Chapter V

CHAPTER - V

HISTORICAL BACKGROUND OF GREEN REVOLUTION

Introduction

In 1757, India became the first country in the world to use sophisticated implements in agriculture. The Battle of Plassey was lost by the Indians to the East India Company of British soldier-traders in that fateful year. The revenue of one Bengal region, the 24-Paraganahs, had to be forfeited to the Company as a result of the defeat. As a result, the British gained rapid control of India's civil revenue system. By 1765, the company had taken control of significant swaths of India, particularly in the provinces of Bengal, Bihar, and Orissa. Thus India's agriculture came under the influence of British management and modernization.

Pre – British Period

Prior to the conquest, agriculture was a traditional way of life in India. It was not just a business venture. In the autonomous Indian villages, agriculture was the primary source of income. Agriculture played such a significant role in Indian culture[1]. It was the preferred source of income for the Indians. The villagers were unconcerned about kingdoms dissolving and being divided. As long as the village remained intact, they did not care who got power or to whom it devolved. The hamlet's internal economy was unaffected. Within the autonomous community, the cultivator was largely self-sufficient. The grower contributed an additional 25% of his crop to various revenue streams. However, the village's religious, cultural, educational, and economic activities received a large portion of the 25%. The tiller of the land would frequently pay this portion of the crop directly to the individuals or entities in charge of the administration. Only 1.5 to 6.0 percent of the total produce went to the political elite and militia, respectively. The aristocracy had no further rights on the land after obtaining its portion of the produce, and in particular, it had no right to separate the cultivator from his land The concept of land as private property of aristocracy, had not yet arrived in India.[2]

The village's political and economic independence, as well as that of the cultivators, was bolstered by the village's immunity to outside industrial and market forces. This is not to

[1] . Alexander walker, Indian Agriculture, 1820, Some Eighteenth Century European Accounts of Indian Science and Technology, Biblia Impex, Delhi 1971, p.230

[2] . Quoted in claudealvarez, Homofaber, Technology and Culture in India, China and the West 1500- 1972, Allied Publishers, Delhi 1971

suggest that pre-British India was devoid of industry or commerce. Significant amounts of silver and gold were transported into India to buy Indian, goods until 1757. Britain had not been producing commodities with which to trade with India at the time. Even in 1840, Montgomery Martin, a historian of the early British Empire, could call for a parliamentary enquiry. India was a country that was both industrial and agricultural, with a rich history of industry. Agriculture and industry operations were closely linked[3].

Pre-British India's most important industrial activity, textile manufacturing, was largely done by agriculturists in their spare time. According to Marx, the village system was centred on this close cooperation between farm and industry, this "domestic unity of agricultural and manufacturing interests." By relieving agriculture of the demands of a larger industry or market, this collaboration ensured the village's autonomy[4]. As a result, the charkha and the handloom became symbols of traditional Indian culture of autonomous agricultural communities. For both Gandhi and Maxy, these were symbols of a revived India, but especially for Gandhi, of an India reborn through the independence of her agriculture and villages. These autonomous and virtually self-sufficient village communities had achieved high skills and technological efficiency in both agriculture and manufacturing. Agriculture had practically reached its pinnacle of excellence[5]. Great doctors, astronomers, philosophers, writers, and painters emerged on the Indian soil as a result of village communities encouraging varied arts, crafts, sciences, and technologies. Following the loss of 1757, local villages and agricultural lands were taken over by the British[6].

British Period

Agriculture as a way of life in India did not interst the British. Agriculture, which they had taken control of, was nothing more than a source of income for them. They began to amassing ever-increasing sums of money with great zeal[7]. Both the cultivators and the villages were destroyed by the British method of revenue administration. The British, on the other hand, were indifferent as long as agriculture fulfilled its new role of feeding British coffers. Warren Hastings' letter to the Company's Board of Directors eloquently demonstrated

[3] . The Fifth Report of the Select committee on the Affairs of the East India company, 1812 Reprint Delhi 1984, p.158.
[4] . R.PalmDutt, India Today, London 1940, pp.129-130
[5] . Karl Max, The British Rule in India, Newyark Daily Tribune, June 25. Progress publishers Moscow 1968, p.35-41
[6] . Alexander Walker, “Indian Agriculture”, reprinted in Dharmapal p. 244
[7] . G.L. Prendergast, House of Commons Papers, 1812 – 13, Volume 9, p.468

how agriculture lost its former position as a provider of fundamental necessities and became merely a source of British wealth. 1772. He wrote this better on a year after the great Bengal famine[8], which killed an estimated ten million people.

Agriculture's transformation from a source of livelihood in India to a source of 'development' in England, resulted in unspeakable agony, with irrigation systems in shambles. Huge swaths of once-productive land had been transformed into jungles. The farmers were forced to migrate. Education had been abolished. In the disciplines of philosophy, science, and literacy, everything came to a halt. Civilization came to a halt as a result of the deaths. The story of British looting and ensuing poverty in India is well documented, although it is not well understood by educated Indians. It is critical to remember that the most essential feature of that awful period in Indian history was not merely the the immediate loss and grief. There had been previous plunders, and they could have caused just as much grief. The British, on the other hand, were fundamentally different from past plunderers that came to India. Earlier robbers, such as the legendary Mohammed of Ghazni, raided temple surpluses and dealt mostly with nobility. With their legalised pillage, Lord Hastings and his forces, on the other hand, destroyed every cottage in every community. This kind of unrestrained looting could not last long. The British rapidly realised that the devastation done in India by their early administrators would kill the goose that lay golden eggs[9].

However, India will never be the same again, and this is a crucial aspect of Indian history to remember. People, especially farmers, would never be self-sufficient again. There would never be another generation of self-sufficient farmers, farming their land to meet their own needs. State, industry, and market demands, all of which had been separated from agriculture, and they would always take precedence. Agriculture would never again be a viable source of income. It had devolved into purely a commercial operation. It has finally been'modernized[10].' Apart from the use of force by the early British, the system of landlords, which was introduced for the first time in India, was the main tool of modernization. Independent farmers, who farmed their own land, were unlikely to choose their fundamental food and clothing needs over their external economic needs. A landlord who was financially secure could be trusted to produce and sell what the industry or the state required. Farmer

[8] . Opcit., p.245.
[9] . R.P. Dutt, Cited earlier, p.114
[10] . Opcit, Quoted from Claude Alvarez

were compelled to convert good agricultural land to opium, indigo, and other crops while the kingdom was devastated by famines. The landlord became a modernising force by making agriculture responsive to the market and the state. Crop output figures, during the last fifty years of British rule can be used to judge how successful the British were in modernising and adapting Indian agriculture to industry needs and market volatility[11]. In the late 1800s, the federal government began disclosing such information. The time, leading up to the First World War was distinguished by a favourable worldwide market for all export crops and an expansion of domestic textile and jute manufacturing capabilities.

As a result, Indian agriculture thrived throughout this time, with agricultural output outpacing population growth. It was without doubt, one of the most prosperous times in British Indian agriculture, with per capita food availability ranging from 540gm per day, despite Despite the high volume of rice and wheat exports. After that, there was World War I, the Great Depression, and World War II. Export markets had shrunk. Agriculture crop prices had decreased. Agriculture in India has suffered a blow. Despite some imports, as the population rose, food grain output began to decline. Food availability, per capita, was 417 grammes per day for the quinquennium ending in 1946. Surprisingly, sugarcane was the only crop that grew at the period, and it was protected by additional import taxes. The area under this economically advantageous crop, expanded by nearly 40%, between 1930-1931 and 1938-1939, when famine was imminent[12].

During the last fifty years of British rule, Indian agriculture had risen and fallen in line with global economic pressures. These factors, rather than the needs of the people, decided how much Indian agriculture would produce. Despite the fact that economic progress was achieved, lives were lost. During the Independence period, India's economy was in shambles, and agriculture in particular, was in awful health. Bengal had lately experienced a catastrophic famine. In 1946, per capita food availability was alarmingly low, at 417 grammes per day. In rural regions, indebtedness had been steadily rising. Rural indebtedness nearly doubled between 1929 and 1936. Farmers struggled to pay contractual obligations such as rent and land revenue. Many of them were headed for a life of landless labourers. The country's division aggravated the problem. Crops for both commercial and food purposes

[11] . Obcit, p.115
[12] . Karl.Marx, ‘ The Future Results of British Rule in India’ Newyork Daily Tribune, August 8.

were in short supply in the country. Something urgently had to be done to improve agriculture[13].

One obvious course of action would be to focus on expanding irrigation capabilities, which had previously been limited due to division. Irrigation was used on only 19.7% of the net planted land in the Indian Union. Land reforms must be implemented in addition to increased irrigation. Given the ideal that people demanded with independence, land reform had become a political necessity. On both these fronts, action began soon after independence. The net irrigated area increased from 18.9 to 20.2 million hectares between 1947-48 and 1949-50. More land was irrigated by wells and other small sources, which accounted for the majority of the increase[14].

A positive impact on agricultural production was the gradual expansion of irrigation facilities, as well as the restoration of some fairness in land relations. During the 1950s, crop output increased at a faster rate than population growth. Almost every crop's area under cultivation and yield per hectare both increased. After independence, India, on the other hand, aspired to be industrialised. It was not enough for India to modernise and industrialise if agricultural output had not increased[15]. Agricultural output, too, had to be responsive to market demands. It was critical to get food to the market for sale in particular. Agriculture is an important source of food for the industrial sector as a whole. Because food accounts for such a large portion of an industrial worker's pay, a consistent supply of food from the farm sector is critical to the industrial sector's long-term stability[16].

Although irrigation expansion and various land reform programmes had resulted in a steady increase in agricultural productivity, this increased output was not reaching the markets in time to reach the industrial sector. According to the National Commission, despite improving output, the food situation during the Second Plan Period was defined by rising demand for food grains and a progressive drop in market arrivals. According to the Commission, "speculative holding of shares by the grain trade" was part of the explanation for this phenomenon[17].

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[13] . George Blyn, Agricultural Trends in India, 1891-1947, Univ of Pennsylvania Press, Philadelphia 1949
[14] . NCAR 1976, Vol. p.199(National Centre for Admospherice Research)
[15] . NCAR 1976, Vol. I p.219
[16] . NCAR 1976, Vol. I p.221
[17]. NCAR 1976, Vol.V p.43

Improved land relations and irrigation, both of which contributed to increased output. But the average per capita food availability was low and a large portion of the rural population, only 40% in 1960-61, had the financial means to obtain the bare minimum of 2250 calories per day[18].

According to the National Commission on Agriculture, a grower's ability or willingness to put in labour determines how much he or she can produce. After being released from the yoke of landowners, agriculture began to reclaim its basic features of self-sufficiency[19]. As a result, Indian planners had to balance expanding production while limiting market arrivals, as well as boosting agricultural sector independence from the urban sector[20].

Accoding to the National Commisssion on Agriculture, "Instead of spreading the efforts thin across the country, it was decided in 1950-51 to concentrate such efforts in compact areas designated "intensive agriculture areas," which held assured water supply and fertile soils. The intense strategy was recommended by the Ford Foundation's Agricultural Production Team in 1959. In response to the Second Plan's apparent failure to provide food to market despite increased production, a new Intensive Agricultural District Program (IADP) was established in the final years of the plan. The program's declared goal was to pool resources and efforts in specially endowed areas in order to execute the Agricultural Area Program (IAAP). For project funding, only locations with adequate production potential in terms of secured water and infrastructural amenities, with the a focus on farm profability, were chosen[21].

Traditional technologies, which evolved in a more egalitarian context, where cultivators' food needs were prioritised over surpluses to support 'progress,' were simply incapable of making land absorb more than its fair share of resources, and the Ford Foundation's experts had little to teach Indian farmers about possible improvements within that context[22].

The efforts of Indian planners to increase production by using "better" approaches in areas, with access to utilities such as water and manure failed. The attempt, in fact, was a complete failure. Rice yields in the 12 rice districts and wheat yields in the four wheat

[18] . NCAR 1976, Vol. II p.14
[19] . NCAR 1976, Vol. I p.188
[20]. NCAR 1976, Vol.II p.9
[21] . NCAR 1976, Vol.I p.143
[22] . NCAR 1976, Vol. p.149

districts averaged 13.3 and 13.5 quintals per hectare, respectively, under the IADP, compared to 12.4 and 10.2 quintals before the package. When compared to these marginal yield gains, the recommended packages' additional expenses were comparable to 10 quintals of wheat on an average and 10 to 12.4 quintals of paddy in most districts. The package's efficiency for other crops was even worse[23].

The policy sought a technological solution to what the British had achieved politically – namely, the subjugation of agriculture to the needs of industry and the market at the expense of the producers' life-sustaining needs. The goal of agricultural development was to provide resources and capital for urbanisation as well as to meet the needs of the rural population. Planners were looking for ways to make the rural sector more reliant on the city by weakening its independence[24].

Planners were looking for an agricultural technology, that could bring about such a shift since the 1950s. When the intense approach strategy was devised and implemented, there was no such technology. However, by the mid-1960s, such technology was available in the form of new'miracle seeds,' which had proven successful in Mexico[25].

At the same time, it would make agriculture extremely reliant on industrial inputs like chemical fertilisers and pesticides, as well as cultivators' reliance on urban experts for knowledge of proper agricultural practise, effectively eliminating the "dangerous tendency" of agricultural self-sufficiency[26].

Due to its high cost, this technique could not be used across the country. However, none of that mattered. All that was needed was a small increase in surplus areas to ensure that the urban-industrial sector could meet their demand.

Seeds, too, had to be imported at first. Between 1965 and 1966, the monsoon season in India, as well as the rest of South and Southeast Asia, was thankfully disrupted. As a result of the failure, fears of a terrible famine arose, with foreign experts predicting disaster and some estimating that one million people could die of malnutrition in Bihar alone. This

[23] . J.A. Volcker, Report Improvement of Indian Agriculture , Calcutta 1893, Second edition 1895, New Delhi p.10-11
[24] . NCAR 1976, Vol. I p.411
[25] . Speech of the Sri. C. Subramaniam Chairman, National Commission on Agriculture, NCAR 1976, Vol. I p.27
[26] . Agro – economic Research centres at Various locations in the country in 1968-69 by Rameswaram, available in NCAR 1976, Vol. I Appendix 4.3

incident put an end to any concerns about getting new seeds, even if it did necessitate massive imports. The Ford Foundation and the Rockefeller Foundation's ever-helpful attitude aided in the acceptance of new technology. In 1966-67, a new agricultural development plan was launched, focusing on the introduction of new technology, particularly in the IADP and IAAP areas. Almost immediately, the effort was deemed a success. The Green Revolution was recognised as a result of this success[27].

Given the extensive historical background to this assessment of the Green Revolution, we believe it is impossible to assess the revolution's merits without first knowing the ongoing struggle in Indian agriculture between "tradition" and "modernity" since the arrival of the British. Without understanding the historical trend for agricultural modernisation, which tries to make agriculture more responsive to needs other than the cultivator's personal life-needs. It is hard to see how this event could be considered a revolution because it did not enhance aggregate rates of agricultural output growth, did not reduce agricultural import dependency, and did not increase per capita food availability.

Green Revolution in India

When there were sufficient resources to effectively implement the new technology of the 'miracleseeds' and associated practices, it was successful in producing high yields. It is possible to make use of it. The increase in yield had been revolutionary in some extremely well-endowed areas. Several studies conducted as part of the High Yielding Variteies (hyv) Program to establish a scientific evaluation of the response of various crops to various locations, backed up this assertion.

The Green Revolution was regarded as a watershed moment in agricultural research. The Green Revolution in India should be viewed as a watershed moment in the country's agricultural history. These two approaches to this new technology resulted in very different outcomes. It is not enough to judge the Green Revolution as a turning point in Indian agriculture's development by looking at the success of a few crops in a few isolated locations. The overall response of Indian agriculture to the Green Revolution must be examined.

[27] . Ibid., 1976, Vol.2

Aggregate Rates Growth in Agriculture

The compound rates of primary agricultural development metrics before and after the Green Revolution, are displayed in the Table. The year 1967-68 was chosen as the dividing line since this was when the Green Revolution was deemed to have started. The years before the Revolution, I was were 1949-50 to 1964-65, while the years, after the Revolution were 1967-68 to 1977-78, omitting the catastrophic years of 1965-66 and 1966-67. Where to draw the boundary between these two periods of post-independence agriculture is a contentious issue.

Compound Rates of Growth

Crop	Production		Area		Yield	
	1949-50 to 1964-65 (a)	1967-68 to 1977-78 (b)	1949-50 to 1964-65 (a)	1967-68 to 1977-78 (b)	1949-50 to 1964-65 (a)	1967-68 to 1977-78 (b)
Foodgrains	2.98	2.40	1.34	0.38	1.61	1.53
Non-Foodgrains	3.65	2.70	2.52	1.01	1.06	1.15
All crops	3.20	2.50	1.60	0.55	1.60	1.40
Rice	3.37	2.21	1.26	0.74	2.09	1.46
Wheat	3.07	5.73	2.70	3.10	1.24	2.53
Pulses	1.62	0.20	1.87	0.75	-0.24	-0.42

The first thing is that the post-Revolutionary period's expansion of aggregate agricultural production was slower than the previous period. While total agricultural production grew at a compound annual rate of 3.20 percent in the preceding quarter, it only grew by 2.50 percent the following quarter. The output of both foodgrains and non-foodgrains may have reduced[28].

Praductivity Simply put, productivity had reached a saturation point with available technology and resources prior to the Green Revolution, and without a technological breakthrough, earlier rates of productivity growth, which admittedly fell a little after the Green Revolution, would have collapsed. One of the factors, that had contributed to improved

[28] . George Blyn, India's Crop output Trends past and present in C.H. Shah Agricultural Development in India. Policy and problems, Orient Longman, Bombay 1979

yields in India up to that point had run out, indicating that the law began to work around 1964-65[29].

Table 2 shows the growth rates of agricultural production, area, and productivity during the plan period. During the Third Plan (1961-62 to 1964-65), the years immediately preceding the decision to introduce the HYVP, agricultural productivity in India reached an all-time high[30].

Plan-wise compound rates of Growth of Agricultural Production, Area under Crops and Yield in Percent Per Annum*

Plan Period	Production	Area	Yield
First Plan (1951-52 to 1955-56)	4.1	2.6	1.4
Second Plan (1956-57 to 1960-61)	3.1	1.3	1.8
Third Plan (1961-62 to 1964-65)**	3.3	0.6	2.7
Fourth Plan (1969-70 to 1973-74)	2.2	0.8	1.0

Growth rates are calculated, on the basis of triennial averages with the base and last year of each plan as the midyears. For the Third and Fourth Plan, instead of the triennial periods, the years 1964-65 and 1973-74, respectively, were taken as the end-years, to avoid, ** 1965-66, being an exceptionally bad year[31].

Costs of Production under the New Technology

As the new technology was introduced, the rate of increase of production and productivity in Indian agriculture had slowed. Even this slower rate of growth came at a significant cost. The HYV technology was widely recognised to have substantial energy with soil fertility, environmental, and economic implications. It is commonly accepted that modern agricultural practices have negative repercussions for the environment and soil fertility[32]. Chemical fertilisers disrupt soil balance by changing the flora. As a result, larger amounts of chemical inputs are required to achieve the same yield from a plot of land employing this

[29] . Opcit, Bombay 1979
[30] . Keith Griffin, The Political Economic of Agraniam Change second edition, Macmillan London 1979. Tables 1.1 and 1.2
[31] . Joseph.S.C., Food Policy and Economic Development in India, 1961.
[32] . Economic and Energy comparison of crop production and orange and conventional com – Belt Forms, Academic press, Newyork 1977.

method of farming. This cycle of escalating chemical inputs year after year has the potential to harm the soil irrevocably. Pesticides, which are a large part of the new technology, increase environmental costs. These insecticides have a way of getting into people's bodies and other living things, posing a long-term health risk. In short, these new technologies have major environmental and energy costs, which must be considered in any assessment of the Green Revolution[33].

India's agricultural self-sufficiency is generally linked to the Green Revolution. This idea is based on the belief that foodgrain imports decreased considerably during the Green Revolution. Indeed, the amount of grains imported in the decade preceding the Green Revolution, from 1956 to 1965, was only marginally higher than the 38 million tonnes imported in the decade following the Green Revolution, from 1968 to 1977[34]. During the Green Revolution, the agricultural sector's reliance on foreign inputs rose in a variety of ways. Only food had to be imported previously but now, a range of inputs must be imported as well. Many of the new agricultural needs required farmers to rely even more on the government and the industrial sector, while the government had to rely on other countries for many of the new agricultural requirements. There was a rise in reliance on the outside world in general[35]. To summarise, the so-called Green Revolution did not result in a revolutionary increase in the overall production and productivity of Indian agriculture. If anything happened, it was a slowing of India's agricultural expansion. What appeared to be a revolution turned out to be a game of cultivating a few commercially essential foodgrains in places where there were already surpluses. As a result, subsistence farm yields appear to be lower than they were before the "Green Revolution."[36]

However, from an urban-industrial standpoint, the development was truly groundbreaking. Despite the fact that many individuals still had the financial means to buy 2400 calories of food, more food streamed into the urban market and government coffers as expansion focused on existing surplus areas, and the urban industrial sector became food self-sufficient[37].

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[33]. Economic survey 1980-81. Government of India, Delhi 1981
[34] . Ibid, George Blyn
[35] . Opcit, Government of India, Delhi 1981
[36] . NCAR Vol. II, p.199 and Economic survey 1980-81
[37] . Alexander walker, reprinted in Dharmapal p. 233

Alternatives to Green Revolution

Was the Green Revolution the only choice? The answer to that question is contingent on one's aspirations for an agricultural revolution. The Green Revolution may be the best answer if all that is required is a consistent supply of food and resources to urban markets and government stockpiles. The HYV technology was designed to be used exclusively in places where there was already a surplus of food due to its significant reliance on commercial resources. It ensured that all increasing outputs would find their way into the market by making these surplus areas more surplus. Our subsistence farmers had a "alternative" to the Green Revolution's and that was immediate action to ease the acute resource limits that were putting great strain on agriculture[38].

Irrigation is the most crucial input for traditional agricultural practices since it protects the farmer[39]. It a side from irrigation, traditional agriculture requires a large number of labour. The amount of labour that a farmer is willing to or capable of putting in determines traditional agriculture production. Because labour is necessary, small farms, even those under one hectare in size, can achieve significantly higher output than larger farms[40].

Green Revolution in the Madras State

Madras is known for its rich agrarian history among modern Indian states. \ Their economy remained based on agriculture. Agricultural operations were mostly managed and supervised by landlords known as Zamindars during the pre-independence period. Agricultural labourers were still treated as serfs who were enslaved to the land. The deplorable state of the ryots began to improve after India's independence. The abolition of the Zamindari System liberated them from the tyranny of the Zamindars, ushering in a new life for them[41]. Though the people of Madras Presidency were well aware of the greeneries and their impact on the toiling millions, former USAID director William Gaud coined the term "Green Revolution" in 1968. "These and other innovations in the world of agriculture contain the making of a new revolution," he observed while discussing the new technology.

[38] . NCAR 1976, Vol. I p.437-438
[39] . NCAR 1976, Vol. I p.437
[40] . NCAR 1976, Vol. I p.437
[41] . Ibid, p.437

It was not a bloody Red Revolution like the Soviet Union's, nor was it a peaceful White Revolution like Iran's Shah[42]. It was the "Green Revolution"which refers to the adoption of innovative agricultural practices, as well as the subsequent rise in agricultural output. The Green Revolution began in the early 1960s as a result of changes in agricultural production that were supported by international financing agencies. The term "Green Revolution" refers to a huge increase in cereal-grain yields, in many developing nations beginning in the late 1960s, owing in large part to the introduction of genetically modified cultivars[43]. A relatively tiny region of the so-called Green Revolution. Belt had produced a significant amount of food grain. During the 1960s, the Green Revolution referred to the discovery and use of High Yield Variety Seeds, which resulted in a massive increase in food crop output[44]. Agriculture is defined as "the science or the art of large-scale soil cultivation in order to produce crops," As a result, agriculture is man's attempt to push beyond natural limitations and alter the environment to better fit his requirements. The Agrarian Revolution was the name given to the implementation of new environmental technologies and the enclosure movement Engalnd. "The Green Revolution" is the term used to describe the dramatic growth in the production of food grains in India that began in 1968 and continues to this day[45].

The introduction of HYV of wheat and rice was regarded as a significant achievement since it provided considerable hope. The Green Revolution not only solved the country's food problem and helped to keep food production growing faster than the country's population growth rate, but it also created regional inequalities in agricultural development, which went against the basic spirit of the planning objectives, which was to eliminate regional imbalance and bring social justice[46]. The Green Revolution was founded on the belief that technology provides a superior substitute for nature, and hence a means of generating growth that is not bound by nature's limitations. It is a prime example of how diversity is being suffocated from inside. With the arrival of the western Green Revolution worldview, agriculture's basic meaning was modified[47].

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[42] . NCAR 1976, Vol. I Appendix 4.1
[43] . Madras Assembly proceedings, Vol. XI, I 1948, p.395
[44] . Barbara Harriss, white and John Harriss, Green Revolution and after : The North Arcot papers and Long term studies of the political of Rural Development in South India p.5
[45] . Dhindsa, K.S.Anju Sharma, Dynamics, of Agricultural Development, Vol.I, p.32
[46] . Noor Mohammed, New Dimensions in Agricultural Geogrpahy, Historical Dimensions of Agriculture, p.78 1992
[47] . Jain T.R., Mukesh Trehan, RanjuTrehen, Rajinder Uppal, “Indian Economy” V.K.Global p.57

Traditional farming systems have always had excellent productivity since they require very little external inputs. While the Green Revolution has been credited with increasing productivity in the aggregate, it has been found to be counterproductive and ineffective when resource use is taken into account. The introduction of high-yield varieties and the application of scientific and organised methods to their cultivation has resulted in a rise in cereal crop production in developing countries[48]. The introduction of high-yield grain varieties and improved productivity through management techniques resulted in a major boost in agricultural productivity[49]. The term "Green Revolution", is used to refer to the years 1967 to 1978. The Green Revolution has given birth to a new era, and it has been observed that contemporary technology has been a big contributor to increased output[50].

Green Revolution refers to any food rich in colour such as red, green, yellow, orange, purple, and others, which provide all of the necessary vitamins, minerals, antioxidants, and fibre for a healthy body[51]. The introduction of genetic modification into life science, specifically agricultural research, constitutes this revolution[52]. New seeds, cropping patterns, crops and techniques, fertilisers, insecticides, and weedicides, as well as new instruments and technology, are rapidly emerging as a result of the agricultural technological revolution[53]. William Gaud explained this unprecedented increase in food production[54].

As much as it was a genetic revolution, the Green Revolution was also a social one. It was first discovered in Asia as the development of wheat types that responded well to fertiliser and water. The Green Revolution represents the possibility of increasing agricultural yields, in a variety of crops, in a variety of settings. The term 'Green Revolution' refers to a growth in agricultural value through time as a result of increased production per area. The Green Revolution, or "Green Movement," is a worldwide phenomenon. It has touched almost every facet of our life, as well as every profession and discipline[55]. In a nutshell, the Green Revolution refers to the fast increase in agricultural practices, since the mid-1960s, which signalled a shift in traditional agriculture[56]. The terms 'Green Revolution' and 'Seed Fertilizer

[48] . Ali, Mohammed, Abdul Munir, Shamsul Haque, Siddique 'The Geographer' Journal 1948, p.81
[49] . Vandana Shiva, Stolen Hervest; The Hijacking of the Global Food Supply p.13
[50] . Jonathan Green, Dictionary of Jargon, London,2010, p.262
[51] . Webster's II College Dictionary, Newyork, 1995.
[52] . Venkateshvarlu, B Dynamics of Green Revolution in India, Agri Cole, pub, 1985, p.3
[53] . Komal Taneja, The Green Revolution,2008, p.1
[54] . Kieth Engine Maskus, "Intellectual property Growth and Trader, p.489
[55] . The perspective plan for Taminadu 1974-84, p.266
[56] . Gita Gopalakrishnan, M.S.Swaninathan, One Man Guest for a – Hunger free world, p.45

Revolution' were coined to describe a set of agricultural practices , employed by farmers in the 1960s and afterward, to increase the output[57].

The Green Revolution's goal of increasing yields per unit area of land was achieved in the region, but at the cost of rising energy subsidies that outweighed the increased energy output. High yielding seed varieties, use of chemical fertiliser, pesticide and herbicide, and reliable irrigation were all part of the Green Revolution, which resulted in life-saving outcomes state in South India states in liberally used chemical fertilisers in the mid-1990s, and economic aid to farmers was made avaialble as well. Agriculture productivity soared thanks to a confluence of favourable conditions. The "Green Revolution" is the name given to this occurrence. Increased agricultural productivity was promised by the Green Revolution, which signalled the shift of agriculture from a traditional to a modern stage. Two ideas are implied by the word revolution[58]. a) rapid change in a phenomenon; the change is so rapid that it is easily discernible; and b) the change's impact is felt over a lengthy period of time because it causes fundamental changes. Green is a colour associated with agricultural crops, and the term 'Green Revolution' refers to a significant advance in agriculture. The goal was to educate farmers and aid them in implementing novel farming practices that were relevant to their communities. The specialists also held agricultural radio schools on a regular basis, which were quite successful[59].

In Tamilnadu, Radio Rice was the name given to a rice variety known as ADT27[60]. As a result of the Green Revolution, our Indian economy had improved. The Rockefeller Foundation produced high-yielding hybrid cereal grain strains, to facilitate the Green Revolution. With agriculture's Green Revolution, there were two major shifts. The Green Revolution is the term used to describe the adoption of contemporary western farming techniques to developing countries like India. It is the application of science and technology to the field of agriculture. For instance, genetically engineered high yielding types of staple crops like rice and maize, as well as a package of fertiliser, pesticide, and herbicide technology, as well as water management, worked together to create favourable conditions[61]. It encourages the development and improvement of technologies and techniques. Thirty new

[57] . Steven Bleicher, Temporary Color, Theory and Use, 2011, p.197
[58] . Mukhenjee.S, Chakrabarti, 'Evolution of Indian Econonmy and Elementary statristics' p.168
[59] . Stephen Codington, Plant Geography, p.676
[60] . Nirmala.V, 'Economic Analysis of Rice Cultivation, Concept Publishing Company, 1992, p.25
[61] . Ishwar, C. Dhingra, ' The Indian Economy : Resources planning Development and problems' p.235

HYVs were released between 1966 and 1985. These updated HYVs solved some of the issues with previous HYVs[62].

Despite the fact that the Green Revolution enabled India to become more self-sufficient in food, it did so at the expense of expanding the gap between rich and poor in rural areas[63]. During the early stages of the Green Revolution, Tamilnadu benefited the most. During the early post-Green Revolution period, there were notable geographical differences[64]. The term "Green Revolution" refers to a significant rise in food grain production as a result of the use of HYVS on irrigated land combined with regular fertiliser and pesticide application[65]. The success of the Green Revolution was determined in part by the soil. Agriculture thrives on flat land, with a small incline. After trenches and other soil conservation measures, sloping land that has been moderately eroded is suitable for agriculture, whereas slope land that has been heavily eroded is suitable for the profitable formation of terraces[66]. Irrigation facilities, in combination with rainfall and soil characteristics, allow us to split the state into several agro-climatic zones, which can explain differences in agricultural labour and pay circumstances across the State[67].

The first zone was the Cauvery-irrigated delta areas of Thanjavur, Thiruchirapallli, and South Arcot districts, where paddy is the primary crop. The next zone, which included the districts of Coimbatore, North Arcot, parts of South Arcot, and Salem, is primarily irrigated by wells[68]. Crop rotation should be chosen so that the soil's long-term production is not harmed. For a breakthrough in agricultural productivity, multiple cropping of short varieties of paddy, maize, bajra, jowar, barely, ragi, oilseeds, potatoes, and vegetables must be developed. Multiple cropping not only diversifies and boosts agricultural earnings but it also improves soil fertility and makes better use of late-season precipitation[69].

The Royal Commission on Agriculture divides India's soils into four categories: crystalline tract red soils, black cotton or rigour soils of the Deccan trap and some isolated areas in Madras state, alluvial soils of the Indo Gangetic plain and other river deltas, and

[62]. Sherif Kamel, 'E-Strategies for Technologies Diffusion and Adoption, p.246
[63] . Daina Carney, John Farrington, 'Natural Resource Management and Institutional Change, p.11
[64] . Garrett Nagle, ' Development and Under development, p.58
[65] . David Hardiman, 'Gandhi in his time and ours, the Global Legacy of his ideas, p.200
[66] . Anis ' chowdhary, wahiduddin Mahmud, 'Handbook on the – south Asian Economics' p.30
[67] . RenuNayar, ' Economics part +B – Indian Economic Development for class XI, p.17
[68] . Gopalakrishnan, M. Gazetteers of India, Tamilnadu State, the Nilgiris District, p.336
[69] . Randhawa, M.S. 'A History of Agriculture in India' – Vol.1947 – 1981 p.209

laterite soils at the foot of the Eastern and Western Ghats. This classification is largely applicable to the Madras State, as all these basic types can be found in some part of the state. Despite the fact that the District did not conduct a modern soil survey to categorise the soils into modern classification units, an estimate of the major soil groups was developed from existing data[70]. The report of the working group for the formation of the Indian Fourth FiveYear Plan proposals on soil and water management, under irrigated conditions was entirely technical, with no mention of any social scientist conducting research on organisational aspects of irrigation or water administration staff management[71].

Irrigation

Irrigation played a critical role in the Green Revolution's success. Because of the State's seasonal and unpredictable rainfall patterns, as well as substantial evaporation losses, reliable irrigation is a must for sustainable agricultural production. Irrigation works in the State date back to the Second Century, when the Cholas are thought to have built the Grand Anicut on the Cauvery River. Irrigation projects now cover roughly half of the state's cropland[72]. Canal irrigation is essential in the Cauvery delta and the Palar and Poonaiyar river basins. Water is used to generate electricity at Periyar Dam during the summer and later using it for agriculture. The Vaigai reservoir was built during the period of the First Five Year Plan. During the First Five Year Plan, another significant irrigation project, the Manimuthar Reservoir Project, was also built[73].

As a major contribution to the Grow More Food Drive, the Congress Government devised a new irrigational works project in 1947. The strategy consisted of three plans: a five-year or short-term plan for minor irrigational works, to cover every district in the state, a long-term plan for harnessing the water of the major rivers, and a mid-term plan for utilising the minor river's resources. The short-term programme includes 300 projects, all of which were planned to be finished by the year 1952. They approved the digging of over 60,000 wells, the construction of approximately 5,000 private tanks, and the construction of over 240 minor irrigation works under the wells and irrigation schemes. Through geophysical investigations and the installation of tube wells, filter point tube wells, and rejuvenation of

[70] . Ibid, p.210
[71] . Ibid, p.211
[72] . Gazetteers of India, Tamilnadu, Tirunelveli District, p.249
[73] . Heong, K.L. “Rice is life, Scientific Perspective for the 21st Century, p.363

derived up wells, the Agricultural Engineering Department assisted farmers in identifying wells. The Agricultural Engineering Department provided subsidies to small, marginal, and tribal farmers for the **sinking of tube wells and deepening of wells** as part of a specific food grains production programme.

The Green Revolution, was limited to crops cultivated under irrigation. In arid places, the chance of total loss was higher, and cultivators, who spent on fertilisers and superior seeds, could incur a risk that their counterparts in the Green Revolution Belt did not. Further, dry agricultural tracts were poorer and farmer's standard of life was significantly lower than in the irrigated zone. As previously indicated, over 60% of the gross cultivated area in Tamilnadu was irrigated by rain. Despite twenty years of planned development, the proportion of unirrigated land to total cropped land was remained constant. Three issues must be kept in mind while carrying out the small irrigation programme. To begin with the schemes should be chosen after a thorough examination of the possibilities. Second, existing works, which were out of use due to lack of maintenance, may be repaired at a reasonable cost and they should be given priority. Finally, the benefits of modest irrigation schemes have been shown not to survive for long due to a lack of proper preparations for their repair, and therefore, responsibility for the maintenance of the works must to shifted to the people. For obtaining the greatest output from the land, a timely and appropriate supply of water is critical. Nearly four-fifths of India's cultivated land is dependent on rainfall, which is rarely adequate or timely across the country.

The most effective technique, to increase crop production in India, is to offer an additional source of water to cultivated area through irrigation. Irrigation is often divided into two categories: major and minor. However, water remains a concern in many sections of the State, and irrigation is a top priority in the state's agricultural plans. The usage of private tube wells and pump sets irrigates the majority of crop area, in every successful agricultural location. The Western Ghats, which operate as a barrier, prevent the state from receiving the full force of the south-west monsoon winds. The north east monsoon, on the other hand, brings roughly half of the typical rainfall to Tamilnadu, which aids in the continuation of rain-fed agriculture[74]. Although the irrigation factor was successful in establishing the preponderance of labour availability in multiple cropping, both within and between Indian states, it does not allow us to quantify the impact of irrigation on cropping intensity. Such a

[74] . Walter Coward, E., ‘ Irrigation and Agriculture Development in Asia, p.28

measurement is required to shed light on how much irrigation expansion is likely to increase cropping intensity[75].

Rationale behind the Green Revolution

The Green Revolution increased food production dramatically, and it is often regarded as the best thing that has ever happened to poor countries in their long quest for a better life. The Green Revolution was a technique of overcoming technological limits, imposed by the environment, culture, and religion in order to increase agricultural productivity and production[76]. Scientific study and purposeful use of enhanced agricultural knowledge, notably in the biological and chemical components of agricultural technology, Green Revolution, which was the result of either the Marxian mode of production approach or the neo-classical production function approach, to solve the problem of food security. In general, radical political economics posits that a social order marked by unequal distribution of power and assets will affect institutional arrangements, which, in turn, will affect individual farmers' output potential[77]. The First Five Year Plan emphasised the importance of land reform, stating that how the land problem is solved, could determine the pattern of economic and social organisation[78].

The origins of the Green Revolution may be traced to the 1940s, when US Ambassador to Mexico, Daniels and US Vice President, Henry Wallace, established a scientific mission to assist Mexico in developing agricultural innovations. Miracle seeds, also known as High Yielding Varieties, were used widely in the new technique. As a result, the Mexican government and the Rockefeller Foundation collaborated, to start a plant breeding programme in Mexico. Dr. Norman Borlaug, an American agricultural scientist of Norwegian ancestry, was the forerunner of this great scientific breakthrough. Borlaug's "miracle seeds" of dwarf wheat types were developed in 1954. Population expansion was putting an unsustainable strain on third-world food supplies, prompting the both of new technologies. Two worldwide agricultural research stations were established in connection with the "wonder seeds" programme: the International Maize and Wheat Improvement Centre

[75] . Gazetters of India, Madras, Madurai, p.147
[76] . Agro star, Commission On Agriculture, p.2
[77] . Dharm Narain, Shyamal Roy, 'Impart of Irrigation and Labour Availability of Multiple Cropping p.22
[78] . "From Green to Ever – Green Revolution "The Financial Express" 10. August 2009

(CIMMYT) and the International Rice Research Institute (IRRI). By the mid-1960s, the New Agricultural Strategy, a country-wide campaign by the Rockefeller Foundation to introduce new seeds, had evolved into these centres. In 1966, IRRI began producing'miracle rice' in response to CIMMYT's'miracle wheat.' From the 1940s to the 1960s, the Rockefeller Foundation, the Ford Foundation, and the US government supported the Green Revolution in Mexico, the Philippines, and India. Since the 1960s, it played a prominent part in the global agricultural landscape.

Independent India and the American Relative

Following independence, hunger relief became a national priority. As part of free India's effort to increase production and thus ensure food security, various programmes such as the Grow More Food Campaign, Intensive Agricultural Development Programme IADP, Community Development Programme of 1952, National Extension Service NES, and Intensive Agricultural District Programme (IADP) were implemented. All these events were dress rehearsals for the advent of Green Revolution. Drought, for example, had a severe impact on food output in 1965-66. There were no famines since the scarcity was alleviated by large-scale food imports, notably through the United States' PL 480 programme. For a long time after independence, the country was obliged to rely on imported food from the West. During this time, American influence in India progressively increased. The Indian economy's subsequent reliance on US aid, bolstered American domination. In almost every sector, the American connection began to play an increasingly vital role in directing Indian policy. A report by American experts, signalled a shift in agricultural development policy was funded by the Ford Foundation. It urged for a dramatic shift in policy and it away from populist Community Development ideals and towards scientific solutions to the agricultural development conundrum. The Green Revolution arose as a result of this transition[79].

New Agricultural Strategy

India's reaction to the severe and long-running food crisis that peaked in the 1960s was the 'New Agricultural Strategy,'. Food self-sufficiency was a top priority for the administration, and it was included in the First Five Year Plan. The success of the IADP and the First Five-Year Plan, led to a mix of pride and apathy toward agricultural development in the agricultural sector. With the agricultural success of the First Plan came an offer from the

[79] . "David Barkin, "Food production consumption, and policy" Encyclopedia of Mexico Vol. I, p.494

US government to supply agricultural surpluses from accumulated stocks on extremely favourable terms. Agriculture was moved to second place on the priority list when the Second Plan began. The Second Plan's neglect of agriculture resulted in a food crisis, which was aggravated by a brief war with China in 1962 and a severe drought inEast India. Food grain production in the country declined to 72 million tonnes in 1965-66, down from 89 million tonnes the year before[80]. Meanwhile, there was a rising perception among donor countries that international food aid resources were insufficient to meet the demand for assistance from food-insecure developing countries. President Lyndon B. Johnson of the United States refused to prolong food supplies beyond a month unless India and the United States agreed to the Green Revolution scheme. When Lal Bahadur Shastri was elected Prime Minister, he and the Minister for Food, C Subramaniam, resolved to make agriculture a priority in government strategy, and hence the urgency for the implementation of the Green Revolution. The new plan placed a strong emphasis on agricultural research[81].

History of Agricultural Research in India

Agricultural research, has always played a limited role in most developing countries. Such research in India was largely concentrated on export commodities like rubber, sugar cane, and bananas, which were commodities of interest to the imperial power, even up until the beginning of the second half of the Twentieth Century. Increases in the area under cultivation fueled the expansion of these crops' output.Attempts to boost yields and productivity, relied primarily on imported technology from developed countries. In many situations, such equipment was inadequate or insufficient for agricultural circumstances in poor countries. As a result, gains in productivity and yield were minor. In 1897, the country became the first in the world to conduct organised agricultural research, over 50 years after Europe and the United States. Agriculture operations were meant to bridge the gap between high-performing and low-performing locations by selecting and adapting high-performing and low-performing varieties. The purpose was to boost food production by evaluating local customs objectively and using new scientific concepts. Because of its indigenous roots, agricultural research in India began with a concentration on the peasantry. The research strategy described above did not survive long. Colonial states' commercial and economic

[80] . 'Agrarian Relations and annulations "The Mode of Production Debate in India and USA patnaik's (1900)

[81]. International Maize and Wheat Improvement Center (CIMMIC) Mexico, was set up in 1956 on the basis of the Rockfellel Foundation and Mexican Government programme and IRRI, established in 1960, by the Rockfeller and Ford Foundation.

interests crept in quickly. The Central Cotton Committee was established in 1921 in order to increase cotton production, which was a major concern for British industry at the time.

Through various departments of agriculture and their experimental farms, it supported research development in the impacted areas. The Imperial Council of Agricultural Research (ICAR) was established to coordinate agricultural research in the country, and the Royal Commission on Agriculture was encouraged by this effort. Jute, oilseeds, spices, cashew, and other economic crops received research following support, the footsteps of cotton. Formal agricultural research had grown from the initial trials of European colonists to the British government's botanical gardens and provincial experiment stations, to the current national public research agency, the ICAR, and the State Agricultural Universities. One of the most important interventions, made by the Indian government for agricultural improvement, was organised agricultural research in the public sector.

The experimental farms of the provincial department of agriculture were used for food crop and animal research. The Indian Council of Agricultural Research (ICAR) assisted the state department, and the Indian government provided direct funding to a few central institutes. The distribution of research money indicated that the research portfolio had broadened over time, with commercial crops accounting for a significant share of the total. The ICAR and Commodity Committees were critical in the building of state research systems. Several central research institutions were established in the 1950s, some with special goals to address vital requirements and others to develop captive units for the Commodity Committees. By the end of the 1950s, there were 564 research stations under the control of provincial agriculture departments. In the mid-1960s, the 'New Agricultural Strategy' was announced, emphasising the importance of technology and research. The ICAR was reconsituted to oversee all government-funded agricultural research. The Council also contributed to the state by providing direct and substantial financial support to the newly founded State Agricultural Universities. Another ICAR effort, the All India Co-ordinate Research Projects (AICRP), took the state system into the mainstream. Since then, the public system has expanded in scope and complexity[82].

[82] . Ibid., CIMMIC, 1960

Supply and Demand Factors in Research

The national agricultural research system was examined by a number of review organisations and observers. The system's most obvious flaw was its orientation. Although agricultural research in the country began with farmers' methods, it has since evolved into a supply-driven system. Scientists explored the West for new industrial concepts, methods, and materials, which they subsequently attempted to develop or adapt. The complete disregard for demand side variables, especially indigenous behaviours and local physical and economic constraints, resulted in the present environment and culture that severely limits the aim and breadth of research. To begin with, it implemented a departmental approach policy that prioritised peer adulation over problem-solving. Agricultural technology has been formalised and promoted to the status of a department. Second, it created an atmosphere in which no scientist wanted to leave the laboratory or the experimental farm, and the farmer was considered ignorant. As a result, research has become increasingly irrelevant and lacking in relevance. When the system adopted the Land Grant Model in the 1960s, it attempted to close the gap by combining extension, research, and teaching, but this endeavour devolved into a departmental effort. Scientists provided suggestions based only on their own research, but they were not involved in the dissemination process, which was handled by the extension division or directorate. As a result, technological development and transmission are two separate realities or processes. In the evaluation, only scientific output was considered. Scientists boast about their accomplishments but they are not concerned about how they were implemented, blaming failure on policy or extension issues.

Indian Experience of Green Revolution

In India's post-independence decades, agriculture began to be reformed in accordance with the new paradigm's objectives. Despite the constraints. India's agricultural prosperity began in the mid-1960s with the Green Revolution. It was made feasible by a comprehensive programme, involving improved seeds, inorganic fertilisers, irrigation, and plant protection measures, as well as agricultural research and development and the hard work of Indian farmers. The Green Revolution was essentially a biological "eureka" moment centred on "wonder seeds." Biological technology became to be the most important type of agricultural technology[83].

[83] . Report of the Famine Commission (1901:1)

Green Revolution Technology

The new seeds, introduced under the green revolution, put the traditional agriculture's respect for nature's limits and cycles to the test. As a result, the Green Revolution's research concentrated on the'miracle' seeds. Modern cultivars have increased their ability to efficiently use nutrients and water, diverting more of them to grain production rather than other portions of the plant like the leaf. Other characteristics distinguish the miraculous seed's dream-plant. It isnot bothered by the time of day. In layman's terms, this means it can grow and run continuously even in foggy conditions, reducing the time it takes to produce a harvest significantly. As a result, the yield increases by a factor of 10. Between 1965 and 1990, India's food supply situation improved dramatically, with frequent surpluses, better food security, and improved overall nutrition. This occurred despite the addition of around 390 million people to India's entire population over the last quarter-century,with a 2.2 percent annual population growth rate compared to other periods in agricultural history, the Green Revolution transformed agriculture in an astonishingly short period of time[84].

The percentage growth of all new inputs was extraordinarily high during the first decade of the Green Revolution, 1960-61 to 1970-71. Over a ten-year span, fertiliser use increased by 665 percent. Over the same time span, fertiliser consumption per hectare increased by 609 percent. The number of electrical irrigation pump sets had increased, as well as diesel irrigation pump sets and the number of tractors[85]. Depending on the state and locality, the Green Revolution package varied in type and scope. Other determinants were the amount of operational holdings, water availability, farmer ingenuity, government control, and other issues. In India, Punjab was a key Green Revolution hotspot. Between 1967 and 1984, Punjab's HYV seeded area expanded from 3.58 percent to 99.5 percent, while Haryana's increased from 1.73 percent to 95.2 percent. Punjab's fertiliser use has always been higher and it had grown faster than Haryana. Compared to Haryana, Punjab's consumption increased from 40.3 to 133.2 kg per hectare between 1970 and 1981. Teams from Cambridge and Madras Universities studied numerous villages in the North Arcot area of Madras State during the Green Revolution period in 1972-73, In 1982-83 and 1983-84, they repeated the experiment[86]. According to the studies, agricultural developments in the region had benefited almost all economic classes in the region, including small paddy farmers and landless laborers. The shift to HY rice varieties, a large increase in fertiliser use, and the expansion

[84].“The team of experts was headed by “Dr. SheemanE.Johnson and it submitted the report in April, 1959”
[85] . Economic Intelligence Service (1994) Basic statistic relating to the Indian Economy (Table 6.1)
[86] . CMIE (1994) based on statistics relating do the Indian Economy

and mechanisation of irrigation, which had resulted in intensification of paddy production and the mechanisation of a number of other activities, have been the most significant changes in the region's agricultural economy[87].

Green Revolution and Economic Development in India

India was enjoying fast economic growth, particularly during the 1990s, when it began to fully liberalise its economy. India's Green Revolution which began in the late 1960s, and as a result of its success, the country achieved food self-sufficiency within a decade. However, the first 'wave' of the Green Revolution was mostly focused on the wheat crop and northern India, particularly Punjab, resulting in a modest contribution to the country's overall economic progress. Agricultural expansion in the 1980s, on the other hand, included practically all crops, including rice, and spanned the entire country. It allowed for a near-doubling of rural income and a significant reduction in rural poverty. Rural India's rise as a'market' for non-agricultural products and services was a necessary precondition for India's rapid economic expansion, based on non-agricultural sector development after 1990[88].

Introduction of Economic Development in India

India, as one of the BRIC countries, has seen significant economic expansion and growth in recent years, particularly since the 1990s, when it began to liberalise its economy on a large scale. Without a doubt, succession of economic liberalisation measures introduced in India after 1991 had a significant role in the country's rapid expansion up to the present day[89]. To begin with, the study's main contention was that agricultural expansion should come before modern economic growth, which is built on industrialisation. The development of a home market for non-agricultural products and services,is a key pre-requisite for the success of industrialization. Rural income was increased and rural poverty relieved by agricultural development through productivity growth, such as the Green Revolution.

As a result, the Green Revolution can contribute to general economic development by providing a market for non-agricultural products and services in rural regions. The Green Revolution in India began in the late 1960s and continues to this day. By the end of the 1970s (the first 'wave' of the Green Revolution), India had achieved food self-sufficiency in less

[87] . Opcit, CMIE, 1994 Table 6.1
[88] . Murray leaf, anthropologist effect of green revolution" 1978
[89] . Opcit, 1978

than a decade. However, because it was limited to wheat crops and northern India, such as Punjab, it failed to increase income in the country's vast rural areas. The second 'wave' of the Green Revolution, on the other hand, eventually reached India in the 1980s. It blanketed the entire country and involved practically all crops, including rice. It was able to help raise rural income and reduce rural poverty throughout the country. As a result, the second Green Revolution in the 1980s proved critical to India's economic prosperity[90].

Before we look at the agricultural sector's development in India, let's take a look at the country's overall economic development from independence in 1947 to the present day. Until the late 1970s, India had relatively modest economic growth rates of roughly 3.5 percent per year, with substantial variations due to the impact of the agricultural sector, which was heavily influenced by the monsoon situation[91].

1. Until the mid – 1960s

During the first half of the Twentieth Century, the agricultural sector of British colonial India, notably the crop sector, remained completely unchanged or even declined. This tendency was reversed after the intervention of United States. India's food grain output increased by 4.13 percent, on an average between 1951-52 and 1960-61, with both sown area expansion and crop yield, contributing to the increase. However,the rate of expansion in the agricultural sector slowed with time. The government's agriculture plan prioritised institutional improvements such as land reform and the promotion of farmer cooperatives. After the Second Five Year Plan (1956-57 to 1960-61), India promoted massive industrialization as a "socialist" society, largely ignoring the rural economy[92]. India was struck by severe two-year 'consecutive' droughts in the mid-1960s. Agriculture suffered a substantial fall, resulting in a severe food scarcity in India. Agriculture's fall harmed the economy as a whole, as well as the political regime[93], because the agricultural sector still accounted for about half of GDP. India's severe economic and political challenges in the mid-1960s, compelled the government to make a fundamental shift in its agriculture strategy, focusing on technological innovation and importing new agricultural technologies from

[90] . Bardhan, P.K, "Land Labor and Rural Poverty, 1984
[91] . Op cit, 1978
[92] . Bhaduri, A.1973, " A study of Agricultural Backwardness under semi-fenodalism" Economic Journal, March 120-137
[93] . Blyn.G., 'Agricultural Trends in India" (1891 – 1947) 1966

overseas[94]. In the mid-1960s, our seed-fertilizer technology began to expand throughout the tropical developing countries, which was a fortuitous coincidence for India. With the exception of a few drought years, new seed – fertiliser technologies, particularly for the wheat crop, spread quickly in Northern India, and helped. India to reach food self-sufficiency within a decade or two. It was the first 'wave' of the Green Revolution is known as [95]. The initial wave of the Green Revolution had disadvantage in terms of India's overall economic progress. The Green Revolution was unable to raise rural income and alleviate rural poverty in a greater area since its spread was limited to the wheat crop in North India, such as Punjab, Haryana, and the western part of Uttar Pradesh. Rural India remained poor, with the exception of a few isolated locations.

Role of the Green Revolution and Economic Development

The impact of India's Green Revolution, particularly the second wave of Green Revolution in the 1980s, on the country's general economic development was significant. The most significant lesson we learnt was that contemporary economic growth, based on industrialisation, should come before agricultural growth. The following are the reasons for this. The agriculture sector was deemed 'big' in at the start of economic development. Agriculture and related activities provide a living for a vast portion of the people. It is important to note that export-oriented industrialization was more difficult, and entrepreneurs should first rely on the domestic market, which is more familiar to them, before venturing into the export market. In this sense, the existence of a domestic market for their products was critical while promoting industrialization. Because the majority of people at this stage of development reside in rural regions, the challenge is to figure out how to increase income and alleviate poverty in rural areas. As a result, the agricultural sector, particularly the staple food industry, should be developed first, as the majority of rural people rely on it for their living. If increasing rural population income is the goal, agricultural growth should be driven by productivity gains rather than 'horizontal' farmland expansion.

India paid a high price for its agricultural sector's neglect prior to the mild 1960s, in the shape of the 'lost decade' from the mid-1960s to the mid-1970s.[96]. Finally, during the 1980s, India's second Green Revolution was able to play a critical role in preparing a large

[94] . Op.cit., 1984
[95] . Ibid., 1996
[96] . James Home, Maura MC Dermott, “The Next Green Revolution”, Atlantic publishers Distributors Pvt Ltd, (2004).,

market in rural areas for non-agricultural products and services, which later became the foundation of the country's rapid economic growth based on non-agricultural sector development after the 1990s[97].

Green Revolution and Agricultural Laborers

The only feasible and safe way of improving the economic condition of the poorer section of the rural population was to encourage faster agricultural growth through subsidisation of chemical-biological breakthroughs in production and the promotion of agrarian capitalism in the countryside. Allow industrious capitalist farmers to fatten up so that agricultural labourers can flourish on the larger crumbs from their table and this was the New Agriculture Strategy, which dominated government agricultural policy in the 1960s. The glowing accounts of visiting foreign friends about the all-around prosperity they witnessed while driving through their favourite Punjab villages, convinced them of the essential soundness of this policy. The only major source of concern was that the Green Revolution did not spreading quickly enough to paddy agriculture. It was hopes that some Rice Research Institute somewhere, with Rockefeller Foundation funding, would discover exactly the right strains of high-yielding rice, that would be suited to the soil climate complex of India's paddy regions.

The Green Revolution was taking place in the wheat fields of north-west India – Punjab, Haryana, Western Uttar Pradesh, and so on. For performing various agricultural operaiotns like ploughing etc[98]. The so-called Green Revolution did not help to raise agricultural pay rates in real terms, in north-west India. In fact, there were some signs of a real wage rate decline in several sections of this region. Because of an extraordinarily steep growth in the cost of living index of agricultural labourers over the 1960s, the observed high cash wage rates, were misleading in most of these places. It employment had expanded rapidly enough over this period, a stagnant or even declining real wage rate would be consistent with a major improvement in the working conditions of farm labourers. Unfortunately, data on rural employment in India was notoriously scarce and unreliable, especially when compared over time.

[97] . Pranab Bardhan, "Green Revolution and Agricultural Labourers" 1970, p.548
[98] . Op.cit., 2004

It is interesting to record that Green Revolution did not enrich farmers economically. When the data from the Second Agricultural Labour Inquiry (1956-57) was compared with the data from the N.S.S. 19th Round (1964-65), it was evident that the number of full days, per year, in wage-paid employment for male agricultural workers it increased from 194 to 208, and for female agricultural workers increased from 127 to 138 in the country as a whole. This was hardly a particularly significant increase in wage-paid employment, especially given that agricultural production increased by more than 27% over this time span.[99]Regarding the consumption these large masses of extremely impoverished people did not fare well fared in the 1960s as the Green Revolution was success fully executed[100].

The estimates of percentage shares of total consumption expenditure for the bottom 30% of the rural population in India during much of the 1960s, indicated that the relative position of the bottom 30% of the rural population had not changed significantly despite the Green Revolution.

Services of C. Subramaniam

No one wanted to take up the Food and Agriculture Ministry when Lal Bahadur Sastri was forming his new team for the new ministry in 1964. This Ministry had the dubious distinction of being the graveyard of reputations. Others cautioned C.Subramanian against accepting a position that damage demanding and thankless. C.Subramanian, rose to the challenge of developing a new plan to boost agricultural output and make the country self-sufficient in food grains.

Implementation of New Technology in Agriculture

C.Subramanian's vision for agricultural reform, as well as the critical political decisions required to make the new strategy succeed, should never be overlooked. Technology can be developed by science, but agricultural statements must be developed in order for it to be useful at the farm level[101]. His greatest accomplishment as an Agriculture Minister was initiating the "Green Revolution in Agriculture," which helped India to emerge self-sufficient in food. By promoting sciences and Technology in Agriculture, he was

[99] . National sample Survey Organization 2006
[100] . FAO (Food and Agriculture Organization) 1995
[101]. Pranab Bardhan, “Green Revolution and Agricultural Labourers” 1970, p.548

primarily responsible for the 'Green Revolution.[102]When the country was in the grip of the 1966 drought, he was on his feet. C.Subramanian boldly stated in the Parliament that the country would be self-sufficient in food production in five years[103].

To the chagrin of many, he did not hesitate to accept all available assistance from the United States of America, in order to make his ardent attempts to ensure seed stains a success. As Minister of Planning in 1971, he had to see that this promise was kept. C.Subramaniam's comments on the issue of agriculture, reflected not only his thorough understanding of the revised features of Indian agriculture, but also his deep interestscience. . C.Subramanian was able to enlist the help of a large number of agriculturists, scientists, economists, and administrators for this project. Agricultural development should, in his opinion, go hand in hand with industrial developmen[104]. C.Subramaniam's knowledge of the complex of circumstances involved in achieving the "Green Revolution", was genuinely extraordinary as an administrator. He recognised the importance of inputs and worked tirelessly to enhance the supply and use of fertilisers, safe drinking water, plant production supplies, research staff, and extension workers. He recognised the importance of price policy and, more importantly, he understood and demonstrated that no strategy could work without a 'Organized Will' to succeed.[105]The revelation that the new technology was available to the little farmer, tenant, or owner, was one of Subramanian's most valuable discoveries.

He also realised that conventional social and political practices and structures stood in the way of providing full assistance to small farmers[106]. He put forth a lot of effort to shape credit and other institutional organisations to help the underprivileged reach higher incomes. It was a never-ending task that took centre stage in the Fifth Plan. C.Subramaniam's ideas, which he launched in 1964, remained the key to achieving Indian agricultural self-sufficiency and achieving social justice. [107] His tenure as Minister of Food and Agriculture from 1964 to 1967, was pivotal. It was thanks to C.Subramaniam's administrative prowess that large-scale suffering and malnutrition were avoided as a result of two years of severe drought. Despite the fact that a large nationwide food famine posed challenges to food production,

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[102] . Narman, E., Borlaug and Glenn Anderson, ‘ Felicitation to Subramaniam” C.S. 65, C. Subramaniam’s 65th Birthday Commutation Volume, p.33
[103]. Indian Ere press (Weekend)
[104] . Grawford.J.G., “Subramainam and Organized will” C.S.65, P.23
[105]. Subramaniam.C, India of my Dreams, p.17
[106]. Ranganathan.S, ‘ The Five Laws of Library Science’ op cit, p.78
[107]. Subramaniam.C, “Indian of my Dreams”, p.17

C.Subramaniam successfully overcame them[108]. It was C.Subramaniam's resolute courage that the country's minister of food and agriculture can announce today that the country had reached food sufficiency and would no longer import cereals[109].

Crop Insurance Scheme

On November 20, 1964, C.Subramaniam introduced a bill to establish the Food Production Corporation. It was through this government agency that he prepared the path for peasant crop loans[110]. It also increased India's food production. In Agriculture, he developed the 'Crop Insurance Scheme' for the benefit of farmers. Due to C.Subramaniam's policy intervention, paddy with a long harvesting period was replaced by paddy with a quick harvesting period. He created a crop rotation programme and persuaded farmers not to leave regions uncultivated[111]. In 1964-65, he devised a crop rotation programme on 16 lakh hectares of land. The following year, it was expanded to 110 lakh hectares of land. As a result, the output was improved[112].

Increased Food Supply

C.Subramaniam put in a lot of effort for wheat production. Wheat output grew to 1100 kilogrammes per hectare in 1965-66, up from 100 kilogrammes per hectare in 1963-64, thanks to his hard effort[113]. He brought 70 thousand tonnes of wheat from Pakistan and 10,000 tonnes from Thailand into the country. In 1964, 75 thousand tonnes of food were shipped from Australia, 80 thousand tonnes from Canada, and 25 million tonnes from México to alleviate food crisis[114]. He signed PL 480, a contract to import four lakh tonnes of wheat from America, on August 6, 1964. The Fair Price Shops were supplied with PL 480 Wheat.[115] He also brought in 18,000 to 20,000 tonnes of the "new" Mexican wheat for testing and utilisation. Without this gesture of trust and the excellent research conducted in India, the Indian wheat industry would not have developed successfully, and the situation in the 1970s would have been disastrous[116.] C.Subramaniam sought advance on food production from the

[108]. Dr. Raja Sir MuthiahChettiar, Madras, Letter to Jawaharlal Nehru National Youth Centre, on 14, January 1975
[109] . Craw Ford. J.G., "Subramaniam and Organized will", p.23
[110]. Ibid, p.24
[111] . Ibid, p.25
[112] . Ranganathan S., op.cit, p.78
[113] . A personal interview with C. Subramaniam Son S.Rajeskar Dec 25, 2020
[114] . Dr. Malcolm.S, Adiseshiah, ' A many splendored sprit", C.S.65. pp.43-44
[115] . Lok Sabha Debates, Vol. XXXV, November 1964, p.2036
[116] . Lok Sabha Debates, Vol. XXXVI, November 1954, p.1432

Food and Agriculture Organization of UNO. As a consequence, he received 25 different types of wheat seeds,which produced a large quantity of such wheat in a short period of time[117]

Other Developments

Despite the fact that his country was suffering from famines, he exported 2.30 lakh tonnes of sugar to other countries in 1964. [118]. He had gone to great lengths to produce honey. In 1965, 52 thousand kilos of honey were produced, compared to only 20 thousand kilogrammes in 1964. He restricted the price of all cereals, including paddy, in the same year. Wheat and maize are the two most common grains.[119] In 1965, he proposed to employ nine waterfalls to generate power, after examining the benefits of electric current in food cultivation. He took measures in that direction[120].

Agricultural Institutions

C.Subramaniam developed plans to establish Agricultural Colleges and Research Centers across the country. On January 10, 1965, he founded a Research Centre in New Delhi with the goal of developing new farming processes and scientific procedures. It provided excellent training, with the help of the Rockefeller Research Institute of America. He introduced 12 types of rice seeds to improve productivity with the help of this institution[121]. C. Subramaniam instructed the guests and specialists to develop the land in accordance with its fertility. He asked the Ministry of Agriculture to provide services to hamlets for three years in order to help the settlements flourish[122]. He organised a group under the direction of G.B. Chalam in 1966 to get Rice Research Institute (IRRI) to develop new varieties of paddy and the people to know the procedure. This group went on a nationwide tour to train farmers on how to plant seeds right away.[123] In January 1967, he introduced MDD 27, a novel hybrid paddy variety, in Tanjore district to make a major breakthrough in state agriculture in Tamilnadu.

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[117] . Ibid, p.1562
[118] . Subramaniam.C, "Nan kanavirumbum India", 2007, p.1
[119] . Lok Sabha Debates, Vol. XVI, December 1966, p.864
[120] . Lok Sabha Debates, Vol. XXXVI, November 1964, p.1562
[121] . Indian Express, Madras 7, August 1964
[122]. Craw ford, J.G., 'Subramaniam and organized will", p.23
[123] . Lok Sabha Debates, Vol. XXX, November 1964, p.5430

This paddy can be grown three times each year[124]. C. Subramaniam believed that the only way to create a "Welfare State" would be to eliminate food scarcity, rather than through war or revolution.[125]. He used to attended the General Conference of the Food and Agriculture Organization of the United Nations, where he was highly esteemed, throughout his stint as Minister of Food and Agriculture. C.Subramaniam was the Chairman of the Panel of Experts convened by the Secretary-General to address the protein crisis in developing nations at the United Nations. C.Subramaniam's and his colleagues' contributions to agricultural reform have had far-reaching consequences in many places outside India's boundaries. In the summer of 1967, then-US President Lyndon B. Johnson recorded his admiration for C.Subramaniam's accomplishments as India's Minister of Food and Agriculture. He was widely regarded as the Father of the Green Revolution in the United States. He has a legitimate claim to being the driving force behind India's Green Revolution, despite the fact that he had changed portfolios before it became a reality[126].

Contribution of Dr.M.S.Swaminathan

Dr. M.S. Swaminathan is a well-known Indian geneticist and administrator who was instrumental in the successful implementation of India's Green Revolution programme. He enabled the country to become wheat and rice self-sufficient. His father, a surgeon and social reformer, influenced him greatly. After graduating from zoology, he joined at Madras Agricultural College and earned a B.Sc. in Agricultural Science. His desire to become a geneticist was influenced by the Great Bengal Famine of 1943, which resulted in numerous deaths owing to a lack of food. Because he was a natural philanthropist, he sought to assist poor farmers by increasing their food production. He began his career at the Indian Agricultural Research Institute in New Delhi, eventually rising to become the driving force behind India's "Green Revolution," a programme that provided poor farmers with high-yielding wheat and rice seeds. He worked in India for decades, doing research and administration as well as teaching modern farming methods. TIME magazine called him one of the Twenty most influential Asians of the twentieth century. He has garnered numerous national and international awards for his services to agriculture and biodiversity.

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[124]. Lok Sabha Debates, Vol.VII, January 1964, p.346

[125] . A.P. “A personal Interview with C. Subramaniam on 16th out 1988” (Recard from Chennai archives Dec 24, 2020)

[126] . Subramainam.C, “New strategy in Indian Agriculture, New Delhi 1972, p.86

Childhood & Early Life

Dr. Swaminathan was born on August 7, 1925, in Kumbakonam, Madras Presidency, to Dr. M.K.Sambasivam and Parvati Thangammal Sambasivam. His father was a surgeon and a social reformer. He was nurtured by his uncle, M.K.Narayanaswami, a Radiologist, Since his father died when he was 11 years old. He went to Little Flower High School in Kumbakonam and subsequently Maharajas College in Tirvandrum. He graduated with a bachelor's degree in biology in 1944. After seeing the Bengal famine in 1943, he was encouraged to pursue a career in agricultural sciences. He studied at Madras Agricultural College and received a Bachelor of Science in Agricultural Science as a result[127]. In 1947, he started working at the Indian Agricultural Research Institute (IARI) in New Delhi, and in 1949, he earned a master's degree in genetics and plant breeding. He was awarded a UNESCO Fellowship and went to Wageningen Agricultural University in the Netherlands to study genetics. There, he continued his IARI potato genetics study and he was successful in standardising techniques for transferring genes from a range of wild Solanum species to the cultivated potato, Solanum tuberosum. He began his studies at the University of Cambridge's School of Agricultural Sciences in 1950, earning his PhD in 1952 for his thesis, "Species Differentiation and the Nature of Polyploidy in Certain Species of the Genus Solanum - Section Tuberarium." He went on to work as a post-doctoral researcher in the United States at the University of Wisconsin. He was offered a full-time faculty position at the college in early 1954, but he declined and went pack to India. From 1954 to 1966, he worked as a teacher, researcher, and research administrator at the Indian Agricultural Research Institute (IARI) in New Delhi. He was named Director of IARI in 1966, a position he held until 1972.

Meanwhile, he worked at the Central Rice Research Institute in Cuttack from 1954 until 1972. From 1971 to 1977, he served on the National Commission on Agriculture. From 1972 until 1979, he was Director General of the Indian Council of Agricultural Research (ICAR), which was part of the Indian government. From 1979 to 1980, he worked as a Principal Secretary in the Ministry of Agriculture and Irrigation of the Indian government. In the mid-1980s, he was also the Deputy Chairman of India's Planning Commission. From June 1980 to April 1982, he was a member of India's Planning Commission (Agriculture, Rural Development, Science, and Education). At the same time, he was Chairman of the Indian

[127] . Indian Express, Madras, 11 January 1965

Cabinet's Science Advisory Committee. In 1981, he was named Chairman of the Blindness Control Working Group and Chairman of the Leprosy Control Working Group. From 1981 to 1982, he was Chairman of the National Biotechnology Board. From 1981 to 1985, he was the Independent Chairman of the Food and Agriculture Organization (FAO) Council. From April 1982 to January 1988, he served as Director-General of the International Rice Research Institute (IRRI) in the Philippines. From 1988 to 1989, he was Chairman of the Planning Commission's Environment and Forestry Steering Committee. From 1988 until 1996, he served as President of the World Wide Fund for Nature-India. From 1984 until 1990, he was President of the International Union for the Conservation of Nature and Natural Resources. From 1986 until 1999, he was a member of the World Resources Institute's editorial advisory board in Washington, D.C.

He was the one who came up with the original 'World Resources Report' concept. From 1988 to 1989, he was Chairman of the Commonwealth Secretariat Expert Group. He founded the Iwokrama International Centre for Rainforest Conservation and Development. He was the Chairman of several Government of India committees engaged with crafting draft legislation for the Biodiversity Act from 1988 to 1998. From 1989 to 1990, he was the Chairman of the Government of India's Core Committee for the Development of a National Environment Policy. He was also the Chairman of the High Level Committee for Review of the Central Ground Water Board. He was Chairman of the M.S. Swaminathan Research Foundation from 1989 to the present. In 1993-94, he was contincies as the Chairman of an Expert Group for the development of a draught National Population Policy, and from 1994 onwards, he was the UNESCO Chair in Ecotechnology at the M.S. Swaminathan Research Foundation in Chennai. In 1994, he served as Chairman of the Commission on Genetic Diversity of the World Humanity Action Trust.

He also became Chairman of the Genetic Resources Policy Committee of the Consultative Group on International Agricultural Research. From 1994 to 1997, he was the Chairman of the World Trade Organization's Committee for Research on Agricultural Exports. From 1996 to 1997, he was the Chairman of the Committee to Restructure Agricultural Education. From 1996 to 1998, he was the Chairman of the Government of India's Committee on Redressing Regional Imbalances in Agriculture. In 1998, he was the chairman of the Committee to draft a National Biodiversity Act. In 1999, he founded the Gulf of Mannar Biosphere Reserve Trust. From 2000 to 2001, he was the Chairman of the Tenth Plan Steering Committee for Agriculture and Related Sectors. He was the President of the

Puguwash Conference on Science and World Affairs from 2002 to 2007. In 2004, he served as Chairman of the Task Force for a National Agricultural Biotechnology Policy. From 2004 to 2006, he was the Chairman of the Government of India's National Commission on Farmers. In 2005, he chaired the Task Group on Revamping and Refocusing the National Agricultural Research System and the Expert Group for a Review of Coastal Zone Regulation. In April 2007, he was elected to the Raiya Sabha. From August 2007 to May 2009, and again from August 2009 to August 2010, he was a member of the Agriculture Committee.

He is currently a member of the Leadership Council for Compact 2025, which assists decision-makers in the fight against malnutrition during the next decade. Dr. Swaminathan is widely regarded as the "Green Revolution" initiative's creator. He is also an accomplished writer. He has produced a number of research articles and publications on Agricultural Science and Biodiversity, including 'Building a National Food Security System,' 'Sustainable Agriculture: Towards an Evergreen Revolution,' and others. For his contributions to agricultural science, Dr. Swaminathan has received various awards. The Ramon Magsaysay Award for Community Leadership (1971), the Albert Einstein World Science Award (1986), the UNESCO Mahatma Gandhi Prize (2000), and the Lal Bahadur Sastri National Award are among the many awards he has received (2007). In 1967, he received the Padma Shri, in 1972, the Padma Bhushan, and in 1989, the Padma Vibushan. He has also been awarded more than 70 honorary doctorates from universities all around the world[128].

The Green Revolution in India was time during which Indian agriculture was transformed into an industrial system through the use of modern methods and technology such as high yielding variety (HYV) seeds, tractors, irrigation systems, herbicides, and fertilisers. This period, which was primarily led by Indian agricultural scientist M.S. Swaminathan, was part of Norman Borlaug's bigger Green Revolution initiative, which used agricultural science and technology to boost agricultural productivity in underdeveloped countries. During the agricultural revolution, the usage of chemical pesticides and fertilisers surged, wreaking havoc on the soil and land (e.g. land degradation). The Green Revolution was initially executed in India in the late 1960s in Punjab as part of a development

[128] . C.V. Narasimban, VNO, Newyork, letter to Jawaharlal Nehru National Youth Centre, New Delhi, on December 1974

programme supported by international donor agencies and the Indian government. The grain economy of India was established on a one-sided exploitative relationship during the British Raj and as a result, when the country gained independence, it was immediately vulnerable to famines, financial instability, and low productivity. These factors came together to create a compelling case for India's embrace of the Green Revolution as a development strategy.

During the early years of the Green Revolution, the economy flourished. The Green Revolution, which was initially adopted in Punjab, resulted in large gains in the state's agricultural output, which aided India's overall economy. Punjab was producing 70% of the country's total food grains by 1970, and farmer incomes had increased by more than 70%. Punjab's prosperity after the Green Revolution became an example for other states to follow. Despite the initial prosperity in Punjab, the Green Revolution was met with widespread opposition throughout India[129].

Indian Economic Sovereignty and Impact of Green Revolution

The cost of adopting HYV seeds for many small farmers, as well as the concomitant demands for more systems and pesticides, has been a source of criticism of the Green Revolution. Where farmers acquire Monsanto BT cotton seeds, In practise, they must still pay for costly pesticides and irrigation systems, which may necessitate more borrowing to finance these seed kinds that are more expensive. Many farmers struggle to pay for pricey technologies, especially if their harvest is poor. These high cultivation costs force rural farmers to take out loans with hefty interest rates. Over-borrowing frequently traps farmers in a debt cycle. Furthermore, India's liberalised economy exacerbates the farmer's situation. This is the'second Green Revoultion according to Indian environmentalist Vandana Shiva. She claims that the first Green Revoultion was mostly supported by the government. She claims that the current Green Revoultion is driven by private interests particularly Monsanto as well as the neoliberal setting. In the end, this will result in foreign ownership of the majority of India's agriculture, putting farmers' interests at risk. Farmers' financial problems have been particularly evident in Punjab, where rural areas have seen an alarming increase in suicide rates. Without accounting for the many unreported cases, the number of suicides in Punjab increased by 51.97 percent in 1992-93, compared to a countrywide increase of 5.11 percent.

[129]. Norman.E, Borlaug & Glenn Anderson, Vol.12 (1990), published online Dec 29, 2009,pp.341-342

According to a 2019 Indian news story, indebtedness is still a serious problem for Punjabis today, as evidenced by the fact that over 900 farmers have committed suicide in Punjab in the last two years.

Environmental Damage

Excessive and improper fertiliser and pesticide use contaminated rivers and destroyed beneficial insects and mammals. It has resulted in the overuse of soil and the rapid depletion of its nutrients. The widespread irrigation techniques eventually resulted in soil degradation. The use of groundwater has drastically decreased. Farmers' biodiversity has been lost as a result of their increased reliance on a few primary crops. These issues were exacerbated by a lack of instruction on how to handle new technologies and widespread illiteracy, which led to excessive chemical use.

Increased regional disparities

The Green Revoluion only affected irrigated and high-potential rainfed areas. Villages or regions with insufficient water availability were excluded, resulting in wider geographic disparities between adopters and non-adopters. The new method cannot be implemented in dryland areas since HYV seeds can only be planted in areas where there is an assured supply of water and other inputs such as herbicides, fertilisers, and other agricultural chemicals. Punjab, Haryana, Western Uttar Pradesh, and other states with appropriate irrigation and other infrastructure facilities were able to reap the benefits of the Green Revolution and achieve faster economic development, while other States were denied the advantages of green revoluation. In the twentieth century, massive public investments in modern scientific research for agriculture led to huge yield advancements in industrial countries. The wheat story in England is typical. Wheat yields climbed to 0.5 to 2 metric tonnes per hectare over 1,000 years, but from 2 to 6 metric tonnes per hectare took only 40 years. Modern plant breeding, improved agronomy, and the advent of inorganic fertilisers and modern insecticides all contributed to these advancements. Most modern countries had created long-term food surpluses and had eliminated the threat of starvation by the second part of the Twentieth Century. Although the term "Green Revolution " was first used to describe the evolution of rice and wheat., high yielding sees of other crops like millet, maize, cassava, and beans, were also developed.

The popularity of HYVs skyrocketed. By 1970, HYVs had taken over approximately 20% of wheat and 30% of rice lands in developing countries, and by 1990, the share had climbed to over 70% for both crops. The harvests of rice and wheat virtually doubled. Due to improved yields and profitability, farmers increased their rice and wheat acreage at the expense of other crops. The Green Revoultion resulted in a considerable increase in land returns, which boosted farmer earnings. Farm families also spurred an overall increase in demand for products and services, thanks to more money to spend and new demands for agricultural supplies, milling, and marketing services. This bolstered rural communities' nonfarm economies, which thrived and generated significant new income and jobs on their own. Asia's real per capita income nearly doubled between 1970 and 1995, and poverty reduced from around three out of every five Asians in 1975 to less than one in 1995. The number of poor people fell from 1.15 billion in 1975 to 825 million in 1995, despite a 60% increase in population. Prior to the mid-1960s, the proportion of India's rural population living in poverty fluctuated from 50 to 65 percent, but by 1993, it had reduced to roughly one-third of the population.

A big part of the steady decline in poverty, was due to agricultural expansion and lower food prices. The Asian Green Revolution spurred a flood of empirical research into how agricultural technology development affects poor farmers. Large farm owners were the principal users of new technologies. Since they had better access to irrigation water, fertilisers, seeds, and loans. Small farmers were either unaffected or disadvantaged as a result of the Green Revoultion, which resulted in lower output prices, higher input prices, and landlords' attempts to raise rents or evict tenants. Critics also contended that the Green Revoultion lowered rural incomes and job opportunities by encouraging unnecessary automation. Although a number of village and household surveys conducted shortly after the introduction of Green Revolution technology suggests mixed results. Despite the fact that small farmers were slower to adopt Green Revoultion technologies than large farmers, many of them did so in the end. Many of these small-farm users profited from greater production, increased employment opportunities, and higher incomes in the agricultural and nonfarm industries. In addition, the vast majority of smallholders were able to keep their land, and overall production grew dramatically. In other cases, small farmers and landless laboure learned more money than larger farmers, resulting in a net improvement in community income distribution. The Green Revoultion has also been condemned for its environmental pollution. Fertilisers and pesticides used in excess and ineffectively have contaminated

streams, poisoned agricultural workers, and destroyed beneficial insects and other animals. Irrigation techniques have resulted in salt build-up, causing some of the greatest farming lands to be abandoned. Groundwater levels are falling in areas where more water is withdrawn for agriculture than can be replenished by rain. Furthermore, fields have lost diversification due to a significant reliance on a few key wheat species.

As millions of mostly illiterate farmers began to use modern inputs for the first time, some of these consequences were unavoidable. In sufficient lack of effective water quality regulation, and input pricing and subsidy policies that made modern inputs cheap and encouraged their excessive use all had negative environmental consequences. These concerns are gradually being solved without yield loss, and in some cases with production improvements, thanks to regulatory reforms, improved technologies, and management practices. Some of the options include pest-resistant cultivars, biological pest control, precision farming, and crop diversification. While the majority of this region was blessed with good soil, water, and labour resources, and its productivity in this field was historically the highest in the country, its dominance has eroded in recent times due to institutional, technological, economic, and other factors. Because of the more favourable conditions, the Green Revolution technology performed better in the northern and southern regions when it arrived in the country in the mid-1960s. The government did not create the necessary infrastructure or bring the necessary inputs within easy reach of the growers due to the region's administrative and managerial deficiencies. As a result of this neglect, the problem of unemployment and poverty in these states has worsened.[130]

B.Sivarraman made a vital contribution to the green revolution. He collaborated with C.Subramanian to develop self-sufficient agricultural equipment. He became president on January 1, 1969, and served until November 30, 1970. He was given the title of "PadmaVibbushan" by the Indian government, which is the country's second highest civilian honour. After the success of his programme, which resulted in a record wheat production in 1972, C.Subramanian, together with M.S.Swaminathan and B.Sivaraman, emarged as the architect of India's Modern Agricultural Development Policy. He is the author of the well-known book "Bitter Sweat. Govergine of Indian Transition." B.Sivaraman discussed accepted administrative and advised agricultural co-operative crop cultivation, contribution of farmers

[130]. DesmukhC.D, ‘ A valued friend’ C.Subramaniam., 65th Birthday communication, P.19

work, progation, land, production programme, and what it means for the people in that book[131].

In this Chapter, the historical background of the green revolution briefly discussed, as well as the challenges India experienced in adopting the green revolution. In terms of economic conditions during the Independence period, India's independence came at a time when agriculture was in a particularly terrible state. There was an overpopulation problem, severe starvation, unemployment, and so forth. Following independence, India faced a slew of issues. India's agriculture was transformed into modern methods as a result of the green revolution, resulting in industrialization. During the early years of the Green Revolution, the economy prospered greatly. The Green Revolution became a paradigm for other countries to follow.

[131] . . Dr.M.S.Swaminathan, “Agriculture Research Insitute Library” Chennai. Librarian Suresh.