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Participatory Approaches for Varietal Improvement, It's Significances and Challenges in Ethiopia and Some Other Countries: A Review

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Abstract: *Participatory approaches have become a motivating force for agricultural investigation and rural development for example participatory plant breeding (PPB) and participatory varietal selection (PVS). Over the earlier decades these approaches have been established as an alternative to centralized breeding methods designed to better incorporate the perspective of end users into the varietal development process to efficiently address the desires of the agriculturalists for increasing food security and improving livelihoods of farmers, especially in resource poor areas.In search of this concept, this review article argues the concepts, advantages, experiences, impact and challenges in these participatory approaches stressing the existing evidence of success by various authorities from different countries. From setting activity goals to choosing variable, early generation material in PPB, farmers are actively involved in the breeding process. Farmers are given a wide range of new cultivars to test for themselves in their own fields In case of PVS. In some of the crops the breeder and farmers selection were almost similar nonetheless on some other crops differences existed. Since participatory approaches include research and development oriented procedures to organize genetic materials at on farm experiment so that the variety developed through participatory approaches remarkably increased varietal diversity that can meet demand of different stakeholders. It could be concluded that, the " rights of new technologies being tested and transferred; increasing degree of farmers" awareness, increase varietal diversity and mobilization of farmers "are some of the benefits of participatory research approach includes improvement of farmers' indigenous knowledge available within local communities for proper planning and empowerment.Various authors" indicated that participatory approach is a dominant way to encompass farmers for selecting and testing new cultivars that are adjusted to their needs, cropping systems and existing environments. Therefore, for viable progress and benefit particular to the desires and circumstances of farmers, appropriate execution of participatory approach in research and development programs is decisive particularly for small scale and resource poor farmers.*

Keywords: *Participatory, PVS, PPB, farmers, improved varieties*

1. INTRODUCTION

Development of a sustainable production system suitable for diverse ecological, social and economic environments has been among the biggest problems encountering agricultural research, especially in developing countries. Particularly in developing country, the increase in population and succeeding rise in the demand for agricultural products are expected to be greater in regions where the production is already inadequate. Agricultural technologies progress plays a significant role in the improvement and underpinning of indigenous agricultural systems. Growth in agriculture is fundamental or backbone to the overall economic growth as result large share of agriculture in the Ethiopian economy (Yazzie Chanie, 2015). Currently, to achieve the planned goal for agricultural growth programme phase-2 (AGP-II) the government of Ethiopia designed an approach; community level participatory planning (CLPP) to make the agricultural activities demand driven and problem solving.The Ethiopian government also offers considerable resources to agricultural research and extension in view of inspiring small-scale farmers to rise their productivity and to enable them achieves food self-sufficiency. Herein, numerous improved crop technologies (crop varieties, improved management practices, pre and post-harvest technologies) have been generated, evaluated and made ready for users through research but few of them have failed to find their way into the smallholder farming systems probably because they were not fitted to the smallholder farmer's needs and production environment. Moreover, not all the released and high yielding varieties were equally accepted by farmers due to differences in farmers" preference for the crop varieties in diverse localities. This was because the varieties were developed through conventional breeding that didn"t consider farmers" criteria. The rate of adoption of most of the varieties developed by the conventional breeding approach is believed to be

far below expectations (Gemechu et al. 2004). The major stakeholders are not involved in the selection and development of the varieties in conventional breeding that is why most breeding experiments suffer from the disadvantage. As stated by Osiru et al.,(2010) this scenario leads to poor adoption and diffusion of the resulting technologies. Hence, involving or participating farmers who are the key beneficiaries of improved agricultural technology is mandatory. Today involvement of farmers‟ in agricultural activities are fundamental. According to Cromwell et al.,(2003) Participatory processes grew out of what is seen as inappropriate varieties, practices or extension that did not fit local environmental conditions and specific social needs.

So as an alternative to centralized breeding, farmer participatory approaches using participatory varietal selection and participatory plant breeding can be used. PPB is an extension of PVS whereby the results of PVS were exploited by using identified cultivars as parents of crosses. Participatory variety selection (PVS) refers to processes whereby farmers are involved in selecting lines that they judge to be most appropriate for their own uses from among a range of fixed (stable) lines that are being field tested. PPB generally involves a higher and more complex degree of involvement of farmers, as they are engaged in decision-making in earlier and more fundamental stages of the variety development chain; PPB therefore has a higher empowerment effect than PVS (Witcombe 2005). Ortiz-Ferrara et al., 2007 reported that PVS is meant involving farmers from planning, to promotion of new and old crop varieties.

Participatory variety selection is broadly defined as an approaches that involve a mix of actors (including scientists, breeders, farmers and other stakeholders) in plant breeding stages (Fekadu,2013). Because the objective is to produce varieties, which are adapted to both physical and to the socio-economic environment in which they are utilized. Hence, as stated by Ashby (2009), the outcome of PVS is that more farmers adopt PVS varieties over wider areas, leading to increased food and income benefits. Witcombe et al. 1996 suggested that participatory Varietal Selection (PVS) can be utilized to identify acceptable novel varieties and thereby overcoming the constraints that cause farmers to grow landraces or obsolete cultivars. Farmers‟ participation in the bean variety selection in their production environments ensures acceptance and eventual adoption of common bean varieties (Fekadu, 2013), maize (Daniel etal.2014, De Groote et al. 2002), bread wheat (Asaye et al., 2014), soybean (Adissu etal.2016), rice (Joshi and Witcombe, 1996) and Faba bean (Tafere etal.2012).

Participatory varietal selection experience in Ethiopia and other countries showed that the maize, common bean, soybean, bread wheat, faba bean, rice varieties were highly preferred by farmers. Hence, in various countries participatory variety selection has been used successfully to identify different varieties and these varieties are also spreading within and outside the PVS study areas. It has been reported that PVS as an efficient approach for disseminating new improved varieties (Joshi and Witcombe 1996; Ortiz-Ferrara et al., 2007; Thapa et al. 2009; Witcombe et al. 2003).

Depending on who controls the breeding process (researchers or farmers) and the scale on which the work is undertaken (community-centred or research to extrapolate results) two broad categories are usually differentiated: 'farmer-led' and 'formal-led' PPB. The success of this, and other, PVS and PPB programmes in identifying preferred varieties is not reviewed and well documented. It is less well understood how improved varieties selected through participatory variety selection and PPB. Therefore, this work would give emphasis for overview of participatory agricultural research experience and its concepts, impacts, significance as well as key challenges. It would help to inform main actors i.e. agricultural research institutes, ministry of agriculture, agricultural universities and non-governmental organizations (NGOs) working in the area to see and revise their method of acting towards farmers interests and incorporate farmers‟ needs at the grass-root level in to their development plans.

Therefore the general objective of this seminar work is to review participatory agricultural research experiences, findings of participatory selection (PVS) research data emphasizing Ethiopia, PPB approach and its importance as well as key challenges.

2. SOME DEFINITIONS OF PARTICIPATION AND APPROACHES

It may be difficult to give a sole definition of participation as the exercise and assumption or theories differ considerably (Lilja and Ashby, 1999 cited in Yazie Chanie, 2015). World Bank (2007) defined

participation as the method over which stakeholders‟ inspiration and share control over priority setting, policy-making, resource allocations and access to public goods and services. It indicates "authorizing people to congregation their personal abilities, be social actors, rather than passive subjects, manage the resources, make decisions, and control the activities that affect their lives."(Cernia, 1985).

Participation can be any „voluntary contributions by rural people to pre-determined programs or project‟ like participation in a survey, serving as key informant, or participation in an experiment which is researcher-managed trials. Pearse and Stiefel, 1979 reported that participation as the planned efforts to increase control over resources and regulative institutions in given social situations on the part of groups and movements hitherto excluded from such control. Hence, participation for this deskwork purpose is "any voluntary cooperation or collaboration and contributions of farm households to any research and development programs or projects". As stated by Narayan, 1993 participatory development has been defined as involving users and communities in all stages of the development process.

Degrees of participation: degree of participation may vary according to nature of research topic, level of researchers‟ facilitation skills, experience of farmers in on-farm trial and level of shared trust between researchers and farmers. Participation level is often defined by a scale as collaborative, consultative, farmer managed and researcher managed.

Participatory plant breeding is the method by which farmers are involved in a plant breeding programme regularly with chances to make decisions throughout. According to Halewood et al. (2007) involvement of farmers in PPB can take many forms: defining breeding goals and priorities; selecting or providing sources of germplasm; hosting trials on their land; selecting lines for further crossing; discussing results with the scientists; planning for the following year‟s activities; suggesting methodological changes; and multiplying and commercializing the seed of the selected lines.

Participatory variety selection (PVS) refers to processes whereby farmers are involved in selecting lines that they judge to be most appropriate for their own uses from among a range of fixed (stable) lines that are being field tested. PPB generally involves a higher and more complex degree of involvement of farmers, as they are engaged in decision-making in earlier and more fundamental stages of the variety development chain; PPB therefore has a higher empowerment effect than PVS (Witcombe 2005).

3. TYPES OF PPB

PPB approach can be consultative and collaborative. It will be influenced by the crop and the availability of resources. Consultative: Farmers are consulted at every stage for instance, in setting the breeding goals, choosing the appropriate parent, and by making shared selections with breeders from material grown by breeders. Hence, until there is a finished product from the breeding programme for farmers to test in PVS trials, farmers are not involved in growing material in their fields.

Collaborative: Farmers grow the variable PPB material in their own fields and select the best plants from it. Researchers can then obtain seed from farmers to test their selections in research station and participatory trials.

It was used when no prevailing cultivars are identified that are appropriate for testing in a PVS programme and when PVS has been tried nevertheless has failed to identify any varieties that farmers desire. Furthermore to make crosses the PVS can be efficiently pursued by PPB since farmer preferred cultivars are the ideal parents for PPB programmes. Some examples are PVS cultivar x high-yielding variety, local landrace x PVS cultivar and local landrace x high-yielding variety.

4. BENEFITS OF PARTICIPATORY APPROACHES

4.1. Participatory Plant Breeding

PPB methods suggests a number of possible reward compared to the conventional approach to plant breeding.

Cost-efficiencies and effectiveness: fewer research dead-ends, additional occasions for cost sharing in research and less expensive means of diffusing varieties. Actual meeting of user needs higher degree of farmer pleasure, wider range of users reached, including marginal farmers and promotion of group learning through farm walks. There is often a tradeoff between yield and early maturity.

An early maturing crop variety escapes common end of season droughts, and produces a harvest at the hungriest time of the year, before other crops mature, reaches the market first, so its grain fetches a higher price (Witcombe, J.R. 1998)

Enhancement of Biodiversity: societies have broader access to germplasm, wider access to related knowledge and increased inter- and intra-varietal diversity.

Production gains: yield and stability increases, faster uptake, wider diffusion and higher market value of products.

4.2. Participatory Variety Selection

In traditional breeding and testing programs, on-farm trials are conducted as the final step (variety verification) in a long selection procedure that may include many replicated trials conducted on research stations. Researchers usually succeed conventional on-farm trials. These experiments are good for measuring agronomic traits, however they often do not include a phase where farmers are asked their view about the varieties in the test. PVS trials are managed by farmers or use the same management techniques used by farmers, and they always include a stage in which farmers‟ ideas are collected in a way that allows the information to be shortened as numbers or ratings, as well as in lists of farmers‟ comments about the varieties.

In this phase, the views of women farmers, poor farmers, and farmers from minority ethnic and social groups are precisely sought. Thus benefiting disadvantaged beneficiary groups, such as women, by promoting gender equity in access to resources and agricultural knowledge through participatory research should be social goals of participatory research (Thelma et al., 2007).

World Bank (2007) PVS approach needs to be more widely tested in the heterogeneous rain fed environments of Africa, where involving farmers, especially women farmers, in selecting varieties has shown early successes for beans, maize, and rice. In Syria scientists working in the Barley Program at ICARDA carried out a groundbreaking piece of participatory research with the involvement of women in the determination of best varieties adapted to their unique environments were considered an important achievement in an agricultural practice that has been dominated by male farmers (Patricia, 2011).

PVS approach encompasses three steps to identify preferred variety; situation analysis and identify farmers‟ needs; search for genetic materials to test in farmer's condition; Experimentation of on-farm research and dissemination of favored varieties. The situation analysis categorizing farmer's needs requires community meetings to identify, prioritize and document specific varietal traits preferred by farmers.

PVS is a simple way for breeders and agronomists to learn which varieties perform well on-farm and are preferred by farmers. Introducing PVS into a variety development program can increase the chances that its products will be adopted. Various authors‟ recommends that PVS procedures be included as a standard part of crop breeding programs. There are two basic stages in the recommended PVS system: - The mother trial is an on-farm trial in which a set of new lines or introduced varieties is compared with local checks using farmers‟ crop management practices. In this step, agronomists measure yield and other important traits. Groups of farmers are invited to visit the trial and rate the varieties using a simple technique called preference analysis (PS).

If the "mother" trial already conducts researcher-managed on-farm trials, demonstration trials in which data are collected, or even advanced on-station multi-location trials at several research centers, farmers can be invited to visit the trial site.

The "baby" trial: Varieties that perform well and are chosen by farmers in the mother trial are evaluated by farmers on their own farms in baby trials. Baby trials are small trials of 2 to 5 varieties that are given directly to farmers. Researchers do not lay out these trials. They are planted and harvested by farmers. Researchers may take crop cuts to measure yield if resources permit, but farmer ratings, comments, and yield reports have been shown to be highly reliable and are the main output of the baby trial. Farmers rate the varieties in comparison to their own cultvar.

5. MAIN BARRIERS TO RATE OF ADOPTION OF IMPROVED CROP VARIETIES AND APPROACHES TO OVERCOME IT

Adoption rate of improved crop cultivars has been limited in some systems.

Three main reasons are often suggested for this poor rate of adoption:

5.1. Varieties Selected on Research Stations may Not Perform Well Under Farmer Management

The problem of variety trials carried out on the research station are often managed very contrarily from farmer practice. For instance, researchers apply more fertilizer, achieve more complete weed and pest control, and irrigate more frequently than farmers can.

High-yield varieties that perform well under these "high-input" conditions may not perform well under more stressful conditions faced by poor farmers who cannot spend much on purchased inputs or who lack the labor to completely control weeds. So participatory variety trials, which are conducted on-farm and under the complete management of farmers, provide information about the performance of new varieties under the real conditions faced by farmers. Traits like weed competitiveness and yield under low-fertility conditions can be assessed in PPB and PVS trials.

5.2. Breeders may not be Aware of Some of the Important Traits that are Needed or Chosen by Farmers

Similarly the difficulty of conventional varietal testing focuses on agronomic performance (traits like yield, duration, and disease resistance), but farmers consider many other features of a new variety when deciding whether or not to adopt it. Cooking and eating quality is a critical factor in the adoption of new varieties. Farmers may also be concerned with straw quantity, weed competitiveness, harvestability, and storability. These factors are very hard to evaluate in conventional variety testing programs, but may be strongly related to farmers‟ decisions on adoption. Therefore, conducting PPB & PVS trials involving farmers include formal steps in which farmers express their opinions and preferences about varieties under evaluation. Farmer input is sought on both production and end-use traits, using tools that ensure that traits important to farmers are emphasized. This input is very useful in predicting whether or not farmers are likely to adopt a variety.

5.3. Farmers may not have Access to Information about or Seed of New Varieties

Many farmers in rain fed environments rely almost entirely on their own seed supply for planting material, and on their relatives, friends, and neighbors for new germplasm. They may be unaware of or have no access to improved varieties. Therefore, PPB & PVS trials are an inexpensive and effective way to expose farmers to new germplasm. Farmers often freely adopt varieties they observe or grow on their own farms in PVS trials. In some situations, dissemination of varieties is one of the goals of PVS trials.

However, the main purposes of participatory approaches are to provide information about variety performance and acceptability. Other mechanisms, notably large-scale seed distribution schemes, are likely to lead to more rapid dissemination of farmer-preferred varieties.

6. ACHIEVEMENTS, FARMER'S EVALUATIONS AND EXPERIENCES OF PARTICIPATORY APPROACHES IN DIFFERENT COUNTRIES

PPB and PVS experience indicated that farmers involved in these approaches are researchers beside the plant breeders. Smith and Weltzien (2000) also indicated that certain farmers are known for their skill in seed selection and saving and are especially good to have on a participatory breeding team. Though the skill of farmers in selection and their ability to handle distinct populations is often questioned, in many projects farmers have proved to be vastly knowledgeable.

Sthapit et al. (1996) stated that participatory rice breeding program in Nepal in increased the farmers effort and time they invested in breeding as the project started showing results . Joint selections by farmers and breeders have produced most of the successful lines from this program. Lines selected by farmers have become popular and are spreading to other villages in the area (Gyawali et al. 2007).

Ceccarelli et al.(2001) also reported that in Syria, farmers were more effective than breeders at selecting superior barley genotypes in their own fields, and farmers were able to handle large numbers

of entries, including segregating materials in early generations in participatory barley breeding program. Ashby (2009) highlighted the impact of PPB and PVS on various crops such as cassava in Brazil and Colombia; pearl millet in Namibia and India; beans in Colombia, Tanzania, Ethiopia and Rwanda; tree species in Burundi; potatoes in Rwanda, Bolivia, Peru and Ecuador; rain fed rice in India; paddy rice in Bangladesh, India and Nepal; maize in Mali, India, Ethiopia, Honduras and Brazil; and barley in Syria, Morocco and Tunisia by citing different authors.

Kirsten (2010) reported that in Burkina Faso, varieties with a short growing cycle are planted in villages or house fields –mainly due to better bird control – while later-maturing varieties are allocated to farmland or bush fields Selection decisions can thus vary depending on availability of fields and human resources for managing two sowing dates . Similarly in Rwanda, farmers identified as bean experts helped make selections on-station by ranking breeding lines for traits of interest and then taking 2–3 of these lines to grow in home gardens alongside their traditional mixtures. The lines identified by local farmers out-yielded the local mixtures 64–89% of the time, with an average increase in yield of 38%.

In contrast, Sperling et al. 1993 indicated that breeder selections out-yielded local mixtures 41–51% of the time on a national scale, with an average 8% increase in yield. In Ethiopia, some efforts have been made to develop and popularize common bean varieties through both PPB and PVS (Asfaw *et al.*, 2004; Gurmu, 2007); popularize through PVS. On common bean (Fekadu, 2013); on maize (Daniel etal.2014, De Groote et al. 2002), on bread wheat (Asaye et al., 2014), on soybean (Adissu etal.2016) and on Faba bean (Tafere etal.2012).

6.1. PVS in Bread wheat in West Gojam Zone , Ethiopia

Participatory varietal selections are farmer-centered varietal selections limited to testing of the finished varieties. Farmers evaluate various traits that are vital to them and help to increase on-farm varietal diversity, faster varietal replacement and rapid scaling up. Besides, quality traits on wheat like percentage of milling, taste,cooking and keeping quality and market price can be assessed in PVS that are difficult or expensive to evaluate in conventional trials (Asaye et al, 2014)

Table1. *Farmers' preference scores and ranking of grandmother trial.*

	Parameters and scores								
Varieties	Plant stand	Number of tillering	Seed coat color	Seed size	Spike length	Number of kernel	Disease resistance	Total scores	Rank
Paven-76	3.6	2.3	2	2.3	2.6	2	1.3	16	8
HAR1685	4.3	5	3.3	4	4.3	4.3	3.3	28	2
Millennium	4	2.6	2	2	2	2	2	17	7
Plcafeor	3.3	3	2	2	2	2	2	16	8
HAR3730	5	3.6	4.6	4.6	5	4.4	4.6	31	1
ETBW5518	4.3	3	2.3	2.3	4.3	3.6	4.3	24	4
ETBW5519	2.6	3	2	2	2	2	4.3	18	6
ETBW5520	3.6	3.6	2	2	3	2.6	3	20	5
ETBW5521	5	3.3	3	3	4.6	3.3	5	27	3
ETBW5522	3.6	3.6	2	2.3	2.6	3.3	3	20	5
ETBW5525	5	4	2.6	3.3	4.3	4	4	27	3
ETBW5526	4.6	3.6	3	3	5	4	4.6	27	3

N.B: *Farmers preference ranking, key for scaling (1-5); 1=least 5=best. (Source: Asaye et al., 2014)*

Table2. *Mean separation of different agronomic traits for 11 treatments in grandmother trial*

Treatments	PH	SL	SKPSP	YD	HLW	TGW	LR	GFP	MA	HD	HI
Paven-76	92.2abc	8.2dc	16.4bcd	3.4d	75cde	27ef	21.6cd	43.6f	103.3e	59.6f	34.2cde
HAR1685	85d	8.2dc	15.8cd	4bcd	72.2e	25f	23.3cd	47bc	111ab	64abc	32.7cd
Millennium	93abc	7.8d	16.6bcd	3.7cd	77.2abc	30.3cde	33.3ab	46.6bcd	110.3b	63.6bcd	35.5bcde
Plcafeor	90.1bcd	8.4dc	16.6bcd	4.8ab	77.3abc	35ab	18.3d	49a	105de	56g	41.2ab
HAR3730	97.4a	9.2ab	17.2b	5.4a	80.8a	35.3a	33.3ab	45.6de	107.6c	62de	45.6a
ETBW5518	93.6abc	8.4dc	17bc	5.3a	79.8ab	33.6abc	28.3bc	46.6bcd	110.3b	63.6bcd	40.7abc
ETBW5519	88.8cd	8.4dc	17.2b	3.5d	74.5cde	26f	21.6cd	47.6b	113.3a	65.6a	31e
ETBW5520	92.5abc	8.2dc	15.3d	4.4abcd	75.7cde	31bcde	28.3bc	46cde	107cd	61ef	37.1bcde

ETBW5521	94.9ab	8d	16.8bc	4.7abc	77.6abc	33abcd	23.3cd	47.3b	111.6ab	64.3ab	37.6bcd
ETBW5522	94.8ab	9.73a	15.7cd	4.1bcd	74.8cde	31.6abcd	16.6d	45.3e	107.6c	62.3cde	37.3bcde
ETBW5525	96.6a	8.7bc	19.1a	4bcd	73de	29def	21.6cd	47bc	111ab	64abc	34.4cde
ETBW5526	95.3ab	9.8a	16.2bcd	4.6abc	76.2bcd	30.6cde	36.6a	47bc	112.3ab	65.3ab	37.2bcde
Mean	92.88	8.61	16.68	4.36	76.2	30.63	25.55	46.58	109.22	62.63	37.07
CV (%)	3.55	4.32	4.88	14.05	3.05	7.8	19.09	1.44	1.33	1.72	10.48
LSD	5.58	0.63	1.38	1.03	3.94	4.05	8.26	1.14	2.46	1.83	6.58
SE	1.9	0.21	0.46	0.35	1.34	1.37	2.81	0.38	0.83	0.62	2.24

PH=Plant height (cm), SL= spike length (cm), SKPSP= spikeletes per spike, YD= grain yield (t/ha), HLW= hectoliter weight (kg/hl), TGW= thousand grain weight (g), LR= leaf rust (%), YR= yellow rust (%), GFP= grain filling period, MA=days to maturity, HD= days to heading, HI= harvest index, CV(%)= coefficient of variation, LSD= least significant difference, SE= standard error,Alpha = 0.5. (Source: Asaye et al., 2014)

Table3. *Mean yield of the bread varieties in grandmother trial.*

Treatments	Yield(t/ha)	Ranks for yield
Paven-76	3.4d	11
HAR1685	4bcd	8
Millennium	3.7cd	9
Plcafeor	4.8ab	3
HAR3730	5.4a	1
ETBW5518	5.3a	2
ETBW5519	3.5d	10
ETBW5520	4.4abcd	6
ETBW5521	4.7abc	4
ETBW5522	4.1bcd	7
ETBW5525	4bcd	8
ETBW5526	4.6abc	5
Mean	4.36	
CV (%)	14.05	
LSD	1.03	
SE	0.35	

CV(%)= coefficient of variation, LSD= least significant difference, SE= standard error, Alpha = 0.5.(Source: Asaye et al., 2014)

6.2. PVS in Common Bean in Sidama Zone of Southern Ethiopia

The farmers' usually give priority to common bean qualitative traits such as seed color, drought tolerance, disease resistance, marketability, seed size, shattering tolerance, taste and cooking time which indicates farmers choice criteria for common bean were beyond yield (Fekadu, G. 2013). Based on these criteria, all farmers who participated in the common bean mother trial preferred the variety Ibado as a number one variety because of its seed color (red speckled), seed size (large), demand in the market (high), early maturity (<90 days) and relatively good yield (>2 tons ha-1). The local variety was ranked second as a result of its seed color (light red), marketability and taste (Table 5). Whereas researchers selected Awash-1 and Omo-95 based on grain yield (Table 4). He stressed also that farmers were well conscious of the selection criteria and they know how to select and rank the varieties. Some of the criteria match with the breeder's ones and some are beyond breeder's expectations. This is substantiated by the report of Gemechu *et al*. (2002), who reported that growers and scientists have their own unique and common know-how, which should be effectively exploited in the study process.

Table4. *Grain yield (kg ha-1) of common bean varieties tested across three locations at Umbulo Watershed in 2004 and 2005*

Years x locations											
S.No	Varieties	2004				2005				Overal l mean	Overall Rank
		UmbuloWacho	Umbulo Kejima	Umbulo Tenkaka	Mean	Umbulo Wacho	Umbulo Kejima	Umbulo Tenkaka	Mean		
1	Awash-1	2365.2	2350.5	2458.0	2391.2	2367.6	2112.3	2530.0	2336.6	2363.9	1
2	Awash M.	2226.3	1990.4	2094.6	2103.8	2205.6	2070.5	2109.7	2128.6	2116.2	4
3	Roba-1	1892.4	1595.2	1688.2	1725.3	1902.2	1984.2	1865.9	1917.4	1821.4	6
4	Ibado	2065.0	2479.2	1894.4	2146.2	2004.5	2142.3	2163.3	2103.4	2124.8	3
5	Omo-95	2228.4	2117.7	2244.6	2196.9	2206.2	2292.4	1897.2	2131.9	2164.4	2

6	Local	2415.6	1264.0	1711.2	1796.9	2102.4	2036.7	1882.0	2007.0	1902.	5
	CV (%)	14.7									
	LSD	74.6									
	SD	305.1									
	Mean yield	2082.1									

Source: *Fekadu, G. 2013*

Table5. *Mother trial farmers' preference ranking of common bean varieties for different qualitative traits in Umbullo Watershed*

Varieties	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14	F15	Av. R.	Av. R. R.
Awash-1	4	4	3	3	4	2	4	4	4	4	3	3	2	2	3	3.3	4
Awash M.	2	3	3	4	3	2	1	5	3	3	4	3	2	2	3	2.9	3
Roba-1	6	6	4	5	5	4	2	2	5	3	5	4	3	4	4	4.0	6
Ibado	1	1	1	2	1	1	3	1	2	1	1	1	2	1	1	1.3	1
Omo-95	5	2	4	6	5	3	5	2	3	5	5	3	4	5	2	3.9	5
Local	3	2	2	1	2	3	3	3	1	2	2	2	1	3	2	2.1	2

F1= Farmer1, F2= Farmer2, F3= Farmer3… Av. R. = Average rank, R = Rank, Awash M. = Awash Melka ***NB:*** *The qualitative traits were seed color, drought tolerance, disease and pest resistance, marketability, seed size, shattering tolerance, taste and cooking time.(Source: Fekadu, G. 2013)*

6.3. PVS in Faba Bean in Dabat District in Ethiopia

Tafere et al., (2012) mentioned that PVS was carried out at four different growth stages by conducting a field day at each stage i.e. at vegetative, flowering, maturity, and harvesting using farmers' preference criteria such as plant establishment (PES), stem strength (STS), number of branches (NOB), overall performance (OAP) and seed size (SS) and grain yield (Table 6 & 7). He further indicated that farmers and the researcher used different parameters and methods to evaluate the tested genotypes. Thus researchers must contemplate farmers choice traits in their varietal development such as seed yield, seed size and overall field performance. The current selection process also confirmed that farmers were capable of selecting important traits for grain yield and based on those traits demonstrated to identify superior varieties adapted to their locality. Generally, PVS was effective and reliable for identifying appropriate faba bean cultivars through partnership with resource-poor farmers (Tafere etal.2012).

Table6. *Sum of scores at three farmer sites for each trait, overall mean value of each selection criterion and ranking of genotypes.*

Farmer's criteria								
Variety	PES	OAP	STS	NOB	SS	Total	Mean	Rank
HOLETTA-2	9	8	8	10	13	48	9.6	6
DOSHA	14	12	12	15	15	68	13.6	1
EH99051-3	11	10	8	10	8	47	9.4	7
CS20DK	8	8	7	7	13	43	8.6	8
WOLKI	13	13	15	13	12	66	13.2	2
SELALE	11	12	15	12	7	57	11.4	4
GEBELCHO	8	7	10	8	10	43	8.6	8
DEGAGA	8	8	8	10	7	41	8.2	9
WAYU	12	12	15	12	12	63	12.6	3
MOTI	13	8	8	10	15	54	10.8	5

PES=Plant Establishment, OAP=Overall Performance, STS=Stem Strength, NoB=Number of Branches, SS=Seed Size; Rating of the performance of variety for a given criteria: 5= very good, 4= good, 3= average, 2= poor and 1 = very poor. (Source: Tafere et al., 2012)

Table7. *Mean yield (t/ha) of the faba bean varieties for grandmother trial.*

Genotype	Grain yield(t/ha)	Rank for yield
HOLETTA-2	5.7cd	8
DOSHA	13.2b	3
EH99051-3	9.7bcd	5

CS20DK	7.0cd	7
WOLKI	11.2bc	4
SELALE	24.9a	1
GEBELCHO	4.5d	10
DEGAGA	8.0bcd	6
WAYU	21.9a	2
MOTI	5.4d	9
Mean	11.1	
LSD (5%) 8	5.54	
CV (%)	28.97	

LSD=Least Significant Difference, CV=Coefficient of Variation. (Source: Tafere et al., 2012)

6.4. PVS in Soybean Bean in Pawe District of North-Western Ethiopia

Farmers' participatory evaluation of soybean varieties was done at vegetative and physiological maturity stage and they were agreed with plant height, no of pods per plant, seed Size, shattering, uniformity and market demand as selection criteria (Addisu etal., 2016**)**. Majority of the particpnats preferred Awassa-95 from the early set, Gishama from the medium set and Wegayen from the late maturing soybean varieties and Researchers based on the average yield selected soybean Wegayen for late set, Gishama for medium set and Awassa-95 for early set recorded high (Table 8 &9). In this case the farmers' preferences coincide with the breeders' selection (Addisu etal., 2016).

Olaoye et al., 2009 explained that due to poor participation of farmers in variety selection process only a small percentage of varieties developed by breeders are eventually utilized. Ceccarelli and Grando,(2007) also stressed that farmer's Participatory Varietal Selection is a way to overcome the limitations of conventional breeding by offering farmers the possibility to choose, in their own environment, the varieties that better suit their needs and conditions

Table8. *Farmers' selection criteria and varieties preference*

Variety	Ph	NPP	Sh	MD	SS	U	Total	mean	Rank
Awassa 95	15	16	16	17	16	18	98	12.25	1
Crowford	6	4	10	14	14	15	63	7.875	3
Willams	6	9	12	17	18	17	79	9.875	2
Belase-95	9	14	16	15	13	18	85	10.625	3
Ethio-Yugoslavia	16	15	14	15	16	16	92	11.5	2
Wegayen	17	14	12	17	17	18	95	11.875	1
AFDAT	18	14	13	16	16	17	94	11.75	2
Gishama	15	13	19	17	17	17	98	12.25	1
Gizo	10	13	12	15	14	16	80	10	3

*Where, Ph= plant height, NPP=No of pods per plant, SS=Seed Size, Sh=Shattering, U=uniformity, MD=market Demand, The Rating of the performance of variety for a criteria: 5= very good, 4= good, 3= average, 2= poor and 1 = very poor (Source: Addisu etal. 2016**)***

Table9. *Mean yield of the varieties*

Variety	Maturity class	Yield (kg/ha	Rank for yield
wegayen	Late set	1496.7a	1
Belase-95	Late set	1411.5a	2
Ethio-Yugoslavia	Late set	1398.5a	3
Gizo	Medium set	1114.4a	3
Gishama	Medium set	1461.3a	1
AFGAT	Medium set	1335.7a	2
Awassa 95	Early set	1095.5a	1
Willams	Early set	882.2a	3
Crowford	Early set	948.5a	2
	CV(%)	23	
	LSD	669.9	
	Alpha	0.05	

Mean values with the same letter indicated that there is no significant difference among them.

6.5. PVS in Maize Varieties in Chilga District of North Western Ethiopia

According to Daniel etal.,(2014) farmers' participatory evaluation of maize varieties was done at vegetative and physiological maturity stage and farmers' selection criteria were earliness, drought tolerance, grain yield, vigorousity, husk cover, cob size, grain color and, grain size. This shows farmers may require multiple traits from one key crop such as maize and emphasized that farmers' varietal selection criteria should be taken into by researcher consideration during crop improvement programme (Daniel et al., 2014).However, researchers may not know the traits that are important to farmers and vice versa. Participatory varietal selection has significant role in technology adaptation and dissemination in short time than conventional approach.

The rank given by researchers rank did not match with farmers rank except for single variety clearly showed that farmers a major selection criterion is not yield rather combination of other non reproductive parameters (Table 10 & Table 11). Bellon (2002) also confirms the observation that farmers' perception about crop varieties are not always the same as researchers and if given the opportunity, farmers are able to express their preferences differently for early maturing maize varieties rather than yield. This is in agreement with De Groote *et al*. (2002) who stated that there were growing interests among farmers in the use of early maize varieties in short rain fall season.

Participatory plant breeding/selection has shown success in identifying more number of preferred varieties by farmers in shorter time (than the conventional system), in accelerating their dissemination and increasing cultivar diversity (Weltzien, E. *et al*., 2003). Therefore, adding information on farmers' perspectives of plant and grain trait preferences to these criteria will be helpful to the variety selection process. Research costs can be reduced and adoption rates increased if the farmers are allowed to participate in variety testing and selection (Yadaw *et al*., 2006).

Table10. *Farmers two years Average Varietal Assessment Result in Chilga district of North West Ethiopia (2012 and 2013)*

Varieties	Anguaba Village	Serako Village	Eyaho Village	Average	Rank
BH-540	1.812	1.750	2.000	1.854	1
BH-543	1.875	2.125	3.250	2.417	5
BHQPY-545	1.875	1.875	2.312	2.020	2
BH-660	2.000	2.375	2.812	2.396	4
BH-661	2.625	2.437	2.562	2.541	6
BH-670	2.187	2.312	2.500	2.333	3

Source: *Daniel et al., 2014*

Table11. *Ranking of the varieties according to farmers and researchers*

Varieties	Researchers' rank	Farmers'
BH-540	5	1
BH-543	4	5
BHQPY-545	6	2
BH-660	2	4
BH-661	1	6
BH-670	3	3

Source: *Daniel et al., 2014*

7. IMPACT OF PARTICIPATORY APPROACHES

These PPB and PVS approaches had various types of impact:

- **Variety Development:** a number of varieties have been already adopted by farmers even though the program is relatively young in breeding terms
- **New Variety Adoption and Enhancement of Biodiversity**

In PPB and PVS approaches different varieties have been selected in different areas within the same country, in response to different environmental constraints and users' needs. In Syria, where this type of impact has been measured more carefully, the number of varieties selected after three cycles of

selection is 4-5 time higher than the number of varieties entering the on-farm trials in the conventional breeding program. Pandit et al., 2007 reported that in Bangladesh wheat varieties were being demonstrated and selected through PVS approach could make remarkable impact in replacement of farmers' old varieties as result varietal diversity and adoption of new varieties were also increased amazingly . Joshi and Witcombe (1996) reported that adoption rates of cultivars would be improved by increased farmers' participation and poor farmers adopt new varieties as rapidly as wealthier ones through PVS. PVS approach again proved itself as a superior concept than the traditional one. PVS was a more rapid and cost effective way of identifying farmers-preferred cultivars if a suitable choices of cultivars are supplied to test (Witcombe et al. ,1996)

- **Seed production and Preservation**

Providing training to the farmers for seed production and preservation was very important for higher yield. PVS activity has improved the knowledge of farmers in seed production and preservation. PVS helped the farmers getting rapid advantage from new varieties. Otherwise, reaching seeds of new varieties to the farmers in normal channel needs at least 5 years.

- **Sources of Agricultural Knowledge**

The farmers of Bangladesh get agricultural knowledge from different public and private organizations and personnel. After few years of PVS activity, there were remarkable changes in information sources due to frequent visit and discussion of researchers and extension personnel with the farmers (Pandit et al., 2007). Development agent and research personnel were the most reliable sources of agricultural information.

- **Income Change**

Farmers of PVS villages have brought changes in their income participating in PVS research. Due to cultivation of modern wheat varieties and use of recommended production technologies, yield was increased remarkably. They were also able to save seeds using recommended seed rate. Farmers' participating in PVS research who grew only new varieties using recommended production technologies got additional income(Pandit et al., 2007). A financial analysis revealed that a very high internal rate of return is possible to get from investment in participatory variety selection (Witcombe, 1999; Grawali et al., 2002).

- **Attitude Change**

PVS activity has changed the attitudes of the farmers, researchers, extension and NGO personnel, and policy makers. During PVS activity, lots of interactions were made with the farmers by the researchers, extension and NGO personnal and a good number of trainings were imparted to them. As a result, their attitudes about researchers and extension personnel were changed remarkably. In several countries, the interest of policy makers and scientists in PPB as an approach which is expected to generate quicker and more relevant results has considerably increased. Atlin et al., 2002 has also emphasized on institutionalization of the PVS approach for getting long term sustainable advantage of the system.

- **Farmers' (men and women) Skills and Empowerment**

The cyclic nature of the PPB and PVS programs has considerably enriched farmers' knowledge, improved their negotiation capability, and enhanced their dignity. In the impact assessment interview, all farmers of them replied that their knowledge on agricultural activity was increased through PVS and PPB due to interaction with the researchers.

8. CHALLENGES OF PARTICIPATORY APPROACHES

Participatory processes take strong commitment and time to work along with men and women farmers. Cook and Kothari (2003) and Misiko (2010) articulated that regardless of the benefits and growth of participatory work, there are fundamental drawbacks that persist. While the opportunity seems very promising, there are likely to be some bottlenecks in the participatory plant breeding. For example, there are numerous methodological difficulty due to too many forms of ''participation'' being implemented in spite of insufficient insight into systems complexity, differences in reference frameworks, and methodological errors (Van Asten et al., 2008). The methods used to involve farmers in research can lead to the collection of inaccurate and/or misleading information (Misiko, 2009;

Werner, 1993). Misiko (2010) also reported that it can be very wasteful when implementing researchers are unskilled, negligent or do not systematise collection of social and other contextual data for lessons building. The increase in participatory plant breeding and other collaborative programs involving farmers, their communities and formal sector scientists raise new questions and challenges for recognizing innovation in plant breeding:

- High cost for participating farmers*:* Unlike traditional approaches to plant breeding in which most work is done by scientists, farmers participating in PPB have to invest resources – their time and intellectual capital, and sometimes traditional production inputs such as land, labor, and capital. The amount of resources farmers must invest increases in proportion to their degree of participation. Therefore, poor farmers may be unwilling or unable to participate in PPB schemes because participation tends to be relatively costlier for them.
- Additional training needed for scientists: Scientists require specialized skills that are not normally taught in traditional plant breeding programs to be proficient at using PPB methods.
- High overall cost for breeding programs*:* Scaling up PPB methods for work at the regional, national, or international level could require large investments in resources.

Despite several technical reports on the success of PPB and PVS, more analysis is required to assess its emerging challenges.

9. CONCLUSION

Participatory approaches are the selection by which farmers evaluate adavanced, finished or near-finished products from plant breeding programs on their own farms. Most importantly, it was noted that farmer‟s adoption of new crop varieties came during and after the implementation of PPB and PVS as revealed by the fact that collaborating farmers in participatory approaches had higher adoption rates than non-participating farmers. The related link between research and development effort and adoption may be because collaborating farmers receive more information that facilitate their appreciation of the value of new crop varieties. Thus, the results affirm the importance of adopting participatory approach in the transfer of technology in various countries. Findings of PPB & PVS on different crops have shown the possibility of enhancing on-farm varietal diversity and increasing adoption rates. The approach allows evaluation of new crop varieties under a range of biological and socio-economic conditions; it increases chances of success and offers the benefit of new genetic resources five to six years in advance of the formal research system. Developed participatory approaches solve many constraints related to farmers' participations, set parameters, select superior varieties, evaluating the performance of better varieties, and identify better varieties and accelerating the dissemination of farmers' selected varieties in the target areas. Once identified, the seed of farmer-preferred cultivars needs to be rapidly multiplied and cost-effectively supplied to farmers. Farmers' exposure to evaluate and select new varieties is an advantage to exploit their potential knowledge of identifying adapted varieties that best meets their interest which further helps to include such selections in their varietal portfolio for seed production. Most farmers also recognized well that improved cultivars will perform better if accompanied by recommended cultural practices.

Hence, interaction of researchers and farmers will also help to design research objectives to overcome rejection of varieties developed by researchers alone, enhances the acceptance of varieties and reduces costs associated with variety development. Moreover, as women have an important role in post-harvest quality assessment, in spreading new genetic materials, biological yield and indigenous knowledge systems are important considerations while developing new crop varieties to enhance varietal adoption and diversification.

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