

Progress and Performance of Agriculture in India

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Abstract—The history of agriculture in India dates back to the Rig-Veda. Today, India ranks second worldwide in farm output. Agriculture and allied sectors like forestry and fisheries accounted for 13.7% of the GDP (gross domestic product) in 2013, about 50% of the workforce. The economic contribution of agriculture to India's GDP is steadily declining with the country's broad-based economic growth. Still, agriculture is demographically the broadest economic sector and plays a significant role in the overall socio-economic fabric of India. India exported \$39 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide and the sixth largest net exporter. Most of its agriculture exports serve developing and least developed nations.

1. INTRODUCTION

As per the 2010 FAO world agriculture statistics, India is the world's largest producer of many fresh fruits and vegetables, milk, major spices, select fibrous crops such as jute, staples such as millets and castor oilseed. India is the second largest producer of wheat and rice, the world's major staples. India is the world's second or third largest producer of several dry fruits, agriculture-based textile raw materials, roots and tuber crops, pulses, farmed fish, eggs, coconut, sugarcane and numerous vegetables. India ranked in the world's five largest producers of over 80% of agricultural produce items, including many cash crops such as coffee and cotton, in 2010. India is one of the world's five largest producers of livestock and poultry meat, with one of the fastest growth rates, as of 2011.

One report from 2008 claimed India's population is growing faster than its ability to produce rice and wheat. Other recent studies claim India can easily feed its growing population, and produce wheat and rice for global exports, if it can reduce food staple spoilage, improve its infrastructure, and raise its farm productivity to those achieved by other developing countries such as Brazil and China.

India exported \$39 billion worth of agricultural products in 2013, making it the seventh largest agricultural exporter worldwide, and the sixth largest net exporter. This represents explosive growth, as in 2003 net export were about \$5 billion. India is the fastest growing exporter of agricultural products over a 10-year period, its \$39 billion of net exports is more than double the combined exports of the European Union (EU-

28). It has become one of the world's largest suppliers of rice, cotton, sugar, and wheat. India exported around 2 million metric tons of wheat and 2.1 million metric tons of rice in 2011 to Africa, Nepal, Bangladesh, and other regions around the world.

Aquaculture and catch fishery is amongst the fastest growing industries in India. Between 1990 and 2010, the Indian fish capture harvest doubled, while aquaculture harvest tripled. In 2008, India was the world's sixth largest producer of marine and freshwater capture fisheries and the second largest aquaculture farmed fish producer. India exported 600,000 metric tons of fish products to nearly half of the world's countries.

India has shown a steady average nationwide annual increase in the kilograms produced per hectare for some agricultural items, over the last 60 years. These gains have come mainly from India's green revolution, improving road and power generation infrastructure, knowledge of gains and reforms. Despite these recent accomplishments, agriculture has the potential for major productivity and total output gains, because crop yields in India are still just 30% to 60% of the best sustainable crop yields achievable in the farms of developed and other developing countries. Additionally, losses after harvest due to poor infrastructure and unorganized retail cause India to experience some of the highest food losses in the world.

2. HISTORY OF AGRICULTURE IN INDIA

Vedic literature provides some of the earliest written record of agriculture in India. Rigveda hymns, for example, describe plowing, fallowing, irrigation, fruit and vegetable cultivation. Other historical evidence suggests rice and cotton were cultivated in the Indus Valley, and plowing patterns from the Bronze Age have been excavated at Kalibangan in Rajasthan. Bhumivargaha, an Indian Sanskrit text, suggested to be 2500 years old, classifies agricultural land into 12 categories: urvara (fertile), ushara (barren), maru (desert), aprahata (fallow), shadvala (grassy), pankikala (muddy), jalaprayah (watery), kachchaha (contiguous to water), sharkara (full of pebbles and pieces of limestone), sharkaravati (sandy), nadimatruka (watered from a river), and devamatruka (rainfed). Some

archaeologists believe rice was a domesticated crop along the banks of the river Ganges in the sixth millennium BC. So were species of winter cereals (barley, oats, and wheat) and legumes (lentil and chickpea) grown in northwest India before the sixth millennium BC. Other crops cultivated in India 3000 to 6000 years ago, include sesame, linseed, safflower, mustards, castor, mung bean, black gram, horse gram, pigeon pea, field pea, grass pea (khesari), fenugreek, cotton, jujube, grapes, dates, jackfruit, mango, mulberry, and black plum. Indian peasants had also domesticated cattle, buffaloes, sheep, goats, pigs and horses thousands of years ago.

Some scientists claim agriculture was widespread in the Indian peninsula, some 3000–5000 years ago, well beyond the fertile plains of the north. For example, one study reports 12 sites in the southern Indian states of Karnataka and Andhra Pradesh providing clear evidence of agriculture of pulses (*Vigna radiata* and *Macrotyloma uniflorum*), millet-grasses (*Brachiaria ramosa* and *Setaria verticillata*), wheats (*Triticum dicoccum*, *Triticum durum/aestivum*), barley (*Hordeum vulgare*), hyacinth bean (*Lablab purpureus*), pearl millet (*Pennisetum glaucum*), finger millet (*Eleusine coracana*), cotton (*Gossypium* sp.), linseed (*Linum* sp.), as well as gathered fruits of *Ziziphus* and two *Cucurbitaceae*.

Some claim Indian agriculture began by 9000 BP because of early cultivation of plants, and domestication of crops and animals. Settled life soon followed with implements and techniques being developed for agriculture. Double monsoons led to two harvests being reaped in one year. Indian products soon reached trading networks and foreign crops were introduced. Plants and animals—considered essential to survival by the Indians—came to be worshiped and venerated.

The middle ages saw irrigation channels reach a new level of sophistication, and Indian crops affected the economies of other regions of the world under Islamic patronage. Land and water management systems were developed with an aim of providing uniform growth.

Despite some stagnation during the later modern era the independent Republic of India was able to develop a comprehensive agricultural programme.

3. AGRICULTURE AND COLONIALISM

Over 2500 years ago, Indian farmers had discovered and begun farming many spices and sugarcane. It was in India, between the sixth and fourth centuries BC, that the Persians, followed by the Greeks, discovered the famous "reeds that produce honey without bees" being grown. These were locally called Saakhar, pronounced as saccharum. On their return journey, the Macedonian soldiers carried the "honey bearing reeds," thus spreading sugar and sugarcane agriculture. People in India had invented, by about 500 BC, the process to produce sugar crystals. In the local language, these crystals were called khanda, which is the source of the word candy.

Before the 18th century, cultivation of sugarcane was largely confined to India. A few merchants began to trade in sugar — a luxury and an expensive spice in Europe until the 18th century. Sugar became widely popular in 18th-century Europe, then graduated to becoming a human necessity in the 19th century all over the world. This evolution of taste and demand for sugar as an essential food ingredient unleashed major economic and social changes. Sugarcane does not grow in cold, frost-prone climate; therefore, tropical and semitropical colonies were sought. Sugarcane plantations, just like cotton farms, became a major driver of large and forced human migrations in 19th century and early 20th century — of people from Africa and from India, both in millions — influencing the ethnic mix, political conflicts and cultural evolution of Caribbean, South American, Indian Ocean and Pacific Island nations.

The history and past accomplishments of Indian agriculture thus influenced, in part, colonialism, slavery and slavery-like indentured labor practices in the new world, Caribbean wars and world history in 18th and 19th centuries.

4. INDIAN AGRICULTURE SINCE 1947

In the years since its independence, India has made immense progress towards food security. Indian population has tripled, and food-grain production more than quadrupled. There has been a substantial increase in available food-grain per capita.

Before the mid-1960s India relied on imports and food aid to meet domestic requirements. However, two years of severe drought in 1965 and 1966 convinced India to reform its agricultural policy and that they could not rely on foreign aid and imports for food security. India adopted significant policy reforms focused on the goal of food grain self-sufficiency. This ushered in India's Green Revolution. It began with the decision to adopt superior yielding, disease resistant wheat varieties in combination with better farming knowledge to improve productivity. The state of Punjab led India's green revolution and earned the distinction of being the country's breadbasket.

The initial increase in production was centered on the irrigated areas of the states of Punjab, Haryana and western Uttar Pradesh. With the farmers and the government officials focusing on farm productivity and knowledge transfer, India's total food grain production soared. A hectare of Indian wheat farm that produced an average of 0.8 tons in 1948, produced 4.7 tons of wheat in 1975 from the same land. Such rapid growth in farm productivity enabled India to become self-sufficient by the 1970s. It also empowered the smallholder farmers to seek further means to increase food staples produced per hectare. By 2000, Indian farms were adopting wheat varieties capable of yielding 6 tons of wheat per hectare.

With agricultural policy success in wheat, India's Green Revolution technology spread to rice. However, since

irrigation infrastructure was very poor, Indian farmer innovated with tube-wells, to harvest ground water. When gains from the new technology reached their limits in the states of initial adoption, the technology spread in the 1970s and 1980s to the states of eastern India — Bihar, Odisha and West Bengal. The lasting benefits of the improved seeds and new technology extended principally to the irrigated areas, which account for about one-third of the harvested crop area. In the 1980s, Indian agriculture policy shifted to "evolution of a production pattern in line with the demand pattern" leading to a shift in emphasis to other agricultural commodities like oilseed, fruit and vegetables. Farmers began adopting improved methods and technologies in dairying, fisheries and livestock, and meeting the diversified food needs of a growing population.

As with rice, the lasting benefits of improved seeds and improved farming technologies now largely depends on whether India develops infrastructure such as irrigation network, flood control systems, reliable electricity production capacity, all-season rural and urban highways, cold storage to prevent spoilage, modern retail, and competitive buyers of produce from Indian farmers. This is increasingly the focus of Indian agriculture policy.

India's agricultural economy is undergoing structural changes. Between 1970 and 2011, the GDP share of agriculture has fallen from 43% to 16%. This is not because of reduced importance of agriculture or a consequence of agricultural policy. This is largely because of the rapid economic growth in services, industrial output, and non-agricultural sectors in India between 2000 to 2010.

Agricultural scientist MS Swaminathan has played a vital role in the green revolution. In 2013 NDTV awarded him as 25 living legend of India for outstanding contribution to agriculture and making India a food sovereign country.

Two states, Sikkim and Kerala have planned to shift to a fully organic farming by 2015 and 2016 respectively.

5. IRRIGATION IN INDIA

Indian irrigation infrastructure includes a network of major and minor canals from rivers, groundwater well-based systems, tanks, and other rainwater harvesting projects for agricultural activities. Of these, the groundwater system is the largest. Of the 160 million hectares of cultivated land in India, groundwater wells and an additional 22 million hectares can irrigate about 39 million hectare by irrigation canals. In 2010, only about 35% of agricultural land in India was reliably irrigated. About 2/3rd cultivated land in India is dependent on monsoons. The improvements in irrigation infrastructure in last 50 years have helped India improve food security, reduce dependence on monsoons, improve agricultural productivity and create rural job opportunities. Dams used for irrigation projects have helped provide drinking water to a growing rural

population, control flood and prevent drought-related damage to agriculture.

6. AGRICULTURAL OUTPUT IN INDIA

Indian agriculture is diverse, ranging from impoverished farm villages to developed farms using modern agricultural technologies. This image shows a farming community in a more prosperous part of India. The changing face of Indian agriculture: formation of larger farms and adoption of wind power generation technologies. Amul: an integrated dairy with milk processing plant in Gujarat state. India has some of the world's best agricultural yields in its tea plantations.

As of 2011, India had a large and diverse agricultural sector, accounting, on average, for about 16% of GDP and 10% of export earnings. India's arable land area of 159.7 million hectares (394.6 million acres) is the second largest in the world, after the United States. Its gross irrigated crop area of 82.6 million hectares (215.6 million acres) is the largest in the world. India is among the top three global producers of many crops, including wheat, rice, pulses, cotton, peanuts, fruits, and vegetables. Worldwide, as of 2011, India had the largest herds of buffalo and cattle, is the largest producer of milk, and has one of the largest and fastest growing poultry industries.

7. MAJOR CROPS AND YIELDS

The following table presents the 20 most important agricultural products in India, by economic value, in 2009. Included in the table is the average productivity of India's farms for each produce. For context and comparison, included is the average of the most productive farms in the world and name of country where the most productive farms existed in 2010. The table suggests India has large potential for further accomplishments from productivity increases, in increased agricultural output and agricultural incomes.

The Statistics Office of the Food and Agriculture Organization reported that, per final numbers for 2009, India had grown to become the world's largest producer of the following agricultural products:

Fresh Fruit, Lemons and limes, Buffalo milk, whole, fresh, Castor oil seeds, Sunflower seeds, Sorghum, Millet, Spices, Okra, Jute, Beeswax, Bananas, Mangoes, mangos teens, guavas, Pulses, Indigenous buffalo meat, Fruit, tropical, Ginger, Chick peas, Areca nuts, Other bastfibres, Pigeon peas, Papayas, Chilies and peppers, dry, Anise, badian, fennel, coriander, Goat milk, whole, fresh.

Per final numbers for 2009, India is the world's second largest producer of the following agricultural products:

Wheat, Rice, Fresh vegetables, Sugar cane, Groundnuts, with shell, Lentils, Garlic, Cauliflowers and broccoli, Peas, green, Sesame seed, Cashew nuts, with shell, Silk-worm cocoons, Cow milk, whole, fresh, Tea, Potatoes, Onions, Cotton lint, Cottonseed, Egg plants (aubergines), Nutmeg, mace and

cardamoms, Indigenous goat meat, Cabbages and other brassicas, Pumpkins, squash and gourds.

In 2009, India was the world's third largest producer of eggs, oranges, coconuts, tomatoes, peas and beans.

In addition to growth in total output, agriculture in India has shown an increase in average agricultural output per hectare in last 60 years. The table below presents average farm productivity in India over three farming years for some crops. Improving road and power generation infrastructure, knowledge gains and reforms has allowed India to increase farm productivity between 40% to 500% over 40 years. India's recent accomplishments in crop yields while being impressive, are still just 30% to 60% of the best crop yields achievable in the farms of developed as well as other developing countries. Additionally, despite these gains in farm productivity, losses after harvest due to poor infrastructure and unorganized retail cause India to experience some of the highest food losses in the world.

India and China are competing to establish the world record on rice yields. Yuan Longing of China National Hybrid Rice Research and Development Centre set a world record for rice yield in 2010 at 19 tons per hectare in a demonstration plot. In 2011, this record was surpassed by an Indian farmer, Sumant Kumar, with 22.4 tons per hectare in Bihar, also in a demonstration plot. These farmers claim to have employed newly developed rice breeds and system of rice intensification (SRI), a recent innovation in farming. The claimed Chinese and Indian yields have yet to be demonstrated on 7-hectare farm lots and that these are reproducible over two consecutive years on the same farm.

8. HORTICULTURE IN INDIA

The total production and economic value of horticultural produce, such as fruits, vegetables, and nuts has doubled in India over the 10-year period from 2002 to 2012. In 2012, the production from horticulture exceeded grain output for the first time. The total horticulture produce reached 277.4 million metric tons in 2013, making India the second largest producer of horticultural products after China. Of this, India in 2013 produced 81 million tons of fruits, 162 million tons of vegetables, 5.7 million tons of spices, 17 million tons of nuts and plantation products (cashew, cacao, coconut, etc.), 1 million tons of aromatic horticulture produce and 1.7 million tons of flowers (7.6 billion cut flowers).

During the 2013 fiscal year, India exported horticulture products worth ₹14365 crore (US\$ 2.1 billion), nearly double the value of its 2010 exports. Along with these farm-level gains, the losses between farm and consumer increased and are estimated to range between 51 to 82 million metric tons a year.

9. PROBLEMS OF AGRICULTURAL MARKETING IN INDIA

India lacks cold storage, food packaging as well as safe and efficient rural transport system. This causes one of the world's highest food spoilage rates, particularly during monsoons and other adverse weather conditions. Food travels to the Indian consumer through a slow and inefficient chain of traders. Consumers buy agricultural produce in suburban markets known as 'sabzi mandi' such as one shown or from roadside vendors.

Indian agriculture includes a mix of traditional to modern farming techniques. In some parts of India, traditional use of cattle to plough remains in use. Traditional farms have some of the lowest per capita productivities and farmer incomes.

Since 2002, India has become the world's largest manufacturer of tractors with 29% of world's output in 2013; it is also the world's largest tractor market.

A 2003 analysis of India's agricultural growth from 1970 to 2001 by the Food and Agriculture Organization identified systemic problems in Indian agriculture. For food staples, the annual growth rate in production during the six-year segments 1970-76, 1976-82, 1982-88, 1988-1994, 1994-2000 were found to be respectively 2.5, 2.5, 3.0, 2.6, and 1.8% per annum. Corresponding analyses for the index of total agricultural production show a similar pattern, with the growth rate for 1994-2000 attaining only 1.5% per annum.

10. INFRASTRUCTURE

India has very poor rural roads affecting timely supply of inputs and timely transfer of outputs from Indian farms. Irrigation systems are inadequate, leading to crop failures in some parts of the country because of lack of water. In other areas regional floods, poor seed quality and inefficient farming practices, lack of cold storage and harvest spoilage cause over 30% of farmer's produce going to waste, lack of organised retail and competing buyers thereby limiting Indian farmer's ability to sell the surplus and commercial crops.

The Indian farmer receives just 10% to 23% of the price the Indian consumer pays for exactly the same produce, the difference going to losses, inefficiencies and middlemen. Farmers in developed economies of Europe and the United States receive 64% to 81%.

11. FARMER SUICIDES IN INDIA

In 2012, the National Crime Records Bureau of India reported 13,754 farmer suicides. Farmer suicides account for 11.2% of all suicides in India. Activists and scholars have offered a number of conflicting reasons for farmer suicides, such as monsoon failure, high debt burdens, genetically modified crops, government policies, public mental health, personal issues, and family problems.

12. CAUSES OF LOW AGRICULTURAL PRODUCTIVITY IN INDIA

The low productivity in India is a result of the following factors:

1. The average size of land holdings is very small (less than 2 hectares) and is subject to fragmentation due to land ceiling acts, and in some cases, family disputes. Such smallholdings are often over-manned, resulting in disguised unemployment and low productivity of labor. Some reports claim smallholder farming may not be because of poor productivity, since the productivity is higher in China and many developing economies even though China smallholder farmers constitute over 97% of its farming population. A Chinese smallholder farmer is able to rent his land to larger farmers, China's organized retail and extensive Chinese highways are able to provide the incentive and infrastructure necessary to its farmers for sharp increases in farm productivity.

2. Adoption of modern agricultural practices and use of technology is inadequate, hampered by ignorance of such practices, high costs, and impracticality in the case of small land holdings.

3. According to the World Bank, Indian branch's Priorities for Agriculture and Rural Development, India's large agricultural subsidies are hampering productivity-enhancing investment. Overregulation of agriculture has increased costs, price risks and uncertainty. Government intervenes in labor, land, and credit markets. India has inadequate infrastructure and services. The World Bank also says that the allocation of water is inefficient, unsustainable and inequitable. The irrigation infrastructure is deteriorating. The overuse of water is being covered by over-pumping aquifers but, as these are falling by one foot of groundwater each year, this is a limited resource. The Inter-governmental Panel on Climate Change released a report that food security may be a big problem in the region post 2030.

4. Illiteracy, general socio-economic backwardness, slow progress in implementing land reforms and inadequate or inefficient finance and marketing services for farm produce.

5. Inconsistent government policy. Agricultural subsidies and taxes often changed without notice for short-term political ends.

6. Irrigation facilities are inadequate, as revealed by the fact that only 52.6% of the land was irrigated in 2003–04, which result in farmers still being dependent on rainfall, specifically the monsoon season. A good monsoon results in a robust growth for the economy, while a poor monsoon leads to a sluggish growth. Farm credit is regulated by NABARD, which is the statutory apex agent for rural development in the subcontinent. At the same time, over-pumping made possible by subsidized electric power is leading to an alarming drop in aquifer levels.

7. A third of all food that is produced rots due to inefficient supply chains and the use of the "Walmart model" to improve efficiency are blocked by laws against foreign investment in the retail sector.

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