Adopting Improved Haricot Bean Varieties in the Central Rift Valley of Ethiopia

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Introduction

Haricot bean plays an important role in the economy of small farmers. It is the most important traditional pulse crop in lowland areas of Ethiopia, particularly in the Rift Valley (Tesfaye 1993). Its grain is used for food and making money, whereas its by-product, including its stalk and leaves, is used for firewood and feed. Moreover, since it is short maturing and has moderate drought tolerance, it is used as the main or the only food in short growing seasons and poor annual harvest areas. Thus, it plays a vital role in farmers' risk aversion strategies.

Nazret and Zway are major white pea bean producing regions in Ethiopia. Among the sample farmers in these areas, 83% cultivate 20% of their land with this crop. The crop is produced mainly for market and is the first cash crop to 21% of the farmers and the second to 28% of the farmers (Aleligne 1993). Seventy-five percent of it produced is marketed. Farmers usually sell it to settle fertilizer debt for *tef* harvest, to pay taxes, and for clothing expenses.

Farmers have been facing problems of extremely poor yield mainly due to diseases (Habtu Aseffa and Dereje Gorfu 1985). The average yield of haricot bean has declined to below eight quintals per hectare (CSA 2003). To restrain this problem, research on haricot bean was started in 1970s.

The Study Area

The study area is located between 7 º and 90 º N and 38 º and 40 º E at an altitude range of 1500 to 2300 m (Zonal Atlas 1999). The mean annual temperature range is from 15 to 20 ºc. The mean seasonal rainfall from January to September also ranges from 500 to 800 mm and the length of crop growing period is 210 days. The area generally falls within subtropical zone and represents moisture stress dry areas with the highest experience of water deficit. It suffers from poor and erratic distribution of rainfall. It covers 7840.5 km^2 of land.

Mixed farming is practiced in the area where *tef*, maize, haricot bean, wheat, and barley are given the highest priority. According to the national statistics, the total haricot bean production in the sample areas in 2002 was 13753.7 t, which was 8% of the national crop production (CSA 2002).

Soils of this area are generally formed from volcanic ash parent material. They are light, loose, and porous with high draining capacity that absorbs much water. They are fragile and easily taken away by rain and/or wind.

Methodology

Two-stage, purposive and simple-random, sampling was followed to identify sample farmers. In the first stage, key informants comprising the *wereda* and zonal bureaus of agriculture, development agents, peasant association leaders, and selected community members were used to select four districts (*Weredas*) in the central rift valley of Ethiopia based on the distribution (land area coverage) and importance of haricot beans. Thus, Adama, Boset, Dugda-Bora and Adami-Tulu w*eredas* were selected. Two-hundred-forty (240) farmers (0.5 % of growers) were randomly selected from a list of haricot bean growers from 10 peasant associations of 70 villages. The farmers live between 0.05 and 14 kms away from the office of the development agent (where 77% live within 5km radius). Data was collected using structured questionnaires that were pre-tested and modified as appropriate. Trained enumerators were used for data collection with close supervision of researchers. Interviews were also conducted in 2001/2.

Analytical work

This paper uses Feder's definition of adoption that the degree of use of a new technology is in equilibrium when a farmer has full information about the new technology and its potential in the long run (Feder *et al.* 1985). Adopters are farmers who have experiences in using a new technology at least once.

To assess the rate of adoption, the logistic curve is used. The curve is constructed using proportion of farmers who have adopted at least one innovation, i.e., improved variety. The basic assumption is that adoption increases slowly at first and then increases rapidly approaching a maximum level (CIMMYT 1993). Mathematically, it is put as follows:

$$Y_t = \frac{K}{1 + e^{-a-bt}}$$

Where Y_t = the cumulative percentage of adopters at a time t
K = the upper bound of adoption
e=a constant
b = a constant related to the rate of adoption
a = a constant related to the time when adoption begins

But the decision to adopt a technology may be influenced by farm and farmer characteristics and environmental situations (CIMMYT 1988; Adesina *et al.* 1992; Misra *et al.* 1993), such as size of land or wealth, age or experience, sex, education, labor, weather, and extension activities.

In this study, the logit model with the following functional form is used, McFadden (1981) and Green (2000), to assess factors affecting adoption of haricot bean varieties. The expression $\beta' X$ is defined as follows:

$$\mathrm{Prob}(Y = 1) = \frac{1}{1 + e^{-(\beta' X)}}$$

$$\beta' X = \beta_0 + \beta_1 X_1 + \beta_2 X_2 ... + \beta_n X_n + \varepsilon$$

Where β_0 = the constant, $\beta_1, \beta_2 ... \beta_n$ = coefficients to be estimated,

$X_1, X_{2...Xn}$ = independent variables

ε = the error term with zero mean and constant variance

The model was formulated using a number of working hypotheses based on factors (Table 1) related to farmers' circumstances affecting adoption of improved varieties (CIMMYT 1993).

Table 1. Explanatory variables (hypothesized)

Variable/factor	Code	Expected sign	Explanation
Climate (rainfall availability, dummy variable)	Climate	+/-	Favorable climate facilitates adoption and farmers benefit from better harvest.
Sex of household head (dummy variable)	Sex	+/-	Adopting improved technologies increases with male farmers
Off-farm activity (dummy variable)	Off-farm	+	Off-farm activity enhances adoption.
Credit use (status, dummy variable)	Credit	+	Farmers who use credit may buy improved and alternative technologies to increase total production
Dependent family member	DepFam	-	The increase in size of the dependent family members may deter adoption of improved technology
Farming experience (Years)	Experience	+	Experienced farmers are more likely to adopt improved technologies.
Education of household head (years)	Education	+	Education increases adoption since it increases the farmer's ability to evaluate alternatives.
Labor use (status, dummy variable)	Labor	+	Labor availability and use enhances adoption by absorbing the new farming practices generated by the new technology.
Tropical livestock unit	TLU	+/-	The increase in size of livestock increases farmers' adoption status since it increases their economic position
Farmers' participation in extension programs (Proxy for extension information, dummy variable)	Ext part	+	Farmers' participation in extension programs creates awareness and access and increases their knowledge and decision on a new technology.
Land holding (hectare)	Land	+	Availability of land enhances adoption as potential benefits are larger and transaction costs relatively lower

Farmer's Characteristics

Demography

The majority of respondents (86.3 %) and most adopters (91.9%) were men. The mean age of the sample household heads (HHH) was 44 years with about eight members (Table 2). Significant difference in age was observed only among farmers above 50 and below 10. Sixty-three per cent of the household members were between 10 and 50 years, which is an economically active category. Despite lack of significant difference among adopters and non-adopters in education, 62% of adopters and 67.6% of non-adopters were illiterate. Farmers' experience in farming haricot bean was lower by 50% than their general farming experience. Comparatively, non-adopters had lower experience with haricot bean than adopters.

Table 2. Demographic characteristics of sample farmers' households

Characteristics	Sample farmers (N=240)		Adopters (N=74)		Non-adopters (N=166)		t-statistic
	Mean	Std.	Mean	Std.	Mean	Std.	
Age of HHH	44.41	13.68	44.42	12.38	44.40	14.26	-0.01
Family size	7.70	3.86	7.18	3.12	7.94	4.14	1.42
Age above 50	0.58	0.81	0.70	0.89	0.52	0.77	-1.58*
Age between 20 and 50	2.39	1.72	2.20	1.49	2.48	1.81	1.14
Age between 10 and 19	2.43	2.00	2.24	1.83	2.52	2.08	0.98
Age below 10	2.29	1.77	2.01	1.49	2.42	1.88	1.65*
Level of education of HHH	1.53	2.55	1.43	2.59	1.57	2.54	0.39
General farming experience of HHH	25.79	12.39	27.08	11.54	25.22	12.74	-1.08
HHH's farming experience with haricot bean	12.8	8.09	11.73	6.76	13.28	8.60	1.37*

** Significant at 5% level, StD=standard deviation, HHH=household head*

Farm Characteristics

There has been significant difference among farmers in size of land, *Mofer* (wooden plough) possession, *Kenber* (yoke) possession, and laborers hired. The average land area owned by sample farmers was three hectares (Table 3). Adopters have allocated greater portion of their land to haricot bean than non-adopters. They had more wooden ploughs and yokes than non-adopters. Even though other factors were not statistically significant, adopters were relatively better than non-adopters in owning them.

Table 3. Some economic variables for sample farmers

Characteristics	Sample farmers (N=240)		Adopters (N=74)		Non-adopters (N=166)		t-value
	Mean	Std.	Mean	Std.	Mean	Std.	
Total land owned (ha)	3.15	1.84	2.87	1.44	3.27	1.99	1.56*
Total land cultivated (ha)	2.81	1.57	2.87	1.69	2.78	1.52	-0.42
Haricot bean area (ha)	0.69	0.65	0.91	0.77	0.60	0.57	-3.47
Tropical livestock unit**	9.27	10.39	10.71	12.21	8.63	9.45	-1.43
Oxen owned	1.83	1.54	2.24	1.50	1.64	1.53	-2.81
Hoe owned	1.4	1.64	1.48	1.24	1.37	1.77	-0.47
Mofer owned	1.28	0.69	1.56	0.68	1.18	0.68	-3.89*
Kenber owned	1.31	0.76	1.53	0.83	1.23	0.73	-2.74*
Total laborers hired	3.04	5.53	4.54	6.28	2.38	5.04	-2.84*

** Significant at 5 per cent level, **Tropical livestock unit is an animal unit calculated in 250 kg live weight of an animal.*

Land Tenure

There was a significant difference among adopters and non-adopters in land tenure arrangement in most variables during 2001/2 (Table 4). Adopters were using more leased land (0.42 ha) than non-adopters (0.16 ha). However, non-adopters have been leasing out their land or sharecropping it with others. This may be one of the positive sides of being an adopter (i.e., employing more land for additional crop production).

Table 4. Land tenure system of sample farmers

Tenure system	Mean		Std.		t-value
	Adopters	Non-adopters	Adopters	Non-adopters	
Total own land cultivated (ha)	2.45	2.61	1.09	1.51	-0.82*
Own land cultivated in sharecropping (ha)	0.02	0.10	0.11	0.60	-1.17*
Own land leased out (ha)	0.11	0.17	0.29	0.49	-0.92*
Land sharecropped from others (ha)	0.00	0.01	0.00	0.07	-0.93**
Land leased (ha)	0.42	0.16	1.13	0.40	2.61*
Total land cultivated (ha)	2.87	2.78	1.69	1.52	0.42

** Significant at 5% level, ** significant at 10 per cent*

Income Source

Adopters and non-adopters depend on their income from sale of different crops (Table 5). However, adopters obtain income more from livestock and credit than non-adopters. This entails that adopters have diversified source of income. The crops market value for adopters and non-adopters are as follows: haricot bean (41.6% significant at 10% level), *tef* (30.7%), and maize (26.2% significant at 1% level) for adopters; haricot bean (41.8%), maize (31.9%) and *tef* (22.4%) for non-adopters.

Table 5. Comparison of income sources of adopters and non-adopters

Source of farm income	Adopters (%)	Non-adopters (%)	Total (%)	χ^2
Farm produce (crop)	64.2	74.8	71.6	
Livestock	25.8	18.9	21	27.3*
Off-farm activity	3.1	5.6	4.8	19.4
Credit	6.8	0.7	2.6	57.5**

***significant at 1% level, *significant at 10% level*

Crops and Cropping Systems

Maize, tef and haricot bean were allocated more area than other crops (Table 6). The variation between adopters and non-adopters has been significant. Adopters reserved a significantly large land area for haricot bean, whereas non-adopters did for maize. Most of the farmers (95 percent) were practicing sole cropping, whereas the rest did mixed cropping system.

Table 6. Land allocated to major crops by sample farmers (2001/2)

Land allocation	Mean area (ha)			Std.	
	All*	Adopters	Non-adopters	Adopters	Non-adopters
Maize	1.17	0.86	1.31	0.58	0.98
Tef	0.66	0.85	0.58	1.00	0.64
Haricot bean	0.69	0.91	0.60	0.77	0.57
Sorghum	0.04	0.07	0.02	0.15	0.10
Wheat	0.15	0.11	0.17	0.24	0.32
Barley	0.06	0.06	0.06	0.18	0.17
Hot pepper	0.30	0.00	0.43	0.00	2.20
Total land cultivated	2.81	2.87	2.78	1.69	1.52

**significant ($p<0.01$)*

Recommended Management Practices

Farmers were advised to plough their land three times before planting haricot bean. That is, the first immediately after the previous harvest, the second a month after, and the third at planting. Planting time depends on the onset of rainfall. Usually, when rainfall starts in mid-June, planting during late June and mid-July is recommended. In poor soil, adding 100 kg and 50 to 100 kg ha^{-1} of Di-ammonium phosphate (DAP) and urea, respectively, is recommended.

Hand weeding should be done twice. Accordingly, farmers should undertake the first hand weeding two weeks after planting, and the next weeding

depending on the type and level of weed population and crop growth stage. It may be done when the first flowers begin to emerge.

For annual grasses and broad-leafed weeds, applying chemical Alachlor at the rate of four liters per hectare is recommended. The effect of major insect pests, such as African bollworm, may be reduced by intercropping haricot bean to maize and *Bruchids,* keeping storage places and materials clean, keeping old and newly harvested seeds separate, and treating seeds with chemical, such as Primiphos-methyl, at the rate of 25 gram per ten kilogram of seed. To control most important yield reducing diseases, such as bacterial blight, anthracnose, and rust; using clean, disease-free seeds and avoiding repeated cropping in the same field and planting disease-tolerant varieties is recommended.

Most farmers did not use the recommended weeding (57 %) and chemicals, including fertilizer (only 67 %), on haricot bean. Few farmers (33 %) used them below the recommended rate. Sample farmers were not used to applying pesticides. Lack of money to buy fertilizer and chemicals and the low income from the sale of haricot bean, as compared to the other crops have been major impediments to allocate required resources and use the recommended crop management practices.

Cropping Calendar

According to farmers, all activities from land preparation to threshing are done from April through November (Table 7). June and July are the busiest periods when most farm activities are overlapping and September through November are peak labor demand periods.

Table 7. Haricot bean cropping calendar

Operation	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Land preparation				9……..22								
Planting						8…17						
Fertilizer application						8…17						
Weeding						22…..16						
Harvesting									11...25			
Threshing									25….9			

Seed Sources

Sample farmers grew six local cultivars: Bora, Waka, Dima, Bolonde, Fosolia and Gale-Abesha; and three improved varieties: Awash 1, Mexican 142 and Roba 1. To grow these varieties, farmers mostly use the informal local seed sources. This constitutes farmer-to-farmer exchanges, using own seed stocks, and using undeveloped seed markets (Table 8). The system operates haphazardly without giving due regard to seed availability and quality. But, it is the most accessible seed source to poor farmers. The formal system, mainly involves the Ethiopian Seed Enterprise, has not reached farmers.

Likewise, there has not been coordinated seed production and distribution mechanism. Moreover, farmers (Adam & Tilahun 2003) did not receive any seed from the formal sectors for many years (Table 8). All farmers use seeds from their previous harvest and from open markets. Adopters get seeds from other farmers. They also get improved seeds from the Ethiopian Agricultural Research Organization (EARO) and the bureaus of agriculture. Statistically significant difference (at 1% level, $\chi^2 = 27.9$) was also observed between the two categories of farmers in selecting seed sources. In order of priority, the major sources of improved seeds for farmers have been research centers and the Ministry of Agriculture (MoA). Despite the inefficiency of the informal mechanism in supplying pure and sufficient amount of improved seed, it has been generally found to be effective in targeting and meeting farmers' existing situations (i.e., poverty).

Table 8. Usual seed sources

Seed sources	Adopters (N=74)	Non-adopters (N=166)	All
Farmers' own stock	52.7	74.7	67.9
Other farmers	18.9	6.0	10.0
Market	18.9	19.3	19.2
EARO/MoA	9.5	0.0	2.9
All	100.00	100.00	100.00

Credit and Extension Services

According to farmers, 36.7% of adopters and 17.5% of non-adopters used credit to promote their production in 2001/2. The major sources of credit were non-governmental organizations (NGO's), such as CARE-Ethiopia, World Vision, and local moneylenders (Table 9). The data shows that most farmers seek credit to buy fertilizer. NGO's and service cooperatives are also beginning to address the farmers' needs (Table 9). Private moneylenders have been the oldest and traditional credit sources. Other sources have not been well developed to alleviate farmers' problems. The sustainability of this system depends on efficient and alternate financial sources, which minimize the level of poverty and the effect of unfavorable drought

Table 9. Credit sources

Types of credit	Credit sources	Adoption status	
		Adopters (%)	Non-adopters (%)
Cash	Private farmers	1.4	-
Fertilizer	NGO's	24.3	13.3
	Private farmers	-	1.2
	Service cooperatives	6.8	-
Seed	NGO's	0.7	-
	MOA	0.7	0.6
	Private farmers	-	1.2
	Service cooperatives	-	0.6
	Traders (haricot bean)	1.4	-
Fertilizer and seed	MOA	1.4	0.6
Sum		36.7	17.5

On the other hand, farmers' reaction towards extension messages in 2001/2 indicates that the message focused mainly on crop production and livestock husbandry, where crop production was skewed towards adopters and livestock husbandry towards non-adopters (Table 10). There had not been any special training organized for haricot bean. Extension activities focused on educating only selected farmers in general crop production (Table 10).

The study shows that there were few farmers who had not received extension information either through the informal or the formal way. Moreover, the

extension messages on haricot bean were given less emphasis. Only six (2.5%) farmers had attended haricot bean demonstration and nine (3.8%) household heads could not get involved in any practical demonstration programs due to lack of oxen and physical disability, particularly old age and illness.

Table 10. Proportion of farmers receiving extension messages

Extension message	Adopters (%)	Non-adopters (%)
Crop production	72.3	45.0
Crop protection	3.3	5.1
Forestry and conservation	2.7	11.1
Livestock husbandry	10.9	21.2
Post harvest (storage)	0.5	0.8
Home economics	0.0	0.2
Soil conservation	7.6	9.9
No extension message	2.7	6.7

Improved Varieties

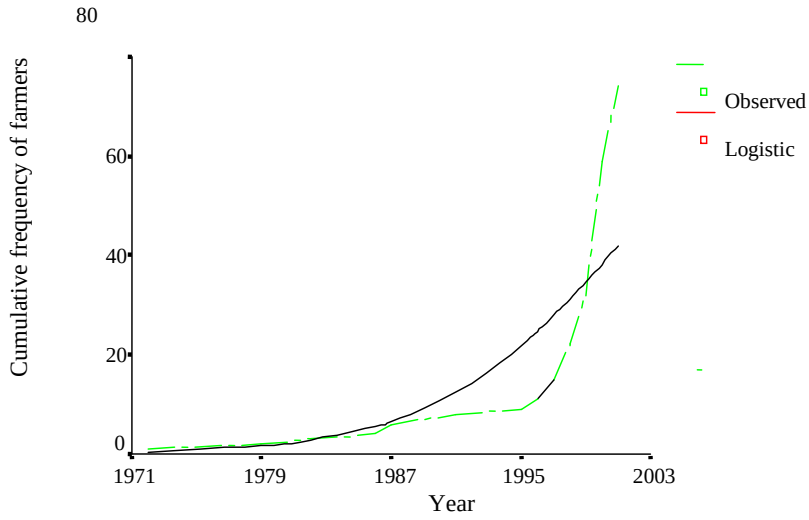
Sample farmers grew three of the improved varieties (Table 11). These varieties were recommended for areas between 1400 and 2000 m, which represent low and mid- altitude areas. The major reasons for growing improved varieties were earliness (11.9%), high yield (56.8%) and market demand (31.3%). In all cases, Mexican 142 was the most preferred variety (71.6%), particularly by adopters. Only few farmers preferred Roba 1, which might be related to its novelty.

Table 11. Farmers' reasons for adopting improved varieties (N=74)

Reason	Farmers response (%)			Total
	Roba 1	Awash 1	Mexican 142	
Earliness	-	-	11.9	11.9
High yield	6.0	9.0	41.8	56.8
High market demand	-	13.4	17.9	31.3
Total	6.0	22.4	71.6	100.0

Rate of Adoption of Improved Varieties

The tendency to adopt improved varieties is increasing since 1995 (Fig.1). The rate of adopting improved haricot bean from 1972 to 2002 was 0.33. This rate was achieved as a result of the combined effect of the significant explanatory variables (Fig.1).



Factors Affecting Adoption of Improved Varieties

The logit model was estimated after explanatory variables with unstable coefficients and insignificant variances are dropped. The model is significant at $p<0.01$ level and explains 74% of the total variation in the sample (Table 12). The chi-square also indicates that the parameters are significantly different from zero at 1% level. Sex of household head, dependent family member, land size, tropical livestock unit, credit, farmer's participation in

extension programs (proximity for extension information) and climate (explained by rainfall availability) were significant factors affecting adoption of haricot bean varieties and the signs of their coefficients were as expected. However, the prior factors that affected the varieties were climate, size of dependent family members and size of owned land. Farmers facing less frequent rainfall shortage (in *Woina Dega* or intermediate altitude) were 3.5 times less likely to adopt improved varieties than frequent rainfall shortage areas (in *Kola* or low elevation areas). This might be farmers' vulnerability to frequent drought-associated risks of crop failure in low elevation and low rainfall areas. The short maturity period and low input requirement of improved varieties serve farmers as the immediate and life rescuing mechanisms in frequent drought and erratic rainfall areas. Using credit and labor had a significant impact on farmers' choice to adopt improved varieties.

Table 12. Determinants affecting adoption of improved varieties

Parameter	Coefficient	t-ratio	1/Exp (B)
Constant	-2.5849**	-2.454	13.26
Sex	0.9599***	1.791	0.38
Education	-0.0517	-0.739	1.05
Experience	0.0100	0.74	0.99
Depfam	-0.2017**	-2.034	1.22
Land	-0.2441**	-2.201	1.27
TLU	0.0336***	1.935	0.97
Off farm	-0.5110	-1.057	1.67
Labor	0.5045	1.577	0.60
Credit	1.1877*	3.166	0.30
Extpart	1.4996***	1.778	0.22
Climate	-1.2565**	-2.078	3.51
Sample size		240	
Log likelihood function		-129.3	
Restricted log likelihood		-148.2	
Chi-square		37.78	
Degrees of freedom		11	
Significance level		0.000	
Cases correctly predicted		0.7375	

** Significant at p<1%, ** significant at p<5%, *** significant at p<10%*

Probabilities of adopting improved varieties were calculated (Table 13) to show the likely effects of changes in the significant explanatory variables, keeping continuous variable to their mean and dummy ones at zero. The probability that an average farmer would adopt improved varieties decreased from 7% in frequently drought stricken areas to 2% in relatively better rainfall areas.

Adoption was high for male household heads than for females. It increased to 19.8% if a farmer received credit and 25.2% if participated in extension activities. On the other hand, adoption probability of an average farmer increased to 9.6% and decreased to 3.8 and to 3.1% with a 10% increase in tropical livestock unit, dependent family members and land size, respectively.

Table 13. Probabilities of significant factors affecting adoption of improved varieties

Factor	Probability (%)	Percent change
Climate		
Low rainfall	2.0	250.0
Drought	7.0	
Sex of household head		
Female	7.0	134.3
Male	16.4	
Credit		
Not received	7.0	182.9
Received	19.8	
TLU (10% increase)	9.3–9.6	3.2
Farmer's participation		
Non-participant	7.0	257.1
Extension participant	25.2	
Dependent family members (10% increase)	4.0–3.8	(5.3)
Land (10% increase)	3.4–3.1	(9.7)

Conclusion and Recommendations

Haricot bean is among the top three crops grown by sample farmers in the study area. Farmers have been growing the three improved varieties (Roba 1, Awash 1 and Mexican 142) for food and market.

The sample farmers consist of 63% economically active members. The average age of household heads was 44 years with 26 years of farming experience (13 years with haricot bean). However, most of them (66 %) were illiterate.

The rate of adoption for 1972–2002 was 33%. This trend was influenced by technological, farmer-related, and external environmental factors besetting small-scale farmers. The use of improved varieties was low in areas where prevalence of drought was low. Adopting improved varieties increased with the severity of drought to secure money for immediate household and debt needs. Therefore, besides strengthening efforts in relatively drought affected areas for fast adoption, developing varieties where and when drought is less severe is necessary for wider dissemination of the technologies and maximizing total output in the future.

In the study area, improved varieties were limited in number, type, and availability. The existing, market winner variety (Mexican 142) has been under production for more than two decades and may accidentally lose its potential. Farmers' usual seed sources, informal system, are weak in their performance but dominant as a system. The role of these sources in supplying clean and value-adding seeds and grain is uncertain. On the other hand, the contribution of the formal system was non-existent or unreported. Therefore, developing additional and alternate new varieties depending on the local and global markets is essential to guarantee sustainable production and better prices for producers. Moreover, efficient seed supply and management system that adjusts itself to the existing small-scale farmers and transforms their traditional system should be promoted for successful adoption of new technologies. The latter may involve establishing and promoting farmers' seed

business and facilitating the complementary functioning of the formal and informal seed systems.

Only 23% of the farmers use credit to buy agricultural inputs, but the sources of credit were inaccessible to most farmers. According to the analytical model, farmers who use credit are more likely to adopt the varieties. However, most farmers (over 66 %) are illiterate and need technical advice. Thus, there is a need to promote formal and informal institutions to ensure low transaction costs and high rate of loan recovery. This addresses small-scale farmers vulnerable to the threats of drought and crop failure. This may require establishing farmers groups and credit societies. Most farmers also need continued training and technical advice on the benefits and uses of credit money.

Livestock ownership increases the adoption probability of varieties. Livestock are indicators of wealth and increase farmers' potential to purchase agricultural inputs for adoption. Thus, in order for farmers to adopt new technologies, improvement of their financial status is necessary.

Farmers' participation in extension programs increases the adoption probability of varieties since it provides farmers with access to technological information. However, extension programs for farmers in the past were either non-existent or weak. The programs focused on few farmers and broad subject matters.

The study indicates that most farmers did not weed, row plant, apply fertilizer, and take the necessary crop production and management activities on haricot bean. Farmers' knowledge of the use of haricot bean grain is limited. It is highly probable that this limited knowledge of the use of haricot beans at home does not justify the creation of wide demand; hence, it retards adoption. The distribution of improved varieties is high for men since they are usually exposed to new technologies. Improving the current extension approach to cover specific topics regarding haricot bean technologies and their utilization is needed to reach other farmers, men and women. Moreover, advocating the merits of improved varieties equitably among gender groups is an important gap to be filled to create wider dissemination of the technologies.

Farmers with higher dependent family members and relatively larger landowners were less likely to adopt new technologies. The possible reason could be shortage of active laborers for farm operations due to either the composition of members or inability to use the existing active laborers for farm activities, or both. Therefore, appropriate family planning and a study on how to promote haricot bean technologies among farmers of large dependent family members is required.

References

Adam Bekele and Tilahun Mulat. 2003. Haricot bean seed managementin the rift valley of Ethiopia. Research Report No, 50. Ethiopian Agricultural research Organization (EARO). Addis Ababa.

Adesina A. and M. Zinnah. 1992. Adoption, diffusion and economic impacts of modern mangrove rice varieties in western Africa: Further results from Guinea and Sierra Leone. *In:* Towards a new paradigm for farming system research/extension. Working paper for the 12th annual farming system symposium. East Lansing: Michigan State University. Pp. 443–466.

Aleligne Kefyalew. 1993. Haricot bean marketing in Ethiopia: Some policy implications. *In:* J.B.Smithson (ed.). Proceeding of the third annual multidisciplinary workshop on bean research in East Africa. Thika, Kenya, 19–22 April 1993. Network on bean research in Africa, workshop series No.28. CIAT, Kampala, Uganda. Pp. 264–271.

CIMMYT. 1988. From agronomic data to farmer recommendations: An economics training manual. Mexico D.F.: CIMMYT.

CIMMYT. 1993. The adoption of agricultural technology: A guide for survey design. Mexico D.F.: CIMMYT.

CSA (Central Statistical Authority). 2002. Statistical Abstract, March 2002. Addis Ababa, Ethiopia.

CSA. 2003. Area and production for major crops. Addis Ababa, Ethiopia.

Feder G., R.E. Just and D. Zilberman. 1985. Adoption of agricultural innovations in developing countries: A survey. Economic Development and Cultural Change 33 (2): 255–297.

Greene W. H. 2000. Models with discrete dependent variables. Econometric analysis. Prentice-Hall, NJ, 4: 499–521.

Habtu Aseffa and Dereje Gorfu. 1985. A review of food legume disease research in Ethiopia. *In:* Tsedeke Abate (ed.). Proceedings of the first Ethiopian crop protection symposium, Addis Ababa, Ethiopia, 4–7 February 1985.

McFadden D. 1981. Econometric models of probabilistic choice. *In:* C.F. Manski and D. McFadden (eds.). Structural analysis of discrete data with econometric applications. Cambridge, Massachusetts: MIT Press. Pp. 198–272.

Misera S.K., D.H. Carley, and S.M. Fletcher. 1993. Factors influencing southern dairy farmer's choice of milk handlers. *Journal of Agriculture and Applied Economics (July):* 197–207.

Tesfaye Beshir. 1993. Management of bean anthracnose in Ethiopia. *In:* J.B. Smithson (ed.). Proceedings of third multidisciplinary workshop on bean research in eastern Africa, Thika, Kenya, 19-22 April 1993. Network on bean research in Africa. Workshop series No. 28. CIAT, Kampala, Uganda.

Office of Planning and Economic Development of East Shewa. 1999. Zonal Atlas of Eastern Shewa. Adama.