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Farmer participatory seed production: extending the Indian experience to Africa

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Abstract

Quality seed is the key input for realizing potential productivity. In most of the crops, the small and marginal farmers depend on their own farm saved seeds for crop production. Moreover the crops are raised for market and a small portion of the grains are separated, stored and used as seeds in the next season which may not meet the quality aspects as expected for a seed which results in poor field stand, and ultimately low yield. Despite implementation of the organized seed programme, there exists an alarming gap between the demand and supply of quality seeds. The immediate increase in the productivity and production of these crops can be achieved by a higher distribution of quality seeds of new and high yielding varieties. In this context, the concept of seed village which advocates village self-sufficiency in multiplication and distribution of quality seeds is getting momentum. The paper deals with the concept of participatory seed production at farmer's level under the guidance of scientist/agriculture department. Case study of seed village programme for different crops and spices in selected villages have been discussed in this paper. Under this, quality seeds of improved varieties of prominent crops of the area were distributed by the Krishi Vigyan Kendra (KVK), CAZRI, Pali to the identified farmers in the area as per annual programme. The farmers used these quality seeds and took their own seed multiplication in operational area which showed a considerable spread of improved variety in nearby villages. Thus there is vast scope to produce and distribute quality seed in most crops for which seed village concept is a novel and highly practical approach and needs to be promoted to facilitate production and timely distribution of quality seeds of desired varieties at village level.

Keywords: adoption, seed village, horizontal spread.

Introduction

After soil and water, seed is one of the most important components of agricultural production and has the potential to increase crop yield by 20-30% within a very short time, which not only eradicates problems of food security but also enhances livelihoods of poor people rapidly. Most of the growing cultivars are old, are low yielding and also vulnerable to pest and diseases. In places where the national economy is mainly based on smallholder agriculture, the innovation systems approach must make sure that the interest, knowledge, priority and innovations of the smallholder farmers are occupying greater space. In countries like Ethiopia, adoption of the innovation system approach by the major actors in research and development is an opportunity, provided that the main players in the system are the smallholder farmers that make 85% of the total population in the country. Non-availability of quality seed material at the right time and place during cropping season is the common problem for farming community particularly for small and marginal farmers. It is however equally important to determine the critical innovation value, to explain a logical linkage and fair balance between technical/institutional innovations, poverty reduction and environmental safety. Existing mechanisms to meet the quality seed requirements of small-scale farmers are not adequate and

have serious limitations. In spite of many efforts, seed supply particularly of food grain crops is a serious concern till today (Hedge, 2004). Lack of timely availability of good quality seeds of high-yielding varieties is one of the major constraints contributing to stagnant yields of major crops. More than 80% of crops in developing countries are sown from seed stocks selected and saved by farmers (Almekinders *et al*., 1994). Hence, large area under food grain crops is still sown with seeds saved by farmers. Experimental evidences are there that cereal crops give 10-20 percent less yield per hactare when farmers use their own saved seed (Reddy *et al.*, 2010). The poor performance in the agricultural sector has led to decline in agricultural production and overall low economic growth. This has called for the intensification of agriculture through development of improved varieties and production technologies.

There is need of substitute to ensure availability of quality seed of improved varieties at village level and integration of informal seed enterprises and farmers in the seed production and supply systems to enable timely availability of quality seed at the door-step of farmers (Singh et al., 2018) .Village based seed banks provide an alternative seed system to these problems and help farmers become self-reliant (Reddy *et al.,* 2006).

Seed Categories

The potential yield of the crop depends on the quality of the seed used for sowing. One of the main reasons for low productivity of crops is non-availability of reliable quality seeds in local markets. To enhance productivity, seed should be of high quality, which will express full potential yield of the genotype under favorable cultivation environment .Seed used by farmers for taking up crop production belongs to one of the following types:

1) Farm-saved seed: The farm-saved seed used for crop production by farmer might be the seed saved from the crop grown on his own field or exchanged, bartered or purchased from other farmers/farmers' organizations/Community Based Organizations, etc. In India, up to 80% of seeds which are used for sowing purpose are farmer saved seeds (Singh et al, 2018). Farm-saved seed must not be confused with that of farmer's variety. Farm-saved seed may be of HYVs developed by public and private research institutes and the farmers' varieties and local landraces. Before the establishment of organized seed production system in the India, farm-saved seeds were the only source of seeds available to farmers. During the Green Revolution period, High yielding varieties (HYVs) of rice and wheat became very popular among farmers owing to high productivity. In the following decades, hybrids of pearl millet, maize, sorghum and cotton were developed, multiplied and distributed by public sector seed agencies and were quickly adopted by farmers. Private sector participation in seed R&D, production and marketing increased as a result of liberalization of Indian seed policy by enforcement of New Policy on seed Development 1988. Private sector has been concentrating its efforts on development of hybrids in low-volume and high value crops and crops of commercial interest. As a result of policy changes, farmers' dependence on seed for sowing has shifted from farm-saved seed before green revolution period through use of HYVs developed by public sector during green revolution period to proprietary hybrids and technologies developed by private sector at present. As a result, farmers' dependence on external sources of seed has increased over the period. In the process, farmers have become dependent on private seed companies, traders, seed dealers and public sector organizations for seed.

In general farmers can save seeds of varieties for 3 to 4 years without significant reduction in yield. There are instances wherein farmers use farm-saved seeds of own field for 3 to 4 years followed by purchase of farm-saved seeds from farmers in neighboring villages which would be used for another 3-4 years. For instance, farmers in Ujaliya village in Jodhpur district were using farm-saved seeds of carrot for the last 6 to 7 years without any reduction in

the quality and yield of the crop. Farmers in this village take up seed production of carrot every year on a small scale just to meet their family seed requirements. SRR of carrot by farmers in Ujaliya was only 12.5 percent (farm-saved seeds used for 8 years in succession as on rabi 2015-16) but the quality of seed was excellent as reported by farmers. Farmers were also using farm-saved seeds of onion and garlic with SRR of 34 and 27.7 percent respectively. The cases of spurious seeds were nil in case of farm-saved seeds (Dipika, 2016). When undertaken with due care, farm-saved seeds can be of highest quality since the producer and consumer (user) of the seed is the same farmer or his relatives and villagers (Manjunatha, 2015a). The exchange/bartering or purchase of farm-saved seeds is always based on trust and credibility of the seed growing/supplying farmer. Generally, the farm-saved seeds purchased from individual farmers are in the unpackaged form. Seeds sold by farmers' organizations and CBOs may be packed. PPVFRA 2001 upholds farmers' rights to save, exchange, barter, sell, use and reuse seeds of protected varieties without any restrictions except that he will not sell branded seeds of protected varieties for commercial purposes.

The participation of private sector in Indian seed system is increasing in terms of development of innovations (new varieties, proprietary hybrids and technologies), protection of these innovations (under Indian Patent Act and PPVFRA), production and marketing (value share of domestic seed market). Moreover, private seed companies are interested in developing hybrids forcing farmers to purchase seeds every year. This trend has serious implications for farmers' rights because farmers cannot save the seeds of hybrids. When he cannot save the seeds, farmers' rights have no meaning in case of hybrids. Scientists argue that terminator seeds are banned in India. But in reality and practice, hybrids and terminator seeds have same implications for farmers. Hence, technical barriers to realization of farmers' rights nullify the legal rights provided under PPVFRA 2001 in India in case of hybrids (Manjunatha, 2015b and Manjunatha 2016).

2) Certified Seed: The seed certified by State Seed Certification Agency authenticating the quality of seeds is called certified seed. Only State Seed Certification Agencies, which are autonomous bodies, can certify the seeds in India. The certified seeds will have both certification and labeling tags. The details about the certified seed and the procedure for its production are provided in the next section.

3) Truthfully Labeled Seed (TLS): TLS is a type of seed that is not certified but the labeling is done to indicate its quality or standard in a truthful manner. It is a form of regulated seed production in which seed producer/distributor declares that the seeds adhere to quality parameters even though they are not certified by third party State Seed Certification Agency. The term 'quality seed' is used synonymously to refer to TLS in the literature in Indian context. Generally private seed companies produce and supply seeds as TLS. ICAR institutes and SAUs also produce and supply TLS in limited quantities under various schemes and projects.

Production Dynamics

The production of certified and truthfully labeled seeds by farmers are discussed as under.

I) Farmer to Certified Seed Producer

Certified seed producer means a person/organization that grows or distributes certified seed in accordance with the procedures and standards of the certification. Generally, farmers produce grains for their own consumption and sale in the market. For this, there is no need to follow any prescribed rules and regulations. But, if a farmer wants to produce crop which is to

be used for the seed purpose in next sowing season, he has to follow some basic principles and procedure. Under Indian system, anybody can engage in seed production activity by registering himself/group of farmers as seed growers with State Seed Certification Agencies. State Seed Certification Agencies which are established for every State/group of States in the country take responsibility of certifying the crop which is meant for seed purpose. After certification only, the seed can be sold in market as Certified Seeds. In India, according to Seeds Act 1966, *"Seed certification is voluntary but labelling is compulsory"*. With this provision, the seed has to be labeled before selling in market and label should contain all the quality requirements prescribed under minimum seed standards which varies with crop to crop. To maintain minimum seed standards, one has to maintain minimum field standard in field from land preparation to harvesting.

II) Farmer Participatory Seed Production (FPSP)

The restructured Central Sector Scheme "Development and Strengthening of Infrastructure Facilities for Production and Distribution of Quality Seeds" was implemented from the year 2005-06. The objective of the scheme is to develop and strengthen the existing infrastructure for the production and distribution of certified /quality seeds to farmers. Seed village programme is one of the components that cover all agricultural crops. The alternate seed system model envisages integration of formal and informal seed systems to achieve the objective of providing quality seed of improved varieties at the right time and at reasonable price to small-scale farmers. The concept of village seed production is based on decentralised and technologically appropriate modes of production as a supplement, or even alternative, to rehabilitating the existing donor-financed capital intensive and centralised mode of production. The establishment of local farmer organizations has facilitated connections between formal plant breeding programs and informal seed systems by connecting farmers to demonstrations and field trials meant to provide information about the use and re-use of improved varieties, as well as by providing farmer seed producers with training and technical support (Bishaw and Turner 2008; Coulibaly et al. 2008).However, it is essential to identify farmer-preferred variety (ies) first before the implementation of the alternate seed system. Thus, the model was implemented in two steps: farmer-participatory varietal selection and establishment of Village seed bank (VSB). The objectives of this programme are:

1. To upgrade the quality of farm-saved seed, financial assistance is provided for distribution of foundation/certified seed at 50% cost of the seed of crops for production of certified/quality seeds only.
2. Assistance to train the farmers on seed production and seed technology @ Rs.15000/- for a group of 50-150 farmers.
3. To encourage farmers to develop storage capacity of appropriate quality for farmers for procuring seeds storage bin of 20 quintals capacity. Assistance @ 25% subject to maximum of Rs. 1000/- for farmers for making seeds storage bin of 10 quintals capacity in the seed villages where seed village scheme is being implemented.
4. The seed produced in these seed villages will be preserved/stored till the next sowing season. In order to encourage farmers to develop storage capacity of appropriate quality, assistance is given to farmers for making/procuring of Bin/Mud bin/Bin made from paper pulp for storing of seed produced by the farmers on their farms.

Methodology and procedure

The concept of VSBs envisages village self-sufficiency in production of quality seed by and distribution to farmers. VSBs operate under peer supervision with utmost transparency, mutual trust and social responsibility toward fellow farmers. Though this is not an entirely new concept to villagers, it is being promoted to reduce their dependence on external nonreliable sources,

including government subsidized seed distribution. The VSBs at the village level can be efficient as a micro seed enterprise. The steps involved are described below:

1. **Selection of crop and variety:** The crop which is widely grown in the region and variety recommended for the agro-climatic zone must be selected for seed multiplication (Narappa, et al, 2018). The farmers must be well versed in the production of the crop selected for seed production and its technology (Table 1).

Table 1- Technology demonstrated and popularized.

Crops	Thematic Area	Technology demonstrated	Popularization methods
Area specific	Improved production technology	Improved variety	Result Demonstration
		Seed treatment,	Method demonstration
		Line sowing	Method demonstration
		Irrigation Scheduling,	Extension activities viz. Field day, Farmers Meet, Field visit, Farmers' Scientists Interaction, crop exhibition, farmers' fair etc.
		Weed management, Integrated Nutrient Management, Integrated Pest Management	
		Post Harvest Management	

2. **Procurement of seed from authenticated sources:** The Foundation Seed or Certified Seed have to be procured from authenticated sources. The performance of whole seed production programme rests on the quality of seed supplied to farmers for seed multiplication. Efforts must be made to procure seeds directly from the research institute/state agriculture university (SAU) which has released that particular variety or from National Seed Corporation (NSC) and State Seed Corporations (SSC).
3. **Selection of participating farmers:** The success of the seed village also depends on the farmers on whose field the seed production will be undertaken. Interested and resourceful farmers were identified in the project villages to take up trials/demonstrations of selected improved varieties under the guidance of scientific staff from the consortium institutions. The farmers with previous experience in seed production were selected. The farmer must be willing to devote a major portion of land for seed production. Other criteria such as availability of assured irrigation source, suitability of soil have to be verified by actually visiting the field. Only interested farmers may be selected and forcing farmers to undertake seed production may result in negative consequences. In Malawi the concept is that agriculture department extension staffs select and supervise the smallholder farmers participating in seed multiplication. Each smallholder is supplied foundation seed sufficient for cultivating 0.4 ha. During the season a decentralised seed control unit inspects the crop, and after harvest, accepts or rejects the crop as seed. The accepted crop is bought from the farmers at a price slightly above that of the official marketing board (Friis-Hansen, 1995).

The number of villages and farmers to be selected depends on the scope of the project, resources available and the target quantity of seeds to be produced and procured. Seed production is a scale neutral enterprise in the sense that it can be undertaken irrespective of size of the landholding of the farmer. However, technical and economic considerations have to be taken into consideration in selecting number of farmers. It may be prudent to select very few farmers with larger land holdings (and willing to devote for seed production) than selecting many farmers willing to devote small area for seed production. Monitoring and field inspection of few seed plots is technically feasible and economically

viable for the sponsoring institute and certification agency. The location of the seed production plots/farm also matters. Too much interior fields far from road connectivity may be avoided.

3. **Registration of farmers and other procedures:** Project staff has to conduct a meeting of all participating farmers preferably in the village and inform the farmers about the terms and conditions of seed production related to procurement of seed, procurement price and all issues having financial implications. Memorandum of understanding (MoU) has to be signed between sponsoring institute and farmers clearly stating the objectives and other details. In case of certified seed production, sponsoring institute has to take steps to register the farmers for certification and coordination with State Seed Certification Agency. All other doubts expressed by farmers have to be satisfactorily answered before signing MoU. The roles and responsibilities of sponsoring institute and farmers have to be made clear.
4. **Close coordination between farmers and project staff:** Project staff including scientists and technical staff coordinating the programme ought to work in close coordination with farmers. Project staff has to ensure that farmers follow scientific practices such as timely sowing, maintaining isolation distance, rouging operations, pest and disease management, etc. Farmers have to be educated about the importance of these practices in quality seed production. Project staff should visit the farmers' field regularly other than for field inspection. This will develop trust between farmers and project staff. Project staff must share their phone numbers/telephone numbers so that farmers can communicate to them regularly. Even project staff must regularly be in contact with farmers over phone especially when they are not in a position to visit the seed production plot for a long time. Record keeping is a must for both the project staff and the farmers. Farmers have to be educated about the importance of record keeping. Farmers have to record both cultivation aspects as well as financial expenditure incurred in the entire programme. This helps them to compare the expenditure incurred and income generated between seed production and commercial crop production.
5. **Field inspection:** Project staff has to inspect the field to verify those factors which can cause irreversible damage to the genetic purity or seed health. In case of certified seed, persons authorized by the Certification Agency shall conduct field visit without prior notice to the seed producer. Report of the field inspection has to be handed over to the farmer. Farmer's presence during inspection may be ensured and he may be advised to take timely action based on the field inspection report. Number of field inspections may depend upon the crop and one or more inspections may be done depending on the need.
6. **Harvesting the seed crop:** Before harvesting, project staff has to make rough estimate of the yield in consultation with the farmers. This will act as benchmark/reference point for amount of seed procured by farmer after the harvest. Project staff has to ensure that harvesting of seed crop is done separately and no other seed is mixed inadvertently. These seeds have to be cleaned and processed at farmer level before it is procured by the institute.
7. **Procurement and payment to farmers:** The seeds procured from farmers have to be physically inspected and tested for quality parameters. After ensuring requisite quality, farmers may be paid as per agreed upon prices. Public organizations including ICAR institutes have the practice of crediting the money directly to the bank accounts of the farmers. This is being appreciated by farmers. It has to be ensured that payment to farmers is not unduly delayed.
8. **Seed treatment, packing and labeling:** The seeds passing the quality parameters have to be treated with chemicals to prevent seed borne diseases. The seeds have to be packed in appropriate containers/bags. General practice is that seed rate recommended for one acre is packed per container. The labeling is compulsory and the label should indicate the name of the crop, variety, quantity of seeds, date of test, date of packaging, validity period, price,

and other quality parameters pertaining to germination percentage, percent of pure seeds, inert matter, other crop seeds, weed seeds, moisture, genetic purity, etc.

Case study on Farmer Participatory Seed Production

It requires good husbandry to achieve high yields of quality seed, but this does not necessarily imply tractor mechanization or need for capital-intensive equipment. A village-based seed farm could depend on draught-oxen for ploughing, weeding and local transport. Crop processing, dressing seeds with fungicides and packing in bags can be done at the village level, using already known labour-intensive technologies. Improved seed could be produced and consumed within the same local area, thus drastically reducing the transport costs, which today make up the major part of the present seed price. At 1988 prices, the estimated production cost of improved composite maize by village-based seed farms in Tanzania was 10 times less than the consumer price of hybrid seed (Friis-Hansen, 1995). Village-based seed farms could constitute a sustainable model for securing sufficient and stable supplies of improved seeds. Breeder seed production of the varieties and hybrids developed by the respective institutes as per the indent of the Ministry of Agriculture is one of the important mandates of the Indian council of agriculture research (ICAR) institutes and State Agriculture Universities (SAU) in the country. Other than breeder seed production, ICAR institutes and SAUs undertake production of foundation and certified/quality seeds in a limited scale. ICAR-CAZRI regularly undertakes the TLS production of pearl millet, green gram, moth bean, cow pea and cumin. Generally large scale seed production is being undertaken in the farms of the institute only. Farmer-participatory seed production is also being undertaken in limited scale.

i. Seed village programme for arid pulses:

To promote the pulse production at the national level, Ministry of Agriculture and Farmers' Welfare, Government of India has initiated a project entitled, "Creation of seed hubs for increasing indigenous production of pulses in India" under National Food Security Mission for 2016-18. ICAR Institutes, SAUs and Krishi Vigyan Kendra (KVK) are involved in this project. A case study on farmer-participatory seed (TLS) production of selected crops undertaken by ICAR-Central Arid Zone Research Institute is provided in the subsequent section. Central arid zone research institute (CAZRI) took seed production of green gram, moth bean and cow pea. In the rainy season of year 2016-17, production of TLS of green gram, moth bean and cow pea was undertaken in the farmers' field in participatory mode. Participatory seed production was based on MoU between CAZRI and participating farmers. Participatory seed production was undertaken in villages in Jodhpur and Pali districts. The participating farmers were identified based on certain criteria such as experience in organized seed production, availability of assured irrigation facilities and farmer's interest. The information pertaining to varieties and villages where seed production was undertaken is given in table 2.

Table 2: Details of farmer participatory seed production undertaken

Crop	Variety	Yield of improved variety (q/ha)	Farmer practice yield (q/ha)	Villages where seed production was undertaken
Green gram	IPM-2-03	8.2	4.2	Kanodia, Tinwari, Kotra and Ujaliya villages in Jodhpur district and Sinla, Sari ki Dhani villages in Pali district.
	GM-4	8.4	4.1	Sonai Majhi, Sari ki Dhani, Sindhion ki Dhani

				and Dalpatgarh in Pali district.
Moth Bean	CZM-2	5.8	3.8	Kanodia, Tinwari, Kotra and Ujaliya villages in Jodhpur district and Dalpatgarh and Khutani villages in Pali district.
Cow Pea	RC-101	7.3	4.12	Tinwari and Kotra villages in Jodhpur district and Sardarsamand village in Pali district.

The technical guidance and assistance to farmers in Jodhpur and Pali were provided by scientists of CAZRI and KVK, Pali respectively. In general the productivity was high in case of improved variety in all the three crops as compared to the local farmers practice using traditional variety. The seeds produced by the farmers were procured back by CAZRI and farmers were paid a premium price. The price fixed by CAZRI was higher by Rs. 1200 to Rs. 1500 over and above the existing market price for seeds grown for commercial purpose. The participatory seed production was successful in all villages in terms of farmers' participation and achievement of seed production targets.

ii. Seed village programme(SVP) for cereals and spices:

To fulfill the requirement of quality seed in arid zone seed village programme was undertaken by KVK, Pali in selected villages for cereals like wheat, barley, mustard and spice crops like cumin, fennel, fenugreek and Ajwain. Under this programme improved varieties of selected crops were distributed as per action plan and the programme was implemented.

a. Yield gain and improved variety through SVP: The findings (Table 3) revealed that there was a substantial increase in the yield of selected variety in all the crops as compared to the local or traditional variety used by the farmers (Table 3). In wheat the varieties Raj 4037 yielded 42.2 q/ha as compared to 33.9 q/ha from local variety thus showing 24% increased yield advantage. In mustard there was a 35.7 % yield advantage by using improved variety Urvashi over the local variety. In barley the variety RD 2035 yielded 39.90 q/ha over the local variety which yielded 29.20 q/ha thus gaining a yield advantage of 37% .Similarly in cumin the SVP farmers got an average yield of 6.7 q/ha from cumin variety RZ 223 as compared to local variety yielding 4.2 q/ha, thus depicting an yield advantage of 60% over the local variety. Increased yields were also obtained in case of Ajwain, fennel, cumin and fenugreek. The results are also in accordance with the results of Singh *et al.* (2011) who stated that improved agricultural technologies and varieties significantly increased the yield in Rabi crops under normal climatic conditions. Research suggests that there is good potential for improving performance and productivity in the agricultural sector which can only be attained through positive transformation of the sector, including increased availability and use of improved variety (Ampofo, 1990). The agricultural sector has benefited from myriad interventions that seek to improve yield, reduce poverty and increase incomes. Farmers have benefited much from the dissemination of high-yielding crop varieties in addition to other complementary technologies (Langyintuo and Dogbe, 2005; Faltermeier, 2007).

Table 3- Comparative yield of improved vs local variety of different crops under SVP

S. No.	Name of crop	Variety	Yield of improved variety (q/ha)	Farmer practice yield (q/ha)	Per cent increase
1.	Wheat	Raj 4037	42.20	33.90	24.48
2.	Mustard	Urvashi	20.90	15.40	35.71
3.	Barley	RD 2052	39.90	29.20	36.64
4.	Ajwain	AA-1	13.7	9.80	39.8
5.	Fennel	RF-125	16.6	10.4	59.6
6.	Fenugreek	RMt -305	15.4	10.5	46.7
7.	Cumin	GC- 4	10.8	5.90	70.2
8.	Cumin	RZ 223	6.70	4.20	59.52

Further an attempt was made to find out the economics of the improved variety and to compare it with the local variety (Table: 4). The experimental findings revealed that in all crops the cost of cultivation of local variety was at par with the improved variety but in case of the gross returns and benefit cost ratio, a significant difference was observed. In general the B: C ratio for improved variety used in SVP ranged from 2.1-3.9 whereas in case of local variety it varied from 1.4-2.9. These results are also in close proximity with the result of Singh *et al.* (2005 & 2009) who reported similar results while experimenting with different crops. This has been achieved mainly due to the adoption of new varieties and improved production technology.

Table 4: Comparative economics of improved vs local variety of different crops under SVP

S. No.	Name of crop	Gross Return (INR/ha.)		Cost of cultivation (INR/ha.)		B:C ratio	
		Improved Variety	Local Variety	Improved Variety	Local Variety	Improved Variety	Local Variety
1.	Wheat	55,205	35,200	26,200	25,000	2.1	1.4
2.	Mustard	78,300	59,400	20,900	20,000	3.7	2.9
3.	Barley	50,715	33,600	18,600	17,900	2.7	1.9
4.	Cumin	89,800	68,200	32,300	32,000	2.8	2.1
5.	Ajwain	14900	14200	56600	41800	3.7	2.1
6.	Fennel	21500	20300	66500	51900	3.1	2.5
7.	Fenugreek	17800	17000	69900	44400	3.9	2.3
8.	Cumin	23500	22200	71500	59800	3.0	2.6

b. ***Horizontal spread of improved variety through SVP:*** Wheat variety Raj. 4037 has more number of effective tillers and higher number of grains per spike. It performs well even under slightly saline irrigation water and soil conditions, hence from an initial of 12 farmers it spread to 55 farmers covering 10 cluster villages (Table 5). Also the area increased from 6 hectare to 23 hectares. Early vigorous growth and branching of Mustard variety Urvashi spread to 7 villages covering 67 hectares of land. RD 2035 barley is four row varieties which is high yielding under even under slightly saline/ sodic irrigation. From an initial number of 10 farmers it spread to 39 farmers covering 67 hectares of land. Cumin var. RZ 223 is resistant to powdery mildew and blight.This variety produced good quality seed with better aroma due to higher volatile oils as compared to local one. This variety spread to 91 farmers from an initial of 12 farmers and covered an area of 175 hectares. Similarly other spice crops like Ajwain, fennel, fenugreek and cumin also showed a considerable spread in area with increase in number

of farmers. The results are in accordance with the findings of Pandit *et al.* (2011) who concluded that farmers emphasized more on simultaneous selection rather than empirical selection on yield only. Farmers' selected varieties are extending very rapidly and farmers to farmers seed transfer were found very effective in scaling-up seed transfer and increase varietal diversity. Joshi *et al.* (1995) also reported that in addition to grain yield, farmers also consider other parameters like growing period, plant height, threshability, milling recovery, taste and other characters of rice. Farmers contribute in goal setting in identifying traits and in providing a testing system that is multi-farmers, multi-locations and allow the trade-off between many traits (Joshi *et al*., 2002).

Table 5: Horizontal spread of improved variety from seed villages

S. No.	Name of crop	Variety	Number of farmers		Number of villages		Area covered (ha.)	
			Initial	Final	Initial	Final	Initial	Final
1.	Wheat	Raj 4037	12	55	2	10	6	23
2.	Mustard	Urvashi	6	35	3	7	10	67
3.	Barley	RD 2035	10	39	4	12	8	26
4.	Cumin	RZ 223	12	91	5	18	22	175
5.	Ajwain	AA-1	23	65	5	13	21	69
6.	Fennel	RF-125	37	89	7	11	25	82
7.	Fenugreek	RMt 305	44	96	5	8	33	67
8.	Cumin	GC-4	65	123	8	13	37	175

C. Adoption of improved seeds under seed village programme: Data presented in Table 6 revels that for all the selected crops i.e. wheat, mustard, barley Ajwain, fennel, fenugreek and cumin, the beneficiary farmers have high level of adoption ranging from 52.7%-86.81% whereas in case of local variety the adoption rate was very low ranging from 13-47% showing the importance of improved variety over the traditional variety. results from Malawi indicated that, all seed produced by seed village has been sold shows that the scheme has been filling a real demand for seed(Friis-Hansen, 1995).. The main criteria for such high adoption rate are high yield with superior plant and grain characters. The results are also in conformity with Rashid *et al*. (2004) who indicated that farmers consider other characters like bold grains, large spike, strong stem, earliness, etc., along with yield therefore, breeders have to emphasize farmers' attitudes during selection; otherwise their varieties may not be well accepted by the users. Above findings are also in line with the findings of Baksh *et al.,* 2003, Singh *et al*., 2007 and Kudi *et al.,* 2011 who pointed that high yield, got the highest score and ranked first in adoption followed by other post harvest characters.

Table 6: Adoption of improved seeds by the farmers in seed villages

S. No.	Name of crop	Variety	Per cent adoption	Variety	Per cent adoption
1.	Wheat	Raj 4037	78.18	Local	21.82
2.	Mustard	Urvashi	82.85	Local	17.15
3.	Barley	RD 2035	74.36	Local	25.64
4.	Cumin	RZ 223	86.81	Local	13.19
5.	Ajwain	AA-1	55.3	Local	44.7
6.	Fennel	RF-125	52.7	Local	47.3
7.	Fenugreek	RMt 305	60.2	Local	39.8
8.	Cumin	GC-4	72.4	Local	27.6

Conclusion

Under the participatory mode of seed production seed village program is very effective tool for combating seed shortage at village level. A substantial increase in the yield of selected crop varieties was obtained as compared to local varieties with a high rate of horizontal spread of seeds to more farmers. The results also show that for all the selected crops the beneficiary farmers recorded high levels of adoption for improved varieties as compared to local varieties. All of this shows their willingness to accept new technologies. seed village concept is a novel and highly practical approach and needs to be promoted to facilitate production and timely distribution of quality seeds of desired varieties at village level in developing nations.

Recommendation and Implication

- The SVP is an efficient and sustainable model that can be out scaled to other crops and areas.
- There is need to form a network between research institutes, agencies involved in quality control and various NGOs, community-based organizations (SHGs, farmer schools, farmer youth clubs, farmer associations) interested in various aspects of seed production and utilization.
- In SPV there is ample scope for farmer-participatory varietal selection and feedback to the scientific community on the performance of cultivars.
- SVP is sustainable because of farmers' involvement from the beginning of seed production, storage and marketing through their own investment.
- This initiative enhances the crop productivity leading to overall positive impact on the livelihoods of farming communities.

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