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2 Evaluation of Recently Released Andean Bean Varieties with the Participation
3 of Farmers in Mid-altitude Region of Gedeb Zuria, Gedo Zone
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9 **ABSTRACT**

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11 During the 2012 mehere season, a study was conducted in the income Gedeb Wereda of the
12 Gedio zone in Ethiopia to evaluate farmers' selection criteria for beans and the performance
13 of newly released Andean common bean varieties. The study utilised participatory variety
14 selection (PVS) trials. The findings revealed that qualitative features were given more
15 importance by farmers compared to quantitative traits. Among the different genotypes
16 tested, Gegeba and Ibado emerged as the top two varieties. Farmers considered five
17 qualitative characteristics as superior to production: seed size, marketability, maturity
18 duration, pest and disease resistance, the ability to tolerate cool temperatures, and seed
19 color. Gegeba, with its large, red-speckled seeds, high market demand, upright growth habit,
20 early maturity (90 days), and reasonably high yield (>2 tonnes ha⁻¹), was the preferred
21 choice for almost all farmers. The study suggests that future bean development efforts
22 should focus on promoting the selected varieties and developing new ones that align with
23 farmers' preferences, particularly in terms of adaptation to the mid-highlands, suitability for
24 domestic consumption, local markets, and export markets.

25
26 **Key words:** common bean, PVS, selection criteria.
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29 **1. INTRODUCTION**

30 In Ethiopia, the primary pulse crops cultivated are Faba bean, common beans, chickpeas,
31 haricot beans, lentils, mung bean, and vetches. According to CSA (2016), the common bean
32 (*Phaseolus vulgaris* L.) holds the utmost significance as a pulse crop in terms of both area
33 coverage and annual production volume in Ethiopia. It is extensively grown by smallholder
34 farmers in the Southern Nation, Nationalities, and People's Region (SNNPR), making it one
35 of the major grain legumes in the region. Legumes play a vital role in providing protein in
36 Ethiopia, with common bean (*Phaseolus vulgaris* L.) being a prominent contributor alongside
37 faba bean and field pea (CSA, 2016).
38

39 The rural areas of Sidama Zone heavily rely on the crop sector for their livelihoods. In this
40 specific region, the primary crops cultivated are 'Enset' and maize. Enset, a perennial root
41 crop, is unique to Ethiopia and is mainly grown in the courtyard alongside other crops like
42 coffee, common bean, and maize. The food derived from Enset, called 'Kocho', is consumed
43 either alone or mixed with boiled beans and maize. Enset plays a crucial role in generating
44 income as its straw is used as livestock feed, and it also enhances soil fertility through
45 nitrogen fixation in the cropping system. Despite the potential yield of beans reaching up to 5
46 tonnes per hectare, the average yield of local bean varieties in the study area is only about
47 1.7 tonnes per hectare, which is significantly low. This can be attributed to various factors,
48 such as soil conditions, climate, diseases, and pests. Moreover, the limited availability of
49 improved varieties in different market classes and agro-ecologies, coupled with insufficient
50 awareness,.

51
52 Furthermore, farmers in different regions have shown varying levels of acceptance towards
53 the released and high-yielding varieties. This can be attributed to the fact that these varieties

54 were developed using conventional breeding methods, which did not take into account the
55 preferences of farmers. According to a study conducted by Gemechu et al. (2004), the
56 adoption rate of most varieties developed through conventional breeding has been lower
57 than expected. The researchers argue that involving farmers in the research process from
58 the outset is crucial, as farmers have their own selection criteria that go beyond just yield
59 potential. Another factor contributing to the lower adoption rate is that the selected varieties
60 may perform well in controlled research station environments but not in diverse field
61 conditions. This is due to the influence of genotype-environment interactions, as highlighted
62 by Ceccarelli and Grando (2006).

63
64 Gemechu et al. (2002) emphasised the importance of effectively utilising the unique and
65 shared knowledge of farmers and researchers in the research process. They recognised that
66 both farmers and professional plant breeders possess valuable knowledge and skills that
67 can complement each other. Participatory variety selection (PVS) encompasses a range of
68 approaches that involve various stakeholders, including scientists, breeders, farmers, and
69 other actors, in the different stages of plant breeding. The objective of PVS is to develop
70 varieties that not only adapt to the physical environment but also to the socio-economic
71 conditions in which they will be utilized. According to Ashby (2009), the adoption of PVS
72 varieties by more farmers across larger areas leads to increased food production and
73 income benefits. Additionally, PVS enhances research efficiency by generating more
74 relevant and desirable research outcomes. Ashby (2009) cited examples from different
75 countries and crops to highlight the impact of PVS.

76
77 Participatory variety selection (PVS) is becoming increasingly popular in African countries as
78 a way to discover and promote new crop breeding materials. This method involves farmers
79 selecting new varieties from predetermined lines in different target environments.
80 Participatory variety selection encompasses a wide range of approaches in plant breeding,
81 engaging scientists, breeders, farmers, and other stakeholders.

82
83 The common bean is commonly cultivated in low-altitude and hot environments in Ethiopia
84 (Cheng, 2021). Nevertheless, specific Andean bean genotypes possess the capability to
85 adjust to mid-altitude regions with cooler climates because of their phylogenetic and gene
86 pool origins. Consequently, this study represents one of the few pioneering experiments
87 carried out at a moderate elevation to introduce the adaptation of Andean beans in both
88 Ethiopia and the southern region
89 Moreover, we can credit the discovery of this bean to the unique climatic conditions found in
90 this area.

91
92 Therefore, the objectives of this study were to:

93
94 . The objective is to assess and choose the most successful Andean common bean varieties
95 that are suitable for adaptation in the mid-highland region.

96
97 Additionally, the aim is to evaluate the selection criteria used by farmers in choosing
98 common bean varieties in the mid-highland, with active participation from the farmers.

99
100 Furthermore, it is crucial to identify the key criteria that will guide future improvements in
101 bean cultivation in the region and surrounding areas.

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105 2. MATERIAL AND METHODS

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107 The study was conducted in the Gedeb district, Gedio Zone, SNNPR Region. Situated at an
108 elevation of 2200 m.a.s.l., the region receives an annual rainfall of 1200 mm. The soil in this
109 area is characterised by a sandy-loam texture. Ensete, maize, barley, wheat, potato, faba
110 bean, and field pea are the main crops cultivated in this predominantly agricultural region.
111 Additionally, the region experiences bi-modal rainfall, allowing for the cultivation of grain
112 crops during both the Meher and Belg seasons.

113

114 The initial phase of the experiment took place in Gedio Zone, GedebWereda. The
115 experiment involved seven different Andean bean varieties, namely Ibado, Gegeba, Tatu,
116 Remeda, Wajo, Awash-2, and Batu. To ensure accuracy, a randomized complete block
117 design (RCBD) was implemented. Each plot had a size of 12.8 m², consisting of four rows
118 measuring two metres in length. The spacing between rows was 40cm, while within a row it
119 was 10cm. A total of 100 kg of NPS/ha fertilizer was applied. All recommended agronomic
120 practices, including weeding and cultivation, were diligently carried out. Detailed
121 observations were made on phenological, agronomic, and yield traits. Additionally, for the
122 secondary trials, twenty farmers from the surrounding area were selected. Each farmer
123 received one kilogramme of two bean varieties based on their personal preferences, and
124 they were responsible for managing their own plots. The experiment was initiated in 2012,
125 and the harvest took place in July of the same year.

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128 3. RESULTS AND DISCUSSION

129 Researcher's evaluation

130 The PVS trial for the common bean in the Gedeb district was evaluated by the researchers,
131 with a specific focus on grain yield (Table 1). The different varieties showed a significant
132 range in grain yield, with Gegeba achieving the highest yield of 2500 kg/ha and Batu having
133 a lower yield of 1300 kg/ha. The analysis of the PVS trial indicated a noticeable difference in
134 grain yield among the varieties in Gedeb during the 2012–2013 period (Table 1). Ibado and
135 Gegeba were selected for the initial trial based on factors such as seed size, earliness, pod
136 length, disease resistance, and overall yield, as determined by both male and female
137 farmers. These chosen varieties are characterized by early maturation and are well-suited
138 for double cropping, especially during the Belg season. While faba bean and field pea are
139 the primary legumes in the mid-highland areas, common bean can also be considered a
140 viable alternative legume crop.

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142

143 **Table 1. Mean yield (Qt /ha) with farmers preference rank at Gedeb**
144 **2012/13**

No.	Varity	Market class	Yield kg/ha	Farmers Preference	
				Male (15)	Female(5)
1	Ibado	Large Red mottled	2000	2	1

2	Tatu	Large Red mottled	2300	3	4
3	Batu	Large White	1700	6	6
4	Gegeba	Large Red mottled	2500	1	2
5	Awash-2	Large White	1900	7	7
6	Wajo	Large White	2000	5	5
7	Remeda	Red Kidney	2200	4	3
Cv(%)			24		

145 **Farmers Evaluation**

146 n the study area, farmers engaged in participatory variety evaluation and selection. They
147 assessed various criteria to determine their acceptance or rejection of bean varieties. These
148 criteria encompassed pod load, earliness, yield, seed size, red colour, market value, seed
149 shape, maturity period, disease resistance, insect resistance, pod appearance, and green
150 leaf. Out of the fourteen different traits, farmers selected the ones they frequently utilized
151 when evaluating common bean genotypes for adoption. This indicates that although farmers
152 take into account multiple traits, there are only a few that they commonly rely on, and it is
153 crucial to identify these traits. Similar findings have been observed in previous studies
154 conducted by Gurumu (2013) and Wondimu (2016) on common beans, where farmers
155 utilized a combination of a few traits when evaluating new genotypes

156

157 **Table 2. Trait (selection criteria) used by farmers with preference rank at**
158 **Gedeb 2012/13**

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Trait (Selection criteria)	Remeda	Ibado	Gegeba	Batu	Awash-2	Wajo	Tatu
Number pods/plant	4	6	5	2	5	1	3
Time of maturity(Earliness)	4	6	5	2	1	3	5
Grain harvested	5	6	5	1	3	1	3
Grain shape	3	6	4	2	3	3	2
Largeness of Seed	2	6	5	2	5	2	1
Red and Red Mottled color	3	2	5	3	3	2	6
Demand by the market	4	3	6	1	4	1	4
Largeness of Seed	4	6	6	1	5	1	4
Growth period	3	4	6	1	2	1	3
Disease Tolerance	6	5	2	1	4	1	1
Insect Tolerance	5	6	4	1	3	1	1

Brightness of Seed	1	5	6	2	3	1	1
Stay green	6	1	5	1	3	1	4
Mean Preference rating	3.85	4.77	4.92	1.54	3.38	1.46	2.92
Rank	3	2	1	6	4	7	5

160 **Table 3. Rank of The best preferred criteria used by men and women farmers at**
161 **Gedeb, 2012/13**

Selection criteria	Men	Women
Pods/plant	4	3
Number of seed /pod	5	6
Pod filing	8	7
Diseases and Insect tolerance	6	5
Seed size & pod length	7	8
Seed color(speckled or uniform color)	3	4
Growth period	2	2
Erectnessor climbing growthhabit	8	8
Yield	1	1

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165 **4. CONCLUSION**

166

167 The most preferred genotypes identified by the farmer's discussion through PVS and the
168 researchers' analysis results were Gegeba and Ibado. These genotypes need to be
169 demonstrated on large plots in a pre-extension demonstration (PED), and finally, the
170 varieties need to be upscaled through participatory seed production. The first two varieties
171 (Gegeba and Ibado) were also identified by researchers as the most preferred varieties for
172 yield and other desirable traits. The study indicates that to assure the quality and quantity of
173 data, enough resources have to be made available.

174

175 Gegeba and Ibado have been identified as the most favored genotypes through the farmers'
176 discussion and the researchers' analysis. To showcase these genotypes effectively, they
177 should be grown on extensive plots in a pre-extension demonstration (PED). Furthermore,
178 participatory seed production should be employed to expand the cultivation of these
179 varieties. The researchers have also recognised Gegeba and Ibado as the top selections for

180 yield and other desirable traits. The study highlights the significance of allocating ample
181 resources to guarantee the quality and quantity of data.

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184 **RECOMMENDATIONS**

185 According to the findings, it is imperative to carry out the following measures:

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187 ➤ Encourage the adoption of specific cultivars and their associated farming techniques
188 in the experimental locations where they have been implemented.

189

190 ➤ Formulate plans for the multiplication and distribution of seeds to ensure the
191 continued availability of these cultivars for farmers in the long term.

192

193 ➤ Begin the development of new cultivars suitable for the mid-highland region, using
194 Andean genotypes, with the goal of introducing improved alternatives for the area.

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196

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203 **Ethical approval**

204 The present study followed, national, Regional and/or institutional guidelines for Crop
205 Science Research and complied with relevant legislation from *Southern Agricultural
206 Research INSTITUTIONAL REVIEW OR Hawassa Research Center GUIDELINE *.

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