

Title: **Participatory Chickpea and Lentil Variety Selection**

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Abstract

This report provides a summary of activities on chickpea and lentil participatory variety selection (PVS) undertaken between September 2010 and February 2013. There is a huge gap between potential yield and the actual yield farmers are getting for chickpea and lentil in the region. The gap between actual and potential yield is the result of mainly lack of adoption of improved production packages. Farmers are still using low yielding local varieties of chickpea and lentil. In order to minimize this gap participatory variety selection with objectives of selecting high yielding and acceptable chickpea varieties adapted to the growth environment was conducted at Taba kebele of Damot Gale district, Jole Andegna kebele of Meskan district and Huleteegna Choroko of Halaba district. For lentil it was conducted at Huleteegna Choroko of Halaba district. At Taba, where the growth environment was more optimal, the Kabuli types, Habru and Chefe had shown excellent performance and were chosen by farmers as first and second choices. At Jole Andegna kebele, where the environment was sub-optimal, the desi type variety Mastewal was chosen by farmers for its high grain and straw yield, earliness and vigor. At Halaba district of Huleteegna Choroko, varieties Habru and Ejere, kabuli types, were selected as first and second choice by participant farmers. The selected cultivar exceeded the local cultivar under production by 62% at Taba and by 89% at Jole Andegna. Based on the promising results of 2011 preliminary seed increase and pre-scaling up activities were conducted with farmers at two sites. Moreover, a consultative meeting with stakeholders on 27 February 2013 reached an agreement to carry out a full pre-scaling up activity for chickpea in three districts with the involvement of the Bureau of Agriculture as a major stakeholder. The PVS experiments have also shown that parts of the southern region are high potential areas for chickpea production which needs emphasis in terms of extending improved technology and research.

Key words: Chickpea, lentil, participatory variety selection, yield, pre-scaling up

Introduction

One of the most tested means of enhancing productivity with minimized cost is through introduction of adapted high yielding crop varieties. It is vital to plan and carry out such activities with participation of farmers in order to make sure that farmers take up the results later. Thus, a participatory variety selection was instituted for chickpea at Taba, Jole Andegna and Huleteegna Choroko and for lentil at Huleteegna Choroko.

Chickpea is the third most important crop in volume of production after faba bean and haricot bean, in Ethiopia (CSA, 2010). National average yield of chickpea in Ethiopia is 1.33 t ha^{-1} (CSA, 2010), which is far below the potential yield of 4.5 t ha^{-1} . In southern Ethiopia, the average of 1.04 t ha^{-1} is even below the national average. The gap between actual and potential yield is the result of mainly lack of adoption of improved production packages. Farmers are still using low yielding local varieties. Therefore, a participatory variety selection experiment was carried out in 2011 and 2012 at Taba Kebele of Damot Gale district, at Jole Andegna kebele of Meskan district and at Huleteegna Choroko Kebele of Halaba district so as to select adapted and high yielding varieties among the nationally released varieties of chickpea.

The average yield of lentil in the region is 0.72 tones ha⁻¹, which is low compared to the 1.16 tone ha⁻¹ of the national average yield (CSA, 2010). The low average yield of the crop in the region could be attributed to lack of adapted high yielding cultivars and inadequate agronomic management. Therefore a participatory variety selection experiment was carried out so as to test and select among the nationally released varieties of lentil that adapts to Halaba special district of Huletegna Choroko Kebele and similar agroecologies

Materials and Methods

The research was conducted using the mother and baby participatory trial approach. Farmers participating in variety selection trials were selected in collaboration with the development agent of the Kebele based on their consent and ability to provide land for the research. Accordingly, five farmers were selected in each of the sites. Selected farmers were let to prepare their land as they used to prepare for their chickpea production. The crop was sown in mid-September 2011 at Taba, in late September at Jole Andegna 2011 and in late August 2012 at Huletegna Choroko. Planting was done at 40 cm row spacing and 10 cm plant spacing. The collected data was analyzed using randomized complete block design. The experiment was installed on five model farmers, one mother trial and four baby trials on each of the locations.

The following were the test varieties:

No.	Variety Name	Type
1	Arerti	Kabuli
2	Chefe	Kabuli
3	Ejeri	Kabuli
4	Habru	Kabuli
5	Shasho	Kabuli
6	Mastewal	Desi
7	Naatolii	Desi
8	Wolayita Local (check)	Desi



Picture 1. Participatory variety selection trial at the farm of Mr. Yohannes Urago at Taba (A) and a farmers' field day at Taba kebele (B) in 2011.

Data were collected on days to flowering, days to maturity, *Fusarium* wilt reaction, straw & grain yield, plant height, number of branches per plant, number of pods per plant and number of seeds per pod. Besides, participatory variety evaluation was carried out with Focus Group Discussion at maturity of the crop & after threshing. During the first evaluation eight women and 37 men were included while during the last evaluation 28 women and 27 men participated. Variety selection at first evaluation was based on adaptability and yield performance while the final evaluation was based on seed quality preferences. The crop adaptability characteristics included disease resistance, drought resistance, earliness to maturity, pod setting, seed color, seed size, seed market demand, straw yield and grain yield. In addition, the taste of three representative varieties, kabuli type, large seeded desi type, and small sized desi type chickpea varieties, were evaluated by preparing a snack of roasted and boiled seeds, which are some of the usual ways of consumption by farmers. Accordingly, varieties were evaluated for their yield components and adaptability criteria using matrix ranking on both locations.



A



B

Picture 2. Focus group evaluation by farmers at physiological maturity (A) and on seed quality parameters (B) in 2011.

Results and discussion

Since there was variation in the performance of the varieties at the three sites, the results are given separately as follows:

Taba Kebele

All improved varieties except Naatolii had significantly higher grain yield over the local variety (Figure 1A). In terms of straw four out of the seven tested improved cultivars types produced more straw than Wolayita local. The top yielding cultivar, Chefe, out yielded Wolayita local by 62% in grain yield and by 80% in straw yield. The high productivity of Chefe and Habru were

mainly attributed to their high number of pods per plant (Table 1). There was no significant difference between Chefe and Habru varieties for grain yield.

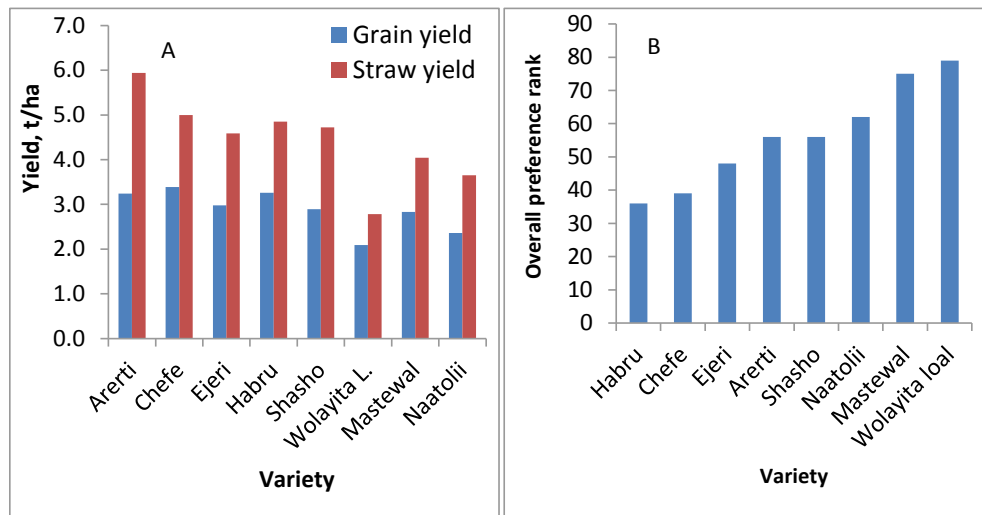


Fig. 1 Chickpea participatory variety selection at Taba kebele of Damot Gale district showing (A) grain and straw yields and (B) farmers' preference evaluation in 2011.

Table 1. Agronomic parameters of chickpea from a participatory variety selection research at Damote Gale Woreda, Taba Kebele in 2011.

Variety	DFL	DTM	HSW	PH	PPP	SPP	HI
Arerti	60 ^{ba}	133 ^{ba}	26.68 ^c	63.90 ^a	139 ^{ba}	1.05 ^b	35.48 ^b
Chefe	40 ^d	126 ^c	30.78 ^b	64.95 ^a	173 ^a	1.70 ^a	42.04 ^a
Ejeri	38 ^d	127 ^c	34.15 ^a	66.35 ^a	102 ^{dc}	1.25 ^b	39.42 ^{ba}
Habru	41 ^d	132 ^{ba}	30.33 ^b	66.35 ^a	161 ^{ba}	1.25 ^b	40.62 ^{ba}
Wolayita Local	41 ^d	123 ^d	12.65 ^c	48.90 ^c	136 ^{bdac}	1.70 ^a	41.92 ^{ba}
Mastewal	50 ^c	130 ^b	23.00 ^d	54.10 ^b	93 ^d	1.75 ^a	41.03 ^{ba}
Naatolii	54 ^{bc}	134 ^a	31.08 ^b	57.70 ^b	121 ^{bdc}	1.60 ^a	38.85 ^{ba}
Shasho	62 ^a	133 ^{ba}	29.58 ^b	65.65 ^a	124 ^{bdc}	1.2 ^b	38.85 ^{ba}
CV	8.48	1.36	5.61	5.61	23.03	17.0	17.84
P Value	<.0001	<.0001	<.0001	<.0001	0.018	0.01	0.003
LSD	6.01	2.60	2.25	5.14	44.40	0.34	6.50

Key: DFL= Days to flowering, DTM= Days to Maturity, HSW=Hundred seed weight (gm), PH=Plant height (cm), PPP=pod per plant, SPP=Seed per pod, HI=Harvest index

Diseases, such as *Fusarium* wilt and *Ascochyta* blight have affected the crop throughout the growing season and at pod setting, respectively. The tested chickpea varieties showed differential responses to *Fusarium* wilt (Fig. 2). Accordingly, variety Chefe was more affected by the *Fusarium* wilt (16.85 % of plant population affected per plot) than the other improved

varieties. Nevertheless, Chefe is one of the top ranking varieties among the tested entries since the disease was not severe enough. Wolayita local and Arerti varieties have resisted *Fusarium* wilt better than the rest of the varieties. The large seeded improved desi varieties, Mastewal and Naatolii and the local small seeded cultivar Wolayita local, suffered heavily from *Ascochyta* blight starting from the seed filling stage.

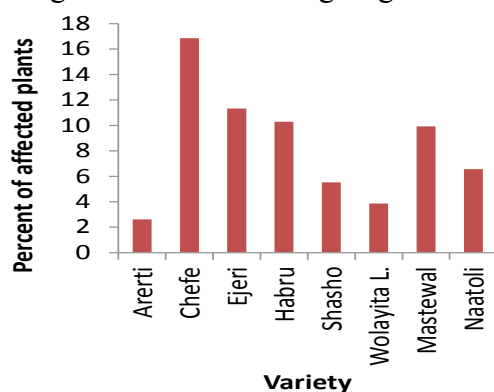


Fig. 2 Relative infestation of chickpea varieties by *Fusarium* wilt at Taba Kebele, Damot Gale district, in 2011 cropping season.

Overall, the kabuli type chickpea varieties have performed better than Wolayita local and the desi type improved varieties. Among the tested varieties, Habru and Chefe were preferred by farmers as 1st and 2nd choices, respectively (Fig. 1B). In spite of their similar yield, Habru resisted *Fusarium* wilt attack better than Chefe and also has shown superior seedling and plant vigor and earliness to flowering. Therefore, we recommend Habru for production at Taba Kebele of Damot Gale district and probably to nearby kebeles with similar agroecology. Moreover, the area is shown to have a huge potential for increasing chickpea production which should be exploited through expansion and introduction of improved technology.

Based on the recommendation, seed increase and scaling up with limited number of farmers is going on two of the project sites during the 2012 cropping season.

Jole Andegna kebele

The highest yield was obtained from the improved desi cultivar, Mastewal, which was significantly superior to all other tested varieties (Fig. 3A). The greater yield from Mastewal is attributed mainly to greater number of seeds per pod and heavier seed weight. Mastewal exceeded the local cultivar in both grain and straw yield by 89%.

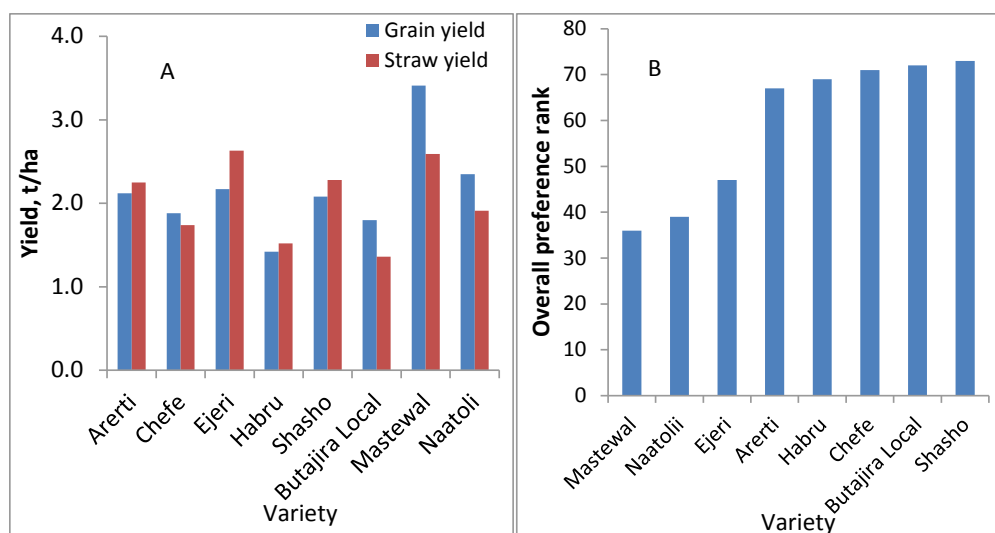


Fig. 3 Chickpea participatory variety selection at Jole Andegna kebele of Meskan district showing (A) grain and straw yields and (B) farmers' preference evaluation.

Table 2. Agronomic parameters of chickpea from a participatory variety selection research at Maskan Woreda, Jole Andegna Kebele in 2011.

Variety	DFL	DTM	HSW	PH	PPP	SPP	HI
Arerti	57 ^{ba}	132 ^a	26.63 ^c	51.70 ^a	161.45 ^a	1.25 ^{bc}	0.41 ^{cb}
Chefe	38 ^d	128 ^{ba}	32.20 ^a	52.73 ^a	114.00 ^{ba}	1.20 ^{bc}	0.34 ^{cd}
Ejeri	35 ^d	126 ^b	31.40 ^a	53.65 ^a	147.65 ^{ba}	1.25 ^{bc}	0.45 ^b
Habru	38 ^d	121 ^c	31.13 ^a	48.50 ^a	93.25 ^b	1.25 ^{bc}	0.28 ^d
Butajira Local	40 ^d	116 ^d	12.15 ^e	40.40 ^b	124.00 ^{ba}	1.70 ^a	0.30 ^d
Mastewal	48^c	129^{ba}	22.93^d	50.48^a	171.10^a	1.70^a	0.56^a
Naatolii	50^{bc}	125^{bc}	28.30^b	49.63^a	133.35^{ba}	1.50^{ba}	0.36^{cbd}
Shasho	60 ^a	132 ^a	28.08 ^{cb}	54.00 ^a	133.45 ^{ba}	1.10 ^c	0.41 ^{cb}
CV	11.64	2.52	4.019	8.32	30.92	15.96	23.28
P Value	<.0001	<.0001	<.0001	0.004	0.231	0.006	0.66
LSD	8.00	5.00	1.57	6.13	61.27	0.34	0.11

Key: DFL= Days to flowering, DTM= Days to Maturity, HSW= Hundred seed weight (gm), PH=Plant height (cm), BBPP=Branch per plant, PPP=pod per plant, SPP=Seed per pod, HI=Harvest index.

Disease and insect pests occurred during the growing season of the crop like that of Taba Kebele of Damote Gale district (Fig. 4). The serious disease on this site was *Fusarium* wilt. The disease score revealed significant differences among varieties in response to *Fusarium* wilt. The highest percentage of affected plants was seen on Chefe and Ejeri varieties. The resistant variety was Arerti followed by all desi type chickpea varieties (Naatolii, Mastewal and Butajira Local). The other disease (*Ascochyta* blight), however, was minor and inconsistent in its expression.

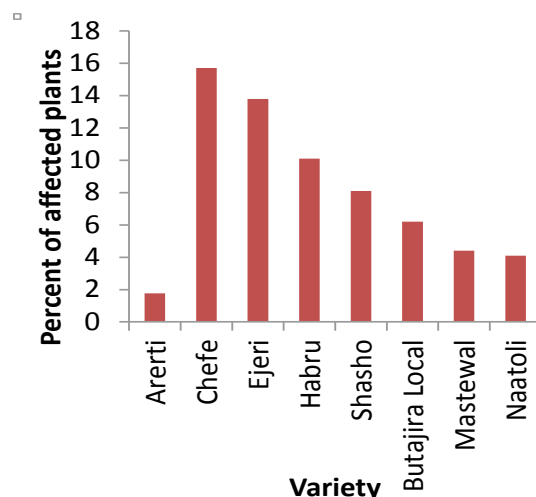


Fig. 4. Relative infestation of chickpea varieties by *fusarium* wilt at Jole Andegna Kebele, Meskan district, in 2010/11 cropping season.

The variety Mastewal was chosen by farmers' focus group discussion for its high grain and straw yield, earliness and vigor (Fig. 3B). Moreover, its drought and disease resistance were important additional factors. In fact the two improved desi types, Mastwal and Naatolii, have shown remarkable resistance to the severe limitation of moisture in the area.

Performance and choice of varieties differed between the two test sites. At Taba where there was good moisture, the kabulis had shown an excellent performance while at Jole Andegna where moisture was limiting, the improved desi, Mastewal, showed a superior performance. Under optimum environments especially with sufficient moisture, the kabuli types can express their high yield potential while under drought stress the improved desi types were found to be resistant and more productive.

Based on the analysis and participatory evaluation results the improved desi variety Mastewal is recommended for Jole Andegna Kebele and nearby areas with similar agro ecology. Moreover, it may be necessary to include one kabuli type chickpea variety since both selected varieties were desi type which, have slightly less market value than the kabuli types. Based on the ranking, Arerti is additionally recommended provided that it is planted early.

As a follow-up work, the selected cultivar is being increased at the site during the 2012 cropping season.

At Huletigna Choroko Kebele

Days to flowering and plant height

The number of days to flowering of the varieties ranged from 52 to 61 days (Table 1). Varieties Ejere, Chefe, Habru and Local produced flowers after 52 days from emergence which are the early maturing varieties compared to others, whereas varieties Mastewal and Natoli took 59 and 61 days, respectively. The varieties were also significantly different in plant height. Varieties

Habru, Ejere, Chefe and Natoli have tall plant height in the range of 44.65 -46.5 cm while varieties Arerti and Local have short plant height (37.49 and 37.99 cm).

Yield and yield components

The analysis of variance results showed that varieties were significantly different in pods per plant, seeds per plant and 100-seed weight. The highest number of pods and number of seeds per plant was counted from the Local variety followed by varieties Mastewal and Habru, however the 100-seed weight was the lowest for the local variety but highest for varieties Ejere, Chefe and Habru (Table 3).

Table 3. Days to flowering, Plant height, yield components and straw and grain yields q/ha.

Var/trait	DF	PH (cm)	PPP	SPP	SW	SY	GY	Rank for yield
Habru	52	46.5a	54.17ab	60.13b	25.28c	16.67a	2.0a	2
Mastewal	59	39.67bc	54.77ab	62.57b	19.00f	15.68a	1.93a	4
Natoli	61	44.65a	40.57b	41.43c	22.77d	15.66a	1.74a	6
Chefe	52	44.84a	46.57b	51.90bc	26.68b	17.71a	1.87a	5
Ejere	52	45.84a	49.67b	51.87bc	28.97a	16.46a	2.4a	1
Arerti	57	37.49c	53.23b	54.97bc	20.96e	15.74a	1.65a	7
Shasho	56	43.59ab	45.00b	46.33bc	23.35d	16.80a	1.61a	8
Local	52	37.99c	67.37a	92.33a	9.92g	14.24a	1.99a	3
+LSD 5%		4.87	14.83	18.26	1.31	4.74	0.59	

where DF, Days to flowering; PH, Plant height in cm; PPP, pods per plant; SPP, seeds per plant; SW, 100- seeds weight in gm; SY, stover yield in q/ha; and GY, grain yield t/ha.

The analysis of variance result revealed that there was no significant difference among varieties in straw and grain yields. However, the average grain yield across the six farms was high for variety Ejere (2.04 t/ha), followed by varieties Habru (2.0 t/ha) and Local (1.99 t/ha).

Participatory Evaluation of Chickpea Varieties

Participatory evaluation of chickpea varieties was done at two stages by 25 farmers (8 women and 17 men). Firstly discussion was made with farmers on plant characters used by farmers for chickpea variety selection, and agreed that earliness, height-branching, pod setting, seed size and seed yield are important parameters for chickpea variety selection at Huleteegna Choloko kebele in Halaba district. The first evaluation was carried out at the field for plant characters such as earliness, plant height-branching and pod setting, while the second evaluation was for seed size and seed yield after harvesting. Many farmers identified varieties Habru, Local and Ejere as early maturing varieties, and varieties Habru, Chefe and Natoli for their taller plant height with many branches. Farmers also selected varieties Habru, Chefe and Ejere for highest number of pods per

plant, varieties Ejere, Habru, and Natoli for larger seed size and varieties Local, Habru and Ejere for their highest yield. Over all, varieties Habru and Egere were selected as first and second choice by participant farmers in Huletegn Choroko kebel (Table 4).

Table. 4. Participatory variety evaluation result at Huletegn Choroko (number of farmers)

Variety/character	Earliness	Height	Pod setting	Seed size	Seed yield	Cumulative number	Rank
Habru	58	78	55	90	61	342	1
Mastewal	21	7	5	0	32	65	7
Natoli	24	40	25	59	26	174	4
Chefe	34	55	50	51	14	214	3
Ejeri	36	25	36	95	54	256	2
Arerti	9	5	4	2	29	49	8
Shasho	2	30	20	25	32	109	6
local	25	5	15	0	75	120	5

Lentil

Introduction

The average yield of lentil in the region is 0.72 tones ha⁻¹, which is low compared to the 1.16 tone ha⁻¹ of the national average yield (CSA, 2010). The low productivity in the region could be attributed to lack of adapted high yielding cultivars and inadequate agronomic management. Therefore, a participatory variety selection experiment was carried out in order to test and select among the nationally released varieties for adaptation and productivity.

The test varieties were:

No.	Variety Name
1	Alem Tena
2	Alemaya 98
3	Chekol
4	EL-142
5	Teshale
6	Halaba Local

Participating farmers' were selected in the same way as indicated for chickpea above. The crop was sown in mid-August 2011 in rows of 30 cm and 2.5 cm between plants.

Results and Discussion

The two top yielding cultivars were Halaba Local and Alemaya-98 without a significant difference between them (Table 3). They had relatively greater number of pods per plant and more number of seeds per pod though the former was not significant (Table 3). With regard to growth duration the local variety matured nine days earlier than Alemaya 98. The matrix ranking results of farmers' preference of lentil varieties revealed that varieties Halaba Local and Alem Tena were selected as first and second choices, respectively (Table 4). Although the yield performance of Alemaya 98 was good and at par with the local variety, the crop was late to mature and suffered more from terminal water stress. As a result the consultation with experts from the review workshop has suggested earlier sowing of the variety, Alemaya 98, which will be useful to enhance yield by avoiding exposure to terminal drought.



Picture 3. Lentil variety trial at Huleteгна Choroko Kebele, Halaba Specila district.

The overall data from researchers and farmers' focus group discussion revealed that there is no variety that exceeded the local variety in overall evaluation. Thus, Halaba Local and Alem Tena are selected as first and second choices, respectively.

A request for introduction of germplasm from the International Center for Agricultural Research in Dry Areas (ICARDA) for the 2012 cropping season was initiated. However, probably due to the problem the center has faced, it did not materialize. The information concerning the performance of the released varieties was shared in a project review workshop that was held at Hawassa University between 17 to 19 may 2012 in the presence of the various stakeholders including researchers from the Ethiopian Institute of Agricultural Research. One

important point researchers forwarded during the discussion was that all the improved lentil cultivars are late maturing as a result of which they need to be planted earlier to realize their potential.

Table 3. Yield and yield components of lentil participatory variety selection at Halaba Special district, Huletegna Choroko Kebele, 2012.

Varieties	Days to flowerin g	Days to maturit y	Hundred seed weight (g)	<i>Fusarium</i> wilt (%)	Plant height (cm)	No of pod per plant	No of seed per pod	Straw yield (ton ha ⁻¹)	Grain yield (ton ha ⁻¹)	Harve- st Index
Alem Tena	56.00 ^a	94.67 ^a	2.97 ^a	5.2 ^a	28.40 ^{bac}	38.67 ^a	1.40 ^b	1.46 ^a	0.73 ^{bc}	23.3 ^{ab}
Alemaya 98	55.67 ^a	97.67 ^a	3.03 ^a	5.0 ^a	26.10 ^c	40.80 ^a	1.67 ^{ba}	1.56 ^a	0.90 ^{ba}	25.8 ^{ab}
Chekol	55.00 ^a	94.00 ^a	2.00 ^b	7.4 ^a	32.07 ^a	44.07 ^a	1.87 ^{ba}	1.36 ^a	0.63 ^c	21.5 ^b
EL-142	54.33 ^a	93.33 ^a	1.87 ^b	4.7 ^a	32.48 ^a	36.47 ^a	1.87 ^{ba}	1.36 ^a	0.76 ^{bc}	26.8 ^{ab}
Halaba Local	47.33 ^b	85.33 ^b	2.17 ^b	4.5 ^a	27.77 ^{bc}	48.93 ^a	1.93 ^a	1.21 ^a	9.73 ^a	30.2 ^a
Teshale	57.00 ^a	96.00 ^a	3.33 ^a	6.3 ^a	31.53 ^{ba}	33.40 ^a	1.60 ^{ba}	1.63 ^a	0.70 ^c	25.9 ^b
<i>LSD</i>	3.80	5.29	0.56	3.4	4.21	20.90	0.52	0.50	0.18	7.28
<i>CV</i>	3.85	3.11	12.09	33.82	7.78	28.44	16.65	14.42	12.89	20.30
<i>P value</i>	0.002	0.006	0.006	0.436	0.031	0.636	0.268	0.922	0.020	0.340

Table 4. Evaluations of Farmers' Preference Criteria on Lentil Varieties Using Matrix Ranking Method.

Variety	Earliness					Seed					Sum
	Disease resistance	Drought tolerance	to maturity	Pod setting	Seed color	Seed Size	market demand	Straw yield	Grain yield	Harvest index	
Local	1	2	1	6	4	4	2	5	1	1	27
Alem Tena	4	4	4	2	3	1	4	2	4	4	32
Alemaya 98	3	6	6	1	1	3	6	4	2	3	35
Teshale	5	3	5	4	2	2	5	1	5	5	37
EL-142	2	5	2	3	5	6	3	6	3	2	37
Chekol	6	1	3	5	6	5	1	3	6	6	42

The Way Forward

Based on the encouraging results from the PVS program conducted during 2011 and 2012 a workshop was held on 27 January 2013 to discuss on the way forward. The participants included vice head of Bureau of Agriculture, extension head of Bureau of Agriculture, district heads of the Bureau of Agriculture, College of Agriculture Officials, experts from the Institute of Agricultural Research and team members of the CIFSRF project. During the workshop results of the PVS activities were presented followed by discussions on the findings. After a thorough discussion agreement was made to start the pre-scaling up work in all three districts: Meskan, Damot Gale and Halaba) with some caution at Halaba. The following specific agreements were also reached:

- Bureau of agriculture should be responsible for the implementation of the pre-scaling up (PS) program.
- Input such as seed and chemicals against cut worm and boll worm should be prepared ahead of time.
- The work should be on cluster basis not fragmented.
- Short term training (as short as one day) should be provided by the university for farmers
- Seed multiplication should be done on adjacent farms
- The PS at Halaba special district should be done preferably after maize green harvest or after an early tef harvest
- The project can purchase up to 1.5 ton seed.
- Seed treatment could be a safeguard against cut worm and boll worm by using Apron Star chemical.
- Tentatively about 500 farmers can participate. This number will not be shared equally. Rather, it will depend on the likelihood of success. For instance the largest share will go to Damot Gale.
- The seed requirement for Habru is 140 kg per hectare while for Mastewal it is 100 kg per hectare.
- Memorandum of understanding should be signed between key responsible organizations.

Finally, a committee was established to work out the proposal, budget and terms of reference needed to carry out the PS work forward. The following are the members:

1. Ato Debebe from Bureau of Agriculture, SNNPRS
2. Ato Germame from Bureau of Agriculture, SNNPRS
3. Dr. Woldeyesus Sinebo, from SARI
4. Dr. Berhanu Abate, from HU
5. Ato Zenebe, from HU

References

CSA (Central Statistical Agency). 2010. Agricultural Sample Survey 2009/2010: Area and Production of Crops (Private Peasant holdings, Meher Season). Statistical Bulletin 446, Addis Ababa, Ethiopia.