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Cluster Based Pre-Scaling Up of Improved Chickpea Variety at Adola Rede District of Guji Zone, Oromia Regional State Government, Ethiopia

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Abstract

Farmers of the study areas have no experience to cultivate chickpea, probably due to lack of improved chickpea varieties prior to on farm demonstration that was conducted to create demand. But the demand for dissemination was not carried out due to lack of multiplied seed and budget shortage to incur from other sources. Therefore, funded by AGP-II, cluster based pre scaling up of improved chickpea variety (Habru) was carried out at Adola Rede district, Guji Zone in 2019. The main objective of the study was to promote improved chickpea variety and thereby increases production and productivity and income of the farmers in the study area and similar agro ecologies. Two peasant associations were selected based on their potential to produce chickpea. FREG approach was followed to implement pre scaling up process. Consequently, 12 farmers of gender inclusive were clustered as FREG at each trial sites owing three hectares of land, each farmer contributing 0.25 hectare. Trainings were given for farmers. In total, 24 farmers (16 male & 8 female were benefited scaling up). Development agents, subject matter specialists and different stakeholders were participated on field day & field visit. Recommended seed and fertilizer rates, row between space and plant were used with all management practices. Joint monitoring and evaluation were organized. Field day was organized on which different stakeholders participated and experience was shared. Quantitative data such as yield was collected and analyzed using SPSS whereas farmers' feedbacks were analyzed qualitatively. In spite of the pest infestation at the flowering and pod setting stages and prevalence of little rainfall, a mean yield of 1.19 tons ha^{-1} was obtained which is promising and very important in improving livelihood of farmers. Therefore, this technology should be sustained for more popularization. Agrochemicals in advance to avoid pest infestation, planting at early September to escape from drought occurrences should be given due emphasis.

Keywords

Cluster based pre scaling up, FRG approach, Habru variety

1. Introduction

Chickpea (Cicer arietinum L.) is a very important crop that is mainly used for human and animal food [1], and it is the second most widely grown legume worldwide [2] after soybean [3]. This crop can be grown in many areas, including marginal land and low fertility areas [4], and its cultivation plays a key role in maintaining soil fertility, especially

in tropical regions, thus representing an important component of crop rotation. Current global chickpea production is approximately 13 million tons [5].

Chickpea is widely grown across the highlands and semi-arid regions of Ethiopia and serves as a multi-purpose crop. The country is also considered as the secondary center of diversity for chickpea [6]. It has a major role in the daily diet of the rural community and parts of urban population. The crop is being exported to Asian countries and is contributing positively to the country's foreign exchange earnings. The total land coverage and yield of chickpea in Ethiopia are estimated to be 242703.73 hectares and 499425.55 tons, respectively [7]. Despite its nutritional values, high economic importance, the national average yield of chickpea is still lower than its potential, 2.058 tons ha^{-1} [7]. This is due to pest/disease and lack of improved chickpea varieties.

Chickpea is considered less labor-intensive crop and its production requires less external inputs as compared to cereals. As stated in [8], it plays a significant role in improving soil fertility by fixing the atmospheric nitrogen. It can fix up to 140 kg N ha^{-1} from air and meet most of its nitrogen requirement. After harvest, it leaves substantial amount of residual nitrogen for subsequent crops and adds some amount of organic matter to maintain and improve soil health and fertility. This saves the fertilizer input cost not only for chickpea but also for the subsequent crops [9]. Chickpea has the ability to grow on residual moisture which gives farmers the opportunity to engage in double cropping, where chickpea is sown at the end of the rainy season following the harvest of the main crops [10]. This allows more intensive and productive use of land, particularly in areas where land is scarce. It is also an excellent source of protein, fiber, complex carbohydrates, vitamins, and minerals thus can help alleviating malnutrition and improving human health. The growing demand in both the domestic and export markets provides a source of cash for smallholder producers. Because of its deep tap root system, chickpea can withstand drought conditions by extracting water from deeper soil layers. It also increases livestock productivity as the residue is rich in digestible crude protein content compared to cereals.

In spite of its immense use, chickpea is not in the production in the potential areas of Guji Zone and farmers of the study areas have no experience to cultivate, probably due to lack of improved chickpea varieties. To mitigate under production, adaptation trial of different chickpea varieties were conducted in midland of Guji Zone. Consequently, Dalota and Habru were best performed in yield and their trait to tolerate drought and disease. Accordingly, on farm demonstration of these two varieties were conducted at few farmers of Adola Rede, midland district of Guji Zone through Farmers Research Group (FRG) approach in the recent years. During demonstration of chickpea, farmers liked and preferred those varieties based on their criteria of yield performance, good economic return, market demand, tolerant to drought and disease. Consequently, farmers of the study areas were demanding these technologies for dissemination since the demonstration stage alone could not assure the sustainability of these technologies for wider popularization and to enhance the livelihood of smallholder farmers in the study areas. But due to lack of multiplied improved chickpea varieties, these varieties were not further disseminated in midland areas. Therefore, conducting cluster based pre scaling up of improved chickpea variety (Habru) was crucial to pave the way for further popularization and dissemination of this technology among farmers of midland agro-ecologies in Guji Zone.

1.1. General Objective

To promote improved chickpea variety and thereby increase production and productivity and income of the farmers in the study areas and similar agro ecologies.

1.2. Specific Objectives

The specific objectives of the study were to:

- ✓ Create wider demand pull by reaching large number of users over relatively wider geographical areas.
- ✓ Increase farmers' income and livelihood.
- ✓ Increase local capacity for future scaling up of the technology.

2. Materials and Methods

2.1. Description of the Study Area

The district is located in southern part of Oromia, Ethiopia, at a distance of 468 km from Finfinne, the capital of Ethiopia. Astronomically, the district is located between 5º44'10"-6º12'38" latitudes and 38º45'10"-39º12'37" longitudes. The district is characterized by three agro-climatic zones, namely humid, sub humid and dry arid zones. In terms of the agricultural calendar, the rain fall pattern of the district is bimodal for lowlands and midland areas and mono-modal for highland parts. The dry arid agro-climatic zones attributed to little rainfall while the humid agro-climatic zones receive extremely high rainfall. Rain-fed agriculture is a common practice for many farm households in this district. However, a semi-nomadic economic activity is also practiced as a means of livelihood by some of its dwellers. This district has 29

peasant associations and two urban centers. The farmers of this district produce both in autumn and spring seasons. They produce cereals such as teff, wheat, barley and maize, pulses such as haricot bean, and others such as fruits and vegetables. Overall, wheat, maize and teff are the major crops cultivated by the farmers in the study areas. They also engaged in the production of coffee as means of livelihood.

2.2. Implementation Approaches Followed to the Cluster Based Pre Scaling Up Activity

In principle, pre scaling up activity is led by demonstration and participatory variety selection with farmers and pertinent stakeholders. Therefore, the chickpea technology was demonstrated on certain farmers at the respective sites in the recent years where the technology was intended to be scaled up. Results from the evaluation process publicized that Habru variety had met the farmers' requirement that paved the way to this project. It was based on that result the cluster based pre scaling up phase was planned and executed using necessary extension approaches.

For the sake of enhancing efficiency and effectiveness, integration and cooperation with different stakeholders implemented for the achievements of the strategy. Accordingly, organizing stakeholder forum for discussion with responsible and cooperative participants at district level to have a common understanding of cluster based pre scaling up activity, signing memorandum of understanding, appointing contact persons and establishing Farmers Research Extension Groups (FREGs) at each peasant association were done successfully. Trainings on capacity building regarding knowledge, skill and attitude of chickpea production, management and package, post-harvest handling, concept of cluster based pre scaling up, economic importance of chickpea, FREG approach and seed dissemination mechanism was delivered for farmers, agricultural experts and development agents (DAs) by multidisciplinary team consists of breeder, pathologist, agronomist, agricultural research-extensionist and socio economics. Chickpea technology (Habru) with its recommended packages and other agricultural inputs like fertilizers, pesticide the so called PROFIT were distributed to participating farmers after training. FREG member farmers and other follower farmers were encouraged to participate in the physical activities from the beginning up to the end. Joint monitoring and evaluation like regular field visit by extension agents and extension counterparts, joint field visit and supervision at different crop stages, field day organized, discussion session and result communication forum were also structured. Seed delivery mechanisms like convincing the host farmers to appreciate farmer-to-farmer seed exchange mechanism with an optimum price at the end of the activity life span facilitated.

2.3. Stakeholder Analysis

In enhancing chickpea variety generation, dissemination, improving chickpea production and productivity, Bore Agricultural Research Center was closely working and has made frequent consultation with its respective stakeholders. Pre scaling up activity should be done by different actors in partnership and collaborative approach. So, stakeholder analysis is highly important for institutional arrangement (who does what?) before embarking on the pre scaling up activity. Thus, stakeholder analysis was undertaken to identify potential stakeholders. Points such as: who are the stakeholders? How big is their stake? How much they are closer to the project? What are their roles, duties and responsibilities in implementing the activity? How does the collaboration support the opportunities to bring the required impact? Consequently, zonal and district agricultural experts, district cooperatives, Development Agents and researchers were the identified stakeholders with their roles, duties and responsibilities clearly stated in implementing the activity.

2.4. Site and Farmers Selection

This pre-scaling up activity was the continuation of the past demonstration of the chickpea varieties recent years before. Selection of the district was accomplished by a multi-disciplinary team of Bore Agricultural Research Center (BoARC) using self-experience gained during chickpea demonstration activity in collaboration with experts of the respective district. Accessibility and potentiality, convenience of the areas to the technologies and representativeness of the trial fields in terms of location and suitability for more farmers to visit the field, were the most important criteria to select both the district and the kebeles under consideration.

As Development Agents are nearer to, and information rich about the farmers in their respective jurisdiction, the task of farmer selection was entirely left to them given the farmers fulfill the criteria set by researchers. On top of this, having appropriate and sufficient plots, good history of managing experimental or non-experimental plots were the other criteria used to select the host farmers. Accordingly, from each peasant association one FREG which comprises 12 clustered farmers was nominated based on their interest to work in group and provide three hectares of land per cluster (one fourth of hectare per farmer). The clustered FREG member farmers were re clustered in to three sub groups comprising of four farmers with one hectare of land. Consequently, a total of 24 hosting farmers were organized as FREG, under which other farmers were trained and organized as follower farmers to share knowledge, skill and experience for further promotion mechanism (Table 1).

Table 1. Roles and responsibilities of stakeholder and hosting member farmers of FRG in implementing the activity

No	Stakeholders	Roles and responsibility
1	Bore Agricultural Research Centre	➢ Coordination and facilitation ➢ Provision of chickpea technologies ➢ Provision of training ➢ Technical backstopping ➢ Organize Field days and ➢ Supervision and joint monitoring and evaluation with zone and district Bureau of agriculture and Natural Resource
2	Agriculture and Natural Resource Office (at zone, district and peasant association)	➢ Assist in site and participant farmers' selection ➢ Follow up day to day activities from zone to peasant association level ➢ Assist in providing training ➢ Facilitate seed distribution ➢ Jointly organize and participate on field days
3	FREG farmers	➢ Allocate land and perform required agronomic practices ➢ Actively participate in the training for capacity building ➢ Share skills and experiences to neighbour farmers ➢ Transfer produced seed to follower and surrounding farmers and ➢ Finally, supply excess produced seed to cooperatives
4	Cooperatives	➢ Agricultural input supply ➢ Facilitate chickpea seed marketing

2.5. Pre-Scaling Up Design

Bore Agricultural Research Centre was the supplier of all agricultural inputs; seed, fertilizers-NPS and UREA, PROFIT- pesticide). One improved chickpea variety (Habru) was planted on clustered farmers during the autumn season. The seed were incurred in advance from other source of improved seed supplier in consultation with Debre Zeit Agricultural Research Center. The variety was treated with full recommended chickpea production packages (agronomic recommendations and practices). Row planting method and other crop management practices were used during the pre-scaling up activity. The recommended seed rate of 100 kg ha^{-1} with the spacing between rows 40 cm and between plants 10 cm. Shallow planting of 5 cm depth was used in the presence of moderate soil moisture. The recommended inorganic fertilizer rate 30 kg ha^{-1} N and 60 Kg ha^{-1} NPS were applied at planting time. All farm operations (land preparation, land levelling, planting, weeding, agro-chemical spray to avoid chickpea pod borer, harvesting, threshing) were carried out by FREG member farmers with close assistance and supervision of concerned participating institutions (Research Center and Extension Division of Agricultural and Natural Resource Office). Farmers' full participation at all stages of the activity was maintained during the implementation period.

2.6. Joint Monitoring and Evaluation

From the very beginning of site selection until harvesting, frequent visits to farmers, monitoring and provision of technical advice, follow up actions were designed based on emerging knowledge, skill and technical needs. Researchers, extension agents, experts and farmers were jointly participated on continues supervision of the experiment.

2.7. Technology Dissemination Methods

Appropriate extension approaches and all extension teaching methods were employed during the implementation of the cluster based pre scaling up activity. These were:

- ✓ Telephone call
- ✓ Field visit and supervision
- ✓ Field day
- ✓ Method demonstration (to impart the skills) and result demonstration (to show the performance)
- ✓ Group meeting and discussion
- ✓ Training (both theoretical and practical)
- ✓ Mass media (OBN Television)
- ✓ Print Media (leaflets, brochures, posters) were used for creating awareness, enhancing clients' knowledge and skill, changing attitude on using fully recommended packages of improved chickpea technology and the importance of farmer-to-farmer variety dissemination across similar agro-ecologies.

2.8. Method of Data Collection and Analysis

Data such as total amount of inputs distributed for participant farmers, total number of farmers participated in the training, field day by gender, role of farmers and other stakeholders in technology dissemination, yield data, income from adoption of technology, impact in livelihood due to adoption of the technology and farmers perception were collected using checklists through interview and discussions. The collected data were entered into SPSS and analyzed using descriptive statistics and narrative.

3. Results and Discussion

3.1. Yield Performance

In spite of the inevitable variability in performance between and even within clustered locations, yield performance of the chickpea variety was still promising. The variability in yield performance might have stemmed from difference in land preparation as the farmers of the study areas were very busy in harvesting crops of the main rainy season, so lagged behind in preparing their land in the recommended extent, the status of soil fertility, difference in management and pest infestations during flowering and pod setting stages coupled with prevalence of little rain fall in the areas and others. Despite this fact, a mean yield of 1.19 tons ha^{-1} was obtained (Table 2).

Table 2. Yield of chickpea across clusters in Adola Rede district

No	AGP- II peasant association	Yield across clusters in Adola Rede district (in tons ha^{-1})			Total	Mean
1	Cluster at Darartu	Sub- cluster one	Sub- cluster two	Sub- cluster three		
		1.5	1.3	1.1	3.9	1.3
2	Cluster at Kiltu Sorsa	1.2	1.1	0.9	3.2	1.07
	Total	2.7	2.4	2.0	7.1	1.19

3.2. Capacity Building and Knowledge Sharing

3.2.1. Training of Farmers and Other Stakeholders

Participatory training was given to farmers and stakeholders by multi-disciplinary team of researchers consisting of breeder, agronomist, pathologist, extensionist and economist drawn from Bore Agricultural Research Center (BoARC) on issues like economics importance of chickpea, nutritious, suitable ecologies and weather condition for chickpea production, the importance of crop rotation to break mono cropping problem, chickpea production and management packages, diseases like insect and pests and their controlling ways; agrochemical applications and post-harvest and the concept of FREG approaches. A total of 114 farmers (27 female) from the districts of which 24 FREG member farmers, 16 DAs, 9 subject matter specialists (SMS), and 2 experts from cooperative office at Adola Rede district were participated (Table 3). The training materials were printed and dispersed to the agricultural experts and development agents.

Table 3. Summary of chickpea training participants

Year	AGP- II District	Participants					
		Farmers		Total	DAs	Experts and stakeholders	Grand total
2019	Adola Rede	Male	Female				
		87	27	114	16	11	
	Total	87	27	114	16	11	141

3.3. Input Distribution

All the necessary inputs like seeds and fertilizers were distributed for the host farmers. Anti pest chemical, the so called profit was also distributed and sprayed at the pest infestation period. During the course of cluster based pre scaling up process, a total of 24 farmers (16 male and 8 female) were directly reached.

Table 4. No of beneficiary farmers, area covered and input distributed

AGP- II District	Area covered (hectare)	No of farmers		Amount of inputs distributed			
		Male	Female	Seed (in quintal)	NPS (in quintal)	UREA (in quintal)	Profit (in liter)
Adola Rede	6	16	8	6	3.6	1.8	6
Total	6	24		6	3.6	1.8	6

3.4. Field Day

Field day is one of extension services and methods used to transmit information and creation awareness for larger clients and on which bad and good practices evaluated. Field day can be organized at different stages in crop production systems. It can be two or three times on which the stages are at vegetative, flowering and maturity depending on crop type and nature produced with available financial and logistic resources. Field day is used as tool to address large number of farmers, even invited farmers who did not produce improved chickpea to create massive awareness and large impacts on technologies for further production and scale up on farmers' fields. Not only farmers but also other stakeholders were invited to participate on the event.

Consequently, a total of 52 farmers, 6 development agents and 5 experts from district government offices were participated on the occasion. In addition, during field day mass extension methods like leaflets, banner and Television were used to reach large clients. The field day was communicated by Oromia Broadcasting Network, a Regional State Television Program to disseminate information for wider community in local language. A total of 40 leaflets were distributed for the participants which describes the production, agronomic practices and overall managements of improved chickpea. Finally, at the end of the visit during field day, group discussion was conducted to grasp farmers' feedback on strength and weakness of improved chickpea. Besides, broad issues like constraints in agricultural production, needs and interests of farmers on other improved varieties and availability of agricultural inputs are points rose by participants on the program.

3.5. Farmers' Feedback about Chickpea

During the course of the cluster based pre scaling up process and at the final stage of the activity, an assessment was made to know how the farmers perceived the technology. Result of the assessment revealed that chickpea liked by farmers as it is planted at the end of the main rainy season following the harvest of the main crops and has the ability to grow on residual moisture, can survive drought conditions, which gives farmers the advantage to engage in double cropping. This allows more intensive and productive use of land. It was also revealed to have good market price.

3.6. Economic Return to Farmers

Farmers of the study areas benefited from this cluster based pre scaling up process in multi dimensions; clustered FREG member farmers obtained chickpea seed of 6 quintals, NPS 3.6 quintals, UREA 1.8 quintals and 6 liters of PROFIT-pesticide chemical for free. This sidestepped the burden of suffering inputs which could have cost them about 3,000 ETB, 1,350 ETB and 200 ETB for seed, fertilizers and chemicals respectively, a total of 4,550 ETB ha^{-1}. Besides, every management activities like from the beginning of land preparation up to threshing was performed by the cooperation of clustered FREG farmers themselves and expenses for wage was minimized. Chickpea seed were properly stored at the house of each host farmers. So that follow farmers and other farmers from similar agro-ecologies were advised to access to those variety at their dominion. This could also avoid the transaction cost of acquiring chickpea seed for follower farmers and enable to extend the availability of chickpea seed, FREG member farmers produced an average yield of 1.19 tons ha^{-1} and hence got a benefit of 41,650 ETB ha^{-1}, with an average price of 3500 ETB a quintal. This could contribute a lot to minimize food insecurity and improve livelihood of farmers at the study areas and similar agro ecologies.

4. Conclusions and Implications

The result indicated that the variety gave promising under moisture stress cropping season, and good trait for double cropping and marketability. The high protein content of chickpea increases its nutritional value and therefore improves the consumption behaviors of the community. Moreover, it was profitable and generally adds soil fertility. For the combined effect of all these traits, the technology is very important in improving livelihood of farmers in the study areas. Hence, the technology should be sustained to reach more number of farmers over wider geographical areas of similar agro ecologies. Bureau of Agriculture and Natural Resource of Adola Rede district should go further as Bore Agricultural Research Center (BoARC) could not go beyond this limit. Securing agro chemicals in advance to avoid pest infestation, timely preparation of land and planting at early September depending on the soil moisture content to escape from drought occurrence should be given due emphasis.

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