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Research Article

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An Impact Assessment of Front Line Demonstrations on Yield and Economics of Finger Millet and Barnyard Millet under Rainfed Conditions of Uttarakhand

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ABSTRACT

Small millets are more nutritious and have a lower glycemic index than rice and wheat, but factors like lack of improved varieties, agronomical packages and practices as well as unorganized seed system are constraining production and productivity. Therefore, the present study was carried out to know the yield gaps between improved practices and farmers' practices under Front Line Demonstrations (FLDs) of finger millet and barnyard millet crops under rainfed conditions of Tehri Garhwal and Uttarkashi Districts of Uttarakhand. A total of 1,123 farmers were selected for frontline demonstrations in both the Districts, of which 80 ha land was covered by high yielding finger millet (PRM-2) and barnyard millet (PRJ-1) varieties over the last five years. The conducted FLDs made a very positive and significant impact on grain as well as on fodder yield of finger millet that ranged from 26.75 to 32.65 per cent and 23.18 to 29.27 per cent overall increase respectively while in barnyard millet, 36.50 to 42.17 per cent and 29.60 to 35.80 per cent overall increase in grain and fodder yield respectively was recorded during the last five years. The higher technological gap (5.63 to 8.81 qtl/ha), extension gap (4.82 to 8.25 qtl/ha) and technological index (23.46 to 40.05 %) in both the crops indicating that there is an urgent need of dissemination of location specific suitable package of practices. The data revealed that the conducted FLDs also enhanced the farmer's income by increasing B:C ratio that ranged from 1.25 to 1.48 in both the crops. The impact of such demonstrations are quite strong as it is also visible from the fact that barnyard millet variety PRJ-1 has been one of the most accepted varieties by farmers of Uttarakhand for the last more than ten years and has been constantly under FLD programme since its release in year 2003 on farmers' demand.

Key words: *Small millets, Frontline demonstration, Technology gap, Extension gap, B:C ratio*

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INTRODUCTION

The environmental, social and economic challenges of 21st century like climate changes, water scarcity, increasing world population, rising food prices, and other socio-economic impacts are expected to generate a great threat to agriculture and food security worldwide, especially for the poorest people who live in arid and sub-arid regions as stated by Saleh *et al*.[7], therefore, there is need of alternative crops that can resist changing environmental condition and provide nutritive food source. Ushakumari *et al*.[12] stated that the millets are considered as crop of food security because of their sustainability in adverse agro-climatic conditions. Small millets are small sized grains and grown in different regions of the world form east to west because they share a set of characteristics which make them unique amongst cereals due to their productivity and short growing season under dry, high-temperature conditions and can survive in areas with as little as 300 mm or less of seasonal rainfall.

Upadhyaya *et al*.[13] stated that the small millets are under-utilized crops and continued to be neglected in terms of support for production, promotion, research and development. Their presence in the food basket has been declining over the years. One of the main reasons for this decline is the increased availability of other staple and commercial crops such as rice, wheat, maize, *etc.* as a result small millets are in a situation of crisis in India because a dramatic decrease from 1960 to 2009 in cultivated area (80% for small millets, 46% for finger millet); 76 per cent decrease in total production of small millets which caused significant reduction in per capita availability of all millets (despite high productivity gains for some varieties); and a steep fall in overall millets consumption.

Small millets occupy an important place in the agriculture of the Uttarakhand especially in hilly regions. Apart from being a source of food, they provide fodder for cattle which thereby reduces the pressure on grazing fields and forests and helps to balance the delicate ecosystem in the Himalayas. Small millets are grown up to an altitude of 3000 m above sea level in both pure and mixed stands and under Jhuming (shifting) cultivation. But the productivity per unit area is low as compared to other small millets growing areas. Major production constraints include the low yield of existing varieties, poor seed quality and lack of access to improved varieties by farmers. Moreover, poor agronomic practices such as higher seed rate, faulty nutrient management and negligence of plant protection measures are responsible for low productivity. However, the demands of small millet and their product increasing day-by-day due to their nutritional values in national as well as international market. Therefore, to increase the farmer's field productivity, a modern concept was formulated by agricultural scientist called "frontline demonstration" with the objective to demonstrate newly released high yielding varieties, crop production and protection technologies and management practices at farmer's fields under different farming situations. While demonstrating the technologies in the farmer's fields, the scientists are required to study the various factors contributing higher crop yield, constraints in field production and thereby required to generate production data and feedback information. Keeping these in view, frontline demonstration of improved high yielding varieties with the thematic area to replace local seeds with high yielding improved variety seed on finger millet and barnyard millet were conducted to enhance the seed replacement rate, productivity, economic returns and also convincing the farmers for adoption of newly developed high yielding varieties in small millets.

MATERIAL AND METHODS

The frontline demonstration was carried out under ICAR- All India Coordinated Research Project on Small Millets (AICRPSM), Ranichauri, Tehri Garhwal, Uttarakhand from 2013 to 2017 during *Kharif* seasons. Before conducting the FLDs, meetings with farmers, surveys and diagnostic visits were under taken for selection of the farmers and villages and after that an orientation training programme was imparted to the beneficiaries related to crop under demonstration. A total of 1,123 farmers were selected for frontline demonstrations in District Tehri Garhwal and Uttarkashi, of which 80 ha land was covered by high yielding finger millet and barnyard millet varieties during the five years. The quality seeds of finger millet variety PRM-2 and Barnyard millet variety PRJ-1 were distributed to the selected farmers under FLDs in the month of April and May every year. During the FLDs from sowing to harvesting, frequent monitoring was carried out to monitor the adopted package of practices, timely sowing, effective plant protection and weed management in both the practices (farmer's practice and improved practice) to keep all the remaining input same except seed. The average yield of each FLD and farmer's practice, cost of cultivation, gross return, net return and benefit cost ratio (B:C ratio) was taken for subsequent five years for interpretation of the results. The extension gap, technology gap and technology index were calculated using the following formula as suggested by Samui *et al.*[8]

$$\textbf{Technology index} = \frac{\text{Potential yield} - \text{Demonstration yield}}{\text{Potential yield}} \times 100$$

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

$$\textbf{Extension gap} = \text{Demonstration yield} - \text{Yield under farmer's practices}$$

$$\textbf{B:C ratio} = \frac{\text{Net income (Rs./ha)}}{\text{Cost of cultivation (Rs./ha)}}$$

$$\textbf{\% increase over farmer's practices} = \frac{\text{Improved practices} - \text{Farmer's practices}}{\text{Farmer's practices}} \times 100$$

RESULTS AND DISCUSSION

Production constraints of small millet

Finger millet and barnyard millet ranks second and third respectively in terms of area after rice during *Kharif* season in hilly area of Uttarakhand. During the FLDs, the problems faced by farmers in small millet production were documented and the perusal data is presented in Table 1. The major problems faced by farmers are wild animal damage (86.67 %) that causes the huge losses of crops followed by lack of high yielding varieties (81.17 %), timely availability of quality seeds (78.33 %), marketing (76.33 %), low technical knowledge (74.78 %), use of higher seed rate (71.50 %) while diseases like grain smut in barnyard millet and Cercospora leaf spot in finger millet also observed by farmers (41.67 %) as a major grain production constraint followed by insect (21.17 %). However the other production constraints observed during FLDs are limited possibility of mechanization to reduce the drudgery associated with production and post-harvest operations, food of marginalized communities, although it is consumed by the majority of households in the mid and high hills regions in varying quantity, irrespective of ethnicity and lack of awareness on the nutrient composition and value of small millets on human health; consequently there is a low rate of consumption especially among the younger generation. Singh[9] also conducted a frontline demonstration on wheat in Rudraprayag District of Uttarakhand and reported almost similar production constraints. Dhruw *et al.*[4] has also reported similar constraints in maize.

Table 1: List of production constraints and their rank given by farmers

Sl. No.	Major constraints	Percentage	Rank
1	Damage by wild animals	86.67	I
2	Lack of high yielding varieties	81.17	II
3	Timely availability of quality seeds	78.33	III
4	Marketing	76.33	IV
5	Low technical knowledge	74.78	V
6	Use of higher seed rate	71.50	VI
7	Diseases of small millets	41.67	VII
8	Insect-pests of small millets	21.17	VIII

Grain and fodder yield

Grain and fodder yield of barnyard millet and finger millet under improved practices and farmers' practices are presented in the Table 2 and Table 3, which clearly elucidated that the use of high yielding varieties helping for boosting the productivity of finger millet as well as barnyard millet under rainfed conditions of Uttarakhand. The average grain yield of barnyard millet under improved practices ranged from 16.19 to 18.37 qtl/ha which is 36.50 to 42.17 per cent higher than farmers' practices while, fodder yield varied from 44.79 to 47.35 qtl/ha with an 29.60 to 35.80 per cent enhancement over farmers' practices. Similar trends were also recorded in finger millet, which showed 26.75 to 32.65 per cent grain yield and 23.18 to 29.27 per cent fodder yield advantage over farmers' practices during five years. Thakur *et al.*[11] reported 140.12 per cent higher grain yield of finger millet under improved practices than farmers' practices whereas, 53.5 to 61.3 per cent higher yield in finger millet and 53.5 to 101.8 per cent more yield of barnyard millet under improved variety over local variety was recorded by Yadav and Yadav[15] in Himalayan hills.

Technology gap

The average technological gap for grain yield in barnyard millet ranged from 6.63 to 8.81 qtl/ha and 5.63 to 7.81 qtl/ha in finger millet over the five years while fodder yield varied from 32.65 to 35.21 qtl/ha in barnyard millet and 27.65 to 30.21 qtl/ha in finger millet (Table 2 & 3). The higher technological gap may be attributed mainly due to the uneven distribution of rainfall, variations in soil fertility and cultivation on marginal lands and local specific crop management problems faced in order to harness the yield potential of specific crop cultivars under demonstration plots. The average technology gap 9.91 qtl/ha for finger millet was reported by Thakur *et al.*[11], Dhaka *et al.*[3] in maize and Joshi *et al.*[6] in wheat. Vedna *et al.*[14] stated that the location specific crop management is the need of hour to bridge down the gap in potential and demonstration yields.

Table 2: Impact of improved and farmers' practices on grain yield of barnyard millet under front line demonstration

Years	Area (ha)	No. of FLD	Grain Yield (qtl/ha)			Fodder yield (qtl/ha)			Grain Yield			Fodder yield		
			I.P.	F. P.	%	I.P.	F. P.	%	TG (qtl/ha)	EG (qtl/ha)	TI (%)	TG (qtl/ha)	EG (qtl/ha)	TI (%)
2013	**5.00**	**75**	18.37	10.12	42.17	46.68	29.07	35.26	6.63	8.25	30.14	33.32	17.61	41.65
2014	**5.00**	**75**	17.08	10.14	38.15	45.26	28.57	32.45	7.92	6.94	36.00	34.74	16.69	43.43
2015	**10.00**	**151**	16.19	10.59	40.51	44.79	32.52	29.60	8.81	5.60	40.05	35.21	12.27	44.01
2016	**10.00**	**151**	18.02	11.75	36.50	47.35	31.00	35.80	6.98	6.27	31.73	32.65	16.35	40.81
2017	**10.00**	**151**	17.66	10.01	41.25	46.42	32.48	31.10	7.34	7.65	33.36	33.58	13.94	41.98

I.P. = Improved Practices, F.I.= Farmers' Practices, T.G.= Technology Gap, E.G.= Extension Gap and T.I. = Technology Index

Table 3: Impact of improved and farmers' practices on grain yield of finger millet under front line demonstration

Years	Area (ha)	No. of FLD	Grain Yield (qtl/ha)			Fodder yield (qtl/ha)			Grain Yield			Fodder yield		
			I.P.	F. P.	%	I.P.	F. P.	%	TG (qtl/ha)	EG (qtl/ha)	TI (%)	TG (qtl/ha)	EG (qtl/ha)	TI (%)
2013	**5.00**	**65**	18.37	13.12	28.60	46.68	35.17	24.65	5.63	5.25	23.46	28.32	11.51	37.76
2014	**5.00**	**65**	17.08	11.87	30.50	45.26	32.01	29.27	6.92	5.21	28.83	29.74	13.25	39.65
2015	**10.00**	**130**	16.19	10.90	32.65	44.79	32.67	27.05	7.81	5.29	32.54	30.21	12.12	40.28
2016	**10.00**	**130**	18.02	13.20	26.75	47.35	36.37	23.18	5.98	4.82	24.92	27.65	10.98	36.87
2017	**10.00**	**130**	17.66	12.58	28.75	46.42	33.85	27.08	6.34	5.08	26.42	28.58	12.57	38.11

I.P. = Improved Practices, F.I.= Farmers' Practices, T.G.= Technology Gap, E.G.= Extension Gap and T.I. = Technology Index

Extension gap

The average extension grain yield gap for barnyard millet was calculated 5.60 to 8.25 qtl/ha while extension grain yield gap for finger millet ranged 4.82 to 5.29 qtl/ha over five years. However, fodder yield showed higher extension yield gap in both the crops that varied from 12.27 to 17.61 qtl/ha in barnyard millet and 10.98 to 13.25 qtl/ha in finger millet. The higher extension yield gap due to lack of awareness for the adoption of improved farm technologies by the farmers indicating that there is a strong need to aware and motivate the farmers for adoption of improved farm technologies in finger millet and barnyard millet over existing local practices. Choudhary *et al.*[2] argued that the refinement in the local farmers' practices for higher adoption of location specific generated farm technology for sustaining crop productivity is another option open for the research scientists whereas, the successful development, dissemination and adoption of improved technologies for small-holders depend on more than careful planning of research and the use of appropriate methodologies in extension as stated by Biggs and Smith[1].

Technology index

The average technology index was quite higher in both the crops over five years as indicated by Table 2 & 3. The technology index calculated for barnyard millet showed higher value that ranged from 30.14 to 40.05 per cent for grain yield while 40.81 to 44.01 per cent technology index was calculated for fodder yield. However, similar trend were also observed in finger millet that varied from 24.92 to 28.83 per cent for grain yield and 36.87 to 40.28 per cent for fodder yield over the five years under rainfed conditions. Poor field establishment at early vegetative stage due to water stress under rainfed farming with uneven rainfall distribution, long dry spell and increasing pressure of diseases and insect pests are the possible reason for poor yields causing higher technology index in both the crops. Technology index indicates the feasibility of generated farm technologies in the farmers' fields under existing agro-climatic conditions as stated by Vedna *et al.*[14] and Choudhary *et al.*[2]. Lower the technology index, higher is the feasibility of generated farm technology under farmers' fields and vice-versa. Similar results were also reported by Jeengar *et al.*[5] in maize and Singh *et al.*[10] in mustard.

Economics analysis

Highest gross returns with 46,731.30 Rs./ha, net returns with 25,390.22 Rs./ha and B:C ratio with 1.48 were calculated under improved practices while under farmers' practices highest gross returns with 44651.30 Rs./ha, net returns with 24,300.22Rs./ha and B:C ratio with 1.30 were observed across the years for barnyard millet (Table 4).

Table 4: Economic analysis of barnyard millet under frontline demonstration

Year	Area (ha)	No of FLDs	Gross Returns Rs./ha		Net Returns Rs./ha		B:C ratio	
			I.P.	F.P.	I.P.	F.P.	I.P.	F.P.
2013	**5.00**	**75**	44786.40	42706.40	22856.75	21766.75	1.38	1.18
2014	**5.00**	**75**	43441.55	41361.55	21770.89	20680.89	1.31	1.13
2015	**10.00**	**151**	45465.77	43385.77	24670.22	23580.22	1.48	1.30
2016	**10.00**	**151**	46731.30	44651.30	25390.22	24300.22	1.29	1.15
2017	**10.00**	**151**	45826.32	43746.32	25056.18	23966.18	1.35	1.17

I.P. = Improved Practices and F.I. = Farmers' Practices

Table 5: Economic analysis of finger millet under frontline demonstration

Year	Area (ha)	No of FLDs	Gross Returns Rs./ha		Net Returns Rs./ha		B:C ratio	
			I.P.	F.P.	I.P.	F.P.	I.P.	F.P.
2013	**5.00**	**65**	44331.98	41322.98	24980.51	21890.51	1.32	1.17
2014	**5.00**	**65**	43948.36	40939.36	24567.35	21477.35	1.29	1.12
2015	**10.00**	**130**	42798.98	39789.98	23377.90	20287.90	1.25	1.11
2016	**10.00**	**130**	47696.81	44687.81	27089.55	23999.55	1.38	1.16
2017	**10.00**	**130**	46922.18	43913.18	26130.85	23040.85	1.33	1.19

I.P. = Improved Practices and F.I. = Farmers' Practices

Whereas, finger millet gross returns under improved practices ranged from 42,798.98 to 47,696.81 Rs./ha followed by net returns (23,377.90 to 27,089.55 Rs./ha) and B:C ratio (1.25 to 1.38) while gross returns under farmers practices varied from 39,789.98 to 44,687.81 Rs./ha, net returns 20,287.90 to 23,999.55 Rs./ha and B:C ratio 1.11 to 1.19 (Table 5). The variations between the years in the economic returns may be attributed to the variable performance of respective crops in terms of grain yield under improved practices in frontline demonstration. Higher returns and B:C ratio under improved practices in frontline demonstration was also reported by Thakur *et al.*[11], in finger millet crop, similarly higher net returns and B:C ratio in the FLDs on improved technologies compared to the farmers practices reported by Joshi *et al.*[6] in wheat.

CONCLUSION

The grain as well as fodder yield under improved practices was recorded higher than the farmers' practices, which not only increased the yield per unit area but also enhanced the farmers' income. However, a wide gap in potential yields, demonstration yields and farmers plot yields under both the crops due to technological and extension gaps indicating that there is a need of proper dissemination of location specific technologies imbedded with high yielding varieties to improve productivity and profitability of rainfed farming of Uttarakhand.

REFERENCES

1. Biggs, S.D. and Smith, G., Beyond methodologies: Coalitionbuilding for participatory technology development. *World Dev*. **26:** 239-248 (1998).
2. Choudhary, A.K., Yadav, D.S. and Singh, A., Technological and extension yield gaps in oilseeds in Mandi district of Himachal Pradesh. *Ind. J. Soil Cons*., **37(3):** 224-229 (2009b).
3. Dhaka, B.L., Meena, B.S. and Suwalka, R.L., Popularization of improved maize production technology through frontline demonstrations in south-eastern Rajasthan. *J. Agril. Sci.* **1(1):** 39-42 (2010).
4. Dhruw, K.S., Sengar, R.S. and Yadav, K.N., Level of knowledge and adoption about recommended maize production technology. *Agril. Update* **7(3&4):** 311-315 (2012).

5. Jeengar, K.L., Panwar, P. And Pareek, O.P., Front line demonstration on maize in Bhilwada district of Rajasthan. *Current Agriculture*, **30(1/2):** 115-116 (2006).
6. Joshi, N.S., Bariya, M.K. and Kunjadia, B.B., Yield gap analysis through front line demonstrations in wheat crop. *International J. Scientific Res. Pub*. **4(9):** 1-3 (2014).
7. Saleh, A. S., Zhang, Q., Chen J. and Shen Q., Millet Grains: Nutritional Quality, Processing, and Potential Health Benefits. *Comprehensive Reviews in Food Science and Food Safety,* **12:** 281-295 (2013).
8. Samui, S.K., Mitra, S., Roy, D.K., Mandal, A.K. and Saha, D., Evaluation of front line demonstration on groundnut. *J. Indian Soc. Coastal Agric. Res.,* **18(2):** 180-183 (2000).
9. Singh, S. B., Impact of frontline demonstrations on yield of wheat *(Triticum aestivum*) under rain fed condition in Uttarakhand. *Inter. J. Sci., Envi. Technol*. **6(1):** 779 – 786 (2017).
10. Singh, S.N., Singh, V.K., Singh, R.K. and Singh R. K., Evaluation of on-farm frontline demonstrations on the yield of mustard in Central Plain Zone of Uttar Pradesh. *Indian Res. J.Ext.Edu.* **7(2&3):** 79-81 (2007).
11. Thakur, A. K., Kumar P. and Yadav, S. C., Impact of Front Line Demostration (FLD) on the Yield and Economics of Small Millet on Bastar District of Chhattisgarh, India. *Int.J.Curr.Microbiol.App.Sci*. **6(9):** 1489-1497 (2017).
12. Ushakumari, S. R., Shrikantan, L. and Malleshi N. G., The functional properties of popped, flaked, extruded and roller dried foxtail millet (*Setaria italica*). *Inter. J. Food Sci. Technol.* **39:** 907-915 (2004).
13. Upadhyaya, H. D., Vetriventhan, M., Dwivedi, S. L., Pattanashetti, S. K. and Singh, S. K., Proso, barnyard, little and kodo millets. *In:*Mohar Singh and HD Upadhyaya (*eds*) Genetic and Genomic Resources for Grain Cereals Improvement. Oxford: Academic Press, Elsevier, pp 321-343 (2015).
14. Vedna, K., Kumar, A., Kumar, A. and Bhateria, S., Demonstration - an effective tool for increasing productivity of rapeseed- mustard in Kangra district of Himachal Pradesh. *Himachal J. Agril. Res.* **33(2):** 257-261 (2007).
15. Yadav, R. and Yadav, V. P., Harnessing productivity potential of small millets in Himalayan Hills. *Indian Res. J. Ext. Edu*. **9(1):** 62-64 (2009).