Indian Journal of Agricultural Sciences **85** (7): 902–7, July 2015/Article

Participatory research for assessing the suitability of potential innovations: A case study on high-yielding varieties options for rice farmers in north east India

V P BHADANA[1], M A ANSARI[2], PUNITHA P[3], N PRAKASH[4], I M SINGH[5], P K SHARMA[6], SUDHIR KUMAR[7], SHIV DUTT[8], B LAL[9] and S V NGACHAN[10]

ICAR RC for NEH Region, Manipur Centre, Imphal 795 004

Received: 8 October 2014, Accepted: 1 May 2015

ABSTRACT

This study examines the potential of participatory research to investigate the suitability and performance of high yielding rice varietal technologies with farmers of both hill and valley districts of Manipur based on front line demonstrations (FLDs) conducted from 2005 to 2012. Demonstrations were carried out in all the 9 districts (4 valley and 5 hill) in coordination with Krishi Vigyan Kendras to demonstrate the performance of RC Maniphou 10 on the farmers' fields. Leimaphou a very popular variety among the farmers was grown as a check variety. The average yield of check variety ranged from 3.3 to 4.8 tonnes/ha, whereas the demonstrated variety RC Maniphou 10 recorded yield ranging from 4.6 to 6.2 tonnes/ha and yield gain over the check variety ranged from 27 to 43% in different districts. It was found that net returns have increased from 34% (in Imphal West) to 69% in Tamenglong- under improved practice (IP) than farmer's practice (FP). The crop profitability has also increased by 40% in Imphal West and 75% in Tamenglong. The technology gap analysis revealed highest gap in the demonstration yield over potential yield in Senapati and Chandel districts (3.89 tonnes/ha), whereas it was lowest in Thoubal district (2.36 tonnes/ha). High extension gap of 1.52 tonnes/ha was recorded in Churachandpur followed by Tamenglong district. The technology index was minimum in Thoubal (27.7%) as compared to other districts. From this participatory research, farmers were convinced about the performance of RC Maniphou 10 and neighbouring farmers have taken seed which helped in spread of the variety. The variety was found suitable for both valley and hill areas.

Key words: Productivity, Profitability, RC Maniphou 10, Transfer of technology, Technology gap, Technology index

The dissemination of farm management techniques among farmers are a long term educational activity conducted in a systematic manner in farmers' fields to showcase worth of a new practice/technology. Farmers in India are still producing crops based on the knowledge transmitted to them by their forefathers leading to a grossly unscientific agronomic, nutrient management and pest management practices. As a result of these, they often fail to achieve the desired potential yield of new varieties of various crops. Under rainfed situation, where the water supply for crop production is not fully under the control of the grower, water-limiting yield may be considered as the maximum attainable yield for yield gap analysis assuming other factors are not limiting crop production. However, there may be season-to-season variability in potential yield caused particularly by quantum and pattern of rainfall. Water-limiting potential yield for a site could be determined by growing crops without any growth constraints, except water availability (Singh *et al.* 2001). The involvement and participation of farmers in deciding the location specific research priorities is key to acceptance of technology by the farmers. Agriculture is mainstay of Manipur's economy and rice is the most important staple food crop in Manipur grown in more than 70% of total area. Rice covers 2.12 lakhs ha area with production and productivity of 5.2 lakh metric tonnes and 2.45 tonnes/ha respectively (Government of Manipur 2012). There are many

[1] Senior Scientist, Plant Breeding (e mail: vp_pb@yahoo.co.in), Directorate of Rice Research, Rajendranagar, Hyderabad; [2] Scientist, Agronomy (e mail: merajalam_ansari@yahoo.com); [3] Scientist, Agricultural Extension (e mail: kppunithaa@rediffmail.com), [4]Joint Director (e mail: nprakashicar@gmail.com), [5] Principal Scientist, Seed Technology, (e mail: meghais@rediffmail.com), [7] Scientist, Plant Breeding (e mail: sudhiraaidu2006@gmail.com), ICAR Research Complex for NEH Region, Manipur Centre, Imphal; [6] Principal Scientist, Plant Pathology (e mail: pawan112000@gmail.com), NBAIM, Mau Nath Bhanjan, UP; [8] Senior Scientist, Plant Breeding (e mail: shivdatts1@gmail.com), IP and TM Unit, KAB I, Pusa, New Delhi 110 012; [9] Scientist (Agronomy), CRRI, Cuttock; [10] Director, ICAR RC for NEH Region, Umiam

local landraces grown in Manipur as there is dearth of high yielding varieties possessing resistance to locally prevailing biotic and abiotic stresses and farmers' preferred quality characteristics. RC Maniphou 10, a high yielding rice variety under valley conditions and terraces of hills, developed by ICAR Manipur Centre possessing high degree of resistance to blast and desirable quality features, viz. soft cooking quality, low amylose content was taken up for demonstration. Prior to inclusion in FLDs the variety was tested in On Farm Trials (OFT) in farmers' fields and based on consistency in performance under different situations. The OFTs and FLDs are taken up with the perception that farmer are more receptive to newer technology when they see it with their own eyes. The field demonstrations are conducted under the close supervision of scientists of the National Agriculture Research System is called front-line demonstrations (Sharma *et al.* 2011). The FLDs with RC Maniphou 10 were carried out for eight years from 2005 to 2012 with the objectives to demonstrate the performance of RC Maniphou 10 and identify different types of yield gaps as well as profitability under demonstrated improved practice over farmers' practices (local checks) in both hills and valley districts of Manipur.

MATERIALS AND METHODS

Farmers for Front line demonstrations (FLDs) were selected in consultation with the extension workers of KVKs working in respective districts to demonstrate the performance of RC Maniphou 10 on the farmers' fields. Demonstration sites were easily accessible to the farmers of neighbouring villages. The details of the number of beneficiaries, area covered and average size per demonstration in different districts is given in Table 1.

Table 1 Details of districts, no. of beneficiaries and area covered under FLDs of RC Maniphou 10 (mean of 8 years, from 2005 to 2012)

District	No. of beneficiaries (*Average of 8 years)	Area covered (ha) (*Average of 8 years)	Average size of demo. plot (ha)
Valley districts			
Imphal West	17	12.5	0.74
Imphal East	9	7.5	0.83
Thoubal	9	7.5	0.83
Bishnupur	9	7.5	0.83
Hill districts			
Churachandpur	11	8.0	0.73
Chandel	11	5.5	0.50
Ukhrul	5	4.5	0.90
Tamenglong	6	5.0	0.83
Senapati	3	2.0	0.67
Total	80	60.0	0.75

*The total 640 beneficiaries covered in a total area of 480 ha in 8 years of participatory demonstration of technologies.

Participating farmers belonging to different villages of hill and valley districts of Manipur were purposively selected as partners within a participatory learning who were previously cultivating local rice varieties. Researchers and farmers jointly sown the nursery and visited the plots at germination, transplanting, panicle initiation, milking, maturity and harvesting. Visits were also done weekly by farmers alone to carry out independent monitoring and evaluation in order to record observations free from researchers' influence. Collectively designed forms were also used to enable organised data collection. Farmers' notes were used in focus group discussions, and during community studies. At the end of this process, yields were calculated on per hectare basis and presented by researchers to participants for discussions.

Manipur lies between $92^{0}58'$E to $94^{0}45'$E longitude and $23^{0}50'$N to $25^{0}42'$N latitude. Altitude varies from 750 to 3114 m above mean sea level draining from North to South. Out of total geographical area of 22 327 sq km, 90% area is under hill tract and rest is valley in Manipur. Monsoon starts in June and remains active till end of September with an average annual rainfall of 1 450-2 000 mm. Average sunshine hours during *kharif* season are less than 5. Due to varied level of altitude and slopes the climate of Manipur varies from subtropical to semi-temperate. The soil type ranges from heavy (valley region) to light (hill slopes) in texture.

Participatory approach was followed in conducting demonstrations associating with farm scientists, extension workers and demonstrating farmers, in order to ensure effective implementation and better adoption and diffusion of the variety.The demonstrations were conducted as per recommended package of practices (Table 2). The present investigation was carried out in the adopted villages located in the operational area of KVKs in both valley and hill districts. Before laying out the FLDs with RC Maniphou 10, training programmes for farmers were organized in the respective districts to explain the package and practices for cultivation of RC Maniphou 10. The data from local checks collected where farmers were using their own practices for cultivation of rice crop. The technology and extension gaps and technology index were calculated as given by Samui *et al.* (2000) and explained hereunder:

Technology gap (tonnes/ha) = Potential yield – Demonstration yield

Extension gap (tonnes/ha) = Demonstration yield – Yield from farmers practice (Local check)

Technology index = (Potential yield – Demonstration yield) × 100/ Potential yield

RESULTS AND DISCUSSION

Assessment of suitability of variety

The results from the suitability assessment exercise revealed that RC Maniphou 10 performed well under lowland valley areas as well in terraces of hills and recorded superior performance over Leimaphou. Both leaf and neck

Table 2 Details of package of practice adapted under farmer practice (FP) and improved practice (IP)

Criteria	Farmers' practice	Interventions under improve cultivation practice
Method of sowing	Broadcasting/transplanting	Transplanting under ICM (integrated crop management)
Variety	Local (Leimaphou)	Improved varieties (RC Maniphou 10)
Spacing	Inadequate	20 × 10 cm
Seed treatment	Rarely	Always
Fertilizer management	Rarely and not adequate	60-60-40 kg, N, P and K respectively as basal
Top dressing	Never	20 kg N as top dressing at tillering stage
Weed management	Sometime hand weeding	Cono/rotatory weeder + weedicide
Pest management	Applying fungicide after appearance of disease (EIL) in whole field	Applying fungicide (ETL) just appearance of disease in field

blast which is most devastating disease of the rice in hill region and causes huge yield losses. It is also known that blast fungus is, pathogenically is highly variable and more than more than 80 rice blast resistance genes have been identified in various rice cultivars (Ballini *et al.* 2008) even than resistant varieties becomes susceptible within 3-4 years. On the contrary, RC Maniphou 10 never recorded susceptible reaction to blast during 8 years at any of the locations. Being a medium duration variety (130 days), it fitted well in prevailing cropping system. Above all, RC Maniphou 10 was received well on account of its desirable quality features preferred by consumers. Farmers were able to use the participatory research methods to identify options for including high yielding varieties into their system, to identify ways of adapting the technology to fit their specific conditions and to explore the potential impacts on the wider system. The process allowed farmers and researchers to jointly analyse and explore the different options. Mutual interaction highlighted factors of importance of farmers which warranted consideration in on-farm experimentation as well as some issues requiring consideration by researchers, e.g. regarding the robustness and effectiveness of the technology in different conditions.

Yield and crop productivity

Leimaphou, a very popular variety among the farmers was grown as a check variety. The Table 3 shows that the average yield of check variety ranged from 3.29 to 4.80 tonnes/ha, whereas the demonstrated variety, RC Maniphou 10 recorded grain yield ranging from 4.6 to 6.2 tonnes/ha. The yield increase over the check ranged from 27 to 43%. Farmers were very happy with the performance of RC Maniphou 10 as expressed in the field day conducted to seek their reaction. The crop productivity also increased under improved practice with new variety from 27 to 42% in various hill districts over farmer practice (Fig 1). From the Table 3, it could be inferred that the performance in terms of yield of RC Maniphou 10 is comparatively high in valley districts than hill districts. The lower yield of rice under farmers' practice (FP) was mainly due to use of poor quality seeds, that they are procuring from neighbouring farmers and use of conventional methods of cultivation with very poor nutrient and weed management. Farmers who adopted improved practice under demonstration used quality seeds of improved varieties and scientific practices like integrated crop management (ICM) with proper nutrient and weed management recorded higher rice yield. Our

Table 3 Performance of RM Maniphou 10 over the years (2005-2012) in different districts of Manipur

District	Farmers practice (Baseline survey)	Yield (tonnes/ha)							
		Improved practice							
		2005	2006	2007	2008	2009	2010	2011	2012
Valley									
Imphal West	4.40±0.06	6.04±0.28	5.51±0.29	5.96±0.20	5.57±0.23	5.34±0.09	5.06±0.13	5.71±0.17	5.61±0.12
Imphal East	4.34±0.09	5.84±0.14	5.64±0.26	5.80±0.17	5.54±0.03	5.78±0.15	5.23±0.18	5.87±0.20	5.74±0.14
Thoubal	4.80±0.12	6.92±0.23	5.96±0.32	6.19±0.21	6.10±0.21	6.03±0.15	5.87±0.06	5.92±0.06	6.14±0.09
Bishnupur	4.64±0.09	6.20±0.29	5.74±0.32	6.28±0.12	5.85±0.14	5.75±0.09	5.42±0.12	6.32±0.12	5.98±0.09
Hill									
Churachandpur	3.94±0.15	5.82±0.22	4.43±0.20	5.73±0.18	5.54±0.09	5.27±0.09	5.52±0.09	5.62±0.12	5.74±0.03
Chandel	3.29±0.17	4.69±0.15	4.42±0.29	4.99±0.26	4.52±0.15	4.52±0.11	4.52±0.12	4.67±0.15	4.70±0.12
Ukhrul	3.70±0.12	5.20±0.29	5.32±0.12	4.91±0.12	4.62±0.04	4.78±0.09	4.55±0.14	4.70±0.10	4.71±0.12
Tamenglong	3.30±0.12	4.90±0.23	5.05±0.26	4.87±0.18	4.41±0.12	4.72±0.09	4.52±0.12	4.60±0.06	4.59±0.06
Senapati	3.55±0.20	4.72±0.12	4.68±0.29	4.58±0.23	4.48±0.17	4.50±0.17	4.65±0.09	4.70±0.12	4.57±0.04
SEm±	0.14	0.23	0.19	0.20	0.15	0.12	0.07	0.14	0.10
LSD (P=0.05)	0.41	0.69	0.58	0.60	0.45	0.36	0.22	0.41	0.31

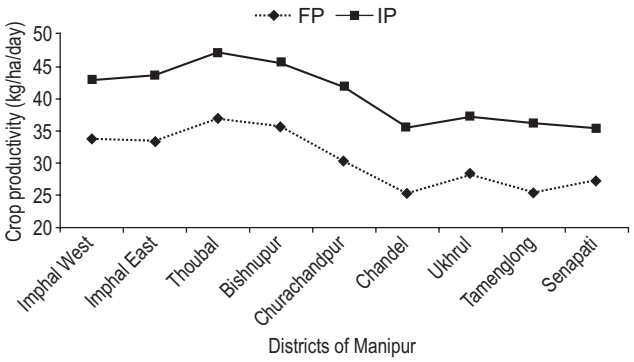

Fig 1 Productivity of rice under farmers' and improved practice (mean of 8 years) in different districts of Manipur

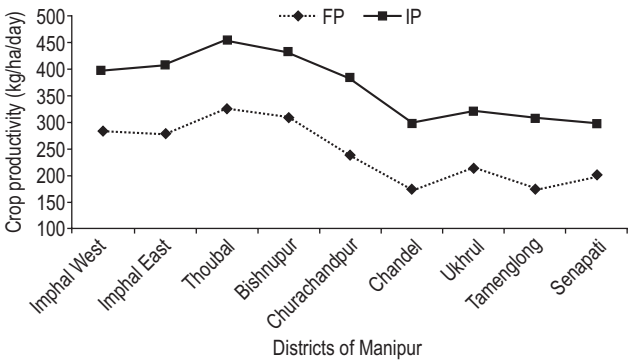

Fig 2 Crop profitability of rice under farmer and improved practice (mean of 8 years)

results are in close agreement with Yadav *et al.* (2013) and Ansari *et al*. (2013).

Economics and crop profitability

The inputs and outputs prices of commodities prevailed during 2012-13 was taken for calculating cost of cultivation, net return and benefit cost ratio. Profitability in terms of economic returns of any system is the integral component for its adoption by farmers. The current study indicates higher variable cost, gross returns, net returns and benefit cost ratio (B:C) in improved practice as compared to farmers practice (Table 4). The higher variable cost in IP was mainly due to use of quality seed material, optimum fertilization, proper weed management and pest management with better package and practices. The higher gross returns, net returns and B:C ratios were due to more production of economic products in IP as compared to FP. The lower cost of production, gross returns, net returns and B:C ratios in CFS might be due to use of poor quality seed material of local varieties with very poor management practices. Net returns have increased from 34% in Imphal West to 69% in Tamenglong under IP than FP and accordingly crop profitability has also increased by 40% and 75% in Imphal West and Tamenlong districts respectively. These results are in accordance with Haque (2000) and Jeengar *et al.* (2006). The year wise fluctuation in yields and economics were observed mainly on the account of variations in moisture availability on account of variable rainfall in different years.

Technological impact

Yield in front line demonstration trials and potential yield of the crop was compared to estimate the yield gaps which were further categorized into technology and extension gaps (Hiremath and Nagaraju 2009). The technology gap shows the gap in the demonstration yield over potential yield and it was highest in Senapati and Chandel (3.89 tonnes/ha) and lowest in Thoubal (2.36 tonnes/ha). The observed technology gap was mainly attributed to rainfed conditions, variation in soil conditions etc. prevailing in the districts. The other reasons include dissimilarity in soil fertility status, marginal land holdings and hilly terrain. Further the higher extension gap of 1.52 tonnes/ha was recorded in Churachandpur followed by

Table 4 Economics of rice cultivation with RC Maniphou 10 and Leimaphou in different districts of Manipur

Districts	Economics							
	Gross returns (₹ × 10^3/ha)		Net returns (₹ × 10^3/ha)		B: C ratio		Net B: C ratio	
	FP	IP	FP	IP	FP	IP	FP	IP
Valley								
Imphal West	57.20±0.75	72.72±1.15	37.00±0.75	49.92±1.15	2.83±0.04	3.19±0.05	1.83±0.04	2.19±0.05
Imphal East	56.46±1.13	73.80±1.50	36.26±1.13	51.00±1.50	2.80±0.06	3.24±0.07	1.80±0.06	2.24±0.07
Thoubal	62.40±1.50	79.86±1.36	42.20±1.50	57.06±1.36	3.09±0.08	3.50±0.06	2.09±0.08	2.50±0.06
Bishnupur	60.36±1.13	77.20±1.03	40.16±1.13	54.40±1.03	2.99±0.06	3.39±0.04	1.99±0.06	2.39±0.04
Hill								
Churachandpur	51.18±1.88	70.89±0.66	30.98±1.88	48.09±0.66	2.53±0.09	3.11±0.03	1.53±0.09	2.11±0.03
Chandel	42.77±2.26	59.98±0.34	22.57±2.26	37.18±0.34	2.12±0.11	2.63±0.02	1.12±0.11	1.63±0.02
Ukhrul	48.10±1.50	62.95±0.85	27.90±1.50	40.15±0.85	2.38±0.08	2.76±0.04	1.38±0.08	1.76±0.04
Tamenglong	42.94±1.50	61.24±0.75	22.74±1.50	38.44±0.75	2.13±0.07	2.68±0.03	1.13±0.07	1.68±0.03
Senapati	46.19±2.63	59.96±1.97	25.99±2.63	37.16±1.97	2.29±0.13	2.63±0.09	1.29±0.13	1.63±0.09
SEm±	1.78	1.21	1.78	1.21	0.09	0.05	0.09	0.05
LSD (P=0.05)	5.39	3.67	5.39	3.67	0.27	0.16	0.27	0.16

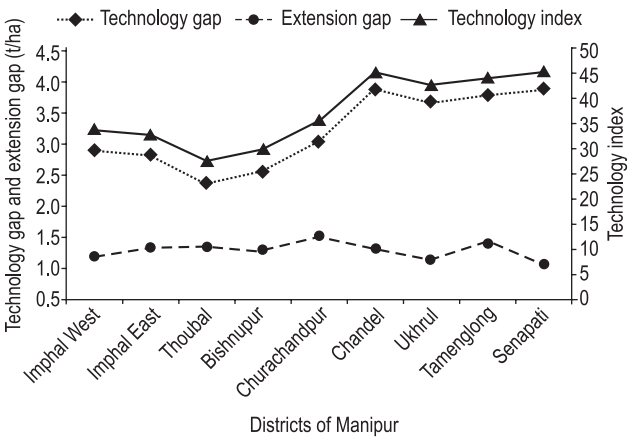

Fig 3 Technological impact of front line demonstration (mean of 8 years)

Tamenglong districts. This emphasized the need to educate the farmers through various extension means for the adoption of scientific practices in cultivation of rice. Mukharjee (2003) has also opined that depending on identification and use of farming situation, specific interventions may have greater implications in enhancing system productivity. The data presented in Fig 3 revealed that, the technology index was minimum in Thoubal (27.7%) as compared to other districts. Technology index shows the feasibility of evolved technology at the farmer's field and lower the value of technology index more is the feasibility of the technology (Jeengar *et al.* 2006 and Mokidue *et al.* 2011).

The present study was focussed on farmers' participatory assessment of a high yielding rice variety for suitability to the farmers existing systems under valley and hill situations in Manipur. Based on performance in more than 600 FLDs organized for 8 years in nine districts, it was found that the variety was received by the farmers on account of its consistent superior performance and desirable quality features. This case study has demonstrated that participatory research and extension methods provide useful tools with which 'suitability assessment' process can be undertaken in NEH Region. The FLDs is one of the best means for the farmers for not only to see the performance of a given variety but also to convince the neighbouring farmers. During the process of participatory assessment, farmers were encouraged to sell the seed harvested from demonstration plots to the interested farmers and in this way RC Maniphou 10 have speeded to larger area in the state through farmers to farmers seed exchange. Analysis revealed technological and extension gaps which can be bridged by popularizing improved package of practices with emphasis on the seed of improved crop varieties, use of proper seed rate, balanced nutrient application and proper use of plant protection measures. Replacement of local varieties with the RC Maniphou 10 of rice would increase the production and net income of the farmers.

ACKNOWLEDGEMENT

The authors are thankful to the farmers of hilly and valley districts of Manipur, staff of KVKs for participating in adoption and evaluation of high yielding varieties. FLDs sanctioned by Department of Agriculture, Government of India and coordinated by DRR, Hyderabad is duly acknowledged. The support from Director, ICAR RC for NEH Region, Umiam is also gratefully acknowledged.

REFERENCES

Ansari M A, Prakash N, Baishya L K, Punitha P, Yadav J S, Sharma P K, Sailo Blessa and Ansari M H. 2013. Comparative study on conventional and improved integrated farming systems for sustainable production, income generation and employment opportunity among the tribal farmers in hilly Regions of Manipur. *Indian Journal of Agricultural Sciences* **83**(7): 765–72.

Ballini E, Morel J-B, Droc G, Price A, Courtois B, Notteghem J-L and Tharreau D. 2008. A genome-wide meta-analysis of rice blast resistance genes and quantitative trait loci provides new insights into partial and complete resistance. *Molecular Plant-Microbe Interaction*, **21**(7): 859–68.

Dorward P T, Shepherd D D and Wolmer W. 1997. Developing farm management type methods for participatory needs assessment. *Agricultural Systems* **55**(2): 239–56.

Government of Manipur. 2012. Economic survey 2011-12. Department of Economics and Statistics, Directorate of Economics and Statistics Government of Manipur, Imphal.

Haque M S. 2000. Impact of compact block demonstration on increase in productivity of rice in Maharashtra. *Journal of Extension Education* **19**(1): 22–7.

Harding T J. 1982. Farm management advice to peasant agriculture: the transfer of technology. *Journal of Agricultural Economics* **33**: 47–56.

Hiremath S M and Nagaraju M V. 2009. Evaluation of front line demonstration trials on onion in Haveri district of Karnataka. *Karnataka Journal of Agricultural Science* **22**(5): 1 092–3.

Jeengar K L, Panwar P and Pareek O P. 2006. Front line demonstration on maize in Bhilwara District of Rajasthan. *Current Agriculture* **30**(1-2): 115–6.

Meena B P, Kumawat S M and Yadav R S. 2011. Effect of planting geometry and nitrogen management on groundnut (*Arachis hypogaea*) in loamy sand soil of Rajasthan. *India Journal of Agricultural Sciences* **81(**1): 86–8.

Mokidue Islam, Mohanty A K and Sanjay Kumar. 2011. Correlating growth, yield and adoption of urdbean technologies. *Indian. Journal of Extension Education* **11**(2): 20–4.

Mukharjee N. 2003. *Participatory Learning and Action*, pp 63–5. Concept Publishing Company, New Delhi.

Ray G L. 2008. *Extension Communication and Management*. Kalyani Publishers, New Delhi.

Rehman T and Dorward A. 1984. Farm management techniques and their relevance to administration, research and extension in agricultural development. Part I—their evolution and use in developed countries. Part 2—an appraisal of their potential in LDCs. *Agricultural Administration* **15**: 177–90, 239–54.

Samui S K, Maitra S, Roy D K, Mondal A K, Saha D. 2000. Evaluation on front line demonstration on groundnut (*Arachis hypogaea* L). *Journal of Indian Society Coastal Agricultural Research* **18**: 180–3.

Sharma A K, Vinod Kumar, Jha S K and Sachan R C. 2011. Frontline Demonstrations on Indian mustard: An Impact Assessment. *Indian Research Journal of Extension Education* **11**(3): 25–31.

Singh P, Vijaya D, Chinh N T, Pongkanjana A, Prasad K S, Srinivas K and Wani S P. 2001. Potential productivity and yield fap of selected crops in the rainfed regions of India, Thailand, and Vietnam. Natural Resource Management Program Report no. 5. International Crops Research Institute for the Semi-Arid Tropics, pp 1–25.

Yadav Gulab Singh, Chandan Debnath, Datta M, Ngachan S V, Yadav J S and Babu, Subhash. 2013. Comparative evaluation of traditional and improved farming practices in Tripura. *Indian Journal of Agricultural Sciences* **83**(3): 310–4.