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Yield Gap Analysis and Prioritization of Major Production Constraints of Rice in Dhubri District of Assam: An Experience from NICRA Village

C.K. DEKA, B.C. DEKA, R.K. SAUD[1], R. ISLAM, M. HUSSAIN, A. PAUL, P. SUTRADHAR AND P. RAJBONGSHI
Krishi Vigyan Kendra, Dhubri
Corresponding Author: Email: bhabesh_ch_deka@yahoo.co.in, Mobile No. 7002859081

Abstract

The situation specific rice varieties were disseminated through frontline demonstrations to the farmers of Udmari village of Dhubri district and the demonstrations conducted from 2011-12 to 2016-17 were considered for the study. The study revealed that there was considerable yield increase ranging from 7.14 to 87.5 percent among the demonstrated cultivars over the local varieties of farmers. The technology gap in Swarna Sub-1 variety ranged from 1000 kg/ha to 2167 kg/ha. In case of Gitesh it varied from 976 kg/ha to 1600 kg/ha. Similarly in case of Joymati and Luit the technology gap ranged 24kg/ha to 863 kg/ha and 50kg/ha to 1060 kg/ha respectively. The extension gap among the demonstrated cultivars ranged from 485 kg/ha to 2100 kg/ha. The technology indices varied from 1.35 to 29.09 percent among the varieties, indicating the scope of improving the technology adoption. From the yield gap analysis it is clear that farmers incurred considerable yield loss due to cultivation of some local varieties with low yield. Average rice yield have considerably increased with the introduction of HYV and improved crop management technologies. From the study it was observed that although the additional cost were incurred for cultivating the demonstrated varieties, additional net return were obtained with higher B C ratio in comparison to farmers practice. The major constraints like flood damage the kharif *crops, non availability of quality seed, submergence of crop by flash flood, high incidence of pest and diseases, early season drought (dry Spell) etc causing heavy yield loss and value loss need to be addressed through Research. The socio economic constraints also need policy interventions to bring about awareness and upliftment of rice farmers and thereby enable them to get stable yield in rice.*

Keywords: Yield Gap, Technology Gap, Extension Gap, Technology Index, Production constraints, Rice

Introduction

Rice is the stable food crop of nearly half of the world's population. In Asia, more than 90% of rice is produced catering the needs of nearly 560 million hungry people (Mohanty, 2013). Globally, India stands first in rice area and second in production after China. It is the major stable food crop in India with annual production of 106.29 million tons during 2013-14(www. Oryza.com).

Among the food grains, rice is the principal crop of the state of Assam. The agro climatic situation prevailing in this zone favours rice cultivation in the state. Hence, Assam being the one of the main rice growing state of India can contribute a lot the national economy. In 2015-16, Assam produced 522645 lakh MT from an area of 2495279 lakh ha with the productivity of 2120 kg/ha which is low as compared to the national average of 2390 kg/ha.

The study village Udmari is one of the flood affected village of Bilasipara Sub division of Dhubri District. Dhubri district of Assam is one of the agriculturally advanced district of Assam. In 2015-16, Dhubri district produced 236461 MT from an area of 86058 ha with the productivity of 2765 kg/ha which is higher as compared to the national average of 2390 kg/ha. However, the productivity of winter rice is 1292

[1]Directorate of Extension Education, AAU, Jorhat

kg/ha which is quite low.

The village "Udmari" where National Innovation in Climate Resilient Agriculture (NICRA) has been implemented since 2011 by Krishi Vigyan Kendra, Dhubri, is situated in Lower Brahmaputra Valley Agro climatic Zone of Assam at $26^0$15.425/ to 26^0 16.570/ N Latitude and $90^0$14.034/ to 90^0 18.040/E Longitude at an elevation of 128 from MSL. Flood is the major constraints affecting the productivity of rice in the project village Udmari as well as Dhubri District. The flood in the project village was found to occur two to seven times in a year during mid May to mid September.

Rice is the main crop of Udmari village and farmers of this village mainly cultivate winter as well as summer rice. Flood is the major contingency affecting *kharif* rice resulting in crop loss up to 20 to 100 percent depending upon the duration of submergence of crop. Sometimes flood water does not allow farmers to transplant rice seedlings in time during rainy season. The crop loss during the *kharif* season is due to submergence of crop by flash flood for longer period of time. In order to address the climatic vulnerability "Flood", Krishi Vigyan Kendra, Dhubri has demonstrated various site specific technologies in the farmer's field under NICRA during 2011-2016. Demonstrations are one of the practical approaches to maximize the production by display of relevant technologies at farmers field under strict supervision of agricultural experts helped to narrow down the extension and technological gaps to a considerable extent (Katare *et al*, 2011). In order to improve the production and productivity of rice, different HVY rice varieties developed by Assam Agricultural University and other organizations were demonstrated in the farmer's field. Among the technologies, demonstrations of different rice varieties were the prime concern. This involved demonstration of submergence tolerance rice variety "Swarna Sub-1", staggered planting rice variety "Gitesh", short duration rice variety "Luit" for post flood situation and summer paddy variety "Joymati" to escape early flood. Average rice yield have considerably increased with the introduction of HYV and improved crop management technologies. But there is still a wide gap between the potential and actual yield of farmers. Increasing the productivity of rice remains to be the major challenge for the governments and the researchers in all rice growing countries (Devi and Pannuarasi, 2009). Hence, an effort was made to see the performance assessment with the following objectives:

1. To study the yield and yield gap of rice as experienced by the farmers.
2. To identify the constraints based on yield loss and socio-economic aspect as perceived by the farmers.

Materials and Methods

The present study was carried out in the Udmari village where NICRA project were implemented by KVK, Dhubri during 2011-2016. The improved cultivars of rice- Swarna Sub1, Joymati, Gitesh and Luit developed by different organizations having the potential yield capacity of 55q/ha , 51 qt/ha, 55 qt/ha and 37qt/ha respectively has been demonstrated through field demonstrations with the guidance of KVK scientists. The demonstrations were conducted in Udmari village from 2011-12 to 2016-17. A total of 300 farmers involved in the demonstrations conducted during 2011-2016 were selected for the study. The yield of these varieties and other related particulars such as production constraints, yield loss were collected at the end of the demonstrations. From the village, 150 participating farmers were interviewed for identifying the constraints in rice cultivation.

The methodologies developed by the International Rice Research Institute (IRRI) has been adopted to estimate the magnitude of yield gaps, wherein potential yield, potential farm yield and farmers yields are defined as yield obtained on research stations, demonstrations plots and farmers field respectively(Gaddi *et al*., 2002). Yield gap is the difference between the potential yield and actual yield. All the constraints together supposed to account for the total yield gaps. Yield gap is separated into two parts i.e. Yield Gap I (Technology Gap) and Yield Gap –II (Extension Gap).

To estimate the technology, extension gap and technology index, the following formulas have been used:

1. Technology Gap(Yield Gap I)
   = Potential Yield—Demonstration yield
2. Extension Gap(Yield Gap II)
   = Demonstration Yield—Farmers Yield
3. Technology Index :

$$= \frac{\text{Potential Yield—Demonstration yield}}{\text{Potential Yield}} \times 100$$

(Sawardekar *et al*., 2003)

The data was tabulated and analysed with

suitable statistical tools.

Results and Discussion

It is evident from the table 1 that the increase in yield of rice over farmers practice with popular variety Swarna Sub-1 across years ranged from 23.44 to 87.50. Likewise in case of variety Gitesh, the yield increase over farmers practice ranged from 37.09 to 62.50. Similarly, in case of Joymati and Luit variety the yield increase over farmers practice ranged from 7.14 to 81.85 and 23.94 to 56.25 respectively.

Further table 1 indicates that the technology gap in Swarna Sub-1 variety ranged from 1000 kg/ha to 2167 kg/ha. In case of Gitesh the technology gap varied from 976 kg/ha to 1600 kg/ha. Similarly in case of Joymati and Luit variety, the technology gap ranged from 24kg/ha to 863 kg/ha and 50kg/ha to 1060 kg/ha respectively.

The result of extension gap shown in table 1 indicates that in case of Swarna Sub-1, the highest gap 2100 kg/ha was noticed in 2013-14 and lowest gap was 633 kg/ha in 2014-15. Similarly the extension gap for variety Gitesh, the highest gap was 1610 kg/ha in 2013-14 and the lowest was 1185 kg/ha in 2015-16. The extension gap for Joymati was highest (1907 kg/ha) in 2013-14 and lowest (300 kg/ha) in 2016-17. In case of Luit, the extension gap in 2011-12 was highest i, e 1350 kg/ ha and the lowest was in 2014-15 i.e. 510kg/ha. Similar types of results were also reported by Padmaiah. M and Venkattakumar.R (2009).

The results on technology index presented in table 1 reflect the feasibility of using the technologies

Table 1: Yield, technology gap, extension gap and technology index of improved cultivars

Year	Cultivars	No. of Demo	Yield (kg/ha) PY	DY	FP	% increase over FP	Technology gap(kg/ha)	Extension Gap(kg/ha)	Technology Index (%)
2011-12									
	*Swarna Sub 1	-	-	-	-	-	-	-	-
	Gitesh	21	5500	3900	2400	62.50	1600	1500	29.09
	Joymati	21	5100	5100	4200	21.42	00	900	00
	Luit	70	3700	3650	2400	56.25	50	1350	1.35
2012-13									
	*Swarna Sub 1	-	-	-	-	-	-	-	-
	Gitesh	2	5500	3900	2400	62.50	1600	1500	29.09
	Joymati	16	5100	5041	4200	20.02	59	841	1.16
	Luit	4	3700	3450	2400	43.75	250	1050	6.76
2013-14									
	Swarna Sub 1	2	5500	4500	2400	87.50	1000	2100	18.18
	Gitesh	4	5500	4200	2590	62.16	1300	1610	23.64
	Joymati	24	5100	4237	2330	81.85	863	1907	16.92
	Luit	4	3700	3600	2500	44.00	100	1100	2.70
2014-15									
	Swarna Sub 1	4	5500	3333	2700	23.44	2167	633	39.4
	Gitesh	14	5500	4071	2700	50.78	1429	1371	25.98
	Joymati	22	5100	5076	4440	14.32	24	636	0.47
	Luit	12	3700	2640	2130	23.94	1060	510	28.65
2015-16									
	Swarna Sub 1	4	5500	4005	2820	42.02	1495	1185	27.18
	Gitesh	10	5500	4005	2820	42.02	1495	1185	27.18
	Joymati	24	5100	4775	4290	11.31	325	485	6.37
	Luit	2	3700	3000	2325	29.03	700	675	18.92
2016-17									
	Swarna Sub 1	5	5500	4449	2953	50.66	1051	1496	19.11
	Gitesh	10	5500	4524	3300	37.09	976	1224	17.75
	Joymati	21	5100	4500	4200	07.14	600	300	11.76
	Luit	4	3700	3300	2400	37.50	400	900	10.81

(PY: Potential Yield, DY: Demonstration Yield, FP: Farmers Practice)
Swarna Sub-1 variety was not released in 2011 and 2012.

Table 2: Economics of Demonstrated Rice cultivars (2011-12 to 2016-17)

Cultivars	No. of Demo	Av. Yield (q/ha) demo	Local	Cost of cultivation (Rs/ha) Demo	FP	Additional cost of cultivation (Rs/ ha)	Gross return (Rs/ ha) Demo	FP	Net Return (Rs/ ha) Demo	FP	Additional Net Return (Rs/ ha)	B:C ratio Demo	FP
Swarna Sub 1	15	40.72	27.18	32745	28125	4620	50900	33975	18155	5850	12305	1.55	1.21
Gitesh	61	41	27.17	32250	27975	4275	51250	33962.5	19000	5987.5	13012.5	1.59	1.21
Joymati	146	47.88	39.43	34500	31800	2700	59850	49287.5	25350	17487.5	7862.5	1.73	1.55
Luit	96	32.73	23.59	30000	27525	2475	40912.5	29487.5	10912.5	1962.5	8950	1.36	1.07

in the farmer's field. The lower the value of technology index, the more feasibility in use of technology. The technology index of Swarna Sub-1 variety ranged from highest 39.4 % in 2014-15 and lowest 18.18 % in 2013-14. The technology index for Gitesh was highest 27.18% in 2015-16 and the lowest was 0.47 % in 2014-15. The technology gap for Joymati was highest 16.92 % in 2013-14 and the lowest was 0.47 % in 2014-15. In case of Luit, the technology index was highest 28.65 % in 2014-15 and the lowest was 1.35 % in 2011-12. In all the demonstrated varieties the technology indices were low which indicates that suitability of these varieties in that village situation.

The economics of demonstrated varieties were presented in table 2. It indicates that the additional cost incurred for Swarna Sub1 variety was Rs. 4620.00/ha for which the additional net return obtained was Rs.12305.00/ha with a B.C ratio of 1.55 in case of demonstration plot and 1.21 in case of farmers practice respectively. Similarly for variety Gitesh, the additional cost involved was Rs. 4275.00/ha which in turn gave additional net return of Rs. 13012.50/ha and the B.C ratio calculated was 1.59 for demonstration plot and 1.21 for farmers practice. In case of Joymati the additional net return obtained was Rs. 7862.5/ha with additional cost of Rs. 2700.00/ha and B.C ratio calculated was 1.73 for demonstration plot and 1.55 for farmers practice. In case of post flood situation Luit variety the additional net return obtained was Rs. 8950.00/ha with additional cost of Rs. 2475.00/ ha with B.C ratio of 1.36 and 1.07 for demonstration plot and for farmers practice respectively.

Constraints faced by the farmers in cultivation of rice:

A. Constraints faced by the farmers of NICRA village on the basis of yield loss.

The constraints faced by the farmers in cultivation of rice are presented in table 3. It is evident from the table 3 that among the constraints, flood damages the *Kharif* crops, submergence of crop by flash flood and non availability of quality seed ranked 1st, 2nd and 3rd respectively. Problem of quality seed may be due to shortage of government seed firm and village level seed producer. The other constraints like heavy rainfall, non use of recommended fertilizers, high incidence of pest and diseases, early season drought and lack of knowledge on scientific cultivation of rice were ranked as 4th, 5th, 6th, 7th and 8th respectively.

A. Socio economic Constraints faced by the farmers of NICRA village.

The socio economic constraints faced by the farmers in cultivation of rice are presented in table 4. It is evident from the table 4 that among the major constraints, high cost of inputs, shortage of labour and lack of assured market ranked 1st, 2nd and 3rd respectively. These three constraints really hinder the rice cultivation in the village. The other constraints like poor economic condition, post-harvest storage problem, high incidence of intervention of middle men, lack of proper extension service and

Table 3: Constraints faced by the farmers of NICRA village on the basis of yield loss

N=150

S. No.	Problems	Frequency			Total Score	Rank
		Very serious (2)	Serious (1)	Not so serious(0)		
1	Flood damages the *kharif* crops	124	26	0	274	I
2	Lack of knowledge on scientific cultivation of rice	30	85	35	145	VIII
3	Non availability of quality seed	80	55	15	215	III
4	Non use of recommended dose of fertilizers	60	70	20	190	V
5	Heavy rainfall	74	53	13	201	IV
6	High incidence of pest and diseases	64	56	30	184	VI
7	Early season drought (dry Spell)	58	63	29	179	VII
8	Submergence of crop by flash flood	90	44	16	224	II

Table 4: Socio economic constraints faced by the farmers of NICRA village

N=150

S. No.	Problems	Frequency			Total Score	Rank
		Very serious (2)	Serious (1)	Not so serious(0)		
1	Lack of proper extension service	49	69	32	167	VII
2	High incidence of intervention of middle men	53	65	32	171	VI
3	Lack of assured market	70	53	27	193	III
4	Post-harvest storage problem	55	70	25	180	V
5	High rate of interest on loan charge by the professional money lender	56	24	70	136	VIII
6	Shortage of Labour	78	45	27	201	II
7	High cost of inputs	81	45	24	207	I
8	Poor Economic condition	65	55	30	185	IV

high rate of interest on loan charge by the professional money lender were ranked as 4th, 5th, 6th, 7th and 8th respectively.

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