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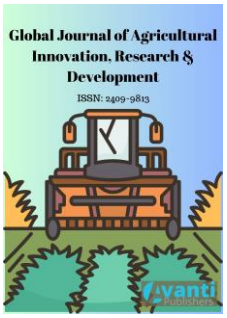


# Pre-Extension Demonstration of Shiro Type Field Pea Technologies in the Highlands of Guji Zone, Oromia Regional State, Ethiopia

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## ABSTRACT

For improvement of field pea production, agricultural research centers have released many varieties. However, productivity of field pea is low due to insufficient demonstration of released and adapted varieties at farmers' level. Hence, demonstration of released and improved varieties is the key approval for large scale production of field pea. Therefore, this experiment was exhibited at three highlands to estimate profitability and evaluate the yield of shiro kind field pea varieties. The Bilalo variety was demonstrated with local varieties by 12 farmers during the year 2022. Yield and costs of production were collected. The data was analyzed through cost benefit analysis and descriptive statistics. The result indicated that the Bilalo variety gave a better yield (25.92 Qt/ha) compared to the local variety (18.33 Qt/ha). Cost benefit analysis indicated that the Bilalo variety gave better returns (108672 ETB/ha) compared to the local variety (54022 ETB/ha). Farmers prefer the Bilalo variety because it provides a higher harvest, is more disease tolerant and has high market value over the local variety. The use of the improved shiro field pea variety is significant for yield increment and profit growth. Thus, the Bilalo variety should be used for shiro type field pea production in highland areas. Additional research is desirable to promote the Bilalo variety through scaling up in the highland and similar agro-ecologies of the Guji zone.

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# 1. Introduction

Among annual crops, the field pea (*Pisum sativum* L.) is a self-pollinated diploid (2n=14). It is the main food pulse, a low-priced center of protein possessing critical amino acids which ensure high nutritious value for poor households [1-4]. It grows in the cool temperate and highlands of tropical areas [5, 6]. Field pea has the perspective of emergent in flexible ranges of elevations from 1800masl to 3000 masl [7-13]. The crop is also produced in different soil types except salty and drenched circumstances [3, 14, 15].

The rank of field pea among the worldwide pulse is second [8, 16, 17] and in Ethiopia it occupies the fourth rank of pulse crops and covers 219,927.59 hectares of land with yield productivity of 17.27Qt/ha [18]. It is the chief diet peas and inexpensive sources of protein having important amino acid for poor farmers [3, 19-21]. It has environmental and economic significance in Ethiopia [6]. It increases crop yield through improving soil fertility (by its capacity to fix nitrogen) [3, 22, 23]. Field pea is appropriate for alternation arrangements to diminish the undesirable influences of mono-cropping on cereal-based farming [3, 11, 12, 17, 24-26]. Field pea is also used as a means of income generation for small holder farmers and alien exchange for the nation [3, 11, 27-29]. It is also used as livestock feed [11, 20, 30].

Regardless of its significance, 1.7 t/ha of field pea productivity is very little [13, 18, 22, 31, 32] related to possible production of 3.556 t/ha [33, 34] and Mogiso [35] show that 4.17 t/ha field pea was harvested from research stations while the most yield of 7-8 t/ha was harvested in developed nations [36]. The small production of field peas by farmers is mostly due to the use of local varieties [35, 37, 38]. Contrast to this, above 80 new field pea diversities have been released to highland areas of Ethiopia [39]. These released varieties are not exhaustively produced by the smallholder farmers.

Accessibility and usage of released field pea is a great challenge. Therefore, the government of Ethiopia dedicated demonstration of new and improved varieties to a learning process of farmers about varieties before large scale production. The Highland Guji zone is suitable for field pea cultivation. The crop can be used in shiro type (in powder used to prepare Ethiopian *shirowet* eaten with *injera*) in households and in hostels. Shiro type field pea cultivation is imperative as the variety is typically consumed in the country, including rural and town areas. Meat prices are increasing at an alarming rate and farmers and poor people cannot afford them. However, the field pea can substitute meat since it has amino acids and is a source of protein for farmers and people. Therefore, promotion of field peas in the form of demonstration is desirable. In Guji Zone, farmers used local field pea varieties [39, 40]. As a result, there is small production of field peas irrespective of the capabilities of highland parts. Field pea is extremely wanted domestically and countrywide due to its daily nutritional utilization and high value crop for farmers.

Demonstration is an event for providing farmers with experiment showing how the new variety, technology and methods can be applied and utilized to bring positive changes on farmers' farm [41]. In agricultural demonstration, researchers test and demonstrate the critical advantage of technologies and approaches [42, 43]. Demonstration can be envisaged in actual circumstances to which farmers can relate [44]. On farm demonstrations could thus be arranged for transferring the traditional knowledge and skills of farmers to the contemporary and engage the active bottom up learning activities [45]. Demonstration event could provide the opportunity for farmers and other stakeholders to discuss about technology or variety, cooperatively resolve the problems, compare practices in similar to their own and familiar to the practical activities [41]. Demonstration recognized as hands-on engagements perceived by organizers and partakers to generate a wide range of positive belongings for farmers, with a principal concentration on certifying actual learning opportunities and empowerment of farmers on demonstration [46]. Agricultural research institutes visibly show an imperative role in on-farm demonstration to transfer their research output to be more successful on farmers land than advisory services [47, 48].

In Ethiopia, there are different agricultural technology transfer approaches from research to the farmers. Participatory variety selection, pre-extension demonstration, pre scaling up and large scale technology promotions are currently applied approach in the country [49]. In participatory variety or technology selection, different

varieties will be shown to the farmers and the farmers will judge the best variety to their contest. In pre-extension demonstration, farmers themselves participated in the research at their land from land preparation to post management in order to approve the importance of the recommended new or improved variety/technology in their farming circumstance. At this stage farmers decision and preference can determine the adoption of the variety. The best variety selected at pre-extension demonstration stage can further popularize through pre-scaling up and large scale production [50] to increase production and maximize farmers' benefit. In this study context, the pre-extension demonstration intended to test the recommended and the improved shiro type field pea variety and packages to the local context. After the approval of varieties by the farmers the scaling up and large scale production through cluster farming is expected from extension system. Therefore, demonstration of shiro type field is important as an entry point for large production. The objectives of this study were to assess harvest performance, estimate cost-effectiveness of farmers' circumstances and judge farmers' responses to the promotion of improved shiro type field pea in the highlands of Guji zone.

# 2. Materials and Methods

### 2.1. Site Selection and Farmers' Selection

This demonstration was organized in three highlands of Guji. Based on field pea production, Bore, Ana Sora and Arda Jila Mea Boko districts were purposively selected. In each district, two kebeles were selected. Finally, in each kebele, three (3) experimental farmers sowed shiro type field pea.

### 2.2. Research Design and Materials

The improved shiro form field pea called Bilalo variety and the local variety was used during 2022 year. Twelve (12) experimental farmers planted Bilalo and local field peas. Each variety was sown on the plot area of 10mx10m. This demonstration used the recommended 100kg/ha of NPS, 100kg/ha of seed, 10cm between plants and 40cm between rows. Knowledge and skills of farmers' on shiro type field pea production was enhanced through training. Mini-field day was arranged at one of the highland districts at maturity time to disseminate the shiro type field pea in the Guji zone.

### 2.3. Methods of Data Collection and Analyze

Observation, measurement and interview methods were used in data collection. Yield, costs of inputs (fertilizer, seed, and land rent), labor costs (harvesting, threshing, weeding and sowing) were collected and analyzed via cost benefit and descriptive statistics. The multiplication of the yield and farm gate price of field peas at threshing time gives the total revenue (TR). The total variable cost (TVC) included costs of fertilizer, seed and labor costs. The land rent was the fixed cost (FC) assumed for field pea production. The summation of TVC and FC gave the total cost (TC). In this demo, the cost-effectiveness of field pea varieties was analyzed by cost benefit analysis (CBA), which was gained by deducting the TC from the TR. The Benefit Cost Ratio (BCR) was calculated by dividing the TR of each variety by its TC. Farmers' opinions on a field pea trait and varieties were analyzed in descriptive way.

$$TR = qxp \tag{1}$$

$$TC = TVC + FC \tag{2}$$

$$CBA = TR - TC \tag{3}$$

# 3. Results and Discussion

### 3.1. Stakeholders Training and Field Day on Shiro Type Field Pea Demonstration

Stakeholders such as development agent, farmers, subject specialists and others were trained to improve production and promote field peas in their farming. Consequently, 33 kebele based Development Agents, 182

farmers, and 25 district agricultural office subject specialists were trained during the demonstration. Moreover, different stakeholders and farmers visited the demonstration site on the mini-field day (Table **1**). Participants witnessed that the improved field pea variety was recognized by the participants, and they were excited to produce the Bilalo variety and decided that the improved variety was delivered by a research center and/or gained from other seed sources. Training and mini-field days have facilitated the technology transfer from research to large extension. Hence, agricultural extension service should concentrate on the capabilities of end users [51-56].

**Table 1: Participants on shiro type field pea demonstration.**

| Capacity Building Methods Used | Stakeholders | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Development Agents | | | Farmers | | | Subject Matter Specialist | | | Others | | |
| | Male | Female | Total | Male | Female | Total | Male | Female | Total | Male | Female | Total |
| Training | 23 | 10 | 33 | 160 | 22 | 182 | 16 | 5 | 21 | 4 | - | 4 |
| Mini field day | 5 | 1 | 6 | 40 | 11 | 51 | 4 | - | 4 | 2 | - | 2 |
| Total | 28 | 11 | 39 | 200 | 33 | 233 | 22 | 3 | 25 | 6 | - | 6 |

## 3.2. The Yield Performance of Improved Shiro Type Field Pea Varieties

From Table **2**, the Bilalo variety produced 25.92 Qt/ha while the local variety gave 18.33Qt/ha. The improved shiro type variety produced more yield than the local one. The yield gap between Bilalo and the local variety was 7.59 Qt/ha. This indicated that Bilalo yielded more than the local variety. The yield of Bilalo harvested from this demonstration was more than the national productivity of field pea (17.27Qt/ha) in Ethiopia [18]. This revealed that the highland districts of Guji zone where this demonstration was conducted were most suitable for field pea farming. At the time of the demonstration, Bilalo returned a 32 Qt/ha yield. This designated the use of better-quality such as the Bilalo variety can raise the field pea yield. The yield harvested in the highlands of Guji was comparable to the results of Lemma [57] who indicated that on the farm and on the station, Bilalo, could have 20.39 Qt/ha and 26.68 Qt/ha, respectively. This revealed that there was yield disparity between on farms and on stations as on station was managed by researchers and on farms were managed by farmers where there were diverse management practices that lead to yield difference. Besides, in some highlands of the Guji zone, the Bilalo variety generated 38.96 Qt/ha [39] which was more than the yield result of this study. This variation might be due to management performance by the farmers and weather conditions. The Bilalo variety was also eaten by wild animals in the vegetative stage. Due to the sweetness of the variety, it was eaten by humans at pod stage. These challenges affected the yield of Bilalo during demonstrations. Hence, Bilalo production should be near to home to supervise and protect humans and wild animals.

Among the selected three districts, the Bilalo variety gave better yield (27qt/ha) at Ana Sora district while there was a lower yield at Arda Jila Mea Boko (Fig. **1**). Although the variety was affected by wild animals and humans, the Ana Sora highland areas were more conducive to shiro variety production than other highlands of the Guji zone.

**Table 2: Yield (Qt/ha) of demonstrated shiro type field pea varieties.**

| Varieties | N | Minimum | Maximum | Mean | Std. Dev. |
|---|---|---|---|---|---|
| Bilalo | 12 | 22 | 32 | 25.92 | 2.88 |
| Local | 12 | 15 | 22 | 18.33 | 2.55 |

The results of the independent t test showed that there was a 7.58 Qt/ha yield difference between the local and Bilalo varieties (Table **3**). Based on the independent t-test ($p = .001 < .05$), the improved Bilalo variety and the local differ in their yield performance.

**Table 3: Mean yield difference analysis.**

| Yield | t-Test for Equality of Means (Qt/ha) | | | | | | |
|---|---|---|---|---|---|---|---|
| | T | Df | Sig. (2-Tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference | |
| | | | | | | Lower | Upper |
| Equal variances assumed | 6.854 | 22 | .001 | 7.583 | 1.106 | 5.289 | 9.878 |
| Equal variances not assumed | 6.854 | 21.660 | .001 | 7.583 | 1.106 | 5.287 | 9.880 |

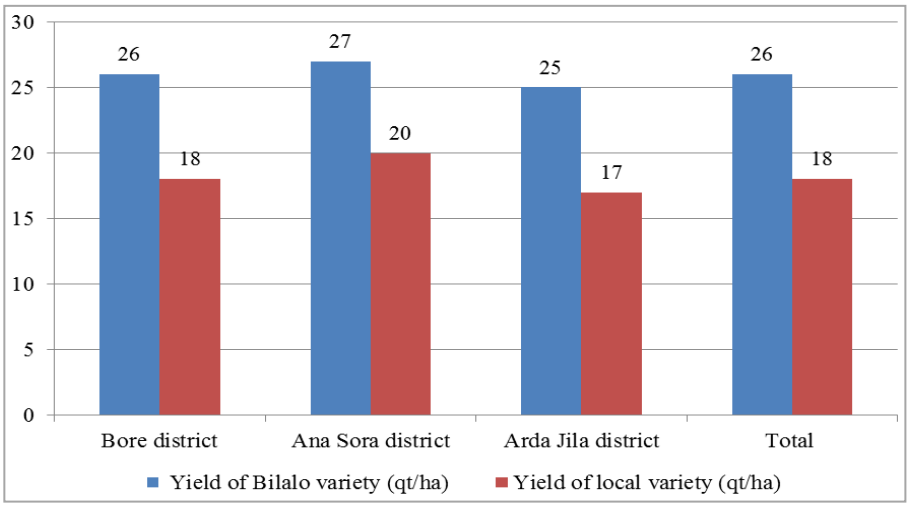


**Figure 1:** Yield production of improved Bilalo and the local variety among the districts.

### 3.3. Cost-Effectiveness of Shiro Type Field Pea production

More yield and return can determine the acceptability of variety in agricultural production. Adoption of varieties by farmers is interlinked with the amount of return generated from a new variety. More cost-effectiveness variety or technology is easily adopted and produced by farmers. Therefore, estimation of the profitability of the shiro type variety in this study is essential to decide whether the return was financially feasible for the farmers. The local variety cost 4000 ETB/Qt while Bilalo was 5000ETB/Qt in the production year. The return obtained from the Bilalo variety was108672.50 ETB/ha and the local variety generated 54022.50 ETB/ha. Production of the Bilalo variety was more cost-effective (6.25) than the local one (3.5). This discovered that field pea production by improved seed returned twofold from producing the local variety. Bilalo can profit from the lowest of 88800 ETB/ha and the extreme of 139100 ETB/ha (Table **4**). This showed that in addition to household consumption branded as shiro wat in Ethiopia, the Bilalo variety can generate excess earnings that can help farmers with their livelihood. The cost benefit analysis showed that the use of the Bilalo variety produced additional profits over the local variety in the Guji highlands.

### 3.4. Farmers' Preferences and Feedbacks on Shiro Type Varieties

The size of land occupied by the field was becoming smaller and smaller as the local variety was troubled by the pod borer. This limits farmers to producing field peas in larger areas due to low yield and diseases have affected the yield of local field pea. In addition, there was a mixture of seed as it revolved from farmer to farmer for a long period and obtaining pure seed was challenging as the farmers were mentioned during the demonstration. Farmers' preference on varieties and traits depends on their importance to farmers' farming [58]. In a demonstration of shiro type field, the Bilalo variety was mostly chosen by farmers due to its market demand, disease tolerance, purity and higher yield. Compared to the local variety, the Bilalo variety has a more number of

branches and a more number of pods that used to increase yield. Farmers gave their intension to using the improved shiro type rather than the local one (Table **5**). Moreover, the shiro type field pea was highly demanded because many people use it for day-to-day *wat* preparation. Hence, the supply and production of the Bilalo variety can increase farmers' income, which can diversify farmers' agricultural business for improvement of their livelihood. The dark color of Bilalo, likened by farmers as a small amount of hot pepper powder, is enough for shiro *wat* preparation. This can save farmers and hotel owners from extra expense for the purchase of *berbere* in preparing *wat*.

**Table 4: Cost benefit analysis of shiro type field pea production.**

| Elements | N | Min | Max | Mean | Std. Dev |
|---|---|---|---|---|---|
| Yield of Bilalo (Qt/ha) | 12 | 22 | 32 | 25.92 | 2.88 |
| Yield of Local (Qt/ha) | 12 | 15 | 22 | 18.33 | 2.54 |
| Farm gate price of Bilalo (ETB/ha) | 12 | 5000 | 5000 | 5000.00 | .00 |
| Farm gate price of local variety (ETB/ha) | 12 | 4000 | 4000 | 4000.00 | .00 |
| TR of Bilalo (ETB/ha) | 12 | 110000 | 160000 | 129583.33 | 14374.59 |
| TR of local (ETB/ha) | 12 | 60000 | 88000 | 73333.33 | 10138.44 |
| TVC of Bilalo (ETB/ha) | 12 | 12350 | 13400 | 13119.17 | 276.09 |
| TVC of local (ETB/ha) | 12 | 10750 | 11800 | 11519.17 | 276.09 |
| FC (ETB/ha) | 12 | 7500 | 8000 | 7791.67 | 257.46 |
| TC (ETB/ha) | 12 | 19850 | 21400 | 20910.83 | 417.08 |
| CBA of Bilalo (ETB/ha)= TR-TC | 12 | 88800 | 139100 | 108672.50 | 14484.23 |
| CBA of local (ETB/ha)= TR-TC | 12 | 40200 | 69050 | 54022.50 | 10366.59 |
| BCR of Bilalo = TR/TC | 12 | 5 | 8 | 6.25 | .87 |
| BCR of local = TR/TC | 12 | 3 | 4 | 3.5 | .52 |

**Table 5: Farmers' choice standards for field pea.**

| Shiro Type Varieties | Rank give | Possible Reasons for Rank |
|---|---|---|
| Bilalo | 1st | Higher yield, disease tolerant and uniformity of seed |
| Local | 2nd | Lower yield, susceptible to disease and no uniformity |

# 4. Conclusions and Recommendation

Improved variety is important to boast agricultural productivity. Therefore, demonstrating the role of improved variety on farmers' land is imperative. Hence, technology transfer through agricultural extension is a commitment to demonstration. Bilalo and local varieties were demonstrated to indicate their potential on farmers' land. Based on the findings, the Bilalo variety was a high yielder and generated a feasible return over the local variety. In addition, the Bilalo variety was preferred by experimental farmers because of more market demand, more disease tolerant, higher yield and more purity than the local one. Dissemination of the Bilalo variety is important in the highland areas of the Guji zone. Farmers should sow their field peas around home to escape from wild animals and people attack.

# Conflict of Interest

The authors have declared that they have no conflicts of interest in publishing this paper.

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