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KNOWLEDGE AND POLITICS OF GREEN REVOLUTION AND ITS CONTESTATIONS WITH TRADITIONAL AGRICULTURAL PRACTICES WITH REFERENCE TO THE LEGACY OF R. H. RICHHARIA

Amrit Kumar Yadav
Research Scholar, Department of Political Science, University of Delhi
Himanshu Singh
Research Scholar , Department of Continuing Education and Extension
University of Delhi

INTRODUCTION

India, which is geographically very diverse and ecologically rich, encompassing all types of soils and seasons with adequate precipitation, has the world's second most agricultural land and among the most fertile ones, which has 20 agro–climatic zones on which nearly half of the population is dependent. Agriculture practices are not a machine-based production model in which, for a particular combination of inputs, large machine-based processes always result in some definite output. Agriculture is a very dynamic means of creation rather than machine-based production, which assimilates shared knowledge, cultural practices, and lived experiences of community, contrasting with the commodification model of machine-based production.

Since ancient times, farming has been community-based and holistic in nature, in which seeds play a pivotal role. Seeds, since ancient times, have been part of the “public domain and common resource” which are shared and exchanged among the communities. The rich farming practices and varied productivity are destroyed by colonizers with the imposition of heavy taxes on land, and policies such as permanent settlement create huge challenges for farmers without focusing on land reforms and agricultural investment (Singh, 2021). Agricultural development and its practice are cumulative knowledge, which carries the shared community knowledge and mundane practices which evolved over thousands of years. Understanding of agriculture cannot be realized solely through genes, bioengineering, or technical jargon; it can be understood in terms of shared practice.

At the time of Independence, in the process of nation-building, the Planning Commission of India (PCI) focused more on industrial development rather than on food production for a hungry nation.

Agricultural data refutes the misleading notion that India was unable to produce. From 1950 to 1965, it saw an increase in productivity in all crops (Kumar, 2019), and a flawed notion of hunger and famine was created to legitimize the demand of green revolution.

The term “Green Revolution” was coined by William S. Gaud of the United States Agency for International Development (USAID) in 1968, to introduce new farm technologies and policies for third world countries with support from industrialized countries in the global north between the 1940s and the 1960s to increase agricultural production. The introduction of high-yielding rice and wheat varieties in the 1960s marked the beginning of India's Green Revolution, which aimed to increase food production to tackle poverty and hunger. With the implementation of the green revolution programme, the production of rice and wheat doubled, but the production of other food crops, like indigenous millets, decreased. This resulted in the extinction of certain native crops as well as their removal from cultivation. Before the introduction of Green Revolution rice, millet, sorghum, maize, etc., were the major crops and surprisingly production of rice and millets is more than wheat, barley, and maize combined, and post Green Revolution, there is a sharp decline in production of millets. Due to the introduction of HYVs and homogeneous farming practices, traditional rice varieties have nearly become extinct, and their number sharply declined from more

than a lakhs to 7000 (Nelson et al., 2019). The traditional foods and cereal-based products like millets that once occupied a part of the regular Indian staple diet are slowly lost due to the emphasis on monocropping of rice and wheat post-Green Revolution. Surprisingly, the self-sufficiency in two cereals came at the cost of another form of dependence on the import of fertilisers, petroleum for irrigation pumps and tractors, and big machines for farms.

The problem with the technocratic approach of agriculture is that the research findings from the labs are treated as universal inventions that are applicable to all farming communities, despite ecological dissimilarities. These research and inventions are similar to industrial models of production, which is a great disaster. Different ecological conditions have different needs for seeds and have different farming practices, which are not suitable for everyone. Farmers need those inputs that suit their ecological environment, and under these conditions, the green revolution was a failure (Singh, 2021). The Green Revolution project was a "straitjacket scientific research programme" which had very little space for involvement of local farming practices, which cannot be incorporated in the Green Revolution. As Dinesh Abrol highlights that Indo –US co-operation for technology transfer leads to "disorientation of research capacity," which includes more focus on HYVs, chemical needs, large machines, and intensive water-based farming practice. These research programme has exclusive focus on cereal crops like wheat, rice, etc., and no focus is given to pulses and oilseeds, and non-irrigated and dry land areas. Thus, the green revolution, which should focus more on farmers' needs, is more homogenized and leads to monoculture farming, which is an essential feature of market-oriented farming. There is no consensus among technical knowledge and integration with indigenous knowledge of farmers, as many scholars argue that a combination of both scientific knowledge and conventional wisdom is necessary for holistic, sustainable development.

KNOWLEDGE, POWER, STATE, and Green Revolution

Power exists in all social relations, from formal to informal, and shapes them; power is itself a mode of relation between two social entities. With a change in power structure, the knowledge structure also changes, and one system of knowledge is useful for only one period, and it changes with other periods. The power relations also promote and suppress knowledge according to its need and feasibility. With changing power dynamics, we not only see it in the societal dimension but also in changes in dominant ideas over time. Power changes the orientations of institutions, and institute also shapes ideas in their interest.

As Foucault examines, "Knowledge as exercise of power and power as function of knowledge". For understanding of power relations among societies, the "genealogical approach" for history gives a critical understanding of event happened and their contextual power relations. Different scholars have different understanding that how thoughts emerge and change over a period of time, and what the reasons are that thoughts are seen only in that particular way.

There is always triangulation of knowledge, power, and governing societies, which shapes the ideas and dominant discourses. The strong admirers of scientific knowledge critique traditional knowledge, which is only accessible to local people and not in a universal form. Various commentators raise some critical questions about the role of science as the only mediator between the state and civil society, or whether it has replaced the whole democratic process. There should be coherence about the final goals of science and 'social objectivity,' and science should always align around the common good of society. However, the wider dependency of science and its innate intervention into our day-to-day life shows that political power is exercised in the guise of technology. The nature of science is not pure and also not value neutral they generate objectivity and gives consent to hegemonic knowledge and tries to make it universal (Hurri & Kestilä, 2019). Thus, these biases and limitations of science call for an understanding of society from an alternative framework.

Traditional knowledge provides an alternative framework for understanding and the development of sustainable use of resources and synergy with ecology, as practiced by shared knowledge and the lived experiences of communities. The notion of traditional, as termed, is not traditional in literal terms; it is more dynamic, continuously engaging with society and accumulated with lived experiences of society over centuries (Singh, 2021).On the same grounds, inquiry into agricultural knowledge needs an epistemological understanding of how dominant knowledge of the green

revolution had marginalized local knowledge. The politics of knowledge framework also inquires about the knowledge and development inter-relations, how some specific set of Western knowledge is made superior over other knowledge and development, and how it legitimizes state power through knowledge. The hegemony of a particular set of knowledge is made through incorporating it in state institutions, like in the education curriculum, state-sponsored funding, and for that particular set of knowledge for administrative posts. Despite the reciprocal relation between knowledge and politics, there is also a dominant Western construction that third-world people are "underdeveloped, weak, ignorant, and overpopulated" and thus need development. As a response to the capitalist model of development, there is a need for "appropriate technologies", according to resources available and fulfilling the country-specific needs. Talking about the Gandhian model of appropriate technologies, these technologies that large-scale production and machines cannot fulfill the needs of the poor (Shiva, 1993).

As Ashish Nandy argues, major post-colonial states use science and development as reasons for their existence apart from the organised violence implicated by science over these states. Nandy further argues that "there is something in modern science itself which makes it a human enterprise particularly open to co-optation by the powerful and the wealthy." Highlighting the importance of knowledge in understanding the post–Second World War period, he argues that dominance is not exercised through structural barriers but with "embedded systems of knowledge"(Singh, 2021). Further, "The edifice of alternative knowledge systems is constituted by local knowledge produced at various places and in multiple forms and is applied by producers and social actors themselves in daily lives" (Singh, 2021).

In the larger context of development in modernization projects, which includes industrialization materialization, consumption, a dominant model that is a path for progress of post-colonial countries, which is challenged by the dependency theorem and theories of development and underdevelopment, provides a critical analysis of development. Rachel Carlson's Silent Spring and other environmental research challenge the notion of development due to harmful chemical dangers associated with these models. These challenges give a need for appropriate alternate sustainable technologies, the latter of which brings discourse of a more decentralized model of development incorporating local communities and their traditional knowledge (Shiva, 1993). Although the dominant narrative of Malthusian theory of population growth and Paddock brothers' prediction about the hunger crises in the Asian continent, and especially for India, suggests that it is very difficult to overcome the need for revolutionary measures for increasing production and birth of the idea of green revolution (Visvanathan, 2003). The Green Revolution was a great success with the domain of Nehruvian notion of scientific development and strongly celebrated that the notions of green revolution has given a resurgence of modern science and embarrassment on the traditional knowledge (Visvanathan, 2003).

In 1952, the Indian government and the US signed a bilateral technical co-operation programme for the sharing of technical knowledge and support for agricultural research and development in India. The US government and its private institutes were confident that their expert commercialized nature and chemical and biological knowledge would be helpful in Indian subcontinent (Saha, 2013).In 1965, on a renewable contract with favourable terms the US decided to give PL-480 wheat shipments to India. These terms cost India a lot which is, India's war with Pakistan should be negotiated and stopped, devaluation of the currency, and opening farm machines and fertilizer markets in India. The Shastri government had successfully renegotiating the continued of imports of PL480 in November 1965, on the terms of, allowing foreign investment in fertiliser plants and also the imports of fertilisers, and opening Indian markets for cereal crops (Kumar, 2019). The philanthropy of the US has two political goals: one is for global dominance and hegemony through technology, and to contain the spread of communism in newly independent countries of Asia and Africa. "In this manner science and technology were used as tools of foreign policy under the larger umbrella of the Truman doctrine… The beginning of the twentieth century witnessed the emergence of food as new instrument of diplomacy" (Singh, 2021). The US Embassy in India points that, Green Revolution (GR) technology seemed

"economically sensible but politically dangerous. India 1965, US dictates its terms about the dependency of their aid on fertilizer imports and establishment of US firms in India. Additionally, in 1965 approximately 85% fertilizer imports

were from US and, one US Department of Agriculture official admits that the GR has offered a big payoff for multinational corporations (Harwood, 2019).

Before the green revolution, the high diversification of crops, which is a distinct quality of the Indian subcontinent, was replaced by crop concentration by a few cereal crops, resulting in loss of biodiversity and the genetic pool of indigenous rich varieties, which are suited to Indian climatic conditions. Mono-culture farming practices based on the market model lead to "debt trap" for small and marginal farmers, and earlier the farming system, which was based on the traditional barter system ('*jazmani*'), is now replaced by the capitalist model of input use in agricultural practices (Cullather, 2010).

CRITICAL ANALYSIS OF THE GREEN REVOLUTION

In the late 1950s, when India was under serious food stress, there was a need for six million tons of grains, and India reached out to the United States for the need of two million tons of grains. The motive of support from the US was not on humanitarian grounds but had political motives aligning with the Truman doctrine to contain communism through political and economic stability through agriculture research and development. In the mid-1960s, the USA used food as foreign policy for the implementation of the Green Revolution in.

Recovering from the crunches, the main challenges for the post-colonial state are to look for a development model that can fulfill the diversified needs. Agriculture is set to modernize based on a state-sponsored capitalist model with intervention with High-Yielding Varieties (HYVs), modern infrastructure, and the use of miracle seeds for solving hunger problems for millions of people. The new agricultural model, based on a technocratic industrialised model, destroyed the agro diversity, losing the traditional model, which favours big land holders and leaves poor farmers in vain (Singh,2021). The agricultural modernization was an outcome of modern science and has political implications. US philanthropism was politically motivated to contain the spread of communism, and for that, two important foundations, Ford and Rockefeller, helped America to achieve its objective. These two foundations make a false narrative of food insecurity, where India is producing export crops like tea, coffee, jute, etc., where "jute accounts for one third foreign exchange earnings" is deliberately ignored(Singh,2021).

The technocratic project of agriculture in India failed miserably, an imitation of the capitalist market model of farming system in tropical countries like India, which doesn't provide high capital investment, large landholdings, and infrastructural development for this farming method. On the other hand India farming is mainly subsistence farming, which was not commodified, and the whole project of the Green Revolution was to make capital-intensive market model farming (Saha, 2013). Earlier internal inputs (non –purchasable) agricultural items were used by traditional farmers, but the implant of the green revolution used high capital investment in high-yielding varieties (HYVs) in irrigation facilities and chemical fertilizers. "Violence lies at the heart of modern scientific vision, which enforces homogeneity, centralization and renders the indigenous ways of knowing redundant" (Singh, 2021).

To get quick and targeted results as compared to previous models of capacity building, in 1965, the Ministry of Food and Agriculture, Government of India, signed an agreement with the Rockefeller Foundation to assist the modernization programme, which included training of Indian scientists in the US, and for research and capacity building. In the pre-green revolution period, the Community Development Programme led the way for Intensive Agricultural Development Programme (IADP), which was first launched in Ludhiana (Punjab) for the introduction of new technology like improved seeds, irrigation facilities, and extension of credit services to avail the benefits. The green revolution comes with the support of a complex web of technocratic politicians, scientists, and research institutes, which deliberately ignore the possibilities of these policies on small and marginal farmers. It shows the inherent biases of science and market domination that only a few people dictate the term when and how and in what ways technologies reach a specific segment of people, and this is no exception for the green revolution (Singh, 2021).

The Green Revolution was aimed at boosting productivity in targeted regions, replacing subsistence farming with commercial farming, and making people reliant on markets for input purchases. Harry Cleaver suggested that "GR programmes could be seen as the latest episode in a long history of attempts to extend capitalism into as yet uncolonised areas of the economy". Shiva and others argued that the Green Revolution paved the way for

commercialization and “it strategically integrated third world farmers into the global market of fertilizer, pesticide, and seeds (Shiva, 1991).

For the implementation of the green revolutions, Subramaniam and his group distanced themselves from state bureaucracy and social scientists, and created a consensus for the implementation of the Green Revolution (Visvanathan, 2003). Ambassador Chester Bowles came to India and became more involved in agricultural planning and development. US diplomats held the view that “free from hunger” is a prerequisite for “political development” and thus laid the foundation of agricultural aid from the Ford Foundation initially through a community development plan. The whole project of this support of agricultural modernization through investment in HYVs, fertilizers, irrigation facilities, and agricultural research.

Central to the green revolution are seeds, which are going from community to market in form of HYVs. The HYVs varieties produce 20% more grain than their pervious cultivars and were more effective with the nitrogen fertilizers for high production, and reduced the cropping period, by which farmers can produce 2-3 crops per year earlier which was not possible. For example, the new IR-8 variety takes only 130 days to mature, and the latter varieties, such as IR-72 which only take 100 days for maturity, contrasting to that the traditional rice cultivars take more than 5-6 months for maturity. Due to the green revolution between 1960 and 1985 third world developing countries saw double in per hectare yield production (Nelson et al., 2019). Thus, “the Green Revolution involved the use of HYVs of wheat and rice and the adoption of new agricultural practices involving the use of chemical fertilizers, pesticides, and tractors, controlled water supply to crops, mechanical threshers, and pumps. The combination of these techniques was commonly termed “high-yielding variety technology (HYVT)” (Nelson et al., 2019). IR-8 was the most famous rice varieties introduced during the Green Revolution. This variety was developed on learned experiences in developing the Norin variety of Japan and the Ponlai variety of Taiwan. IR8 which was short, stiff and has well responsive to the high fertilizer dose.

The green revolution is limited to only a few crops like wheat, rice, corn, etc., and for targeted regions and rich farmers. It leads to homogenization of crops based on new seeds limited to only productivity based on the market model, and leaves no space for marginal farmers and improvement in the productivity of other crops. “All it gave was more wheat, which did not even form the staple diet of a majority of Indians at that time. Moreover, it did not make India selfsufficient in food, but only in wheat and rice, and that too at the cost of the rest of our plate.” The production of millet from 55.6 million hectares in 1968, has reduced to only 28 million hectares in 2006 (Planning Commission Data). The per capita wheat availability went up to 27.4 kg, whereas the per capita availability of millets, gram and pulses has reduced by 42 kg from 1961 to 2006(Kumar, 2019).

As Saha argues, traditional agricultural practices based on “*Krishi-Parashara*” and “*Kashyapiyakrisisukti*” show that assessment of soil is majorly in ancient India was based on its physical and biological qualities, like soil should be devoid of bones, stones, plastic, and other harmful material, and how different qualities show distinct character of soil. Our various issues related to the green revolution, high use of fertilizers like Ammonium sulphate, not only disrupt the agro-ecological balance but also change the taste and nutritional values, and excessive use of fertilizers hampers the water retention capacity of soil. These technological interventions have undermined the ancient agricultural knowledge of farmers, and the market-focused input-intensive Green Revolution model has been imposed over the whole of India. This model takes the farmer's place of repository of knowledge as a seed conversation, sowing and propagating to complex market and institutional structures where seed is commoditised. (Singh, 2021). The indigenous varieties developed over generations of accumulated knowledge, which reserve the “Bio-wealth” suited to the geo-climatic condition, are termed as non-scientific only based on productivity and input-intensive farming methods. With the Green revolution improvised seeds are promoted systematically, resulting in the loss of indigenous seeds and traditional knowledge associated with them, which also starts to disappear (Singh, 2021).

The dominant hegemonic epistemology of agriculture, which puts production through HYVs at the center, ignores the basic ecology, seeds, and intricate balance, showing larger projects of modernity that place economic prosperity and consumption at the center. In this technocratic view, seeds are seen as creations of labs and farms as places of production, same as of industry lines where mass-scale production occurs. This technocratic approach alienates knowledge producers (scientists) and knowledge practitioners (farmers) from the whole process. The use of big machines is a symbol of a dominant agricultural development model, which shows modernization and efficiency, showing production as its unchallenged dominant system (Singh, 2021).

Before the introduction of chemical fertilizers, Indian farmers used organic manure, wet humus, green manure crops, green peas, and legumes in crop rotation are very effective in maintaining soil fertility with very little investment without changing the nature of soils. Research conducted in 1955-56 shows that Sesbania aculeata (*dhaincha*), which proved resistant to the waterlogging commonly seen in low-lying areas along India's coast, is still widely practiced. Pre-green revolution agriculture practices in India are tagged as traditional on western notion of less chemical-intensive farming practices. Indian scientists also failed to incorporate the local knowledge and traditional farming practices for increasing productivity. They continue their research and development on the western models, which is a big failure of the green revolution (Saha, 2013). The implementation of new technological aspects in the form of the green revolution has a primary focus on increasing productivity to make India self-sufficient from hunger and foreign exports. It didn't benefit the target underprivileged due to a lack of institutional settings, weak local bodies, land ceilings, and it excluded the "social imperatives" of rural underprivileged sections (Ladejinsky, 1970).

INDIGENEOUS FARMING PRACTICES AND CONTESTATIONS WITH THE LEGACY OF R. H. RICHHARIA

Vandana Shiva gives a deep critical perspective on the green revolution's socio-economic, ecological, and cultural impacts, arguing that it represents a form of violence against marginalized groups, particularly small farmers, women, and whole ecosystems. Shiva criticizes the green revolution as violence that goes "beyond physical harm," which includes environmental destruction, economic exploitation, social inequality, and cultural erosion (Shiva, 1993).The traditional practices "work on the principle of agroecology," where farmers use their indigenous seeds, locally available internal inputs for practices, without depending on market needs for seeds and fertilizers. According to Albert Howard in *An Agriculture Testament* (1940), agroeccological practices focus on natural ways of maintaining soil fertility and water retention, indoor methods for composting, and mixed cropping patterns are natural ways of maintaining the soil's natural balance(Singh,2021).

Moreover, the aid and collaborations that were given for the Green Revolution were to gain control over the country, and the main role of agricultural scientists is to steer the mechanism of innovation and production management. Most agricultural scientists have no end-user connection; they pick problems from the literature, having ideas about challenges in the field and local farming practices. These scientists don't focus on the local knowledge practices like local non–chemical methods of manure, crop rotation, with low investment farming practices, with the use of internal inputs. Knowledge from labs should be consistent with the cumulative generational knowledge about farming practices, but the green revolution has ignored all these aspects of traditional knowledge on the basis of not being scientific and having a parochial nature.

However, for tackling the looming crisis of famine and food for all, C. Subramaniam has the typical Nehruvian answer, 'Science'. He argued that "Every country which has improved its agriculture has done so only through the introduction of science and technology into farming. India cannot be an exception". Subramanian, a strong supporter of science and technology, wanted to modernize agriculture on the same grounds as his previous portfolio, the Steel ministry, but he failed to recognize the basic difference between the Steel and Agriculture ministries (Visvanathan, 2003). Subramaniam was very critical of the condition of agriculture from a scientific bias that

"the long tradition of practice there was no need for the farmers to learn anything new, as farmers knew everything about agriculture". He discarded the whole gamut of rich ancient agricultural knowledge, which was purposely destroyed by the colonizers, and still, these rich practices are able to sustain the nation. In another parochial understanding of local farming practices through a modernization lens, he goes to the extent that "Indian farmers

were mostly illiterate and traditionbound and would not take to this type of agriculture in which chemical fertilizers had to be applied at high rates…"(Visvanathan, 2003). As mentioned, these dominant notions and the coupling of various institutional factors aligned with state and market support based on a false narrative give the way for the green revolution in India.

The dominant notion that science has all possible solutions was challenged by an eminent scientist and practitioner, R.H. Richharia. Born in an environmentally rich district of Madhya Pradesh, Richharia had always deep connection with their native Adivasi community, from whom he developed a keen interest in their rich cultural knowledge and traditional farming practices. During his vast career as an agricultural scientist, he worked as an Oil Seed Scientist and in 1959 as director of the Central Rice Research Institute, Orissa.

Richharia was among the few scholars who vehemently opposed the idea of capital-intensive green revolution and the commodification of agriculture. There is a vast pool of indigenous seeds suited for different climatic conditions, having high productivity, tolerance to pests, resistant qualities, and very low fertilizer demand as compared with HYVs and will ensure the increased productivity, which tackles looming issues of hunger. Richharia was of the view that with the help of our traditional farming practices and with some cross-genetic modifications, we can get better results with HYVs with high nutritional value crops with low chemical use (Dogra, 1991). Due to political and institutional pressure for resisting GR policies, Richharia was forced to resign prematurely in 1976, and despite his seniority, he wasn't made the director of the Indian Council of Agriculture Research (ICAR). Again in 1971, he was called from retirement to head Madhya Pradesh Rice Research Institute (MPRI) and made Agricultural Advisor to the government of Madhya Pradesh, and from 1971 76, he dedicatedly worked for preserving the indigenous seeds and heritage of common people. In his last years, disadvantaged of all scientific work, he continued his work from his residence in Bhopal.

Richharia's conception of agriculture is not only confined to farming but also to social participation and cultural integration as a whole. Agriculture connects the whole ecosystem with the environment, like fodders for animals, different local pest control methods, and crop rotation cycles according to farm needs. Introduction of these HVYs with indigenous seeds also affects the taste and nutritional values of agricultural products, which, on one hand, homogenize single varieties of crops, which is against the diversity of local food resources in India (Dogra, 1991).

Richharia also inquires about how the global capitalist system works in agriculture. There is a wide north south debate over the free exchange of *'germplasm'* from global north to global south and this sparked controversy over free exchange and also some capitalist countries has accumulated their germplasm in developing countries and those countries has free access to genetic material used by industrial countries and then sold back to markets of third world countries which promotes marketization of seeds (Dogra, 1991)."According to the ICDA (International Convention for Development Action) study, around 90% collected plant material gene bank is stored in Northern countries' gene bank, which is inaccessible to the South, where 75% material came from originally…"(Dogra,1991).

In the mid-1960s, under the guidance of Richharia, the Central Rice Research Institute (CRRI) was more focused on the productivity based on indigenous rice varieties. "As a result of my knowledge of the working of the three research institutes referred to above, my great discovery of life is that the control of the rice culture, which yields the World's most important cereal food, is gradually passing on in the hands of a few individuals working at IRRI, supported by unlimited wealth..." (Dogra, 1991). At CRRI Cuttack, he developed an indigenous variety TN(1), which is disease and pest-resistant for use with IR8, but this project couldn't proceed. Similarly, like Richharia, another scientist, Gangadharan, developed a mutant variety of rice that is deep water and flood resistant, but also didn't get due attention (Singh, 2021). Richharia was in favour of the use of "clonal propagation in rice," an indigenous alternative for HYVs, and the results were published in a British Journal, Nature, in 1962, entitled "Clonal propagation a practical means of exploiting hybrid vigor in rice". The breakthrough of Richharia was quashed for political and institutional reasons for promoting HYVs in the country, for which Richharia was always against.

In India, the foreign interference in germplasm happened at Madhya Pradesh Rice Research Institute (MPRI), Raipur, of which Richharia was director sums his experience at the conference in Malaysia. In another incident, which collaborated with IRRI and MPRI, which gives Rs. 40 million aid to MPRI to be merged with Jawahar Lal Nehru Krishi Vishwavidalaya to gain access to the rich genetic pool of seeds from MPRI (Dogra,1991). This leads to growing interventions from the International Rice Research Institute (IRRI), bringing infected germplasm without quarantine measures into Indian labs, for which Richharia warned and issued strict guidelines for handling these.

During his director tenure, MPRRI, under his guidance, has collected about 17000 cultivators from the Chhattisgarh region, and several improved versions were made from indigenous varieties through germplasm for increasing productivity (Dogra, 1991).“From an estimated 200,000 Indigenous paddy seed varieties in the 1950s, fewer than 2,000 remain with farmers. Over 99% of

Traditional paddy seeds are extinct within just 65 years of the Green Revolution”. These varieties are very diverse in nature from drought resistant, saline resistant, some varieties also use very little water, and some varieties don’t even need boiling for cooking. (*Hidden Truth behind Green*

Revolution- Exposed, 2017). Richharia's main focus was on high productivity based on readily available indigenous varieties. These varieties are available at a cheap cost and have high productivity with minimal chemical and water use in the process. 967 improved versions of

‘bd(Baronda)’ varieties were sent to pan India with less fertilizer use and no pest protection measure applied, and the results of these varieties are very astonishing. “…. It results in 3984 kg/Ha of paddy grain or 2669 kg/ha of rice. In terms of the definition of a high-yielding variety in respect of yield 3705 kg/Ha, as accepted by the M.P. Agriculture Dept. The improved seeds recommended here can be accepted as high-yielding.” Some of the high-yielding indigenous varieties are “Gadur Sela (Bd: 810) from Bastar, which yielded 9746 kg/ha at Badi bag. Balkoni (Bd: 504) yielded 5000 kg/ha in Durg, J.S.5 (Bd: 49) yielded 4820 kg/Ha at Lakhanadown (Seoni), C.R. 1014 (Mrignain) yielded 4800 kg/ha at Chhuriya (Rajnandgaon) TD. 2 (Bd: 45) yielded 6125 at Bartunga (Raipur) X 10 (Pallavi) (Bd: 193) yielded 4165 at Marod (Raipur)”(Dogra ,1991).On the same line, Richharia has developed various indigenous varieties with draught-resistant varieties like Chilkat Bd: 103, Kanakchudi Bd: 104, Bansgati Bd: 101, scented varieties like hinnor of Balaghat (village Kaidi), Dubraj of Sehawa Nagri, and Kali Muchh of Dabra (Gwalior), and various other early maturing varieties(Dogra,1991).In the development of superior rice varieties with cultural improvisation varieties like “Suramtia and Baikoni” under identical conditions as HYVs performed better than the HYVs with heavy fertilizer use. Several studies found that while green revolution cultivars react more strongly to high fertilizer levels (compared to advanced Indian varieties), these benefits were susceptible to decreasing returns above a modest fertilizer level. This implies that after a certain time, the high fertilizer amounts suggested by Rockefeller employees would not significantly affect output (Harwood, 2019). Despite heavy investment in HYVs and several-fold rise in fertilizers and intensive water need and research, the growth is not according to expectation and contrasting to that some indigenous varieties with little water and chemical need have more hectare production as compared to these HYVs. Talking about the limitations of GR and penetration, if we remove Punjab from the picture of the production of rice, the whole project of the green revolution will look cloudy (Dogra,1991).The failure of exotic rice varieties relates to the following reasons: narrow dwarf genetic base material, which is unsuitable for most of India, mostly uplands, and very susceptible to insects and pests, are some of the limitations of HYVs for the green revolution. With the introduction of these HYVs comes new varieties of pests and insects like, gall midge, brown plant hopper, leaf folder, whorl moggot, etc., and in some parts, crop loss due to these is 30 to 100 percent, and no development is seen as effective pest control and gene modification, which is naturally present in traditionally modified breeds.

Post green revolution, the productivity of rice varieties is at a slow pace, and on request from the office of Prime Minister Indira Gandhi, he drew an action plan for increased production, which has following components: rice production based on Indigenous germplasm, a decentralized approach for production, and a clonal propagation technique for improving rice varieties. Richharia was against the introduction as HYVs with rich indigenous varieties and argued “…agro-ecological balance has been disturbed in the environment in respect of the existing germplasm

which had been built up in course of time for centuries by the natural process of empirical breeding and selection establishing ecological balance in different environments", what in modern times can be interpreted as 'ecological breeding' (term coined by a Japanese worker in 1959)(Dogra,1991). Another proponent of the green revolution, Swaminathan, accepts the sensitive nature of the green revolution and advocates for the link between biodiversity and biotechnology, which links community participation. He consistently advocates for new concepts for community participation in technology, like "*Bio village,"* which are active sites of gene bank and seed bank, which is the internalization of science into communities (Visvanathan, 2003).

The hegemony of the green revolution emanates from its very "industrial base of knowledge" without considering other epistemologies of inquiry, and it is only possible with state-sponsored technology and policy, with the utilization of government resources. The new technologies of the green revolution have a hierarchical structure that is biased against a wide variety of indigenous seeds and their productivity, and sustainable farming practices that suit the local needs. Richharia argues that "We must evolve a fresh strategy based on our experiences and vast knowledge of our environment to select good seeds of our dominant varieties and genetically upgrade them by the selection method."

CONCLUSION

Excessive use of chemical fertilizers changes the natural micro flora, raising the soil's salinity and alkalinity, and it degrades the soil both chemically and physically. In several regions of the nation, the water table was drained by the overuse of groundwater for irrigation due to increased use of private tube wells. These new HYVs seeds, which are product of green revolution have limited genetic base as compared to traditional varieties.

The green revolution was more centered on per-hectare production, but if we closely look from the farmer's side, it is not only a matter of production; there are various other natural needs from the farmer's side, like fodder for livestock, natural manure for soil, sometimes as fuel for domestic use, and many more farm needs. Amartya Sen gives an alternative understanding of farmers' productivity, that small landholders were generally less profitable than large ones, despite that they were more productive per hectare, and raises a new debate over the efficiency and productivity of large farms. Green revolution is more focused on targeting the supply of fertilizer , use of big machines and intensive water should be concentrated on selected "target areas" where such farming conditions and infrastructure are available, and the farmers are quite responsive to these new technological models.

A report of the Rockefeller Foundation on the green revolution in India depicts that "India's peasants are breaking out of centuries-old patterns of subsistence agriculture and entering the new world of commercial food production." Ford Foundation, in its ten-point programme aimed to elevate Indian agriculture in 1959, and one of their objectives is related to increase the income of specific farmers which leaves behind small and marginal farmers and also they have very less emphasis on increasing the food production.As Singh (2022) also argues about the misconception of the green revolution about increased productivity as compared to indigenous varieties, and where Richharia (1977) also shows high-yielding rice varieties of Madhya Pradesh and Chhattisgarh, only with organic inputs.Analysing the impact of the green revolution at both macro and micro levels, it has differentiated impacts. The green revolution has benefited wheat most and paddy crops to some extent; it has also increased regional and social inequalities among farmers (Das, 1972).

The green revolution's impact is seen only in certain portions like Punjab, Haryana, Western Uttar Pradesh, Andhra Pradesh, Tamil Nadu, and is confined to only selected crops like wheat, rice, and corn, creating several socio-political inequalities. It targeted the preferred areas, and big landholders and capitalist farmers were beneficiaries, sidelining the needs of small and marginal farmers.

After several criticisms of the green revolution, the US Agency for International Development (USAID) sent Francie Frankel and Wolf Landejinsky for assessment. Landejinsky highlights that new technologies have infused inequality in agricultural societies, and Frankel finds that rural inequality gets accentuated by modern technology. The story of Richharia shows that local knowledge is easily sidelined when they are not in favour of power holders. For how long will we practice a model that focuses mainly on increasing productivity and excluding everything else?

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