



Bringing Green Revolution to Eastern India: Experiences and Expectations in Jharkhand

A Poonam, S Bhagat, Y Kumar and VD Shukla

Summary

Jharkhand has been affected by conjugative droughts five times from 2001 to 2010 and food grain productions were low in drought years. Paddy, which is the principal crop of Jharkhand, had average productivity of 1.4 t ha^{-1} and 1.1 t ha^{-1} in 2004-05 and 2005-06 respectively. The state faced a deficit of rainfall by approximately 47% in 2010 and consequent to that 1 Mha of land could not be brought under paddy cultivation and total food grain production decreased by half; average paddy productivity in 2010-11 was 1.5 t ha^{-1} . This added to the food grain deficit the state faced even during the normal rainfall year. A strategic initiative 'Bringing Green Revolution in Eastern India' (BGREI) to develop high potential Eastern Region of the country for food grain production has been initiated since 2010-11. The Program is being implemented with the objective to increase the productivity of rice based cropping system through promotion of recommended agriculture technology and package of practices by addressing the underlying constraints of different agro-climatic sub-regions. The Program included a bouquet of three broad categories of interventions, viz., Block demonstrations of rice and wheat, asset building activities for water conservation and utilization. Block demonstration of rice, each of 1000 hectares was proposed to be implemented in five agro-ecological sub-regions namely rainfed uplands, rainfed low lands (shallow low land, medium, deep water) and irrigated rice (traditional, hybrid). The objective of the demonstration was to improve seed replacement rate (SRR), promote line sowing/ planting coupled with promotion of plant nutrient and plant protection technologies.

1. State background

Jharkhand state was created in November 2000 through the reorganization of erstwhile Bihar. Comprising of the Chhotanagpur, Santhal Parganas and Hazaribag divisions of the undivided Bihar, this state has a total geographical area (TGA) of $79,714 \text{ km}^2$. Jharkhand is landlocked and is an integral part of the north-eastern portion of the Peninsular Plateau of India. The state is divided into three agro climatic subzones, namely Zone IV (Central and North Eastern Plateau), Zone V (Western Plateau) and Zone VI (South Eastern). Sub-zones IV, V and VI are characterized by humid and sub-humid tropical, sub-humid to sub-tropical and humid to sub-tropical respectively. Broadly, the region represents an undulating



plateau dotted by hills and mountains. The reduced number of perennial rivers, depleting forest due to mineral and industrial exploitation is a matter of concern.

Agriculture is the principal source of livelihood in the state with 66 % of the people engaged in farming. Land-use statistics suggest that in spite of large cultivable area (52%) only 22% is under cultivation, which is below the national average of 47%. The state receives an average annual rainfall of about 1200 mm, mainly from the south-west monsoon. However, only about 25% of the water is retained and utilized and the remaining is lost through run-off. Irrigated area is only 10% of the net sown area making the rainfed mono-cropping zone to cover ~85%. The overall cropping intensity is 114%. Jharkhand has notified 23,605 km² area (~30% TGA) under forests. In addition to agriculture, forests continue to be an important supplemental source of livelihoods for the rural communities.

Table 1. Agro climatic division with broad characteristics.

Zones	Agro-climatic regions	Districts	Total geographical area (m ha)	Net cultivated area (%)	Irrigated area (%)
Zones-IV	Central Eastern	North Chatra, Koderma, Plateau Godda, Hazaribag Bokaro, Ramgarh, Ranchi Khunti, Giridih Dhanbad Deoghar, Pakur, Dumka Sahebjunj, Pakur, Jamtara	4.1	55	6.58
Zones-V	Western Plateau	Garhwa, Palamau, Lohardaga, Gumla, Latehar and Simdega	2.5	24	9.65
Zones-VI	South Eastern	Purbi Singhbhum, Paschimi Singhbhum and Saraikela	1.3	31.6	4.54

The major area of the state is dominated by sandy loam to loamy acidic soils (pH 4.5–6.5) showing low productivity. The average land holding in Jharkhand is 1.58 ha and is slightly higher than all-India average of 1.57 ha. The land surface is rugged and undulating, ranging from flat lands to almost steep slopes. Rice area in Jharkhand is only 4% of total 44.0 Mha which is 1.62 Mha with a production of 3.33 Mt and productivity of 2.02 t ha⁻¹.

2. Major interventions with BGREI

The major interventions in Jharkhand were crop-based interventions, asset building, site specific activities, marketing support and capacity building.

2.1.1. Cluster Demonstration

Under crop-based interventions, quality seeds of HYVs (Naveen, Shahbhagidhan, Abhishek, IR 64 improved, IR 36 and Lalat) and hybrids (KRH 2, PHB 71, DRRH 3, Arize 6444) of rice were distributed to the farmers for enhancing the seed replacement rate in the state. Besides,



the ecology based cluster demonstration of improved production technologies of rice i.e. medium land and shallow low land rice were conducted to enhance the productivity of the crop. The activities under cluster demonstrations were deep ploughing, line sowing / planting, seed / seedling treatment, green manuring, soil health card-based nutrient application, pre-emergence herbicide application, need-based plant protection and harvesting and storage at right moisture. But later on since 2015-16, emphasis was given on cluster demonstration of five improved production technologies.

1. Line transplanting (Manual and Mechanized): The traditional way of random transplanting is labour intensive and involves drudgery and plant population is low. Line transplanting (Manual and Mechanical) helps in maintaining an optimal plant population. Mechanical rice transplanting is cost effective and operation friendly and helps in maintaining soil physical properties and considered to be a better option from crop management and productivity point of view. In Line transplanting the seed rate is low and provides the opportunity for use of implements and machineries for intercultural operations.
2. Direct seeded rice (DSR): In Jharkhand still a majority portion of the area is under broadcasted DSR where maintenance of optimal plant population is difficult. The seed rate in traditional DSR is very high leading to high population of plants which often results in higher level of competition at early stage but lower population after beushening. Besides, weed is a major problem in traditional DSR which leads to decrease in yield. In modern DSR line sowing is practiced followed using a seed cum fertilizer drill and application of pre emergence herbicide for controlling the weeds. The seed rate and weed population in modern DSR is low compared to traditional DSR with option of using mechanical weeder.
3. Stress tolerant variety: Rice production and productivity is severely affected by the increasing impact of abiotic stress factors such as drought, flood, salinity etc. Jharkhand is frequently affected by drought. The production and productivity was reduced drastically due to moisture stress. The stress tolerant varieties for moisture deficient condition with the appropriate production technology can be a great promise.
4. Cropping system based production technologies: Rice monocropping is the major activity in Jharkhand. Rice followed by other dry crops is grown in rainfed areas using residual soil moisture. However some areas remain fallow owing to low productivity or abiotic and biotic stresses to the sequence crop in the system. Introduction of short duration and stress tolerant pulses can maintain the soil fertility and increase the pulse production. Deep rooting, nitrogen fixation, leaf shedding ability and mobilization of insoluble soil nutrients are some of the unique characteristics of pulses which substitutes the requirements of nutrients for the next season.
5. System of rice intensification (SRI): System of Rice Intensification (SRI) is a combination of several practices which include nursery management, time of transplanting, water and weed management. It is a unique package to improve productivity by transplanting 8-12 days old seedling at spacing of 25 x 25 cm, about 16 plants per square meter with use of organic manures, mechanical weed control through cono-weeder and alternate wetting and drying method of water management. The water requirement in SRI is quite less as compared to other practices and thus was demonstrated in irrigated medium lands for enhancing the productivity of small and marginal farmers.
6. Popularization of Improved HYVs and Hybrids: The HYVs and the hybrids released under the last 10 years were demonstrated under the cluster demonstration. Good quality

seeds of these varieties along with micronutrients and soil ameliorants like zinc, gypsum and bio fertilizers were supplied to the demonstrating farmers for yield improvement. Similarly need based plant protection measures were taken up in the cluster demonstrations. The following varieties have been currently recommended ecology wise for promotion under the Program.

Table 2. Rice varieties recommended for Jharkhand.

Ecologies	Recommended for promotion under BGREI
Irrigated	Abhishek, CR Dhan 305, Arize Tej, DRH 775
Aerobic	CR Dhan 202, CR Dhan 204
Rainfed Upland	Sahbhagi Dhan, CR Dhan 40, Birsa Vikas Dhan 111, Birsa Vikas Dhan 203
Rainfed Shallow Lowland	Improved Samba Mahsuri

2.1.2. Asset building and site-specific activities

Asset building activities were taken up for improvement of the irrigation facilities and farm mechanization in the program areas. The state has created water conservation structures through 175 Birsa Pucca Check Dams (BPCD), 167 Loose boulder check Dam (LBKD) and 450 lift irrigation facilities from rivulets, 12305 pump sets were distributed to strengthen irrigation by carrying water from the source to its destination in rainfed rice area. Similarly a total of 2458 farm machineries were distributed among beneficiary farmers which includes 24 seed drills, 1336 cono weeder, 229 rotavators, 1 self propelled paddy transplanters, 300 threshers and 1214 sprayers. Under Post harvest and marketing support 85 mini rice mill, 5 marketing shed, 13 (100 tons capacity) godown, 7 pre-fabricated storage godown, 12 weighing machine/ moisture meter/ portable bag closing machine each were provided.

3. Areas of demonstrations

The state of Jharkhand implemented the BGREI Program in 20 non NFSM districts namely Bokaro, Chatra, Dhanbad, East Singhbhum, Garhwa, Giridih, Jamtara, Latehar, Pakur, Palamu, Sahebganj, Simdega, Ranchi, Koderrna, Ramgarh Godda, Dumka, Hazaribag Deogarh Khunti. The state has demonstrated different improved production technologies through cluster demonstrations. The state has till date demonstrated line transplanting, system of rice intensification (SRI), stress tolerant variety, HYV, hybrids and cropping system-based demonstrations.

Table 3. Targets for Block Demonstration on Rice in Jharkhand (2010-11 to 2018-19).

Cluster Demonstration	Target area (ha)	Achieved area (ha)
DSR	97840	90567
Line transplanting	9200	9120
SRI	12495	12075
Stress Tolerant Variety	20400	19435
Hybrids	69450	67141
HYVs	87413	53426
Cropping system	15320	15292
Total	312118	267056

*The data of 2015-16 is not included

4. Trends in area, productivity, production of rice and wheat since 2009-10

In 2011-12, there is marked increase in production (103.52%) in Jharkhand due to the favourable rainfall year. Yield and production decrease in the year 2015-16 due to occurrence of drought and the production range varied from 15.0-87.3% across the state.

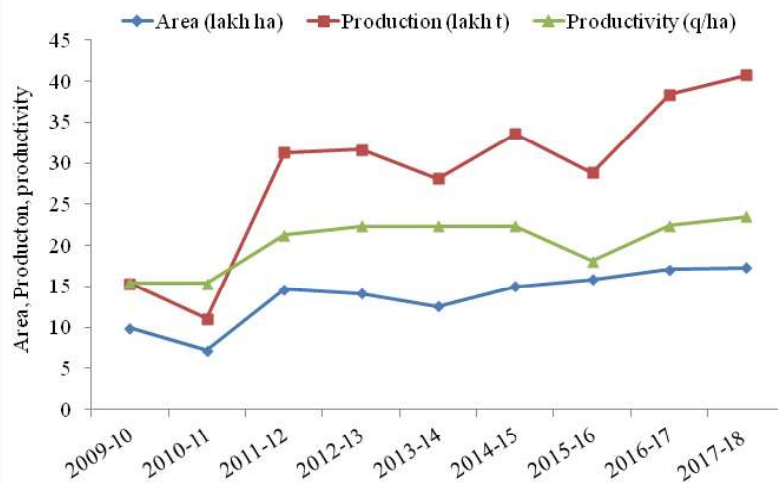


Fig 1. Trends of area, Production and productivity of rice from 2009-10 to 2017-18.

5. Effects of BGREI interventions

Improved HYVs i.e., Sahbhagi Dhan, MTU 1010, Lalat, IR 36, IR 64, Abhishek, Naveen and hybrids i.e., KRH 2, PHB 71, Arize 6444, DRRH 3 have been already popularized. In the year 2017-18, the average yield of demonstrated plot under HYVs and stress tolerant rice varieties were was 4.67 to 5.44 t/ha and that of hybrid been 6.77 t/ha in the good rainfall years. Hybrids have been popular for low seed requirement and higher grain yield, in the medium lowlands where rainwater accumulates being lowest lands in terrace land. Stress tolerant variety Sahbhagi Dhan has also been popular in most of the blocks for its drought resistance. Significant positive effect of BGREI Program in Jharkhand has been recorded. The technical interventions like block/cluster demonstrations, cropping system based demonstration, seed production, seed distribution, asset building & site specific works and



creation of storage structures and marketing facilities has tremendous effect on increasing rice production and productivity at highest level as well as reducing the storage losses. The BGREI farmers have adopted new proven technology with high production and productivity of rice and thereby, these technologies are being adopted by the non-BGREI farmers.



6. Production and Productivity Comparison of BGREI and Pre BGREI Years

The area has increased from 1.68 to 1.73 Mha from 2008-09 to 2017-18, which is the only 2.98% over the last nine years whereas the increase in production is 16.14% and increase in productivity is 13.62%. The area, production and productivity is lower during 2009-10 is due to the declared drought year. The increase in area from the non-BGREI years (average of 2007-08, 2008-09, 2009-10) to BGREI years (average of 2015-16, 2016-17, 2017-18) was 23.22% (Fig. 2). The increase in productivity from the non-BGREI years (average of 2007-08, 2008-09, 2009-10) to BGREI years (average of 2015-16, 2016-17, 2017-18) productivity was 12.21%.

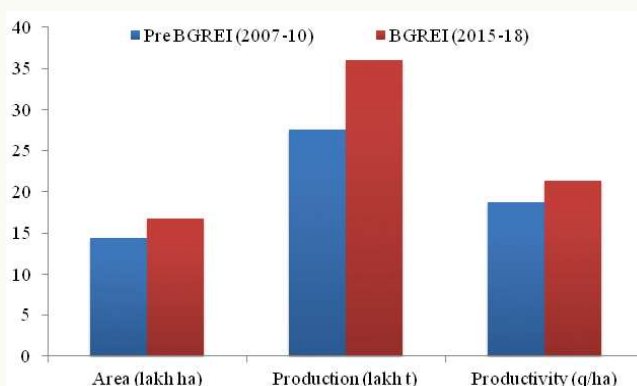


Fig. 2. Comparison of area, production and productivity of rice in Jharkhand in pre-BGREI and BGREI years.

The annual average rainfall in the state is about 1386 mm, which occurs mainly during in four months (June-Sept) Out of that, 80-85% received in 3½ months, from 15th June to 30th of Sept, 10-15% from October to January and very few rainfalls received in rest of the period .Out of total rain, 60% is used to be waste due to surface run-off and leaching. Therefore, only 40% rain remains left for crop use. Despite of having an average rainfall of 1400 mm, only an average of 10 to 12% of the net sown area is under irrigation against the national average of 40 per cent and the remaining almost 90% of cultivable area is dependent on rain. In the recent years due to the unprecedented successive drought, which largely hampers kharif prospects, paddy need to be taken in only those areas where water accumulates in low rainfall conditions.

Table 1. Meteorological fetures of different agro-ecological zones of Jharkhand.

Months	Rainfall (mm)		
	Zone IV	Zone V	Zone VI
June-September	1098 (82.4%)*	1174 (83.3%)	1053 (80.6%)
October-November	90 (6.0%)	96 (6.7%)	69 (5.3%)
December-February	54 (4.1%)	71 (5.0%)	58 (4.4%)
March-May	88 (6.1%)	68 (4.8%)	122 (9.4%)

*Percent of annual rainfall



7. Suggestions

- Irrigation infrastructure is very poor in Jharkhand which need to be strengthen immediately for higher productivity of rice as the crop production during *kharif* season largely depends on rainfed.
- Strengthen regular monitoring and progress meeting and capacity building for Block level Agril. Officers, other field functionaries and farmers
- Timely supply of inputs like fertilizer, herbicide and pesticide etc. with good coordination among the state officials.
- Beneficiary selection for hybrids must be done based on availability of irrigation facility and shorter duration rice varieties need to be promoted to avoid problems from late onset and early withdrawal of monsoons
- Zero tillage/fertilizer cum seed drills and wheel hoes/finger weeder and spraying equipments needs to be provided to accelerate adoption of DSR in drought prone areas

Agriculture in Jharkhand is largely rainfed, practiced in the undulating topography with a meager irrigated area of only 10%, even the most proven technology fails to show its potentiality. However, implementation of the BGREI Program has definitely made a difference by increasing the area, production and productivity of Jharkhand state. Further strengthening of irrigation facilities at appropriate locations will further improve the total productivity of the state.