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# Pre-extension Demonstration and Evaluation of Double Cropping Practice (Legume followed by Sorghum Crop) in Fedis District

**Abdulaziz Teha, Bedasso Urgessa, Oromia Megersa**

Oromia Agricultural Research Institute, Fedis Agricultural Research Centre, Harar, Ethiopia

## ABSTRACT

Climate-smart technology intervention in production and productivity enhancement of the agriculture sector for smallholder farmers' livelihood improvement is an indispensable option. Taking this into consideration the double cropping practice research activity was undertaken with the objectives of evaluating the productivity and profitability of double cropping practice technology under farmers' conditions, building farmers' knowledge and skill of different crop combination production and management practices, and strengthening linkages and collaboration among stakeholders. A total of fifteen trial and follower farmers were selected and organized as FRGs. Improved varieties of common bean (KATB-1 and Batu) and sorghum (Melkam and Local) were replicated on the plot of 10mx10m. The yield performance of the improved varieties (Batu, KATB-1, Melkam, and Local sorghum) were 13, 14.50, 35.50, and 29.00 qt/ha at Fedis Balina Arba kebele. Double cropping practices are preferred as they diversify the crop, higher yield, shorter crop cycles, better copping the dry spells, efficient use of land, reduce risks of striga, and reduce risk of bird infestation. Moreover, based on the obtained result, Batu, KATB-1, and Melkam combination is preferred by farmers since they can harvest twice within a single season. Therefore, it is better to be promoted and scale up in a wider area and reach a large number of farmers.

***KEYWORDS:*** *Demonstration, Double cropping, FRG, Legume, District*

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## INTRODUCTION

Rain-fed agricultural areas of East Africa are often food insecure due to rainfall variability and ongoing soil degradation that negatively impacts crop yields. Agricultural activities and consequently the livelihoods of people reliant on agriculture will be affected by changes in temperature and precipitation conditions in large parts of Sub-Saharan Africa (Muller *et al*., 2011). Under climate change, many areas in Sub-Saharan Africa are likely to experience a decrease in the length of the growing season, while in some highland areas rainfall changes may lead to a prolongation of the growing season (Thornton *et al*., 2006). Mono-cropping of sorghum whether it is long or early maturing is their usual practice which aggravates the infestation of *striga* in case of susceptible varieties and has risk of crop failure in most cases due to erratic and unreliable rainfall (Samuel *et. al*., 2013). Since the eight-month-cycle sorghum is rain-fed, is simply late maturing and too vulnerable to pests and dependent on rainfall patterns. A reorientation towards shorter cycle crops like early maturing sorghum, pulses, and oil crops would help farmers better cope with the climatic hazards of the area (Ibid, 2013). In the moisture-stress bimodal rainfall distribution environments of Ethiopia, sorghum is an integral part of a mixed crop-livestock farming system. These locations are mostly characterized by poor agricultural practices such as monocropping systems (Alemu, 2018).

The degree of climate change impacts on agricultural production differs among crops and agricultural systems (Thornton et al., 2011). Therefore, the farmers' choice of an adequate cropping system and crop cultivar, especially in precipitation-limited areas, might be an important adaptation strategy to changing climate conditions. However, farmers in the Fedis area are accustomed to sowing the local varieties from the end of March to the middle of April though

they know the advantage of using improved sorghum varieties reduces the risk of striga and yield. This is because farmers do not want to leave their land idle when the rain starts early in March/April until the right planting time of the early maturing striga-resistant sorghum varieties. Whereas, these improved varieties are sown after the local varieties from the middle of June to the beginning of July and farmers who are adopting improved sorghum varieties are forced to leave their land idle to synchronize its maturity with long-maturing sorghum varieties to reduce the high bird infestation prevailing in the area (Fuad *et al*., 2017).

To alleviate this problem experiments have been done at Fedis on the evaluation of double cropping combination and mung bean, haricot bean, and cowpea were found to be economically and ecologically convenient in the area as preceding crops followed by early maturing sorghum in the area (Fuad *et al.,* 2017). Therefore, farmers' participation in technology promotion is very important to be accepted by the whole community of the area. Therefore, this activity is proposed to demonstrate and evaluate suitable double cropping sequences under the farmer condition through the FRG approach in the Fedis area.

**Specific Objectives**

- To evaluate the productivity and profitability of double cropping practice technology under farmers' conditions.
- To create awareness among different stakeholders regarding the improved technologies
- To strengthen linkages and collaboration among stakeholders

**Materials and Methods**

This pre-extension demonstration of double cropping practices was conducted in the Fedis district of Eastern Hararghe Zone.

**Site and Farmers Selection**

Balina Arba kebele was selected. Farmers were selected based on their interest, innovation he/she has, land provision for this pre-extension demonstration, interest in cost-sharing, and willingness to share experiences with other farmers. The selected farmers were grouped in the form of Farmers Research Group (FRG) with members of 15 (3 male trial farmers and 2 female trial farmers) and 10 farmers working with trial farmers.

**Table 1: Site and farmers selected with area coverage of the experiment**

| District | Kebele | No. of trial farmers &followers | Area covered |
|---|---|---|---|
| Fedis | Balina Arba | 10 1FTC | 10mx 10m for each plot |
| Total | | 10 1 | |

**Technology evaluation and demonstration methods**

The evaluation and demonstration of the trials were conducted on farmers' fields to create awareness about the double cropping practices. The evaluation and demonstration of the trials followed a demonstration approach by involving FRGs, development agents, and experts at different growth stages of the crop. The activity was jointly monitored by FRGs, researchers, experts, and development agents.

**Table 2: Treatments**

| No. | Preceding crop | Succeeding crop |
|---|---|---|
| 1 | KATB-1 | Melkam |
| 2 | Haricot bean var. Batu | Melkam |
| 3 | Local sorghum | Local sorghum stays |

**Experimental design**

Land preparation was done by tractor-powered and animal traction systems. The land was ploughed and smoothened to bring the soil to a fine and a tie ridge was made to conserve moisture. Seeds of sorghum were drilled in a row of 75 cm between rows and 15-20 cm between plants.Haricot bean was sown 40cm x 10 cm between rows and plants, respectively, and for KATB-1 the spacing was 40 cm x 5 cm between rows and plants, respectively. Di Ammonium Phosphate at the rate of 100 kg/ha. Four weeks after emergence sorghum and KATB-1 urea were applied at the rate of 100 kg/ha and Haricot beans were applied at the rate of 50 kg/ha when the soil moisture was enough. At the end of June, the preceding crops were harvested and threshed after it is sun-dried for one week except the control since it takes 7 to 8 months to mature, and grain yield per plot was recorded. The succeeding crop and the control sorghum were harvested on maturity.

**Data Collection**

Qualitative data like farmers' feedback were collected through personal field observation and Focus Group Discussion by using a checklist. Quantitative data such as yield data, cost data, and the number of farmers who benefited from the technology and farmers who participated in training and mini field day were collected.

**Data analysis**

Quantitative data was analyzed using simple descriptive statistics (Mean, Frequency, and Percentage) while the qualitative data were analyzed using narrative explanation.

**Results and Discussion**

**Training of farmers and other stalk holders**

The multidisciplinary research team; crop- extension, and socio-economic research team, and other stakeholders (Offices of Agriculture and Natural Resource) actively participated by sharing their experience and knowledge and journalists for publicity of the work done, Development agents, experts, and farmers participated on the training given on double cropping practices and management, post-harvest handling, and marketing information.

**Table 3: number of participants in the training**

| No. | Participants | Balina Arba | | |
|---|---|---|---|---|
| | | Male | Female | Total |
| 1 | Farmers | 22 | 8 | 30 |
| 2 | DAs | 3 | - | 3 |
| 3 | District experts | 2 | 1 | 3 |
| 4 | Journalists | 3 | 0 | 3 |
| | Total | 30 | 9 | 39 |

Source: Own computation

Among the training participant stakeholders, 76.9% were farmers. Of those farmers, 26.6% were female farmers' participants.

**Table 4: number of participants on the mini field day**

| No. | Participants | Balina Arba | | |
|---|---|---|---|---|
| | | Male | Female | Total |
| 1 | Farmers | 20 | 8 | 28 |
| 2 | DAs | 1 | - | 1 |
| 3 | District experts | 2 | 1 | 3 |
| 4 | Journalists | 3 | 0 | 3 |
| | Total | 26 | 9 | 35 |

Source: Own computation

For those individuals, 70 leaflets and 40 small manuals on the technology that are organized in Afaan Oromoo and English languages were distributed. Most farmers showed high interest in improved double cropping technology production because of better yield and earned income by selling it to different stakeholders. Generally, all farmers were very interested in having the technology for their future production.

**Agronomic and yield performance**

The following table describes the yield performances of the demonstrated Batu, KATB-1, Melkam, and Local sorghum varieties across the study sites. The yield performance of the improved varieties (Batu, KATB-1, Melkam, and Local sorghum) were 13, 14.50, 35.50, and 29.00 qt/ha at Fedis Balina Arba Kebele.

**Table 5: Yield performance of improved varieties**

| Kebele | Crop | Varieties | Std. Deviation | Mean (qt/ha) | Maximum | Minimum |
|---|---|---|---|---|---|---|
| B/Arba | Common Bean | Batu | 1.086 | 13.00 | 13.10 | 11.00 |
| | | KATB-1 | 0.940 | 14.50 | 14.40 | 12.00 |
| | Sorghum | Melkam | 2.949 | 35.50 | 35.50 | 27.60 |
| | | Local Sorghum | 1.812 | 29.00 | 29.00 | 24.10 |

Source: Own computation

The average yield performance of Melkam is higher than local sorghum at Balina Arba even though double harvest were obtained from the plot of Melkam but single harvest from the plot of local sorghum variety.

**Cost-benefit analysis**

Cost-benefit analysis was used to evaluate the productivity and profitability of the technologies. As shown in the table below the benefit-cost ratio for the technologies was greater than one which is profitable.

**Table 6: Cost-benefit analysis for sorghum and common bean varieties**

| Parameters | Varieties | | | |
|---|---|---|---|---|
| | Batu | KATB-1 | Melkam | local |
| Yield qt/ha(Y) | 13 | 14.50 | 35.50 | 29 |
| Price(P) per quintal | 2000 | 2000 | 1000 | 1000 |
| Total Revenue (TR)=Y*P | 26,000 | 29,000 | 35,500 | 29000 |
| **Variable costs** | | | | |
| Seed cost | 250 | 250 | 100 | 100 |
| Fertilizer cost | 283 | 283 | 1701 | 1701 |
| Labor cost | 2,100 | 2,100 | 3000 | 3000 |
| Total Variable costs(TVC) | 2,633 | 2,633 | 4,801 | 4,801 |
| **Fixed costs** | | | | |
| Cost of land | 2000 | 2000 | 2000 | 2000 |
| Total fixed costs (TFC) | 2000 | 2000 | 2000 | 2000 |
| Total cost (TC) =TVC+TFC | 4,633 | 4,633 | 6,801 | 6,801 |
| Gross Margin (GM) = TR - TVC | 23,367 | 26,367 | 30,699 | 24,199 |
| Profit=GM-TFC | 21,367 | 24,367 | 28,699 | 22,199 |
| Cost-benefit ratio=Profit/TVC | 8.12 | 9.25 | 5.98 | 4.62 |

**Source: own computation**

**Farmers' perception**

Farmers in the study area selected the best-performing double cropping practices by using their criteria. Farmers set criteria after having know-how about the varieties. The opinion of those farmers on varietal preference was collected from participants during the varieties demonstration. The major criteria used by farmers were diversification of the crop, more yield obtained, and shorter crop cycle, better coping up the dry spell, efficient use of land, reduced risks of striga, and reduced risk of bird infestation.

**Table 7: Ranks of the varieties based on farmers' selection criteria.**

| Cropping system | Farmers rank | Reasons |
|---|---|---|
| Double cropping | 1st | Diversify the crop, more yield obtained, shorter crop cycle, better to cope up the dry spell, efficient use of land, reduce risks of striga and reduce risk of bird infestation |
| Single cropping | 2nd | Mono cropping, less yield obtained, longer crop cycle, vulnerable to erratic rainfall, leave the land idle, maximize the risks of striga and maximize the risk of bird infestation |

**Table 8: Matrix Ranking of Farmers' Technology Selection Criteria**

| S. no | Traits | Frequency | Percentage (%) | Rank |
|---|---|---|---|---|
| 1 | Diversify the Crop | 3 | 15 | 4th |
| 2 | Yield | 4 | 20 | 2nd |
| 3 | Efficient use of Land | 6 | 30 | 1st |
| 4 | Crop cycle | 1 | 5 | 6th |
| 5 | Cope up the dry spell | 4 | 20 | 3rd |
| 6 | Reduce the striga infestation | 2 | 10 | 5th |
| 7 | Reduce bird infestation | 0 | 0 | 7th |
| Total | | **20** | **100** | |

**Table 9: Direct Matrix Ranking**

| S.no | Traits | Double cropping | Single cropping | Total | Rank |
|---|---|---|---|---|---|
| 1 | Diversify the Crop | 2 | 0 | 2 | 4 |
| 2 | Yield | 2 | 1 | 3 | 2 |
| 3 | Efficient use of Land | 2 | 2 | 4 | 1 |
| 4 | Crop cycle | 1 | 0 | 1 | 6 |
| 5 | Cope up the dry spell | 2 | 1 | 3 | 3 |
| 6 | Reduce the striga infestation | 1 | 0 | 1 | 7 |
| 7 | Reduce bird infestation | 1 | 1 | 2 | 5 |
| Total 12 | | | | | |

**Source: own computation**

**Conclusion and Recommendation**

Farmers in Fedis district have been practicing mono cropping of sorghum for a long period. The average land holding is fragmented and rainfall distribution is erratic. Such mono-cropping does not ensure the production of adequate food for the family. This local sorghum variety is also susceptible to striga and affected by drought. Low yielder than improved sorghum varieties when the season is not good. It requires different planting seasons. Though some farmers are adopting improved sorghum varieties, still most of them are hesitating to delay planting even if the rainfall in March or April is good. The research center should work in collaboration with the concerned body for further scaling up of double cropping practices in the study area and similar agroecologies.

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