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Farmer field school: An innovative approach for boosting spice production in semi arid zone

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Abstract

This paper discusses the concept of Farmer Field School (FFS), its role for sustainable agriculture in semi arid zone and impact on yield of cumin in Pali district of Rajasthan, India. The seed yield improved significantly with the interventions given in demonstrations under FFS as compared to farmers' existing practices. Fine-tuning of the production technology based on the location specific conditions and resources available with the farmers enhanced the adoption rate. The difference in technology gap in various fields indicated the better performance of recommended varieties with different interventions and more feasibility of recommended technologies during the course of study with the other factors like monitoring by farmers, soil type and fertility status of the fields. Similarly, the technology index for all demonstrations in the study was in accordance with technology gap. Higher technology index reflected the inadequate proven technology for transferring to farmers and insufficient extension services for transfer of technology. Economic yield as a function of grain yield and sale price were also taken into consideration. The results indicated higher additional returns and effective yield under FFS demonstrations.

Introduction

After participatory extension approaches emerged in the late 1980s, it was realized that most technologies developed by researchers alone were inappropriate for small holder farmers (Jurgen *et al.,* 2000). In participatory extension, farmers take part in the design, determine management conditions, implement and evaluate the experiments. Agricultural technology development and transfer have largely based on a vertical one-way communication model with information flowing from research to extension and the role of extension is to transfer the information to the farmers. In many of these linear models, problem definition tended skewed toward research interests than to farmer perceived problems. Research results have often also not been delivered efficiently to extension workers, who most of the time lacks of necessary knowledge, skills and resources to motivate farmers for adopting such practices. But during the late 1980s, and early 1990s TDT recognized the central role. Practitioners started to explain farmers' non-adoption of technologies as stemming from the fact that the technology does not fit. The prescription was to change the process by ***emphasizing farmer participation***.

A typical example of participatory extension method is the farmer field school (FFS) approach, now practiced in at least 78 countries (Braun *et al.,* 2006). They are a participatory method of learning, technology development, and dissemination (FAO, 2001) based on adult learning principles such as experiential learning (Davis and Place, 2003). The first FFS were designed and managed by the Food and Agriculture Organization (FAO) of the United Nations in Indonesia during 1989 to train the trainers and farmers on Integrated Pest Management (IPM) in a participatory mode (Matata, *et al.,* 2010). The FFS is a non formal training programme for selected farmers within a locality, usually a village. FFS thus have a social goal beyond mere changes in pest management techniques that seek to promote the empowerment of farmers by building human and social capital (Gallagher, 2000).

Farmers are no longer positioned as receivers of already developed technological packages, but as field experts, who collaborate with the extension staff to find solutions relevant to the local realities. FFS programs emphasize farmers' ownership, partnership and group collaboration. During the past two decades, FFSs have been held for many crops including cotton, tea, coffee, cacao, pepper, vegetables, small grains and legumes (Potinus *et al.*, 2002). Waves of adaptations in FFSs have occurred from a focus on a single constraint (pest management) of a single crop (rice) to an emphasis on the multiple dimensions of crop management to cropping systems to resource management to socio-cultural dimensions of community life. This may be seen as the natural progression of the FFS; the phasing or timing by which particular FFSs would evolve to multi-dimensional and/or higher-level concern is for the

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groups itself to determine (CIP-UPWARD, 2003). Presently the FFS model has been extended to several other topics such as livestock production, forestry, nutrition and health (HIV prevention) (Tripp *et al*., 2005). In total, thirty developing countries in the world are currently experimenting with and implementing the FFS approach (Van den Berg, 2004).

As part of the methodology, a communal plot is made available to teach farmers proven agricultural practices, by which they can protect the crops and increase their yield. Farmers adopt new techniques which they can apply on their own farm. Once the techniques are well mastered, they can also teach other farmers, thus multiplying the positive effect of the methodology. The approach is integrated and organized in such a way so that farmers are not the objects of training but are able to use their experience as the subject of training for research to be effective there must be an efficient mechanism whereby its result can be used by the end users. The process of making available the fruits of research to the farmers is the function of extension. Extension services frequently have many other tasks to perform, e.g. advising farmers on input availability and sources of agricultural credit. The traditional view of technology transfer is a one-way process so, this approach has been describes as "sock-it-to-them" (Rolling, 1996). In participatory extension, methodologies are intended to assist in the research-extension-farmer continuum in a learning process where each group learns from each other. Approaches to improving agricultural technology systems, such as Farming Systems Research (FSR) and Training and Visit (T&V) extension system, are efforts to improve Agricultural Knowledge and Information Systems (AKIS) synergy (Rolling, 1996). Hence it is need for the promotion of participatory multidisciplinary research where the need for empowerment of the farmer will be paramount.

Keeping these points in view on a study was undertaken to study the concept of FFS taking Cumin (*Cuminum sativum*) as crop enterprise.

Material and methods

Concept of FFS

The Farmer Field School Extension Model FFS are platforms and "schools without walls" for improving decision-making capacity of farming communities and stimulating local innovation for sustainable agriculture (Braun *et al*., 2000). FFS offers community-based, non formal education to groups of 20-25 farmers through self-discovery and participatory learning principles. The learning process is based on agro ecological principles covering a cropping cycle. The school brings together farmers who live in the same village/catchment and thus, are sharing the same ecological settings and socioeconomic and political situation. FFS provides opportunities for learning-by-doing. Extension workers, subject matter specialists or trained farmers facilitate the learning process, encouraging farmers to discover key agro ecological concepts practiced in the field. During the learning, all the stakeholders participate on an equal basis in field observations, discussions and in applying their previous experiences and new information from outside the community to reach management decisions on the appropriate action to take for increased production. The FFS model is an example of group-based experiential learning (or "learning by-doing") that encourages farmers in "informal schools" to meet once a week in the same farmer's field and analyze and discuss their farming operations and then determine which agricultural interventions should be adopted and evaluated on their own farms. The overall objectives of FFS are to bring farmers together to carry out collective and collaborative inquiry with the purpose of initiating community action and solving community problems (Oduori, 2002).

To date, Farmer Field Schools have turned out about 4 million graduates. In FFS group session practical exercises and the trial plots the facilitator helps the group make use of actual real life situations, as opposed to simulated experiences. All of these exercises apply Kolb's learning cycle (Kolb, 1984) in the way that farmers use concrete observations to reflect on experiences and from there conceptualize the learning points on which actions are defined.

Selection of site for FFS

Sites selected for conduction of FFS were central point for other participant in the FFS for easy access. As cooperation of lead farmer was key to success of the FFS, some activities were planned well in advance of the scheduled day for FFS. Similarly the use of some of the inputs like seed treatment, application of herbicides and micronutrients may preclude the opportunity to demonstrate some of the situations like disease symptoms, appearance of weeds and symptoms of micronutrient deficiency which are otherwise important for hands on activities and knowledge for the farmers. Therefore a small plot of about 500 square meters or so adjoining the demonstration plot (site of FFS) was established where such situations will develop and can be used for observation as well as hands on activities.

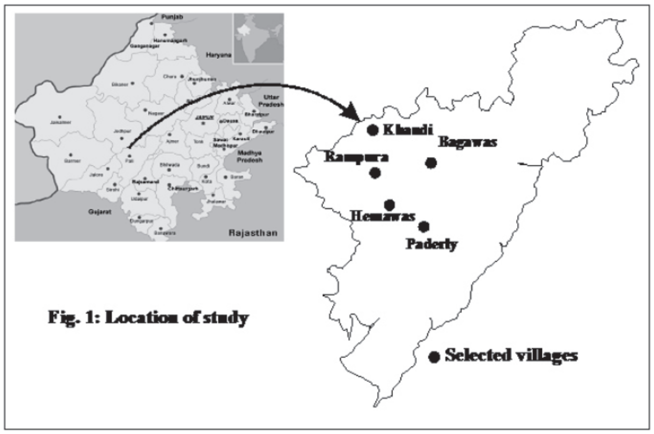

Fig. 1: Location of study

Selection of farmers for FFS

The farmers participating in each FFS were selected by the KVK, Pali and District Agriculture Officer in consultation with village Panchayats and Zilla Parishads. Some elderly and respected people who are already awarded/recognized in the area for progressive agriculture were also selected for FFS. Farmers selected for FFS were within contiguous area in a village or neighbouring villages (Fig.1). The selection of farmers was done well in advance so that other modalities/arrangements for the conduct of FFS are made in consultation with the farmers on whose field FFS is to be conducted. The knowledge of specific assistance being provided to the farmer for the conduct of field demonstration is essential so that the facilitator knows what other inputs and arrangements are to be made for the conduct of this school throughout the season. The members of the FFS visited these demonstrations regularly as and when possible and take note of salient features/activities of these demonstrations. Farmers were divided into homogeneous groups of convenient size.

Arrangements for the conduct of FFS

Arrangements for the conduct of these schools such as, soil testing, provision of inputs, equipments and implements, participation of experts from the SAU (State Agricultural University)/KVK (Krishi Vigyan Kendra)/ICAR (Indian Council of Agriculture Research) institutes and other organisations, stationary and other training material such as posters and charts, manuals, other preparation like multiplication of structured questionnaire and the arrangements for tea and snacks during the conduct of these schools were made by the facilitator before hand. Tentative list of field visits/demonstration, inviting some progressive farmers to deliver a talk on his success story were also arranged well in advance.

Facilitator and technical experts

In the current programme the main sources of facilitator and technical experts were from State Department of Agriculture (SDA), State Agricultural Universities, (SAU), KVK, Pali and ICAR Institutes like NRCSS, Tabiji and RRS, CAZRI, Pali etc. However, SDA and KVK were the main contributors. Before the start of field activities farmers were asked to make some discussion on structured questions and present the outcomes. This whole exercise of structured discussion and presentation was completed within one hour so that there was ample time for hands on activities and other field observations. Farmers were divided in 4-5 groups of convenient size to make some structured discussion on a topic. The facilitator compiled and supplemented the outcome of various groups. Facilitator used this information in finalising the gap analysis exercise to be undertaken in FFS.

Crop selection and interventions taken

Cumin was selected as the crop to be grown under FFS as it, is one of the important major seed spice crops of Rajasthan. Average national productivity of this crop is remaining very less (619 kg ha^{-1}) due to low level of awareness among the farming community about area specific recommended package of practices. Precision farming, introduction of high yielding varieties tolerant to diseases and pest can do the wonders in the growing area. The present study was carried out by the KVK, Pali under ATMA scheme of DOA during Rabi season of 2014-15 on the farmers' fields of selected five villages *viz.* Khandi, Paderly, Hemawas, Rampura and Bagawas of Pali district with following objectives.

1. To exhibit the performance of high yielding cumin variety in Pali district with scientific interventions.
2. To compare the yield levels of FFS fields and local cultivar with farmers practice.
3. Economic analysis and its comparison of scientific interventions through demonstration and farmers' practice.
4. To know the impact of FFS on knowledge level of cultivation practices of cumin farmers**.**

Each demonstration under FFS was of 0.5 ha in area. Improved variety of cumin *viz.*, GC-4 was tested through Front Line Demonstrations (FLDs) with following interventions (Table 1) and compared with local variety grown with farmer's practices.

Table 1.Details of existing farmers' practices and scientific interventions for cumin cultivation.

S. No.	Intervention	Farmers' practice	Scientific proven technology demonstrated
1.	Use of seed	Locally available seed	GC-4 an improved variety.
2.	Sowing method	Broadcasting	Line sowing by tractor operated seed cum fertilizer drill
3.	Sowing time	last week of October to last week of November	first to mid week of November
4.	Irrigation method	Flooding	Sprinkler and drip irrigation method
5.	Seed treatment	No seed treatment	Seed treatment by Bavistin (2.5g kg-1 seed) and Trchoderma viride (4g kg-1 seed).
6.	Fertilizer application	Irregular use of fertilizers	40:20:0 kg NPK ha-1
7.	Plant protection measures	Irregular use of chemicals	Two sprays of malathion (0.2%), two sprays of dithane M-45 (0.2%) and one spray of karathane (0.1%) for the control of aphids, blight and powdery mildew.

In demonstration plots, a few critical inputs in the form of quality seed, balanced fertilizers, agro-chemicals were provided and non-monetary inputs like timely sowing in lines and timely weeding, irrigation and other inter cultural operations were also performed, whereas traditional practices were maintained in case of farmers' practice. The seed was treated with *Trichoderma viride* (4g kg^{-1}) and Bavistin (2.5g kg^{-1}) in a closed container and then shade dried for some time before sowing. Line sowing was performed with the help of multi seed spices seed cum fertilizer drill developed by CIAE (Central Institute of Agricultural Engineering), Bhopal. The phosphorous was supplied through DAP (46% P2O5) before sowing at the time of field preparation. The nitrogen was given in three split doses. First through DAP (18 % N) before sowing in the field as basal dose (15.65 kg N) and remaining through urea (46% N) after 40 and 65 days of sowing as top dressing. Two sprays of malathion (0.2%) at 15 days interval (with the incidence of aphids), two sprays of fungicide i.e. mancozeb (0.2%) at 15 days interval (at 60 and 75 DAS) and one spray of systematic insecticide i.e. karathene (0.1%) for the control of aphids (with the initial appearance of symptoms), blight and powdery mildew, respectively were applied. Growing of locally available variety of cumin without seed treatment and application of only 25 kg ha^{-1} nitrogen at 60-70 days after sowing with irregular/ indiscriminate use of pesticides and fungicides is the farmer's practice prevailing in the area. The sowing was done during second week of November. The front line demonstrations were conducted to study the gaps between the potential and demonstration yield, extension gap and technology index. Data with respect to yield and output for FFS plots and on local practices commonly adopted by the farmers of the area under study were recorded and analysed. The details of different parameters are as under:

Extension Gap = Demonstration Yield (DY) – Farmers' Practice Yield (FPY)

Technology Gap = Potential Yield (PY) – Demonstration Yield (DY)

Technology Index =(PY-DY/PY) × 100

Additional Cost = Demonstration Total Cost – Farmers' Practice Total Cost

Effective Gain = Additional Return – Additional Cost

Additional Return = Demonstration Return – Farmers' Practice Return

Net returns = Total (Gross) Returns – Total Cost of Production

Incremental B: C Ratio = Additional Return / Additional Cost

FFS curriculum activities to be undertaken during the learning period. The FFS was based on a solid tested curriculum, which covers the entire crop cycle. The field guides, study fields plus a collection of group dynamic exercises provided the basis for the field school curriculum. These materials were used according to their appropriateness. Training in the farmer field school is experiential and discovery based. The training activities were designed to have participants learn by doing. Most of the training time was spent in the field. Exchange of information and generation of knowledge is facilitated through sharing observations, brainstorming and long discussions. A corner stone of the FFS methodology is agro-ecosystems analysis (AESA) which is the establishment by observation of the interaction between a crop and other biotic and abiotic factors co-existing in the field. This involves regular (usually weekly) observations of the crop. Participants work in sub groups of 4 or 5, and learn how to make and record detailed observations including: growth stage of the crop insect pest and weeds and disease levels, weather conditions, soil condition and overall plant health. The farmers then take management decisions based on these observations.

Results and discussion

Grain Yield

The grain yield improved significantly with the interventions given in demonstrations under FFS as compared to farmers' existing practices. Maximum yield (578 kg ha^{-1}) under FFS was recorded in the Manpura village, which was higher (27.03%) than the yield (455 kg ha^{-1}) obtained under farmers' practice. While minimum yield (520 kg ha^{-1}) under FFS was recorded in the Khandi village which was highest (29.67%) than the yield (401 kg ha^{-1}) obtained under farmer practice. On the basis of the above study, it is inferred that an overall yield advantage of 24.81 percent over farmers' practices was recorded with the average yield of 552.6 kg ha^{-1} under FFS demonstrations carried out with improved cultivation practices (Table 2). The reason of low yield by farmers practice is due to sowing at improper time followed by non availability of quality seeds, sowing by broadcasting, use of inadequate and imbalanced fertilizers and plant protection measures. The results clearly prove the foundation of FFS "farmers first" philosophy, which is in direct contrast to the transfer of technology approach. "Farmers first" concept is essential to empower farmers to learn, experimentation and technology generation and decision making (Paredes, 2001). The gain in yield results are also in accordance with the results obtained by Lal *et al.,* (2013) and Singh *et al.*, (2011) in seed spice crops.

Table 2.Grain yield and gap analysis of technological interventions on cumin at farmers' field

Demo= Demonstration, FP=Farmers' practice, Ext.= Extension, Tech.= Technology

Village	Area (ha)	Potential yield (kg ha^{-1})	Demo. yield (kg ha^{-1})	F.P. yield (kg ha^{-1})	Yield increase over F.P. (%)	Ext. gap (kg ha^{-1})	Tech. Gap (kg ha^{-1})	Tech. index (%)
Hemawas	0.5	1000	547	470	16.38	77	453	45.30
Paderly	0.5	1000	570	456	25.00	114	430	43.00
Khandi	0.5	1000	520	401	29.67	119	480	48.00
Baghawas	0.5	1000	548	435	25.97	113	452	45.20
Manpura	0.5	1000	578	455	27.03	123	422	42.20
Overall average	0.5	1000	552.6	443.4	24.81	109.2	447.4	44.74

Gap analysis

Data (Table 2) revealed that an extension gap was found from 77 kg ha^{-1} (Hemawas village) to 123 kg ha^{-1} (Manpura village) and on average basis it was 109.20 kg ha^{-1}. This emphasized the need to educate the farmers through innovative methods for adoption of improved technology especially high yielding varieties sown with the help of seed cum fertilizer drill with balanced nutrition, sowing time, irrigation method and appropriate plant protection measures in demonstrations which resulted in higher grain yield than the traditional farmers' practices. These results are in the agreement of the findings of Meena and Singh *(2011)* in cumin crop. The investigation further exhibited a wide technology gap among different fields. It was lowest (422 kg ha^{-1}) in FFS demonstration plot in Manpura village and highest (480 kg ha^{-1}) in FFS at Khandi. The average technology gap of all the fields was 447.40 kg ha^{-1}. The difference in technology gap in different fields is due to better performance of recommended varieties with different interventions and more feasibility of recommended technologies during the course of study with the other factors like monitoring by farmers, soil type and fertility status of the fields. Similarly, the technology index for all demonstrations in the study was in accordance with technology gap. Higher technology index reflected the inadequate proven technology for transferring to farmers and insufficient extension services for transfer of technology. In this study overall 44.74 per cent technology index was recorded, which varied from 42.20 % (Manpura FFS) to 48 % (Khandi FFS). FFS as participatory extension methodology recognize the need to involve farmers in technology development and transfer. In this process, farmers are central in the process of technology development. FFS training emphasizes building on the farmers' ability to experiment and draw conclusions and it empowers farmers to improve their socio-economic conditions (Asiabaka and James, 1999). These promising technologies were validated and disseminated through Farmer Field School (FFS) approach only. Farmer field schools and other successful programs had the common characteristics of group interaction among farmers, regular meetings, discovery-based-learning in the field and regular follow up encounters with individual farmers leading to higher adoption by the farmers (Paredes, 2001)

Economic analysis

Different variables like seed, fertilizers and pesticides were considered as cash inputs for the demonstrations under FFS as well as farmers' practices. Data of economic analysis presented in Table 3 exhibited that on overall average basis, an amount of ₹ 24,000 ha^{-1} was incurred under FFS demonstrations and ₹19,432 ha^{-1} under farmers' practice (FP). An average additional amount of ₹4,568 ha^{-1} was incurred under demonstrations than FP. Economic yield as a function of grain yield and sale price were also taken into consideration. Maximum additional returns (₹19,680 ha^{-1}) were obtained in FFS demonstration field at Manpura village due to higher grain yield and the overall average additional returns of ₹17,472 ha^{-1} was obtained under the FFS demonstration fields. The higher additional returns and effective yield obtained under FFS demonstrations could be due to improved variety, scientific proven technology, non-monetary factors, timely operations of crop cultivation and scientific monitoring. Through farmer field schools, farmers learn about, and investigate for themselves, the costs and benefits of alternative management practices for sustaining and enhancing farm productivity (Gallagher *et al*, 2006). The lowest and highest incremental benefit: cost ratio (IBCR) was 2.89 and 4.93 in the Hemawas and Baghawas FFS, respectively depends on grain yield produced. Overall average IBCR was found as 3.82. The results of the study confirm the findings of Lathwal (2010) on black gram, Meena and Singh, (2011) ,Singh *et al.,* (2014) on cumin and Dayanand *et al*., (2012) on mustard. The results confirm the expected outputs of FFS approach of increased farmers' capacity for research, innovation and informed decision-making subsequently increase in farmer's income as reported by *Ash et al*., 2000. Thus adult education concepts and principles that underlie the design of curricula and the learning process have proven robust in all areas where FFSs have been developed and applied (Braun *et al*., 2005). Convincing evidence exists in terms of impact related to pesticide reduction, increases in productivity, knowledge gain among farmers (Rola *et al*., 2002; Praneetvatakul and Waibel, 2003) and empowerment

Table 3.Economic analysis of technological interventions on cumin at farmers' field

Demo. = Demonstration, INC = Incremental, FP = Farmers' practice

Village	Cost of cash inputs (₹ ha^{-1})	Fixed cost (₹ ha^{-1})	Total cost (₹ ha^{-1})		Add. cost in demo (₹ ha^{-1})	Sale price of grain (₹ qt^{-1})	Total returns (₹ ha^{-1})		Additional returns in demo. (₹ ha^{-1})	Effective gain (₹ ha^{-1})	B:C ratio (IBCR)
			Demo	FP			Demo	FP			
Hemawas	7500	16500	24000	19750	4250	16000	87520	75200	12320	8070	2.89
Paderly	7500	16500	24000	18910	5090	16000	91200	72960	18240	13150	3.58
Khandi	7500	16500	24000	19090	4910	16000	83200	64160	19040	14130	3.87
Baghawas	7500	16500	24000	20010	3990	16000	87680	69600	18080	14090	4.53
Manpura	7500	16500	24000	19400	4600	16000	97480	72800	19680	15080	4.27
Overall average	7500	16500	24000	19432	4568	16000	88416	70944	17472	12904	3.82

Conclusion

The average yield of the FFS demonstration plots with improved varieties and scientific technologies was higher than the yield under farmers' practice. Thus FFS programme was very effective tool in changing attitude, skill and knowledge by using improved varieties and recommended package of practices of cumin cultivation as FFS is based on the premise that the farmers participating farmers become researchers who test various technological options available, during which process they are able to decide what the best alternative for adoption is in their particular circumstance. It is a participatory approach to disseminate and fine tune the production technology in such a way that adoption rate becomes high. The field school offers farmers an opportunity to learn by doing, by being involved in experimentation, discussion and decision-making. This strengthens the role of farmers in the research-extension-farmer chain. It also improves the sense of ownership of technological packages and new knowledge and skills. The FFS approach is a direct response to the needs of the farmers. Unlike other extension tools FFS is a season long two way communication between the farmers and the facilitator who may be an extension or research worker. FFS if properly implemented enhances farmer to farmer extension of technologies and information. When the stakeholders to agricultural research are part of the planning and implementation, they have the sense of belonging and ownership. The use of FFS extension approach will make the farmer to be central to agricultural research and dissemination of cumin production technologies. This approach not only assist in problem solving, but also help in making research more relevant to the needs of the farmers and other users. To summarize, the FFS model is an important institutional and organizational innovation that needs to be studied in depth in different agro-ecological zones, different institutional arrangements and over time. Farmer Field School as a model is the most appropriate methodology for validation and dissemination of agricultural technologies which can lead to people-oriented and sustainable agriculture in developing nations.

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