Indian Journal of Agricultural Sciences **90** (3): 650–8, March 2020/Article

Impact of scientist-farmer interface in rainfed agro-ecosystem of North West Himalayan region: A case of Farmer FIRST Project in Doon Valley

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Received: 18 December 2019; Accepted: 24 February, 2020

ABSTRACT

In North West Himalayan region, farmers tend to face problems related to production and natural resource management due to steep slopes; fragile geology and frequent landslides which leads to high soil erosion. The present study was conducted with the objective to assess the impact of Farmer FIRST Project on the livelihood of beneficiary farmers of study area. A sample of 300 farmers comprising of 180 beneficiary and 120 non-beneficiary farmers were selected through multi stage random sampling. To delineate the impact, with–without and before-after comparison on different aspects of Farmer FIRST Project were carried out. Study revealed that there exists a significant difference between beneficiary farmers and non-beneficiary farmers on various aspects, viz. awareness level, change in decision making behaviour, change in marketing behaviour, change in yield, change in income, change in cropping intensity and change in average annual employment days. Before-after comparison of beneficiary farmers showed that there is a significant increase in crop yield, cultivable area and average annual employment days. Hence, there is a need of upscaling the project for inclusion of more numbers of farmers and securing their livelihood.

Key words: Farmer FIRST Project, Impact, Income, Livelihood, North West Himalayan region, Upscaling

As a source of employment and livelihood, agriculture and allied sectors still remains the leading sector of Indian economy and contributes 17% to the country's gross value added (Annual Report 2016-17, MoA&FW). The slow growth observed in the agriculture sector is causing concerns for the future food and nutritional security of the country. Now a day's various emerging challenges are faced by Indian farmers including inadequate land and water availability, degradation of natural resources, uncertainty of climate, shift in demand and consumption pattern, population explosion and trade liberalization (Lele 2010). More than 86% of Indian farm families are constituted by marginal and small categories of farmers with land holding size of below 1.2 ha (Singh *et al.* 2011). In India 60% of the farmers don't have access to any source of information for modern agricultural technology which can assist them in farming operations (NSSO 2003). Because of declining farm profitability, the farmers are considering agriculture as a secondary occupation which has large scale migration of rural mass to the adjoining towns and cities. There is large yield gap between experimental stations and farmers' field (Mittal 2012). So, there is a need of strengthening agricultural extension and advisory services for transferring research results into tangible benefits at farm level (Babu *et al.* 2012). The diverse nature of Indian subcontinent, due to its varied agro-climatic regions and with its wide range of socio-economic background of rural masses, required specific agricultural extension approaches

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that are context and situation specific (Glendenning *et al.* 2010). Post-independence of India, various approaches of agricultural extension have evolved to reach the farmers but their goals were poorly achieved. India's agricultural extension system played a crucial role during the green revolution in late 1960s, along with Training and Visit (T&V) Extension in the mid-1970s in achieving self-reliance in food grain production but inefficiency of Training and Visit (T&V) Extension system in rainfed areas (Singh 2006) and its unsustainability (Anderson *et al.* 2006), resulted in development of demand driven and participatory extension approaches in which accountability lies with end users of technology (Birner and Anderson 2007, Davis 2008, Kokate *et al.* 2009, Swanson 2009).

In the era of globalization and liberalization, farmers require a vast range of information, not only related to improved packages and technologies for crop production, but also for post harvest technologies and market related information (Sulaiman and Van den Ban 2003). In the current scenario of speedily changing world, agricultural extension has been recognised as an essential mechanism for delivering information and enhancing knowledge about modern agricultural practices to the farmers but in recent times, extension system has undergone a high level of inspection (Sontakki *et al.* 2010, Pal 2008, Joshi *et al.* 2005). Also, in the today's global context, conventional role of agricultural extension system is inadequate (Cho and Boland 2002, Rivera and Zijp 2002). So, time has come to secure livelihood of marginal and small farmers rather than just increasing their agricultural production and for this, there is a need to look beyond agricultural extension to a more inclusive livelihood extension (Farrington *et al.* 2002). For creating a more viable demand-driven technology system, there must be participation of farmers in problem identification, their priorities, implementing on-farm research and extension activities (Rivera *et al.* 2000).

The farmers' perspectives including location specificity of technologies, harmony in the use of natural resources, produce and its post-production treatment for improved marketing and the prerequisite linkages and convergence with different organisations for the entire process is important to address in a holistic manner, such that the farmers are not relegated as mere recipients of technologies, rather are ensured to fully participate as partners in the research-production-marketing process. The active involvement of farmers and other stakeholders in technology assessment will further ensure of the technologies application under real field situations. To cope up with these issues, the *Farmer FIRST* project has been conceived by Division of Agricultural Extension of Indian Council of Agricultural Research (ICAR) to enrich knowledge and integrate technologies in farmer's conditions. The major focus of the project is on farmer centric, enhancing farmer-scientist interaction, creating platform to share tested technologies, strengthening convergence with different stakeholders for ensuring livelihood security. Resource conservation and resource sharing are other important aspects to ensure the sustainable livelihoods. The current situation demands a thorough understanding of household level situations and design interventions based on existing agro-ecosystem and socio-economic consideration. In this context, the present study was undertaken to assess the impact of 'Farmer FIRST' on the livelihood of farmers in the selected hamlets of the North–Western Himalayan region which are predominated by small and marginal farmers' population.

MATERIALS AND METHODS

The study was conducted in the Raipur block of Dehradun district, Uttarakhand state under the Farmers FIRST programme of Indian Council of Agricultural Research. In the first phase, three groups of hamlets, viz. Kotigaon group of hamlets, Sindhwalgaon group of hamlets and Badasi Grant group of hamlets of Raipur block were selected purposively as in this area. There is dominance of rainfed situations, poor access to modern technologies, poor productivity level leading to low marketable surplus in the region. One or more of these reasons shatter the enthusiasm and interest of the farming community in agriculture, which has been one of the main reasons of migration of rural youth to urban and plain areas.

In the second phase, agro-ecosystem analysis using participatory rural appraisal techniques was done to identify the major problems and issues related to agriculture, horticulture, animal husbandry, natural resource management, fisheries, marketing network and existing social organizations. Alternative solutions were discussed during participatory planning process and meetings with the farmers. Accordingly, appropriate interventions were identified and proposed under different technological modules. Apart from this, the scientists of the institute were interacted with the farmers through Field Day, *Gosthi*, Focussed Group Discussion, etc. on a regular basis and organized 5 Kisan *Goshthies (farmers meeting)*, 4 animal health camps, 2 farmer's trainings on *use of hydrogel in rainfed paddy and wheat, 6 trainings on horticultural based alternate land use system,* 2 exposure visits and 6 field visits. Capacity building of the farmers through organization of "Do-how" trainings by the scientists were carried out as and when needed. Various stakeholders like the Tarai Development Corporation (TDC), Krishak Bharati Cooperative Limited (KRIBHCO), Uttarakhand Sheep and Wool Development Board (USWDB) and other state organizations were involved and linkages developed with them for their inputs and expertise for implementation of the project.

In the third phase, impact assessment of Farmer FIRST programme was carried out with experiment and control group. The experiment group is one who has received various types of interventions under close supervision of scientists of Farmer FIRST programme and control group was selected from other groups of hamlets, who had not received any kind of interventions under Farmer FIRST programme. To find out, impact of different interventions under Farmer FIRST programme, both before-after as well

as with-without research designs were deployed in present study. Before-after research design was carried out with the help of base line data and recall memory of respondents.

From each group of hamlet, 60 beneficiary farmers were selected, thus total 180 beneficiary farmers of Farmer FIRST programme and 120 control group farmers were selected from non-beneficiaries villages of Farmer FIRST programme by using multistage random sampling technique. Data was obtained from the farmers using personal interview method with the help of structured interview schedule designed for the study purpose. In the present study, impact was operationalized as changes that have occurred within the community as a result of Farmer FIRST programme interventions**.** Several variables, viz. awareness, scientific orientation, decision making behavior, marketing behavior, social empowerment, change in yield, change in income, extent of adoption etc. were used to assess impact of Farmer FIRST programme. The suitable test statistics were deployed to compare between beneficiaries and non-beneficiaries' farmers of Farmer FIRST programme. For classifying the respondents on scientific orientation, decision making behavior, marketing orientation and awareness level, cumulative cube root of frequency method developed by Dalenius and Hodges (1950) was used. The main advantage of this method is it can be used in case of *ex-post facto* data efficiently for classifying the subjects. It classifies more accurately than mere using mean and standard deviation. The formula used for this method was as-

$$L_i = Y_{i-1} + [(S_k/L - S_{i-1}) / \sqrt{f_i}]*(Y_i - Y_{i-1})$$

where: L = Number of strata, L_i = i^{th} strata, Y_{i-1} = Lower limit of class in which L_i lies, S_k = Cumulative $\sqrt{f_i}$, F_i =Square root of the frequency of the i^{th} class in which L_i (S_k/L) lies, Y_i = Upper limits of the class, and Y_i-Y_{i-1} = Width of the class in which L_i (S_k/L) lies.

RESULTS AND DISCUSSION

Results of the study is presented and discussed under the broad headings of change in awareness level, scientific orientation, decision making behavior, marketing behavior, social empowerment, change in yield, change in income, change in area and change in cropping intensity of the beneficiaries with respect to control farmers of the study area.

Change in awareness level:- To evaluate change in level of awareness, a set of predetermined statements related to agriculture and allied activities were rated by respondents. Data in Table 1 shows, there was substantial change in awareness level of beneficiaries farmers in comparison to non-beneficiaries farmers.

Further it was inferred from Table 2 that beneficiaries had high level of awareness (mean score = 194.58) in comparison to non beneficiaries farmers (mean score = 84.38). Here, the high awareness level of beneficiaries farmers due can be attributed to regular scientist-farmer interaction and linkages developed among farm communities with other organizations. Mann-Whitney U test divulged that there was significant difference between beneficiaries and non-beneficiaries farmers on the issue of awareness level. Test statistics and its level of significance are illustrated in

Table 1 Awareness level of farmers about agriculture and allied activities

Statements	Beneficiaries N=180 *f* (%)	Non beneficiaries N=120 *f* (%)
Do you know improved lentil variety (VLM-514)?	162 (90.00)	65 (54.17)
Do you know any of these improved wheat varieties (VL-892, HS-507, and VL-907)?	175 (97.22)	77 (64.17)
Do you know about hybrid mustard variety (CV5252)?	164 (91.11)	78 (65.00)
Do you know any of these Bael varieties (NB-5, NB-6) which help in reducing land degradation in hilly region?	162 (90.00)	60 (50.00)
Are you aware that Pendimethalin is effective pre-emergence herbicide in wheat?	156 (86.67)	54 (45.00)
Have you ever heard about Pusa Hydrogel?	155 (86.11)	29 (24.17)
Have you ever heard about Vermi Composting?	160 (88.89)	61 (50.83)
Do you agree that Integrated Farming system (IFS) helps in increasing your farm income?	163 (90.56)	61 (50.83)
Have you ever undertaken backyard *poultry units as a supplemental income generating activity?*	158 (87.78)	59 (49.17)
Are you aware *about different Endo and Ecto parasite control methods in animals?*	167 (92.78)	66 (55.00)
Do you know that poly-lined Silpaulin pond can be used for rain water harvesting?	170 (94.44)	71 (59.17)
Do you know that plantation of Napier grass on field bunds on terraced fields is effective in reducing runoff, sediment and nutrient loss?	168 (93.33)	75 (62.50)
Do you know that Urea Molasses Mineral Blocks (UMMB) can be used as feed supplements for cattle?	168 (93.33)	76 (63.33)
Do you know that Jackfruit cultivars are planted to get rid of problems like degraded lands and monkey menace in hilly areas?	166 (92.22)	42 (35.00)
Are you aware about Pradhan Mantri Fasal Bima Yojana (PMFBY)?	171 (95.00)	74 (61.67)

Table 2 Comparison of beneficiaries and non-beneficiaries farmers on their level of awareness

Group	N	Mean rank	Sum of ranks
Beneficiaries	180	194.58	35025.00
Non-beneficiaries	120	84.38	10125.00

Table 3 Mann Whitney U test for level of awareness of beneficiaries and non-beneficiaries farmers and its level of significance

Categories	level of awareness
Mann-Whitney U	2865.000
Wilcoxon W	10125.000
Z	-11.047
Asymp. Sig. (2-tailed)	.000

the Table 3 and the results were found to be significant at 0.01 level of probability.

Extent of adoption: The extent of adoption was measured as the extent to which the different practices were accepted and practically applied in the field by the beneficiary farmers of Farmer FIRST Project (FFP). For this, a schedule was developed with 10 statements reflecting various activities under taken during project implementation. For quantifying the data, each statement was given a score of 1 for non-adoption, 2 for partial adoption and 3 for full adoption. On the basis of extent of adoption the respondents were categorized into five categories, viz. very low, low, medium, high and very high with the help of cumulative cube root frequency method. Table 4 revealed that majority of the respondents (40%) had high level of extent of adoption of different practices under FFP followed by medium (24.44 %) and very low (15.56%).

The possible reasons for this high level of adoption may be due to regular scientist-farmer interface in which scientist provide latest varieties of different agriculture and horticulture crops and location specific technological options, technical know-how of packages of practices of different crops and need based training on different aspects of agriculture and livestock.

Table 4 Distribution of respondents based on their extent of adoption of different practices under FFP (N=180)

Adoption score category	Frequency	Percentage
Very low (< 20.69)	28	15.56
Low (20.69-25.37)	22	12.22
Medium (25.37-27.94)	44	24.44
High (27.94-29.69)	72	40.00
Very high (>29.69)	14	7.78

Table 5 depicts the distribution of respondents according to their practice wise adoption of different components under Farmer FIRST programme. Majority of the respondents had fully adopted the high yielding varieties of wheat VL-907 & VL-892 (93.9%) and lentil (84.4 %). The full adoption of the above varieties by the respondents as these varieties specially developed for North Western Himalayas as well as had higher yield and short duration compared to local check which encouraged the farmers to adopt them. In case of horticulture based alternate land use system, most of respondents (79.4%) had fully adopted different cultivars of mango, jackfruit, guava, bael and lemon as these horticultural crops could be grown in degraded waste land and provide regular source of income as well as give relief to farmers from monkey menace in hilly terrain. In case of backyard poultry (kuroiler), majority of farmers (70%) had fully adopted due to regular source of income by selling eggs and meat of poultry in the nearby market round the year. Around 27.2% of farmers partially adopted the backyard poultry

Table 5 Distribution of respondents according to their adoption level of different components under FFP (N=180)

Different intervention under Farmers FIRST programme	Fully adopted *f* (%)	Partially adopted *f* (%)	Not adopted *f* (%)
Use of high yielding varieties of wheat VL-907 & VL-892.	169 (93.9)	7 (3.9)	4 (2.2)
Use of high yielding variety of lentil VL-514.	152 (84.4)	8 (4.4)	20 (11.1)
Horticulture based alternate land use system for utilization of degraded lands viz. mango, jackfruit, guava, beal and lemon.	143 (79.4)	7 (3.9)	30 (16.7)
Establishment of Backyard poultry (Kuroiler) units as an employment and income generating activity.	126 (70.0)	49 (27.2)	5 (2.8)
Plantation of Napier grass on field bunds for reducing runoff and to address the problem of fodder scarcity.	147 (81.7)	23 (12.8)	10 (5.6)
Establishment of improved composting techniques for solid waste management.	30 (16.7)	95 (52.8)	55 (30.6)
Use of Pusa Hydrogel for moisture conservation in rainfed wheat.	131 (72.8)	43 (23.9)	6 (3.3)
Construction of small water tanks (Silpaulin lined) for supplemental irrigation to the crops.	147 (81.7)	28 (15.6)	5 (2.8)
Use of Urea Molasses Mineral Blocks (UMMB) as feed supplements for productivity enhancement in cattle.	101 (56.1)	64 (35.6)	15 (8.3)
Use of improved techniques for treatment of Ecto and Endo parasite in cattle.	96 (53.3)	65 (36.1)	19 (10.6)

due to lack of knowledge about feeding and vaccination in poultry and 2.8% did not adopt due to some cultural ethos. Majority of farmers had fully adopted (81.7%) napier grass (*Pennisetum purpureum*) due to effective barrier in reducing run off, sediment, nutrient loss and to meet out the scarcity of green fodder in the area. In case of improved composting techniques for solid waste management only (16.7%) had fully adopted followed by (52.8%) partially adopted and (30.6%) not adopted. The partial adoption of improved composting techniques may be due to lack of knowledge about improved composting techniques as generally farmers spread raw dung directly into their field. Majority of farmers had fully adopted (72.8%) pusa hydrogel because of having high water holding capacity and can provide water to crops during moisture stress under rainfed areas.

In case of establishment of silpaulin lined water harvesting tanks, majority of farmers had fully adopted (81.7%) as it helps in rain water harvesting in rainfed areas and could help in providing supplemental irrigation to both agricultural and horticultural crops. Majority of farmers had fully adopted (56.1%) Urea Molasses Mineral Blocks (UMMB) due to its beneficial effect on growth performance and milk yield of cattle. Majority of farmers had fully adopted (53.3%) improved practices which help in control of different ecto and endo-parasite in cattle.

Change in decision making behavior

Farmers should have ability to take important decisions related to their farming activities. It is the degree to which an individual justifies his selection of most efficient option from among the available alternatives on the basis of scientific criteria for achieving maximum economic profit. It was measured by a scale developed by Nandapurkar (1982) with necessary modifications. The items were rated on a five point continuum ranging from strongly agree, agree, undecided, disagree and strongly disagree with respective weightages of 5, 4, 3, 2 and 1, respectively for positive statements and vice-versa for negative statements. On the basis of decision making behavior the respondents were categorized into five categories, viz. very low, low, medium, high and very high by using cumulative cube root frequency method**.**

Table 6 revealed that majority of the beneficiaries respondents belonged to medium level of decision making behavior category (29.44%) followed by (27.78%) in low level and high level (19.44%) of category. Whereas most of non-beneficiaries belonged to medium level of decision making behavior category (30%) followed by (17.22%) in low level and (8.89%) in high level of category.

Comparison of beneficiaries and non beneficiaries on their level of decision making behavior

Further it was inferred from the Table 7 that beneficiaries farmers had high level of decision making behavior (mean score=206.83) in comparison to non beneficiaries farmers (mean score=60). It might be due to the fact that the beneficiaries farmers had regular interaction with scientific staff during project meetings, *kisan gosthis*, exposure visits, field day visit and need based vocational training. Mann-Whitney U test revealed that there was significant difference between beneficiaries and non-beneficiaries on the subject of decision making behavior. Test statistics and its level of significance are illustrated in the Table 8 and the results were found to be significant at 0.01 level of probability.

Change in marketing behaviour: Success of productive enterprise depends to a great extent on the ability of a farmer to make intelligent buying of inputs and selling of produce, so marketing behaviour is important component of sustained progress of the farmers. Modified scale of Samanta (1977) was used to measure the 'marketing behavior'. The scale consists of six statements. There are three positive statements and three negative statements in the scale. The items were rated on a five point continuum ranging from strongly agree, agree, undecided, disagree and strongly disagree with respective weightages of 5, 4, 3, 2 and 1 respectively for positive statements and vice-versa for negative statements. On the basis of marketing behavior the respondents were categorized into five categories, viz. very low, low, medium,

Table 7 Comparison of beneficiaries and non beneficiaries on their level of decision making behavior

Group	N	Mean rank	Sum of ranks
Beneficiaries	180	206.83	37230.00
Non beneficiaries	120	66.00	7920.00

Table 8 Mann Whitney U test for decision making behavior of beneficiaries and non beneficiaries and its level of significance

Categories	Innovativeness proneness
Mann-Whitney U	660.000
Wilcoxon W	7920.000
Z	-14.852
Asymp. Sig. (2-tailed)	.000

Table 6 Distribution of respondents according to their level of decision making behaviour

Beneficiaries (N=180)	*f*	%	Non-beneficiaries (N=120)	*F*	%
Very low (< 15.16)	12	6.67	Very low (< 10.8)	4	2.22
Low (15.16-19.40)	50	27.78	Low (10.8-15.6)	31	17.22
Medium (19.40-23.44)	53	29.44	Medium (15.6-20.4)	54	30.00
High (23.44-28.01)	35	19.44	High (20.4-25.2)	16	8.89
Very high (>28.01)	30	16.67	Very high (>25.2)	15	8.33

Table 9 Distribution of respondents according to their level of marketing behavior

Beneficiaries (N=180)	*f*	%	Non beneficiaries (N=120)	*f*	%
Very low (<18.9)	32	17.78	Very low (<14.56)	42	35.00
Low (18.9-23.51)	53	29.44	Low (14.56-17.81)	21	17.50
Medium (23.51-26.64)	44	24.44	Medium (17.81-20.92)	28	23.33
High (26.64-29.29)	41	22.78	High (20.92-23.60)	13	10.83
Very high (>29.29)	10	5.56	Very high (>23.60)	16	13.33

high and very high by using cumulative cube root frequency method**.** Table 9 shows that majority of the beneficiaries belonged to low level of marketing behavior category (29.44 %) followed by (24.44%) in medium level and high level (22.78%) of category. Whereas most of non beneficiaries belonged to very low level of marketing behavior category (35%) followed by (23.33%) in medium level and (17.50%) in low level of category.

Further it was found from Table 10 that beneficiaries had high level of marketing behavior (mean score =181.16) in comparison to non beneficiaries (mean score =104.52). This was mainly because of the fact that the beneficiaries farmers were sensitized about minimum support price of different commodities and they also started grading of their produce. Mann-Whitney U test revealed that there was significant difference between beneficiaries and non beneficiaries on the subject of marketing behavior. Test statistics and its level of significance are illustrated in the Table 11 and the results were found to be significant at 0.01 level of probability.

Change in yield: To estimate change in yield of wheat and lentil crops, the yield data were collected and compared using 't' test to know the statistical significance. Perusal of Table 12 indicated the comparison of wheat and lentil yield between beneficiary and control group. The average yield of wheat and lentil for beneficiaries was 23.89 q/ha and 9.23 q/ha respectively and for control group it was 14.10 q/ha and 6.48 q/ha respectively. The difference in average yield of wheat and lentil for beneficiary and control group was statistically significant at 0.01 level of probability. This was mainly due to application of hydrogel, adoption of high yielding, short duration, drought tolerant, insect pest resistant varieties by the beneficiary farmers in comparison to control farmers who still dependent on old varieties and don't apply hydrogel in their crops. Due to regular interaction with scientists, beneficiary farmers also came to known about timely sowing, improved soil and water management practices and proper plant protection measures which helped them to get better yield in comparison to control farmers. Similar results were reported by Kalhapure *et al.* (2016) who concluded that application of hydrogel increases productivity in almost all the crops in terms of crop yield.

Table 13 showed that there was a significant increase in yield of wheat and lentil of the beneficiary farmers group. The average production of wheat was 13.26 q/ha before project; whereas after project the yield increased up to 23.89 q/ha. Similar results were found among the lentil beneficiaries where the yield increased from 6.47 q/ha to 9.23 q/ha. Before-after comparison of yield of crop of beneficiary group was tested using paired 't' test. The increase was found to be significant at less than one per cent level of significance for wheat farmers.

Change in income: Table 14 showed the comparison of income of wheat and lentil crops between beneficiary and control group and it was observed that in case of wheat income difference obtained between beneficiary (₹ 42121.02/ha) and control group (₹ 26785.42/ha) was found statistically significant at 0.01 level of probability. Similar results were found for the lentil crops where the difference obtained between beneficiary (₹ 22569.11/ha) and control group (₹ 19959.79/ha) was found statistically significant at less than 0.01 level of probability. Obviously

Table 10 Comparison of beneficiaries and non beneficiaries on their level of marketing behavior

Group	N	Mean Score	Sum of ranks
Beneficiaries	180	181.16	32608.00
Non beneficiaries	120	104.52	12542.00

Table 11 Mann Whitney U test for marketing behaviour of beneficiaries and non beneficiaries and its level of significance

Categories	Marketing behaviour
Mann-Whitney U	5282.000
Wilcoxon W	12542.000
Z	-7.513
Asymp. Sig. (2-tailed)	.000

Table 12 Comparison of beneficiaries and non-beneficiaries farmers on yield of wheat and lentil crops to isolate the impact of FFP

Variables	No. of Farmers (N)	Average yield (q/ha)	Standard deviation	t-value
Wheat production				
Beneficiary	180	23.89	2.04	41.27*
Control	120	14.10	1.97	
Lentil production				
Beneficiary	180	9.23	0.42	65.03*
Control	120	6.48	0.22	

*Significant at P < 0.01

Table 13 Before-after comparison of yield of crop of beneficiary group

Yield (q/ha)	Wheat farmers		Lentil farmers	
	before	after	before	after
Mean	13.26	23.89	6.47	9.23
SD	1.84	2.04	0.32	0.42
Paired t test	69.72*		86.09*	

*Significant at P < 0.01

Table 15 Before-after comparison of increase in area of beneficiary group

Area(ha)	Before the FFP interventions	After the FFP interventions
Mean	0.94	1.41
SD	0.97	1.12
Paired t test	-17.30*	

*Significant at P < 0.01

this change in income was due to more yields of beneficiary farmers' comparison to control farmers and timely availability of market information helps them in better price realization.

Increase in cultivable area: the average cultivable land area of Farmer FIRST Programme beneficiary farmers has increased after the programme interventions than that of before the implementation of the programme interventions. Results in Table 15 showed that there was significant increase in cultivable area and it was found to be significant at less than 0.01 level of probability. This increase in area is an output of adoption of horticultural plants based alternate land use system in degraded lands and construction of small water tanks (Silpaulin lined tanks) by the beneficiary farmers in collaboration with scientists. Horticultural crops such as mango, jackfruit, lemon guava and beal were adopted and raised by the farmers in degraded area, which earlier was a barren land and not used by the farmers for cultivation purpose. Also, construction of small water tanks helps in rain water harvesting and supplemental irrigation in lean season (Yosef and Asmamaw 2015) and it also helps in area expansion of the farmers in the study area.

Change in cropping intensity: It was operationally defined as the number of crops taken up by the farmers in one agricultural year. It is the ratio between gross cropped area to net cropped area. Table 16 showed that cropping intensity of beneficiary farmers was higher than that of control farmers and the difference obtained between beneficiary (159.74%) and control group (120.40%) was found statistically significant at less than 0.01 level of probability. The difference is largely due to increased availability of irrigation water in lean season from small water tanks (Silpaulin lined tanks) constructed under FFP interventions. This finding is similar to Prasad *et al.* (2014) who reported that average cropping intensity across farmers increased by 17% due to open well-constructed in study area.

Change in days of employment: The average annual employment days for beneficiary and control farmers is presented in Table 17. Data revealed that average annual employment days for beneficiary farmers was much higher than control farmers of study area. The difference obtained between beneficiary (265.75 days/year) and control group (178.83 days/year) was found statistically significant at less than 0.01 level of probability.

Table 18 depicted that average annual employment days generated for beneficiary farmers after intervention was 265.75 days/year higher than earlier they had 176.04 days/year. Paired t-test was deployed to know the statistical difference and it was found to be significant at less than one per cent level of significance. This is mainly due to involvement of beneficiary farmers in different activities such as kitchen gardening, backyard poultry (Kuroiler), adoption of horticulture crops, viz. mango, jackfruit, guava, bael and lemon, construction of small water tanks (Silpaulin lined tanks) for rainwater harvesting etc. Beside these, farmers had regular involvement in capacity building programme, exposure visits and demonstrations of improved technologies of institute.

The present study was conducted to know the impact

Table 14 Comparison of income of wheat and lentil crops between beneficiary and control farmers

Variables	No. of farmers (N)	Average income (Rs/ha)	Standard deviation	t-value
Wheat income				
Beneficiary	180	42121.02	2178.03	42.58*
Control	120	26785.42	4031.03	
Lentil income				
Beneficiary	180	22569.11	692.80	34.99*
Control	120	19959.79	529.92	

*Significant at P < 0.01

Table 16 Comparison of beneficiary and control group on cropping intensity

Farmer group	No. of farmers	Average cropping intensity (%)	Standard deviation	t-value
Beneficiary	180	159.74	57.96	35.38*
Control	120	120.40	67.50	

*Significant at P < 0.01

Table 17 Comparison of beneficiary and control group on annual employment days

Farmer group	No. of farmers	Average employment days/year	Standard deviation	t-value
Beneficiary	180	265.75	12.84	72.57*
Control	120	178.83	3.22	

*Significant at P < 0.01

Table 18 Before-after comparison of increase in employment days of beneficiary group

Average employment days/ year	Before the FFP interventions	After the FFP interventions
Mean	176.04	265.75
SD	5.31	12.84
Paired t test	-98.96*	

*Significant at P < 0.01

of different interventions under Farmer FIRST Project of ICAR in Dehradun district. Because of different capacity building programmes, exposure visits, demonstration of improved practices, field days and scientific *gosthi*, the beneficiary farmers were motivated to adopt different modern practices and technologies related to agriculture and livestock. Increased awareness among beneficiary farmers was one of positive impact of Farmer FIRST Programme. Significant difference on decision making ability and marketing behavior was observed between beneficiary and non-beneficiary. Beneficiary farmers had higher cropping intensity in comparison to non-beneficiary due to crop diversification during *kharif, rabi* and summer seasons. There was significant increase in cultivable area between pre and post Farmers FIRST Programme. It is mainly due to inclusion of degraded lands under different horticulture plantations. Yield and income of wheat and lentil crops showed a significant difference between beneficiaries and non-beneficiaries. Over the years, there was a significant difference in wheat and lentil yields of beneficiary farmers. It is largely due to adoption of improved cultivar with better soil and water conservation practices and application of hydrogel. Significant difference in average employment days also observed between beneficiaries and non-beneficiaries and over the years, employment generation of beneficiary farmers was increase due to involvement in different farm and livestock activities. In general, Farmer FIRST programme had shown significant and positive impact on livelihood of beneficiary farmers and such program can be really beneficial for "Doubling of Farmers Income" in the agricultural sector.

ACKNOWLEDGEMENT

The authors are very thankful to the Agricultural Extension division, Indian Council of Agricultural Research (ICAR) for funding the FARMER FIRST project. The authors are very grateful to the Director, ICAR-Indian Institute of Soil and Water Conservation, Dehradun for his constant support and encouragement to do this research work and providing necessary facilities.

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