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Determinants of Improved Forages Adoption in Doyogena District of Kembata Tembaro Zone, in Southern Nations, Nationalities Regional State, Ethiopia

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Abstract- The Doygana district are known as the undulating topography and highland agro ecology endowed with small plots of lands per households that needs improved forage development as a basic instrument for improved cattle production and soil and water conservation; and availability of introduced improved forage technology before more than three decades, Nevertheless, the level of adoption and utilization of improved forage technology is said to be minimal. This study, therefore, was initiated to identify factors that affect the adoption of improved forages decision in the Doyogena district of Kembata Tembaro Zone, Southern Nations Nationalities People Regional State of Ethiopia. The study was undertaken in two kebele. Structured and semi Structured questionnaires were used to undertake 140 sampled farmers.

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I. Introduction

Ethiopia is known as the largest livestock producer in Africa and one of the largest in the world. This livestock sector has been contributing considerable portion to the economy of the country, and still promising to rally round the economic development of the country. Ethiopia's estimated livestock population was approximately 56.71 million cattle, 29.3 million sheep, 29.11 million goats, 2.03 million horses, 7.43 million donkey, 0.4 million mules, 1.16 Camel, 56.87 million poultry and 5.89million bee hives (CSA, 2014/15).

Despite this huge potential of livestock population and its diversity, the benefits obtained from the sector are low compared to other African countries and the world standard. As cited in Asfaw et.al. (2011);Berhanu,(2007) and Pavanello, (2011) 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 in 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 (Zekarias ,2015;ESAP,2003).

Inadequate feed and nutrition are major constraints to livestock production in Ethiopia. To ease such a constraints, national, regional and international research institutions have developed several feed production and utilization technologies. However, adoption of these technologies has so far been low (Gebremedihin, 2003)

The extension and credit service have positive impact in enhancing the probability of adoption of improved forage technologies. The intensity of use of improved forage in the study area was influenced by labor available, size of livestock ownership and farm size. Physical characteristics like distance from farmers' home to all weather roads, markets and input supply played a critical role in the adoption of improved forage technologies. Therefore, the results of the study suggest that the adoption of improved forage should be enhanced by raising farm household asset formation, and providing extension and credit services (Hassen.2013).

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In the southern Ethiopia where this study is conducted, crop and livestock productions are highly integrated as a means to generate income, cope up with market and environmental risks and meet household consumption requirements. The major crops grown by sample households were Enset, wheat, potato, barley, teff, faba bean, field pea, maize, vegetables. The major livestock reared by sample households were local and improved cattle, sheep, equine (donkey, horse and mule), improved and local poultry, local and improved beehives and goats.

The major improved forage crops adopted in the district were Desho grass, elephant grass,oat, vetch and sesbaniaya sesban and tree Lucerne. The straws of crops were used for animal feed. Animals like oxen used for draft power in plowing and planting and threshing crops such as wheat, barley and maize. This study tried to assess the factors responsible for the probability of adoption and utilization of improved forage technologies (desho, elephant grass, oat, vetch and tree Lucerne). The general objective of the study was to identify the determinants of the adoption of improved forage technology in mixed crop and livestock farming systems in Doyogena districts of Kembata Temabaro Zone (SNNPR) of Ethiopia.

a) Methodology

i. *Study location*

Doyogena district is located in Kembata-Tembaro zone, at a distance of 258 km to the South-West of Addis Ababa. It is comprised of 14 sub-districts and has a total area of 17,263.59 hectares. About 86% of the area is used for crop cultivation, 11.8% forest and bushes, 2% grazing land, and 0.2% degraded land. The maximum, average and minimum land holding per household is 3.5ha, 0.75 and 0.25ha, respectively. It has an altitude ranging from 1900 to 2748 meter above sea level (m.a.s.l) with significant on local climate. The district has two major agro-ecologies, Dega (70 %) and Woyina dega (30 %). It has a minimum and maximum temperature of 10°c and 16°c respectively and receives average annual rainfall of 1400 mm (WoA, 2012).

Figure 1 : Map of Doyogena district

Key informant interview

Using Key informant interview, major improved forage produced in the district, intensity of and utilization of improved forage, major constraints and opportunities of improved forage cultivation and factors that hinder/promote the production and improved forage utilization will be characterized. In line with key informant interview, the questioner pretested; awareness creation was made on data collection instrument for the data collectors. In Key informant interview the study considered 20 household from Wonjala keble and Gomora Gewada keble. The primary data has been supported by secondary information.

Table 1 : Sample size considered in household survey across kebele (N=140)

No.	Kebele	Sample size considered (N)
1.	Gomora Gewada	75
2.	Wonjala	65
	Total	140

ii. *Sampling method*

A purposive sampling procedure was followed where three kebele, one each from low, medium and best forage producer sub-districts were selected with experts from district office of agriculture and Non Governmental Organization (Inter Aid France). Based on the guidance from the Woreda experts, twenty farmers from each kebele were selected by kebele development agents for the purpose of focus group discussion and key informant interview. The criteria for selection of kebele and farmers used comprised of gender, existence of improved forage at the farm, intensity of utilization of improved forages and the like. The study considered 10 households for key informant interview and 50 farmers for focus group discussion. A total of 60 farmers were sampled for the study across the three kebele.

iii. *Data collection and sources*

In order to develop effective interventions, it is necessary to first understand farmers' current practices in forage seed and feed production. Thus, both primary and secondary data were collected for the study. To capture the required information for the forage seed production and marketing, a combination of different techniques were applied. Secondary information was collected from district and sub-district offices of agriculture. Different set of checklists and questionnaires

were used for different kebele farmer after group discussions and key informants interviews.

iv. *Review of secondary data*

Secondary sources of data have been consulted and reviewed for the study. Secondary data was collected from previous Feed Resources Assessment reports conducted by SARI (not published), journals, proceedings and Woreda reports and website reports.

v. *Focused group discussion (FGD)*

A team of researchers from different discipline (feed specialist, seed expert, range expert and socio economist) from Areka ARC and experts from WoA and NGO held discussion with different groups of forage sector stakeholders. To extract quantitative and qualitative data during focus group discussion, key informant interview and household survey the main instruments applied. The team also discussed with forages and forage seed producers based in the district. Focused group discussion with farmers was held with three groups of 20 farmers each from three study kebele in the district. The study included two Keble from the Woreda which are known as best adopter and leased adopter of improved forage and forage technologies. The two Keble located in opposite direction to one another (one in south and the other in the north. These two kebele are Wonjala and Gomora Gewada. In addition to these the topography of Wonjala was more of gentle flat, whereas as Gomora Gewada Keble topography was of undulating.

Improved forages developed in the area

Improved forage Adoption refers to the decision to use a new technology of improved forages, method, practice, etc. by a firm, a farmer. 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.

The adoption of agricultural innovations can provide the basis for increased production and income. More precisely, farmers will adopt only those technologies that suit their needs and circumstances. As part of the effort to increase agricultural productivity, researchers and extension staff in Ethiopia have typically promoted a technological package consisting of a number of components. However, because of awareness problem, capital scarcity and risk considerations, farmers are rarely adopting complete packages.

b) Measurement and Definitions of Variables for Adoption

i. *The dependent variables of logistic regression models*

The dependent variable of the Log it model takes a dichotomous value depending on the farmers' decision either to adopt or not to adopt the improved forage technology. Adopters are farmers who developed and utilize improved forage technology (oat, vetch and tree lucerne, sesbainia sesban, desho grass and elephant grass). Non-adopters are farmers who did not developed and use either of this technology during the survey year (2007EC) production year.

ii. *The independent variables and their definitions in the Logistic regression model*

Adoption literatures provide a long list of factors that may influence the adoption of agricultural technologies. Generally, farmers' decision to use improved forage /improved forage technologies and at a given period of time are hypothesized to be influenced by a combined effect of various factors such as household characteristics, socioeconomic and physical environments in which farmers operate. The explanatory variables included in the empirical models comprised of family size, number of cow owned, Enset land, access to training, farmers training center, access to communal grazing land, market point and total land owned.

II. Results and Discussions

Table 2 : Socioeconomic Information of Doyogena Woreda (N =140)

Statistical variables & measurements	Minimum	Maximum	Mean	Std. Deviation
Age of the respondent	18.00	80.00	48.26	12.27
family size	3.00	12.00	6.90	1.94
total land owned in timad	.50	12.00	3.29	2.25
total cultivated land in timad	.10	75.00	3.23	6.42
private grass land in timad	.00	3.00	.34	.43
yearly off-farm income	0	12000	1048.99	2302.44

a) Socio-Economic characteristics of farmers

The socioeconomic characteristics looked in to in the survey duration comprised of age, family size, years of schooling, land owned & cultivated, grass land owned and yearly off farm income level.

i. *Age Distribution of farmers*

The average age of the Pastoralists household head was 48. However, it ranges in between 18 and 80. The proportion of sampled producers whose age lies active and independent age category in the range between 18 and 65 was 90%. The remaining 10% sampled farmers were aged more than 65 years. This findings show that majority the farmers were in the age range of active labor force and only few known to be under dependant age category. Thus, this is very important with respect to the adoption and utilization of improved forage technologies for productivity improvement of livestock and efficient natural resource management.

Table 3 : Age distribution of small scale farmers

Age	Frequency	Percent	Cumulative frequency	Farmers category
18-37	26	18.57	18.57	Youth farmers
38-65	100	71.43	90	Mature farmers
66-80	14	10	100	Dependant farmers
Total	140	100		

ii. *Family Size of small scale farmers*

Table 4 : Family size of small scale farmers

Group	Producers (N=140)	Percent	Cumulative percent
Low family size (3)	6	4.3	4.3
Medium family size (4-6)	50	35.71	40.00
Large family size (7-10)	81	57.86	97.86
Very large family size (11-12)	3	2.14	100

The family size distribution shows that the average family size of Doyogena farmers was 7. However, the range of family size for sampled pastoralist is between 3 and 12. From whole sample households in the area, the proportion of households with family size of 3 family sizes are 4.3%, 4 to 6 are 35.71 %, and 7 to 10 are 57.86 % and 11 to 12 are 2.14 %. The survey result reveals that majority of households belong to medium and large family size. The proportion of households with low and very high family size is few (6.34%).

iii. *Education level of farmers (N=140)*

Table 5 : education level of Pastoralist household head

Category of education level	Frequency	Percentage	Cumulative percentage
Not attended Formal education	34	24.29%	24.29
Primary school(1-4)	36	25.71%	50
Secondary school(5-8)	43	30.71%	80.71
High school (9-10)	20	14.29%	95
Grade above 10	7	5%	100
Total	140	100	100

Source: household survey 2015

The data in the table (3) revealed that 24.29 % of sampled households did not attend formal education whereas; the proportion of small scale farmers household who attended formal education was 75.71%.

The proportion of households attended formal education in the district was three fourth of the total that positively helps in adoption, pre-scaling up and utilization of agricultural technologies in general and forage technologies in particular.

Table 6 : Land ownership of farmers across kebele :(1ha=4timad area of land)(N=140)

Range of land owned (Timad)	Gomoroagewada	Percent	Wonjala	Percent	Total	Percent
0.5-1.5	25	33.33	10	15.38	35	25.00
1.51-2.5	19	25.33	8	12.31	27	19.29
2.51-3.5	21	28.00	14	21.54	35	25.00
3.51-4.5	4	5.33	11	16.92	15	10.71
>=4.51	6	8.00	22	33.85	28	20.00
Total	75	100	65	100.00	10	100.00

The study confirmed that the total land holding per household varies across peasant associations. Majority of the farmers in the district own less than one hectare of land (69.3%) that had its own role in adoption and utilization of improved forages in the district. The farmers dwell around wonjela peasant association where the adoption rate is lower, own larger land size than the farmers in Gomorogewada (where the farmers adopted relatively in better manner).

III. Factors Affecting Small Scale Farmers Household's Choice of Improved Forages Adoption

In order to estimate the participation decision of small scale farmers in adoption of improved forages in the area, Logistic regression Model was employed by (SPSS.v.20.). Here, the factors influencing the household's discrete choice behavior was modeled using a binary logistic model.

Table 7 : Econometric Regression Result of Logit Model: Adoption Determinants

Explanatory Variables	B	S.E.	Sig.	Exp(B)	Odds ratio
Eduformal	.906	.519	.081	2.475	11.88***
Family-siz	-.106	.110	.33	.899	2.46
Gotraing	1.15	.56	.001	2.39	10.91*
Enst-land-timd	-.030	.222	.891	.970	2.64
Access-communal	-2.080	.506	.000	.125	1.13*
FTC dist	-.057	.023	.016	1.058	2.88**
Dist.mkt	-.075	.040	.058	1.078	2.94***
Dairy cow owned	.670	.342	.050	.512	1.67**
Total land(timad)	-.075	.112	.501	.927	2.53
Constant	-1.559	1.347	.247	.210	1.23

*The explanatory variables considered *,**and *** as significantly affecting the probability of adoption in 1%,5% and 10% significance level respectively.*

Then binary logistic regression model allowed the estimation of a set of probabilities of improved forage adoption regimes for households with a given characteristic logit model where only one coefficient is estimated for all the outcomes. To investigate factors embedded in deciding probability of improved forages adoption variables used as explanatory variables include formal education attendance, family size, Enset land size ,land owned, training access, marketing point proximity, dairy cattle number owned and farmers training center proximity.

Access to formal education: The coefficient for the variable formal education attendance is 11.88. Because these coefficients are in log-odds units, they are not as such simple to interpret, so it is converted into odds ratios. The log odds units are converted in odds ration by taking exponentiation of the coefficient manually using excel sheet. As the result, odds ration coefficient for access to formal education=Exp (2.475) = 11.88. This is the proportional odds ratio of comparing farmers those attended formal education to that not attended formal education on improved forage adoption participation given the other variables in the model are held constant. For farmers that attended formal education, the probability of participation in improved forage adoption decision 11.88 times higher than that of farmers not attended formal education, given the other

explanatory variables are held constant. This is to mean that enabling farmers to attend formal education increase probability decision of improved forage adoption participation by about 11.88 units compared to famers not attended formal education. The study is in line with Gethun.et.al (2013) concluded literacy has significant role in adoption on utilization of small ruminants and related technologies in highland of Ethiopia.

Training access: The coefficient for the variable training access is 2.39. Because these coefficients are in log-odds units, they are not as such simple to interpret, so it is converted into odds ratios. The explanatory variable was defined as 1 for those accessed training and 0 otherwise. The log odds units are converted in odds ration by taking exponentiation of the coefficient manually in excel sheet. As the result, odds ration coefficient for training access equates Exp (2.39) = 10.91. This is the proportional odds ratio of comparing farmers accessed training to that not attended training on adoption of improved forages given the other explanatory variables in the model are held constant. For farmers capacitated on improved forage pre-scaling up and utilization, the probability of improved forage adoption decision exceeds 10.91 times higher than for farmers not accessed training, given the other explanatory variables are held constant. This is to mean that enabling farming communities to access capacity building in subject matter increase the probability decision of improved forage adoption participation decision by the probability about 10.91 units as compared to other farmers not accessed to training. The study is in line with findings of Yikaaly and Zebrhe (2015) that indicated that farmers' those had access for frequent extension advice have better adoption. Hence the study finding points out that through capacity building, it is possible to increase the rate of improved forage adoption and utilization in the district.

Access to communal grazing land: the parameter estimate for the variable access to communal grazing land is 0.125. This implies that for one unit distance increase in km in access and utilization to communal grazing land, we expect 1.13 factor decreases in the probability of improved forage adoption, holding all other explanatory variables constant. Since the main goal of introduction and development of improved forages is for providing adequate feeds for their livestock, having been acquainted with freely accessed communal grazing land in vicinity decreases the attention and probability of farming communities in development of improved forages. The study finding implies that if the farmers accessed with communal land that owns zero cost personally to access and utilize it, this by its own could provoke the farmers to own and herd more and more livestock number individually that is beyond the carrying capacity of given natural resource, would result finally in overgrazing and erosion. The study indicated that when the farmers dwell in nearby distance to communal grazing land, they become unwilling to give their plots of lands for improved forages as they are in the position to access to utilize communal land freely. Hence as policy option, enabling the farmers in the district to produce improved forages in freely accessed communal grazing land in form of cooperative could enhance the productivity of the sector and accelerate the adoption improved forage technologies.

Distance to Farming Training center: The coefficient for the variable distance from farmers residence to farmers training center is 1.058. The odds value of parameter estimate was calculated as 2.88. This indicates that for one unit increase distance from farmers' residence to farmers training center, we expect 2.88 decrease in probability of improved forage adoption, holding all other explanatory variables constant. When farmers found themselves in nearby distance to farmers training center, their access and utilization opportunity, visit and know knowhow of forage technology increases, this make higher adoption probability accordingly. Hence, as policy option creating decentralized farmers training center and scaled up improved forage demonstration plots availability at village level, would promote improved forage adoption.

Access to market point: The coefficient for the variable cattle owned is 1.078; which is in logs of odds unit. This indicates that for one unit increase distance from farmers' residence to market point, we expect 2.94 decrease in probability of improved forage adoption, holding all other explanatory variables constant. When farmers found themselves in vicinity distance to livestock and product market point, their access and utilization opportunity of market information, experience sharing and knowhow about improved forage technology increases, this by its own make higher adoption probability accordingly. Hence, as policy option linking improved forage producers to market and market information believed to promote improved forage adoption intensity and utilization. The study finding is in line with Berhanu and et.al (2003) that concluded households with higher proportion of cash income that are closer to livestock markets are more likely to adopt the improved forage technology.

Number of dairy cattle owned: The coefficient for the parameter estimate cattle owned is 0.512. The odds ratio of dairy cattle owned parameter estimate is 1.67. The sign of parameter estimate is positive, which shows number of dairy cow kept by small scale farmers increase the probability of improved forage adoption decision. This implies that one unit increase in dairy cattle owned results in increment of the probability of improved forages adoption by 1.67 times, holding all other explanatory variables constant. The finding is in

line with Solomon (2011) in which the household wealth (livestock) is major determinants for adoption of improved agricultural technologies. As the dairy cattle herd size increases, the probability of small scale farmer household to take part in improved forage adoption increases. The implication is that active adoption and utilization of improved forages depend on farmers attaining and maintaining sufficiently large dairy cattle herd sizes that they become willing to plant and scale up improved forages in his plots of land. Relatively wealthy farmers, with greater dairy herd size, have considerably higher technology adoption and utilization rates and thus adopt improved forages more frequently.

IV. Conclusion and Recommendation

From the study it was concluded that farm investment choice of improved forage modeled as a function of socio economic, institutional and household demographic characteristics. The market access, number of dairy cattle owned, availability of communal grazing land, access to farmers training center significantly affect the probability of investment in improved forage technology.

From explanatory variables used in logistic regression model, access to formal education, training and number of dairy cattle owned affected positively the household choice to take part in adoption of improved forages in the district; while access to communal land, access to market point and farmers training center negatively affected the probability.

Enabling farmers to obtain training, improving market access and attendance in formal education, it is possible to accelerate the level of improved forage adopting in mixed farming districts. Organizing the farmers in form of cooperative that could access freely accessed communal land, scaling up of technology generation and capacitating center in the vicinity to farmers and developing farmers research and demonstration center is believed to promote the improved forage introduction, utilization and improve production and productivity of livestock sector.

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