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Changing Crop Production Cost in India: Input Prices, Substitution and Technological Effects

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Abstract: *The economics of crop cultivation at the aggregate level over the past 25 years, identified sources of cost escalation and evaluated the effects of factor prices, substitution, and technological effects on the production cost. The results reveal that a disproportionate change in gross return vis-à-vis cost resulted in varying rate of return from crop enterprise during the past 25 years. During 2007-08 to 2014-15, the average cost inflation reached the highest level of 13 per cent, more than half of which was contributed by the rising labour cost alone. Further, at the aggregate level, use of physical inputs increased only marginally and a large share of the increase in the cost of cultivation was attributed to the rising prices of inputs. The estimated negative and inelastic demand for inputs revealed a great scope to reduce the cost by keeping a check on input prices, particularly labour wages. The estimated elasticity of substitution indicated imperfect substitution between labour and machine and the present level of farm mechanization is inadequate to offset the wage-push cost inflation in Indian agriculture. It is therefore necessary to accelerate appropriate farm mechanization through the development of farm machinery suitable and economical at small farms and improvement in its access through custom hiring.*

Keywords: *economics, crop, production, India, input, prices, substitution, technology.*

INTRODUCTION

The agrarian crisis that has ravaged India's rural countryside during the post-reform era has grown on a three-pronged set of symptoms: rising input costs, dwindling produce price realisation and the inability of farmers to abandon cultivation without alternative livelihood sources. [1,2,3] It is a well-known fact that the crisis started when the government decided to demolish, without giving adjustment time, the elaborate mechanism that was built up, in stages, in the post-independence period to the beginning of the 1990s to protect the peasantry from the vicissitudes of the market [Patnaik 2003]. These protectionist arrangements, consisting essentially of a system of input price subsidies and output price support, despite weaknesses in implementation, had enabled farmers to take up cultivation in a predictably stable price environment. During the post-reform period, the government not only slashed the subsidies on major inputs, but also absolved itself of the responsibility to produce or procure and distribute these inputs at farm gates. When prices of farm inputs thus went up, private operators seized the opportunity and pushed up prices further. The situation got worse when the rates of interests on institutional credits were raised, while the narrow window of such credits became narrower, dragging the cultivating households into the clutches of private moneylenders [Bagchi 2004]. There is incontrovertible statistical evidence in the vast literature on the subject as to how declining farm prices aggravated the crisis. The views about rising costs of cultivation, on the other hand, though unquestionable, are based mostly on qualitative field level information gathered from areas where farmers' suicides are reported. The costs of cultivation data that the Commission for Agricultural Costs and Prices (CACP) gives in its price policy reports, when put together, would show that expenses on farm inputs have registered a

spectacular increase since the 1990s. [5,7,8]These cost data were generated under a "comprehensive scheme" initiated in the late 1960s by the directorate of economy-mics and statistics (DES) of the ministry of agriculture, government of India and are available from 1970-71 to the present. The literature on India's farm crisis has ignored this valuable source of information. Observers will recall that, when similar data under the farm management surveys (FMS) came out in the 1950s and 1960s, these led to some path-breaking studies on issues like production conditions and production relations in Indian agriculture. This was in spite of the fact that the FMS data were limited in sample size and related only to select districts for just three years at a stretch. As against this, the "comprehensive scheme" collects state-level time series data. Information-wise these were far wider in This paper estimates and compares the paid-out cost of cultivation of wheat in India, the most state-protected crop, during the input subsidy regime of the 1970s and 1980s and after its abolition in the 1990s, when economic reforms were initiated. The study uses the valuable time series information collected as part of the "comprehensive scheme" of the ministry of agriculture. After surveying the pattern of changes in inputs as well as costs of cultivation vis-à-vis the wholesale price index (a proxy for the general price level), the value of inputs which are exclusively market-purchased are analysed. A study of the weighted average of these costs establishes unequivocally that the costs of farm inputs increased very sharply in the post-reform period[9,10,11]

DISCUSSION

With a population of 1.27 billion India is the world's second most populous country. It is the seventh largest country in the world with an area of 3.288 million sq kms. It has a long coastline of over 7,500 kms. India is a diverse country where over 22 major languages and 415 dialects are spoken. With the highest mountain range in the world, the Himalayas to its North, the Thar desert to its West, the Gangetic delta to its East and the Deccan Plateau in the South, the country is home to vast agroecological diversity. India is the world's largest producer of milk, pulses and jute, and ranks as the second largest producer of rice, wheat, sugarcane, groundnut, vegetables, fruit and cotton. It is also one of the leading producers of spices, fish, poultry, livestock and plantation crops. Worth $ 2.1 trillion, India is the world's third largest economy after the US and China.

India's climate varies from humid and dry tropical in the south to temperate alpine in the northern reaches and has a great diversity of ecosystems. Four out of the 34 global biodiversity hotspots and 15 WWF global 200 eco-regions fall fully or partly within India. Having only 2.4 percent of the world's land area, India harbours around eight percent of all recorded species, including over 45,000 plant and 91,000 animal species.

India's economic growth in financial year 2018 is expected to accelerate to 6.75 percent in 2018 on improved performance in both industry and services. India is the world's sixth-largest economy by nominal GDP and the third largest by purchasing power parity (PPP). The country ranks 139th in per capita GDP (nominal) with $2,134 and 122nd in per capita GDP (PPP) with $7,783 as of 2018 (World Bank data). Agriculture accounted for 23% of GDP, and employed 59% of the country's total workforce in 2016.[146]

Agriculture, with its allied sectors, is the largest source of livelihoods in India. 70 percent of its rural households still depend primarily on agriculture for their livelihood, with 82 percent of farmers being small and marginal. In 2017-18, total food grain production was estimated at 275 million tonnes (MT). India is the largest producer (25% of global production), consumer (27% of world consumption) and importer (14%) of pulses in the world. India's annual milk production was 165 MT (2017-18), making India the largest producer of milk, jute and pulses, and with world's second-largest cattle population 190 million in 2012.[153] It is the second-largest producer of rice, wheat, sugarcane, cotton and groundnuts, as well as the second-largest fruit and vegetable producer, accounting for 10.9% and 8.6% of the world fruit and vegetable production, respectively.

However, India still has many growing concerns. As the Indian economy has diversified and grown, agriculture's contribution to GDP has steadily declined from 1951 to 2011. While achieving food sufficiency in production, India still accounts for a quarter of the world's hungry people and home to over 190 million undernourished people. Incidence of poverty is now pegged at nearly 30 percent. As per the Global Nutrition Report (2016), India ranks 114th out of 132 countries on under-5 stunting and 120th out of 130 countries on under-5 wasting and 170th out of 185 countries on prevalence of anaemia. Anaemia continues to affect 50 percent of women including pregnant women and 60 percent of children in the country.[12,13,15]

While agriculture in India has achieved grain self-sufficiency but the production is, resource intensive, cereal centric and regionally biased. The resource intensive ways of Indian agriculture has raised serious sustainability issues too. Increasing stress on water resources of the country would definitely need a realignment and rethinking of policies. Desertification and land degradation also pose major threats to agriculture in the country.

The social aspects around agriculture have also been witnessing changing trends. The increased feminisation of agriculture is mainly due to increasing rural-urban migration by men, rise of women-headed households and growth in the production of cash crops which are labour intensive in nature. Women perform significant tasks, both, in farm as well as non-farm activities and their participation in the sector is increasing but their work is treated as an extension of their household work, and adds a dual burden of domestic responsibilities.

India also needs to improve its management of agricultural practices on multiple fronts. Improvements in agriculture performance has weak linkage in improving nutrition, the agriculture sector can still improve nutrition through multiple ways: increasing incomes of farming households, diversifying production of crops, empowering women, strengthening agricultural diversity and productivity, and designing careful price and subsidy policies that should encourage the production and consumption of nutrient rich crops. Diversification of agricultural livelihoods through agri-allied sectors such as animal husbandry, forestry and fisheries has enhanced livelihood opportunities, strengthened resilience and led to considerable increase in labour force participation in the sector.[17,18,19]

RESULTS

Food production has seen various advancements globally in developing countries, such as India. One such advancement was the green revolution. Notably, the World Bank applauds the introduction of the green revolution as it reduced the rural poverty in India for a certain time. Despite the success of the green revolution, the World Bank reported that health outcomes have not been improved. During the post-green revolution period, several notable negative impacts arose. Exclusive studies were not conducted on the benefits and harms before the introduction of the green revolution. Some of such interventions deviate from the natural laws of balance and functioning and are unsustainable practices.

The green revolution led to high productivity of crops through adapted measures, such as (1) increased area under farming, (2) double-cropping, which includes planting two crops rather than one, annually, (3) adoption of HYV of seeds, (4) highly increased use of inorganic fertilizers and pesticides, (5) improved irrigation facilities, and (6) improved farm implements and crop protection measures (Singh, 2000; Brainerd and Menon, 2014) and modifications in farm equipment. There was a high investment in crop research, infrastructure, market development, and appropriate policy support (Pingali, 2012). Efforts were made to improve the genetic component of traditional crops. This included selection for higher yield potential; wide adaptation to diverse environments; short growth duration; superior grain quality; resistance to biotic stress, insects, and pests; and resistance to abiotic stress, including drought and flooding (Khush, 2001). [20,21,22]After the green

revolution, the production of cereal crops tripled with only a 30% increase in the land area cultivated. This came true all over the world, with a few exceptions. In addition, there were significant impacts on poverty reduction and lower food prices. Studies also showed that without the green revolution, caloric availability would have declined by around 11–13%. These efforts benefitted all consumers in the world, particularly the poor. There were further improved returns to the crop improvement research. It also prevented the conversion of thousands of hectares of land for agriculture (Pingali, 2012). The green revolution helped India move from a state of importing grains to a state of self-sufficiency (Brainerd and Menon, 2014). Earlier, it was the ship-to-mouth system, i.e., India depended on imported food items (Ramachandran and Kalaivani, 2018). There are undoubtedly positive effects on the overall food security in India. Correspondingly, useful and elaborate evidence in support of the positive impact of the green revolution is available. However, after a certain period, some unintended but adverse effects of the green revolution were noticed. This paper introspects the negative impacts of the green revolution on the food system in India. Studies by the departments of conventional agriculture, social sector development, etc. bring out the positive impacts of the green revolution, such as increased yield and reduced mortality and malnutrition (Somvanshi et al., 2020; von der Goltz et al., 2020). On the other hand, studies conducted by the environmental and public health departments suggest that to mitigate the negative impacts, a reduced usage of pesticides is sufficient (Gerage et al., 2017). There are many studies being conducted to find out the extent of the impacts of pesticides and insecticides and other similar chemicals.

Although there are many studies that focused on this topic, this paper makes an effort to inform policy by asserting that many interventions, beneficial for the shorter term, such as the green revolution, without the consideration of ecological principles, can be detrimental and irreversible in the long run (Clasen et al., 2019). Efforts to recover from environmental damage would require extensive efforts, time, and other resources as compared with the destruction of the environment. Hence, any new intervention needs to be checked for its eco-friendliness and sustainability features.[23,25,27]

Carrying forward intensified usage of pesticides is not advisable in an ever-deteriorating environment, and alternative solutions that can promote economic growth, increased yield, and less harm to the environment can be implemented. The vicious cycle of problem-solution-negative impacts has to be broken at some point of time. For example, a second green revolution is focused on in various countries (Ameen and Raza, 2017; Armanda et al., 2019). Instead of this, techniques to promote sustainable agriculture can be considered. Hence, there has to be a wake-up call before the repetition of history.

CONCLUSIONS

Traditionally, Indians consumed a lot of millets, but this became mostly fodder after the green revolution (Nelson et al., 2019). The Cambridge world history of food mentions that the Asian diet had food items, such as millets and barley (Kiple and Ornelas, 2000). As already mentioned, after the period of the green revolution, there were significant changes in food production, which in turn affected the consumption practices of Indians. The Food and Agriculture Organization (FAO) has recorded that over the years 1961–2017, there are a decrease in the production of millets and an increase in the production of rice (Food and Agricultural Organisation, 2019; Smith et al., 2019); thus, rice became the staple diet of the country. Though the green revolution made food available to many, it failed to provide a diverse diet but provided increased calorie consumption.[28,29,30]

Most of the pesticides used belong to the class organophosphate, organochlorine, carbamate, and pyrethroid. Indiscriminate pesticide usage has led to several health effects in human beings in the nervous, endocrine, reproductive, and immune systems. Sometimes, the amount of pesticide in the

human body increases beyond the capacity of the detoxification system due to continuous exposure through various sources (Xavier et al., 2004). Of all, the intake of food items with pesticide content is found to have high exposure, i.e., 10^3-10^5 times higher than that arising from contaminated drinking water or air (Sharma and Singhvi, 2017).

Most of the farmers who use pesticides do not use personal protective gear, such as safety masks, gloves, etc., as there is no awareness about the deleterious effects of pesticides. Pesticides, applied over the plants, can directly enter the human body, and the concentration of nitrate in the blood can immobilize hemoglobin in the blood.[41,42,43] Organophosphates can also develop cancer if exposed for a longer period. Since it is in small quantities, the content may not be seen or tasted; however, continuous use for several years will cause deposition in the body. Dichlorodiphenyltrichloroethane (DDT) was a very common pesticide used in India, now banned internationally as it is found to bioaccumulate and cause severe harmful effects on human beings (Sharma and Singhvi, 2017). However, there is still illegal use of DDT in India.[32,33,35] In India, women are at the forefront of around 50% of the agricultural force. Hence, most of these women are directly exposed to these toxins at a young age and are highly vulnerable[44,45,46] to the negative impacts including effects on their children. It is proven that there is a significant correlation between agrochemical content in water and total birth defects. The damaging impact of agrochemicals in water is more pronounced in poor countries, such as India (Brainerd and Menon, 2014).

The green revolution, which was beneficial in ensuring food security, has unintended but harmful consequences on agriculture and human health. This requires new interventions to be tested and piloted before implementation, and continuous evaluation of the harms and benefits should guide the implementation. An already fragile food system is affected due to the aftermaths of the green revolution. The potential negative impacts are not part of the discourse as it can affect the narratives of development and prosperity. Developments introduced due to necessity may not be sustainable in the future. Organic ways of farming need to be adopted for sustainable agricultural practices. Similarly, alternative agriculture techniques, such as intercropping, Zero Budget Natural Farming (ZBNF) with essential principles involving the enhancement of nature's processes, and elimination of external inputs, can be practiced (Khadse et al., 2018). The government of Andhra Pradesh (AP), a Southern state in India, has plans to convert 6 million farmers and 8 million hectares of land under the state initiative of Climate Resilient Zero Budget Natural Farming because of the positive outputs obtained in the ZBNF impact assessments in the states of Karnataka and AP (Reddy et al., 2019; Koner and Laha, 2020) In AP, it was observed that yield of crops increased to 9% in the case of paddy and 40% in the case of ragi. Net income increased from 25% in the case of ragi ranging to 135% in the case of groundnut (Martin-Guay et al., 2018; Reddy et al., 2019). [37,38,39]There is a need for a systems approach in dealing with food insecurity and malnutrition and other similar issues. Like the already mentioned example, the green revolution was brought in to reduce the problem of reduced yield. [47]Now, there is a green revolution 2 that is planned. Before such interventions are taken, environmental risk assessments and other evaluation studies should be conducted for a sustainable future.[48,49]

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