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The determinants of probability in improved forage technology adoption in wolaita zone: the case of sodo zuria district, southern nations and nationalities peoples state of Ethiopia

Abstract

As identified by preliminary survey Feed and nutrition shortage was one the top ten agricultural production constraints in the region and country level. The adoption and utilization of improved forage technology was believed to be the remedial measure and means of improvement in productivity of livestock sector, ease constraint of feed shortage and also play detrimental role in rehabilitation of degraded lands as biological soil and water conservation option. Even if it was known that improved forage adoption could play significant role in agricultural productivity improvement, little study was carried in area and the sector challenged by updated information for further policy formulation and development intervention. Hence, this study aimed to identify the social, economic, physical and institutional factors that affect farmer's decision to adopt improved forage technology. The logistic regression was employed for the data come from a farm house hold survey of 121 households selected through multistage random sampling procedures. The empirical estimates of probit regression revealed that adoption probability increases with family size and slope on topography of land household head and decreases with total land holding and distance from farmers' home to farmers training center. The study results pointed out possibility in improved forage technology adoption through expanding farmers training center in the vicinity of farmers' residence and awareness creation. Since having larger family size support the management of improved for The study result also justified that the small scale farmers that held small land size showed better probability in adopting the productive improved forages for easing land shortage constraint in the districts.

Keywords: adoption, improved forage, logistic regression and probability, economic, weather fluctuations, farmers, cropping season, energy, protein,

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Introduction

The growth rate of agriculture and GDP is low for several decades mainly due to severe weather fluctuations, inappropriate economic policies and low adoption of improved agricultural technologies and prolonged civil unrest.[2] The yield of crops and livestock is very low because of low utilization of improved technologies. For instance, the amount of inorganic fertilizer applied in the 2008/09 cropping season was 423,000 tons. During the same period, the total area fertilized with inorganic fertilizer for all crops was about 29.6% of total cultivated area in Ethiopia.[3] The proportion of hybrid and exotic cattle breed was 0.81% of the cattle population while the proportion of improved forage utilized by private households was 1.3% in the country.[4] Hence Ethiopian smallholders typically produce with their indigenous seed and breed and are characterized by low adoption of improved agricultural technologies. Because of the low productivity of the agricultural sector, Ethiopia has become highly dependent on food import in that domestic food production and supply have consistently been below the national demand.[1] For instance, the country received 674,000 metric tons of cereals in the form of food aid in 2006 alone.[1] The increasing human population and higher demand for food in Ethiopia is progressively forcing farmers of the highland and mid-altitude areas to cultivate more land at the expense of natural grazing areas. Consequently, the major livestock feed resources in the country are becoming crop residues, which are nutritionally characterized as containing a high proportion of cell wall and being deficient in energy, protein and micronutrients.[5]

Feed scarcity in both quantitative and qualitative dimensions is the major impediments for the promotion of the livestock sub-sector in the country.[6] Much of the available feed resources are utilized to support maintenance requirement of the animals with little surplus left for production. There are marked seasonality in quantity and quality of available feed resources due to various environmental determinants (drought, frost etc.). Appropriate technologies that can optimize utilization of available feed resources and alternative technologies to replace traditional practices are not yet fully developed and database required for the generation of technologies are grossly lacking both at feed and animal level. Although research has identified high yielding and better quality forages adaptable to various agro-ecologies and production systems, improved forages are not yet adopted and developed by the farming community due to inadequate knowledge, poor extension service, and shortage of land and policy issues.[7] As cited in our country average beef yield per animal of 108.4 kg ,1.35 average daily milk yield per day for a cow,1.64 kg honey per hive

and The average number of eggs laid per hen per egg- laying period in the country is about 12, 25 and 107 eggs for indigenous, hybrid and exotic breeds respectively. The major challenges that made the livestock productivities and production in the country were identified as low adoption of improved forages and utilization system, awareness problem on improved forage production and husbandries practices, inadequate market infrastructure, absence of market oriented cattle production system, prevalence of various diseases.

In sodo zuria District where this study is conducted, crop and livestock productions are highly integrated as a means to generate income, cope up with climate and environmental risks and meet household consumption requirements. The major crops grown by sample households were improved and local wheat, barley, teff, local and improved common bean, field pea, maize, local and improved potato, carrot, chickpea, sorghum, haricot bean and faba bean. The major livestock types kept by sample households were improved and local dairy cow, improved and local poultry, local and improved bee hives, sheep, goat, mull and donkeys. The outputs of crops and livestock were used mainly for home consumption but were rarely used for markets to obtain cash income. The straws of crops, enset leaves, browses (tree leaves like wanza), avocado, cassava, local grass and weeds were used for animal feed. June to September and crop harvesting periods are the major feed available periods in the area and majority of farm households face feed shortage in the months of December to April. During these periods they lack source of income to purchase feed and face a problem of food shortage. Animals like oxen were also used for draft power in plowing and planting. There are also farmers who use hand tools like fork, for planting and cultivation. Moreover, the wastes of animal in the form of manure and in organic fertilizer like NPS and UREA were used for improvement of productivity and soil fertility. However, the production and productivity of crop and livestock is very low resulting in food insecurity.

Methodology

Description of study area

The determinants of improved forage adoption and its ways of utilization were carried out in wolaita zone sodo zuria district. The District, which is one of thirteen districts located in wolaita zone of southern regional state. The topography of the District is mainly of 70% flat, 25% steep slope and 5% steep respectively. The agro ecology of the area is 87%, 13% woine dega and dega respectively. It is located an altitude of 1500-2958 meter at sea level and its annual rainfall ranges from1200mm to1300mm. The total land coverage of the District is 38, 0410ha, cultivated land annually of 11,683ha, cultivated land perennial 12,472ha, communal grazing land of 3532.5 ha and private grazing land of 4251respectively. The total population of the District was 208, 519, of this 101,874 were males and 106,645 are females. The total household number of the district was 36981 and out of this, 32851 were male headed and 4319 were female headed households respectively. Accordingly, two kebeles (Kokate Marechare from dega part and Mante Gerara from woine dega were selected from the district. the two Kebles are selected according to their potentiality and less adoptability of improved forages respectively (Table 1). There are also other types of forages in this area, but their extent of adoption is very low as compared to those listed above. Some secondary data were collected in these regard for further information in the study area.

Table 1 Major types of improved forages and its land coverage in Sodo Zuria District

No	Forage types	Land coverage(ha)
1	Desho grass	1267
2	Elephant grass	582
3	Pigeon pea	730
4	Cow pea	482

Methods of data collection and Sampling techniques

Key informant interview (KII)

The major feed crops (grasses) of livestock in the study area were; crop residue (crop by products), hay, natural grass (sanbaleta), enset leaves, browses, improved forages and concentrates etc. the production and the productivity of crops and livestock in area is both from the own farm and through renting. These condition shows dynamic change from to time to due `to climate change, land degradation and other factors. Few measures were employed to minimize these challenges through the use of improved technologies by breed improvement, input use, awareness creation for farm households and extension agents on improved variety utilization (fertilizer use, seed selection, sowing techniques) and adoption of improved forages, and different management activities. Farmers practice different management and conservation techniques in order to survive livestock's in dry seasons. These techniques include; silage (hay) making, feeding fodder and tree browses, feeding of cassava, concentrates. Farmers get surplus/ available feeds in the months of June, July, August, September, October and November; and face shortage of feeding in the months of December-may respectively. During these months the major feeds farmers use were crop residue, tree browses, hay making, enset leaves and local grass etc.

Focus group discussion (FGD)

The data collected in this way was base to formal survey that potentiality of improved forage adoption is well determined. Accordingly to the data, there is difference in the adoption potential and its intensity of use of improved forages. The major types of improved forages in the area were desho grass, elephant grass, pigean pea, sasbania, and cow pea which is in a very small amount. There are many reasons related to difference in adoption. It was related to types of livestock owned, awareness and adaptability, accessibility to market and credit, access to different infrastructures, access to grazing lands (private and communal). The major Sources of improved forages produced in the area were; bureau of agriculture, from neighbor farmers in the form of gift and purchase, from own farm through multiplication. They use improved forages for many purposes as for animal feed, for soil and water conservation specially planting desho grass on erosion sites and around soil bunds, and stem as fences like elephant grass and pigean pea. Dairy cow and calves are the major livestock category which feed improved forages in dry season; this is because in order to get milk and its products, shortage of other feeds, unavailability of improved forages to supply all livestock groups, and less survival of calves. Related to these, there was in supply of improved forages and also input supply did not match with farmers' preference. Land shortage was another problem for the production improved forages in the area (Figure 1).

Figure 1 Improved forages produced in the area.

Sampling Procedure and Sample Size determination

A multistage random sampling method was used for the selection of the sampled respondents. The area was purposively selected based on their accessibility and relevance of the study.

In order to determine sample size, the probability proportional to the population was used.

Data Collection and Sources

Both primary data and secondary data sources were used. These data was collected by socioeconomics researchers through checklist prepared, structured questionnaire designed and pre-tested for formal survey. .In addition, Focus group discussion, key informant interview, Farm visit and/or direct observation were also conducted for data collection and were undertaken.

Results and discussion

Description of variables in adoption models

As noted, the majority of smallholder farmers in Ethiopia are producing both crops and livestock. However, the productivity of the agricultural sector is very low due to low adoption and application of improved agricultural technologies. This study attempts to identify the determinants of adoption and intensity of use of improved forage technologies in the study area. Adoption of any agricultural technology can be measured in terms of both timing and extent of utilization by individuals (Sunding and Zilberman, 2001). In this study, a farmer is defined as an adopter if he or she is found to be producing at least one improved forage technology. This implies that an adopter could still be producing local grass and crop residues alongside improved forages. A farm level (individual adoption) adoption reflects a farmer's decisions to incorporate a new forage technology into the production process of farming. This study focuses on individual or farm household improved technology adoption. Intensity of adoption is measured by the proportion of farm land devoted to improved forages (Table 2).

Table 2 descriptive statistical analysis of variables

Variable	Mean	Std. Dev.	Min	Max
Age (age of household head)	41.89	13.73	23	85
Edu_levl (education level of household head)	4.57	1.77	0	12
Famsz (family size of household head)	6.46	2.22	2	13
landsz_h (total land holding of house hold head in ha)	0.71	0.12	0.06	2
Culti land (cultivable land_	0.49	0.13	0.031	2
Private grass land	0.12	0.04	0	1
No_of dairy cow (total number of dairy cow owned)	1.15	0.22	0	7
TLU (total herd size)	4.18	1.09	0	8.1

Socio economic characteristics' of sample household in sodo zuria woreda (N=121)

I. Age of house hold head: the average age of sample households in the study area was nearly 42. However it ranges between 23 and 85 respectively. This shows that majority of farm households were under the productive age group.

II. Education level of household head: average education level of sample household head in the years schooling was 4.57. This shows that the majority groups of sample households attend the formal education. In fact, educational level of farmers is assumed to increase the ability to obtain process and use agriculture related information and use technologies in a better way. In the study area, the education level of farming community is relatively low similar to the national literacy level.

III. Family size of sample household head: the average family size of sample households was 6.5 however it ranges between 2 and 13.

IV. Total land holding of sample household head: the average total land holding of sampled house hold was 0.7 ha. This was found in the range between 0.0625 and 2 ha respectively.

V. TLU (Total Livestock Unit).the average number of total herd size owned by the sampled household was nearly 4.18. However it ranges between 0 and 8.this means that (0 means that households have not owned livestock unit during survey period).

From the above Table 3, 64.5% of the sample households adopt improved forage technologies and the rest 35.5% were non adopters of the technologies. From the above table, majority of the sampled households produce desho grass which covers 82% from the total farm households who adopt improved forages with the average area coverage of 272.53 square meters (Table 4). It is found in range of 10 square meters to 1600 meter square meter. Elephant grass is the second improved forage adopted next to desho grass, which holds 29.5% with average area coverage of 138.96 square meters. Others sasbania and rodes grass hold 5.13% and1.28% respectively (Table 5).

Table 3 Sample size considered across the kebele and their adoptability of improved forages

Kebeles'	Adopters (0)	Non adopters (1)	Total
Kokate mare chara (1)	43	7	50
Mante gerara (2)	35	36	71
Total	78	43	121

Table 4 Descriptive Statistical analysis of major improved forages produced in the study area

	N	Minimum	Maximum	Mean	Std. Deviation
land allocated to desho in meter square	64	10	1600	272.53	36.34
land allocated to elephant grass in meter square	23	25	625	138.96	25.35
land allocated to sasbania in meter square	4	25	100	50	5.35

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Table 5 Econometric Results for factors affecting Adoption of Improved Forage technology

Do adopt/not	Coef.	Std.err	Z	P>/Z/
Sex of household head	0.497	0.329	1.51	0.13
Age of household head	0.014	0.01	1.27	0.2
Education level	0.021	0.04	0.5	0.62
Family size	0.136	0.06	2.18	0.03**
Access to off farm income	-0.239	0.27	-0.88	0.38
The Topography of land of household	0.506	0.26	1.97	0.05**
Total land owned in ha	-0.735	0.38	-1.95	0.05**
Total livestock unit (TLU)	0.043	0.07	0.67	0.5
Distance from house to all weather road in km	0.095	0.06	1.63	0.1
Distance to livestock market in km	0.041	0.03	1.49	0.14
Distance from house to FTC in km	-0.155	0.07	-2.19	0.03**
Access to credit	0.004	0.29	0.01	0.99
Distance to credit institution in km	0.016	0.02	0.68	0.495
Constant	-0.993	0.85	-1.17	0.242

Explanation of explanatory variables which affects the adoption of improved forage technology

Family size of household head: this is a continuous variable which positively and significantly affects probability of adoption of improved forage technologies at 5% significant level. The probable reason for this finding is that improved practices are labor intensive and hence the household with relatively high labor force uses the technologies on their farm plots more than others similar signs found for other technologies.[2] Total land holding in ha: Farm size influenced negatively the probability of adoption of improved forages at 5% probability level. This might be due to the fact that small farm size requirement of the technology and it might related more to the land allocated for food crops and higher food requirement of the household member than to the adoption of improved forages. A study by[8] also found similar negative and significant influence of farm size on adoption of improved sweet potato varieties. The topography of land of household head. This is another dummy variable which positively affects the adoption of improved forage technologies. This means the steep and undulated land forces farmers to adopt improved forages in terms of soil and water conservation purpose. So that majority of farmers who adopt improved forages have slopy land than those who did not adopt improved forages. Distance to farmers training center (FTC). The coefficient of distance between Farmers Training Center (FTC) and home of the household had the negative sign and significant effect on the probability of adoption of improved forages. Proximity of farmers to such places is crucial to access extension service on time. Hence through preparing farmers training and demonstration sites in vicinity to farmers can promote the improved forage adoption.

Conclusion

The regression result showed that family size, farm size, topography and distance from farmers' home (residence) to farmers training centers were the major factors which significantly affect the probability adoption of improved forage technologies in the study area. The study result indicated that probability of improved forage adoption was higher for farmers with small land size than that of large farm sizes. This implies that having larger land size provokes the farmers to use the locally available grasses and browses than the farmers that have smaller land size. Farmers with larger farm size also prepares private grass land by their own and have access to get crop residue and store it for the next drought periods in order to overcome feed shortages. So that this by itself negatively affect improved forage adoption. So that it is possible to promote improved forage adoption through awareness creation of farmers with large land size. Capacitating center in the vicinity to farmers and developing farmer's research and demonstration center is believed to promote the improved forage introduction, utilization and improve production and productivity of livestock sector and is/are also possible to accelerate the adoption of improved forage in mixed farming communities.

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Conflict of interest

The author declares there is no conflict of interest.

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