

PRESIDENTIAL ADDRESS

Transformation of Indian Agriculture? Growth, Inclusiveness and Sustainability*

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It is a great honour and privilege to deliver the Presidential Address at the 78th Annual Conference of the Indian Society of Agricultural Economics (ISAE). I am grateful to the Society for conferring this honour on me. ISAE is one of the oldest and most reputed professional societies in the country. Recently, it published 74 presidential addresses in three volumes. These addresses provide excellent analyses of changes in performance, policies and planning in agriculture in the pre-Green Revolution Era, Green Revolution Era and, liberalised regime.¹ The first President of the Society was Sir Malcolm Lyall Darling in 1939-40. Since the early 1960s, ISAE was ably led by Dr. M.L. Dantwala, Dr. V.M. Dandekar, Dr. A. Vaidyanathan, Dr. S.S. Johl, Dr. C. Ramasamy and is currently being led by Dr. Abhijit Sen. The Presidents of the Society and all other stakeholders including members have strengthened the Society over the years. The annual conferences of ISAE also provide opportunities for young scholars to present research papers and interact with eminent agricultural economists and other social scientists. Personally, I have learnt a lot from the activities and publications of the Society in the last four decades.

I have been working on the performance, issues and policies of Indian agriculture in the last few decades. Keeping in view the interests of ISAE, I have chosen to speak in this conference on ‘Transformation of Indian agriculture: growth, inclusiveness and sustainability’.²

I

INTRODUCTION

Agricultural development is important for raising the incomes of population dependent on agriculture and growth of non-agricultural sector. There are significant linkages between farm and non-farm sectors. The theory of ‘imbalanced growth’ discusses sectoral linkages and also indicates that agriculture could not become a leading sector due to its weak backward linkages (Hirschman, 1958). In contrast to this view, it is emphasised that agricultural development is essential for improving industrialisation (Kalecki, 1960 and Kuznets, 1968). Another view is that increase in

*Presidential Address delivered at the 78th Annual Conference of the Indian Society of Agricultural Economics held during November 1-3, 2018 under the auspices of Institute of Economic Growth, Delhi at NASC Complex, New Delhi.

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terms of trade in agriculture would reduce profits for industry (Lewis, 1954). Against this view, it was pointed out that rise in terms of trade for agriculture would improve demand for industrialisation (Kaldor, 1957). The importance of agriculture on non-agricultural sector growth is significant (Johnston and Mellor, 1961 and Mellor, 1976). Later, the importance of structure change within agriculture and the role of rural non-farm sector has also been emphasised (Mellor, 1976; Liedholm and Kilby, 1989; Ranis and Stewart, 1993).³

Generally, the share of agriculture in total employment falls much more slowly than its share in gross domestic product (GDP). As a result, labour productivity in agriculture falls behind that of non-agricultural sector. Although employment elasticity of agriculture declines over time, the absolute size of the rural labour force continues till economies attain higher levels of transformation. Labour productivity in agriculture can be increased with structural change in agriculture, development of rural non-farm sector or migration to urban areas. Many countries fail to manage this transformation at an adequate rate and face political problems with low incomes of the agricultural population (Rosegrant and Hazell, 2000).

Agriculture has significant linkages to food and nutritional security (IFPRI, 2015). This sector also plays an important role in adaptation and mitigation strategies relating to climate change (IPCC, 2001 and 2007). Similarly, agricultural development is crucial for reduction in poverty (World Bank, 2008). Thus, farm sector is also crucial for inclusiveness and sustainability. At global level, a goal on agriculture is included in Sustainable Development Goals (SDGs). Goal 2 of SDGs includes targets on agricultural productivity and sustainability as agriculture is also critical to achieve many other SDGs relating to hunger, malnutrition, climate change, gender equity, natural resources protection and jobs. There are also initiatives like Compact 2025 which aims to end hunger and undernutrition by 2025.⁴ This goal has to be attained five years before targeted achievements of SDGs in 2030. One of the questions this initiative asks is: How can we achieve the SDGs when people are hungry?

In the case of India, agricultural sector plays a pivotal role in the economy. India achieved self-sufficiency in foodgrains particularly in rice and wheat due to green revolution. But, soon it was recognised that we have to move beyond green revolution as it has neglected rainfed areas, nutrition crops like millets, non-cereals and resource poor farmers. It has also created ecological and environmental sustainability problems. It is well known that although its contribution to GDP is now around one-seventh, agriculture provides employment to 48 per cent of the Indian workforce. There are also substantial linkages between agriculture and non-agricultural sectors.⁵ In the present context, there is a need to focus much more on agriculture due to low agricultural growth (2.5 per cent per annum in the last four years) and agrarian distress in terms of low agricultural prices and farm incomes. Farmers' suicides in some parts of India is another issue relating to agriculture. Low farm incomes led to farmers' agitations in many states of India. Agriculture sector is

already facing several problems relating to sustainability, stagnant yields, water logging, soil erosion, volatility in prices, natural calamities, and small size of the farms.

As discussed above, agriculture has to focus on growth, equity and sustainability. India also has three broader goals of agricultural development.⁶ These are: (a) achieve 4 per cent growth in agriculture and raise incomes, increasing productivity (land, labour, total factor), structural transformation within agriculture and farm to non-farm sector; (b) second goal is inclusiveness by focusing on small and marginal farmers, lagging regions, Eastern India, rainfed areas, disadvantaged groups, women, contribution to poverty reduction and food and nutrition security; (c) third goal is to maintain sustainability of agriculture by focusing on environmental concerns, climate change and resilience. It may be noted that all these three goals are interconnected.

Narrative of Indian agriculture has been changing in recent years. Some of the changing factors are: urbanisation, globalisation/de-globalisation, tariff wars, diversification within agriculture and fast growing rural non-farm sector, developments in value chains, start-ups, technological changes including IT, developments in climate change, and more emphasis on sustainability than earlier.⁷ There is a need for transformation of Indian agriculture in the changing environment.

The crop production has significantly increased in the last decade. Foodgrains production was 275.7 million tonnes while pulses production was 24 million tonnes in 2017-18. India also witnessed horticultural revolution and production was 305 million tonnes in 2016-17. The production of fruits and vegetables was 93 million tonnes and 178 million tonnes respectively in the same year. The present government, apart from other things, is rightly focusing on enhancing farmers' incomes rather than just increasing production. It wants to double the farm incomes by the year 2022. In this lecture, we examine the strategies and reforms which can move towards achieving the three goals of agricultural development.

Against this background, in this lecture, we will address two questions:

- (a) How far India progressed in the three goals of agriculture in recent decades?
- (b) What are the policies and reforms needed to transform Indian agriculture in the next decade?

The lecture is organised as follows. Developments in global agriculture also influence growth and sustainability of Indian agriculture. Therefore, we discuss in Section II, changes in global agriculture in recent years. Section III puts together the performance and issues in terms of growth, inclusiveness and sustainability of agriculture in India. Section IV provides a blueprint on the policies and reforms needed to improve farm incomes, and three goals of agricultural development. The last section provides conclusions.

II

GLOBAL FOOD AND AGRICULTURE: NEW CONTEXT AND CHALLENGES

There have been significant changes in global food and agriculture in the last few decades. Economic growth seems to be converging across countries. This has implications for convergence of food demand, food production and agricultural policies and trade.⁸

There are many challenges at the global level such as climate change, urbanisation, migration, technologies like automation, increased inequality, changes in political factors like the US policies, Brexit, and protectionism. These factors and anti-globalisation is the changing context for food systems and agriculture.

There are geo-political challenges of uncertainty due to US policies. Recent anti-globalisation measures like threats to NAFTA, TPP (trans pacific partnership) and, tariffs by the US and China may have adverse impact on trade further. The US also does not respect the Paris Agreement on climate change. These actions by the US lead to shift away from multilateral and international agreements. The US started systematically undermining the WTO. It is now questioning the very basic principles on which the WTO is founded. The rules-based system that drives WTO through the dispute settlement mechanism -- so far the only arm of multilateral body that is functioning well -- is now being threatened by the US. Trade wars and anti-globalisation is going to hurt trade further. International trade will have benefits and negative effects. The risks associated with trade opening --including rising inequality, health impact, increasing energy use, and environmental damage should be addressed with policies directly target the source of the problem rather than hampering trade (IFPRI, 2018).⁹

Another challenge is high and increasing inequality. Income of the top 1 per cent in the world has grown twice as much as that of the bottom 50 per cent. Inequality increased both in developed and developing countries. It will have significant implications for food and agriculture.¹⁰ Women, youth, small farmers and other vulnerable groups have to be protected in this sector. At the economy level, the key source of inequality at global level has been technological change favouring higher skills. In Western Europe and the USA, technological progress has also translated into reduction of middle class jobs, a phenomenon known as polarisation (IMF, 2017). One global trend is automation' and 'digitisation' and other new technologies based on Artificial Intelligence (AI) which can take away the routine jobs outsourced to labour abundant economies.

Urbanisation and climate change are other global challenges. The urban share of global population is likely to increase from 55 per cent in 2018 to 68 per cent by 2050.¹¹ It will have implications for agriculture supply, demand, food markets and value chains. Climate change is real and growing threat to food and agriculture which have to change to adapt to and mitigate the impacts of climate change.

The major challenge of food systems¹² is to tackle the problems of hunger and triple burden of malnutrition - undernutrition, micronutrient deficiencies, and obesity. Around 815 million suffer from undernourishment, 155 million children under five are affected by stunting, two billion people lack micro nutrients, two billion adults suffer from overweight and obesity (IFPRI, 2018). As food systems are increasingly globalised, the governance issues relating to food and nutrition security are becoming complex. Hunger and the triple burden of malnutrition have to be addressed at both country level as well as global level. So far the global governance has been weak. There are platforms such as UN organisations for example UN Committee on world food security, FAO, informal coordination mechanism among countries like G7 and G20. But they work in silos. Therefore, designing a governing platform for intergovernmental coordination is needed. There are also suggestions of having 'International Panel on Food, nutrition and agriculture' similar to panel on climate change.¹³ But, the experience of coordination on climate change is a mixed one. Climate change is one issue where global governance is important. It is a public good. But, recent actions by the US show that there are challenges for climate change issues.

What are the likely trends in food and agriculture markets in the next ten years? OECD-FAO Agricultural Outlook 2018 says that the weakening of demand growth is expected to persist in the next decade. Although rate of population declines, it will be the main driver of consumption growth for most commodities. There are increasing uncertainties with respect to agricultural trade policies and concerns about the possibility of rising protectionism globally. The demand for feed will continue to outpace food demand as livestock production intensifies. China continues to have larger share of additional feed demand in the next decade also. Per capita consumption of many commodities and real agricultural prices are expected to be flat at a global level (OECD-FAO, 2018).¹⁴

Global population is projected to reach almost 10 billion by the middle of the century. It is known that current agri-food systems are capable of producing enough but doing in an inclusive and sustainable manner will require major transformations. The growing demand for food has to be achieved by ensuring that the use of the natural resource base is sustainable, while containing green house gas emissions and mitigating the impacts of climate change (vos and Bellu`, 2018).

III

AGRICULTURAL GROWTH, EQUITY AND SUSTAINABILITY IN INDIA: PERFORMANCE AND ISSUES

3.1. Agricultural Growth and Structural Change

It is known that the decline in the share of agricultural workers in total workers has been slower than the decline in the share of agriculture in the GDP. There is a need for structural change in both output and employment of agriculture.

Agricultural GDP +: It may be noted that agricultural GDP refers to agriculture and allied activities. But, if we extend this to throughout the value chains which includes food and agro processing, the share of agriculture GDP will be much higher and has significant linkages with other sectors.¹⁵ Therefore, we can have agriculture GDP+ if we extend the activities and its share in overall GDP would be much higher.

Growth in Agricultural GDP: In the decade of 1960s, agricultural growth rate was around 1 per cent per annum (Table 1). In other periods, the growth rates range from 2.2 per cent to 2.7 per cent per annum. In the post-reform period, growth rate of services was more than 8 per cent per annum. Industry also recorded 7 to 8 per cent during 2004-05 to 2017-18. The highest growth rate of GDP from agriculture was 3.7 per cent per annum during 2004-05 to 2014-15.¹⁶ The growth rate in agriculture in the period 2009-10 to 2013-14 was 4.3 per cent per annum. This is one of the highest growth rates recorded in independent India.

TABLE 1. GROWTH RATES IN AGRICULTURE, INDUSTRY AND SERVICES

Periods (1)	Growth rates of GDP (per cent)		
	Agriculture (2)	Industry (3)	Services (4)
1960-61 to 1968-69	1.04	5.05	5.03
1968-69 to 1975-76	2.24	3.92	3.37
1975-76 to 1988-89	2.47	5.53	5.40
1988-89 to 1995-96	2.76	5.90	6.15
1995-96 to 2004-05	2.28	4.87	7.86
2004-05 to 2014-15	3.72	8.44	8.96
2014-15 to 2017-18	2.55	7.15	8.71

Source: Government of India (2017) up to 2014-15; Calculated from National Accounts Statistics for the period 2014-15 to 2017-18.

The growth rate in agricultural GDP was 2.5 per cent per annum in the last four years of NDA period 2014-15 to 2017-18. To be fair to the government, the first two years had growth rates of -0.2 per cent and 0.7 per cent due to drought. The growth rate in 2018-19 is expected to be around 3.2 per cent. If we add this, the rate of growth in agricultural GDP would be 2.7 per cent per annum for the five year period 2014-15 to 2018-19.

Volatility in Agricultural Production: One of the problems in agriculture is volatility in GDP and production. However, the coefficient of variation has declined from 2.76 per cent during 1961-1988, to 1.87 per cent during 1988-2004 and to 0.75 per cent during 2004-2014 (Table 2). It shows that volatility in agricultural growth has been declining and it was low in the last decade. Variability in pulses was very high at 20 per cent and 5 per cent for cereals during 1990-2004. But it declined drastically in the decade 2005-2014. In other words, resilience to rainfall has been rising for Indian agriculture.

TABLE 2. VOLATILITY IN AGRICULTURAL GDP GROWTH: ALL INDIA

Years (1)	Coefficient of variation (2)
1961-1988	2.76
1988-2004	1.87
2004-2014	0.75

Source: Economic Survey 2016-17.

TABLE 3. VARIABILITY IN PULSES AND CEREAL PRODUCTION: COEFFICIENT OF VARIATION

(1)	Pulses (2)	Cereals (3)
1951-1965	6.86	3.19
1966-1989	6.03	2.04
1990-2004	20.35	5.01
2005-2014	2.42	1.64

Source: Same as Table 2.

Decline in Rise of Agricultural Prices

Prices play an important role in raising incomes of farmers. In the last one and half years, price rise for agriculture has declined significantly and affected the incomes of the farmers adversely. Table 4 provides implicit price deflators for agriculture GVA and total GVA. In 2015-16 and 2016-17, inflation for agricultural GVA was higher than that of total GVA.

TABLE 4. IMPLICIT PRICE DEFLATORS FOR AGRICULTURE AND TOTAL GVA

(1)	Agriculture GVA Growth		Total GVA growth		Implicit price deflators	
	Current prices (2)	Constant 2011-12 prices (3)	Current prices (4)	Constant 2011-12 prices (5)	Agriculture inflation (6)	Total inflation (7)
2015-16	5.2	0.7	8.5	7.9	4.5	0.6
2016-17	11.6	6.3	10.1	7.3	5.3	2.8
2017-18	4.5	3.4	9.7	6.5	1.1	3.2
Q1 2018-19	7.0	5.3	12.9	8.0	1.7	4.9

Source: National Accounts Statistics.

However, in 2017-18 and Q1 of 2018-19, price rise for farm sector was much lower than the rise in general price level. In 2017-18, the price rise for agriculture was only 1.1 per cent as compared to 3.2 per cent for general prices. Consumer price index (CPI) also shows that inflation for food was lower than that of general price index in the same year (Table 5). In other words, terms of trade were moving against agriculture since 2017-18.¹⁷

TABLE 5. CONSUMER PRICE INDEX (CPI) INFLATION

Year (1)	CPI, general (2)	CPI, food and beverages (3)
2015-16	4.9	5.1
2016-17	4.5	4.4
2017-18	3.6	2.2

Source: RBI, Annual Report 2018.

Changing Face of Agriculture and Rural India: Structural Change and Transformation

There has been significant transformation in agriculture and rural areas. Structural change happened at three levels: (1) diversification within agriculture sector; (2) diversification from agriculture to allied activities like livestock and fisheries; and (3) structural change from agriculture and allied to rural non-farm sector.

In terms of area, the share of nutri-cereals declined while the share of oilseeds and fruits and vegetables increased (Table 6). In the case of value of output in agriculture and allied activities, the shares of nutri-cereals, pulses declined while the shares of fruits and vegetables, condiments and spices, livestock and fisheries rose over time (Table 7).

TABLE 6. DIVERSIFICATION IN CROP SECTOR

(1)	Area shares of crops to gross cropped area		
	<i>(per cent)</i>		
	1960-61 to 1968-69 (2)	1975-76 to 1988-89 (3)	2004-05 to 2014-15 (4)
Paddy and wheat	31.3	36.0	37.3
Nutri-cereals	25.5	19.8	12.7
Pulses	14.7	13.3	12.2
Oilseeds	9.5	10.5	13.9
Sugar	1.5	1.7	2.3
Cotton and Jute	5.8	5.0	5.9
Condiments and spices	1.0	1.2	1.5
Fruits and vegetables	1.9	3.0	6.5
Other crops	8.8	9.5	8.0

Source: Government of India (2017).

TABLE 7. SHARE IN VALUE OF PRODUCTION AT 2004-05 PRICES

(1)	<i>(per cent)</i>		
	2004-05 to 2014-15		
	1960-61 to 1968-69 (2)	1975-76 to 1988-89 (3)	(4)
Crops			
Paddy and wheat	18.2	21.2	17.9
Nutri-cereals	6.9	5.0	2.7
Pulses	7.3	5.0	3.0
Oilseeds	7.1	6.3	6.7
Sugar	4.5	4.1	4.5
Cotton and Jute	2.9	2.4	3.3
Condiments and spices	1.7	1.7	2.6
Fruits and vegetables	10.6	14.7	18.8
Floriculture	0.3	0.4	0.9
All crops	77.1	75.4	69.6
Livestock	20.1	21.4	25.8
Fisheries	2.9	3.3	4.6

Source: Government of India (2017).

Table 8 provides shares in value output for year 2015-16 at 2011-12 constant prices. It provides shares of agriculture and agriculture and allied activities separately. The share of fruits and vegetables in crop sector was almost equal to that

of cereals in 2015-16 (Table 8). In the case of allied activities, the shares of livestock and fisheries and forestry rose significantly over time. In fact, the share of livestock is nearly 30 per cent now. It may be noted that the share of agriculture in the total agriculture and allied activities including forestry was only 58 per cent in 2015-16.

TABLE 8. DIVERSIFICATION IN AGRICULTURE AND ALLIED ACTIVITIES:
SHARE IN VALUE OF OUTPUT, 2015-16 AT 2011-12 PRICES

Crops (1)	(per cent)	
	Share in agriculture (2)	Share in agriculture and allied activities (3)
Cereals	27.06	15.72
Oilseeds	7.73	4.49
Fibre	5.60	3.25
Fruits and vegetables	26.64	15.30
Other crops	7.40	4.35
Others	25.80	14.99
Agriculture	100.00	58.10
Livestock	--	28.8
Forestry	--	7.90
Fisheries	--	5.16
Agriculture and allied activities		100.00

Source: Calculated from National Accounts Statistics, MOSPI, Government of India.

There has been diversification of Indian diets away from foodgrains to high value products like milk, meat products, vegetables and fruits.¹⁸ The increasing middle-class due to rapid urbanisation, increasing per-capita income, increased participation of women in urban jobs and impact of globalisation has been largely responsible for the diet diversification in India. High value products have caught the fancy of the expanding middle class and the result is visible in the growing demand for hi-value processed products. Demand for non-foodgrain items has been increasing. The expenditure elasticity for non-cereal food items is still quite high. Per capita consumption of fruits and vegetables showed the highest growth followed by edible oils.¹⁹ Diversification to high value crops and allied activities is one of the important sources for raising agricultural growth.²⁰

Agro Processing and Retail Trade: Food and agro processing sector has huge potential for India in agricultural transformation. The country processes only 10 per cent of fruits and vegetables while many other countries process 40 to 70 per cent. Several changes have been occurring in value chains in the segments of food processing, cold chains, wholesalers, and logistics and they impact the linkages. Similarly promotion of retail trade and foreign direct investment in this sector will also help promoting linkages. The major change in food value chain is emergence of supermarkets.

Changes in Rural India

The face of rural India has been changing. There has been significant rise in some rural activities. These are: rural non-farm employment, connectivity, public

employment, expenditure on social protection like MGNREGA, the role of panchayati raj institutions, education, migration and remittances. Rural India witnessed significant structural change in rural work force for both females and males during the period 1993-94 to 2011-12 (Table 9).

TABLE 9. CHANGES IN STRUCTURE OF RURAL WORKFORCE

Sectors	Male		Female	
	1993-94	2011-12	1993-94	2011-12
(1)	(2)	(3)	(4)	(5)
Agriculture	74.0	59.4	86.2	74.9
Manufacturing	7.0	8.2	7.1	9.8
Construction	3.2	13.0	0.8	6.6
Services	14.8	18.3	5.6	8.3

Source: NSS data on employment and unemployment surveys.

Rural Non-Farm Employment

The rural non-farm sector is being increasingly seen as an important sector in development literature. At the all India level, the share of non-farm sector in rural areas increased from around 19 per cent in 1983 to 36 per cent in 2011-12. Largest increase occurred between 2004-05 and 2011-12. The share of rural non-farm sector for males in 2011-12 was 40 per cent while for females it was 25 per cent (Dev, 2017b). It means still 75 per cent of females in rural areas are in agriculture. First time there was absolute decline in the number of agricultural workers after 2004-05. Entire growth of employment in rural areas during 2004-05 and 2011-12 was due to non-farm employment. This was an important structural break since 2004-05. There are a number of longitudinal village surveys. A recent book by *Himanshu et al.* (2016) provides lots of insights on changes in village India. This volume includes village studies from different regions of India. Village studies by *Rodgers et al.* (2016) also indicate considerable increase in rural non-farm employment in Bihar villages. Migration also increased significantly in Bihar.

Doubling Farm Income: Focus on both Agriculture and Rural Non-Farm Sector

The present government is focusing on doubling farm income by 2022. This is based on the thinking that we need to give importance to the welfare and prosperity of farmers rather than just increasing agricultural production.

The Situation Assessment Surveys of NSSO show that the average monthly income of agricultural households at current prices increased from Rs.2115 in 2003 to Rs.6426 in 2012-13²¹ (Table 10). The share of cultivation in total income is the highest at 46 per cent in 2003 and 48 per cent in 2013. The share of income from animals rose while that of wages and non-farm business declined in 2013 as compared to those of 2003.

TABLE 10. AVERAGE MONTHLY INCOME OF AGRICULTURAL HOUSEHOLDS IN CURRENT PRICES: NSS SURVEYS 2003 AND 2013

(1)	Income (Rs.)		Share in total income (per cent)	
	2003 (2)	2013 (3)	2003 (4)	2013 (5)
Cultivation	969	3081	45.8	47.9
Animals	91	763	4.3	11.9
Wages	819	2071	38.7	32.2
Non-farm business	236	512	11.2	8.0
Total	2115	6426	100.0	100.0

Source: NSS Surveys.

Another source of farmer's income is the All India Rural Financial Inclusion Survey of NABARD. This survey also provides information on income of agricultural households and non-agricultural households for the year 2015-16. The NABARD survey is not strictly comparable with the Situation Assessment Surveys of NSSO due to changes in definitions. This survey shows that 35 per cent income of agricultural households is from cultivation, 34 per cent from wage labour, 16 per cent from salaries and 8 per cent from livestock (Table 11). The share of cultivation and livestock together was 43 per cent in NABARD survey as compared to 60 per cent in NSS Survey of 2013.

TABLE 11. AVERAGE MONTHLY INCOME OF AGRICULTURAL HOUSEHOLDS IN CURRENT PRICES: NABARD SURVEY 2015-16

Source of income (1)	Agricultural households		All (agri+non-agri) households	
	Income (Rs.) (2)	Share in income (per cent) (3)	Income (Rs.) (4)	Share in income (per cent) (5)
Cultivation	3140	35.2	1494	18.5
Livestock	711	8.0	338	4.2
Other enterprises	489	5.5	679	8.4
Wage labour	3025	33.9	3504	43.5
Govt/pvt.service	1444	16.2	1906	23.7
Other sources	122	1.4	138	1.7
Total	8931	100.0	8059	100.0

Source: NABARD (2018).

Another interesting finding is that only 23 per cent of rural income is from agriculture (cultivation+livestock) if we consider all rural households (Table 11). Around 44 per cent of income is from wage labour, 24 per cent from government/private service and 8 per cent from other enterprises. It shows that income from non-farm sector is the major source in rural areas.

NABARD survey provides interesting data on number of sources of income. Only 13 per cent of agricultural households have one single source of income. Around 50 per cent of these households have two sources, 29 per cent three sources and 9 per cent four sources. It shows that agricultural households do not depend only on farm income but they depend on multiple sources for their livelihoods. Thus, both agriculture and non-agriculture are important for raising income of agricultural

households. On the other hand, nearly 80 per cent of non-agricultural households depend only on single source of income.

3.2. Inclusiveness: Equity in Agriculture

The second goal of agricultural development is sharing growth and achieving equity. There is some sort of consensus now that growth should be shared by all sections of the society rather than limiting to few categories of population. This is important to reduce poverty and inequalities in the economy and society. Here we discuss inequalities in agriculture and rural areas. Inclusiveness in agriculture should focus on inequalities in regions, women and youth, disadvantages social groups, small vs. large farmers and irrigated vs. rainfed areas. Focus on eastern region is also important.

Changing Agrarian Structure: Shrinking Size of Farms

The recent Agricultural Census data shows that there were about 145.7 million agricultural holdings in India in 2015-16 (Government of India, 2018). Around 118 million were small and marginal farmers. The share of small and marginal farmers in total holdings increased significantly in the last three decades. As shown in Table 12, the share of marginal and small farmers increased from 70 per cent in 1970-71 to 86 per cent in 2015-16. It may be noted that 69 per cent of land holdings belong to marginal farmers with less than 1 ha. Thus, the smallholding character of Indian agriculture is much more prominent today than even before. The small and marginal farmers account for 86 per cent of total farm hhs but their share in operated area is around 44 per cent. Thus, there are significant land inequalities in India.

Shrinking size of farms is one of the major problems. The average size of farm holdings declined from 2.3 ha. in 1970-71 to 1.08 ha. (2.9 acres) in 2015-16. The average size of marginal holdings is only 0.38 ha. (less than one acre) in 2015-16 (Table 12). Viability of marginal and small farmers is a major challenge for Indian agriculture.

TABLE 12. CHANGES IN AGRARIAN STRUCTURE

Size of farmers	Share in farm holdings (per cent)			Share in operated area (per cent)			Average size of holding (ha)		
	1970-71	1990-91	2015-16	1970-71	1990-91	2015-16	1970-71	1990-91	2015-16
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Marginal	51.0	59.4	68.5	9.0	15.0	24.2	0.40	0.39	0.38
Small	18.9	18.8	17.7	11.9	17.4	23.2	1.44	1.43	1.41
Semi-medium	15.0	13.1	9.5	18.5	23.2	23.7	2.81	2.73	2.70
Medium	11.2	7.4	3.8	29.7	27.0	20.0	6.08	5.84	5.72
Large	3.9	1.6	0.6	30.8	17.3	9.0	18.10	17.20	17.10
All Size	100.0	100.0	100.0	100.0	100.0	100.0	2.28	1.41	1.08

Source: Agricultural Census, 2015-16, Ministry of Agriculture, Government of India.

Note: Marginal – less than 1 ha.; Small – less than 2 ha.; Semi-medium – 2 to 4 ha.; Medium – 4 to 10 ha.; large – above 10 ha.

Inequalities in Consumption, Income and Wealth

In India, consumer expenditure from NSS (National Sample Survey) is generally used to estimate inequality. As shown in Table 13, consumption Gini coefficient is 0.38 in 2011-12. On the other hand, inequality in income is high with a Gini coefficient of 0.55 while wealth Gini coefficient is 0.74 in 2011-12 (Table 13). Income gini is 20 points higher than consumption Gini while wealth Gini is nearly 40 points higher than consumption Gini. Thus, inequality in income and wealth is much higher than that of consumption. Inequality in consumption and wealth is lower in rural areas as compared to urban areas. However, inequality in income is higher in rural than urban areas.²²

TABLE 13. CONSUMPTION, INCOME AND WEALTH INEQUALITY IN INDIA:
RURAL, URBAN AND TOTAL, 2011-12

Sector (1)	Total (2)	Rural (3)	Urban (4)
Consumption Gini	0.375	0.311	0.390
Income Gini	0.553	0.541	0.506
Wealth Gini *	0.740	0.670	0.770

Sources: Income Gini coefficients are estimated from the data of Indian Human Development Survey (IHDS); Anand and Thampi (2016) for consumption and wealth Gini coefficients.

*Refers to 2012.

Table 14 provides trends in inequality in consumption, income and wealth in rural areas. It shows consumption and income Gini increased marginally between 2004-05 and 2011-12. However, wealth inequality increased from 0.63 to 0.67 - by 4 points during the same period.

TABLE 14. TRENDS IN INEQUALITY IN RURAL AREAS

Sector (1)	1993-94 (2)	2004-05 (3)	2011-12 (4)
Consumption Gini	0.286	0.305	0.311
Income Gini	--	0.520	0.532
Wealth Gini *	0.62	0.63	0.67

Source: Same as Table 1.

*Wealth Gini refers to 1991, 2002, 2012.

One can estimate income inequality for agricultural households based on Situation Assessment Survey of NSS. At the all India level, the income Gini at 0.58 was much higher than consumption Gini at 0.28 – around 30 points higher (Table 15). The estimates at state level also show similar results. The income Gini at state level varies from 0.43 in Chhattisgarh and Gujarat to 0.61 in Bihar. The difference between consumption Gini and income Gini for Bihar is nearly 40 points. The income inequality is higher in South Indian states such as Kerala, Andhra Pradesh and Tamil Nadu (Table 15). The consumption inequality is the highest in Kerala.

TABLE 15. ESTIMATES OF INEQUALITY (GINI) IN PER CAPITA INCOME AND MPCE FOR AGRICULTURAL HOUSEHOLDS

States	Gini per capita income: 2013	Gini MPCE 2011-12	States	Gini per capita income: 2013	Gini MPCE 2011-12
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	0.60	0.27	Madhya Pradesh	0.49	0.25
Assam	0.52	0.23	Maharashtra	0.57	0.21
Bihar	0.61	0.22	Odisha	0.53	0.24
Chattisgarh	0.43	0.22	Punjab	0.53	0.29
Gujarat	0.43	0.23	Rajasthan	0.50	0.27
Haryana	0.51	0.25	Tamil Nadu	0.59	0.28
Jharkhand	0.53	0.28	Uttar Pradesh	0.58	0.28
Karnataka	0.58	0.23	West Bengal	0.53	0.28
Kerala	0.59	0.31	All India	0.58	0.28

Source: Chakravorty *et al.* (2016).

A study based on 2013 *Situation Assessment Survey of Farmers*, (Birthal *et al.* 2017) shows that around 70 per cent of the farmers have per capita income less than the average of all the farmers.

Village Studies

In-depth village surveys can give a better idea on inequality in income in agriculture. The project on Agrarian Relations in India (PARI), a project to study village economies in different agro-ecological regions of India provides estimates of income inequality in 17 villages covering 9 states: Andhra Pradesh, Telangana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Uttar Pradesh, Punjab and West Bengal.²³

The 17 villages were surveyed between 2005 and 2011.²⁴ These surveys provide two conclusions. One is that the inequality in income is very high in study villages. It is much higher than consumption inequality. Second conclusion is that there are significant village-wise variations in income inequality. The gini coefficients of household income and per capita income for the 17 villages are given in Table 16. The gini coefficient ranges from 0.781 in Gharsondi village of Madhya Pradesh to 0.372 in Amarsinghi village of West Bengal.

Taking Care of Vulnerable Regions and Groups

There are significant disparities in agricultural growth and incomes across regions. In recent years, some of the less developed states like Madhya Pradesh showed high growth while Punjab recorded low growth (Niti Aayog, 2017). Rain fed area has been neglected for a long time. Eastern region should be the focus area for the next stage of agricultural development in India.

TABLE 16. GINI COEFFICIENTS OF HOUSEHOLD INCOME AND PER CAPITA INCOME, BY STUDY VILLAGES

Village (1)	State (2)	Survey year (3)	Gini coefficient	
			Households (4)	Persons (5)
Ananthavaram	Andhra Pradesh	2005-06	0.656	0.602
Bukkacherla	Andhra Pradesh	2005-06	0.607	0.539
Kothapalle	Telangana	2005-06	0.577	0.565
Harevli	Uttar Pradesh	2005-06	0.667	0.598
Mahatwar	Uttar Pradesh	2005-06	0.527	0.516
Nimshirgaon	Maharashtra	2006-07	0.549	0.491
Warwat Khanderao	Maharashtra	2006-07	0.586	0.531
25 F Gulabewala	Rajasthan	2006-07	0.740	0.686
Rewasi	Rajasthan	2009-10	0.541	0.465
Gharsondi	Madhya Pradesh	2007-08	0.781	0.721
Alabujanahalli	Karnataka	2008-09	0.536	0.467
Siresandra	Karnataka	2008-09	0.511	0.453
Zhapur	Karnataka	2008-09	0.516	0.485
Amarsinghi	West Bengal	2009-10	0.372	0.370
Panahar	West Bengal	2009-10	0.664	0.547
Kalmandasguri	West Bengal	2009-10	0.387	0.334
Tehang	Punjab	2010-11	0.622	0.608

Source: Based on PARI survey data. Estimates for first eight villages are from Swaminathan and Rawal (2011) using PARI survey data. Table prepared by Tapas Modak.

Similarly, incomes of small and marginal farmers are much lower than other farmers. Viability of small farmers is important for promoting equity. The role of women in agriculture is increasing over time as men are migrating to rural non-farm and urban areas. Women work harder than men in agricultural operations. We also need to encourage youth to take up agricultural activities so that more inclusive, innovative agriculture can be achieved. Discrimination of disadvantaged sections in agricultural input and output markets is another issue to be taken up as part of improving inclusiveness in agriculture.²⁵

Agriculture and Nutrition

One of the emerging areas of research and policy focus in India is how to improve linkages between agriculture and nutrition. Malnutrition among women and children inspite of high economic growth is one of the major problems in India. We are stressing on this as undernutrition among children would have long term impact on children's health, their psychosocial well-being, educational and skill achievements and labour productivity. International studies have shown that the rate of decline of child undernutrition tends to be around half of the rate of growth of per capita GDP. Stunting rate among children under three in India declined from 53 per cent in 1992-93 to 45 per cent in 2006, average rate of decline of 1.2 per cent per year. Recent data shows that stunting among children under 5 years declined from 48 per cent in 2005-06 to 38 per cent in 2015-16 at the average rate of 1 per cent per year (Table 17). Underweight has declined only 0.7 per cent per year during this

period. On the other hand, wasting has slightly increased. Malnutrition and anaemia for children and women is higher in rural areas than urban areas. Although there is some improvement in anaemia for children and women and BMI for women, the levels are still high. Around 58 per cent of children and 53 per cent of women are having anaemia in 2015-16.

TABLE 17. NUTRITIONAL STATUS OF CHILDREN UNDER 5 YEARS AND WOMEN (15-49): ALL INDIA

	Total (Rural+Urban)		2015-16 (NFHS 4)	
	2005-06 (NFHS 3)	2015-16 (NFHS 4)	Rural	Urban
(1)	(2)	(3)	(4)	(5)
Children under 5 years				
Stunting (height for age)	48.0	38.4	41.2	31.0
Underweight (weight for age)	42.5	35.7	38.3	29.1
Wasting (weight for height)	19.8	21.0	21.5	20.0
Anaemia among children	69.4	58.4	59.4	55.9
Women (15-49 years)				
Anaemia among women	55.3	53.0	54.2	50.8
BMI below normal (women)	35.5	22.9	26.7	15.5

Sources: NFHS 3 and NFHS 4.

Wealth quintiles show that in the lowest quintile, malnutrition is very high at 51 per cent in 2015-16. It has nearly two and half times malnutrition levels than the highest quintile (Table 18). Scheduled Castes and Scheduled Tribes have 10 per cent points higher malnutrition than other castes. No education category has 20 per cent points higher malnutrition as compared to the category with education of secondary or more.

TABLE 18. NUTRITION STATUS OF CHILDREN UNDER 5 YEARS, STUNTING (HEIGHT FOR AGE): ALL INDIA, 2015-16

Wealth quintile	Stunting (per cent)	Social groups	Stunting (per cent)	Education	Stunting (per cent)
(1)	(2)	(3)	(4)	(5)	(6)
Lowest	51	Scheduled Caste	43	No education	51
Second	44	Scheduled Tribe	44	Primary complete	44
Middle	36	OBCs	39	Secondary or more complete	31
Fourth	29	None of them	31		
Highest	22				

Source: NFHS 4.

At state level, stunting among children declined in all the states during the period 2005-06 to 2015-16 (Table 19). Kerala state has the lowest malnutrition level at 19.7 per cent followed by Punjab, Himachal Pradesh, Tamil Nadu and Jammu and Kashmir. On the other hand, Bihar, Jharkhand, Uttar Pradesh and Madhya Pradesh have high levels of malnutrition (above 40 per cent). Gujarat has malnutrition levels closer to that of all India.

TABLE 19. STUNTING AMONG CHILDREN UNDER 5 YEARS ACROSS STATES:
2005-06 (NFHS 3) AND 2015-06 (NFHS 4)

States	Stunting (per cent)			Stunting (per cent)	
	2005-06	2015-16		2005-06	2015-16
(1)	(2)	(3)	(4)	(5)	(6)
Andhra Pradesh	38.1*	31.4	Madhya Pradesh	50.0	<u>42.0</u>
Assam	46.5	36.4	Maharashtra	46.3	34.4
Bihar	55.6	<u>48.3</u>	Odisha	45.1	34.1
Chhattisgarh	52.9	37.6	Punjab	36.7	25.7
Gujarat	51.7	38.5	Rajasthan	43.7	39.1
Haryana	45.7	34.0	Tamil Nadu	30.9	27.1
Himachal Pradesh	38.6	26.3	Telangana	38.1*	28.1
Jammu & Kashmir	35.0	27.4	Uttar Pradesh	56.8	<u>45.3</u>
Jharkhand	49.8	<u>45.3</u>	West Bengal	44.6	32.5
Karnataka	43.7	36.2	All India	48.0	38.4
Kerala	24.5	19.7			

Source: NFHS 3 and NFHS 4.

*Combined Andhra Pradesh.

Table 20 provides a breakup of the bottom 100 districts with high stunting levels among children under 5 years. It shows that states like Uttar Pradesh, Bihar and Madhya Pradesh have large number of districts among the bottom 100 districts.

TABLE 20. BOTTOM 100 DISTRICTS WITH HIGH MALNUTRITION (STUNTING) LEVELS

States	No. of districts	States	No. of districts
(1)	(2)	(3)	(4)
Uttar Pradesh	29	Meghalaya	4
Bihar	25	Chhattisgarh	3
Madhya Pradesh	13	Maharashtra	2
Jharkhand	6	Haryana	1
Gujarat	5	Odisha	1
Rajasthan	5	Assam	1
Karnataka	5	Total	100

Source: NIN (2017).

Malnutrition depends on many other factors apart from agriculture. However, agriculture and nutrition linkages can be further improved in order to raise both growth and equity (more on policies below).

3.3. Sustainability

The third and important goal of agricultural development is sustainability. This goal is becoming much more important in recent years with global recognition of achieving SDGs. Brundtland Commission 1987 defines sustainability as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (World Commission on Environment and Development, 1987) We have to look at issues such as energy, environment, natural resources and climate change. Intensification of agricultural production in irrigated

and favourable rainfed environments combined with sometimes flawed incentives due to inappropriate policies have caused substantial environmental degradation. Expansion in cropped area into forest areas and onto steeper slopes increased soil erosion. Intensive livestock production also added water and land quality problems. Indian soils are gradually degrading because of soil erosion, loss of organic carbon, nutrient imbalance and salinisation. Water logging, soil erosion and ground water depletion are some of the problems leading to unsustainability of agriculture.

Dr. M.S. Swaminathan appealed to the farmers as early as 1968 not to harm the long term production potential for short term gain. He described this appeal in his own words as follows. "In order to ensure that a productivity based agriculture does not result in ecological harm due to unsustainable exploitation of land and water, adoption of mono culture and excessive use of mineral fertilisers and chemical pesticides, I appealed to farmers in January 1968 not to harm the long term production potential for short term gains. I pleaded for converting the green revolution into evergreen revolution by mainstreaming the principles of ecology in technology development and dissemination. I defined evergreen revolution as increasing productivity in perpetuity without associated ecological harm. I pleaded for avoiding the temptation to convert the green revolution into a greed revolution. Unfortunately, ecologically unsound public policies, like the supply of free electricity, have led to the over-exploitation of the acqifer in Punjab, Haryana and Western UP region. The heartland of the green revolution is in deep ecological distress ...The need for adopting the methods of an evergreen revolution has therefore become very urgent" (p.20, Swaminathan, 2010).²⁶

Land, water, energy, common property resources and forests are some of natural resources that needs to be sustained over time. Fiscal and environmental implications of subsidy policies in energy, water and agriculture sectors are being recognised. It is known that most of these subsidies pose a threat to environment. Soil is under threat in India from soil erosion due to deforestation and use of chemical fertilisers. Free or cheap power has encouraged excess drawal of groundwater leading to falling water tables in large parts of the country.

Climate Change and Agriculture

Climate change is a reality. Agriculture is the sector most vulnerable to climate change due to its high dependence on climate and weather and because people involved in agriculture tend to be poorer compared with urban residents. Agriculture is part of the problem and part of the solution.²⁷

Using district level data on temperature, rainfall and crop production, Economic Survey 2017-18 (Government of India, 2018) examines a long term trend of rising temperatures, declining average precipitation, and increase in extreme precipitation events. The following are the findings of the study.

- (1) The first finding is that the climate change impact in terms of temperature and rainfall is non-linear and felt in the extreme, i.e., when temperatures are higher, rainfall is substantially lower, and the number of dry days higher than normal.
- (2) The second finding which is not surprising is that the impacts of the climate factors are significantly more adverse in unirrigated areas compared to irrigated areas.
- (3) The third finding relates to the impacts on agricultural yields and farm income. Table 21 shows that the extreme temperature shock reduce yields by 4 per cent and 4.7 per cent for *kharif* and *rabi* respectively while the extreme rainfall shocks reduce yields by 12.8 per cent and 6.7 per cent for *kharif* and *rabi* respectively. The same table provides the impact on farm incomes. It shows that extreme temperature shocks results in a 4.3 per cent decline in *kharif* farm income and a 4.1 per cent for *rabi* farm income. In the case of extreme rainfall shocks, the farm income declines by 13.7 per cent for *kharif* and 5.5 per cent for *rabi*.

TABLE 21. IMPACT OF WEATHER SHOCKS ON AGRICULTURAL YIELDS AND FARM INCOME: INDIA

<i>Kharif/Rabi</i>	Impact on agricultural yields		Impact on farm income	
	Extreme temperature shocks (per cent)	Extreme rainfall shocks (per cent)	Extreme temperature shocks (per cent)	Extreme rainfall shocks (per cent)
(1)	(2)	(3)	(4)	(5)
Average <i>kharif</i>	4.0	12.8	4.3	13.7
<i>Kharif</i> , irrigated	2.7	6.2	7.0	7.0
<i>Kharif</i> , unirrigated	7.0	14.7	5.1	14.3
Average <i>rabi</i>	4.7	6.7	4.1	5.5
<i>Rabi</i> irrigated	3.0	4.1	3.2	4.0
<i>Rabi</i> unirrigated	7.6	8.6	5.9	6.6

Source: Government of India (2018).

The study also estimates the farm income loss by applying IPCC-predicted temperatures and projecting India's recent trends in precipitation. These estimates show that farmer income decline from climate change could be between 15 per cent and 18 per cent on average and could be anywhere between 20 per cent and 25 per cent in unirrigated areas. These results show that the impact of climate change on farm income loss would be substantial in India.

IV

WHAT ARE THE POLICIES AND REFORMS NEEDED FOR ENHANCING FARM INCOME, INCLUSIVENESS AND SUSTAINABILITY?

In order to achieve the goals of agricultural development, there is a need for a medium term strategy and action plan. This section examines the policies and reforms needed to raise farm incomes, equity and sustainability in the medium term.

In this section, we first discuss on macro policies and issues under doubling farm income. We will also examine the policies needed for remunerative prices including marketing issues. Then we move on to the policies on water and technology including

information technology. Finally, we will deal with policies on post-harvest activities, inclusiveness, climate change and institutions.

4.1. *Macro Economic Policies and Agriculture*

Agricultural economists generally restrict to the policies relating to farm sector. However, there is a need to look at policies related to macro policies and non-agriculture²⁸ Macroeconomic policies, relating to fiscal, monetary, trade, tariff, exchange rate, have direct and indirect impacts on agriculture. Although the primary objectives of macroeconomic policies are aimed at controlling inflation, sustaining public expenditure and attaining fiscal balance, but these policies through fiscal and monetary policies may have significant impact on agriculture. In order to influence agriculture, fiscal policies have to improve tax revenue and public investment on infrastructure and other supply constraints. Macro policies like financial liberalisation and trade policies may promote or hamper agricultural growth. Similarly, promotion of rural non-farm sector and promotion of labour intensive manufacturing sector and services are important to reduce demographic pressures on agriculture. Macro policies will have general equilibrium impact on agriculture through various linkages. In Section II we have discussed on trends and future scenario for global level agriculture and food. These global trends and policies including climate change will also have impact on Indian agriculture and food systems.

Is the Solution for Agriculture Lies in Non-Agriculture?

Some economists like T.N. Srinivasan (2008) argue that agricultural policies may be important but fundamental factor for low productivity in agriculture lies in non-agriculture. Non-agriculture is not absorbing labour force from agriculture. According to him, the development “strategy completely ignored the lessons of economic history: successful development lies in the transformation of economic structure by shifting a substantial part of the large initial share of labour force in agriculture and other low productivity activities in the informal sector to more productive off-farm activities through rural and urban industrialisation with emphasis on labour-intensive manufactures to supply growing domestic and world markets and raising agricultural productivity” (p.1). This is similar to the views of Arthur Lewis who has put forward his model of “Economic Development with Unlimited Supplies of Labour” which envisages the capital accumulation in the modern industrial sector so as to draw labour from the subsistence agricultural sector (Lewis, 1954).

There have been debates on the roles of agriculture and non-agriculture in reducing poverty. Some studies showed that non-agriculture and urban growth were important for poverty reduction.²⁹ Some other studies indicated that poverty reducing impact of agriculture is much higher than that of non-agriculture (World Bank, 2008;

Gaiha, 2016).³⁰ Recent evidence also shows that growth in agriculture is in general more effective at reducing poverty (two to three times) as compared to that of industry and services. It is also shown that the effects of poverty reduction of agriculture are largely for the poorest in society than those for non-agriculture (Christiaensen and Martin, 2018).³¹

It may be noted that one should have balanced approach regarding the roles of agriculture and non-agriculture in raising agricultural productivity and farmers' incomes. Poverty cannot be eliminated without shifting workers from agriculture to non-agriculture. However, focusing on agriculture is still important for reduction in poverty as it is the biggest provider of livelihoods and has forward and backward linkages with other sectors.³² Thus, both agriculture and non-agriculture are important for agricultural population.

4.2. Doubling Farm Income (DFI)

Several studies have examined the feasibility of attaining doubling farm incomes (DFI) by 2022. NITI Ayog (2017) and the Ashok Dalwai Committee (Government of India, 2017) have given several suggestions for DFI.³³ Chand (2016) discusses sources of growth and strategies for DFI.³⁴ According to him there are six sources for DFI. These are: (a) increase in agricultural productivity; (b) rise in total factor productivity; (c) diversification to high value crops; (d) increase in cropping intensity; (e) improving terms of trade for farmers; (f) shifting cultivators to non-farm and subsidiary activities. The study also discusses strategies for achieving the DFI through these sources. It may be noted that there is overlapping in these sources of growth. For example, agricultural productivity also affects total factor productivity. Therefore, one has to be careful in interpreting the impact of these sources on DFI. In the last four years, the Government has introduced several programmes covering irrigation, crop insurance, minimum support prices and agricultural markets to improve agricultural growth and farmers' incomes.³⁵

Dalwai committee says "on an average 60 per cent of farmers' income is from agricultural output (including livestock), the targets are designed to double this component of income and also improve the ratio between farm and non-farm income from 60:40 as of now to 70:30 by the end of target period. In doing so, various other developments in the form of allied enterprises and support infrastructure are envisaged. These developments will create new sources of income and near-farm jobs, to add to income" (p.v, Vol.2, Government of India, 2017).

It may be noted that there are several issues regarding doubling farm income as given below.

- (1) Estimates on changes in farmers' income show that it tripled in nominal terms during the period 2003 to 2013. But, in real terms the total income rose only 32 per cent in 10 years – 3.2 per cent per annum (Chandrasekhar and

Mehrotra, 2016).³⁶ In other words, we need more than 10 per cent per annum growth in income to achieve DFI in 2022.

- (2) Achieving 10 per cent or more is difficult given that farmer's income growth has been only around 2.5 per cent per annum in the last four years 2014-15 to 2017-18.
- (3) Government seems to be banking on agriculture (crop+livestock) sector for DFI. As mentioned by Dalwai Committee, the focus is on this sector which has 60 per cent share in total farm income. However, recent estimates based on NABARD's *Financial Inclusion Survey* show that agriculture's share is 43 per cent of total farm income in 2015-16. The share of agriculture in total rural incomes is only 23 per cent in the same year.
- (4) It shows that non-farm sector is becoming more important. Some people think that we must go beyond agriculture for doubling farm income.³⁷ Government should promote much more opportunities in non-farm sector in rural areas.
- (5) Although NITI Ayog and Dalwai Committee discuss regional disparities in farm incomes, one has to take into account heterogeneity among different classes of farmers.
- (6) It is also argued that profiling of farmers and identifying their locations are needed in order to move towards DFI (BIRTHAL, 2018).³⁸ It is the marginal farmers, three-fourths of whom stay at the bottom of income distribution, should be at the forefront of any developmental strategy. Some of the marginal farmers controlling for other factors have relatively high incomes through diversification of crops, allied activities and to non-farm sector (BIRTHAL, 2018). What are the lessons from these successful marginal farmers? Also, all efforts should be made to focus more on the Eastern region that has lagged behind in agricultural development and is home to about 60 per cent of the total low-income marginal farmers.
- (7) What about measures for rising incomes of agricultural labourers? They are also part of the agricultural population. Policies have to be different for them.
- (8) As mentioned in Section III, there are lot of inequalities among farm incomes across farmers and locations. Marginal and small farmers who constitute 86 per cent of the total have low incomes and with high volatility. For these farmers, consumption is higher than incomes and indebtedness is high. Even if we double their income, it would not be sufficient to take care of their consumption including health and education. It may be noted farmers incur lot of expenditure on health.
- (9) What about the impact of doubling farmers' income on environment? One can have high agricultural growth and productivity with high growth of capital and other inputs. But, it damages the environment and natural resources. Zero budget natural farming can improve incomes for farmers. There is a need to discuss these issues in the context of DFI.

A cross country study by Mikecz and Vos (2016) examines whether small farmers can double productivity and incomes during the period 2015-2030. This study looked at past trends of land and labour productivity of small farmers for 140 countries. Out of these 140 countries, there were 41 countries in the case of land productivity and 41 countries in the case of labour productivity that managed to double productivity at least once within a 15-year time span. Pro-active government policies seem to have played a key role in pushing up productivity in these countries.

To conclude on DFI, efforts must be made to improve farmers' income whether we achieve the goal of doubling farm income or not by 2022. The focus on income rather than production is in the right direction.

4.3. Price and Marketing Policies

Price factor was important even during green revolution time along with technology. We have not been able to provide remunerative prices for farmers in the last 70 years since Independence. Farmers have been getting low prices in normal, drought and good years because of distortions in price and market policies.

Variation in agricultural prices across regions is quite high in India. Chatterjee and Kapoor (2016) examine spatial price variation using high frequency price and quantity data from the AgMarket portal of Government of India. The study shows that the average standard deviation of log (real) prices across *mandis* in a given month is 0.17. This spatial variation is higher than those of some other developing countries. The price variation persists over time despite substantial investments in rural roads and improvement in information and communication technologies (e.g. mobile phones). District-fixed effects could explain part of the variation but 39 per cent of it is unexplained which could be attributed to the time and location varying factors (Chatterjee and Kapur, 2017). It shows that we have distorted price and market policies.

Distortions in minimum support price (MSP) policy are well known.³⁹ Criticism of the MSP policy is that it is limited to few crops (mainly rice and wheat) and few states. Even for commodities covered, not all farmers are able to sell their produce at the MSP in other regions. Focusing mainly on rice and wheat is creating problems for diversification.

Few months back, government has announced MSP at 1.5 times the A2+FL cost (paid out cost plus cost of family labour) for all *kharif* crops. Increase in MSP is a right move as farmers need higher prices. It is generally argued that increase in MSP and agricultural prices would increase general inflation. But, farmers should not suffer because of urban consumers.

It may be noted that inspite of MSP and subsidies, Indian farmer is net taxed as compared to farmers of other countries. An OECD and ICRIER study shows that PSE (producer support estimates) was negative to the tune of 14 per cent on an average

during the period 2000-01 to 2016-17 (Gulati and Cahill, 2018). In other words, distorted policies are hurting the Indian farmers.

However, increase in MSP does not have any meaning unless we have procurement of crop production. It is known that government procures mainly rice and wheat apart from occasional procurement by NAFED (National Agricultural Co-operative Marketing Federation of India) for few crops.

Recently, the government announced a new Umbrella Scheme 'Pradhan Mantri Annadata Aay Sanrakshan Abhiyan' (PM-AASHA). The scheme is aimed at ensuring remunerative prices to the farmers for their produce as announced in the Union Budget for 2018. It has three components.⁴⁰ (1) Price support scheme (PSS) (2) Price Deficiency Payment Scheme (PDPS). (3) Pilot of Private Procurement & Stockist Scheme (PPPS). There are some issues to be sorted out in each scheme for better implementation.⁴¹ For example, there have been operational challenges including manipulation by traders in *Bhavantar Bhugtan Yojana* of Madhya Pradesh. It is also not clear that how many states will opt for PDPS given the implementation problems. Operationally, *Rythu Bandhu Scheme* of Telangana is better as compared to the above schemes. This is also called Farmers' Investment Support Scheme which is a welfare programme to support farmer's investment for two crops a year by the Government of Telangana. The government is providing 5.83 million farmers, Rs. 4000 per acre per season to support the farm investment, twice a year, for *rabi* and *kharif* seasons. One major problem with this scheme is that tenant farmers do not get anything from this scheme. Most of the farmers' suicides in Telangana are by tenant farmers. We also need proper land records and financial resources to implement this scheme in other states. It may be noted that it is income transfer programme and not price support scheme.

Marketing Reforms and Freedom for Farmers: Agricultural markets witnessed only limited reforms. They are characterised by inefficient physical operations, excessive crowding of intermediaries, fragmented market chains. Due to this, farmers are deprived of fair share of the price paid by the final consumers. For example, sometimes farmers get Rs.1 per kg for tomatoes while consumers pay Rs.40 per kg. Traders get higher margins due to long supply chain. Some of these problems can be overcome with present reforms including APMC. Unfortunately, States have not shown any urgency in reforming agricultural markets due to political factors. The government created e-NAM platform for creating a national market but the progress has been slow. The farmer must be given full freedom to sell his produce to whomsoever he wants. Institutional arrangements like producers' organisations, contract farming, co-operatives, women's self-help groups can help in getting better price for farmers.⁴²

Aggarwal *et al.* (2017) examine Karnataka's agricultural output marketing reforms. The study has two objectives: (a) assessing the state and challenges of implementation and (2) learn lessons from Karnataka's experience for India's e-National Agriculture Market. Based on a field study of 10 mandis across the state, the

study finds that while Karnataka has been consistently pushing through with reforms, there remain significant challenges. Based on Karnataka's experience, the study argues that agricultural market reform in India rests on three pillars: (a) institutions that establish the rules of the game; (b) incentives for agents to participate actively in the market (3) and infrastructure to support the modernised trading platform (Agarwal *et al.*, 2017). They conclude that the reforms are unlikely to succeed unless they address all these three issues simultaneously.

Need to Shift from Cereal Biased Policies

Government policies have been biased towards cereals particularly rice and wheat (Subramaniam, 2018). It procures rice and wheat based on minimum support prices in few states. Cereal-centric policies also provide subsidies for fertilisers, water, power, credit and seeds. Large part of the subsidy goes to these two crops. These subsidies also benefit large farmers, few states and irrigated areas and have adverse impact on soil quality, water quantity and quality and human health. Punjab, Haryana and other states have been focusing mainly on rice and wheat because of government support to these crops. There is a need to shift from cereal-centric policies to non-cereal focused policies. Diversification of cropping pattern is obvious for improving agricultural growth, incomes of farmers and environmental sustainability.

Beyond Harvest: Warehousing, Storage, Value Chains, Food Processing, Exports

Agriculture has to go beyond farming and develop value chain, comprising farming, wholesaling, warehousing, logistics, processing, and retailing. Exports can be included in this holistic approach. Over regulation of domestic trade, agro processing, enterprise size, and land and credit market can discourage private investment.

In developing countries like India, we have 'missing middle' in marketing. Value chain runs from production to processing. For example, storage, processing and agri-business are missing. As mentioned above, India processes very limited quantities of fruits and vegetables. Post-harvest losses are also high. In order to link farmers to retailers and processing, we need investments and increase efficiency. In developed countries we do not find 'missing middle'. One can learn lessons from these countries. Private sector participation can be improved if some of the fears like the Essential Commodity Act, stock limits and export bans are removed.

Exports: The National Export policy is formulated in line with the goal of doubling the farmers' income and increase agriculture exports from present \$30 billion to over \$60 billion by 2022. We do not see consistent policies regarding domestic and international trade. There is no long-term policy on exports and futures markets. Export bans are imposed frequently.

Banning exports hurts the farmers most. It is known that governments ban exports of crops like onion, pulses etc. when the consumer prices rise. Similarly, tariffs for imports are lowered to allow more imports and reduce prices. Sometimes the tariff policy can hurt the farmers. The government controls exports through minimum export price and export bans. There is a need for predictability and stable export policies.⁴³

Start-ups: The government has been promoting start-ups by giving incentives. It announced 'Start-up India' as a flagship programme in 2016. There have been new generation start-ups coming up in agriculture. Rao *et al.* (2017) document the evolution of recent start-ups in agriculture. Broadly, they render either input services or output services in marketing and related jobs. BigHaat.com, Flybird, AgroStar, Stellaps, Kedut, EcoZen, MITRA, EM3, Skymet, YCook, IFFCOKisan, Aarav Unmanned Systems, and CropIn are some of the start-ups involved in input services. For output services, there are several start-ups like Ninjacart, The Agrihub, SVAgri, Sabziwala, Flipkart, and Big Basket.

The start-ups brought several innovations in product, process, marketing and organisation. These startups relied mainly on online and mobile platforms and rendered input and output services (Rao *et al.*, 2017). These start-ups have been altering the value chain and roles of different actors by cutting down the length of value chain. The start-up activity in agriculture, however, falls short of the total activity and accounted for just one per cent of total investment of six billion dollars in 2015. Experience in other countries also show evidence of market failures in entrepreneurial activity in agriculture and need for the state to intervene. Certain amount of start-up fund may be earmarked for spurring innovative start-ups in food and agriculture (Rao *et al.*, 2017). Other suggestions of this study include channeling entrepreneurial activity in food and agriculture include remodeling technology business incubators under Indian Council of Agricultural Research (ICAR) on business principles and ensuing representation of ministry of agriculture in the inter-ministerial board for start-up promotion.

4.4. *Do Not Forget Basics: Water and Technology*

Basics like seeds, fertilisers, credit, water, technology etc. are important for agriculture and they should not be forgotten. Similarly investment in irrigation, rural infrastructure, R&D are important for raising productivity and incomes. The ratio of gross capital formation in agriculture to GVA in agriculture showed fluctuating trend from 18.2 per cent in 2011-12 to 16.4 per cent in 2015-16. Public investment in agriculture was around 2.8 per cent of GVA in agriculture in 2015-16. Studies have shown that public investment in rural infrastructure and R&D has positive effect in reducing poverty.⁴⁴

Here we discuss issues and policies in water and technology as both are crucial for agricultural development.

*Water Management*⁴⁵

Water is the leading input in agriculture and major policy issue in the 21st century. Since Independence, India invested significantly in irrigation infrastructure particularly canal irrigation. Prime Minister's Krishi Sinchai Yojana (PMKSY) introduced by the present government is in the right direction. However, strategy on irrigation development is preoccupied with increasing water supplies and neglected efficiency of use and sustainability (Vaidyanathan, 2010).⁴⁶ Because the government highly subsidises both canal water rates and the power tariff for drawing groundwater, much of this water is unfortunately either used inefficiently or overused. Areas of reforms needed in irrigation are: stepping up and prioritising public investment, raising profitability of groundwater exploitation and augmenting ground water resources, rational pricing of irrigation water and electricity, involvement of user farmers in the management of irrigation systems and, making groundwater markets equitable (Rao, 2005).

There is paradox of high investments in canal irrigation on the one side and shrinking of net irrigated area under canals. Governments have significantly raised plan expenditure on irrigation and flood control since independence. The outlays on major and medium irrigation rose from Rs.376 crores in the First Plan to an outlay of more than Rs.165,000 crores in the 11th Plan with a cumulative expenditure of Rs.3,51,000 crores (Government of India, 2012). A study of 210 major and medium irrigation projects shows that after investing Rs.130,000 crore, these projects delivered 2.4 million ha. less irrigation during 1990–2001 to 2006–2007 (Shah, 2011). The 12th Plan working group indicates that there has been massive time and cost overruns. The average cost of overruns for major irrigation projects is as high as 1,382 per cent. It is known that present water pricing covers less than 10 per cent of the Operation and Maintenance costs (O&Ms) under canal irrigation. In general, water pricing is very low for canal irrigation while we have best practices in water pricing in urban areas which cover around 50 per cent of O&Ms. Water pricing should at least cover major part of O&Ms so that sustainability of irrigation systems is ensured.

Water Use Efficiency, Conservation and Soil Moisture Management: India has successive droughts in 2014-15 and 2015-16. There is a need for strategies in short and long term for mitigating the adverse effects of droughts. It is clear that better and efficient management of water resources is necessary for India to achieve “more crops per drop”.⁴⁷

“India uses 2-3 times the water used to produce one tonne of grain in countries like China, Brazil and USA. This implies that with water use efficiency of those countries India can at least double irrigation coverage or save 50 per cent water

currently used in irrigation” (p.9, NITI Ayog, 2015). NITI Ayog mentions adoption of drip irrigation as one of the mechanisms for efficiency. Investments in three components pond, rural electrification and drip irrigation are needed for enhancing water efficiency (Damodaran, 2016). Drip irrigation can cover ten times the area covered under usual flood irrigation.

In spite of several benefits, the coverage of area under drip irrigation has remained small with less than 5 per cent of net sown area. What are the reasons for this low coverage? High initial capital cost is considered to be one of the biggest obstacles for adoption of drip irrigation. Therefore, alternative financial mechanisms should be explored to fund this initial cost. The present subsidy system is not effective. There are alternative subsidy implementation models (Palanisami, 2015). Some of the measures needed are reducing the capital cost, restructuring subsidy programmes and effective (quality) extension networks for promoting drip irrigation (Reddy and Dev, 2006). Promoting rainwater harvesting and drip irrigation can be important strategies for drought proofing.

Conflicts over water are a grim reality today. Inter-state disputes and conflicts on water at farm level are expected to increase over time. The problem is not due to shortage of water resource, but due to the absence of proper mechanisms for its augmentation, conservation, distribution, and efficient use. Water management should be given number one priority regarding policies on agriculture particularly for drought proofing and to face the risks due to droughts. Main strategy should be to increase water productivity, i.e., ‘more crops per drop’. Conservation of surface and ground water has become imperative. Water use efficiency can be increased significantly in Indian agriculture. Multiple approaches are needed for this purpose. MGNREGA created assets would be useful for drought proofing. Drip irrigation is one of the important mechanisms to improve water efficiency. For ground water management, we need to reduce electricity subsidies and water intensive crops while improving drip irrigation and participatory management.

Land Policy: There is consensus among majority of agricultural economists that land tenure should be legalised. Small holders will have access to land due to this measure. An expert committee chaired by T. Haque prepared a Model Leasing Act at national level. It recommends legalising land tenancy to provide complete security of land ownership rights for land owners and security of tenure for tenants for the lease period.⁴⁸ It also recommends facilitating all tenants to access bank credit and insurance facilities. Another related reform on land policy relates to land records and ownership titles. National Land Records Modernisation Programme (NLRMP) was launched by government of India in 2008. It was revamped in 2014 as the Digital India – Land Records Modernisation Programme (DILRMP). Narayanan *et al.* (2018) present findings of an impact assessment of the programme in Himachal Pradesh and Maharashtra. There are significant differences between land records and ground situation in villages. Based on the findings, the study provides suggestions for better land records management.

Technology, Research and Extension

Yields for several crops in India are lower than many countries of the world. Similarly, growth in total factor productivity in India has been lower compared to countries like Brazil, China and Indonesia (BIC).⁴⁹ What policies, investment and institutions explain these differences? There is no single bullet for lower productivity in India. Overall these three BIC countries invested more in technology, extension, education, transport, energy and better institutions (Lele *et al.*, 2018). India is trailing and should invest more in each of these areas and implement effectively.

Technology (including IT) is crucial for rise in total factor productivity.⁵⁰ The new agricultural technologies in the horizon are largely biotechnologies. There has been a revolution in cotton production due to success of BT cotton. India allowed BT cotton but not food crops so far. Some of the concerns of GMOs relate to food and health safety, control of corporate control on agriculture, pricing of seeds etc. However, many countries adopted GM crops. India did not approve of BT brinjal, mustard and chickpea. Recently, gene editing is becoming popular and this can be encouraged in India.

A study by Madhur (2016) shows economic inefficiency in Indian agriculture. According to him, the implied cost of economic inefficiency is quite high as farmers are losing on an average over two-thirds of their potential income through sub-optimal crop and input choices. It means that farmers' incomes could be increased over three times with the same resources. This can be achieved through extension services. Public sector investment for agriculture research and development, and education in India is only 0.6 per cent of the agricultural GDP which needs to be raised to at least 1.0 per cent, as is being invested by most of the developing countries. The returns to investment on research and extension will be much higher on agricultural growth as compared to other investments.

Information technology can be another source of agricultural development. Digital India is a campaign launched by the Government of India to ensure the Government's services are made available to citizens electronically by improved online infrastructure and by increasing internet connectivity or by making the country digitally empowered in the field of technology. This initiative includes plans to connect rural areas with high speed internet networks. Fourth industrial revolution will also have implications for Indian agriculture. Lele and Goswami (2017) examines how India is facing the fourth industrial revolution in terms of public policy and public-private and NGO partnerships to improve development particularly agriculture and rural development. Their study argues that the new technologies are being used more on governmental redistributive policies than on those directed at improving productivity and livelihood opportunities for the poor. The study emphasises that more investment on technology has to be made in physical and institutional capacity at the ground level in order to raise farm productivity.

4.5. Policies on Inclusiveness

Sharing growth and equity in agriculture is important to improve livelihoods in rural areas. Increasing the viability of small and marginal farmers, reducing social, gender and regional inequalities, improving rainfed areas are some of the goals of equity in agriculture.⁵¹

Increase the Viability of Small and Marginal Farmers

Around 86 per cent of agricultural holdings belong to small and marginal farmers. The average size of land holding has been shrinking and it is matter of concern. In his Radha Krishna Memorial Lectures, Sukhamoy Chakravarty argued that viability of small and marginal farmers have to be increased for sustainability of agriculture (Chakravarty, 1987). We are still talking about viability of small farms even after three decades.

Farmers face several risks in agriculture. These are: production risks, weather and disaster related risks, price risks, credit risks, market risks and policy risks.⁵² These risks are much higher for small farmers.

Table 22 shows that the income of the marginal and small farmers from all sources is only around 1/10th of those of large farmers. The income from agriculture is very low for small farmers. Even if we add the other sources of income, it is not enough to take care of daily consumption and they have to borrow to survive. Small holding farmers have to get part of income from rural non-farm activities. Therefore, promotion of rural non-farm sector is essential for generating incomes for small farmers. Simultaneously, we have to improve the viability of small holdings.⁵³

TABLE 22. MONTHLY INCOME AND CONSUMPTION OF AGRICULTURAL HOUSEHOLDS: 2013
(Rs.)

Land size (ha.) (1)	Cultivate income (2)	Animals income (3)	Wage income (4)	Non-farm business (5)	Total income (6)	Total consumption (7)
<0.01	31	1223	3019	469	4742	5139
0.01-0.40	712	645	2557	482	4396	5402
0.41-1.00	2177	645	2072	477	5371	5979
1.01-2.00	4237	825	1744	599	7405	6430
2.01-4.00	7433	1180	1681	556	10849	7798
4.01-10.00	15547	1501	2067	880	19995	10115
>10.00	35713	2616	1311	1771	41412	14445
All Classes	3194	784	2146	528	6653	6229

Source: NSS Situation Assessment Survey 2013.

However, in contrast to NSS data, a recent survey by NABARD (2018) shows surplus (the difference between income and expenditure classes) for the all the size classes below 2 ha (Table 23). Of course, there is inverse relationship between surplus and size classes except for the size class less than 0.01 ha.

TABLE 23. AVERAGE MONTHLY INCOME AND CONSUMPTION FOR AGRICULTURAL HOUSEHOLDS BY SIZE CLASS OF LAND: 2015-16

(Rs.)			
Size class (1)	Income (2)	Consumption (3)	Surplus (4)
<0.01 ha	8136	6594	1542
0.01 – 0.40 ha	6650	6185	465
0.41-1.00 ha	8171	6653	1518
1.01-2.00 ha	9990	7802	2188
>2.00 ha	14682	9787	4895
All size classes	8931	7152	1779

Source: NABARD, 2018.

Small farmers face several challenges in the access to inputs and marketing.⁵⁴ They need a level playing field with large farms in terms of accessing land, water, inputs, credit, technology and markets. Small holdings also face new challenges on integration of value chains, liberalisation and globalisation effects, market volatility and other risks and vulnerability, adaptation of climate change, etc. (Thapa and Gaiha, 2011).

Small farmers require special support, public goods and efficient links to input and output markets. There are many technological and institutional innovations which can enable marginal and small farmers to raise agricultural productivity and increase incomes through diversification and high value agriculture.⁵⁵ A number of innovative institutional models are emerging and there are many opportunities for small and marginal farmers in India. Group or collective approach, e.g., farmers' organisations, women self help groups is one of the main institutional mechanisms to help marginal and small farmers.

Credit: It is true that there have been some improvements in flow of farm credit in recent years.⁵⁶ However, the Government has to be sensitive to the three distributional aspects of agricultural credit. These are: (a) not much improvement in the share of small and marginal farmers; (c) increase in the share of indirect credit in total agricultural credit and; (d) significant regional inequalities in credit. Indebtedness of marginal and small farmers is another issue to be tackled.

Transformation of small farm economy is the biggest challenge for developing economies like India. Small farmers⁵⁷ are not homogeneous category as some of them have done exceedingly well as compared to others. There are three categories of small farmers: (a) succeed as commercial farmers; (b) diversifying into rural non-farm sector; and (c) subsistence oriented farmers. Policies may have to be different for each of these categories.⁵⁸

Many of the small farmers cannot leave agriculture because of lack of opportunities in non-farm sector. Only option is to organise them into groups to benefit from the co-operative approach and increase their farm incomes.

Eastern Region

This region has the highest poverty in the country. Agricultural development is important to reduce poverty in Eastern India. The region has fertile soil and ample

water resources. Plenty of surface and ground water and less intensive use of land resources reveal that region has considerable scope for raising agricultural productivity. Eastern region is the ideal place for having second green revolution. Rice is an important crop in the region. Of course, diversification is important for raising incomes for farmers. Infrastructure improvement in institutions and input delivery mechanism are needed in the region. Crop varieties that grow well with shorter time schedule should be developed. Creation of adequate marketing infrastructure and support mechanism is needed to have revolution.

In the 1980s, Sen Committee (RBI, 1984) examined the constraints for agricultural productivity in the eastern region. Apart from problems in agrarian structure, irrigation and drainage facilities were the main impediments. Joshi and Kumar (2016) study the transformation of agriculture in Eastern region. It provides various challenges and opportunities for agricultural sector in Bihar and Orissa. The key challenges include low crop yield and high risk, biotic and abiotic constraints, small size of holdings, inadequate infrastructure and weak institutions while opportunities include good soil and ground water potential. The study also says that appropriate policies, institutions and infrastructure should be developed in favour of high value sectors such as dairy, poultry, horticulture and inland fish.

Women in Agriculture

Agriculture is becoming increasingly feminised as men migrate to the rural non-farm sector. Nearly 75 per cent of rural women work in agriculture as compared to 59 per cent of rural men in agriculture in 2011-12. Agricultural policies should correct the gender bias in the functioning of institutions and support systems including property rights for women.⁵⁹

Women work in “land preparation, seed selection and seed production, sowing, in applying manure, fertiliser and pesticides, weeding, transplanting, threshing, winnowing and harvesting etc., as well as in animal husbandry and dairying, fish processing, collection of non timber forest produces (NTFPs), back yard poultry, and collection of fuel wood, fodder and other products for family needs” (Government of India, 2007).

Despite their importance, women are continually denied their property rights and access to other productive resources. Policies that protect women’s rights in land, enhance infrastructure support to women farmers, and give them legal advice on existing laws, will facilitate recognition of women’s role as farmers and enable them to access credit, inputs, and marketing outlets. Women’s names should be recorded as cultivators in revenue records, for family farms where women operate land that is registered under male ownership.

There is increasing recognition of the role of women in agriculture. Women’s co-operatives, producer women’s groups, and other forms of group efforts should be promoted, to overcome the constraints of small and uneconomic land holdings, to

disseminate agricultural technology and other inputs, and for marketing of produce (Agarwal, 2010).

There has also been greater emphasis on women's collectives.⁶⁰ Based on primary surveys, Agarwal (2018) examines the impact of group farming by women on productivity and profitability in Kerala and Telangana. The farms of women's groups under *Kudumbashree* (also called joint liability groups) in Kerala performed much better than the predominantly male-managed individual farms, in their annual value of output per hectare as well as annual net returns per farm. In the case of Telangana group farms (*Samatha Dharani Groups*) perform much worse than individual farms in annual output, but are equivalent in net returns. The study finds that in both states, groups do much better in commercial crops than in traditional foodgrains (Agarwal, 2018). The study demonstrates that group farming can provide an effective alternative, subject to specified conditions and adaptation of the model to the local context.

Youth: In the changed narrative, policies can be taken to attract youth in agriculture. Vijayabaskar *et al.*, (2018) examine the prospects of improving youth livelihoods in agriculture. According to them measures for improving incomes within agriculture while also paying sufficient attention to caste and gender relations, access to land, youth preferences and mobility aspirations are critical sustaining agriculture and youth livelihoods. Around 56.6 per cent of rural youth in the age group 15–29 years continued to rely on agriculture, forestry, or fishing as a source of livelihood (Vijaybaskar *et al.*, 2018). In general, the youth are not interested to continue as farmers due to the falling profitability and incomes in agriculture. They prefer non-agricultural and urban jobs. In order to continue them in farming and attract more youth, we need to encourage mechanised or scientifically supported high yield agriculture, horticulture, animal husbandry, fisheries and the allied processing industry, information technology and start-ups. These measures can generate a demand, market, profits and potentially aspirations of youth in agriculture.

Agriculture and Nutrition Linkages

An emerging area of research relates to linkages between agriculture and nutrition. Nutrition is determined by several factors such as agriculture development, health, sanitation, safe drinking water, women empowerment etc.⁶¹ Researchers say that agriculture, women empowerment and health contribute 1/3rd each to the nutritional status. However, in India, the linkage between agriculture and nutrition is less explored area as compared to other subjects, "Agricultural initiatives alone cannot solve the nutrition crisis in India but they can play much bigger role toward that end than they have done thus far" (p.1, Gillespie and Kadiyala, 2011). Agriculture is a key driver of poverty reduction, but pathways to nutrition are diverse and interconnected (Box 1). Dev and Kadiyala (2011) discuss three entry points namely, importance of agriculture for inclusive growth, agriculture for diversification of diets and role of women in agriculture.

Box 1: Agriculture-Nutrition Pathways

- 1) Agriculture as a source of food
- 2) Agriculture as a source of income
- 3) Agricultural policy and food prices
- 4) Expenditure patterns: how income derived from agriculture is actually spent

Gender Dimension

- 5) Women's status and intrahousehold decisions and resource allocation
- 6) Women's ability to manage young child care
- 7) Women's own nutritional status

Source: Gillespie and Kadiyala 2011.

Agriculture for Inclusive Growth

At the policy level, achieving inclusive growth in agriculture is important for strengthening the linkages between agriculture and nutrition. Agriculture development is part of any inclusive growth strategy in India (Dev 2008), as the majority of the population depends on agriculture for their livelihoods. However, inequalities in agriculture can weaken the agriculture-nutrition linkages. "Inclusiveness and equity in agriculture can be achieved by increasing agricultural productivity in rainfed and resource poor areas, thereby raising the productivity and income of small and marginal farmers" (Dev and Kadiyala, 2011). The bulk of the rural poor, as well as small and marginal farmers lives in such resource-poor areas, where undernutrition is concentrated as well.⁶²

Agriculture for Diversified Diet

The fact that consumption patterns have been changing towards non-cereals presents a good opportunity for farmers to diversify their cropping patterns in order to improve both incomes and nutrition. Agricultural diversification can partly improve diet diversification although there is no one to one relationship between the two. Several women and children suffer from micro-nutrients such as iron, iodine, zinc, vitamin A and vitamin B12. Biofortification is one way of access to micronutrients. We should also promote naturally biofortified crops such as sweet potato, moringa (drumsticks), bread fruit and various berries which are rich in micronutrients (Swaminathan and Kesavan, 2016). Farming system research (FSR) is needed to strengthen linkages between agriculture and nutrition. This will involve crop-livestock-fish integration in research. FSR will help in providing balanced diet with the introduction of dairy, poultry, fish and other animal protein along with cereals. The importance of agricultural value chains and food systems for improving food and

nutrition is well recognised now.⁶³ The nutrition value and safety of foods should be enhanced along the value chains.

Women Empowerment and Nutrition

Improving the productivity of women farmers as well as income levels of women agricultural labourers is crucial for contributing to improved nutrition. The profound gender bias in the functioning of institutions for information, extension, credit, inputs and marketing needs urgent correction, taking into account their mobility, domestic responsibilities and social constraints. Women's cooperatives, producer women's groups and other forms of group efforts should be utilised to encourage production and consumption of nutrient rich foods, enable women and their children access health and nutrition services and for catalysing critical behaviour change for optimal health and nutrition outcome in the long-run. While linking women in agriculture to Mahatma Gandhi Rural Employment Guarantee Scheme (MNREGS) is certainly in the discourse,⁶⁴ these linkages need to be operationalised and tightened.

Conditions under which women are employed (for example, prolonged exposure to fertilisers, pesticides, long working hours) and the support systems to strengthen women's capacity to care for themselves and their children are of utmost importance. Easy access to maternity entitlements, optimum quality day care facilities for children within the community and /or at place of work is critical to strengthen caring capacity and translate higher incomes into health and nutrition benefits (Dev and Kadiyala, 2011).⁶⁵

4.6. Policies on Sustainability and Climate Change

Sustainability of agriculture is becoming much more important now. A crucial step is to provide farmers with a policy environment that will make agricultural growth more sustainable. It also includes review of water, energy and fertiliser subsidies that encourage unsustainable resource use. This is particularly important encouraging agricultural producers to adopt specific technologies that increase agricultural productivity and enhance environment sustainability.

One can achieve higher agricultural growth but it has to be sustainable in terms of using lower resources and less input growth. 12th Five Year Plan report provides the trends in outputs, value added, inputs and factor productivities since independence. These trends are given in Table 24. One can derive interesting findings from this table as given below.

(a) Growth of total value of output in agriculture (crop and livestock) during the 11th plan at 3.8 per cent per annum was the highest as compared to earlier periods since independence. It was also the highest for pulses, fibres, all crops and livestock. The growth rates for all the crop aggregates are higher for 11th plan as compared to those of 9th and 10th plans.

TABLE 24. GROWTH OF OUTPUT, INPUTS AND PRODUCTIVITY: ALL INDIA
(PERIOD AVERAGES OF ANNUAL GROWTH RATES)

(1)	Pre-green revolution 1951/52 to 1967/68	Green revolution 1968/69 to 1980/81	Wider coverage 1981/82 to 1990/91	Early liberalisation 1991/92 to 1996/97	Ninth plan 1997/98 to 2001/02	Tenth plan 2002/03 to 2006/07	Eleventh plan 2007/08 to 2011/12
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I. Value of output (2004/5 prices)							
All Crops	3.0	3.0	3.0	3.1	2.3	2.1	3.4
Livestock	1.0	3.3	4.8	4.0	3.6	3.6	4.8
Crops and livestock	2.5	3.0	3.3	3.3	2.6	2.5	3.8
Fishing	4.7	3.1	5.7	7.1	2.7	3.3	3.6
Forestry	1.7	-0.2	0.3	0.3	2.7	1.3	2.3
Agriculture and allied	2.3	2.4	3.0	3.1	2.6	2.4	3.6
II. Value of Inputs (2004/5 prices)							
All inputs crops and livestock	2.4	4.5	2.2	1.9	3.0	2.5	4.4
Inputs for fishing	4.6	3.3	5.4	6.5	2.7	1.5	3.5
Inputs for forestry	1.7	-0.2	0.1	0.3	2.6	1.3	2.3
All inputs agriculture and allied	2.3	3.9	2.1	1.9	3.0	2.4	4.3
III. Gross value added (2004/5 prices)							
Crops and livestock	2.7	2.7	3.7	3.7	2.5	2.5	3.5
Fishing	4.7	3.0	5.8	7.2	2.7	3.6	3.7
Forestry	1.7	-0.2	0.4	0.3	2.8	1.3	2.3
Agriculture and allied	2.5	2.4	3.5	3.7	2.5	2.4	3.3
IV. Factor inputs into agriculture land (gross cropped area)							
Land	1.3	0.4	0.8	0.3	-0.1	0.6	0.3
Labour	1.8	1.1	0.5	2.3	0.3	0.5	-1.5
Net fixed capital stock	2.3	3.6	2.8	3.1	3.4	4.7	6.0
Of which: public	---	---	3.9	2.0	1.4	2.3	3.6
Of which :private	---	---	1.4	4.3	5.1	6.6	7.5
V. Partial factor productivities (2004/5 prices)							
Land productivity	1.2	2.0	2.7	3.3	2.6	1.8	3.1
Labour productivity	0.7	1.4	3.0	1.4	2.2	1.8	4.8
Capital productivity	0.2	-1.1	0.7	0.6	-0.9	-2.4	-2.7

Source: p.6, Vol. II, 12th Five Year Plan, Government of India.

(b) Growth in intermediate inputs for agriculture and allied activities was the highest for 11th plan at 4.3 per cent per annum compared to 3 per cent and 2.4 per cent respectively for 9th and 10th plans. The growth rates for all the inputs were higher in 11th plan compared to those for 9th and 10th plan. In other words, the high growth rate is accompanied by high input growth which is not sustainable.

Soil quality improvement is one of the major issues for sustainability. Many state governments have recognised the need for improvement in soil health. Similarly water management is another issue for sustainability. India exports rice in large quantities. It is known that rice is a water intensive crop. In other words India is exporting water in terms of rice exports.

In a lecture, Subramaniam (2018) says that "I would urge the CACP in its MSP calculations to quantify not only the private costs and returns of various crops but also their true social costs. For example, the social cost of cultivating rice in north-

western India far exceed private costs because of damage to soil quality, depletion of water tables, damage to human health, and spewing of pollution into the atmosphere” (p.16).

The need for adopting the methods of an evergreen revolution has become very urgent because of sustainable concerns. According to Swaminathan (2010) there are two major pathways to fostering an evergreen revolution. The first one is organic farming. But, so far the experience shows that although we have the practice of organic farming in several pockets of India, the production under organic farming is not significant compared to overall crop production in the country. There is a need for improving organic farming in different parts of India. The second pathway to achieve evergreen revolution is green agriculture. In this case, 'ecologically sound practices like conservation farming, integrated pest management, integrated nutrient supply and natural conservation and enhancement, are promoted' (p. 21, Swaminathan, 2010).⁶⁶

Food safety is another concern for countries like India. We have problems in crop production and allied activities. Severe pesticide is being used in fruits and vegetables, and antibiotics in chickens. More nutritious foods like animal sources, fruits and vegetables have food safety problems. Similarly, maize, groundnut, sorghum have aflatoxin problems. Notwithstanding the focus on market-based solutions, it is likely that specific, well-targeted interventions will be required to support poor people on food safety. The targeting should consider opportunities for groups of poor people to benefit including comparative advantage for certain foods such as dairy or vegetables. Livestock sector should also be focused to help the poor regarding food safety.

Climate Change and Agriculture

We have discussed above (in Section III) that climate change would have adverse impact on Indian agriculture. What are the policies needed to face the impact of climate change? Economic Survey 2017-18 says that India needs to spread irrigation against a backdrop of rising water scarcity and depleting groundwater resources. India pumps more than twice as much groundwater as China or United States (Government of India, 2018). There is a need to review of power and water subsidies.

Agriculture is the sector most vulnerable to climate change.⁶⁷ Consistent warming trends and more frequent and intense extreme weather events such as droughts have been observed. The recent IPCC Special Report (IPCC 2018) has indicated that global warming is likely to reach 1.5°C between 2030 and 2052 if it continues to increase at the current rate. Limiting global warming to 1.5°C is projected to reduce risks to marine biodiversity, fisheries, and ecosystems. Populations at disproportionately higher risk of adverse consequences of global warming of 1.5°C and beyond include disadvantaged and vulnerable populations, some indigenous peoples, and local communities dependent on agricultural or coastal livelihoods

(IPCC 2018). It is well known that we need adaptation and mitigation strategies regarding impacts of climate change.

Climate-Smart Agriculture: FAO (2010) discusses the strategies needed for climate-smart agriculture. It is defined as agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes GHGs (mitigation), and enhances achievement of national food security and development goals.

It provides examples of climate-smart production systems such as soil and nutrient management, water harvesting and use, pest and disease control, resilient eco systems, genetic resources etc. It also discusses about efficient, harvesting, processing and supply chains. Efficient harvesting and early processing can reduce post-harvest losses and preserves food quantity, quality and nutritional value of the product (FAO, 2010). This approach also ensures better use of co-products and by-products, either as feed for livestock, to produce renewable energy in integrated systems or to improve soil fertility.

The report says that ‘there is a need for policies, infrastructures and considerable investments to build the financial and technical capacity of farmers (especially small holders) to enable them to adopt climate-smart practices that could generate economic rural growth and ensure food security’ (p.4, FAO, 2010). The report says that agriculture in developing countries must undergo a significant transformation in order to meet the related challenges of food security and climate change. Effective climate-smart practices already exist and could be implemented in developing country agricultural systems. For small holders, climate smart agriculture offers a triple-win strategy: (a) improving small holder productivity for nutrition crops; (b) help small holders to adapt to climate change; (c) mitigate agriculture’s contribution to climate change (Nawanze and Fan, 2016).⁶⁸

There is a need for an effective climate resilient agriculture (CRA) in India.⁶⁹ Three main issues are discussed here.

First, there is a need for diversified cropping systems in view of climate related risks. For example, cultivation of pulses can be an important strategy for CRA. Pulses are legumes which improves soil fertility. Thus, diversification to pulse cultivation can lead to win-win situation in terms of attaining self-sufficiency and raising soil fertility.⁷⁰ 2016 was the international year of pulses. Three-fourths of the total area under pulses is in the states of Madhya Pradesh, Maharashtra, Rajasthan, Gujarat, Andhra Pradesh, Karnataka and Uttar Pradesh. Pulses are grown largely in rainfed areas as only 16 per cent of area is irrigated. Diversification to pulses is thus a good strategy for CRA particularly in rainfed areas.⁷¹

Second one is crop insurance which can be used as one of the strategies for CRA. In this context, *Pradhan Mantri Fasal Bhima Yojana (PMFBY)* introduced by the Central government is in the right direction. There are many features in the new crop insurance scheme which makes it different from earlier schemes. It has been mentioned that the new crop insurance can be a game changer if the conditions of low

premiums and the SI covering the GVO are met along with quick claim settlements with mobile and satellite technology (Damodaran, 2016).

MGNREGA can be another instrument for drought proofing and CRA. Agricultural and livelihood vulnerability indices developed showed reduction in vulnerability due to implementation of works under MGNREGA and resulting environmental benefits (Esteves *et al.*, 2013). A study on MGNREGA works in Maharashtra shows 87 per cent of the works exist and function and over 75 per cent of them are directly or indirectly to agriculture (Narayanan *et al.*, 2014). These works included land levelling (10 per cent), wells (77 per cent), farm ponds (9 per cent), bunding (12 per cent), irrigation channels (5 per cent), and trenches (5 per cent). A majority of the water works on common lands comprised check dams, followed by bunds and dykes. MGNREGA thus can help as an important strategy for CRA.

The third issue relates to the role of research and extension system in promoting CRA. Research leads to development of climate resilient technologies and extension system will promote them among farmers. There have been some initiatives recently. For example, the National Initiative of Climate Resilient Agriculture (NICRA) was initiated in 2011 by ICAR. The project aims to enhance resilience of Indian agriculture to climate change and climate vulnerability through strategic research and technology demonstration. The research on adaptation and mitigation covers crops, livestock, fisheries and natural resource management. The project has made significant initial impact and was well received in most of the districts. Technologies such as on-farm water harvesting in ponds, supplemental irrigation, introduction of early maturing drought tolerant varieties, paddy varieties tolerant to sub-mergence in flood prone districts, improved drainage in water logged areas, recharging techniques for tube wells, site specific nutrient management and management of sodic soils, mulching, use of zero till drills were enthusiastically implemented by the farmers in NICRA villages across the country (ICAR, 2016). Much more research and extension are needed to have effective CRA particularly in the current environment of climate risks. Thus, diversification, crop insurance, research and extension can become important strategies for climate resilient agriculture.

Conservation Agriculture: It is developed as an alternative to conventional production systems. The spread of conservation agriculture (CA) is largely concentrated in the rice–wheat system in the Indo-Gangetic Plains of the country. The zero-till wheat after rice is the most widely adopted conserving agricultural technology in the Indian Indo-Gangetic Plains. Thus it has become the predominant CA based cropping system. Zero-till wheat has the advantage of significant costs savings and potential yield increase (Government of India, 2017). There are many benefits due to conservation agriculture. These are (a) enhance livelihood security; (b) reduce soil erosion; (c) more carbon sequestration; (d) enhance resource use efficiency; (e) improve soil health; and (f) minimise green house gas emissions (Government of India, 2017).

Zero Budget Natural Farming (ZBNF): This natural farming has been promoted by Subhash Palekar.⁷² Nearly 5 million farmers seem to have adopted ZBNF so far. It does not use fertilisers and pesticides. It only uses natural resources like soil, water, air and, cow urine. Andhra Pradesh has become the first state to adopt ZBNF. The state plans to spread this technology to 6 million farmers by 2024. Unlike the chemical farming, the ZBNF does not add to green house gas emissions. It is important to scale up ZBNF to different parts of India to improve incomes, environment, adapt and mitigate to climate change.⁷³

Vegetarian Vs. Non-Vegetarian Food and Climate Change

Studies have shown that meat and dairy consumes lot of resources and contributes greenhouse gas emissions. Lot of grains are used as feedstock for livestock. “Livestock has the world’s land footprint and is growing fast, with close to 80 per cent of the planet’s agricultural land now used for grazing and animal feed production, even though meat delivers just 18 per cent of our calories” (p.1, The Guardian, 2018). In a report, experts warn that Europe must halve meat and dairy consumption by 2050 to reduce GHG emissions. It also advocates taxes and subsidies to discourage livestock products harmful to health, climate or the environment (The Guardian 2018). In the case of India, meat and livestock will increase with rising incomes. Vegetarianism helped to some extent consuming less natural resources. The per capita meat and dairy consumption in India is not as high as those of developed or some of the developing countries. However, India has to keep in mind that it has to adopt sustainable practices regarding meat and livestock items.

Consumption and Climate Change: There are two types of inequalities regarding consumption patterns and impact on climate change. First one is that the inequality in consumption patterns between advanced countries and developing countries. The developed countries have historical responsibilities. Second one is inequalities in consumption patterns between rich and poor in India. The consumption of the rich in India is more or less equal to the rich of the advanced countries. The rich in India have to contribute much more for sustainable development and climate related issues.

4.7 Institutions and Governance

Strengthening institutions and governance is crucial for achieving the growth, equality and sustainability of agriculture. Rigid institutions and inefficient governance are the primary cause of the poor implementation of various government programs. Inefficiencies, in turn, lead to increased subsidies in the agricultural sector. These institutions and old ways of governance thus need to be changed if agricultural performance is to be improved. Institutions throughout the agricultural value chains and food systems are important for better governance and effective implementation. They are also important for reducing inequality.

Institutional reforms are important particularly in the domain of public systems for transforming agriculture. We need institutional reforms for input and output markets, land and water management and sustainable agriculture.

Farmer Producer Organisations (FPOs): Collectives or producer organisations can help in having economies of scale in input and output marketing by organising the small farmers. They can participate throughout the value chain. Some of them are doing well. But, many FPO's are only on paper. There is a need to support them financially and strengthen the capacity of farmer producer organisations.

The increasing costs of purchased inputs, as well as the problems of quality in terms of sub-standard and spurious seeds and pesticides have also figured as the dominant proximate factors for the crop failures. This has also been recognised as a critical risk factor linked to distress of farmers. Therefore, appropriate institutions are important for delivery of inputs, credit and extension especially for small farmers. We already discussed about the importance of marketing.

Vaidyanathan (2010) who is critical of government policies, says that "There was hardly any change in the strategy for agriculture. It was hardly affected by the reforms. Policies continued as before to focus on large investments in irrigation and other infrastructure, and special programmes to increase rural employment" (p.32). He says that efficiency of investments has to be improved with institutional reforms rather than keep on increasing investments and subsidies.

Institutional factors are the key for improving efficiency in canal irrigation. Mere increase in water pricing may not result in financial sustainability unless institutions are in place to recover water charges (Reddy and Dev, 2006). Maintenance and management of canal systems through the participation of user societies is expected to contribute to an efficient and equitable distribution of water resources. Reforming institutional structures in favour of participatory irrigation management (PIM) and water user associations (WUA) have to be strengthened. Currently there are 56,539 WUA managing 13.16 million hectare of irrigated land (NITI Ayog, 2015). Only 15 States have enacted PIM Acts. However, successful functioning of WUAs is reported only in a few projects in Maharashtra, Gujarat, Andhra Pradesh and Orissa. In strengthening the PIM and WUAs, the only long term solution is awareness building and promoting participatory monitoring and evaluation.

Earlier studies have also shown that several institutions have been working on natural resources management.⁷⁴ Some examples are: (a) Common pool land resources: Tree Growers' Cooperatives, Joint Forest Management, Van Panchayats; (b) Watershed development: Ralegaon Siddhi village in Maharashtra under Anna Hazare; (c) Canal water: Water user associations; (d) Ground water: Pani Panchayats. We have to scale up some of these successful institutions for improving sustainability.⁷⁵

The importance of collective action in climate change adaptation and mitigation is recognised. Research and practice have shown that collective action institutions are

very important for technology transfer in agriculture and natural resource management among small holders and resource dependent communities.

Central and State governments have several agricultural programmes. An earlier evaluation advocates a four-pronged institutional approach to improve the performance of these programmes, including: (a) a credible institutional platform at the local (village and block) level, to serve as a link between the ultimate beneficiaries, the farming community, and the government agencies; (b) greater institutional focus on making available improved agricultural technology and on improving rural infrastructure; (c) a watershed programme, partnering with rural communities to deal with upland, degraded, and desertified areas; (d) more explicit partnership with the private sector at the state level (Raturi, 2011).

Reforms should involve more efficient delivery system of public services. Social mobilisation, community participation and decentralised approach are needed for better governance and implementation. It is recognised that decentralisation in terms of transferring power to local councils is important for agricultural development. For many state governments in India, decentralisation means devolution of power from centre to states. The experience of decentralisation in terms of greater devolution of functions, finances and powers to panchayati raj institutions (PRI) and urban local bodies in many states has not been satisfactory. The PRIs have to be strengthened for achieving growth with equity and sustainability.

Finally, the agriculture policies have to be formulated by taking the views of stake holders. There is a view that policy documents and five year plans had been prepared by the experts without understanding the stakeholders' viewpoints (Deshpande, 2016). Therefore, policies will be successful if farmer-centric decentralised approach is followed.

V

CONCLUSIONS

There are three goals of agricultural development. These are: (a) achieving high growth by raising productivity; (b) inclusiveness by focusing on lagging regions, small farmers and women; and (c) sustainability of agriculture. In order to achieve these goals, we have to provide medium term strategy and action plan. This lecture examines policies and reforms for attaining these goals. The ten conclusions of the lecture are given below.

(1) *Need for Change in Narrative in the New Context:* Basically, we have to change the narrative on agriculture towards more diversified high value production, better remunerative prices and farm incomes, marketing and trade reforms, high productivity with less inputs, cost effective, less chemical and pesticide based, inclusive in terms of women and youth farmers, small farmers and rain fed areas, nutrition sensitive, environmental friendly and sustainable agriculture. The five 'I's in

agriculture: Incentives, Investment, infrastructure, Institutions, Information' have to be modified to achieve the goals.

(2) *Global Trends and Macro Policies are Equally Important for Indian Agriculture*: There are many challenges at global level such as climate change, geo-political and urbanisation. These factors and anti-globalisation is the changing context for food systems and agriculture. Agricultural economists generally restrict to the policies relating to farm sector. However, there is a need to look at macro policies and non-agriculture.

(3) *We have to Walk on Two Legs (Agri. and Non-Agri.) in the Changing Context*: Rural areas are changing. We have to invest in agriculture for raising the livelihoods but simultaneously shift population from agriculture to non-agriculture over time. Thus, both agriculture and non-agriculture are important for raising income of farm households.

Two Agricultures: There are two types of agriculture in India – one is cereal based and the other one is non-cereal based.⁷⁶ Government policies have been biased towards cereals particularly rice and wheat. There is a need to shift from rice, wheat-centric policies to millets based and non-cereal focused policies to promote diversification of cropping patterns.

(4) *Doubling Farm Income (DFI)*: Estimates show that we need more than 10 per cent per annum growth in income to achieve DFI in 2022. Government seems to be banking on agriculture (crop+livestock) sector for DFI. But, as shown above, Government should also promote much more opportunities in non-farm sector in rural areas. Also, one has to take into account heterogeneity among different classes of farmers. Similarly, environmental aspects of doubling farm incomes have to be assessed.

(5) *Remunerative Price is the Most Important Factor for Farmers*: Even after 70 years of independence, we are not able to provide remunerative prices for farmers. Farmers have been getting low prices in normal, drought and good years because of distortions in price and marketing policies. Many reforms in marketing are needed.

(6) *Beyond Harvest and Freedom for Farmers*: Agriculture GDP+ indicates that we have to go beyond farming and develop value chain comprising farming, wholesaling, warehousing, logistics, processing, and retailing. Farmers want freedom from restrictions on market and exports. Private sector participation can be improved if some of the fears like the Essential Commodity Act, stock limit and export bans are removed. Banning exports hurts the farmers most. There have been new generation start-ups coming up in agriculture.

(7) *Do not Forget Basics like Water and Technology*: Basics like seeds, fertilisers, credit, land and water management and technology are important and they should not be forgotten. Similarly, investment in infrastructure and R&D are needed. But, we discussed the issues and policies in water and technology as both are crucial for agricultural development. Basically it is not investment alone but efficiency in water management in both canal and ground water is important. Some countries

invested more in technology, extension, education, transport, energy and institutions. India is trailing behind in all these areas.

(8) *Inclusiveness for Broad Based Growth and Equity*: Inequalities in agriculture are high. There is a need to focus on small and marginal farmers, women, youth, rainfed areas, Eastern and other lagging regions, social groups like SC and ST farmers. We discussed policy issues in each of these elements of inclusiveness in agriculture. The role of women in agriculture has been increasing. Women collectives and group farming can be encouraged to benefit female farmers. An emerging area of research relates to linkages between agriculture and nutrition. There can be three entry points namely, importance of agriculture for inclusive growth, agriculture for diversification of diets and role of women in agriculture for strengthening agriculture-nutrition linkages. Farmer households spend considerable amount of money on health and education. In fact, health expenditures on catastrophic illness lead to indebtedness in agricultural households. Otherwise, governments have to provide farmers income similar to universal basic income.

(9) *Measures to Take Care of Impacts of Climate Change and Improving Resilience in Agriculture and Sustainability*: One can achieve higher agricultural growth but it has to be sustainable in terms of using lower resources and less input growth. Resilience in agriculture has to be improved. Climate smart agriculture is being discussed throughout the world to reduce GHG emissions and increase resilience. FAO says that there is a need for raising technical capacity of farmers particularly small holders to enable them adopt climate-smart agricultural practices. Conservation agriculture and zero budget natural farming are some of the methods that have to be used as part of adaptation and mitigation measures for climate change.

(10) *Institutions and Governance*: Strengthening institutions and governance is crucial for achieving growth, equality and sustainability of agriculture. Institutions throughout the agricultural value chains and food systems are important for better governance and effective implementation. They are also important for reducing inequality. There are several examples of best practices in institutions relating to alternative markets, contract farming, self help groups, farmer federations, farmer producer companies, women collectives like Kudumbashree programme in Kerala, self help groups of women, institutions relating to canal and ground water irrigation and natural resource management. We have to scale up some of these successful institutions for improving agricultural development.

To conclude, agriculture is a state subject according to the Indian constitution. States have to play active role along with central government in achieving the three goals of growth, inclusiveness and sustainability. Achieving high growth is important. But, growth without inclusiveness and sustainability will not be useful. Agriculture transformation has to be viewed more holistically in terms of rural transformation and urban linkages. There is a need to give big push for Indian agriculture for transformation and achieving farmers' welfare.

NOTES

- 1) See ISAE (2016) for the volume on post-reform period
- 2) I am grateful to N. Chandrasekhara Rao for useful suggestions on an earlier draft.
- 3) Recent book by Rodrik *et al.* (2017) examined the structural change and focused on change in terms of shifting from low productive to high productive sectors and change in terms of raising human capital.
- 4) Compact 2025 is an initiative for ending hunger and under nutrition by 2025. By building a knowledge base, promoting innovation, and bringing stakeholders together, Compact 2025 helps countries develop, scale up, and communicate policies and programmes to accelerate progress. For more details on Compact 2025, see their website <http://www.compact2025.org/>.
- 5) On linkages between agriculture and non-agriculture in India, see Rangarajan, 1982; Mythili and Harak, 2013 and Dev (2018).
- 6) On growth, equity and sustainability in Indian agriculture, see various Presidential addresses delivered at the annual conferences of the Indian Society of Agricultural Economics (ISAE, ed., 2016)
- 7) See various plan documents upto 12th Five Year Plan and reports of Niti Aayog.
- 8) See Martin (2018). On agriculture and economic development through global lens, see Pingali (2007)
- 9) Also see Fan (2018)
- 10) On inequalities and agriculture, see von Braun (2005) and Otsuka (2013)
- 11) See IFPRI (2017)
- 12) "Food systems encompass the entire range of activities involved in the production, processing, marketing, consumption and disposal of goods that originate from agriculture, forestry or fisheries, including the inputs needed and the outputs generated at each of these steps" (p.3. FAO, 2013)
- 13) See von Braun (2018)
- 14) In this report, the projections cover consumption, production, stocks, trade and prices for 25 agricultural products for the period 2018 to 2027.
- 15) On secondary agriculture, see Chengappa (2016).
- 16) In Table 1, growth rate includes the year 2014-15 which is part of NDA's period. Even if we exclude 2014-15, the growth rate is more or less same.
- 17) On terms of trade, see Dev and Rao (2015)
- 18) On demand projections, see Kumar and Joshi (2016).
- 19) This is based on NSS data on consumer expenditure.
- 20) On diversification at regional level, see Chatterjee and Kumar (2017).
- 21) These two surveys are not strictly comparable.
- 22) More on inequality, see Dev (2017). On growth, inequality and poverty linkages see Thorat (2016).
- 23) Himanshu *et al.* (2016) also provide estimates of income inequality in villages using longitudinal research
- 24) For details of the project and design of surveys, see www.agrarianstudies.org
- 25) On discrimination in agricultural markets see, Thorat and Sabharwal (2013)
- 26) This quotation was also given by Jeffrey Sachs in his foreword to the book
- 27) Farm sector also contributes to climate change by raising emissions. Agriculture alone contributed 13 per cent of total global GHG emissions in 2000. If we add emissions due to deforestation, agriculture's share would be 30 per cent to global emissions. The sources of emissions from agriculture are: 37 per cent from fertilisers (N₂O), 11 per cent from rice (CH₄), 32 per cent from livestock (CH₄), 13 per cent from residue burning and/or forest clearing and, 7 per cent from manure management (CH₄ and N₂O) (USEPA 2006).
- 28) On the role of agricultural economists in the emerging scenario, see Sen (2016). On Type 1 and Type 2 macro policies, see Goyal (2017)
- 29) See Datt *et al.* (2014) and Dercon (2015)
- 30) Also see Parikh *et al.* (2013)
- 31) This study provides eight insights on the relationship between agriculture, structural transformation and poverty reduction. Also see Ivanic and Martin (2018).
- 32) On agriculture productivity and rural non-farm sector, see Ritadhi and Madhur (2017)
- 33) On well-being of agricultural households, see Radhakrishna and Raju (2016). On agrarian prospects see Sen (2016a).
- 34) On earlier estimates of farmers' income, see Chand *et al.* (2015)
- 35) Some of the main programmes of the Government are: *Pradhanamantri Krishi Sanchayi Yojana*, *Pradhana Mantri Fasal Bhima Yojana*, Soil health cards, e-NAM (National Agricultural Market), *PM-AASHA* on marketing, fixing minimum support prices by 1.5 times to the cost of production (A₂+FL)
- 36) A study by Gulati and Saini (2016) is skeptical about achieving DFI. On estimates of farm income, also see Narayanamoorthy (2016).

- 37) Fan (2018a) says India must get people off farms to double farm income
- 38) Also see BIRTHAL *et al.* (2017)
- 39) On incentives and disincentives, see Dantwala (1967). On price policy, see Acharya (2016), Chopra (2016)
- 40) For details on these schemes see <http://pib.nic.in/newsite/PrintRelease.aspx?relid=183409>
- 41) For merit and demerits of these three schemes see Hussain (2018). Also see Ramaswamy (2018) on agricultural markets
- 42) On agricultural marketing reforms, see Mundle (2018)
- 43) On structural reforms in Indian agriculture, see Dev (2008a). On emerging trends in agriculture see Gulati (2009).
- 44) For a recent study, see Bathla *et al.* (2017)
- 45) For elaboration on water see Dev (2016). On water crisis in India see Gulati and Banerjee (2017).
- 46) On economics of flow irrigation, see Rath (2016)
- 47) On water reforms see, Shah (2016) and Vijayshankar (2016)
- 48) See Haque, Tajmul (2015)
- 49) See Lele *et al.* (2018)
- 50) On technology, see Pal *et al.* (2016), Ramasamy and Ashok (2016)
- 51) On inclusive growth, see Dev (2008) and Rao (2018). On strategies for rain fed areas see Raina (2012)
- 52) See Economic Survey 2016-17, Government of India.
- 53) The inverse relationship between farm size and productivity has been weakening over time. See Deininger *et al.* (2018).
- 54) On small farmers, see Swaminathan and Bakshi (2017), Himanshu *et al.* (2016) on small farmers based on village surveys. On agrarian crisis, see Reddy and Mishra (2010).
- 55) See Vaidyanathan (2010) for efficiency in investments. See Alagh (2013) for a discussion on future of Indian agriculture and Alagh (2017) on a vision for agriculture. On innovative input markets, see Singh (2015).
- 56) Narayanan (2015) examines productivity of credit in India
- 57) It also includes marginal farmers
- 58) See Hazell *et al.* (2007) on small farmers. Also see Vaidyanathan (2016) for the impact of slow down of agricultural growth on small, medium and large farmers.
- 59) On gender and land rights, see Agarwal (1994)
- 60) The NGO Deccan Development Society (DDS), for example, enables women from landless families to access various government programs to establish claims on land, through purchase and lease.
- 61) On triple burden of malnutrition, see Meenakshi (2016). Also see Pingali and Rao (2017)
- 62) Agricultural income also increases BMI of women (Rao and Pingali, 2018)
- 63) For transitioning to toward nutrition sensitive food systems in developing countries, see Pingali and Sunder (2017)
- 64) For a district level analysis on stunting, see Menon *et al.* 2018
- 65) On women empowerment and nutrition, see Dev *et al.* (2017).
- 66) On sustainability, also see Gerber and Raina (2018).
- 67) For an earlier study on climate change and challenges for India's poor, see Somanthan and Somanathan (2009).
- 68) See Babu *et al.* (2017)
- 69) Indian government has formulated National Mission for Sustainable Agriculture (NMSA) for enhancing agricultural productivity especially in rainfed areas focusing on integrated farming, water use efficiency, soil health management and synergizing resource conservation. This is also being used for climate change adaptation
- 70) On pulses see Joshi *et al.* (2017).
- 71) See Joshi (2016) on climate smart agriculture in India.
- 72) For details on ZBNF, see <http://www.palekarzerobudgetspiritualfarming.org/>
- 73) See Kumar, Rajiv (2018)
- 74) For details see Marothia (2016)
- 75) The Report of the Commission on 'Inclusive and Sustainable Development of Andhra Pradesh (CESS, 2016) provides some examples of the following best institutional practices in agriculture in India : (a) Building Alternative Markets: Rythu Bazars, SAFAL (Bangalore); (b)Contract farming: Broiler Poultry and Sam Agritech on grapes in Andhra Pradesh; (c) Farmer Federations: Timbaktu Collective in Anantapur district of A.P, Vegetable and Fruit Promotion Council Keralam (VFPCK); (d)Land lease for livelihood creation: Kudumbashree intervention in leasing and group farming; (e) Use of technology for price discovery: ITC e-Chaupal; (f) Building market infrastructure: Rural godowns by SHGs of small farmers in Germalam village, Erode district, Tamil Nadu; (g)

Strengthening Panchayati Raj Institutions: An experiment in grassroots democracy and self-rule in village Mendalekha Gadchiroli district of Maharashtra.

76) See Subrahmanian, 2018.

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