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Impact analysis of front line demonstration of rice (*Oryza sativa*) on the yield, economics and farmer's knowledge in temperate region of India

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Impact analysis of Front Line Demonstrations (FLD's) of rice on yield, economic returns, level of knowledge and adoption extent was conducted through a study in temperate region of northern India, in which 240 participating farmer respondents and 240 non-participating farmer respondents from 5 representative villages in four districts were selected through stratified random sampling method for the purpose. Based on the data collected during 2014 and the interviews with the two categories of farmers, the study reveals considerable increase in the grain yield (27.75%), economic returns (27.41%) and knowledge (43.70%) among participant farmers as compared to non-participant farmers. Correlation reveals that among participating farmers age, literacy and extension contract were positively and significantly associated with the improved knowledge about rice production in all districts. In respect of non-participating farmers age, literacy, operational land holding, extension contact and farm diversification were contributing positively and significantly towards improved rice production in all districts. However, among the participating farmers exposure to different media was negatively associated with the improved knowledge in all districts. The results of regression analysis revealed that age, literacy, extension contact, attitude towards farm diversification variables among participating farmers have indeed helped in contributing to farmer's knowledge through FLDs.

Key words: Front Line Demonstration (FLD), yield gap analysis, economics, grain yields, knowledge.

INTRODUCTION

Rice is the staple food of over half of the world's population. It is the predominant dietary energy source for 34 countries in Asia, Pacific, North and South America and Africa. Rice provides 20% of the world's dietary energy supply. It is the most important food crop of the developing world and the staple food for more than 60% of the Indian population (Anomymous, 2012). It is one of the most important food crops of India in term of area, production and preferred food item throughout the country. India is the second largest producer and

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consumer of rice in the world, where production crossed the mark of 100 million MT in 2011-2012, which accounts for 22.81% of global production in that year. India needs to produce 120 million tons by 2030 to feed its one and a half billion plus population (Anonymous, 2013). The scenario needs cutting edge technologies for increasing rice production in India. Although productivity of rice has increased from 1984 kg per hectare in 2004-2005 to 2372 kg ha^{-1} in 2011-2012, due to development of high yielding varieties with site specific technology, but huge technological and extension gaps are constantly being reported, which tantamount to identify causes through indept research.

Front Line Demonstration (FLD) has been used as an useful extension tool to demonstrate HYV along with production, protection and management practices in the farmer's field under different agro-climatic regions and farming situations. The improved cultivation practices followed in the national demonstrations have already shown high yield potentials (Anonymous, 2012). But knowledge behaviour of general farmers towards these practices is not known and hardly any systematic research has done to explore these areas. Therefore, it is very essential to conduct investigation on Front Line Demonstrations on rice to assess their effectiveness and efficacy towards enhancement in yield and knowledge. Hence a research study was planned and conducted with the aim to analyse and assess the impact of FLD rice on yield, economics conditions and knowledge of rice growers in temperate region of Kashmir.

MATERIALS AND METHODS

Study area

The study was carried out in the temperate region of Indian Kashmir (Figure 1), where agriculture is the mainstay of more than 70% of people. This region is rich in rice culture from centuries. Rice crop plays a significant role in livelihood of people, which is the main staple food crop of the state. Rice covers an area of 2.613 lakh ha in this temperate region with annual production of 5.077 lakh tonnes with an average yield of 19.43 qha^{-1} (Anonymous, 2014). With the aim to increase the productivity of rice in this region, number of high yielding varieties together with site specific technologies has been developed to boost rice production in the region. Due to this intervention, number of landraces and traditional rice varieties grown earlier has been phased out by the cultivation of high yielding varieties (HYV). Due to its high yield potential (8 t/ha), Shalimar Rice-1 (SR-1) is one of the HYV adopted by the farmers especially due to its susceptibility to blast particularly IC-17 and ID-1 races, which are prevalent in rice growing areas of this temperate region. Seed replacement rate in the region is estimated to be 32.54% during 2012-2013 (Anonymous, 2014). The variety has already proved worth through state-wise as well as national FLD programmes conducted since its release. SR-1 has shown 128% increase in the yield in Andhra Pradesh with grain yield of 7.67 q/ha (Anonymous 2012). During 2005, SR-1 has recorded grain yield of 7.5 q/ha against local check of 4.5 q/ha in Kashmir, which reflects potentials well as huge yield gaps. These yield gaps are attributed to lack of awareness among the farming community regarding improved cultivation practice of rice (Singha and Baruah, 2011).

Data collection and sampling techniques used

The study was conducted in four rice productive districts viz., Anantnag, Budgam, Ganderbal and Kulgam of Jammu and Kashmir, in which 240 participants and 240 non-participants of FLD programme, comprising of 12 farmer respondents each from 5 representative villages were selected through stratified random sampling method. The participant farmers constitute those farmers who participated in the FLD rice production technologies by respective Krishi Vigyan Kendra's (Farm Science Centres) during 2007-2012. Yield and economic data of FLDs and farmers practices were collected and analyzed using different parameters as suggested by (Yadav et al., 2004; Sengupta, 1967). Level of knowledge amongst respondent farmers was calculated based on Client Satisfaction Index developed by (Kumaran and Vijayaragavan, 2005) with little modifications to adjust package of practice for rice as recommended by SKUAST (K). Based on thorough discussions with the experts and review of relevant literature, a total of 18 independent variables comprising of socio-personal, socio-economic, psychological, communication and extension system variables, having some bearing on the dependent variables were identified for inclusion in the study. The independent variables represented age (AGE), literacy (LIT), family size (FSZ), occupation (OCP), farm equipments (FIM), operational land holding (OLH), socio economic status (SES), innovative proneness (INP), achievement motivation (AMT), scientific orientation (SOT), social participation (SPT), cosmos-politeness (CPN), extension contact (EXC), exposure to mass media (EDM) and attitude towards farm diversification(AFD) were empirically measured by procedures evolved for the purpose using appropriate scales and scoring procedures developed by earlier researchers. The data was collected through personal interviews and analysed using R Software.

Analytical tools used

Data analysis was carried out by employing appropriate statistical packages. However, below mentioned formulae were used to analyse yield-gaps and economic returns:

$$\text{Extension gap} = \text{yield through demonstration} - \text{Farmers' practice yield}$$

$$\text{Effective gain} = \text{Additional return} - \text{Additional cost}$$

$$\text{Technology gap} = \text{Potential yield of variety} - \text{Demonstration yield}$$

$$\text{Additional return} = \text{Returns through FLDs} - \text{Returns through Famer's practice}$$

$$\text{Incremental B : C ratio} = \text{Additional return} / \text{Additional cost}$$

$$\text{Technology index} = \text{Demonstration yield}) / \text{Potential yield}) \times 100$$

RESULTS AND DISCUSSION

Grain yield

The increase in grain yield under Front Line Demonstrations was 19.25% (Kulgam) to 35.61% (Ganderbal) than farmers practice with mean average of 27.75%. Maximum and minimum yield was recorded in

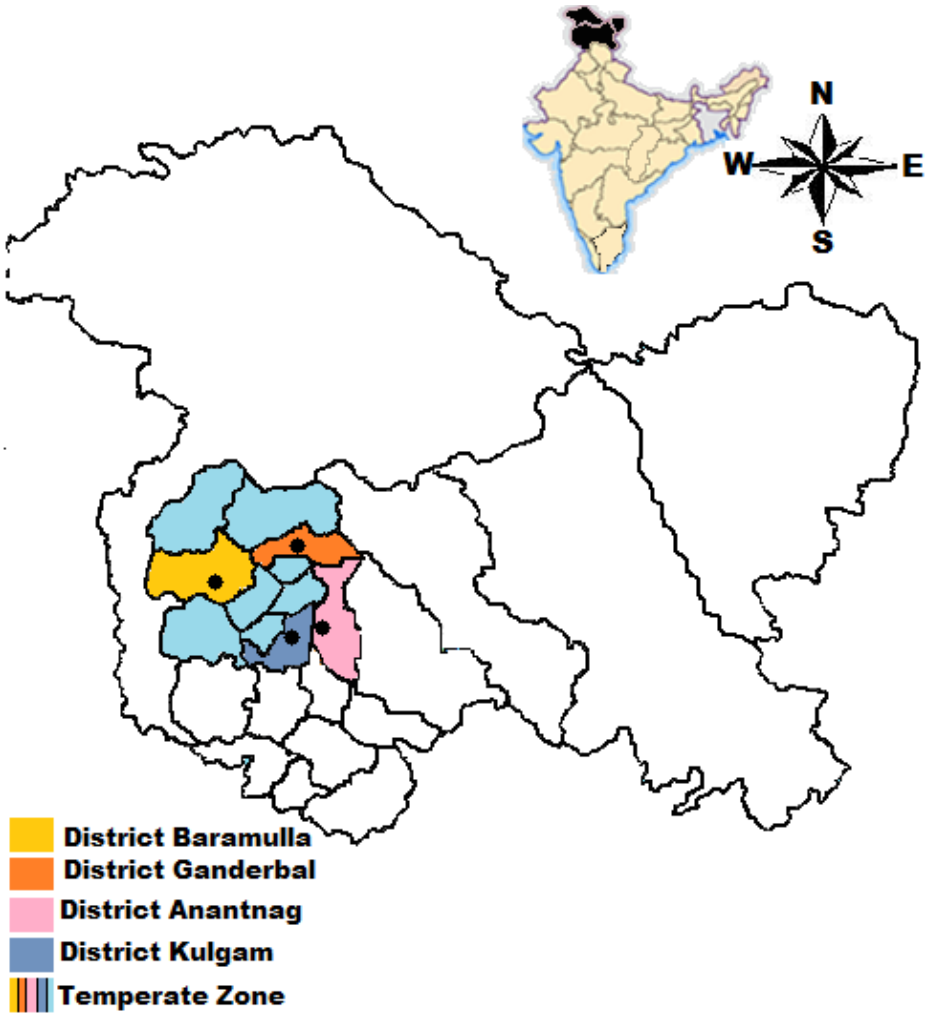

Figure 1. Study area.

Kulgam (56.25 q/ha) and Baramulla (46.92 q/ha) respectively under demonstrations with average demonstration yield of 63.69 q/ha using improved cultivation technology as compared to average yield of 49.99 q/ha using farmers practice (Table 1). Similar yield enhancement in different crops in front line demonstration has amply been documented by (Haque, 2000; Sagar and Chandra, 2003; Singh et al, 2007; Mishra et al., 2009; Kumar *et al.,* 2010; Sheikh et al., 2013; Singh and Sharma, 2004).

Gap analysis

Average extension gap (EG) was 13.70 q/ha which was highest in Ganderbal (16.75%) and lowest in Kulgam 10.83%. Wide technology gaps (TG) were observed in all the districts with average TG of 16.31 q/ha (Table 1). The difference in technology gap during different years could be due to more feasibility of recommended technologies in different districts and variability in climatic conditions. Similarly, the technology index for all the demonstrations were in accordance with technology gap. Higher technology index reflected the insufficient extension services for transfer of technology. The results are in conformance with (Girish et al., 2011).

Economic analysis

Different variables like seed, labour, fertilizers, bio fertilizers and pesticides were considered as cash inputs for the demonstrations as well as farmers practice. An additional average investment of Rs.8046.50/ha resulted effective gain of Rs.29635.75/ha with IBCR of 3.66 (Table 2). Therefore, it can be concluded that FLDs have enhanced the overall grain yield with additional returns as compared to farmers practice. The results confirm the

Table 1. Yield and gap analysis of FLD on Rice at farmers field.

District	No. of demonstrations	Area (ha)	Grain yield (q/ha)		Yield Increase (%)	Extension gap (q/ha)	Technology gap (q/ha)	Technology index
			Participating farmer	Non-participating farmer				
Kulgam	60	24	67.08	56.25	19.25	10.83	12.92	19.26
Anantnag	60	24	65.57	49.75	31.79	15.82	14.43	22.01
Ganderbal	60	24	63.78	47.03	35.61	16.75	16.22	25.43
Baramulla	60	24	58.33	46.92	24.33	11.41	21.67	37.15
Average	60	24	63.69	49.99	27.75	13.70	16.31	25.96

Potential yield of SR-1= 80 q/ha.

Table 2. Economic analysis of front line demonstrations on rice at farmers field.

District	Cost of cash input (Rs./ha)		Additional cost in demonstrations	Sale price of grain (MSP)	Total returns (ha)		Extra returns	Effective gain	IBCR
	FP	Demo	(Rs./ha)	(Rs./qt)	FP	Demo			
Kulgam	45700	52660	6960	2750	184470	154688	29783	22823	3.28
Anantnag	42241	50602	8361	2750	180318	136813	43505	35144	4.20
Ganderbal	47392	55948	8556	2750	175395	129333	46063	37507	4.38
Baramulla	46563	54872	8309	2750	160408	129030	31378	23069	2.78
Average	45474	53520.5	8046.5	2750	175147.8	137466	37682.25	29635.75	3.66

IBCR = Incremental Benefit: Cost ratio; FP = Farmers practice. Demo, demonstrations.

findings of FLDs on Rice by Lathwal (2010) and Dayanand et al. (2011).

Knowledge about improved rice production practices

Knowledge level of respondent farmers on different parameters of improved rice production technologies were measured and compared by applying dependent‘t’ test. It could be seen from the Table 3 that participant farmer’s knowledge was found in the range of medium to high as compared to low to high in non-participating farmers. Among participating farmers maximum farmers (55%) in district Kulgam had highest level of knowledge followed by 46% in Ganderbal. Minimum knowledge level (28.3%) was recorded in district Anantnag amongst participating farmers. In respect of non-participating farmers, maximum (41.8%) farmers from district Anantnag had low level of knowledge. The results are at par with (Singh and Sharma, 2004) and (Singh et al., 2007). It means there was significant increase in knowledge level of the farmers due to frontline demonstration. This shows positive impact of frontline demonstration on knowledge of the farmers. The results so arrived might be due to the concentrated efforts made by the field functionaries.

Correlates of knowledge levels of improved practices of rice

In order to highlight the factors which are related to knowledge levels of improved practices of rice, co-relation analysis was carried out between selected variables of farmers and their knowledge behaviour using statistical package ‘R Software’ and the correlation coefficients are given in Table 4.

From correlation coefficients, it is clear that the age, literacy, operational land holding, extension contact, social participation, achievement motivation and attitude towards land diversification were significant and positive bearing on the knowledge levels of participating farmers towards improved practices. However, negative influence was showed by ‘exposure to different media’ variable. Negative influence of participating farmers about knowledge may be due to media usage for entertainment and personal ambitions. These results implied that high levels of knowledge holders of improved practice of rice would be educated farmers having good extension contact, ability to diversify farms and frequent social participation. Hence educated participant farmers had higher knowledge about improved practices. The results are similar to those of Amol (2006), (Ankulwar et al. (2001) and Singh et al. (2010).

Table 3. Knowledge level comparison between farmers about improved practices.

	Anantnag				Kulgam				Ganderbal				Baramulla			
	PF (N=60)		NPF (N=60)		PF (N=60)		NPF (N=60)		PF (N=60)		NPF (N=60)		PF (N=60)		NPF (N=60)	
Mean (%)	69.26		24.07		77.22		24.81		65.56		24.26		59.44		23.52	
Standard deviation	13.78		16.13		13.94		14.23		18.94		13.49		16.34		13.43	
Range	55.56-88.89		11.11-66.67		55.56-88.89		11.11-66.67		44.44-88.89		11.11-55.56		44.44-88.89		11.11-55.56	
Category	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No**	**%**	**No.**	**%**	**No**	**%**
Low (<Mean - SD)	-	-	25	41.8	-	-	19	31.7	-	-	19	31.7	-	-	22	36.7
Medium (between mean ± SD)	43	71.7	19	31.7	27	45.0	24	40.0	32	53.3	25	41.7	39	65.0	22	36.7
High (> mean + SD)	17	28.3	16	26.7	33	55.0	17	28.3	28	46.7	16	26.7	21	35.0	16	26.7

Table 4. Correlation coefficients of knowledge levels of improved rice production amongst farmers**.**

Variables	Correlation coefficient							
	Participating farmers (N=240)				Non-participating farmers(N=240)			
	Anantnag	Baramulla	Ganderbal	Kulgam	Anantnag	Baramulla	Ganderbal	Kulgam
AGE	0.622*	0.499*	0.379*	0.513*	0.346*	0.425*	0.334*	0.428*
LIT	0.313*	0.423*	0.351*	0.058	0.372*	0.372*	0.374*	0.436*
FSZ	-0.201*	-0.124	-0.086	0.106	0.053	-0.098	0.202	0.041
OLH	*0.190	0.339*	0.308*	0.430*	0.099	0.259*	0.289*	0.053
FIM	-0.112	0.025	0.175	-0.253*	0.033	0.078	0.066	0.179*
SES	-0.056	0.043	0.257*	-0.052	0.221*	-0.250*	0.006	-0.140
OCP	0.030	-0.075	0.108	0.016	0.093	-0.148	0.002	-0.040
AMT	-0.002	0.251*	0.251*	-0.228*	0.150	0.104	0.179	-0.067
IPN	-0.126	0.074	0.111	0.064	-0.213*	-0.019	-0.063	-0.049
CPN	0.009	0.022	0.023	-0.011	-0.015	-0.021	0.067	0.133
SOT	0.126	-0.470*	-0.303*	0.071	-0.231*	-0.431*	0.040	-0.011
SPT	0.130*	0.299*	0.310*	-0.019	-0.151	-0.122	0.198	-0.327*
EXC	0.394*	0.506*	0.396*	0.439*	0.218*	0.623*	0.308*	0.361*
EDM	-0.160*	-0.507*	-0.269*	-0.534*	0.032	0.139	-0.075	0.131
AFD	0.397*	0.499*	0.470*	0.479*	0.127	0.148	0.054	-0.028

*Significant at 0.05 level of probability.

Regression analysis

In order to assess the contribution of various independent variables to the variation in the knowledge level amongst respondent farmers, regression analysis of the dependent variable was done. A regression equation was fitted with the dependent variable of knowledge level scores of improved practices of rice and fifteen independent

Table 5. Regression coefficients of knowledge levels of farmers.

Variables	Regression coefficient							
	Participating farmers (N=240)				Non-participating farmers(N=240)			
	Anantnag	Baramulla	Ganderbal	Kulgam	Anantnag	Baramulla	Ganderbal	Kulgam
Constant	7.066	4.660	2.85*3	4.639	0.257	0.305	-0.498	1.073
AGE	3.996*	0.436	0.872	2.183*	2.726*	0.794*	1.923*	1.054*
LIT	2.776*	2.319*	1.069	0.595	2.970*	1.900*	1.996*	4.096*
FSZ	-1.099	-0.862	0.113	0.528	1.190	-0.211	1.767*	-0.343
OLH	1.469	2.107*	0.843	1.929*	1.321	1.447	0.795	-0.386
FIM	-1.793	-0.755	2.069*	-0.516	0.097	0.176	0.062	-0.409
SES	-1.280	-0.807	2.115*	1.279	0.339	-1.521	0.395	0.137
OCP	1.479	0.524	0.342	1.192	0.445	-0.431	0.642	-1.549
AMT	-1.193	-0.048	0.319	-1.312	-0.504	0.429	0.672	-0.074
IPN	-0.488	-0.910	-0.012	0.764	-1.801	1.198	-0.492	-0.742
CPN	-0.679	1.209	-1.216	0.737	0.237	-0.011	0.126	1.266
SOT	0.835	-1.152	-1.244	-0.217	-2.288*	-0.879	0.215	-0.741
SPT	-0.755	1.275	-0.846	-0.469	-0.179	-0.782	1.342	-2.708*
EXC	2.267*	2.040*	2.410*	2.534*	0.563	4.402	1.77*9	3.607*
EDM	-2.176*	-2.174*	-2.333*	-1.934*	1.242	0.290	-0.802	1.454
AFD	1.952*	3.392*	*2.415	2.070*	-0.557	0.902	1.048	-0.594
R	0.815	0.832	0.764	0.794	0.664	0.776	0.638	0.758
R^2	0.664	0.692	0.584	0.630	0.441	0.603	0.407	0.575
F	5.80**	6.61**	6.68**	5.00**	2.32	4.46	2.02	3.98

*Significant at 0.05 level of probability; ** significant at 0.01 level of probability.

variables. The results of the analysis are presented in Table 5.

A perusal of the results presented in Table 5 indicates that about 22, 9, 18 and 6% variation between participant farmers and non-participant farmers in Anantnag, Baramulla, Ganderbal and Kulgam respectively exists with respect to knowledge of improved rice production practices, which were explained by the independent variables included in the regression equation. Among participating farmers F value had significant 0.01 level of probability throughout the study area. This indicates that the independent variables included in the study were appropriate as they could explain large variance in the dependent variable. Also a cursory look at the table reveals that only five variables viz., age, literacy, extension contact and farm diversification could contribute significantly to the variance and predicting different knowledge levels of improved Rice production practices amongst participant farmers. Moreover, among non-participating farmers only age and literacy was found to contribute significantly. Thus it can be concluded that FLD on Rice has greatly influenced on the knowledge of the participant farmers than non-participant farmers.

Conclusion

Concept of FLD has been instrumental in enhancing yield to the extent of 27.75% with IBCR of 3.66, which is very encouraging. However extension and technology gap of 13.70 and 16.31 q/ha respectively exists still, due to low to medium knowledge levels of improved production practices among majority farmers. Indeed knowledge dissemination through FLD programme has increased level of knowledge among participant farmers as compared to non-participant farmers to a significant level. This shows positive impact of frontline demonstration on yield and knowledge of the farmers. The results so arrived might be due to the concentrated efforts made by the field functionaries. The results of regression analysis revealed that FLD programme has helped in contributing to enhancement of improved rice production technology. This can be seen as a positive indicator for formulating an objective specific and extensive FLD programme to train and educate farmers about improved rice production practices through ‘working by doing’ and ‘doing by learning’ for ensured higher Rice production in the region.

Conflict of Interest

The authors have not declared any conflict of interest.

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