Factors Affecting the Adoption of Improved Sorghum Varieties in Awbare District of Somali Regional State, Ethiopia

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ABSTRACT

The main purpose of this research was to identify factors that affected the adoption of improved sorghum varieties in Awbare District of Somali Regional State, Ethiopia. Individual interviews were conducted to collect data from 180 households in eight *kebeles*. Descriptive statistics and mean comparisons using a t-test and chi-square test were employed to analyze data. The findings indicated that the adopters of improved sorghum varieties were more educated, younger in age, had a larger farm size, had more shoats, lived in a better house, owned a radio and had a positive attitude towards improved sorghum varieties when compared to the non-adopters. The results of the study confirmed that a farmer who had better economic status (as evidenced by larger farm size, more shoats and a better quality house) and had access to market information might be a greater technology adopter. Moreover, targeting younger educated farmers may enhance the adoption of new agricultural technology in the area. High priorities to promote technology adoption are the provision of extension agents with transportation facilities and the establishment of community radio stations.
Keywords: adoption, improved sorghum varieties

บทคัดย่อ

การวิจัยนี้มีวัตถุประสงค์เพื่อจำแนกปัจจัยที่มีผลต่อการยอมรับข้าวฟ่างพันธุ์ปรับปรุง ในเขตอาวบาเร่ แคว้นโซมาลี เอธิโอเปีย โดยเก็บข้อมูลจากเกษตรกรผู้ปลูกข้าวฟ่าง 180 ครัวเรือนใน 8 หมู่บ้าน วิเคราะห์ข้อมูลจากสถิติเชิงพรรณนาโดยหาค่า T-test และ Chi-square ผลการวิจัยพบว่า ผู้ที่ยอมรับข้าวฟ่างพันธุ์ปรับปรุงจะเป็นผู้ที่มีการศึกษา อยู่ในวัยหนุ่มสาว มีพื้นที่ขนาดใหญ่ มีแพะและแกะจำนวนมาก มีที่อยู่อาศัยที่ดี มีเครื่องรับวิทยุเป็นของตนเองและมีทัศนคติในทางบวกต่อข้าวฟ่างพันธุ์ปรับปรุง และเมื่อเปรียบเทียบกับผู้ที่ไม่ยอมรับข้าวฟ่างพันธุ์ปรับปรุง พบว่ามีความแตกต่างกันอย่างมีนัยสำคัญทางสถิติ ทำให้ยืนยันได้ว่า เกษตรกรที่มีฐานะทางเศรษฐกิจดี (มีพื้นที่ขนาดใหญ่และที่อยู่อาศัยที่ดี) และเข้าถึงข้อมูลการตลาดมักจะเป็นผู้ที่ยอมรับเทคโนโลยีอย่างรวดเร็ว ยิ่งไปกว่านั้นกลุ่มคนหนุ่มสาวและเกษตรกร

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ที่มีการศึกษาก็มักจะยอมรับเทคโนโลยีทางการเกษตรใหม่ๆในพื้นที่ การอำนวยความสะดวกในการเดินทางให้กับเจ้าหน้าที่ส่งเสริมและการจัดตั้งสถานีวิทยุชุมชนนับเป็นปัจจัยที่ช่วยสนับสนุนให้เกิดการยอมรับเทคโนโลยี และเป็นความต้องการที่อยู่ในระดับสูง

คำสำคัญ: การยอมรับ ข้าวฟ่างพันธุ์ปรับปรุง

INTRODUCTION

The majority of households (85%) in Ethiopia are smallholders who live in the rural areas and depend on agriculture as their major economic activity. They are involved in crop or livestock production, or both, where livestock provide draught power for crop production, and crop residues are used as animal feed (Central Statistical Agency [CSA], 1999).

Sorghum is a major staple crop in the semi-arid regions of Ethiopia, particularly in Somali Regional State. Sorghum provides not only grain for human consumption, but also stover, which is used as forage for livestock, as building materials for housing and as fuel for cooking (International Institute of Rural Reconstruction [IIRR], 2002). Even though sorghum has multiple uses, its production is constrained by traditional farming techniques, poor complementary services (such as extension, credit, and marketing), and infrastructure.

To boost agricultural production in the early 1990s, a large extension program was started in Somali Regional State with the introduction of modern agricultural technologies such as improved crop varieties and agronomic practices. As part of the extension program, sorghum varieties were introduced into sorghum growing areas of the region. The technology package included: drought-tolerant short-maturing sorghum varieties (*Gambella*, *Birmash*, *Dinkmash*, *Kobomash*, *Seredo*, 76 T1 #23, and *Teshale*), inorganic fertilizer (urea and DAP), and improved agronomic practices such as seeding rate, plant spacing, and fertilizer application among others (Regional Bureau of Agriculture [RBoA], 2002). Awbare District is one of the areas where the technology packages mentioned above were introduced.

Agricultural extension service providers in the region have assumed that institutional factors such as access to agricultural extension services, access to improved farm inputs (that is, seeds and fertilizers), access to credit facilities, and related arrangements made by the Somali Regional Agricultural Bureau have helped in enhancing the adoption of improved sorghum varieties among the small-scale subsistence farmers in the region in general and in Awbare District in particular. Even though extension activities on improved sorghum varieties dissemination have been accomplished over the past years in the region, the level of adoption of the new technologies and the benefits generated as a result of the intervention has not been assessed and evaluated in the district. Therefore, the objective of this study was to identify the factors affecting the adoption of improved sorghum varieties in Awbare District of Somali Regional State.

LITERATURE REVIEW

Technology is the application of knowledge for practical purposes. Generally, technology is used to improve the human condition, the natural environment, or to carry out other socioeconomic activities (Swanson, Bentz, & Sofranko, 1997; Contado, 2003). Technology is often used broadly to encompass physical or biological structures or materials as well as management practices (Place & Swallow, 2000). Therefore, the transfer process for material technology is generally simpler than training and disseminating technical knowledge and management skills to large numbers of farmers who operate in different agro-ecological zones (Swanson et al., 1997). Technically approved technology has inherent qualities to improve product quality, increase production efficiency and heighten productivity. This implies that the potential benefits of technology are actualized only when it is successfully transferred

to a large number of end users. When the perceived technology impact is positive, that is, economically positive and environmentally non-destructive, the technology is likely to be desired and enhanced (Contado, 2003).

Adoption is viewed as a variable representing behavioral changes that farmers undergo in accepting new ideas and innovations in agriculture. The term 'behavioral change' refers to: desirable change in the knowledge, understanding, and ability to apply technological information; changes in feeling behavior such as changes in interest, attitudes, aspirations, values and the like; and changes in overt abilities and skills (Ray, 2001). The traits which influence the rate of diffusion of a technology, as perceived by potential adopters, are: 1) relative advantage—the degree to which an innovation is perceived as better than the idea or objects it is intended to replace. It is usually expressed in terms of economic gain; 2) compatibility—the degree to which farmers perceive an innovation to be consistent with their socio-cultural values and beliefs, traditional management objectives, their past experience, and the existing level of technology; 3) complexity—the degree to which an innovation is understood and can be used by farmers; 4) trialability—the degree to which farmers perceive an innovation can be tried out in small scale on their land; and 5) observability—the degree to which the results of an innovation are visible to farmers (Ray, 2001; Rogers, 2003; VandenBan & Hawkins, 1998). The decision by farmers to adopt or not to adopt is usually based on the profitability and risk associated with the new technology. It is obvious that farmers do critically compare the characteristics of new varieties with those of prevailing varieties. The process of adoption begins with farmers experimenting with new varieties. The decision in favor of a new variety is expected if its performance is viewed to be superior to the local varieties (Rogers, 2003).

Farmers have a subjective preference for technological characteristics and these could play major roles in technology adoption. Adoption or rejection of technologies by farmers may reflect rational decision-making based upon farmers' perceptions of the appropriateness or inappropriateness of the characteristics of the technology under investigation (Adesina & Zinnah, 1993). Therefore, the adoption pattern to a technological change in agriculture is not uniform at the farm level; it is a complex process, which is governed by many socioeconomic factors. The farmer's degree of readiness and exposure to improved practices and ideas, (that is, changes like the awareness and attitude of farmers towards improved agricultural technologies), act as incentives or disincentives to agricultural practices in bringing about technological change in agriculture (Salim, 1986).

The literature on the adoption of improved crop varieties and crop management technologies in developing countries points toward a number of factors operating in quite complex and interactive ways that condition the adoption decision of farmers. According to Kaliba et al. (1998), the factors that affect the adoption of any agricultural technologies are divided into three major categories: farmer-specific and farmer-associated attributes, technology-specific attributes, and the farming objectives. Farmer-specific and farmer-associated attributes are age, farming experience, family size (labor resource), education, farm size, number of livestock owned, income (on-farm and off-farm), availability of credit, distance to the nearest market, and access to information (access to mass media, access to markets, contact with extension services, attendance at agricultural training and field days), among others. Technology-specific attributes are taste, yield, ease of cooking, ease of threshing, and tillering capacity among others (Adesina & Zinnah, 1993).

Many studies on the adoption of technology have been conducted in developing countries. However, because of natural resources, cultural, political, socioeconomic, and institutional differences, the importance of factors affecting technology adoption differs across countries. Technology adoption studies showed that factors influencing adoption

differed by location. Therefore, there is a need to conduct specific studies on technology adoption in areas where extension and research programs are implemented to understand the important factors affecting adoption in these areas (NKonya, Schroeder, & Norman, 1997).

METHOD

The study area

Awbare District is one of the six districts in the Jijiga zone of Somali Regional State. The district's altitude ranges from 1,200 to 1,660 meters above sea level. The climate of the district is semi-arid and is marked by seasonal variations, receiving an annual rainfall that varies from 400 to 900 mm. The area experiences a bimodal type of rainfall classified as a short rainy season (from July to September) and a main rainy season (from March to April). The mean temperature is 14 °C with minimum and maximum temperatures of 20 and 25 °C, respectively (Jijiga Zonal Office of Agriculture [JZOA], 2001). According to CSA (2008), roughly 88 percent of the inhabitants of Awbare District are agro-pastoralists with a population of 299,336 (male 165,148 and female 134,188). The people in the Awbare District are mainly from the Somali tribe and Islam is the main religion.

The farming system of Awbare District is mainly agro-pastoralism. Increasingly, agro-pastoralists are becoming settled farmers. Agro-pastoralists in the district produce sorghum, maize, wheat, and chat through traditional agronomic practices by using oxen to plough, in combination with seed broadcasting and hand thinning, and then threshing by animals. The average production of sorghum and maize in the district is 1,500 and 1,900 kg/ha, respectively (Teka & Azeze, 2002). The low amount and erratic distribution of rainfall, and high evapotranspiration have limited the crop production to the use of drought-tolerant crop varieties (Eshetu & Teriessa, 2000).

Sampling, data collection and analysis

Primary data were collected during January and February 2010. A two stage random sampling procedure was employed to select 180 sample household heads in Awbare District. At the first stage, eight *kebeles* (the lowest administrative unit at village level) were selected randomly. In the

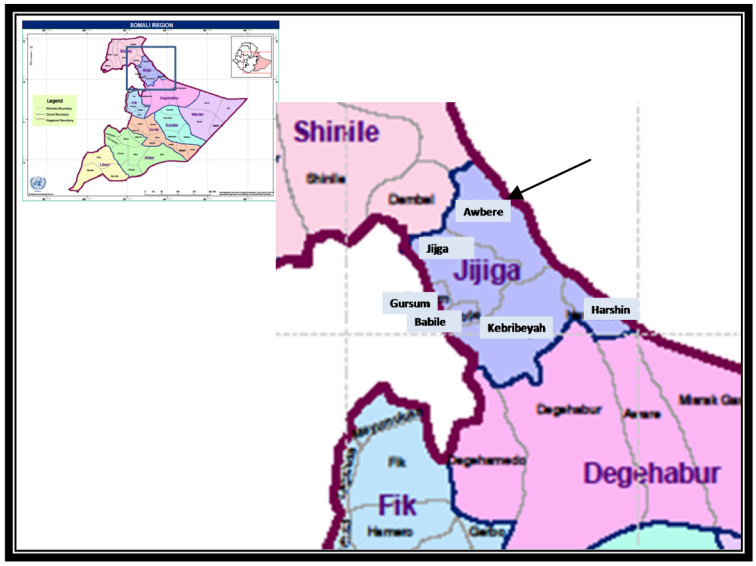

Figure 1 The study area shown by arrow (Awbare District)

second stage, a probability proportional to size sampling technique was used to select sample households (a Somali household is defined as a man, his wife, their children and any other person who is dependent on that household for living) from the selected sample *kebeles*. Enumerators were trained on the contents of the interview schedule and pre-testing of the interview schedule was conducted on some randomly selected non-sample farmers. On the basis of the pre-test, some modifications were made to the interview schedule. Individual interviews with sorghum growers were carried out by trained enumerators using a structured interview schedule. Then, the collected data were analyzed using descriptive statistics, such as percentages and means, and mean comparison methods, such as an independent sample t-test and a chi-square test, to test the influence of variables on the adoption of improved sorghum varieties. Significance was tested at the .05 level.

RESULTS AND DISCUSSION

Socio-economic characteristics of adopters and non-adopters of improved sorghum varieties

Out of the 180 households interviewed, 37.2 percent were adopters and 62.8 percent were non-adopters of improved sorghum varieties. The mean age of adopters was 32.46 years and of non-adopters was 41.36 years; adopters were significantly younger in age than non-adopters (Table 1). Similar findings were obtained by Million and Belay (2004) and Shiferaw and Tesfaye (2006) showing that age had a negative and significant influence on the adoption of improved technologies. It is generally accepted that younger farmers are more innovative than older ones. The age structure of the sample farmers showed that the largest proportion of the adopter respondents (73%) was in the age group of 20 to 35 years and for the non-adopters (75%) was above 35 years.

The analysis of educational level showed that out of the adopters of improved sorghum varieties, 65.7 percent were illiterate and 34.3 percent were literate. Only 8 percent of non-adopters were able to read and write, which indicated that adopters were more educated than non-adopters, and better educated farmers show a better positive response to improved technology adoption. Mariam, Galaty, and Coffin (1993), Nkonya et al. (1997), Million and Belay (2004), and Shiferaw and Tesfaye (2006) obtained similar results that indicated a farmer's education had a positive and significant influence on the adoption of improved technologies. The educational status of the household members showed that 44.8 percent of the households of adopters and 46.9 percent of the households of non-adopters had at least one literate person in their household. The existence of a literate

Table 1 Mean comparison of adopters and non- adopters (total sample = 180) of improved sorghum varieties on continuous socio-economic variables

Household characteristics	Adopters (n=67)	Non-adopters (n=113)	t-test	
			t-value	*p*-value
Age of household head (years)	32.46	41.36	-6.758	0.000*
Household family size (persons)	4.91	5.57	-1.635	0.1040
Farm size (*qodi* = 0.25 ha)	19.82	12.63	4.834	0.000*
Farming experience (years)	16.16	24.45	-6.284	0.000*
Distance to input market (km)	56.19	68.15	-7.933	0.000*
Number of shoats	14.01	8.12	2.945	0.004*
Yearly on-farm income (Birr)	47.84	40.75	0.445	0.6570
Amount of credit taken (Birr)	348.15	287.18	1.181	0.2410

* $p < .05$

member of the household enhances the technology adoption, since the information delivered by members of the household to the household head is more readily accepted compared with other sources of information, because of the trust that exists between household members (Place & Swallow, 2000).

The survey results showed that the average household size of adopters was 4.9 and for non-adopters was 5.5 persons, which were not significantly different. Doss, Mwangi, Verkuijl, and DeGroote (2002) also did not find a clear relationship between household size and the use of improved varieties.

In the study area, farmers started practicing farming at an early age (15 years) while living together with parents. On average, adopters had 16 years of farming experience while non-adopters had 24 years. The finding of the present study, that there was a significant difference between the farming experience of adopters and non-adopters is consistent with Million and Belay (2004), which confirms that experienced and older farmers are reluctant to change their farming techniques. The present study has identified that most of the adopters (61%) had farming experience ranging from 11 to 30 years while most of the non-adopters (64%) had farming experience ranging from 20 to 45 years.

The cropland holding of the sample respondents ranged from 2 to 50 *qodi* (0.5 to 12.5 ha). The average cropland holding of adopters of improved sorghum varieties was larger by 7.19 *qodi* (1.8 ha) than that of non-adopters of improved sorghum varieties. About 51percent of adopters had cropland of 15 to 32 *qodi*, whereas 70.8 percent of non-adopters had 7 to 20 *qodi,* indicating that farmers with more cropland will decide to adopt new technologies by testing on a portion of land without having to worry about endangering the family's food security (Ramasamy, Bantilan, Elangovan, & Asokan, 1999).

Sheep and goats were mostly sold when farmers need cash to buy improved seeds, food for the family, and clothes for children, whereas camels and cattle were reared for milk production and prestige and rarely sold. The average shoat holding of adopters was 14 head which was significantly larger than for non-adopters (8 head). Tesfaye, Bedassa, and Shiferaw (2001), Doss et al. (2002), and Shiferaw and Tesfaye (2006) reported that owning large number of livestock had a significant influence on the adoption of improved technologies.

Regarding the type of house owned, 20.9 and 61.2 percent of adopters lived in corrugated iron and soil-roofed houses, respectively, whereas 49.6 percent of non-adopters lived in traditional houses (only 8 percent lived in corrugated iron houses). This indicated that adopters were living in better houses. The sample respondents reported that the only source of income was from the sale of crops or animals. The yearly average income of adopters and non-adopters was 47.84 and 40.75 Birr, respectively, (1 USD equals 12.6 Birr). This information seems to be unrealistically low due to the existence of food aid in the study area which may have made the farmers feel reluctant to disclose their actual income.

Of the sample farmers, 62.8 percent did not use improved sorghum varieties during the main cropping season in 2009 and their perception of the yield of improved sorghum varieties was poor. About 63 percent of non-adopters did know the production potential of improved sorghum varieties while 15 percent of them thought the yield was inferior to local varieties. About 21 percent of non-adopters knew that the improved sorghum yield was superior to local varieties and their reason for non-adoption was the lack of improved sorghum seed. However, the adopters of improved sorghum varieties had a positive perception towards their yield potential. The response of adopters regarding the yield perception of improved sorghum varieties indicated that 79.1 percent considered it superior and 20.9 percent inferior.

Sorghum yields have been reported to be substantially higher for farmers who used inorganic fertilizer (Wubeneh & Sanders, 2001). The results of the present study showed that only a few farmers used inorganic fertilizers in their fields (about 20.9

percent of adopters and 17.7 percent of non-adopters). The reasons given for the non-use of fertilizers by farmers were fertilizer was expensive and not available (40%), fertilizer was not available (28.9%) and a cash shortage to purchase (12.2%).

Institutional factors

With respect to the distance taken to travel from home to the nearest input market place (Table 2), sample farmers reported that they had to travel an average of 63.7 km, with adopters traveling significantly less (56 km) than non-adopters (68 km). Tesfaye et al. (2001) and Shiyani, Joshi, Asokan and Bantilan (2002) also reported that the distance to the nearest market had a significant influence on the adoption of improved technologies.

A higher number of adopters had access to credit (68.7%) than non-adopters (34.5%). The source of credit for the respondents was mainly from fellow farmers (23%), relatives (17.8%) and neighboring farmers (15.6%). The average credit amount taken over the last year by adopters was 348 Birr whereas for non-adopters it was 287 Birr. Moreover, the responses indicated that respondents

Table 2 Relationship between categorical socio-economic variables and adoption of improved sorghum varieties

(n = 180)

Categorical variable	Adopters		Non-adopters		Chi-square	
	n	%	n	%	χ^2-value	*p*-value
Education of HH					21.906	0.000*
Illiterate	44	65.7	104	92		
Literate	23	34.3	9	8.0		
HH literate	30	44.8	53	46.9	5.660	0.3410
Yield perception	0	0	72	63.7	76.450	0.000*
Unknown						
Inferior	14	20.9	17	15.1		
Superior	53	79.1	24	21.2		
Use of fertilizers					0.280	0.5960
Yes	16	23.9	20	17.7		
No	51	76.1	93	82.3		
Type of house owned	12	17.9	56	49.5	19.635	0.000*
Traditional						
Soil roofed	41	61.2	48	42.5		
Corrugated iron	14	20.9	9	8.0		
Use of credit					19.674	0.000*
Yes	46	68.7	39	34.5		
No	21	31.3	74	65.5		
Contact with EA					1.605	0.000*
None	50	74.6	91	80.5		
Once	15	22.4	21	18.6		
Twice	2	3.0	1	0.9		
Own a Radio					11.556	0.001*
Yes	31	46.3	32	28.3		
No	36	53.7	81	71.7		

* $p < .05$

did not have any access to formal credit sources.

Only 25.4 percent of adopters and 19.5 percent of non-adopters had contact with extension agents. Even though the number of farmers who had contact with extension agents was low, there was a significant difference between adopters and non-adopters. Frequent contact with the extension service has been reported to have a positive and significant influence on the adoption decision of farmers (Nkonya et al., 1997; Tesfaye et al., 2001; Doss et al., 2002; Shiferaw & Tesfaye, 2006). Lower numbers of contact visits with extension agents were due to the fact that the Regional Agricultural Development Bureau had given less emphasis to extension service delivery. The extension agents in the study area did not have any transportation facilities such as a motorcycle or bicycle to travel to *kebeles* far away from their base. Thus, extension agents were able to travel only a few kilometers on foot to deliver extension information and advice.

Among the mass media, only radio was used in the study area. Respondents who owned a radio constituted 37.8 percent (46.3% of adopters and 28.3% of non-adopters) of the sample. About 62 percent of radio owners preferred listening to an agricultural program (64% of adopters and 60% of non-adopters). This represents a good opportunity to prepare extension information for farmers and broadcast it to them via radio.

Summary and concluding discussion

Adopters of improved sorghum varieties were more educated, younger in age, had larger farm sizes, had more shoats, lived in better houses, owned a radio and had a positive attitude towards improved sorghum varieties when compared to the non-adopters. The results indicated that younger, educated farmers were more likely to adopt a new technology as they were more optimistic and were greater risk takers than older farmers. Hence, the introduction of new agricultural technology in the area may be successful if it focuses on younger educated farmers. Moreover, farmers owning better houses and with a large farm size and large numbers of livestock were more likely to adopt improved technologies. Therefore, targeting better-off farmers as opinion leaders or model farmers may enhance the adoption and facilitate the dissemination of new agricultural technology in the area.

Access to information makes farmers aware of and have a better understanding of improved agricultural technologies, which can facilitate change in the behavior of farmers and ultimately lead to a decision to risk technology adoption. Farmers who are nearer to markets and have access to extension agents and agricultural radio programs can obtain information regarding agricultural inputs such as improved sorghum seed. Hence, the provision of market information, improving extension services through the provision of transportation facilities to extension agents, and establishing community radio stations may facilitate the dissemination of new agricultural technologies in the area.

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