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# On-farm Pre-extension Demonstration of Newly Released Pigeon pea (*Cajanus cajan*) Technology with Proper Agronomic Practices in Gamo and Konso Zones of Southern Ethiopia

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## ABSTRACT

Pigeon pea is widely cultivated by Ethiopian farmers, but its production remains low despite suitable conditions. This is partly due to inadequate demonstration of new pigeon pea varieties with proper agronomic practices. To address this, Arba Minch Agricultural Research Center released a new variety, Ashenafi, which showed promise in adaptation trials. However, its farmer preference and socio-economic benefits were not assessed. Therefore, a pre-extension demonstration of Ashenafi and a local check was conducted in 2024 at Karat Zuria and Boreda districts to improve pigeon pea production. The demonstration covered 20 farmers' fields and 2 Farmers Training Centers, with 10m x 50m plots for each variety, using a spacing of 1.2m between rows and 0.5m between plants, a seed rate of 3 kg/ha, and a fertilizer rate of 100 kg/ha NPS. Grain yield data and farmer preferences were collected and analyzed. Ashenafi yielded 1,860 kg/ha compared to the local variety's 1,065 kg/ha at Karat Zuria, and 1,785 kg/ha compared to 890 kg/ha at Boreda. Results at the Farmers Training Center were similar. The significant yield gap of 787 kg/ha suggests a need to encourage adoption of the new variety. Ashenafi proved more profitable and was preferred by farmers for its earliness, quick branch emergence, seed size, grain yield, and pod number. Thus, Ashenafi is recommended for wider production with proper agronomic practices.

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# 1. Introduction

Globally, pigeon pea (*Cajanus Cajan*) ranked third after chickpeas and field peas in terms of production [1]. It is grown on in about 82 countries of the world , mostly in Asia, Latin America and Eastern and Southern Africa with an average yield of 0.97 $t.ha^{-1}$ in the year of 2017 [2]. India, Myanmar, Tanzania, Kenya, Mozambique, Malawi, Haiti, Uganda, Dominican Republic, and Nepal are the top 10 pigeon pea producing countries [3]. The global area of pigeon pea cultivation is around 7.02 million hectares, with South Asia, the Caribbean, and Africa being the major planting regions [4, 5]. The average global productivity of pigeon pea has remained low over the last three decades [6].

In Africa, pigeon pea is grown on 0.56 million hectares where it is an important crop of Malawi, Kenya, Uganda, Mozambique, Tanzania and Ethiopia [7]. It is generally cultivated in combination with yam, millet, sorghum, cassava among other crop [8]. Its demand in Africa increased, especially in ESA, where it occupies an area of about 990, 000 ha [9, 10].

In Ethiopia, pigeon pea is grown well with altitudes between 0-1800 meters above sea level, rainfall between 400 and 750 mm per annum, temperatures of 18 - 30ºC and medium heavy loam soils [11]. In Ethiopia the crop is found distributed all over the geographies in North (Wollo), South East (Bale), Southern Region, Western regions and Central parts of the country growing in sole and intercropped form [12].

Pigeon is a legume crop with many socioeconomic, nutritional, and health benefits [13]. The crop has a high protein content as compared to other legumes like groundnut and cowpea and is also rich in minerals and fiber content [14]. It is usually eaten in cooked form like cooked beans in Ethiopia. Stems of pigeon are a good fuel source, valued for its fast growing habit though their energy value is half that of charcoal. Stems and branches of pigeon pea are also used to make basket. By products of pulses like leaves, pod coats and bran are fed to animals in the form of dry fodder [15, 16]. Apart from this, pigeon pea is an integral part of many diets across the world and they have great potential to improve human health, conserve soil, protect the environment and contribute to global food security, besides serving as an important source of protein [17]. Producing pigeon pea is also used for climate mitigation as a drought escaping mechanism for areas with marginal rainfall patterns [18]. The extensive root system of pigeon pea improves soil structure by breaking plow pans, and improves water holding capacity of the soil.

Despite these all importance, the productivity of the pigeon pea under farmer's field remains low, around 700 $kg.ha^{-1}$ as compared to its potential yield (1,500-3,000 $kg.ha^{-1}$) under research conditions. Farmers in Karat Zuria and Boreda districts predominantly grow local pigeon pea types that take up to a year to mature and are large shrubs in size intercropping with Sorghum, Maize, Cotton, Soy bean production system. This gap may be attributed to unfavorable rainfall, unavailability of improved seeds, low level of adoption of improved management practices and disease and pest infestation. To tackle these problems, Arba Minch Agricultural Research Center released the most productive new pigeon pea variety namely Ahsenafi (OCEAP 00554) and also tested for its adaptation in 8 location and obtained mean yield of 1,820 $Kg.ha^{-1}$ and recommended for pre-extension demonstrations [19]. Although these improved variety showed high potential under research conditions, pigeon pea under farmers' condition was not evaluated. Therefore, this activity was aimed to demonstrate newly released pigeon pea (Ashenafi) at farmers field and Farmers Training Center (FTC) with proper agronomic practices under sole cropping production system at Karat Zuria and Boreda districts of Konso and Gamo Zones with the objectives of:

- To popularize newly released pigeon pea technology in the study areas.
- To assess farmers preferences to the newly released pigeon pea variety.
- To estimate costs and benefits of the pigeon pea technology.

# 2. Materials and Methods

## 2.1. Descriptions of the Study Area's

The activity was carried out at Karat Zuria district of Konso Zone and Boreda districts of Gamo Zone of Southern Ethiopia Regional State of Ethiopia.

Karat Zuria district is one of the districts in Konso Zone of Southern Ethiopia. Geographically, it extends from $5^0$30'00" to $5^0$45'00" N latitude and 37°10'00" to 37°35'00" E longitude. The average elevation of the area is 1,189 meters above sea level with mean annual temperature of 27.8°C and mean annual rainfall of 800 mm [20]. The farming system of the district is characterized by mixed crop-livestock farming system dominated by cereal production. Sorghum, Teff, Soybean, Common bean, Maize, and Pigeon pea were the major crops grown in the area [21].

Geographically, Boreda district is located at $6^0$24′00"to $6^0$39′00" latitude and $37^0$33′00"to $37^0$49′00" longitude. The district has three distinct agro-climatic Zones, Kolla (75%), Woynadega (15%), which was the dominant agro-climatic Zone and Dega (10%). Altitude ranges from 1900-2900m above sea level. The mean annual temperature of the district is 35° C and mean annual rainfall is 1,000mm. It also has a bimodal rainfall distribution such as "Belg", which is a short rain season that extends from April to June and "Kermit" season, which is a long rainy season that lasts between June and October. The major crops produced in the area such as maize, insets, sweet potato, tats, teff, barely, wheat, common bean, pigeon pa and yams.

## 2.2. Descriptions of the Variety

There are about 8 recently released pigeon pea varieties in Ethiopia. Ashenafi (ICEAP 00554) is one of the widely adapted pigeon pea varieties across semiarid environments. It is recommended for cultivation in areas with an annual rainfall of 400 to 900mm. It grows well at an altitude between 400 to1800 m above sea level. It can be grown in a pH range of 4.5 to 8.4 (Table **1**).

**Table 1: Descriptions of the Ashenafi variety.**

| Name of the Variety | Year of Release | Growing Ecosystem | Maturity (Days) | Grain Yield (Kgha-1) | | Released Research Center |
|---|---|---|---|---|---|---|
| | | | | Farmers Field | Research Center | |
| Ashenafi(ICEAP00554) | 2019 | Low to Mid Land | 150-187 | 700-1,600 | 1,800-3,000 | Arba Minch Agricultural Research Center |

## 2.3. Site and Farmers Selection

Karat Zuria district from Konso Zone and Boreda district from Gamo Zone were selected purposively based on their potential for pigeon pea production. 1 Kebele from each district namely Lahayite Kebele from Karat Zuria district and Kodo Hatisa Kebele from Boreda district selected. A total of 20 farmers from the 2 districts were selected based on willingness to implement the technology and provide their land for the demonstration (Table **2**). In addition 1 Farmers Training Centers was used for the demonstration to reach the non-participant farmers. Farmers Research Extension Group, consists of 28 members was organized to work with other non- participant farmers in transfer of the technology.

## 2.4. Extension Approaches Followed

For the demonstration, multidisciplinary approaches were used. Arba Minch Agricultural Research Center, Zone experts, district extension personnel's, Kebele level development agents of the respective districts were involved, and responsibility was shared. Agricultural Technology Transfer and Communication researchers from

the Arba Minch Agricultural Research Center and researchers from the Directorate of crop were fully involved in all stages from the proposal development of the activities to the final results.

**Table 2: Indicate area covered by the demonstration on Pigeon pea technology.**

| Region | Zone | District | No. of Selected Farmers | | Varieties | Hectares |
|---|---|---|---|---|---|---|
| | | | Male | Female | | |
| Southern Ethiopia | Konso | Karat Zuria | 9 | 1 | Ashenafi and Local | 5 |
| | Gamo | Boreda | 7 | 3 | Ashenafi and Local | 5 |
| | Total | | 16 | 4 | | |

## 2.5. Training for Capacity Building

To introduce and promote new technology, training is the most important thing in the extension approach. 78 farmers, 11 development agents and 20 other stakeholders including administrative staff were aware of the importance and quality of technologies as compared to the one under production in the training for one day (Table **3**). The focus of the training was on agronomic and management practices from land preparation to postharvest handling through marketing to boost the production of pigeon pea. During training, computer power point presentations translated in local language, leaflets, posters, audiovisuals, etc. were used as training materials and aid.

**Table 3: Number of participants in training.**

| Category | Type | District | Participants | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Farmers | | Development Agents | | Others | |
| | | | Male | Female | Male | Female | Male | Female |
| Training | Theoretical &practical | Karat Zuria | 30 | 7 | 4 | 2 | 8 | - |
| | | Boreda | 32 | 9 | 3 | 2 | 10 | 2 |
| Total | | | 62 | 16 | 7 | 4 | 18 | 2 |

## 2.6. Research Implementation Design and Technologies Used

Demonstration is the way of providing farmers with experiment showing how the new variety, technology and methods can be implemented and utilized to bring positive changes on farmers [22]. The varieties subjected to demonstration with their production packages were Ashenafi and local check. All agronomic practices were implemented properly. The seeds were supplied by the Arba Minch Agricultural Research Center and jointly distributed to farmers with the district experts and Development Agents. The seeds were placed about 5 cm deep and covered firmly with soil (Table **4**). The date of planting was the same for both varieties at both locations and FTC's.

## 2.7. Methods Data Collection

Grain yield data was determined at maturity stage of the crop by harvesting 2m x 2m quadrant and threshing the pods from the 20 farmers from fields of the lowest, medium and higher performance and converted to $Kg.ha^{-1}$. To study the costs and benefits of the pigeon pea production, the physical inputs required were taken and converted into monetary value to determine the cost of cultivation per hectare. Similarly, main produce and by produces were converted into monetary terms to know the gross returns. The Focus Group Discussion participants were responding their preference level on the relative advantage of each characteristic of the variety compared to local pigeon pea varieties.

**Table 4: Summary of major agronomic practices and the demonstration design for Pigeon pea.**

| No | Practices | Ashenafi Variety | Local check |
|---|---|---|---|
| 1 | Type | Food type pigeon pea | Food type pigeon pea |
| 2 | Plot size for the varieties | 10m*50m=500m$^2$ | 10m*50m=500m$^2$ |
| 3 | Land preparation | 2-3 times | 2-3 times |
| 4 | Seed rate (Kg/ha) | 3 | 3 |
| 5 | Spacing(m) | 1.2 b/n rows and 0.5 b/n plants | 1.2 b/n rows and 0.5 b/n plants |
| 6 | Planting depth(cm) | 5 | 5 |
| 7 | Fertilizer rate (NPS) (Kg/ha) | 100 | 100 |
| 8 | Threshing/shelling | Manual using sticks to avoid grain damage | Manual using sticks to avoid grain damage |

### 2.8. Methods of Data Analysis

The collected data was analyzed by using mean, frequency and percentages and preference rankings. The mean separation of the 2 varieties were done using t- test at 5% significance level. Farmers' preference ranking on the demonstrated pigeon pea variety against the local check using farmer's criteria was analyzed using preference ranking. Likert scale, which assumes ordinal measure scale from poor to very good, was used to analyze farmers preference. Each Likert scale response contains a number used to measure farmer's preferences. Each of the 5 responses would have a numerical value which was used to measure the preferences under investigation.

The yield advantage was calculated by the formula suggested by Rajash [23].

$$\text{Yield advantage (\%)} = \frac{\text{Yield of improved variety (Kgha-1) - Yield of local variety (Kgha-1) X 100}}{\text{Yield of local variety (Kgha-1)}} \quad (1)$$

Moreover, the profitability analysis of pigeon pea was used to compare the economic benefit of the improved technology over the local check with the help of Net benefit analysis formula [24, 25]. The Total Revenue (TR) is the multiplication of the yield and market price of pigeon pea. Total cost (TC) is the addition of all costs of pigeon pea production in the demonstration (Total fixed and Total Variable Costs). Net Benefit is the subtraction of TC from the TR.

$$NB = TR - TC \quad (2)$$

Where NB = Net Benefit, TR= Total Return and TC= Total Cost

### 2.9. Monitoring, Field Evaluation and Field Day

The demonstration fields were evaluated by farmers 3 times i.e., at sowing, knee height and maturity stages. Finally, field days were organized and promoted to mass to share the lessons at farmers' fields and FTC's (Table **5** and Fig. **1**).

## 3. Results and Discussion

### 3.1. Grain Yield Performance of Pigeon Pea at Farmers' Field

The mean grain yield performance of Ashenafi variety was 1,860 Kg.ha$^{-1}$ and that of local was 1,065 Kg.ha$^{-1}$ at Karat district. Similarly, the mean yield performance of Ashenafi and local check recorded at Boreda district were 1,785 and 890 Kg.ha$^{-1}$ respectively. The Ashenafi variety produced more yield than the local one at both districts. Ashenafi pigeon pea variety showed better yield performance in both districts than that of local check (Table **6** and

Fig. **2**). The demonstration's yield was higher than Ethiopia's National pigeon pea average yield [26]. This shows that the study areas had great potential and suitable for pigeon pea production.

**Table: 5: Field evaluation and field day on the demonstration.**

| Category | District | Participants | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Farmers | | Development Agents's | | Others | | Total |
| | | Male | Female | Male | Female | Male | Female | |
| Field evaluation | Karat Zuria | 10 | 3 | 2 | 1 | 7 | 1 | 24 |
| | Boreda | 12 | 5 | 2 | 1 | 7 | 3 | 30 |
| Mini field day | Karat Zuria | 15 | 3 | 3 | 2 | 8 | 1 | 32 |
| | Boreda | 10 | 3 | 3 | 2 | 7 | 2 | 27 |

**Figure 1:** Sample Photo taken from Karat Zuria District pigeon pea mini field day, 2024.

**Table 6: Yield performance of Pigeon pea at Karat Zuria and Boreda districts, 2024.**

| Nº | Districts | Ashenafi | | | Local Check | | |
|---|---|---|---|---|---|---|---|
| | | Minimum | Maximum | Mean | Minimum | Maximum | Mean |
| 1 | Karat Zuria | 1,740 | 1,980 | 1,860 | 780 | 1,350 | 1,065 |
| 2 | Boreda | 1,700 | 1,870 | 1,785 | 850 | 1,030 | 890 |

The results of the independent t- test showed that there was a 7.87 $Qt.ha^{-1}$ yield difference between the Ashenafi and local variety (Table **7**). Based on the independent t-test (p =.001 <.05), the Ashenafi and the local check differ in their yield performance. There was statistically significant difference between the mean yield of Ashenafi and the local check.

### 3.2. Grain Yield Performance of Pigeon Pea at Farmers Training Centers

The crop was also demonstrated on the farms of Farmers Training Center in addition to farmers' field, because it is one of the ways to address other non-participant farmers near and around the Farmers Training Center. The mean yield performance of Ashenafi at Karat Zuria and Boreda was 2,020 and 1,800 $Kg.ha^{-1}$ respectively and that

of local check at Karat Zuria and Boreda district was also 1,550 and 1,370 Kg.ha$^{-1}$ respectively (Table **8**). Ashenafi variety also gave high yield on Farmers Training Centers. This is also a sign that realized yields at farmers' field still have huge potential for improvement in the study area.

**Local check** **Ashenafi(ICEAP00554)**

**Figure 2:** Sample photo of the yield performance of Pigeon pea at Boreda district, 2024.

**Table 7: Mean yield difference analysis of pigeon pea.**

| Yield | t-Test for Equality of Means (Qt.ha$^{-1}$) | | | | | | |
|---|---|---|---|---|---|---|---|
| | T | DF | Sig. (2- Tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | Lower | Upper |
| Equal Varience assumed | 6.712 | 19 | 0.0011 | 7.87 | 0.98 | 5.39 | 9.26 |
| Equal Varience not assumed | 6.714 | 19 | 0.001 | 7.87 | 0.97 | 5.30 | 9.21 |

Note: Qt.ha$^{-1}$ refers to quintal per hectare and 1Qt.ha$^{-1}$=100Kg.

**Table 8: Yield Performance of FTCs (N=2).**

| No | Districts | Yield Performance of Varieties in Kg.ha$^{-1}$ | |
|---|---|---|---|
| | | Ashenafi(ICEAP 00554) | Local |
| 1 | Karat Zuria | 2,020 | 1,550 |
| 2 | Boreda | 1,800 | 1,370 |
| 3 | Grand Mean | 1,910 | 1,460 |

## 3.3. Yield Increase, Advantage and Yield Gap

Ashenafi showed 795 Kg yield increase and 42.7% yield advantage over local variety at Karat Zuria and 905 Kg yield increase and 50.7% yield increase at Boreda (Table **9**). The yield gap of the demonstration is 1,822.5 – 1,0.35.5 = 787 Kg.ha$^{-1}$. This might be due to low adoption of high yielding variety and improved production technologies. The higher yield gap (787 Kg.ha$^{-1}$) indicates that there is a strong need to moblize the farmers for adoption of improved technologies over their local practices.

**Table 9: Yield advantage and yield increases.**

| District | Yield (Kg.ha$^{-1}$) | Local check | Yield Increase (Kg) | Yield Advantage (%) |
|---|---|---|---|---|
| | Ashenafi | | Ashenafi | Ashenafi |
| Karat Zuria | 1,860 | 1,065 | 795 | 42.7 |
| Boreda | 1,785 | 890 | 905 | 50.7 |
| Mean | 1,822.5 | 1,035.5 | 787 | 46.7 |

## 3.4. Farmers Preference to the Demonstrated Pigeon pea Varieties

Farmers' preference on varieties depends on their importance of the technology [27]. Farmers have their own preference criteria to accept or use a specific variety or technology [28]. Farmers set their own criteria to distingush the performance between the new variety and the local check. Farmers selected improved pigeon pea variety by different criteria's. seed color, earliness, seed size, secondary branch, yield, marketability, Number of branch (biomass), plant height, number of pods etc are the settled criteria by farmers and they put their choice on one of the following options for each criterion during focus group discussion and asked to respond to as 1 to 5 which is put for their choice on one of the following options for each criteria, very good (5), good (4), satisfactory (3), poor (2), and very poor (1) [29]. Ashenafi variety was selected as the first choice due to its very good earliness, quickly emerge secondary branch, seed size, grain yield, and number of pods per plant (Table **10**). Majority of the respondents in the field visit also put their opinion that the performance of the variety Ashenafi was better than the local check. Based on its performance the participant farmers finally suggested that Ashenafi should be scaled up for wider production. The result was similar with the findings of the farmer's preference of in Nigeria [30].

**Table 10: Farmer's preference on pigeon pea varieties (N= 20).**

| Nº | Parameters | Districts | | | |
|---|---|---|---|---|---|
| | | Karat Zuria | | Boreda | |
| | | Ashenafi | Local | Ashenafi | Local |
| 1 | Earliness | 5 | 1 | 5 | 2 |
| 2 | Secondary branch initiation | 5 | 1.5 | 4 | 2 |
| 3 | Seed size | 5 | 3 | 4.5 | 2.8 |
| | Seed color | 5 | 3.4 | 5 | 3.1 |
| 4 | Grain Yield | 5 | 1.8 | 5 | 2.4 |
| 5 | Plant Height | 3.3 | 5 | 2.7 | 4.7 |
| 6 | Number of pods | 3.3 | 2 | 5 | 1 |
| 7 | Number of branches | 5 | 4 | 2.4 | 4 |
| 8 | Marketability | 3 | 3.9 | 5 | 2.9 |
| | Total score | 41.3 | 25.6 | 38.6 | 24.9 |
| | Mean score | 4.5(Verygood) | 2.8(satisfactory) | 4.2(good) | 2.7(satisfactory |
| | Rank | 1$^{st}$ | 2nd | 1$^{st}$ | 2$^{nd}$ |

## 3.5. Costs and Benefit Analysis at Farmers Field

Good yield and benefits may determine the acceptability of the technology. More cost effective technology is expected to easily adopted by farmers. Excluding straw sale, seed sale was considered as total return because straw yield is not sold in the area and difficult to covert in to monetary value. Land preparation and harvesting,

seed purchase, and fertilizer purchase considered as Total Variable Cost in this paper. Land is their own and there is no fixed cost for the demonstration. The cost benefit analysis result of the demonstrated varieties from 1 hectare was 142,060 and 57,220 Ethiopian Birr from Ashenafi and local check respectively at Karat Zuria district. Similarly, the Cost Benefit Analysis result of Ashenafi and local check from 1 hectare at Boreda district was 136,120 and 46,720 Ethiopian Birr respectively (Table **11**). The cost benefit analysis of pigeon pea at both districts showed that the use of the Ashenafi variety produced additional benefits over the local check. The study revealed that, proper implementation of better production technology and proficient utilization of required inputs resulted in securing highest net profit.

**Table 11: Cost benefit analysis of demonstrated varieties at farmers field the 2 districts.**

| Nº | Items | Quantity | Unit Price/Cost | Karat Zuria | | Boreda | |
|---|---|---|---|---|---|---|---|
| | | | | Ashenafi | Local | Ashenafi | Local |
| 1 | Mean yield | Kg/ha | | 1,860 | 1,065 | 1,785 | 890 |
| 2 | Selling price | Kg/ETB | 80 for Ashenafi and 60 for local | | | | |
| | Total gain(A) | Birr | | 148,800 | 63,900 | 142,800 | 53,400 |
| 3 | Seed purchase(3Kg) | ETB | 80 for Ashenafi, 60 for local | 240 | 180 | 240 | 180 |
| 4 | Fertilizers purchase | Kg | 50 kg(40ETB) | 2,000 | 2,000 | 2,000 | 2,000 |
| 5 | Land preparation | Ha | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| 6 | Related Labor costs | Person/day | 1day*10 person*300birr | 3,000 | 3,000 | 3,000 | 3,000 |
| | Total costs(B) | Birr | | 6,740 | 6,680 | 6,740 | 6,680 |
| | Net Benefit(C)= A-B | Birr | | 142,060 | 57,220 | 136,120 | 46,720 |

## 3.6. Costs and Benefits Analysis at FTC

The costs and benefits analysis result of the demonstrated varieties from 1 hectare was 154,860 and 86,320 Ethiopian Birr from Ashenafi and local check respectively at Karat Zuria FTC. Similarly, the costs and benefit analysis result of Ashenafi and local check from 1 hectare at Boreda FTC was 137,260 and 75,520 Ethiopian Birr respectively (Table **12**). The cost benefit analysis at FTC'S showed that the use of the Ashenafi variety produced additional profits over the local check, which is relatively similar to that of farmers' field. The study revealed that, proper implementation of recommended agronomic practices and full packages resulted in securing highest net benefits.

**Table 12: Cost benefit analysis of demonstrated varieties at the 2 FTC's.**

| Nº | Items | Quantity | Unit Price/Cost | Karat Zuria FTC | | Boreda FTC | |
|---|---|---|---|---|---|---|---|
| | | | | Ashenafi | Local | Ashenafi | Local |
| 1 | Mean yield | $Kg.ha^{-1}$ | | 2,020 | 1,550 | 1,800 | 1,370 |
| 2 | Selling price | $Kg.ETB^{-1}$ | 80 for Ashenafi and 60 for local | | | | |
| | Total gain(A) | Birr | | 161,600 | 93,000 | 144,000 | 82,200 |
| 3 | Seed purchase(3Kg) | ETB | 80 for Ashenafi, 60 for local | 240 | 180 | 240 | 180 |
| 4 | Fertilizers purchase | Kg | 50 kg(40ETB) | 2,000 | 2,000 | 2,000 | 2,000 |
| 5 | Land preparation | Ha | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| 6 | Related Labor costs | $Person.day^{-1}$ | 1day*10 person*300birr | 3,000 | 3,000 | 3,000 | 3,000 |
| | Total costs(B) | Birr | | 6,740 | 6,680 | 6,740 | 6,680 |
| | Net Benefit(C)= A-B | Birr | | 154,860 | 86,320 | 137,260 | 75,520 |

# 4. Conclusion and Recommendations

Pre extension demonstration of improved pigeon pea technologies with proper Agronomic practices was conducted in the selected farmers field and Farmers Training Center of Karat Zuria and Boreda districts of Konso and Gamo Zones of Southern Ethiopia respectively with 2023/24. Awareness of farmers' on the pigeon pea production technology was created through training. The finding of the demonstration showed that Ashenafi pigeon pea variety at farmers field showed better mean yield performance (1,860Kg.ha$^{-1}$) than that of local check (1,065 Kg.ha$^{-1}$) at Karat Zuria district. Similarly, the mean yield performance of Ahenafi and local check recorded 1,785 and 890 Kg.ha$^{-1}$ respectively at Boreda district at farmer's field. The demonstrations at Farmers Training Center also showed similar results and farmers preferred Ashenafi variety because of good, seed color, seed size, yield and good marketability against the local check. A 42.7% and 50.27% yield advantage over the local check was recorded at Karat Zuria and Boreda districts respectively and this is substantially indicator of the new technology. The profitability analysis result also revealed using Ashenafi pigeon pea variety is better to get higher return. In demonstration sites, farmers show great demand for improved pigeon pea variety and they have worry related to seed sources. Moreover, Agricultural extension subsector of the respective districts need to provide proper technical support to the farmers through different educational and extension methods and farmers should design strong seed exchange mechanisms for better pigeon pea production in the districts. Therefore, it is recommended that Ashenafi can be used for wider production by farmers of the demonstration areas and similar agro ecological settings to enhance diffusion and adoption of the variety with its full packages.

# Conflicts of Interests

The authors declare that they have no conflict of interest.

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