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Impact of Bringing Green Revolution to Eastern India on Rice Production: A Review

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ABSTRACT

To make short and medium-term recommendations for effective management of water, energy, and other inputs to maximize agricultural production on a sustainable basis in the seven Eastern Indian states, the government of India launched the Bringing Green Revolution to Eastern India (BGREI) mega-program in 2010–11. The objectives of the program were to improve and stabilize crop productivity and solve the issues preventing "Rice-based cropping systems" in Eastern India from being more productive. Through this initiative, the farmers were exposed to advanced technologies and received sufficient technical support from research institutes to develop higher skills and gain economic empowerment. This review deals with the impact of BGREI on rice production and productivity in different states and comparison of yield and income between the beneficiaries and non-beneficiaries of BGREI. This review documented several studies and concluded that the farmer centric technological initiative has an affirmative impact on productivity, production and income of the farmers as a whole.

Keywords BGREI, Modern technology, Production, Rice.

INTRODUCTION

Agriculture is the backbone of the Indian economy, accounting for around 19% of the country's GDP in 2020-21 and providing employment to more than half of the people. This sector is vital to rural livelihoods, employment, and national food security. Almost 70% of India's rural families still rely on agriculture for their livelihood. There were seven states in eastern India, namely Assam, Bihar, Chhattisgarh, Jharkhand, Odisha, West Bengal and eastern Uttar Pradesh, which hold about 21.85% geographical area and 34% population of India (Table 1). Table 1 also indicated that lion share of the total population in eastern India live in rural areas (84%) in eastern India. The population density in this area is 1.91 times higher than that of national average. The net sown area is 29.17 million hectares, whereas the total geographical area is 71.84 million ha. The cropping intensity of this region is 150% which is higher than the national average

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Table 1. Availability of natural resources in the eastern region and India. Source: Census 2011, Agri Census 2011, State Focus Paper 2021-22, NABARD.

Natural resources	Eastern region	India	Percentage
Total geographical area (m ha)	71.84	328.73	21.85
Net sown area (m ha)	29.17	141	20.69
Net irrigated area (m ha)	14.36	65.3	22
Cropping intensity (%)	150	141	-
Wetland area (m ha)	4.05	15.3	26.5
Total fresh water area (m ha)	2.92	6.92	42.22
Marginal farmers (<1 ha) (%)	67	62.88	-
Large farmers (>10 ha) (%)	0.46	1.02	-
Total population (million)	406	1210	33.54
Population density (no/sq km)	616	382	-
Rural population (%)	81.54	72.18	-
BPL (%)	32.1	21.9	-
Annual ground water availability (BCM)	145.12	399.25	36.35
Ground water draft (%)	36	58	-

(141%). This region is rich in natural resources where average rainfall varies from 1091 to 2477 mm with a regional average of 1526 mm, sufficient for growing various crops. The irrigated area is less (39%) than the national average (45%).

Though the eastern region is rich in natural resources, it is not used efficiently to improve agricultural productivity, poverty alleviation, and livelihood improvement. On the other hand, the country faces increasing demand for agricultural output as the population rises gradually. Keeping these facts in view, the finance minister launched the Bringing Green Revolution in Eastern India (BGREI) programme in 2010-11 to focus on the seven eastern states with necessary financial allocations to extend the green revolution as the first Green Revolution was limited to the north-western part of the country namely Punjab, Haryana, and Western Uttar Pradesh.

Bringing green revolution to eastern India (BGREI)

Bringing the Green Revolution to Eastern India (BGREI), a sub-scheme of Rashtriya Krishi Vikas Yojana (RKVY), was launched in 2010-11 as a mega-government program to make short-and medium-term recommendations for efficient use of water, energy and other inputs to increase sustainable agricultural production in the seven Eastern Indian states. The program was initiated by states with ICAR-National Rice Research Institute and State Agricultural Universities for technological support. This program aimed to resolve the constraints that limit the productivity of "Rice-based cropping systems" in Eastern India and to improve and stabilize crop productivity. The farmers were exposed to modern technologies with appropriate technical backstopping from research institutes to bring about higher skills and economic empowerment.

Importance of bringing green revolution to eastern India (BGREI)

The first Green Revolution (GR) in India was initiated in the mid-1960s by introducing high-yielding wheat varieties, which mainly benefitted north-western states of the country, namely Haryana, Punjab and western Uttar Pradesh. It helped farmers increase farm productivity, and India became the leading producer of food grains from the "begging bowl." But GR is mainly confined to irrigated areas and could not reach rainfed areas, contributing to about 60% of the country's total food grain production (Bhatt *et al*. 2016). Through Green Revolution India became self-sufficient in food grains as there was a severe scarcity of food; it led to over-exploitation of natural resources coupled with indiscriminate use of inorganic fertilizers and pesticides, resulting in declining productivity factors, increased soil salinity, loss of biodiversity, depletion of the groundwater table, the resurgence of pests and land degradation and its consequences. Therefore, the benefits of the green revolution were overshadowed by the problems it posed. To overcome the issues and ensure food security with a growing population need to develop a strategy. Eastern India holds promise for it through holistic management of land, water, crops, biomass and other available natural resources.

Objectives of BGREI

Accordingly, the "Bringing Green Revolution to Eastern India (BGREI)" Program was intended to address the constraints limiting the productivity of "Rice-based cropping systems" in Eastern India, having the following objectives.

To improve rice and wheat production and productivity through the adoption of the latest technologies for crop growth

Promoting rice fallow area cultivation to increase the farmers 'crop intensity and income

Harness the water potential to enhance productivity and build mechanisms for the water storage

Promoting the development and marketing help after harvest

Strategies adopted for achieving the goals

To achieve the objectives following strategies were adopted:

To encourage improved rice production technologies, including the popularization of high-yielding newly released cultivars and hybrids

To put rice fallow areas under cultivation through a method focused on the cropping system

Popularizing the adoption of varieties resistant to stress

Build irrigation systems such as farm ponds and lift irrigation to increase the capacity for irrigation

Promoting the use of farm machinery and equipment appropriate for small land holding sizes

To create a marketing infrastructure and storage facility

To provide technological support by scientists

Major interventions of BGREI

The BGREI programme considered various interventions that NRRI and SAUs recommended. The major interventions were:

Block/cluster demonstration of improved production technology like direct-seeded rice, line transplanting and system of rice intensification (SRI)

Asset building activities for farm improvement like construction of shallow tube wells, pump sets, tractor-drawn zero drill seed cum fertilizer drill, threshers

Site-specific activities for farm renovation such as construction/renovation of irrigation channels/electricity for agricultural purposes

Seed production and distribution

Need-based Inputs such as seeds, fertilizers, pesticides and herbicides

Marketing support and post-harvest management, including storage, processing and transportation

Ecology specific rice-based cropping and integrated pest management, including chemicals, bio-pesticides/bio-agents and herbicides.

Status of rice production and productivity after implementation of the BGREI programme:

Rice is the primary food crop covering about 63% of the total area under food grains (Panda *et al*. 2020). Rice is grown in all the possible ecologies but has low productivity due to many possible limiting factors. There has been a significant jump in the production of rice post the BGREI period among the majority of the states. After implementing BGREI, Jharkhand reported a 16% increase in rice area, whereas Chhattisgarh, Assam and Eastern Uttar Pradesh have not shown any change compared to pre-BGREI years (Poonam *et al*. 2019 Chattopadhyay *et al*. 2019 Bhagawati *et al*. 2019 Tripathi and Singh 2019). However, Odisha registered the highest decline in rice area with 13%, followed by West Bengal (7%) and Bihar (4%) (Panda *et al*. 2019 Saha 2019 Shahid and Panda 2019).

Bihar recorded the highest increase in rice production by 69%, mainly attributed to cluster demonstration of SRI and Hybrids in the state and increased fertilizer consumption (Shahid and Panda 2019). Chhattisgarh, Jharkhand and Assam reported a 33%, 30% and 29% increase in rice production post-BGREI period despite low irrigated areas (Chattopadhyay *et al*. 2019 Poonam *et al*. 2019 Bhagawati *et al*. 2019). Eastern UP and West Bengal registered a slight increase in the production of 10% and 5% compared to pre-BGREI years 2007- 10 (Tripathi and Singh 2019 Saha 2019). These two states are comparatively high productive states with higher irrigated areas, and the area was also stagnant. However, Odisha maintained the production level despite the reduction in areas which was diversified with other crops in upland rice

areas of the state.

Unlike area and production, rice productivity has increased across all seven states. As stated earlier, the highest increase in productivity has been observed in Bihar (76.4%), which is mainly ascribed to the adoption of hybrids and the SRI cultivation method (Shahid and Panda 2019). Similarly, rice productivity was increased by 27.3 and 30.3%, respectively, in Assam and Chhattisgarh (Bhagawati *et al*. 2019, Chattopadhyay *et al*. 2019). The productivity increase in Eastern Uttar Pradesh, Jharkhand, Odisha and West Bengal was 15.8, 14.5, 12.7 and 12.2%, respectively (Tripathi and Singh 2019, Poonam *et al*. 2019 Panda *et al*. 2019 Saha 2019). West Bengal and Eastern UP were comparatively high productivity states with higher irrigated areas among the eastern Indian states.

Comparison of yield and income between the beneficiaries and non-beneficiaries of BGREI

In the selected districts of Odisha, the beneficiaries' productivity of rice improved from 32.47 q/ha to 49.17 q/ha. i.e., an increase in rice productivity of 51.43%. Compared to non-beneficiaries, beneficiaries produced rice at a rate of 18.66 q/ha higher. Additionally, the beneficiary farmers' yearly income grew by 54.43%, from Rs 1,20,514 to Rs 1,86,107. Beneficiaries had an annual income that was Rs 74,370 greater than non-beneficiaries. The beneficiaries' B:C ratio grew from 1.51 to 2.68, or by 77.48%. The beneficiaries' B:C ratio for rice cultivation was 1.58 times greater than that of the non-beneficiaries (Behera *et al*. 2018). When comparing beneficiary farmers' (697 kg/ha) and non-beneficiary farmers' (2281 kg/ha) with respect to yield gap of rice in Chhattisgarh, it was discovered that the yield gap was relatively low in beneficiaries. Compared to its potential yield of 4563 kg/ha, the state's actual rice production was determined to be 4148 kg/ha and 3239 kg/ha, respectively, for beneficiaries and non-beneficiaries farmers (Chouhan *et al*. 2015). Between BGREI beneficiaries and non-beneficiaries, there was a significant difference in yield and income per unit of land. Beneficiaries of the BGREI enjoy much higher yields and income than non-beneficiaries (Padhan and Mondal 2020).

CONCLUSION

Although the states performed well during the BGREI period, the future increment can be expected by integrating the modern technologies mentioned above. The production technologies need to be scaled up in other areas of the states. Further, ecology-wise development of technological interventions is required to increase rice production and productivity to meet the country's ever-increasing demand. It is evident from the study that BGREI has positive impacts on yield, income and production of the major field crops, rice and wheat. BGREI program helped to augment in most of the states besides popularization of diversification of the crops. This type of technology centric programs needs to be implemented in future for the underprivileged farming community.

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