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

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Summary

Rice is the major crop covering about 63% of the total area under food grains. It is the staple food of almost the entire population of Odisha; therefore the state economy is directly linked with improvements in production and productivity of rice in the state. The annual normal rainfall of the state is 1451.2 mm. The rainfall pattern is highly unpredictable in timing, amount, and distribution and therefore the state suffers from either drought or flood. Rice is the major crop of the state grown in all the above ecologies but having a low productivity due to limitations posed by many production factors. Bringing Green Revolution to Eastern India (BGREI) program was introduced in 2010-11 to enhance the productivity in the state. The Program was implemented in 22 non NFSM districts that are major rice producing districts of the state. The state demonstrated improved rice production technologies through cluster demonstrations. The state has till date covered 3.95, 33.20, 23.20, 39.0, 32.83 and 23.35 lakh hectares in direct seeded rice (DSR), line transplanting (LT), system of rice intensification (SRI), stress tolerant variety, hybrids and cropping system based (CSB) demonstrations respectively which is about 13.5% of the total rice area of the state. Improved HYVs i.e., Ranidhan, CR Dhan 601, DRR 42, Sahbhagi Dhan, Swarna sub 1, Varsadhan, MTU 1010, Chandan, Kalajeera, Ketakijoha, DRHR 2, CR dhan 70, Improved Samba Masuri and hybrids i.e., Ajaya, Arize 6444 have been popularized. Besides, more than 50,000 shallow tube wells, bore wells and dug wells and 122 water harvesting structures and lift irrigations have been created to augment the irrigation facility. Similarly farm mechanization was advanced in the state by distribution of 16,193 farm machineries among beneficiary farmers. The overall increase in yield was 37.79% in the state by practicing improved production technologies like DSR, LT, STV and CSB demonstration plots compared to control plots. The Program made a visible impact on the state productivity. The average productivity during the latest 3 years (18.05 q/ha) of BGREI Program was increased by 12.65% compared to the average productivity of 3 pre-BGREI years (2007-08 to 2009-10) i.e., 16.03 q ha^{-1}. However, the productivity of the state is the lower than the national average and main factor dragging back the productivity of the state is attributed to the higher area under broadcasted rice and less use of herbicides for controlling weeds in broadcasted fields and frequent occurrence of natural calamities. Therefore, efforts may be made to convert all broadcasted rice areas into line sown DSR with use seed drills and herbicides; creating irrigation facilities in rainfed rice areas and diversifying the upland rice areas into horticultural crops.

1. Background

Agriculture in Odisha to a considerable extent means growing rice. Rice covers about 69% of the cultivated area and is the major crop covering about 63% of the total area under food grains. It is the staple food of almost the entire population of Odisha; therefore the state economy is directly linked with improvements in production and productivity of rice in the state. Odisha's share in the country's rice production was more than 11% in the pre-HYV period which gradually declined to 7.9% in 2008-09. Odisha falls under Agro-Climatic Zone

VII as per the classification of planning commission for India. Further, the state of Odisha has been divided into 10 Agro-Climatic sub-Zones based on soil structure, humidity, elevation, topography, vegetation and rainfall.

Fig. 1. Agro-climatic zones of Odisha.

Odisha is located in the subtropical belt in eastern India. The State broadly falls under hot and dry sub-humid, warm and humid, hot and humid, and hot and moist sub-humid regions. Odisha is broadly divided into two agro-climatic zones i.e., Plateau Region and Coastal alluvial plain. The Mountain range separates the eastern part of the state, which is a coastal belt with 482 km of coastline, and the western part, which is an extensive plateau. The coastal region contains about 15% of the geographical area of the state contributing 1.70 Mha of rice land

Table 1. Physiographic features of various agro-climatic zones of Odisha.

Agro-Climatic Zone	Climate	Soil type	Rainfall (mm)	Temp (°C) Min	Max
North Western Plateau	Hot & moist sub-humid	Red, Brown Forest, Red & Yellow, Mixed Red & Black	1600	15.0	38.0
North Central Plateau	Hot & moist sub-humid	Lateritic, Red & Yellow, Mixed Red & Black	1534	11.1	36.6
North Eastern Coastal Plain	Moist sub-humid	Red, Lateritic, Deltaic Alluvial, Coastal Alluvial & Saline	1568	14.8	36.0
East & South Eastern Coastal Plain	Hot & Humid	Saline, Lateritic, Alluvial, Red & Mixed Red & Black	1577	11.5	39.0
North Eastern Ghat	Hot & moist, sub-humid	Brown Forest, Lateritic Alluvial, Red, Mixed Red & Black	1597	10.4	37.0
Eastern Ghat High Land	Warm & humid	Red, Mixed Red & Black, Mixed Red & Yellow	1522	7.5	34.1
South Eastern Ghat	Warm & humid	Red, Lateritic & Black	1710	13.2	34.1
Western Undulating Zone	Hot & moist sub-humid	Red, Mixed Red & Black and Black	1352	11.9	37.8
Western Central Table Land	Hot & moist sub-humid	Red & Yellow, Red & Black, Black, Brown Forest & Lateritic	1614	12.4	40.0
Mid Central Table Land	Hot & moist sub-humid	Alluvial, Red, Lateritic, Mixed Red & Black	1421	14.0	38.7

constituting about 38% of the total rice area. The plateau region has 2.75 Mha of rice land constituting about 62% of the total rice area of the state. The soils of Odisha are mostly red lateritic and acidic in nature leading to seepage/deep percolation of water and thus demanding more water usage. The southwest monsoon enters the state during the second half of June and continues up to first week of October. The annual normal rainfall of the state is 1451.2 mm. The rainfall pattern is highly unpredictable in timing, amount, and distribution and therefore the state suffers from either drought or flood. The mean maximum temperature is 32°C in the coastal districts and can increase upto 42°C in hilly areas. The relative humidity varies from 36 to 98% in the state. The deltaic alluvial soils are generally fertile but low in N and P.

Table 1: BGREI Districts covered under various Agro-climatic zones of Odisha.

Agro-Climatic Zone	Area (%)	Districts	Districts covered under BGREI
North Western Plateau	10.00	Sundargarh, parts of Deogarh, Sambalpur & Jharsuguda	Sundargarh, Sambalpur
North Central Plateau	11.50	Mayurbhanj, major parts of Keonjhar, (except Anandapur subdivision)	Mayurbhanj
North Eastern Coastal Plain	6.00	Balasore, Bhadrak, parts of Jajpur & Anandapur Sub-Division of Keonjhar	Balasore, Bhadrak, parts of Jajpur
East & South Eastern Coastal Plain	13.00	Kendrapara, Khurda, Jagatsinghpur, part of Cuttack , Puri, Nayagarh & part of Ganjam	Kendrapara, Khurda, Jagatsinghpur, part of Cuttack , Puri, Nayagarh & part of Ganjam
North Eastern Ghat	15.00	Kandhamal, Rayagada, Gajapati, Part of Ganjam & small patch of Koraput	Rayagada, Gajapati, Part of Ganjam & small patch of Koraput
Eastern Ghat High Land	8.00	Major parts of Koraput & Nabarangpur	Major parts of Koraput & Nabarangpur
South Eastern Ghat	4.50	Malkangiri & part of Koraput	Malkangiri & part of Koraput
Western Undulating Zone	7.50	Kalahandi & Nuapada	Kalahandi
Western Central Table Land	16.00	Bargarh, Bolangir, Boudh, Sonepur and parts of Sambalpur, Deogarh & Jharsuguda	Bargarh, Bolangir, Boudh, Sonepur and parts of Sambalpur
Mid Central Table Land	8.50	Angul, Dhenkanal, parts of Cuttack & Jajpur	Dhenkanal, parts of Cuttack & Jajpur

Rice is grown in different ecologies i.e. irrigated *kharif* (27.4%), rain-fed upland (19.1%), medium land (12.4%), shallow lowland (22.5%), semi-deep (7.9%), deep (3.4%) and irrigated *rabi* (7.4%). The upland ecosystem is mostly drought prone area whereas the medium land is fairly stress free. The shallow water, semi-deep water and deep water ecologies are flood prone and water logged. Rice is the major crop of the state grown in all the above ecologies but having a low productivity due to many production factors. Bringing Green Revolution to Eastern India (BGREI) program was introduced in 2010-11 to enhance the productivity in the state.

2. Major Interventions with BGREI

Major interventions in Odisha 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 and hybrids of rice were produced and 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. upland, 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) using seed cum fertilizer drill:** In Odisha 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 Line sown 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 line sown DSR is low compared to traditional DSR with option of using mechanical weeder. Line sown DSR has a great potential in Odisha.
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. Odisha is frequently affected by natural calamities i.e. drought and flood almost every year. The production and productivity was reduced drastically due to these events. The stress tolerant varieties like Sahbhagi Dhan for moisture deficient condition and Swarna sub 1

for moisture excess/ flood prone condition with the appropriate production technology can be a great promise.

4. **Cropping system based production technologies:** Rice Based Cropping System is the major cropping system in Odisha. Rice double cropping is generally practiced in the irrigated areas of the state but rice followed by the 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 like Greengram or Blackgram 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 micro nutrients 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 1. Rice varieties recommended for Odisha.

Ecology	Variety/Hybrid
Irrigated	CR Dhan 304, CR Dhan 307, CR Dhan 310, CR Dhan 907, Arize 6444 Gold
Aerobic	CR Dhan 203, CR Dhan 205, CR Dhan 209
Boro	CR Dhan 601
Rainfed Upland	Sahbhagi Dhan, Satyabhama, Mandakini, Jyotirmayee
Rainfed Shallow Lowland	CR Dhan 800, CR Dhan 701, Swarna sub1, Reeta, Rani,
Rainfed Semi deep & Deep Lowland	CR Dhan 409, CR Dhan 500, CR Dhan 505
Coastal Saline	Luna Sankhi , Luna Barial, Luna Suvarna , Luna Sampad

2.1.2. Asset building, site specific activities & marketing support

Asset building activities were taken up for improving the water availability and irrigation facilities as well as farm mechanization in the Program areas. The state has already created 45,805 dug wells and bore wells, 4,999 shallow tube wells, 87 water harvesting structures, 35 river lift irrigation systems. The state has also provided 80,331 pump sets and 7.89 lakh meters of PVC pipes for carrying water from the source to its destination. Similarly a total of

16,193 farm machineries were distributed among beneficiary farmers which includes 1,052 seed drills, 1,936 cono-weeder, 5,060 rotavators, 757 self propelled paddy transplanters, 6,964 threshers, 14 drum seeders, 14 land leveler and 296 sprayers. Under Post harvest technologies, 277 threshing floor yard, 60 paddy seed cleaner cum grader, 144 pucca threshing floor. Besides 2018 cropping system trainings were also provided to the farmers regarding improvement in the crop production.

2.2. Monitoring procedure

The ICAR-NRRI as the nodal organization was involved in providing technical backstopping and monitoring of the program. The Program was planned by the department in discussion with scientists from ICAR-NRRI and OUAT, Bhubaneswar. The Program was monitored at national level by a national level monitoring team constituting members from NRRI Cuttack, Directorate of rice development, Patna and state agricultural department, Bhubaneswar. At district level the Program was monitored by a district level monitoring team where a scientist from ICAR-NRRI or OUAT is the member. The district level monitoring team (DLMT) used to visit 3-4 times during the crop growth period to ascertain the scientific way of executing the cluster demonstrations. In case of any deviation in implementing/executing the interventions were advised then and there to make necessary corrections. For example in case of insect, pest and disease attack the solutions were provided to the farmers. The scientists observed that the department after planning the activities during May/June conducts an orientation training Program of the departmental staffs as well as the farmers of respective clusters where they were explained about the rice varieties and their improved production technologies to be demonstrated under the Program. Under the cropping system based training Programs the farmers were trained 4 times during a year i.e. in May/June and November/December for Kharif crop and January/February and March/April for Rabi crops. The inputs required for the cluster demonstrations were purchased and supplied to the farmers by the state department in the initial period of the BGREI Program. However, currently "Surabhi stores" have been opened in different blocks by the agro industries department of the state where the identified farmers are purchasing the inputs on subsidy. Similarly the state follows online direct benefit transfer (DBT) system for asset building, site-specific activities and marketing support. Finally at the time of harvest, crop cutting experiments and field days were organized to assess the yield advantage achieved in the demonstrated varieties and production technologies.

3. Areas of demonstrations

The state of Odisha implemented the BGREI Program in 22 non-NFSM districts namely Balasore, Baragarh, Bhadrak, Cuttack, Dhenkanal, Mayurbhanj, Kendrapada, Gajapati, Jagatsinghpur, Jajpur, Kalahandi, Khurda, Koraput, Puri, Rayagada, Sonepur, Bolangir, Boudh, Ganjam, Nabarangpur, Nayagarh and Sambalpur. The state has demonstrated different improved production technologies through cluster demonstrations. The state has till date covered 0.40, 0.33, 0.23, 0.39, 3.28 and 2.34 Mha in direct-seeded rice (DSR), line transplanting, system of rice intensification (SRI), stress tolerant variety, hybrids and cropping system based demonstrations, respectively which is about 13.5% of the total rice area of the state.

4. Trends in Area, Production and Productivity of rice since 2009-10

The rice area in the state was 4.36 Mha in the pre BGREI year of 2009-10 out of which 0.69 Mha was under autumn rice and 3.41 Mha under winter rice and 0.26 Mha under summer rice. The area under rice showed a declining trend during the BGREI period. The average area of rice during the BGREI period was 4.03 Mha, which was decreased by 8.09% from the pre BGREI year 2009-10. The rice area coverage was 3.70 Mha in the year 2017-18, which is 15.3% lowered compared to the year 2009-10. The rice production of the state was 6.92 Mt in the year 2009-10 which was varied to a great extent depending upon the occurrence and magnitude of natural calamities in the state. However the productivity of rice showed an increasing trend during the Program period.

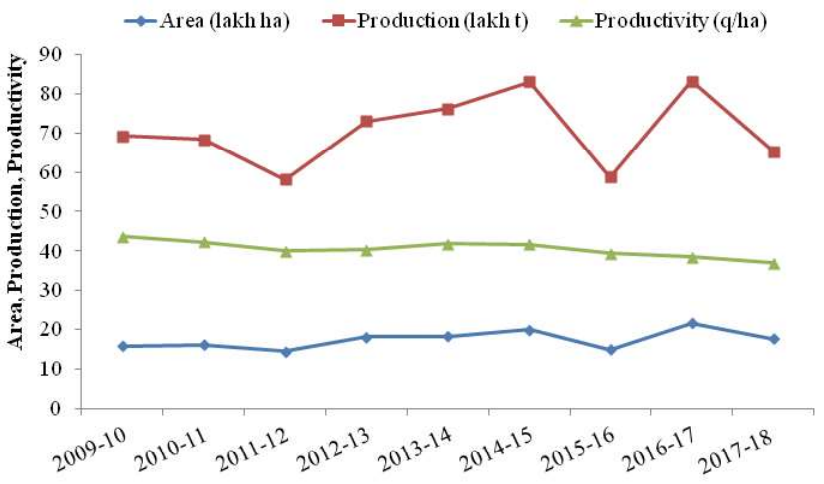

Fig. 2. Trends in area, production & productivity of rice in Odisha during the BGREI period.

5. Effects of the BGREI Interventions

Improved HYVs i.e., Ranidhan, CR Dhan 601, DRR 42, Sahbhagi Dhan, Swarna sub 1, Varshadhan, MTU 1010, Chandan, Kalajeera, Ketakijoha, DRHR 2, CR Dhan 70, Improved Samba Masuri and hybrids i.e., Ajaya, Arize 6444 have been already popularized. In the year 2017-18, the average yield of control plot was 3.79 t ha but the average yield of demonstrated plot under DSR technology was 4.67 t ha^{-1}, which was 23.42% higher than the yield of control plot. The highest percentage increase in yield was found in Khordha district under DSR with 40.37% more than the control plot. Under line-transplanted plot, the average yield of control plot was 3.73 t ha^{-1} whereas the average yield of demonstrated plot was 4.68 t ha^{-1} leading to 25.48% higher yield than the control plot. The highest percentage increase in yield (52%) was found in Bolangir district under this technology. The average yield of control plot was 3.83 t/ha whereas the average yields of demonstrated plot having stress tolerant varieties were 4.69 t/ha resulting in 22.58% higher yield than the control plot/farmers practice. The highest percentage increase in yield was found in Khordha district having stress tolerant varieties whereas highest percentage increases in yield was found in Bolangir district in cropping system based demonstrations. The overall increase in yield was 37.79% in the state by practicing improved production technologies like DSR, LT, STV and CSBD as compared to control plots.

Highest average paddy yield recorded in demonstrated plot of system of rice intensification (SRI) was 5.94 t/ha which was 26.5% higher than the average yield in control plot when pooled over 2 years. The results also indicated that stress tolerant varieties also producing similar yield as of line transplanting however in DSR plots comparatively lower yield is recorded in demonstrated plot. However, the control plot yield around the stress tolerant varieties plot recorded similar yield as the other control plots indicating that the area was neither not subjected to moisture stress or wrong selection of location for the stress tolerant varieties.

Table 2. Performance of Interventions in Odisha (pooled over last 2 years).

Name of the demonstration	Area covered (ha)	No. of crop cutting	Avg. yield in demonstration plot (q/ha)	Avg. yield in control plot (q/ha)	Increase in yield (%)
Line Transplanting	34843	6446	50.3	40.2	25.2
SRI	2400	299	59.4	46.9	26.5
Stress tolerant	36900	6480	50.7	40.9	24.1
DSR	6750	1695	47.2	38.0	24.2
CSBD	29522	5175	49.8	40.3	23.6

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

Average rice production during the BGREI period was 7.01 Mt with an increase by 2.23% from the year 2009-10. The production was decreased by 5.6% resulting in 6.53 Mt for the year 2017-18. The state experienced reduction in production in the year 2011-12, 2015-16 and 2017-18 whereas more than 20% yield increase was recorded in the years 2014-15 and 2016-17.

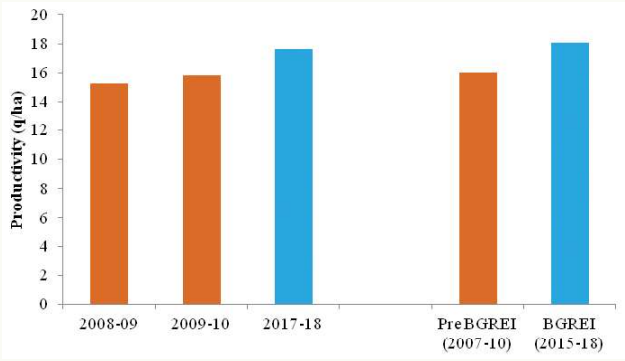

Fig. 2. Comparison of rice productivity in Odisha during the pre-BGREI and BGREI periods.

Productivity of rice increased by 11.4% to 1.76 t ha^{-1} for the year

2017-18 as compared to 1.58 t ha^{-1} in the year 2009-10. The average productivity during the latest 3 years of BGREI Program was 1.80 t ha^{-1}, which is 12.65% higher than the average productivity of 3 pre-BGREI years (2007-08 to 2009-10) i.e., 1.60 t ha^{-1} (Fig. 3).

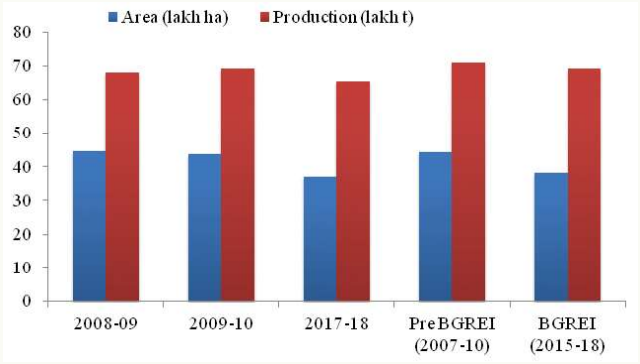

Fig. 3. Comparison of rice area and production of rice in Odisha during the pre-BGREI and BGREI periods.

Productivity of rice was 1.6 t ha^{-1} in the pre BGREI years. The rice productivity of the state increased by 12.46% during the BGREI period which may be attributed to the adoption of new HYVs and improved rice production technologies demonstrated through the program as there was on an average 23-26% increase in paddy yield in the demonstrated plots compared to control/farmers practice (Table 2). BGREI was the major program of the state on rice and implemented in 22 most important rice producing districts out of the 30 districts of the state. The state has already covered 13.5% total rice area under cluster demonstrations during the BGREI Program. Therefore, BGREI may be the key factor behind the increase in rice production and productivity of the state. However, decrease in yield in the year 2011-12 and 2015-16 compared to 2009-10 may be attributed to the natural calamities faced by the state. The state

Table 3. Rainfall pattern in Odisha during the Pre-BGREI and BGREI period.

Year	Normal rainfall (mm)	Actual rainfall (mm)	Deficit/ excess (%)	Natural calamity (Flood/ drought	Districts affected (No.)	Crop area damaged (ha)
2008-09	1473	1553.0	5.43	Flood	20	3,82,080
2009-10	1473	1407.4	-4.43	Flood	17	2,399
				Drought	18	60,913
2010-11	1479	1341.8	-9.25	Flood	6	30,212
				Drought	17	10786 villages
2011-12	1461	1334.1	-8.65	Flood	21	2,60,256
				Drought	21	7,04,718
2012-13	1461	1382.3	-5.35	Flood	5	1061
				Drought	4	314 villages
2013-14	1461	1644.9	12.63	Flood	18	5,61,590
2014-15	1461	1539.2	5.39	Flood	27	3,97,538
2015-16	1461	1210.4	-17.12	Flood	14	46,135
				Drought	27	14,92,565
2016-17	1461	1234.9	-15.45	Flood	6	-
				Drought	4	22658
2017-18	1461	1341.6	-8.14	Drought	15	3,15,000

faced four phases of floods during 2011 in which 21 districts were severely affected. The 1st and 2nd phases of flood occurred in the months of June and August respectively and floods in both 3rd and 4th phase were experienced in the month of September, 2011. In total about 2.60 lakh hectares of kharif crop sustained crop loss of more than 50% due to floods leading to a decline in productivity compared to pre BGREI year 2009-10. Similarly the state also faced both drought and flood in the year 2015-16. The erratic and deficient rainfall during the South West Monsoon-2015 was the main reason for the drought situation and particularly the continued moisture stress during the flowering and grain filling period reduced the rice productivity. Besides drought, the rice crop was also affected because of flood in Jajpur and Bhadrak district leading to 5.9% reduction in the yield compared to 2009-10. The yield decline was minimal during the BGREI period though the state was visited with frequent flood and drought, which may be ascribed to adoption of stress tolerant varieties in later part of the BGREI period.

7. Constraints

Major constraints affecting the rice production in Odisha include frequent occurrence of drought and flood, low irrigated areas, low exploitation of ground water and low and imbalanced nutrient use. Farmers do not have much flexibility in making management adjustments in rice cropping due to the frequent occurrence of drought and erratic rainfall regarding choice of variety, sowing time, and method of crop establishment and they mostly follow a standard set of practices which does not meet their needs during changing climatic situations such as delayed monsoon, early drought, and continuation of stress for a longer period resulting in poor yield. Besides, non-availability of quality seeds and fertilizers are also a reason behind low productivity. Majority of farmers are small and marginal and unable to bear the input cost. The state has a substantial area under rainfed broadcasted direct seeded rice where optimum plant population is not maintained. The knowledge on the insect, pests and dieses is very poor among the farmers. However, while implementing the BGREI Program in Odisha, the following issues aroused and constraints experienced which needs to be addressed of.

- Herbicides use is not popular for weed control in Direct seeded rice as timing of supply and application could not be maintained
- Bund planting of red gram is not successful in low land areas because of very small and narrow bunds
- Non availability of seeds lead to mismatched selection of stress tolerant varieties and location for demonstration
- Use of rotavators and seeding with seed drill/ drum seeder is limited
- Unavailability of high yielding YMV tolerant improved green gram/black gram varieties

8. Suggestions

Though there is substantial increase in the production and productivity of rice, for further enhancement of the rice productivity in the state, the following activities may be introduced/ up scaled in the state under BGREI Program.

- Creation of irrigation facility through cluster bore well/shallow tube wells particularly in rainfed broadcasted rice areas.

- Converting the broadcasted rice areas to drill sown DSR with use of herbicides.
- Planned production and distribution of good quality seeds of HYVs/Hybrids by producing truthful leveled seeds at district level involving Krishi Vigyan Kendras.
- Enhancing/optimizing fertilizer consumption in the state through real time nutrient management i.e. customized leaf colour chart (CLCC).
- Upscaling mechanized transplanting/SRI in irrigated medium land areas.
- Timely identification of insect pest and disease through e-pest surveillance and supply of pesticides.
- Converting the un-bunded uplands to horticultural (fruit) crops.
- Bringing rice fallow under cultivation by promoting cold/heat/YMV tolerant, green gram/ black gram and other low water required oilseed and spices.

The BGREI program could improve production and productivity of rice in state of Odisha. It also increased the farm mechanization activity in the state. Adoption of stress tolerant varieties and the site specific activities like creation of irrigation facility substantial reduced the effect of natural calamities like drought and flood and maintained the production of in the state even if in severe drought and flood occurred during the BGREI period.