher off-season prices. The large farmers are able to do away with middlemen and directly store their produce in the cold storage, taking advantage of delayed sales, off-season sales, or both, while smallholders are not able to get remunerative prices due to distress sales. Smallholders also lack their own means of transport, have no access to remunerative marketing channels, and are victims of unusually delayed payments, leading to greater transaction costs. Nor do they have lack access to advances and credit to buy inputs against the stored commodity, if any, as collateral (Das Gupta *et al.*, 2010b).

Other factors that deter smallholders from efficient marketing of their produce are the absence of markets and market information. They incur high transaction costs, for instance, in collecting market information, negotiating, and monitoring and enforcing business transactions (Jaffee and Morton, 1995).<sup>7</sup> The major factors influencing transaction costs are the types of production and marketing institutions involved, asset-specificity, uncertainty, and externalities (BIRTHAL *et al.*, 2005). The transaction costs can be pared down through organised and consolidated production and marketing of agricultural commodities. Uncertainty in transactions also influences the cost of searching for information, screening, negotiating, bargaining, and monitoring. The higher the uncertainty, the higher is the cost of renegotiating the contract.

Earlier studies have shown that innovative institutional arrangements substantially reduce transaction costs of smallholders (BIRTHAL *et al.*, 2005).<sup>8</sup> The transaction costs of farmers engaging directly with the firm were few due to savings in time, and transportation costs as well as access to market and price information. Literature reveals that access to markets and information about new technologies at negligible costs motivate farmers to participate in innovative institutional arrangements. Unfortunately, there are few successful examples of linking farmers with direct markets.

### *Institutional Finance*

Financing is an important driver for the growth of the agriculture sector. The timely availability of money at reasonable interest rates, especially for smallholders, is critical for inclusive and sustainable agricultural growth. Studies have shown that smallholders lack the financial resources to improve land or purchase crop insurance and have limited access to formal credit (Singh, 2014). Neither do they have enough of their own resources to invest nor do they have access to financial markets. Exposure to different types of shocks and risks traps them in a cycle of poverty (Carter, 2008; Rahman and Smolak, 2014).

During the Green Revolution period, nationalised banks considered agriculture a 'priority sector' for lending purposes in order to make credit easily accessible to farmers and facilitate their adoption of improved technologies. Though the government has been making efforts since 2003-04 to increase the credit flow in agriculture (Table 5), about two-fifths of rural households depend on informal credit.<sup>9</sup> The report of the Task Force on "Credit Related Issues of Farmers" (India, Ministry of Agriculture 2010) states, "... in recent years, policy interventions have led to doubling of agricultural credit, but the limited access of small and marginal farmers to institutional credit continues to be a matter of concern".

It appears that the institutional credit network has not spread adequately in rural areas to benefit smallholders. Cooperatives and commercial banks are the dominant agencies in rural areas. Only 27 per cent of smallholders have bank accounts in scheduled commercial banks, leaving about 73 per cent of them to rely on informal

TABLE 5: CREDIT FLOW TO AGRICULTURE SECTOR IN INDIA BY AGENCY

Year (1)	Co-op banks (Rs. billion) (2)	Regional rural banks (Rs. billion) (3)	Commercial banks (Rs. billion) (4)	Total including other sources (Rs. billion) (5)	Credit disbursed (Rs.)	
					Per holding (6)	Per ha (7)
2000-01	207.18	42.20	278.07	528.27	4405	3313
2005-06	394.03	152.23	1254.77	1084.85	13967	11400
2010-11	781.21	442.93	3458.77	4682.91	33849	29343
2011-12	879.63	544.50	3683.16	5110.29	36938	32021
2012-13	1122.03	636.81	4324.91	6073.75	43902	38058

Source: India Stat.

Note: ha = hectare.

sources for credit.<sup>10</sup> In contrast, 85 per cent of all medium and large farmers own bank accounts in commercial banks. Smallholders received about 55 per cent of the total credit during 2006-07 (Government of India, 2010; a large share (70 per cent) of this credit was short term. On a per holding basis, smallholders received mere Rs. 3,976, while it was Rs. 41,838 for large farmers and Rs.16,718 for medium farmers (Table 6).<sup>11</sup> Both demand and supply side factors determine the credit to smallholders. On the demand side, it is argued that smallholders often prefer a more labour-intensive, as opposed to capital-intensive, production portfolio; such a portfolio requires less credit. On the supply side, the high transaction cost is a disincentive for banks to disburse credit to a large number of smallholders. Smallholders feel that inadequate and untimely credit, along with procedural hassles from formal institutional sources, are hurdles (Pradhan, 2013). Lack of banking information and financial illiteracy among smallholders is also leading to low financing. *Kissan* Credit Cards and the recently introduced RuPay Debit Card (RDC) will play important roles in alleviating supply- and demand-sided constraints.

TABLE 6. ESTIMATED DISBURSEMENT OF INSTITUTIONAL CREDIT BY RECEIPIENT HOLDING SIZE

Holding size (1)	Short-term (Rs. billion) (2)	Medium-term (Rs. billion) (3)	Long-term (Rs. billion) (4)	Total credit (Rs. billion) (5)	Credit per holding (Rs.) (6)	Credit per ha (Rs.) (7)
Small	324.17	91.96	51.55	467.68	3976	6572
Medium	194.44	64.23	75.69	334.36	16718	4776
Large	21.39	9.20	15.24	45.83	41838	2450
All farms	550.00	165.39	142.48	857.87	3983	4455

Source: India, Ministry of Agriculture, 2006-07.

### Extension Services

Information about best farming practices, the weather, and prices is critical for farmers to make informed and better choices. It is widely felt that though the public sector played a crucial role during the Green Revolution period, in recent years its contribution is being excessively scrutinised and debated (Joshi *et al.*, 2005; Sontakki *et al.*, 2010)). Even though the public sector underwent a reforms process during the

last two decades the effectiveness and efficiency of the information delivery system has come under scrutiny and it has been unable to rise to the challenge of meeting its organisational goals and objectives (WGAE 2007; Raabe 2008; Glendenning *et al.*, 2010; Desai *et al.*, 2011). Government efforts toward improving the coverage of, access to, and quality of information provided to marginalised and poor farmers was reported to be unequal and unsatisfactory (Glendenning *et al.*, 2010). According to a “Situation Assessment of Indian Farmers,” only 28 per cent of all farmers use any kind of agriculture-related information (Negi *et al.*, n.d.). A large chunk (72 per cent) of farmers, especially smallholders and other vulnerable groups, do not benefit from any source of information delivery system.

The public sector and government agencies have been the main sources (48 per cent) of information, followed by social networks (29 per cent) and the private sector (23 per cent). Other studies reported that the majority of farmers (49-51 per cent) perceive bottlenecks in the timely availability of public sector-led extension services (Das Gupta, *et al.*, 2010b). However, those using the services, mostly large farmers (39-47 per cent), perceived no such bottleneck. Those accessing information from any source, particularly those with better access to public sources of information such as radio, television, and newspapers and with more than one source of information were found to be better off in terms of land ownership and irrigated area (Birthal *et al.*, n.d.). Those who used information got higher returns (12 per cent) compared to the non-users; they added Rs. 1,140 per ha of cropped area (2002-03 prices), which is much higher than the investment in agricultural research and extension (Rs. 186/ha) (Birthal *et al.*, n.d.). There is a need to strengthen the information and knowledge management and delivery systems in order to reach the last mile in the agricultural research and extension value chain, more so in marginal and backward areas dominated by smallholders. The private sector may be attracted to disseminating information in the favourable and better-off areas dominated by medium and large farmers.

### *Changing Food Baskets*

Food baskets are largely influenced by economic development, per capita income, and changing tastes and preferences. Globalisation and urbanisation are also changing food consumption patterns (Pingali 2004). The food basket of farmers in any developing country is largely influenced by their production of food commodities, purchasing power, and access to the public distribution system. Smallholders produce less while retaining a larger share for their own consumption in comparison to large farmers. According to the 68th Round of the National Sample Survey Organisation (NSSO) survey, smallholders were found to spend about 50 per cent of their total expenditure on food in contrast to 40 per cent by large farmers (NSSO, 2012). However, both small and large farmers have almost identical consumption patterns and trends. In both cases, the per capita consumption of cereals

has been declining and that of high-value commodities increasing, but the quantity varies.<sup>12</sup>

The NSSO data (Table 7) shows that smallholders are consuming more rice (more of carbohydrates and less of protein, iron and other essential micronutrients) while large farmers are eating more wheat, pulses, coarse cereals and milk (rich in protein, iron, and other micronutrients). Consequently, uptake of calorie, protein and other minerals such as calcium, iron, beta-carotene and zinc is lower among smallholders than medium and large farmers (Table 8). Such an imbalance and diet lacking in nourishment leads to several health issues such as anemia, stunting, and low body weight in children.

TABLE 7. PER CAPITA FOOD CONSUMPTION PATTERN BY SMALL AND LARGE FARMERS  
(kg/capita)

Food item (1)	Small holders (< 2 ha)		Large farms (> 4 ha)	
	1988 (2)	2011 (3)	1988 (3)	2011 (4)
Rice	108	89	68	45
Wheat	49	46	86	79
Other cereals	24	8	48	17
Total cereals	181	143	201	141
Pulses	10	10	17	12
Edible oils	4	7	6	10
Vegetables	51	55	48	48
Fruits	9	11	12	13
Milk	39	63	96	136
Sugar	9	10	18	18
Meat, fish, eggs	6	7	8*	10*

Source: Calculated from different National Sample Survey round report.

Note: \* included rural rich.

TABLE 8. CALORIES AND NUTRIENT INTAKE BY SMALLHOLDERS AND LARGE FARMERS

Item (1)	Unit (2)	Smallholder (3)	Large farmers (4)
Calories	kcal/capita/day	2194.0	2492.0
Protein	g/capita/day	60.0	70.2
Fat	g/capita/day	45.0	65.3
Calcium	g/capita/day	625.0	961.0
Iron	mg/capita/day	37.3	46.9
B-carotene	µg/capita/day	1700.0	2159.0
Zinc	mg/capita/day	9.9	10.2

Source: Calculated from different National Sample Survey round report.

Notes: g = grams; kcal = kilocalories; mg = milligrams.

About 17 per cent of people in India are still undernourished, the majority of whom live in rural areas and depend on agriculture. The majority of undernourished are smallholders as they do not have any other alternative livelihood opportunities. More than one-third of the children below five years of age are underweight. In fact, India has been ranked 120 among 128 countries in terms of underweight children due to undernourishment in 2013. The recent Global Hunger Index ranked India at 55th place out of 76 countries in 2014, with a higher number indicating greater severity of

hunger (von Grebmer *et al.*, 2014). Although there has been a noteworthy improvement in India's position in the Global Hunger Index since 2005, it is still way behind than many developing countries in Africa, East and Southeast Asia, and Latin America. This inter-country comparison shows that countries that are less dependent on agriculture attained better nutritional outcomes, implying that agriculture must be less crowded to improve nutritional outcomes, especially in rural areas.

### *Rural Poverty*

There is evidence of low income-generating opportunities, high dependency on agriculture for food and income security, and low agricultural productivity leading to poverty in India. Poor infrastructure and weak institutional arrangements are also contributing factors. The question arises whether crowding in agriculture has any implications on poverty. To test this, we delineated Indian states into four categories based on the crowding of agriculture and extent of poverty:

- Low crowding and low poverty.
- Low crowding and high poverty.
- High crowding and low poverty.
- High crowding and high poverty.

It may be observed that with a few exceptions, states with a higher concentration of smallholders have also high levels of poverty (Table 9).<sup>13</sup> These states were largely confined to eastern India (Bihar, Odisha, Uttar Pradesh, West Bengal, and Jharkhand), northeast India (Mizoram, Meghalaya and Tripura), and central India (Madhya Pradesh and Chhattisgarh).

TABLE 9. MATRIX OF SMALLHOLDERS AND POVERTY IN DIFFERENT STATES IN INDIA

		Poverty	
		Low (< 30 per cent)	High (> 30 per cent)
Smallholders	Low (< 85 per cent)	Gujarat, Haryana, Karnataka, Meghalaya, Maharashtra, Nagaland, Punjab, Rajasthan and Sikkim	Arunachal Pradesh, Jharkhand, Madhya Pradesh, Manipur and Chhattisgarh
	High (> 85 per cent)	(22 per cent smallholders and 21 per cent poverty)	(10 per cent smallholders and 17 per cent poverty)
		Andhra Pradesh*, Goa, Himachal Pradesh, Jammu and Kashmir, Kerala, Mizoram, Tamil Nadu, Tripura and Uttaranchal	Assam, Bihar, Odisha, Uttar Pradesh and West Bengal
		(25 per cent smallholders and 11 per cent poverty)	(43 per cent smallholders and 51 per cent poverty)

*Note:* Figures in parentheses are the share in all-India value.

\*Includes Telengana.



These states have 53 per cent of smallholders and account for about 70 per cent of poor people. Agriculture in these states is largely at subsistence level. These states (with some exceptions of northeastern states) are also way behind than other states in Human Development Index (HDI), rural literacy, and availability and access to toilets (Table 10).<sup>14</sup>

TABLE 10. SMALLHOLDER PRESENCE AND KEY SOCIAL DEVELOPMENT INDICATORS

State (1)	Smallholders (per cent) (2)	Poverty (per cent) (3)	Rural literacy (per cent) (4)	Rural toilets (per cent) (5)	Urbanisation (per cent) (6)	Human development index (7)
Andhra Pradesh*	86	14	67	46	40	0.47
Arunachal Pradesh	35	37	77	87	40	0.57
Assam	86	41	86	86	31	0.44
Bihar	97	41	89	27	40	0.37
Chhattisgarh	80	48	77	23	34	0.36
Goa	89	6	38	90	13	0.62
Gujarat	66	27	57	41	28	0.53
Haryana	67	13	65	75	29	0.55
Himachal Pradesh	87	11	90	74	18	0.65
Jammu & Kashmir	95	15	73	56	37	0.53
Jharkhand	84	42	76	9	39	0.38
Karnataka	76	22	61	29	31	0.52
Kerala	98	11	52	97	7	0.79
Madhya Pradesh	71	44	72	21	36	0.37
Maharashtra	78	20	55	46	23	0.57
Manipur	83	47	70	99	24	0.57
Meghalaya	76	24	80	95	30	0.57
Mizoram	87	27	48	99	16	0.57
Nagaland	15	14	71	100	25	0.57
Odisha	92	46	83	19	30	0.36
Punjab	34	11	63	78	29	0.60
Rajasthan	58	22	75	27	39	0.43
Sikkim	76	18	75	100	21	0.57
Tamil Nadu	92	22	52	34	27	0.57
Tripura	96	25	74	99	15	0.66
Uttar Pradesh	91	40	78	80	24	0.49
Uttaranchal	92	18	69	25	35	0.38
West Bengal	96	30	68	60	28	0.49
All India	85	30	69	41	32	0.47

\*Includes Telangana.

When the states are ranked in ascending order of HDI (Institute of Human Development, 2011), the social development profiles of the lowest human development quartile group underline the need for economic growth and promotion of literacy to realise poverty alleviation and food security. Average landholdings in these states are too small to generate enough income, and the smallholders do not have access to adequate and assured services, markets, and finances.

The other group of states with a relatively lower concentration of poor people but where agriculture is crowded by smallholders, are the three northeast hill states (Himachal Pradesh, Jammu & Kashmir, and Uttarakhand) and four major southern

states. These classifications clearly imply the futility of a “one size fits all” agricultural policy; on the contrary, regionally differentiated agricultural policies and strategies are required. The highly crowded and high poverty states would require a major shift of work from agriculture to non-agriculture coupled with the promotion of a high remunerative production portfolio and relatively more labour-intensive interventions.

#### IV

##### CLIMATE RISK TO INDIAN AGRICULTURE

Indian agriculture is subject to four types of risks: production risk; market and price risks; government policies; and climatic risks. The first three have been well documented. Production risks arise from changing weather conditions and the growing menace of insects, pests, and diseases. Their extent and intensity is increasing and adversely affecting the production and incomes of farmers. Marketing risk encompasses a fall in prices due to increased supply or decreased consumer demand; loss of market access due to the relocation or closing of a processor or other buyer; and lack of marketing power due to the small farm size relative to others in the market (<http://nevegetable.org/big-five-types-agricultural-risk>). There is historical evidence of the volatility of food prices, especially of perishable commodities, with smallholders often being the victims of a price crash in the event of overproduction. Their problem is amplified by the lack of resources to avail of storage facilities and other risk mitigating tools such as agricultural insurance, hedging, warehouse receipts, and so on.

In this paper, we focus on risk arising due to climate change. The agriculture sector, which is already facing multiple stresses, is highly climate sensitive and projected to face disproportionate adverse impacts (IPCC 2014a). The smallholders have the least capacity to overcome the consequences due to their poor resource base to adapt to climate change and are likely to be the worst affected. Ensuring the food security of an increasing number of smallholders and growing population in a scenario of unpredicted climate change is a major policy challenge. Obviously, food security will depend on the capacity of the smallholders to adapt to the current and projected accelerated pace of climate change.

It has been reported that climate change will pose a serious threat to food and nutritional security. Changing rainfall patterns, droughts, and floods have in the past adversely affected food production and led to agrarian distress, often leading to indebtedness by farmers and sometimes suicides in some regions. An increase in the incidence of such extreme events, including rises and falls in temperature and frost, have setback technological advances and adversely affected agricultural production. Smallholders are likely to be the worst hit since they are least equipped because of limited resources to adapt (socially, technologically, and financially) to climate change. There is increasing evidence that rising temperature and changing rainfall

patterns will escalate the frequency and intensity of droughts and floods. The rise in annual mean surface air temperature by the end of the century is projected to be in the range of 3.5°C to 4.3°C (Government of India, 2013). It is also projected that India may experience intense rainfall, leading to massive soil erosion and landslides.<sup>15</sup>

#### *Impact on Vulnerability*

Agriculture, and consequently those depend on it, are more vulnerable to climate change.<sup>16</sup> Recently, Rama Rao *et al.*, (2013) developed a vulnerability atlas for 572 districts in India. The key observations are: (i) very high vulnerability occurs in Rajasthan, Uttar Pradesh, Madhya Pradesh, Bihar, Gujarat, Karnataka, and Maharashtra; (ii) the major exposure factors in Rajasthan and Uttar Pradesh are the projected rise in minimum temperature and decrease in July rainfall, whereas the increase in number of drought years was an additional factor in Madhya Pradesh and Karnataka; (iii) Decrease in July rainfall is the major exposure factor in Bihar, while rise in minimum temperature and increased number of drought years are the factors for vulnerability in Maharashtra; and (iv) the vulnerability was compounded by low livestock density in Punjab, while the major exposure factor is high poverty in Bihar and Uttar Pradesh.

It further highlighted that decline in the groundwater table and a fall in irrigated area is the major constraints to adaptive capacity across the vulnerability classes. A quantitative analysis of exposure, sensitivity, and adaptive capacity on a scale of 0-5 showed that as one traversed from west to east, the exposure and sensitivity increased, whereas adaptive capacity decreased, resulting in increased vulnerability (on a 0-4 scale) (Sehgal *et al.*, 2013). In Punjab and Haryana, it is the high adaptive capacity, largely due to irrigation, but also improved by higher use of chemical fertiliser, a higher degree of electrification, and a better rural road network as compared to Uttar Pradesh, Bihar and West Bengal, which have reduced their vulnerability.

#### *Impact on Agricultural Production*

Agricultural systems are managed ecosystems with a high dependence on climatic conditions. Since smallholders have a poor resource base, their dependence on functioning of natural ecosystems is very high. Therefore, in the absence of adaptive measures, smallholders are more sensitive to rising temperatures, disturbed precipitation patterns, and increasing incidence of pests and diseases. The negative impacts of climate change may be reflected in reduced agricultural productivity, since farming is highly climate dependent. Among the various projections of the effects of climate change on crops and livestock in different zones are a rise in temperature causing a 10-40 per cent loss in crop production by the end of the century (Aggarwal, 2009; Nelson *et al.*, 2010; Knox *et al.*, 2012) and a rice yield loss of 4-20 per cent

under irrigated conditions and 35-50 per cent under rainfed conditions by 2030 (INCCA, 2010).<sup>17</sup> Earlier estimates by Cline (2007) show a 30-40 per cent loss in agricultural production in India. For milk, the negative impact of global warming has been estimated to be about 1.6 million tonnes in 2020 and more than 15 million tonnes in 2050 (Upadhyay *et al.*, 2009). Capture fisheries are likely highly vulnerable to climate change because of their dependency on the productivity of natural ecosystems. A number of processes are climate mediated, such as changing precipitation, melting of snow, and a rising sea level, which will disrupt the hydrology and affect fish production. However, the increased flooding has the potential to increase fishery yields (INCCA, 2010). Other arguments are that the flood mitigation measures to protect agriculture may result in reduced flooding and lower fisheries productivity (Easterling *et al.*, 2007).

#### *Impact on Water Resources and Health*

The recent IPCC report AR-5 reconfirms that tropical Asia will have serious drought and flood episodes at frequent intervals (IPCC, 2014a). It also suggests impacts such as water shortages and the outbreak of water and mosquito-borne diseases. India and China have been included among the many countries that are highly vulnerable, with consequences such as the slowing down of economic growth, a negative impact on human health, and hindering poverty reduction and food security (IPCC, 2014b). Indications are that this will adversely affect the government's determination to increase agricultural production and ensure food security in smallholder-dominated areas through higher investment in agriculture and social safety net programmes.

#### *Impact on Food Prices and Poverty*

The projections reveal that extreme climate events could influence poverty by affecting agricultural productivity and raising prices of staple foods that are important to poor households in developing countries (Ahmed *et al.*, 2009). In a recent study, de Janvry and Sadoulet (2009) found that rural poor households constituted about 77 per cent of those who are negatively impacted by doubling of food prices between mid-2006 and 2008. Kumar *et al.*, (2014) estimated the impact of drought on supply and prices of and demands for major food commodities. The prices of food commodities show a significant inflationary trend under the free market of demand and supply. Rice, being a staple commodity, will witness an increase in its prices of as much as 23 per cent, followed by increases in maize (16 per cent), sorghum and pearl millet (13 per cent each), pigeon pea (10 per cent), and groundnut and cotton (about 5 per cent each) due to 10 per cent drought. Higher deficit rainfall will have much higher impact on increasing inflation of agricultural commodities and adversely affect their demand. Rice demand will fall by about 5.5 per cent due to an increase in

prices in a situation of 10 per cent drought. For other food commodities the demand will decline by about 2 to 4 per cent in 2020. Projections show that a 20 per cent drought may cause a demand-supply gap in rice to the tune of 15 million tonnes. The projected huge deficit will have two serious implications: (i) global food prices will significantly shoot up as India would import to meet its demand; and (ii) the food security of the poor in India will suffer, and many will be dragged into a poverty trap due to a rise in food prices.

The impact of climate change will not remain confined to food production only but is likely to affect other aspects of the food system—including availability of food, access to food, utilisation of food, and stability of food supplies over time—in far-reaching ways. This will lead to a downward trend in human development indicators such as health and education (FAO, IFAD, and WFP, 2014). The smallholders, whose farming largely depends on rainfall and who are deprived of basic human development amenities, are more vulnerable to any climate change event. Limited access to financial options also limits smallholders' capacity to absorb shocks during adverse times (Fan *et al.*, 2013).

Climate change is likely to have a vast impact on the availability of food, its access, its use and the stability of supply over time leading to a downward trend in human development indicators such as health and education (FAO, IFAD, and WFP 2014). At the global level, there are projections that climate change will cause an additional 600 million smallholders to face acute malnourishment by 2080 (UNDP 2008). Unfortunately, the smallholders, whose farming largely depends on rainfall, will be highly vulnerable to any climate change event, further exacerbated by their limited access to financial options to absorb shocks (Fan *et al.*, 2013).

This evidence indicates that climate change will adversely affect the government's determination to increase agricultural production and ensure food security in smallholder-dominated areas through higher investment in agriculture and social safety net programs. India has laid particular emphasis on climate change adaptation in agriculture—unlike global climate policy, where agriculture is not in focus. Subsidy has been used as a mechanism for promoting adaptation in development programs, and policy statements are quite elaborate, but their implementation mechanisms are often missing.

#### V

#### A TALE OF TWO MOST CROWDED AGRICULTURAL STATES<sup>18</sup>

This section illustrates the case of Bihar and Odisha, two prominently agrarian states classified as being the most backward and poverty ridden (the poverty rate in Bihar is 41 per cent and in Odisha is 46 per cent) and having a high concentration of smallholders (97 per cent in Bihar and 92 per cent in Odisha).<sup>18</sup>

The states are characterised by low productivity, inadequate infrastructure, complex social stratification, and weak institutional capacities. These states are

trapped in a vicious cycle of “low input-low output agriculture.” Farming is mostly traditional and less intensive with limited resources. Agriculture in these states is still characterised as subsistence-level, inefficient, and risky. Concurrent floods, droughts, and numerous pests and diseases are some of the challenges faced by farmers. Due to low urbanisation (11 per cent in Bihar and 17 per cent in Odisha), there are few alternative income opportunities. However, the states are blessed with plenty of rainfall, sufficient groundwater, favourable soils, sunshine, and labour, which are the key drivers for the agriculture sector.

In Bihar, the share of agriculture has declined from 48 per cent in triennium ending (TE) 1995 to 26 per cent in TE 2011. The corresponding values for Odisha were 45 per cent and 20 per cent, respectively. Nearly 77 per cent of the total workforce in Bihar and about 65 per cent in Odisha depend on agriculture for their subsistence. Limited off-farm employment and low urbanisation have forced the poor to depend on agriculture for a livelihood. About 97 per cent of all holdings in Bihar and 92 per cent in Odisha were small (<2 ha) in 2011. Smallholders occupy 76 per cent of the area in Bihar and 70 per cent in Odisha, with the average landholding being a mere 0.3 ha in Bihar and 0.8 ha in Odisha.<sup>19</sup> Absentee land owners, tenancy and sharecropping impede the adoption of improved technologies and discourage investment in agriculture in both states.

The crop sector is the principal source of output in both the states. Its share in the total value of agricultural output was 58 per cent in Bihar and 70 per cent in Odisha. Rice is the main staple crop with respect to area. Rice yields in Bihar were very low (1,662 kg/ha), compared to the all-India level (2,168 kg/ha) in 2009. Yield gaps are astonishingly high, ranging between 131 per cent and 300 per cent.<sup>20</sup> Low seed replacement rate (<15 per cent), poor land and water management, high risk due to biotic and abiotic constraints, and increasing intensity of climate change are the important reasons for low yields.<sup>21</sup>

Cropping intensity is low at 136 per cent in Bihar and 124 per cent in Odisha. A large operated area (3.7 million ha) during the winter season remains fallow. This constitutes nearly a third of all rice-fallow land, which is largely confined to the eastern India. This large area could not be utilised due to abiotic constraints like low residual moisture and terminal drought; lack of short-duration rice varieties; lack of inputs and cash to buy seeds and inputs; poor access to information on varieties available and management practices; crop damage due to grazing; and high production and price risks due to inaccessible markets (Joshi *et al.*, 2002).

In both Bihar and Odisha, financial, insurance, and marketing institutions have been unable to deliver effectively due to overcrowding of agriculture. The institutions are very weak and thinly distributed. In addition, the thinly spread and underdeveloped agricultural markets are one of the important constraints in accessing markets and leading to a lower price of farmer produce. Bihar has only 62 markets per thousand square kilometers under the state agricultural marketing board, while

there are 35 markets in Odisha, all inadequately equipped in terms of infrastructure such as cold storage, warehousing, grading facilities, and other public utilities.

The Agriculture Produce and Market Committee (APMC) Act has not been implemented in both the states, and the organised private sector's entry into marketing of agricultural commodities is rare. However, in Odisha, the APMC Act was amended to increase effectiveness, bring about liberalised reforms, and encourage the private sector to develop markets. Though there are provisions for direct marketing, contract farming, and so on, private investment has not taken place as expected because markets are underdeveloped and provisions of the Model Marketing Act are not effectively and fully enforced.

Credit delivery is weak in both the states due to the inadequate distribution of banking facilities. There are reports that one bank branch in Bihar serves four times the population of its counterpart in Punjab (NAAS, 2010). The situation is no different in Odisha, where the credit delivery status is lagging behind that of agriculturally advanced states such as Punjab, Haryana, Andhra Pradesh, and Karnataka. Similarly, the insurance sector is in its infancy in both the states, where flood and drought regularly damage agricultural crops. In Bihar, less than 6.5 per cent of the area is covered under agriculture insurance.

Electrification, which is crucial for agro-processing, is underdeveloped in both the states, with only 52 per cent of the total inhabited villages electrified in Bihar and 60 per cent in Odisha, much lower than the all-India level (81 per cent) by 2008.<sup>22</sup> Low power availability constrains groundwater development and the entry of the private sector into agri-business. Though both states have plenty of surface and groundwater that is under utilised, the irrigation system is inefficient and underdeveloped. Over 60 per cent of the cropped area in Bihar is irrigated but irrigation efficiency is low, as indicated by the low irrigation intensity (137 per cent). Only 40 per cent of the groundwater has been exploited in Bihar.

As far as opportunities are concerned, the states are diversifying in favour of high-value agriculture. The share of high-value commodities in the total value of agriculture was as high as 60 per cent in Bihar and 50 per cent in Odisha during 2010-2011. A sector-wise disaggregation shows that while livestock is gaining in popularity in Bihar, it is fruits and vegetables in Odisha. Smallholders in these states with an abundance of family labour benefit from these commodities, which bring relatively higher profits than cereals and pulses and suit the needs of smallholders and their resource endowments. Lessons can be learnt by scaling up public sector initiatives such as *Udayan Fresh* in Odisha, and *Sudha* dairy in Bihar, and private-sector initiative such as *ase-Kuteer* in Odisha, and *Kaushalendra Foundation* in Bihar to integrate the large number of smallholders growing fruits and vegetables and involve them in the entire value chain. High-value commodities are pro-poor, with enormous scope to contribute toward income and employment opportunities for smallholders.

The livestock sector has multiple benefits. It provides a regular income and mitigates risk during drought. The Bihar State Cooperative Federation (COMFD) and

Odisha State Cooperative Milk Producers' Federation Limited (OMFED) are making significant contributions to the production, procurement, processing, promotion and marketing of milk and milk products for the economic uplift of resource poor farmers. Appropriate market linkages to promote livestock and horticultural commodities will go a long way in achieving inclusive agricultural growth.

Agro-processing offers huge opportunities in these states but suffers from several constraints such as grossly inadequate capacity and huge postharvest losses (ranging from 15 per cent to 50 per cent) of fruits and vegetables due to the absence of pre-cooling, grading, sorting, processing, and pack-house facilities. Non-availability and irregular power supply is another major limitation. Alleviating the power constraint will substantially change the agro-processing sector and attract the organised private sector to develop modern processing plants.

The challenges and opportunities in these highly crowded states show that appropriate actions will contribute to accelerating inclusive and sustainable agricultural growth. There is need to reform the agricultural sector, invest in agriculture, bridge yield gaps, promote agricultural diversification, strengthen agricultural markets, improve infrastructure, and create huge employment opportunities outside the agriculture sector.

## VI

### OPPORTUNITIES FOR SMALLHOLDERS

Crowding in agriculture and reducing poverty are possible with new jobs within and outside the agriculture sector. In the short term, a beginning could be made by bridging the yield gaps of major commodities and promoting high-value agriculture to increase incomes of a large number of smallholders. Success would depend on the efficacy of connecting production centers with back-end service providers and remunerative output markets. In the medium and long terms, either or both pathways may be followed: developing the food processing sector to generate agri-based income and employment opportunities and improving skills so that a chunk of the agrarian population is absorbed in the service and manufacturing sectors.

#### *Bridge Yield Gaps*

There are huge yield gaps between the best available practices and the farmers' actual yields. Regions with a large concentration of smallholders obtained lower yields, especially of cereals. At the all-India level, the difference between attainable and actual yield for rice was 2.8 tonnes per ha and for wheat it was 2.6 tonnes per ha (World Bank 2014). These can be very well attained through improved seeds and better management practices. Smallholders face numerous constraints such as inadequate access to improved seeds, information, markets, and finance to achieve potential yields.<sup>23</sup> They are also deprived of adequate and assured irrigation facilities.



The earlier debate on farm size productivity, however, revealed that given the same environment, smallholders are more efficient than large farmers. However, since smallholders are concentrated in more vulnerable areas with high risk and inadequate infrastructure, their yield levels are much lower than those of their counterparts in favourable areas. The vicious cycle of low crop yields, tiny marketable surpluses, low income, scant investment in agriculture, and high poverty continues in regions where smallholders dominate. A recent report from the World Bank (2014) argued that improving farm productivity should be the Indian government's prime goal, with a greater focus in eastern India where there is high concentration of smallholders. Bridging yield gaps and increasing crop yields, especially of cereals (for food security) will release some of the land for commodities that are more remunerative and increase the incomes of smallholders.

There is also considerable scope of increasing cropping intensity. The average cropping intensity at all-India level is mere 137 per cent. In states such as Bihar (136 per cent), Odisha (127 per cent), and Chhattisgarh (121 per cent), the cropping intensity was lower than the national average. In contrast, cropping intensity was high in Punjab (197 per cent) and Haryana (191 per cent). Limited irrigated area, non-availability of location-specific cultivars for different crops, and lack of resources and finance are the main reasons for lower cropping intensity in smallholder-dominated areas.

To address future challenges, agricultural research and extension will play an important role. Unfortunately, research and extension investment in smallholder-dominated agriculture is far below that in favourable areas. For example, research and extension investment was less than Rs. 10 per thousand people in Bihar, Madhya Pradesh, Odisha, Uttar Pradesh, and West Bengal. It is disappointing that the research and extension investment (2004-05 prices) in all these states, except West Bengal, has declined between 2001 and 2010.

Regionally differentiated improved technologies are already available for adoption. High-yielding varieties, cost-saving soil and water management techniques, labour-saving farm mechanisation, and land reclamation technologies are available for different rainfall regimes and soil conditions (Birthal, 2013). A new concept of "climate smart agriculture" is being advocated to increase farm yields and income, reduce climatic risk, and mitigate greenhouse gas emission and improve carbon sequestration. Stress-tolerant varieties, conservation agriculture, laser land leveling, soil test-based nutrient management, and improved water management practices are some of the technological components of climate smart agriculture. It also includes value-added weather advisories using information and communication technology (ICT) tools and agricultural insurance to guard against climatic risks. It is time that the government allocates sufficient resources to promote climate-smart agriculture in order to attain the twin objectives of increasing farmers' food and income security and minimising risk against any climatic threat.

### *High-Value Agriculture*

Growing demand for high-value commodities (such as horticulture, livestock, and fish) offers enormous opportunities for smallholders. Earlier studies have demonstrated a positive association between high-value agriculture and poverty alleviation (Barghouti *et al.*, 2007; BIRTHAL *et al.*, 2014; BIRTHAL *et al.*, 2015). The consumption of meat, eggs, and fish is projected to increase by more than 100 per cent and that of fruits, vegetables, and milk by approximately 90 per cent between 2000 and 2025 (Kumar *et al.*, 2007). Cereal consumption during the same period is projected to increase by around 33 per cent. High-value commodities bring higher, quicker, and more regular returns to farmers compared to cereals (Joshi *et al.*, 2003; BIRTHAL *et al.*, 2005; Joshi *et al.*, 2007). At the national level, the share of high-value commodities in the value of agricultural output increased from 24 per cent in 1990-91 to about 42 per cent in 2010-11. The livestock sector grew faster; its share is now more than 25 per cent. Since they are labour intensive, smallholders have an advantage given the abundant family labour they can garner. However, growing wages in rural areas and rural-urban migration may soon deprive smallholders of this advantage.

We grouped the states based on the number of smallholders and the share of high-value commodities in the total value of agricultural output. It was observed that states with a higher concentration of smallholders have a higher share of high-value agriculture in the total value of agricultural output.<sup>24</sup> Eastern India (Bihar, Jharkhand, Odisha and West Bengal); southern India (Andhra Pradesh and Tamil Nadu); central India (Madhya Pradesh and Chhattisgarh); the northeast hill region (Meghalaya, Mizoram, Sikkim, and Tripura); and the northwest hill region (Himachal Pradesh, Jammu & Kashmir, and Uttarakhand) are overcrowded and largely depend on high-value commodities to generate income opportunities (Table 11). These states account for a 40 per cent share of the total value of the country's high-value commodities.

It appears that farmers in these states produce cereals and pulses for their own food security and high-value commodities for income opportunities. The problem with high-value commodities compared to cereals is that the former are riskier to produce and market; are more vulnerable to many biotic and abiotic stresses; and have thin, fragmented, and distant markets. This is in addition to the high volatility in their prices (Joshi *et al.*, 2007). In the absence of cold storage facilities and refrigerated chains, the markets are not well integrated, leading to high price fluctuations. A small increase in their supply in local markets can lead to a steep fall in their prices. So the success of promoting high-value agriculture in smallholder-dominated areas will depend on how markets are developed and mechanisms are evolved to connect farmers to remunerative markets.

TABLE 11. STATE WISE CONTRIBUTION OF LIVESTOCK AND ALL HIGH-VALUE COMMODITIES IN TOTAL VALUE OF AGRICULTURAL COMMODITIES

State (1)	<i>(per cent)</i>					
	Share of smallholders		Share of livestock in value of agricultural output		Share of all high-value commodities in value of agricultural output	
	1990-91 (2)	2010-11 (3)	1990-91 (4)	2010-11 (5)	1990-91 (6)	2010-11 (7)
Andhra Pradesh*	77.30	86.09	23.24	30.73	34.03	45.20
Arunachal Pradesh	35.10	37.32	4.69	19.15	15.24	30.98
Assam	82.50	85.57	9.20	11.96	36.09	37.22
Bihar	89.70	96.92	26.80	37.43	40.99	59.53
Chhattisgarh*	N.A.	80.45	N.A.	20.34	0.00	43.58
Goa*	91.70	93.45	15.03	10.82	32.75	36.40
Gujarat	52.30	66.01	18.93	22.90	26.66	34.82
Haryana	60.50	67.58	27.64	31.57	30.08	38.44
Himachal Pradesh	83.10	87.92	21.88	21.83	46.30	62.51
Jammu & Kashmir	90.30	94.78	18.16	24.97	43.92	60.59
Jharkhand	N.,A.	84.06	N.A.	22.95	0.00	52.91
Karnataka	66.70	76.44	16.10	16.53	40.26	37.46
Kerala	97.80	98.96	21.61	21.74	35.30	33.84
Madhya Pradesh	60.10	71.45	22.35	23.87	27.87	34.66
Maharashtra	63.40	78.53	18.18	17.69	37.99	33.64
Manipur	83.10	83.38	28.55	19.58	38.84	45.28
Meghalaya	64.70	81.35	27.88	25.15	57.64	47.29
Mizoram	83.90	87.03	17.89	15.22	30.02	39.03
Nagaland	24.30	15.75	20.98	22.37	38.59	36.16
Odisha	79.80	91.85	9.22	18.34	34.95	49.61
Pondicherry	90.66	94.08	21.35	30.74	29.11	35.78
Punjab	44.80	34.19	27.69	31.09	31.02	38.54
Rajasthan	49.70	58.40	37.74	37.11	38.76	39.22
Sikkim	71.20	76.63	13.47	15.07	29.05	44.44
Tamil Nadu	89.00	91.00	24.26	33.77	38.86	52.64
Tripura	89.50	94.92	12.89	14.01	31.72	43.73
Uttar Pradesh	89.30	92.37	21.11	26.44	29.92	39.91
Uttaranchal	N.A.	79.93	N.A.	24.83	0.00	46.27
West Bengal	91.40	95.92	24.52	20.06	46.18	52.02
All India	78.20	84.98	21.25	25.41	33.91	42.12

Source: Government of India (2013).

\*includes Telangana. N.A.-not available.

### *Institutional Innovations*

Smallholders cannot capitalise on economies of scale due to their tiny landholdings. Institutional innovations such as self-help groups, cooperatives, contract farming, cluster farming, and farmer producer companies that have emerged in the last decade can help in this matter. Most of the innovations are led by the private sector, following the Government's initiation of pro-poor policies. Amending the APMC Act, promoting farmer producer companies, allowing contract farming, strengthening cooperatives, and enabling the concept of warehouse receipts can attract the private sector to link farmers in production or marketing or both.

Literature is replete with instances of the success of contract farming and cooperative models. For instance, the Gujarat milk cooperative model's success led

India to become the largest milk producer in the world. The model gathered numerous members to collect milk and linked with modern value chains to sell milk and milk products. A majority of milk cooperatives are dominated by smallholders. Similarly, contract farming has been highly successful in the poultry sector. The model has facilitated vertical integration by involving smallholders in “asset building” through procurement, market information, education, credit disbursement, extension services, etc., so that they may gainfully participate in the emerging urban food markets. The poultry sector was the fastest growing sector during the last decade, with an annual increase of 8-10 per cent in egg and broiler production. As a result, India became the fifth largest producer of eggs in the world. The corporate sector has played an extraordinary role in developing an efficient model of vertical integration from farm-to-fork. These models increased production efficiencies and incomes, assured markets, and reduced production and market risks.

Successful contract farming models in *basmati* rice, maize, fruits, and vegetables led by the private sector have delivered high dividends to farmers in the form of reduced transaction costs and greater incomes (BIRTHAL and Kumar, 2009). However, the contract farming models were successful only where the private sector was retailing the produce, adding value through processing, differentiating product and branding, exporting raw or processed products, and retailing or exporting niche commodities. Enabling policies and institutional arrangements that attract the private sector to promote organised front-end retailing, develop agro-processing, and facilitate exports are key to the success of contract farming.

The Ministry of Agriculture’s innovative equity-linked Farmer Producer Organisation (FPO) initiative is an enterprise directed at organising farmers for collective production and marketing. Its vision is to promote agribusinesses by encouraging institutional and private-sector investments and developing linkages to ensure all-round empowerment of farmers. The Ministry of Agriculture declared 2014 to be the “Year of Farmer Producer Organisation” to serve as an incentive. So far, 402 FPOs have been registered and are successfully operating in India. They are not only integrating the backend with service providers but also linking wholesaling, retailing, agro-processing, and exporting.

More than 55 per cent of FPOs are concentrated in five states: Andhra Pradesh (13 per cent), Tamil Nadu (13 per cent), Uttarakhand (11 per cent), Madhya Pradesh (9 per cent), and Maharashtra (9 per cent). These states identified niche commodities and promoted best agricultural production and marketing practices through FPOs to bring together farmers to take advantage of economies of scale. There is considerable scope for FPOs to become part of modern retailers’ supply chain (Trebbin 2014). Their successes have been evident in reduced cost, higher yields, and increased incomes (India, SFAC 2014). Unfortunately, the spread of FPOs is very thin in the eastern region (Bihar, Jharkhand, Odisha, and West Bengal) and northeast, where there is high concentration of smallholders.

### *Food Processing*

Food processing can play an important role in increasing incomes and generating employment opportunities in rural and peri-urban areas. This emerging sector promise sample employment and income opportunities for smallholders. It is one of the largest industries in India and is ranked fifth in terms of production, consumption, export, and expected growth (IBEF, 2014). In 2012-13, the food processing industry contributed nearly Rs 845 billion to the gross domestic product of the country. During the last five years, the sector's average growth was 8.4 per cent. In 2012-13, its share in agriculture was about 12.2 per cent and in the manufacturing sector 9.8 per cent. The Ministry of Food Processing is striving to harness opportunities from processed products. Its Vision Document 2015 aims to increase processing of perishables from the existing 6 per cent to 20 per cent, value addition from 20 per cent to 35 per cent, and share in global food trade from 1.5 per cent to 3 per cent by next year. An estimated investment of Rs 1 trillion would be required to achieve these high targets by 2015 (IBEF, 2014).

This is a very daunting and ambitious task in view of the inherent constraints the industry is facing, such as low capacity utilisation, high wastage at all stages of the food processing chain, low penetration of modern technologies leading to poor recovery of the finished product, problems of arranging adequate working capital and its management, low quality intermediate and final processed products, low R&D priority, and unreliable power support (Singh *et al.*, 2012). Apart from a systematic evolution in agri-business friendly policies, improving the capacity for entrepreneurship development and the technical skill to use modern technologies will spell success for the sector.

## VII

### WAY FORWARD

This section gives few suggestions for managing crowding and risk in agriculture.

### *Land and Labour Reforms*

Land and labour reforms are pre requisites to transform Indian agriculture and to shift wage earnings from agriculture to the non-agriculture sector. Land reforms did not receive due attention in India, with the exception of the states of Kerala and West Bengal. Following independence, there were voluntary and state-mediated land reforms in a few states, but only West Bengal and Kerala took it forward. The famous *Operation Bargha* program initiated by West Bengal gave high dividends with respect to equity, investment in agriculture, increase in yields, and also substantial increase in farm income. Few states followed land consolidation, which helped the

farmers to better manage their land and invest in agriculture for high yields and income. In 1971-72, the Land Ceiling Act was enacted to redistribute land with the purpose of empowering landless or marginal farmers by allocating state-owned land or land from large farmers. While these initiatives did empower the poor, over time land size shrank due to fragmentation of landholdings, threatening the viability and sustainability of smallholders. It is time to fix a ceiling below which landholding size should not fall. Simultaneously, land consolidation and policies dealing with land lease need improvement so that the tenant is able to invest in agriculture and the owner avoids the risk of losing his land.

Coming to labour and their rights, there have been more than 17 laws enacted after independence that are not industry friendly, and therefore discourage direct hiring of human resources. While reforming labour laws, care has always been taken to ensure for workers a high level of protection. There is a need to simplify labour laws so that the industrial and service sectors can absorb surplus manpower from the agriculture sector. Simultaneously, non-farm skill development programmes should be initiated for labour so that it is available to the non-farm sector. Provision should also be made so that farmers can work part time in another sector, as is happening in Japan and South Korea. It will ease the pressure from agriculture and ensure a decent life for smallholders. Land and labour reforms need to be put in place simultaneously to take advantage of emerging opportunities.

### *Market Reform*

An assured market is a pre-condition for ensuring access to inputs and remunerative output prices. Unfortunately, both input and output markets are not well developed in areas with a high concentration of smallholders. Meager inputs together with a scant marketable surplus hike the transaction cost of smallholders and make a marketing chain inefficient. The private sector is developing markets in areas where there is assurance of uniform quality and bulk transactions. Where high transaction costs prevail, they serve as a disincentive for the private sector to develop markets. In the absence of input and output markets, smallholders are exploited by the local traders and middlemen. This is where the public sector can play a constructive role. A region-differentiated approach may be adopted for commercial, transforming, and subsistence areas. In subsistence and backward areas, public sector intervention is necessary to develop markets, while in commercial and favourable areas the field may be left open to the private sector. A public-private partnership may be desirable in areas where agriculture is going through a transformation process. The crux of the matter therefore lies in four areas: (1) developing markets in areas with a high concentration of smallholders; (2) adopting a cluster approach while developing markets for location/region-specific commodities; (3) developing appropriate institutions that link smallholders with the remunerative markets; and (4) minimising

risk in marketing of agricultural commodities, especially perishable commodities, by developing cold storage, cold chains, and so on.

Can we learn from the successes of the milk cooperative movement in Gujarat and the contract farming-supported poultry sectors where smallholders have tiny marketable surpluses? Can these models be replicated for cereals, pulses, fruits, and vegetables? As stated earlier, self-help groups, cooperatives, contract farming, cluster farming, and farmer producer organisations offer enormous scope, with the rider that the transactions are transparent and inclusive. Ample examples of such models linking smallholders in the entire value chain are scattered and region- and commodity-specific.

Corporate houses have recently introduced the concept of “Rural Business Hubs” to provide agri-services at the back end, assure procurement of commodity outputs, process agri-commodities, and link smallholder farmers with emerging supermarkets and retail chains. *Hariyali Kissan Bazar*, *e-Chaupal*, and *Viswash* are some examples which contributed in improving the entire value chain, from farm to market. They provide inputs, financing, custom hiring, agro-advisories at the backend, and also procure some of the commodities. They serve as one-stop shops for farmers at the backend and reduce their transaction costs while assuring quality inputs and services.

Unfortunately, these interventions were very limited and could not be scaled up or replicated in areas with small holders. Due to seasonality in transactions (both in inputs and outputs) and steep competition from local traders, some of these models could not continue even in the commercial and favourable areas. However, the models do demonstrate the possibility of innovations in providing input delivery services and assuring input quality. The question is how to make these viable and sustainable. Learning from the Rural Business Hubs model, a parallel system such as the public distribution system could be provided in backward areas in public-private partnership mode to provide all sorts of agri-services and sale of inputs.

The other possibility would be to engage the private sector in agribusinesses to strengthen the entire value chain of selected commodities. In Maharashtra, a public-private sector consortium ensures good input quality, increases production of important commodities, and augments farm income. One innovative model on pulses initiated by Tata Chemicals covered approximately 64,000 farmers, providing them good quality seeds, testing soil for better nutrient management, facilitating the purchase of pulses at procurement centers, and linking them with supermarkets and retail chains (FICCI, 2013). Similarly, the public sector-led cluster approach in Chhattisgarh formed 812 clusters covering 190,284 ha, benefitting 141,042 farmers in 6,087 villages in 11 districts who cultivate fruits, vegetables, and medicinal plants (Government of India, 2012b). This initiative was part of the National Horticulture Mission program to expand the area under horticultural commodities.<sup>25</sup> If such public sector-driven models engaging the private sector in pulses and perishable commodities can be successful, they can work for all commodities provided there is

scale for transactions. A commodity-specific cluster approach in production and marketing will help smallholders take advantage of remunerative markets.

### *Reform Agricultural Extension System*

In the past, the agricultural extension system has significantly contributed to food self-sufficiency in India. However, over the years, despite several reforms, the system has become outdated as the agriculture is facing new challenges and also opportunities. The existing extension system needs to be reformed by expanding its mandate and functioning. The new agricultural extension system needs to be run by agri-business professionals by adopting new tools and approaches. Their role should be expanded beyond disseminating information to integrating farmers into farmers' groups or clubs or farmer producer companies. These agri-business professionals may be mandated to develop business plans for farmer groups and link them with service and technology providers and output markets. An incentive-linked pilot scheme in selected areas may be developed for implementation by the Ministry of Agriculture in partnership with agri-business schools. The private sector has already started doing this in favourable areas. The government may launch such initiatives in backward and smallholder dominated areas. Unless smallholders are organised and agriculture is professionally managed, the future may witness agrarian distress with serious socioeconomic and political consequences.

### *Minimise Risk in Agriculture*

Indian agriculture is experiencing climate change that adversely affects the livelihoods of smallholders. More climate shocks are being predicted, and these will increase vulnerability in agriculture. In order to develop resilience against climatic risk in agriculture the government should (1) promote climate smart agriculture; (2) promote agricultural insurance; and (3) strengthen weather advisory services.<sup>26</sup>

Climate smart agriculture increases crop yields, reduces climate risks, and increases carbon sequestration while minimising greenhouse gas emissions. As stated earlier, climate smart technological options that are location-specific are available, and they need to be mainstreamed for wider adoption. The condition for success is the capacity of extension staff to educate farmers about climate risks and coping strategies. Agricultural insurance can play an important role in improving farmers' capacity to recover quickly from shocks. At present there are a number of agricultural insurance products, but these are neither attracting farmers nor the insurance industry. At present, all agricultural insurance products are relying on subsidies. The private sector may be encouraged to develop innovative and attractive crop- and income-insurance products to reduce premiums and to make loss-assessment methods effective. Similarly, weather advisory services are necessary so that farmers can take informed decisions. Information and Communication Technology (ICT) plays a



critical role in disseminating value-added weather advisory services. Public-private partnerships should be tapped to raise the investment needed to establish weather stations that can provide farmers with key information.

#### *Promote Convergent Innovations and Programmes*

There are numerous innovations driven by the public sector, private sector, or both that are occurring across the entire food value chain in which smallholders are involved. The time is right to go for convergent innovations: a multidimensional (economic and human development) transformation approach that brings together multiple actors and innovations to congregate at the target domain and stakeholders (Jha *et al.*, 2014). These innovations are in areas related to social mobilisation, frontier technologies, financing and marketing institutions, processing, and retailing. Similarly, there are various government programmes that are being implemented either by the government or involving the private sector.

The concept of convergent innovation has been adopted by the Government of Maharashtra to benefit a large number of farmers by developing public-private sector partnerships. It consists of forming consortia of the private sector to develop an entire value chain for different agricultural commodities. The farmers, especially smallholders, benefit from assured and quality backend services, such as capacity development, soil test-based nutrient management, access to improved varieties of seeds, balanced nutrients, and management practices. In the front end, the private sector is exempted from the APMC Act and therefore can directly procure from farmers and sell in supermarkets, organised retail chains, or both. The consortia are building synergies with on-going government programmes in a public-private partnership mode. Observations have revealed that farmers saved fertiliser cost, increased yields, raised farm incomes, and improved the sustainability of soil and water resources (FICCI, 2013). Such initiatives make agriculture more sustainable and climate resilient. There is evidence that they improve farmers' capacity to adapt to climate change and reduce mitigation of greenhouse gases in logistics, transport, and processing. The success is possible not only in commercial crops such as soybean, cotton, and maize but also in pulses and millets. In view of the successes of convergent innovations in the public-private partnership mode, it is time to bring these innovations and programmes to smallholder dominated areas.

#### *Non-farm Employment Opportunities*

The non-farm sector has great potential and may provide income and employment opportunities for smallholders. It will require strengthening industry and the manufacturing sector to absorb the labour force from the agriculture sector. In the long run, more employment opportunities need to be created in this sector, especially in rural or peri-urban areas, in order to reduce some of the pressure on farm land. This

will require (1) providing basic infrastructure and social amenities to attract private investment; (2) developing the non-farm sector (especially processing, manufacturing, services, etc.) near rural and peri-urban areas; (3) developing youth skills and capacity in these areas; (4) evolving simple labour laws; and (5) promoting favourable financing and regulatory policies. A capacity building programme could be initiated in a cluster of villages to promote a specific non-farm sector.

## VIII

### CONCLUSIONS

Indian agriculture is showing a growing dominance of landless labourers and smallholders and experiencing an increasing threat of climate change. The emerging agricultural environment of rising wages, increasing rural-urban migration, and growing climatic and market risks are depriving smallholders a place in the agri-food system. In a changing scenario, they may not be able to compete, connect, and collaborate in domestic and global markets, given the lack of adequate finance, markets, technology, and information. Their growing number and climatic risks are putting more pressure on the natural resource base, making them poorer and vulnerable and eventually adversely affecting their food and nutritional security.

Appropriate policies, programmes, and institutional arrangements are necessary to protect the interests of smallholders. Regionally differentiated policies and programmes are necessary to manage the crowding of agriculture and reduce climatic risks. As stated earlier, a “one size fit for all” policy will not be effective in improving the welfare of smallholders and their ability to adapt climate change. States, which are dominated by smallholders, should play a proactive role in evolving pro-smallholder policies and programmes. Successful models dominated by large farmers may not be replicated in improving the condition of smallholders. This paper proposes six broad conditions for managing crowded agriculture, improving livelihoods of smallholders, and reducing the risk to agriculture due to climate change.

The first condition for success is to reform existing land laws. It would be most desirable to impose a ceiling at the lower level to check the fall in the size of land holdings. The second condition for success is to organise farmers and engage them in the entire value chain. Smallholders are unorganised and cannot take advantage of economies of scale or incur higher transaction costs for accessing technology, information, finance, and markets. Innovative institutional arrangements in the form of self-help groups, cooperatives, contract farming, cluster farming, and farmer producer organisations need to be promoted and effectively linked with the back-end service providers and front-end agro-processors and remunerative domestic and global markets. In favourable and commercial areas, the private sector may be encouraged to develop such linkages. In backward and subsistence areas, the public sector may create a new cadre by hiring agribusiness professionals to make

smallholders agri-entrepreneurs: this will involve consolidating smallholders and developing value chains for niche commodities.

Third, the state governments need to delineate agri-commodity zones for developing infrastructure so that niche commodities are produced and marketed together by smallholders. This will require an “agro-based model” of development from production to processing and marketing, restructuring of the Department of Agriculture, and evolving new roles and responsibilities for its technical staff in view of changing marketing opportunities. The model should evolve with the philosophy of “together we produce, together we market,” while at the same time promoting production of those commodities that give higher, quicker, and regular returns to the farmers; allow them access to collective credit, insurance, and markets; and provide them with scope to share farm equipment, technology, and information.

The fourth condition is to popularise “climate-smart agriculture” (CSA) and “climate-smart value chains (CSV)” for adapting climate risk and minimising greenhouse gas emissions. CSA interventions in the form of technologies (efficient use of cultivars, water, energy, and nutrients), value-added weather advisories, and agricultural insurance are available. CSA is a win-win proposition in an uncertain climate change scenario. Similarly, CSV (efficient production, post-harvest management, transport, and processing marketing) need to be replicated in smallholder dominated areas to adapt climate change, mitigate greenhouse gas emission, and maximise farm income.

Fifth, there is a strong need for convergence of various value-chain programmes and innovations. At present, most government programmes lack inter-ministry coordination, inter-departmental coordination, or both in their design and implementation. It is an opportune time to converse various programmes and schemes of central and state governments in the recently launched *Sansad Adarsh Gram Yojana*. Opportunities also need to be explored to shift sizable smallholders from farming to being agri-entrepreneurs or to non-farm sector by developing appropriate skills.

Finally, there is a need to develop state-level smallholder agricultural policy and action plans, which should foster a roadmap with clear roles and responsibilities for the public and private sector to make smallholders viable and improve their livelihood opportunities. The action plan must incorporate expansion of employment opportunities in the rural non-farm sector to absorb surplus labour from agriculture along with investment in developing human capital, as per the requirement of non-farm activities. Many of the problems in agriculture, including crowding and risk, may be solved outside the agriculture sector.

The consequences of not attending to the challenge of a growing number of smallholders and the emerging threat of climate change will lead to agrarian distress and negate government efforts to ensure food security, alleviate poverty and face the challenge of climate change.

## NOTES

1. The operated area with smallholders increased from 43 million ha in 1980-81 to about 71.15 million ha in 2010-2011.
2. While in Punjab it fell from 45 per cent in 1990-1991 to 34 per cent in 2010-11, in Goa, the decline was marginal – 90 per cent in 1990-1991 to 89 per cent in 2010-11 due to shift toward the tourism industry. In Punjab, the share of smallholders in total operated area declined from 11 per cent in 1990-1991 to 9 per cent in 2010-2011. The average size of their landholding in Punjab has marginally increased from 0.98 ha in 1990-91 to 1.03 ha in 2010-11.
3. Land inequalities in Bihar increased from 0.53 in 1995 to 0.77 in 2010-11. The corresponding Gini concentration ratio for Uttar Pradesh were 0.46 and 0.55; while these were 0.51 and 0.62 in West Bengal.
4. Long-term experiments under the All India Coordinated Research Improvement Project (AICRIP) revealed that phosphorous and potash in soils have declined when only N was applied.
5. Smallholders get only about Rs. 1260 per holding fertiliser subsidy in contrast to Rs. 17,646 per holding by large farmers.
6. The share of marketable surplus was 42 per cent for paddy in West Bengal for small holders and 59 per cent for large farmers (Sarkar *et al.*, 2012). In Uttar Pradesh, the corresponding figures were 77 and 94 per cent (Reardon *et al.*, 2012). For wheat, the marketable surplus of small holders ranged between 74 per cent and 81 per cent in Haryana and Punjab, while it was 92 and 94 per cent, respectively, for large farmers (Grover, *et al.*, 2012; Tuteja, 2013). For red gram, the marketable surplus was 81 per cent for smallholders and 92 per cent for large farmers in Gujarat (Borate *et al.*, 2011).
7. Transaction costs are those costs incurred by trading partners associated with the exchange of goods and services. In a perfectly competitive situation, institutions with the lowest production and transaction costs for a given activity will have an edge over others and dominate the market (Coase, 1960; Williamson, 1979, 2001).
8. It is reported that the transaction cost of contract farmers for perishable commodities such as milk and vegetables was 20 per cent less than non-contract farmers (Birthal *et al.*, 2005).
9. The flow of agricultural credit since 2003-2004 has consistently exceeded targets (Government of India, *Economic Survey 2013*). It increased from about Rs. 52.8 billion in 200-01 to Rs. 6074 billion in 2012-13 (IndiaStat).
10. The Prime Minister's recent *Dhan Jan Yojana* might have increased the account holders manifold.
11. Rs. stands for rupees.
12. This phenomenon has also been observed at the national level for both rural and urban rich and poor consumers.
13. The exceptions were Himachal Pradesh, Jammu and Kashmir, Uttaranchal, Andhra Pradesh, Karnataka, Kerala and Tamil Nadu, where poverty is lower than the national average but there is a high concentration of the poor.
14. Rural literacy in the overcrowded and high-poverty states was lower than the all-India average (67.8 per cent), with the exception of Odisha in 2011.
15. Lal *et al.*, (2010) estimated that the number of rainy days in India will decline by 15 days, but its intensity will increase by 1 to 4 mm per day.
16. In the context of agriculture and climate change, the vulnerability refers to the propensity of the entity to face a climate shock and suffer loss in production and/or income from agriculture (IPCC, 2007a) and is impacted by biophysical as well as socio-economic factors.
17. There is enough evidence to show that wheat production falls by 4-5 million tonnes with every 1°C rise in temperature (Aggarwal, 2009).
18. This section is heavily drawn from Joshi and Kumar (2014).
19. There was a slight increase in the size of small holder holdings from 0.78 in 1990-91 to 0.80 in 2010-2011.
20. In Odisha, the yield gap for rice was low (20-44 per cent) due to previous better yields.

21. The key biotic constraints in rice are sheath blight, bacterial leaf blight, blast and stem borer, causing losses of about 25-40 per cent. Flood, drought, soil sodicity, soil salinity and water logging are the key abiotic constraints.
22. There is 100 per cent electrification in the states of Andhra Pradesh, Haryana, Punjab and 98 per cent in Karnataka.
23. Only 34 per cent of smallholders use certified seeds compared to 83 per cent by large farmers.
24. The correlation coefficient across states between share of smallholders and high-value agriculture was 0.44 in 2010-11; it was only 0.26 in 1990-91.
25. A cluster consists of 250 ha with 10-20 villages within a radius of 15-20 km, with at least one village having a minimum of 10 ha under one crop.
26. For more information refer Joshi and Mahendra Dev (2014).

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