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AGRICULTURAL TRANSFORMATION IN INDIA: PROBLEMS AND PROSPECTS

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1. Introduction

One of the Millennium Development Goals of the U.N.O is reducing poverty by 50 per cent by the year 2015. India could however, reduce poverty by around 32 per cent in spite of the population increasing from 1028.74 million in the year 2001 to close to 1305 million (estimated as on 01-01-2016). The below poverty line population has declined from 407 million to 276 million during the period. The world to-day is endeavoring to achieve the ‘Sustainable Development Goals’ or ‘Global

Goals' set by the UNO by the year 2030. Poverty eradication is again the pioneering slogan of the UNO's Global Goals.

1.1 Millennium Development Goals (MDGs): 2000-2015

The **Millennium Development Goals (MDGs)** are the eight [international development goals](#) that were established following the [Millennium Summit](#) of the [United Nations](#) in 2000, following the adoption of the [United Nations Millennium Declaration](#). All 189 [United Nations member states](#) at the time (there are 193 currently), and at least 23 [international organizations](#), committed to help achieve the following Millennium Development Goals by 2015:

1. To eradicate [extreme poverty](#) and [hunger](#)
2. To achieve [universal primary education](#)
3. To promote [gender equality](#) and empower women
4. To reduce [child mortality](#)
5. To improve [maternal health](#)
6. To combat [HIV/AIDS](#), [malaria](#), and other diseases
7. To ensure environmental sustainability
8. To develop a global partnership for development

1.2 Sustainable Development Goals (SDGs): 2016-2030

Sustainable Development Goals (SDGs): The Sustainable Development Goals, otherwise known as the Global Goals, build on the Millennium Development Goals (MDGs), eight anti-poverty targets that the world committed to achieving by 2015. The MDGs, adopted in 2000, aimed at an array of issues that included slashing poverty, hunger, disease, gender inequality, and access to water and sanitation. Enormous progress has been made on the MDGs, showing the value of a unifying agenda underpinned by goals and targets. Despite this success, the indignity of poverty has not been ended for all. The 2030 Agenda comprises 17 new Sustainable Development Goals (SDGs), or Global Goals,

which will guide policy and funding for the next 15 years, beginning with a historic pledge to end poverty. Everywhere. Permanently.

1. **Poverty** - [End poverty in all its forms everywhere](#)
2. **Food** - [End hunger](#), achieve [food security](#) and improved nutrition and promote [sustainable agriculture](#)
3. **Health** - Ensure healthy lives and promote [well-being](#) for all at all ages
4. **Education** - Ensure [inclusive](#) and [equitable](#) quality education and promote [lifelong learning](#) opportunities for all
5. **Women** - Achieve [gender equality](#) and [empower](#) all women and girls
6. **Water** - Ensure availability and sustainable management of water and sanitation for all
7. **Energy** - Ensure access to affordable, reliable, sustainable and modern energy for all
8. **Economy** - Promote sustained, inclusive and sustainable economic growth, full and productive employment and [decent work](#) for all
9. **Infrastructure** - Build resilient [infrastructure](#), promote inclusive and [sustainable industrialization](#) and foster [innovation](#)
10. **Inequality** - Reduce [inequality](#) within and among countries
11. **Habitation** - Make cities and human settlements inclusive, safe, resilient and sustainable
12. **Consumption** - Ensure sustainable consumption and production patterns
13. **Climate** - Take urgent action to combat [climate change](#) and its impacts
14. **Marine-ecosystems** - Conserve and sustainably use the oceans, seas and marine [resources](#) for sustainable development
15. **Ecosystems** - Protect, restore and promote sustainable use of terrestrial [ecosystems](#), sustainably manage forests, combat [desertification](#), and halt and reverse land degradation and halt [biodiversity](#) loss
16. **Institutions** - Promote peaceful and inclusive societies for [sustainable development](#), provide [access to justice](#) for all and build effective, accountable and inclusive institutions at all levels
17. **Sustainability** - Strengthen the means of implementation and revitalize the global partnership for [sustainable development](#)

India in 'its' quest to achieve 4 per cent annual rate of growth in agriculture to attain 'Faster, More inclusive and Sustainable Growth' all around during the 12th Five year Plan (2012-13 to 2016-17), has embarked on several ambitious programmes including infra-structure development, skill development, reach of banking services to all sections, pro-poor programmes and inclusiveness programme including health and education.

2. Growth and Performance of Indian Agriculture since Independence

Agriculture plays an important role in the Indian economy by providing employment and livelihood to rural people even though its contribution to the India's Gross Domestic Product (GDP) has declined. The share of agriculture in GDP has registered a steady decline from 36.4 percent in 1982-83 to 13.4 percent in 2013-14. Yet it provides employment to 52 percent of the workforce and contributes about 12.2 percent of national exports. India has achieved tremendous progress in agricultural production over time. The agriculture sector recorded phenomenal growth due to usage of improved technology, irrigation, and inputs apart from the implementation of various agrarian development policies and programmes. The advent of Green Revolution during the late sixties led to a rapid agricultural growth in India in terms of many-fold increase in food grain productivity. The major sources of agricultural growth are: public and private investments in agriculture and rural infrastructure including irrigation, technological change, diversification of agriculture and fertilizers.

In terms of growth, the performance of agriculture during the post-independence era has been impressive as compared to that during the pre-independence period. The all crop output growth of around 2.7% per annum in the post-independence period (during 1949-50 to 1999-00) was much higher than the negligible growth rate of around 0.4% per annum during the first half of the previous Century. As a result, India achieved self-sufficiency in food grains at the national level by mid-1970s. The growth in GDP in agriculture was around 2.2% to 2.5% per annum during 1950-51 to 1980-81. It recorded the highest growth rate of more than 3% per annum in the 1980s. During the post-reform period, the growth rate declined to 2.76% per annum. Growth in agriculture GDP, which was 4.7% per annum during Eighth Plan (1992-97), declined to 2.1% during Ninth plan (1997-2002) and to 1.8% per annum during Tenth Plan (2002-07). Thus, there has been a significant deterioration in the growth rate of agriculture since mid-1990s. However, there are signs of revival of agricultural growth to more than 3% per annum during the past few years. The Eleventh Plan, which had attempted to reverse

deceleration of agricultural growth during the Ninth and Tenth Plan, had some success in as foodgrains production has touched a new peak of 241.56 million tonnes in 2010-11 and growth in agriculture in the Eleventh Plan is likely to be about 3.3 percent per year. However, to achieve between 4 and 4.5 percent average growth in agricultural sector in the Twelfth Plan period adequate efforts were taken. The Twelfth Plan (2012-13 to 2016-17) had envisaged a growth target of 4 per cent for agriculture and allied sectors, necessary for the Indian economy to grow at over 8 per cent. During the last three years, the growth rates in agriculture have been fluctuating at 1.5 per cent in 2012-13, 4.2 per cent in 2013-14, and (-) 0.2 per cent in 2014- 15. According to the CSO (Central Statistics Office) estimates released on 8 February 2016, the growth in the ‘agriculture, forestry and fishing’ sector is estimated at 1.1 per cent in 2015-16 which was well below the 4 per cent target. The shortfall in growth in agriculture is explained by the fact that 60 per cent of agriculture in India is rainfall dependent and there have been two consecutive drought years in 2013-14 and 2014-15. Moreover, there are issues of expansion in irrigation and its efficiency, growth of capital formation in the sector has been declining and there is volatility in the markets, especially of prices, altering and distorting cropping patterns of some crops. This suggests that for the agriculture sector to achieve a target of 4 per cent, a significantly different approach has to be followed.

If we look at the value of output of various sub-sectors (Table 1), the crop sub-sector, which was growing at an annual rate of 1.8 per cent in the seventies, grew at the rate of 2.2 per cent in 1980s and 3.0 per cent in the nineties. Though the same growth in the crops was maintained, it fell short of the targeted growth rate of 4 per cent in the eleventh five year plans.

Table 1: Growth Rate in Output of Various Sub-sectors of Agriculture at 1999- 00 Prices, 1950-51 to 2008-09

| Period | Crop Sector | Livestock | Fruits & Vegetables | Non-Horticulture Crops | Cereals |
|--------------------|-------------|-----------|---------------------|------------------------|---------|
| 1980-81 to 1989-90 | 3.06 | 1.42 | 0.74 | 3.52 | 3.95 |
| 1960-61 to 1969-70 | 1.70 | 0.41 | 4.87 | 1.09 | 2.10 |
| 1970-71 to 1979-80 | 1.79 | 3.92 | 2.86 | 1.49 | 2.40 |
| 1980-81 to 1989-90 | 2.24 | 4.91 | 2.63 | 2.12 | 2.89 |

| | | | | | |
|--------------------|------|------|------|------|------|
| 1990-91 to 1999-00 | 3.02 | 3.79 | 5.95 | 2.07 | 2.24 |
| 2000-01 to 2008-09 | 3.06 | 3.90 | 3.35 | 2.89 | 2.31 |

(Per Cent/year)

However, the concern is regarding food crops. There was no growth in the output of cereal crops like rice, wheat, and coarse cereals. Similarly, there has been stagnancy in pulses and oilseed crops. The foodgrains output was 174.8 million tones (Mt) in 2002-03, 213.2 Mt in 2003-04, 198.4 in 2004-05 and 208.6 Mt in 2005-06. It was phenomenally increased by 244.49 Mt in 2010-11, 259.29 Mt in 2011-12 and reached the peak 264.77 Mt during 2013-14. Later, it was slightly declined to 253 Mt during the year 2015-16. This is a

Record with paddy and wheat production touching 104.8 Mt and 89 Mt, respectively.

| Year | Cereals | Pulses | Foodgrains |
|---------|---------|--------|------------|
| 1971-75 | 164 | 19 | 183 |
| 1976-80 | 172 | 18 | 190 |
| 1981-85 | 179 | 17 | 196 |
| 1986-90 | 182 | 16 | 198 |
| 1991-95 | 192 | 15 | 207 |
| 1996-00 | 191 | 14 | 205 |
| 2001-05 | 177 | 12 | 189 |
| 2004-07 | 174 | 12 | 186 |
| 2013-14 | 171 | 15 | 186 |

As shown in Table 2, per capita production of cereals, pulses and food grains declined significantly since the early-1990s.

| Years | Rice | Wheat | Coarse Cereals | Total Cereals | Total Pulses | Total Food grains | Oilseeds |
|--------------------|-----------------|-------|----------------|---------------|--------------|-------------------|----------|
| 1980-81 to 1985-86 | 1.67 | 2.10 | 0.27 | 1.69 | 1.49 | 1.63 | 1.08 |
| 1985-86 to 1990-91 | 1.75 | 1.38 | 3.75 | 2.52 | 0.96 | 2.12 | 3.13 |
| 1990-91 to 1995-96 | 0.73 | 0.92 | 0.90 | 1.11 | 0.29 | 1.08 | 1.57 |
| 1995-96 to 2000-01 | 0.65 | 0.85 | 0.59 | 0.86 | 0.08 | 0.95 | -0.53 |
| | 1.63 (0.24*) | -0.71 | 1.71** | 1.03 | 0.22 | 0.52 | 4.53 |

Table 3: Per Capita Production of food grains per Year (in kg)

Table 3: Growth Rate of Yields for Food grains and Oilseeds: 1980-81 to 2005-06

The major concern during the post-reform period is the decline in yield growth for both food grain and non-food grain crops (Bhalla, 2006). During the period 2000-01 to 2003-04, all crop output growth declined further to less than 1% per annum. Reduction was much higher for food grains than non-foodgrains.

Recent data given in Table 3 also indicate the story of yield slackness in a fairly telling manner. For the past five years, yield levels for most crops or crop-groups stood almost frozen, as shown by the 0.5% growth (lowest ever in recent times) per annum for food grains. Yield growth for rice showed fluctuations. The growth was 1.63% during 2001-02 to 2005-06, but declined to 0.24% during 2003-04 to 2005-06. Wheat recoded a negative growth in the past five years. Only the yield growth of oilseeds recovered during 2001-02 to 2005-06.

3. Agricultural Transformation

3.1 Agricultural Diversification and its Contribution to growth

This section presents the decomposition of agricultural growth by crop and source—area under

cultivation, prices, yields, and land reallocation or diversification—to quantify their contributions to growth. In the 1980s, agricultural growth was not centered on a few crops, but rather diverse crops. Cereals, oilseeds, and high-value crops each contributed 25–30 percent to overall agricultural growth. In the following decade, the contribution from high-value crops and cereals improved to 47 percent and 38 percent, respectively; oilseeds ceased to be a source of growth. During the 2000s, the contribution from cereals declined drastically to 15 percent and from high-value crops to 39 percent. In contrast, oilseeds, fiber crops (e.g., cotton), and sugarcane consolidated their shares during this period. There are considerable regional differences in growth trends, where crops and their contribution to growth are concerned; and there have been significant changes in their patterns of growth and their relative shares of growth. These differences can be explained by the relative changes in area, yields, and prices of different crops. For example, rice and wheat accounted for a larger share of growth in the northern region in the 1980s and the 1990s, mainly because of widespread cultivation of improved varieties and the availability of good irrigation infrastructure. Likewise, oilseeds have, by and large, remained concentrated in the southern and western regions, and their higher contribution to growth in the 1980s can be attributed to favorable policies.

The decomposition of agricultural growth by different sources, namely in terms of cultivated areas, yields, prices, and diversification indicates that yield improvements—a proxy for technological change—had been the main source of growth in Indian agriculture in the 1980s, when they contributed close to half to the overall growth. If the area effect on growth is trivial, this indicates the limited scope of bringing additional areas under cultivation. There is, however, a possibility of enhancing total cropped area through the intensification of land use. For example, about 60 percent of 142 million ha of net cropped areas in India remains fallow in the post-rainy season; this land can be brought under cultivation through investments in irrigation, infrastructure, and agricultural research and development. Prices are influenced by domestic and trade policies, and therefore, price-driven growth is neither sustainable, nor desirable because of its inflationary and distributional effects. In the case of India, government-set, ‘minimum support’ prices of rice and wheat have influenced agricultural growth more than any other commodity. Furthermore, small farmers do not benefit much from price increases of these crops since the benefits accrue in proportion of the marketed surplus, which is minimal with small farmers. On the other hand, the prices of high-value food commodities are market-determined.

Nonetheless, given the crucial role of prices in land reallocation and in balancing supplies and demands for various agricultural commodities, it is important to have appropriate pricing policies and regulatory mechanisms in place.

Diversification has emerged as an important source of growth in Indian agriculture in the past two decades. This can be attributed to the rapid growth in demand for high-value food commodities like fruits and vegetables that increased at an annual rate of 4.5 percent in the 2000s, compared to 3.0 percent in the 1980s. Demand-driven growth was supported by investments in public infrastructure (roads and markets) and favorable policies: (i) the food processing industry was deregulated in 1991; (ii) the limit to foreign direct investment (FDI) in food processing was gradually raised to 100 percent; (iii) agricultural markets were liberalized to allow private investment in markets; and (iv) it became easier for agro-processors to procure farm produce directly from producers outside the state-regulated agricultural markets, through institutions like contract farming or otherwise.

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3.2 Small farmer participation in high-value agriculture

Indian agriculture is dominated by small farmers. Small land holdings (≤ 2.0 ha) comprise 86 percent of total land holdings and occupy 44 percent of the land area. Their average size is small (0.53 ha) and is likely to further decline given the limited scope for land redistribution. Small farmers also make a larger contribution to the production of high-value crops: they contribute to as much 70 percent of the total production of vegetables, 55 percent of fruits, and 49 percent of spices, as compared to their share of 44 percent in total land area. Their share in cereal production is also significant: 62 percent in rice, 54 percent in coarse cereals, 52 percent in wheat, and 69 percent in milk production. These figures indicate that small farmers, despite being more diversified towards high-value commodities, are also the custodians of India's food security.

High-value agriculture is more remunerative and labor-intensive, but the capability of small farmers to diversify towards these is often doubted on several counts. First, the average size of small farmer landholdings may be too small to permit them to divert more land from staples towards high-

value crops at the cost of their household food grain security. Second, poor access to capital, technology, inputs, and information may inhibit their participation in the production of high-value commodities (BIRTHAL et al., 2007). Third, most high-value commodities are perishable, and therefore have greater production and market risks, which risk-averse small farmers are reluctant to bear. Fourth, their scale of production, hence their marketed surplus, may be too small to be remuneratively traded in the distant urban markets because of higher transportation and transaction costs (BIRTHAL et al., 2005). Fifth, small farmers may be excluded from supply chains given their low volumes, the difficulty to comply to food safety standards, and the higher management costs associated with dealing with large numbers of small-scale farmers. Even though the agri-food marketing system in India is gradually changing from an open marketing system to a vertically coordinated system that will benefit farmers, the fear is that small farmers will be left out.

3.3 Agricultural Credit

With access to institutional credit, farmers found agriculture to be more profitable. The following measures have been taken for improving agricultural credit flow and bringing down the rate of interest on farm loans: Farmers have been availing of crop loans up to 3 lakhs, with the effective rate of interest at 4 per cent per annum (who promptly repay their loans). In order to discourage distress sale of crops by farmers, the benefit of interest subvention has been made available to small and marginal farmers having Kisan Credit Cards against negotiable warehouse receipts (NWRs) at the same rate as available to crop loan. Andhra Pradesh is the first state in the country to promulgate an Act no.18 of 2011, (The Andhra Pradesh Land Licensed Cultivators Act, 2011) to provide loan and other benefits to the land licensed cultivators. The Government of Andhra Pradesh is implementing Rythu Scheme under which the Interest free Crop loans to all the farmers up to Rs. 1.00 lakh and Pavalu Vaddi for crop loans from Rs. 1.00 lakh to 3.00 Lakhs are given if repaid in time beginning with Rabi season of 2011. Similar schemes may be thought of in other states also.

3.4 Crop Insurance

With a view to insulate the farmers against the loss caused by adverse natural calamities, pests and diseases and to ensure credit worthiness for the ensuing season, various crop insurance schemes

were implemented from time to time wherein the premium was shared by State, Centre and farmers. Major agricultural and horticultural crops are covered under different crop insurance schemes currently to protect the farmers against natural perils. Participation of farmers however, in crop livestock insurance schemes are not widespread since the loss estimation is not individual based. Though it is going to be cumbersome, still the government should come forward with a scheme that would attract every farmer and the government contribution to meet premium and indemnity requirements may be kept at a substantial level considering the quantum of loan waiver in the past. When loans/ crops are insured, then the interest of the financial institutions and the farmers will be protected. The sorry state of affair relating to non-repayment of loans anticipating a loan waiver, will be removed which will be good and beneficial to all concerned in the long run.

3.5 ICT in Agriculture

Fast and effective transfer of technologies using the latest ICT tools and the pride of using electronic gadgets create the confidence amidst the farmers and ensure the needed information reach in time to take decisions with regard to crop planning and crop husbandry. TNAU Agritech portal (<http://agritech.tnau.ac.in>) holds around seven lakh pages in Tamil and English with content multiple media. This provides information on all aspects of agriculture in both Tamil and English has a very wide reader base. Video clippings on important technologies are being developed and disseminated through mobile phones and Television Programmes, other mass media including radio for better research. Technologies are also broadcast through Community Radio Stations to serve small hubs.

3.6 Micro irrigation

Micro irrigation technologies have a significant impact on resource saving, reduction in cost of cultivation and enhancement of crops yields, quality of produce and farm profitability. The recent data released by the Task Force on Micro-irrigation in India shows that during the past 4 years, peninsular India had recorded the highest growth in the adoption of drip systems. Maharashtra ranks first (22,358 ha), followed by Andhra Pradesh (17,556 ha) and Karnataka (16,731 ha). The major crops for which drip systems are currently adopted are cotton, sugarcane; banana, orange, grapes, pomegranate, lemon, citrus, mangoes, flowers, and coconut. In India, sprinkler systems are mainly used for field crops such as wheat, sorghum, pearl millet, groundnut and mustard. However, recently, farmers have started using micro-sprinklers and mini-micro-sprinklers for potato, groundnut and alfalfa. For a speedy

growth of micro-irrigation in the state, the financial institutions may be geared up to offer special loans for the installation of drip and sprinkler irrigation. This will encourage even the resource-poor marginal and small farmers to go for wider adoption of micro irrigation.

3.7 Institutional Changes

3.7.1 Agricultural Produce Marketing Committee (APMC) Act

Karnataka has taken all the necessary reforms given in Model APMC Act such as direct marketing, contract farming and marketing in private/ co-operative sectors initiatives and in addition the establishment of Rashtriya e-Market Services Limited (ReMS), a joint venture of Karnataka Government and NCDEX Spot Exchange Limited in February, 2014. The Unified Market Platform (UMP) has integrated farmers, traders, commission agents for all the regulated commodities in the state. ReMS offers automated auction and post auction process, assaying facilities in markets, facilitate warehouse-based sale of produce, facilitate commodity funding to benefit all stakeholders, price dissemination, secondary market development and capacity building for stakeholders through single licensing system, increased competition, easy and fast trading, better price discovery, etc. States like Andhra Pradesh and Maharashtra also try to emulate the success of Karnataka model which already implemented the Model APMC act completely. In Tamil Nadu, APMC Act has already provided scope for the reforms suggested by the Model Act to be made effective, but implementation of UMP is still under consideration. Since Kerala has not adopted the APMC Act, further reforms will become difficult to take place. The Government of India has allocated Rs. 200 crore for three years to set up an online National Agriculture Market by integrating 585 wholesale markets across India based on the success of Karnataka Model. The Council of State Agricultural Marketing Boards (COSAMB) which is an Apex body at National level can facilitate periodical interaction among regional SAMBs of all states at National level to better inform harvest seasons existing for crops in different states to farmers so as to help them make sale decisions and in the long run to participate actively in marketing to realize higher income. Farmers should be made aware that without marketing agriculture is incomplete.

3.7.2 Agri marketing and emergence of coordinated supply chains in India

Supply chain management (SCM) is the management of the flow of goods and services. It includes the movement and storage of raw materials, work-in-process inventory, and finished goods

from point of origin to point of consumption. The agri supply chains in India and their management are now evolving to respond to the new marketing realities thrown by the wave of globalization and other internal changes like rise in the level of disposable income of consumers, change in the food basket of the consumers towards high value products like fruits, vegetables and animal protein. The new challenges of the agricultural economy of the country have now spurred the government agencies to go in for different legal reforms for enabling and inviting private investment in agricultural marketing infrastructure, removing different entry barriers to promote coordinated supply chain and traceability.

The amended APMC Act, the major agricultural Marketing Act of the country, being implemented by the different states of India, now contains enabling provisions to promote contract farming, direct marketing and setting up of private markets (hitherto banned). These measures will go a long way towards providing economies of scale to the small firms in establishing direct linkage between farmers, and processors/ exporters/ retailers, etc. Thus, the measure will provide both backward and forward linkages to evolve integrated supply chains for different agri produce in the country.

3.7.3 Grower Associations for Empowerment

Horizontal integration of growers at village/ cluster of village level or based on crops grown by them and supporting them to form 'Growers Association' will help them articulate problems, prospects, inputs mobilization, marketing decisions, credit arrangements, etc. This would also lead to aggregation of produce and those greater volumes offering better storage and marketing options to ultimately enhance farm income.

3.7.4 Weather Forecasting and Price Forecasting

Medium range Weather forecasting is done by the Agro Climate Research Centre (ACRC) in TNAU, for the benefit of farmers to take crop husbandry decisions under weather based farming. During 2014-15, messages were sent to 19,44,562 registered farmers. Tamil Nadu Agricultural University renders Price forecasting and Market intelligence services through its Domestic and Export Market Intelligence Cell (DEMIC) and the information is also, spread through newspapers, extension organics radio and other mass media for 24 major Agricultural and Horticultural crops which help to

take decision on crop selection area allocation and timing of marketing of harvested produce.

3.7.5 Farm Extension reforms

Government of Tamil Nadu leads the country in effective utilization of ICT tools in agriculture under AGRISNET platform. TNAU launched Agri tech portal which disseminates all agricultural technologies to farming community and it further strengthens the Agriculture Extension delivery system. In order to implement farm level interventions through micro level planning and execution “Farm Crop Management System (FCMS)” software has been developed and launched in six districts of Tamil Nadu on pilot basis. It facilitates to narrow down the yield gap and easy access to information like weather, input availability, and farm based interventions, market intelligence and scheme benefits besides farm plans and input requirement at farmer level. Such kind of schemes /farm extension reforms should be implemented in the other states to increase the productivity.

4. Problems in Indian Agriculture

4.1 Low Productivity

The yield of the crops in the country is low in comparison to the international level. Per hectare output of most of the crops such as rice, wheat, cotton and oilseeds in India is much lower than that of U.S.A., Russia and Japan. The labour productivity in Indian agriculture is also very low in comparison to international level. The vast rainfed areas of the country, particularly dry lands which mostly grow coarse cereals, pulses and oilseeds have very low yields.

However, in the recent years the total food grain production, horticulture production and milk production have increased. The total food grain production which hovered around 197 to 230 million tonnes (m.t) during the period from 2000-01 to 2007-08, broken that barrier and increased from 234 m.t. in 2008-09 to 244 m.t. in 2010-11, 259 m.t. in 2011-12, 257 m.t. 2012-13 before reaching 265 m.t. in the year 2014-15.

In states like Tamil Nadu, the total food grain production has increased from 76 Lakh tonnes (L.T) in 2010-11 to 101L.T. in 2011-12 to 110 L.T. in 2013-14 and to 128 L.T. in 2014-15. This could be possible as a result of a systematic approach to crop planning by farmers because of soil test based nutrient information, price forecasting based crop planning, weather based crop advisory and all these information made available through mass medias and personalized SMS. Such an approach can be replicated for better effort at regional and national level.

4.2 Land Issues

Small Farm Size and Fragmentation of Landholdings: There are a large number of marginal and small farmers in the country. The share of marginal and small farmers accounted for around 85 per cent of operational holdings in 2010-11 as compared to about 62 per cent in 1960-61. Similarly, the area operated by small and marginal farmers has increased from about 19 per cent to 44.58 per cent during the same period. The average size of operational holding has declined to 1.15 ha in 2010-11 compared to 1.23 ha in 2005-06. The small and marginal holdings taken together constituted 85.01 percent in 2010 - 11 against 83.29 in 2005- 06 and the operated area stood at 44.58 per cent in 2010-11 against 41.14 per cent in 2005- 06. **Thus, the small holding character of Indian agriculture is much more prominent today than even before.**

Degradation of Cultivable Lands: One of the serious problems that arises out of faulty strategy of irrigation and agricultural development is degradation of land resources. This is serious because it leads to depletion of soil fertility. The situation is particularly alarming in irrigated areas. A large tract of agricultural land has lost its fertility due to alkalization and salinization of soils and water-logging. Alkalinity and salinity have already affected about 8 million ha land. Another 7 million ha land in the country has lost its fertility due to water-logging. Excessive use of chemicals such as insecticides and pesticides has led to their concentration in toxic amounts in the soil profile. Leguminous crops have been displaced from the cropping pattern in the irrigated areas and duration of fallow has substantially reduced owing to multiple cropping. This has obliterated the process of natural fertilization such as nitrogen fixation. Rained areas in humid and semi-arid tropics also experience degradation of several types like soil erosion by water and wind erosion which are often induced by human activities.

4.3 Decline in Public Investments in Agriculture

The main source of long-run growth is technological augmentation of yields, which could be obtained through concerted efforts of farmers, agricultural technologists and government departments. However, the technological gains are not evenly shared across different parts of the country. The nature of technology is such that it benefits mostly regions endowed with water resources, so the rained areas remain neglected. Agricultural growth has been decelerating across states since 1990s. This deceleration, although most marked in rained areas, occurred in almost all the states and covered

all major sub-sectors. Despite the impressive growth in food grain production and agriculture exports, the share of agricultural GDP was continuously declining from 19 per cent in 2004-05 to 13.4 per cent in 2013-14 (Constant prices). Many reasons could be attributed for the decline in the contribution of agricultural sector to development of the economy as a whole.

- The plan allocation for the development of agricultural and allied sectors was comparatively lesser than that of other sectors. During, ninth, tenth and eleventh plan, the actual plan expenditure for the agricultural development was 4 per cent, 3.8 per cent and 4.4 per cent of the total plan expenditure, respectively.
- The share of agricultural and allied sector to total Gross Capital Formation (GCF) was only 7.5 per cent in 2004-05 and it marginally increased to 7.7 per cent in 2012-13. The share of public capital formation in agricultural sector to total GCF is continuously declining from 6.7 per cent to 4.7 per cent while there was slight increase in private capital formation in agricultural sector for the period, i.e., from 7.8 per cent to 8.6 per cent. Thus, the lesser contribution of public capital formation than that of private capital formation in agricultural sector is a cause for concern.
- The Steering Committee Report on agriculture for 11th Plan (GOI, 2007a) has identified the possible reasons for deceleration in agriculture since mid-1990s. It looks like that the progress on all these sources slowed down in the 1990s particularly since mid-1990s. According to the report, the causes of slow down are: increase in subsidies crowding out investment in infrastructure, degradation of natural resources, failure in conservation and improvement of rain-fed land, knowledge gap with existing technology, low market infrastructure and too much regulation, institutions not geared to help women farmers, imperfections in land market and plight of small farmers.

4.4 Issues related to irrigation water

- The agriculture sector in India uses nearly 80% of the available water though the irrigation efficiency is only 20 to 50%. Average irrigation efficiency of the irrigation system, at present, is very low (canal irrigation system < 40% & ground water irrigation system 60%). Considering the fact that significant amount of water is wasted primarily due to inefficient use of irrigation water, the irrigation efficiency can be improved both at the storage level and at the

field level application.

- Key issues relating to irrigation water in the region that require research attention and development attention are, water scarcity during summer, intermittent floods, salinization of groundwater, inequality in water distribution, deterioration of water quality due to pollution, high intensity of aquatic weeds in waterways, interrupted power supply, and poorly maintained system tanks. The major research taken up includes; irrigation scheduling, alternate furrow irrigation, border strip irrigation, drip and sprinkler irrigations, mulching, alternate wetting and drying, System of Rice Intensification (SRI), paired row system, subsurface drip fertigation, recharge shaft, and conjunctive use of surface and groundwater. However, the research results are to be effectively transferred to the farmers' field.
- The adoption level of water management technologies by farmers is comparatively low. Only about 22% of the technologies/practices released by the research stations are adopted by the farmers. Given the poor adoption rate of the research station technologies (22%) and their poor financial returns (only 55% of them had a financial rate of return of more than 10%), the success rate of the water management technologies is only about 12%.
- In the southern region, the widely adopted technologies are irrigation scheduling, the alternate furrow method of irrigation, drip irrigation, sprinklers, and SRI. These technologies, by and large, have resulted in significant field scale saving in water and increase in yield of crops. The returns to water management research are varied from 16 % to 39 %. The drip method of irrigation is found to be a viable technology. However, considerable public support is required to enable farmers to adopt.
- The yield of crops under improved technologies/practices had registered a significant increase of 15% to 71% in Karnataka, 20% to 70% in Kerala, and up to 60% in Tamil Nadu, however, mostly on irrigated land and the lot of rainfed agriculture areas deserve attention.
- Constraints faced by farmers in adopting water management technologies are (i) high capital or initial investment, (ii) too technical to adopt, (iii) lack of skills, (iv) maintenance problems, (v) not matching with local situation.

4.5 Farmer's Suicides and Agricultural Policy

The unprecedented agrarian crisis in India has now been affecting farmers across the country for nearly a decade. Yet the policy responses, have been so intermittent and comprehensive measures to address the systemic problems are yet to be taken. While suicides are the most dramatic and ghastly expression of the desperation among the cultivating community, these should not distract from the other manifestations of what has become a deep rural depression. The point is that all this has not simply happened on its own, or because of some inexorable workings of fate in the form of the working of global markets, but because of policies pursued in the past decade and more that have denied cultivators basic protection and exposed them to unfair competition as well as enhanced exploitation by private companies and traders in different ways. While the issues are complex and require detailed investigation of each area, they generally reflect not only structural conditions but especially the collapse of public institutions that affects farmers and farming. It is evident that solutions to the current agrarian crisis require interventions in six important areas, which would do the following:

- Correction spatial inequities in access to irrigation and working towards sustainable water management
- Bring all cultivators into the ambit of institutional credit, including tenant farmers and even straightening out the commercial bank credit as now most agricultural loan are Jewel loans which are not covered by crop insurance and farmers face difficulties when the crop fails and they do not have other sources for consumption loans as Jewels are already pledged, besides depriving them of loans in the next season.
- Shift policies to focus on dry land farming through technology, extension, price and other incentives
- Encourage cheaper and more sustainable input use, with greater public provision and regulation of private input supply and strong research and extension support
- Protect farmers from high volatility in output prices
- Emphasize rural economic diversification, to more value-added activities and non-agricultural activities.

4.6 Climate Change

Climate change is likely to have a significant impact on the agriculture. In general, the faster the climate changes, the greater will be the risk of damage. Human society will face new risk and pressures. Food security is unlikely to be threatened at the global level, but some regions are likely to experience food shortages and hunger. Agronomic studies suggest that extensive warming could cause significant reduction in yield. Simulation studies also confirm that- if temperature rose by 4.0°C, the grain yield would fall by 25-40 per cent. Water resources will be affected as precipitation and evaporation patterns change around the world. Physical infrastructure will be damaged, particularly by sea-level rise and by extreme weather events. Economic activities, human settlements and human health will experience many direct and indirect effects. The poor and disadvantaged are the most vulnerable to the negative consequences of climate change. The impact of climatic change affects not only producers of food and fibre products, but also the supporting industries including seed, fertilizer and pesticide industries and their management and services.

The impacts are:

- Frequent weather extremes like droughts, floods, heat and cold waves are the inhibiting factors for stagnation in the food grains production.
- South India may require alternative crops or suitable genotypes tolerant to water stress, high temperature and water logged conditions.
- Spatial and temporal shift will occur in monsoon onset and distribution.
- Reduction in length of growing season due to late onset of rainfall or early withdrawal.
- Cropping season may shift from one to another
- Reduction in yield of major food crops -Risk on food security
- Surface water resources such as river and tank will be short termed.
- Spatial and temporal shift in rainfall season, quantity and distribution will result in spatial shift in crop potential, change in length of growing season, which will directly impact on food security.
- Frequent occurrence of droughts would warrant development of drought tolerant varieties to sustain agricultural production over the states.

- The frequency of cyclones is likely to increase as per the global projections. Tamil Nadu and Andhra Pradesh along the East coast are prone to cyclones.
- The C3 plants such as; wheat, rice, barley, groundnut, cotton, sugar beet, potatoes, chick pea, coconut, etc., will respond more favorably to increasing CO₂ than C4 plants such as Maize, sorghum, millet, sugarcane etc.
- The C4 crops account for 1/5th of the world's food production, maize alone accounts for 14 % of overall production.
- Climate change may bring a spatial shift in crop potential. Eg. Rice belts may replace maize and maize by soybean, etc.,
- Simulation studies also confirm that there will be yield increase in food grain production up to 2030 due to positive impact of CO₂, which nullify the negative impact of temperature. After 2050, food production would be under risk in South India.

5 Reforms Required: The Way Forward

5.1 Government Initiatives to invigorate Agricultural Growth

The centrally sponsored or central sector programmes implemented in tandem with State Governments such as; Rashtriya Krishi Vikas Yojana (RKVY), National Horticultural Mission (NHM), National Food Security Mission (NFSM), Watershed Development Projects, National Agricultural Development Programme (NADP), National Mission on Sustainable Agriculture (NMSA), National Mission on. Agricultural Extension and Technology (NMAET) focus on infrastructure creation for development and addressing production constraints to increase productivity. However, the components of these schemes are to be identified and finalized in consultation with the states so as to sustain production increases on long-term and cost effective basis.

Mechanisation suited to Indian conditions in terms of its farm size and soil type should be strategized and concerted efforts should be made to design and fabricate machinery as there is exponentially increasing demand to mechanise seed to seed operations. However, the progression should be planned in such way to smoothen the labour intensive operations from being difficult to easy before considering all operations so as not to drastically effect the process of moving labour out of agriculture.

5.2 Land related Issues

Unregistered cultivators, tenants, and tribal cultivators all face difficulties in accessing institutional credit and other facilities available to farmers with land titles. One priority is to record and register actual small and marginal cultivators including tenants and women cultivators, and provide passbooks to them, to ensure that they gain access to institutional credit and other inputs. Small and uneconomic holdings are at the root of many difficulties in the way of agricultural development and farmers' incomes. In order to improve the incomes of marginal and small farmers, there are suggestions to promote cooperative farming. Andhra Pradesh has some experiences in cooperative farming particularly in the case of women. One of the most interesting examples of this is the Deccan Development Society (DDS), an NGO working with poor women's collectives in some 75 villages in Medak district – a drought-prone tract of A.P. The DDS has helped women from landless families in establishing claims on land, through purchase and lease, using various government schemes. One such scheme of the Scheduled Caste Development Corporation in A.P. provides subsidized loans to landless scheduled caste women for buying agricultural land. Catalyzed by DDS, women form a group, apply for the loan after identifying the land they want to buy, and divide the purchased land among themselves, each women being registered as the owner of about an acre. Cultivation, however, is done jointly by each group.

Due to crop failure or poor crops, farmers' capacity to continue production is affected. Such situation pushes small and marginal farmers into the trap of money lenders that subsequently build up into agrarian distress. This can be checked by adequate and quick supply of institutional credit and making agricultural insurance accessible and affordable to all farmers. That would also protect the interest of farmer and financial institutions.

5.3 Water related Issues

Capacity-building programmes on water management technologies can be built in the extension programmes of the research stations, KVKs and State Agriculture departments in each region. The NGOs operating in different regions can also be roped in. The details regarding the additional costs and benefits of new technologies should be explained to farmers. Convergence of government programmes in technology transfer should be made so that scaling up of the technologies

will be easier through the involvement of different stakeholders, such as government departments, NGOs, the private sector, and farmers.

Water Users Associations (WUAs) to manage and maintain tanks are to be more active in resource mobilisation to manage and maintain tanks. Considering the importance of various institutions in relation to tank management, defining the roles of different organizations is crucial at this stage so as to achieve sustainable management of tanks. This will facilitate developing linkages between different organizations involved in natural resource management - tank management in particular, to resolve conflicts and promote proper maintenance and management of tanks.

5.4 Climate Change funds

Investment priorities must now be oriented towards realistic accelerated growth of agriculture for meeting the growing needs of the population. Therefore, public policies should be such that these trigger the much needed private sector investments for infrastructure development. Climate change has added a new dimension to future agricultural growth, which is a major concern. The worst affected would be small farm holders located in the marginal and under-privileged areas. Therefore, investment options for both adaptation and mitigation, and policies which can help in reducing the impact of climate change, are urgently needed at this stage, especially to provide incentives to the small farm holders for the adoption of technologies and practices such as conservation agriculture, carbon sequestration, etc., that can mitigate the impact of climate change.

Some of the recent initiatives on Climate Change

1. National Bank for Agriculture and Rural Development (NABARD) on Thursday got an accreditation from the Green Climate Fund (GCF) - a global multilateral fund that is meant to assist developing and poor countries in taking up their respective mitigation and adaptation measures to fight climate change. The funding will support a range of activities including installation of renewable (solar, wind and bio-mass) energy, enabling farmers to grow drought-resistant crops and reducing deforestation.
2. National Clean Energy Fund (NCEF): As on 31 May 2014, around 44 projects worth Rs.16,035 crore have been recommended for funding through the NCEF. The NCEF funds

eligible projects including innovative schemes like the Jawaharlal Nehru National Solar Mission's installation of solar photovoltaic (SPV) lights and small capacity lights, installation of SPV water pumping systems, SPV power plants, grid connected rooftop SPV power plants, pilot project to assess wind power potential, and generation based incentive schemes for grid interactive wind power projects.

3. India has been proactive in its approach to the carbon market and it represents a significant component of the global CDM (Clean Development Mechanism) market. As of 31 March 2014, 1493 out of a total of 7472 projects registered by the CDM Executive Board were from India, which so far is the second highest by any country in the world.

5.5 Farm Extension Reforms

To implement farm level interventions through micro level planning and execution by the Departments viz., Agriculture, Horticulture, Agricultural Engineering, Agricultural Marketing and TNAU, a specially developed software package "Farm Crop Management System" has been developed. FCMS is being implemented in six districts of Tamil Nadu on Pilot basis viz; Trichy, Coimbatore, Erode, Vellore, Virudhunagar and Tiruvarur to be expanded to cover all the districts. The information based crop management, considering price forecasting for crop planning, soil analysis and weather advisories for nutrient management and other crop husbandry activities can be replicated in wider areas.

Besides, Personal Digital Assistants (PDA) are being distributed to collect detailed data-base on field, inform availability of inputs such as; seeds, fertilizers, pesticides, bio-pesticides etc., record biometric observations of crops at critical stages to arrive estimated yield, pest and disease outbreak, improved cultivation technologies, individual based insurance settlement and linkages for marketing of harvested crops. the data will be used to narrow down the yield gap and to facilitate the farmers for easy access to information like weather, input availability, farm based interventions, market intelligence and scheme benefits besides knowing details of their own farm plan and inputs requirement.

Such kind of schemes /farm extension reforms should be implemented in the states to increase the productivity.

5.6 Role of Technology

In view of the stagnation in the growth rate of yield of many crops in recent times, new efforts are necessary to sustain the overall agricultural growth. Allocation for research and investment needs to be stepped up to break the yield barrier. Expansion of production frontier of the Indian agriculture at present depends on technological breakthrough in crop production, which scientists and policy makers often refer to as ‘second green revolution’ or ‘ever green revolution’.

The recent advances in biotechnology, nano-technology and agronomical practices like precision farming, System of Rice Intensification and SSI in sugarcane are part of the renewed scientific effort to break the yield barrier and increase productivity in agriculture. Biotechnology offers powerful new tools for improving agricultural productivity, environmental quality, and the nutritional quality of staple foods. At the same time, some applications of biotechnology raise concerns of safety, access, and equity in benefits. Development of biotechnology as a component of our strategy to increase agricultural productivity and economic growth hence, needs to be further explored.

Precision farming is an integrated agricultural management system which incorporates several technologies. At farm level precision farming techniques needs to be popularized to increase the input put use efficiency, productivity, and to reduce environmental pollution from agrochemicals.

Bringing in a technological breakthrough should be viewed in the context of changing behaviour of research funding, institutions and priorities among different stakeholders. Applicable technologies developed in richer countries may not be readily accessible because of intellectual-property protection of privately owned technologies. The emerging situation calls for new approaches and strategies in agricultural research management and in international cooperation in research and development.

5.7 Producing for the Markets

Transformations in the global food system are causing changes in food production and marketing. Economic growth in India as well as in Southern states has pushed up consumers' purchasing power and urbanization. This resulted in rising demand for food, and shifted food demand away from traditional staples and toward higher-value foods like meat and milk and towards ready-to-cook and ready-to-eat foods. There is a growing domestic market for horticultural produce, in both traditional and exotic vegetables. Production and marketing arrangements are responding to changing demand driven by urbanization and diet change. It is therefore useful to examine trends in consumption patterns and reorient the research and production pattern in agriculture by suitably incentivizing the production.

5.8 Agro processing

One of the important reasons for poor agricultural development is the persistent inability to make the necessary move up in the value chain (vertical diversification) and to develop alternative commodity chains (horizontal diversification). Such diversification is of primary importance to achieve higher growth in agricultural sector. Processing adds value and increases the time available for marketing. Access to processing technology can provide new market opportunities by reducing perishability. Small-scale agro-processing enterprises create employment at low levels of investment and make effective use of local resources. Processing also provides a more convenient and attractive product to consumers, who demand reasonably priced, safe, and high-quality food. The introduction of agro industrial products can also stimulate the growth of retail outlets, including supermarkets.

5.9 For establishing a national common market, the following reforms will have to be taken:

- Review and amend the APMC Act, Essential Commodity (EC) Act, Land Tenancy Act, and any such legally created structures whose provisions are restrictive and create barriers to free trade.
- Rigorously pursue alternate marketing initiatives, like direct marketing and contract farming with greater emphasis on food safety and traceability.
- Examine inclusion of agriculture related taxes under the General Goods and Services Tax (GST)
- Establish stable trade policy based on tariff interventions instead of non-tariff trade barriers.

- Develop and initiate competition in the agro-processing sector. Incentivize the private sector to scale up investments.
- In this scenario of bumper production and stocks, a paradigm shift in the role of the government in all aspects of food grain production and distribution is necessary.
- Promoting Farmer Producer Organizations in a large way is essential.

Conclusion

A strategic vision for agriculture must factor in three important elements: (a) India's National / Regional / State comparative advantage; (b) efficient markets at home and freer trade; and (c) environmental sustainability of the agricultural practices and activities. The agriculture sector, thus calls for, major reforms, from marketing to investment and institutional change, especially in water management, generation of new technologies, land markets and creation of efficient value chains, besides innovative ideas to make agricultural credit and insurance work.

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