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DETERMINING THE FACTORS AFFECTING THE ADOPTION OF FODDER CROPS BY FARMERS IN ETHIOPIA AND KENYA

Report of the master's thesis in the scientific programme

Sustainable International Agriculture

at Georg-August-Universität Göttingen, Faculty of Agricultural Sciences and

University of Kassel, Faculty of Organic Agriculture

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ABSTRACT

Fodder crop production enables farmers to improve their livestock production and to provide a higher level of self-sufficiency with livestock products. This study aimed to determine the level of adoption of fodder crops and assess factors that influence their adoption by farmers in selected regions of Ethiopia and Kenya. Study areas were selected purposively since forage production is limited to specific regions with intensifying dairy production in both countries. Village-level data was collected by the International Livestock Research Institute (ILRI) from Tigray, Amhara, Southern Nations Nationalities and Peoples Region (SNNPR), and Oromia regions of Ethiopia, as well as Upper Rift, Western, Nyanza, Central and Coast regions of Kenya, in 2015. Data was obtained from 180 villages or peasant associations per country through group interviews based on a structured questionnaire. Descriptive statistics and Tobit model were used to identify factors influencing the adoption of fodder crops.

Research findings showed that fodder adoption intensity, expressed as the proportion of the total area allocated to fodder crop production, is 2% and 10.66% in Ethiopia and Kenya, respectively. The most commonly adopted species were Napier (*Cenchrus purpureus*, various varieties), Sesbania (*Sesbania sesban (L.) Merr*), and Rhodes grass (*Chloris gayana Kunth*) in Ethiopia; Napier, Calliandra (*Calliandra calothyrsus Meisn*.) and Rhodes grass in Kenya. The Tobit analysis revealed that the number of fodder projects had a positive influence on the adoption intensity of fodder crops in Ethiopia, while arable land per farm household had a negative effect ($p<0.05$). The effect of the arable land per farm household was negative and significant ($p<0.05$) also in Kenya, suggesting that larger farms were less likely to produce fodder crops in study sites. Other variables that had a negative and significant effect on fodder adoption in Kenya were distance to the nearest town centre ($p<0.05$) and the share of tractor tillage ($p<0.01$). Furthermore, altitude, milk marketing rate, number of dairy cows per farm household, and the price of Napier grass were found to have a positive and significant impact on the proportion of land allocated for fodder crop production in Kenya.

The findings imply that fodder adoption projects and market-related variables are the key drivers to increase the intensity of fodder adoption in Ethiopia and Kenya, respectively. Therefore, especially in regions where dairy cattle keeping predominates, the adoption of improved fodder crops should be enhanced by raising fodder awareness among farmers and facilitating the commercialization of dairy products. In addition, the study revealed the significant effects of some regional variables such as altitude and distance to the nearest town centre on fodder adaptation intensity. Based on the findings, the study will guide the government and stakeholders to focus on the regions with high fodder adoption potential in fodder-related projects.

Keywords: *adoption, Tobit model, improved forage, feed resource, Ethiopia, Kenya.*

1. Introduction

The livestock sector is one of the most important economic sectors in Ethiopia and Kenya as it provides livelihood and food security for millions of people (FAO 2005; Njarui et al. 2016a; FAO 2019). Although the livestock population is high in Ethiopia and Kenya, their contribution to the national economy is below their potential due to low productivity caused by inadequate feed quality and quantity, poor health care, poor management practices, and harsh environmental conditions (Asmare et al. 2016; Njarui et al. 2016b). It is known that there is a solid relationship between livestock productivity, feed availability and quality (Njarui et al.

2016b). Fluctuations in the amount and quality of feed obtained from natural sources affect productivity and production of livestock since feed is one of the most important input factors in all livestock production systems (Madubuike 1993). For instance, in Kenya, most farmers face feed shortages for about 4 to 6 months in the dry seasons of the year (Njarui et al. 2011). Henceforth, farmers have adopted planted forages such as Napier grass in only a few areas. Natural grazing is also the primary feeding source for livestock in Ethiopia. Crop residues and agro-industrial by-products are other necessary feed resources with variable seasonal and spatial availability while planted fodder crops are quite limited (Birhan & Adugna 2014).

Many projects have been implemented in Ethiopia and Kenya to increase the production of fodder crops so far. However, current fodder production levels show that most of these projects have not fully achieved their goals. Population growth is increasing the demand for arable land to produce food for humans while limiting the opportunities for fodder production (Mengistu 2002). It is crucial to determine the factors affecting the adoption of fodder crops by farmers in different regions to support the development of appropriate policies as well as increase the livestock sector's production and productivity through forage production in Ethiopia and Kenya.

2. Objectives of the Study

The general objective of the study was to identify factors that affect the adoption of fodder crops in selected regions of Ethiopia and Kenya with an emphasis on regional characteristics beyond the household level. The specific objectives of the study were to determine the level of adoption of fodder cultivation in selected regions of Ethiopia and Kenya and to recommend policy interventions to promote the adoption of fodder crops in Ethiopia and Kenya.

3. Methodology

3.1. Study Area

The study was conducted in both Ethiopia and Kenya. **In Ethiopia,** the study area consists of 20 districts (woredas) from 12 zones of 4 regions (the first administrative unit). These woredas are Bahir Dar Zuria, Dejen, Farta, Fogera, Mecha, Yilmana Densa from Amhara Region; Ada'a, Chiro Zuriya, Diga, Ejerie, Girar Jarso, Sibu Sire, Welmera from Oromiya Region; Awasa Zuriya, Bolossa Sore, Dale, Sodo Zuriya from Southern Nations, Nationalities, and Peoples (SNNP) Region; and Atsbi Womberta, Enderta, Kilte Awlaelo from Tigray Region.

In Kenya, the study area consists of 12 counties. These are Trans-Nzoia, Bungoma, Kakamega, Nandi, Uasin Gishu, Homa Bay, Nyamira, Kisii, Nyandarua, Murang'a, Kiambu and Kilifi.

3.2. Sampling Methods and Sample Size

The data used in the study were collected by International Livestock Research Institute (ILRI) in 2015. As forage production is limited to specific regions in Kenya and Ethiopia, the survey focused only on these areas. A sample size of 180 communities in each of the two countries for focus-group discussions at village level (Kenya, one randomly selected village per randomly selected sub-location) and peasant-association level (Ethiopia) were fixed based on budget limitations and the opportunity for statistical analysis of sub-groups. An equal number of sampling units was selected from each of the purposively selected counties and districts (15 sub-locations per county in Kenya; 9 PAs per district in Ethiopia). This provided sub-samples of sufficient size to compare groups of counties and districts.

4. Results

Tobit model was employed to determine the factors influencing fodder adoption intensity in the study areas in Ethiopia and Kenya. Fodder Adoption Intensity of villages, which is the dependent variable of the study, represents the proportion of cultivated area allocated by farmers for fodder crop cultivation. Table 4.39 and Table 4.40 represents the results of the Tobit regression analyses for Ethiopia and Kenya, respectively. These tests showed that the models were significant at the 1% and 0.1% level of probability for Ethiopia and Kenya cases, respectively. The Pseudo R^2 values of the models were 17% in Ethiopia and 44% in Kenya which represent the good fit and excellent fit of the models, respectively, according to McFadden's (1977) criterion.

As presented in Table 4.39, a total of 7 continuous independent variables were used to compute the Tobit model to identify factors influencing fodder adoption intensity in Ethiopia. Out of the total variables, only the arable land area per farm household and number of fodder project were determined to significantly influence the adoption intensity of fodder crops by farmers in Ethiopia.

Table 4.1 *Tobit regression results of fodder adoption intensity in Ethiopia*

Coefficients	Estimate	S.E.	z value	Pr(>|z|)
(Intercept)	1.012e-03	1.337e-02	-0.076	0.9397
Wage Level (ETB/male/day)	1.326e-04	1.150e-04	1.153	0.2488
Arable Land per Farm HH (ha)	-3.314e-03	1.560e-03	-2.124	0.0337 *
Altitude (m a.s.l.)	8.534e-07	5.145e-06	0.166	0.8683
Share of Marketed Milk (%)	1.172e-04	6.541e-05	1.792	0.0732 .
Number of Fodder Projects (n)	2.901e-03	1.280e-03	2.267	0.0234 *
Distance to Nearest Town (km)	1.585e-04	1.614e-04	0.982	0.3259
Dairy Cow (Crossbred) per Farm HH (n)	7.037e-03	4.081e-03	1.725	0.0846 .
Log(scale)	-3.656e+00	5.421e-02	-67.443	<2e-16 ***
Log-likelihood: 377.2 on 9 Df				
Wald-statistic: 23.52 on 7 Df, p-value: 0.0013853				
Pseudo R^2: 0.166				
Left-censored observations: 7				
Right-censored observations: 0				
Uncensored observations: 171				

Note: Significance Codes: . p<0.1, * p<0.05, ** p<0.01, *** p<0.001

Estimates of the parameters of the independent variables expected to affect the fodder adoption intensity in Kenya are presented in Table 4.40. Among the 12 hypothesized explanatory variables (10 continuous and 2 categorical variables), seven variables were found to have a significant effect on fodder adoption intensity at 0.01 and 0.05 level. Arable land per farm household, distance to the nearest town, altitude, share of marketed milk, number of dairy cows per farm household, price of Napier grass, and share of tractor tillage were the variables that significantly influence adoption intensity of fodder crops in Kenya.

Table 4.2 *Tobit regression results of fodder adoption intensity in Kenya*

Coefficients	Estimate	S.E.	z value	Pr(>|z|)
(Intercept)	5.257e-02	8.772e-02	0.599	0.54902
Arable Land per Farm HH (ac)	-1.165e-02	4.541e-03	-2.565	0.01032 *
Dairy Cow (Crossbred) per Farm HH (n)	1.087e-02	4.143e-03	2.624	0.00870 **
Distance to Nearest Town (km)	-1.408e-03	5.971e-04	-2.357	0.01840 *

Milk Price (KES)	-5.682e-04	5.859e-04	-0.970	0.33216
Milk Collection Centre Availability	1.854e-02	2.161e-02	0.858	0.39084
Share of Marketed Milk (%)	9.522e-04	3.883e-04	2.452	0.01420 *
Napier Price (KES)	1.118e-02	3.634e-03	3.076	0.00210 **
Altitude (m a.s.l.)	3.633e-05	1.770e-05	2.053	0.04005 *
Wage Level (KES/male/day)	8.280e-05	1.103e-04	0.751	0.45276
Share of Tractor Tillage (%)	-7.201e-04	2.697e-04	-2.670	0.00758 **
Extension Visit (Fodder) Availability	2.817e-02	1.957e-02	1.440	0.15000
Awareness Level of Participants	6.842e-04	3.662e-04	1.868	0.06172 .
Log(scale)	-2.36399	0.05519	-42.84	<2e-16 ***
Log-likelihood: 147.7 on 14 Df				
Wald-statistic: 93.56 on 12 Df, p-value: 1.0078e-14				
Pseudo R^2: 0.443				
Left-censored observations: 15				
Right-censored observations: 0				
Uncensored observations: 165				

Note: Significance Codes: . p<0.1, * p<0.05, ** p<0.01, *** p<0.001

5. Concluding Summary

The general purpose of the study was to identify the level of fodder adoption and the factors influencing fodder adoption intensity in Tigray, Amhara, Southern Nations Nationalities and Peoples Region (SNNPR), and Oromia regions of Ethiopia and Upper Rift, Western, Nyanza, Central and Coast regions of Kenya. Descriptive statistics and a Tobit model were used to identify factors influencing the adoption of fodder crops.

The livestock sector, which is generally characterized by smallholder farm households, is one of the most important livelihood sources in study sites. However, the productivity of the sector is low due to various reasons, including feed shortages. Especially during dry seasons, many farmers experience severe feed shortages in both countries. Crop residues and grazing lands represent the major part of feed sources in study sites. The research findings revealed that only 2% and 10.6% of the total cultivated land was allocated for the production of fodder crops in Ethiopia and Kenya, respectively.

It was observed that the extension services, training modules, and adoption projects regarding fodder crops are more common in Ethiopia. These projects improve the technical capacity of farmers and increase the awareness level regarding fodder crops. The results of the Tobit analysis revealed that the variable of the number of fodder projects in Ethiopia positively and significantly affected the fodder adoption intensity.

On the other hand, the other factor influencing the fodder adoption intensity in Ethiopia was the area of arable land per farm household. The results showed that there was a negative and significant relationship between the area of arable land per farm household and the adoption intensity of fodder crops. Since farmers with relatively larger arable land size do not have a serious feed shortage problem, they generally prefer to cultivate food and cash crops and use residues of these crops as a feed source. This result indicates that the number of livestock kept in farms, which represents feed requirement, was not directly proportionate to the size of their arable land in Ethiopia.

The effect of the variable of arable land per farm household on fodder adoption intensity was also negative and significant in Kenya. As in Ethiopia, it was determined that farmers with larger lands in Kenya did not prefer fodder crop cultivation due to their relatively low exposure

to feed shortage. The variable of arable land area per farm household was the only explanatory variable that was significant in both countries of Ethiopia and Kenya. In addition to this, when the villages surveyed in Kenya were examined according to the number of dairy cows per farm, it was found that the fodder adoption intensity of villages increased as the number of dairy cows per farm household rose. This finding shows that farmers engaged in income-oriented dairy farming allocated more resources for fodder crop production. The relationship between the number of dairy cows, which is a proxy of the feed demand, and the land endowment representing the feed supply affected the fodder adoption intensity in Kenya.

The share of marketed milk was the other variable that significantly influenced the fodder adoption intensity in Kenya. The relationship between the two variables was positive, suggesting that higher cash income led to higher investment in fodder production. In addition, the effect of the distance to the nearest town centre, which is a proxy of market access, on the fodder adoption intensity was negative and significant. Apart from its impact on milk commercialization, the distance to the nearest town centre played a critical role in farmers' access to information, input, and new technologies. Furthermore, the price of Napier grass was also obtained as an important parameter determining fodder adoption intensity in Kenya. Napier grass was one of the most important fodder crops in Kenya and it was observed that the land allocated by farmers for fodder production increased as the price of Napier grass increased.

Tractor use also had a significant impact on fodder adoption. The results of the Tobit analysis show that the intensity of fodder adoption was lower in villages where the rate of tractor tillage was relatively high in Kenya. Food or cash crops were more commonly produced in villages where tractor use was intensive. This factor plays a Tractor use also had a significant impact on fodder adoption. The results of the Tobit analysis show that the intensity of fodder adoption was lower in villages where the rate of tractor tillage was relatively high in Kenya. Food or cash crops were more commonly produced in villages where tractor use was intensive. This factor plays a critical role in the determining of farming systems in the surveyed villages in Kenya. Another variable that was thought to have an impact on farming systems was altitude. Tobit results revealed a significant relationship between altitude and fodder adoption intensity in Kenya. The findings indicate that villages located in higher regions have a significantly higher fodder adoption intensity. It is known that small-scale dairy farms are common in the highlands of Kenya. As a result of this, fodder adoption intensity was high in these regions.

Identifying the problems faced by farmers in the adoption and production process of fodder crops and providing a framework to eliminate these problems play a critical role in the development of the livestock sector in Ethiopia and Kenya. The findings imply that fodder adoption projects and market-related variables are the key drivers to increase the intensity of fodder adoption in Ethiopia and Kenya, respectively. Therefore, especially in regions where dairy cattle keeping predominates, the adoption of improved fodder crops should be enhanced by raising fodder awareness among farmers and facilitating the commercialization of dairy products. In addition, the study revealed the significant effects of some regional variables such as altitude and distance to the nearest town centre on fodder adaptation intensity. Based on the findings, the study will guide the government and stakeholders to focus on the regions with high fodder adoption potential in fodder-related projects.

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