



Revolutions, Innovations in Indian Agriculture System : A Review

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Abstract: With a population of 1.38 billion to feed in 2019, innovations in Indian agriculture all along the value chains are critical to develop sustainable, productive and profitable agriculture. In this paper focus laid on innovations in various production technologies, farming practices, policies and institutional engineering that had significant impact in raising production and have been termed as Revolutionary for Instance, Green Revolution is identified with significant changes in production of wheat and rice. White revolution in milk, blue revolution in fisheries, red revolution in poultry meat and eggs, golden revolution in fruits and vegetables, gene revolution in cotton. This paper also focus on innovations that currently unfolding another inputs in different production processes as like in irrigation, use of fertilizers, maintaining soil health, using of farm machinery in different fields of agriculture.

Key words : Innovations, Revolution, Agriculture, technologies, productivity.

Introduction : Innovations means employed the new idea, ideas and techniques in any field which beneficial for human kind. An agriculture there could be innovations in seeds that give higher productivity, protect plants from pests, are climate resilient may even contain more minerals, vitamins and proteins. There could also be innovations in application of water irrigation, fertilizers, pesticides etc which can give higher value from less quantities / costs. There could be innovations in farming practices that not only give higher productivity, but could save on costs or promote sustainable agriculture that can better withstand climate change. In fact innovations can go much beyond production technologies and get into the space of institutions that ensures effective implementation of policies. Thus innovations can spread all along the agrivalue chains of food, feed and fiber, from farm to fork, or more aptly in a demand driven system from “plate to plough”. It is important to recognize that starting from mid 1960s, Indian Agriculture has made significant strides in the production of cereals, milk, fisheries, poultry, fruits and vegetables and lately in cotton, where innovations in seed technologies, innovations in policies and institutions played instrumental role in driving the transformation.

This paper main focus on major transformations in Indian agriculture and deciphers the nature of innovations that were introduced.

Revolutions in agriculture :

- 1. Green Revolution :** Indian agriculture has been an industry of constant innovations. India inherited acute food scarcity after independence in 1947. In mid 1960s, it was caught in a back to back drought against this backdrop and scarcity India imported 18,000 tonnes of high yielding varieties (HYV) of wheat from Mexico Lerma Rojo 64-A and Sonara 64 that ushered in the famous green revolution in India. Key to success was not only innovative “miracle seeds” developed by Norman E-Borlaug but also Institutional Reform brought about through creation of Food Corporation of India (FCI) and Agricultural Prices Commission (APC) in 1965. Extensive irrigation and fertilizers usage, along with adaption of imported germplasm to innovative indigenous varieties like Kalyan Sona and Sonalika aided in the spread of green revolution in India. All Indian Coordinated Research Project (AICRP) worked continuously to further increase rice yields and produced Padma and Jaya, first Indian HYR varieties. IR8 and Jaya formed the back bone of India’s revolution in rice. Other innovations in seeds and farming technologies especially in rice production such as introduction of early maturity high valued Basmati (Pusa Basmati 1121 and Pusa Basmati 1509) system of Rice intensification, rice hybridization program, direct seeding, zero tillage etc. are largely contributing towards improved yields and efficient resource management. This is great move towards nutritional security as these innovations in biofortified foods can help alleviate malnutrition only when they are scaled up with supporting policies.
- 2. White Revolution (Milk) :** Another Big transformational change in Indian agriculture came through Institutional innovation of operation flood that ushered on the white revolution during 1970’s through mid 1990s and policy innovation of the de-licensing. The dairy sector in 2002, which has made India today the largest producer of milk in the world 176.4 MMT in 2017-2018. Varghese Kurien, who steered the operation flood innovated the institutions of small holders for Milk collection through a farmer’s co-operative structure.
- 3. Blue Revolution (Fisheries) :** During late eighties India experienced it’s blue revolution in fisheries sector. The real turn around on fisheries came from innovations in the development of genetically improved brooding stock, which led to the emergence of intensive carp culture during mid 1980s In marine segment Innovations in motorization of Indigenous crafts and mechanization of boats led to scaling up of operations. At present India is the second largest producer of fisheries in the world and sea food exports constitute the second largest share in the total agri-exports from India after rice.
- 4. Red Revolution (Poultry meat & eggs) :** Since 2000-2001, India’s poultry industry experienced significant shift in the structure and scale of operation leading to red revolution policy innovations such as liberalization of imports of grandparent poultry stock, contract farming modal transformed the poultry sector from a mere backyard activity into a major organized commercial one.

5. **Gene Revolution (Cotton)** : In case of fiber release of BT Cotton technology in 2002 the only genetically modified crop (GM) crop so far in the country paved the way for the gene revolution it has made the country, the largest producers with an estimated 37.2 million bales production in 2017-18 and second largest exporter of cotton in the world with 93.14% cotton area is under BT cotton.
6. **Golden Revolution (Fruits & Vegetables)** : During 2004-2005, with the implementation of the national horticulture mission (NHM). India experienced Golden Revolution in the fruits and vegetables segment of agriculture, but not as significant as compared to the green revolution of mid 1960s and the white revolution of 1970s. Systematic research work under public institutions such as ICAR, Indian Institute of Horticulture Research (IIHR), Central Institution of Sub Tropical Horticulture (CISH) etc. led the way towards cultivation of Hybrid fruit and vegetables crop. Innovations in tissue culture, ultra high density plantation (UHDP) drip irrigation, aeroponic system, etc. contributed majorly to this structural shift and record setting production. Globally, India today has the second place in production of fruits & vegetables, next only to China.

Innovations in agriculture technologies :-

1. **Microirrigation** : In India almost 54% of area faces high to extreme water stress of the total fresh water resources of the country, agriculture consumes more than 78% of water, given the extent of water stress and severely low water use efficiency (as low as 40% to 49%) In this situation innovations in micro-irrigation technologies (such as sprinkler and drip) accompanied by solar pump sets, hold the potential for improving water use efficiency (85% to 90%) and saving energy a good beginning in this direction has already been made with a steady growth in micro irrigation it was reported that water requirement of water guzzling crops like rice, sugarcane, banana and cotton under drip has been reduced to 45% to 50% less than what it is under flood irrigation solar pump sets, replacing diesel pump sets, could be a game changer innovations in saving costs of irrigation and improving profitability in cultivation. Innovation in uberization or custom hiring of solar pump sets operating under the principle of (pay as you go) makes better economic sense. Solar trees as a third crop on farmer's fields could also be a promising innovation in this regard.
2. **Uberization of Farm machinery**: In India, small holding land size (1.08 ha in 2015) pose serious challenges to adoption of modern technologies and farm mechanization. Given that, agriculture labour is becoming expensive, India is at an inflexion point of making major strides in the use of farm machinery. The on demand business model of "Uberization" of farm machinery and equipments, such as harvest combines and tractors, etc. is an innovative arrangement that make mechanization accessible and affordable to small farmers on the basis of "Pay you as per use" principle. Hi tech machinery hubs for high value crops like sugarcane, cotton, etc. established by Govt. of India and custom hiring centre has been setup. At the state level, Govt. of Karnataka, Andhra Pradesh, Madhya Pradesh, Uttar Pradesh

and Punjab are promoting CHCs on Public Private Partnership (PPP) Model with rising startups namely EM3, Trringo, Farmart, TAFE etc. coming forth.

3. **Soil Nutrient Management** : India is the second largest producer and consumer of urea in the world. Consumption of urea at all India level increased from 103.5 kg/ha to 149.3kg/ha over during the period 2000-2001 to 2016-2017 However imbalanced use of nitrogen in relation to phosphate and potash leads to environmental problems such as soil degradation, water pollution and green house gas emission. To combat these challenges Govt. of India launched two schemes are Neem Coating of Urea (NCU) and two, Soil Health Cards (SHCs). According to exports application of NCU slows down release of nitrogen from urea and reduces loss due to leaching. In a study titled “Impact of Neem coated urea on production, productivity and soil health in India (2017)” conducted by Agricultural Development and Rural transformation Centre (ADRTC) under Institute of Social and Economic Changes (ISEC) DES Ministry of Agriculture, It is observed that NCU Led to an increase in yields by 38% in Soyabean, 34% in red gram, 8% each in paddy and maize, 5% in sugarcane in 3% in jute crops. Both the approached NCU and SHCs are working towards ensuring improved soil management and efficient use of fertilizers.

Conclusion : In this paper we give focus on the types of Innovations in production technologies that Indian agriculture has experienced in the past with large scale impact and also those innovations that are unfolding in recent years, which may influence Indian agriculture in the years to come. In particulars focus was on innovations in seed technologies that led to green revolution and gene revolution in India. Innovations in institutions and technologies related to logistics of milk that led to white revolutions. Innovations in fishery and poultry, developing institutions of Vertical integration and contract farming which have transformed these sectors these innovations have already shown large scale impact and transformed Indian agriculture. The innovations that are unfolding now related to better use of water for irrigation, better use of fertilizers and better use of farm machinery through uberization model. These innovations give only flavor of what, is happening in Indian agriculture. The bottom line is that these innovations and revolutions in production technologies and institutions have turned India from a food deficit country to a net exporter of agri produce. The innovations that are unfolding in recent years and that are likely to accelerate in the years to come and focused not only in increasing productivity and overall production, but also ensuring better use of water, fertilizers, and farm machinery so that efficiency can be promoted along with sustainability.

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