Research Application Summary

Factors affecting the adoption of woodlots by smallholder tobacco farmers: A case of Mutoko district, Zimbabwe

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Abstract

Tobacco in Zimbabwe is ranked among the top major crops which give foreign currency to the country and is also a major cash crop among smallholder farmers. Deforestation in Zimbabwe has been a country-wide problem most tobacco farmers are reluctant to observe regulation about the environment when their growing tobacco for the market in their farms. Addressing this problem is very crucial so that environmental degradation can be reduced. The objective of this study was to assess the factors affecting the adoption of woodlots by smallholder tobacco farmers in Mutoko District of Zimbabwe. The research specifically focused on evaluating farmers' perceptions towards woodlots as a source of energy for tobacco curing, determining farmers' awareness of the regulations requiring the establishment of plant woodlots and the challenges that hinder the successful integration of woodlots on smallholder tobacco farms. Two wards, Nyamuzizi ward 28 and Huyuwuyu ward 29, were purposively selected based on tobacco production and prior activities related to the promotion of woodlots. Then a sample size of 100 households was collected. Data analysis was based on descriptive and inferential statistics in the form of measures of central tendency and the binary probit model respectively. The findings showed that 55% of the farmers had adopted woodlots on their farms. The majority (95%) were supportive of the idea of using woodlots. However, the main constraints were lack of access to water, the incidence of pests and diseases and high plant mortality rates. The probit regression model results showed that the likelihood of woodlots adoption was mainly influenced by livestock assets index (p>|z|;0.01), family size (p>|z|;0.01) and tobacco returns (p>|z|;0.01). Therefore, households that had more income, more livestock and larger families were more likely to adopt woodlots. Based on the results, there is a need for follow-up on tobacco farmers to ensure that woodlots are established. This can be achieved through a multi-sectoral approach that includes organizations such as TIMB, ZTF and TRB. Incentives such as tax reduction/holidays for adopters of woodlots. In this regard, there is a need for an integrative farmer contract which may tie the new loan or support to farmers' ability to demonstrate that they would have established woodlots in the previous season (young stands).

Keywords: Adoption, cash-crop, deforestation, environment, perception, smallholder-farmers, tobacco, woodlots

Résumé

Le tabac au Zimbabwe est classé parmi les principales cultures qui rapportent des devises étrangères au pays et constitue également une culture de rente majeure pour les petits exploitants agricoles. La déforestation au Zimbabwe est un problème national pour la plupart des producteurs de tabac

sont réticents à observer la réglementation sur l'environnement lorsqu'ils cultivent du tabac pour le marché dans leurs fermes. Il est crucial de résoudre ce problème afin de réduire la dégradation de l'environnement. L'objectif de cette étude était d'évaluer les facteurs affectant l'adoption des parcelles boisées par les petits producteurs de tabac dans le district de Mutoko au Zimbabwe. La recherche s'est spécifiquement concentrée sur l'évaluation des perceptions des agriculteurs à l'égard des boisés en tant que source d'énergie pour le séchage du tabac, la détermination de la sensibilisation des agriculteurs aux réglementations exigeant l'établissement de boisés végétaux et les défis qui entravent l'intégration réussie des boisés dans les petites exploitations de tabac. Deux quartiers, le quartier 28 de Nyamuzizi et le quartier 29 de Huyuwuyu, ont été sélectionnés à dessein sur la base de la production de tabac et des activités antérieures liées à la promotion des parcelles boisées. Ensuite, un échantillon de 100 ménages a été collecté. L'analyse des données était basée sur des statistiques descriptives et inférentielles sous la forme de mesures de la tendance centrale et du modèle binaire probit respectivement. Les résultats ont montré que 55% des agriculteurs avaient adopté des boisés sur leurs fermes. La majorité (95 %) étaient favorables à l'idée d'utiliser des boisés. Cependant, les principales contraintes étaient le manque d'accès à l'eau, l'incidence des ravageurs et des maladies et les taux élevés de mortalité des plantes. Les résultats du modèle de régression probit ont montré que la probabilité d'adoption des boisés était principalement influencée par l'indice des actifs du bétail (p>|z|;0,01), la taille de la famille (p>|z|;0,01) et les revenus du tabac (p>|z|; 0,01). Par conséquent, les ménages qui avaient plus de revenus, plus de bétail et des familles plus nombreuses étaient plus susceptibles d'adopter des boisés. Sur la base des résultats, il est nécessaire d'effectuer un suivi auprès des producteurs de tabac pour s'assurer que les boisés sont établis. Cela peut être réalisé grâce à une approche multisectorielle qui inclut des organisations telles que TIMB, ZTF et TRB. Des incitations telles que des réductions d'impôts/ vacances pour les adoptants de boisés. À cet égard, il est nécessaire de mettre en place un contrat d'intégration des agriculteurs qui puisse lier le nouveau prêt ou le nouveau soutien à la capacité des agriculteurs à démontrer qu'ils auraient établi des parcelles boisées au cours de la saison précédente (jeunes peuplements).

Mots-clés : Adoption, culture de rente, déforestation, environnement, perception, petits exploitants agricoles, tabac, bosquets

Introduction

Tobacco is widely grown as a cash crop in Sub-Saharan Africa where it constitutes an important source of household income (Murphy, 2018). In the Zimbabwean context, tobacco production is largely dominated by smallholder farmers (TIMB, 2017). Most of these farmers are resource-constrained and are therefore supported by wealthy multi-national companies who are involved in input supply, production, trade and manufacturing (Kibwage *et al*., 2008). Tobacco has been grown in Zimbabwe for over 100 years and currently contributes about 25 percent of the Gross Domestic Product (GDP) (TIMB, 2017). Since the turn of the millennium, the tobacco sector experienced increased output contributing more than 30% of national income (TIMB, 2018). In 2017, about 250 million kilograms of tobacco were sold resulting in approximately US$1 Billion in revenue for the nation (TIMB, 2018). While most of the tobacco output produced in Zimbabwe since 2000 was dominated by smallholder farmers, it was largely the domain of white large-scale commercial farmers before the year 2000. Most of the commercial farmers relied mostly on coal, unlike the natural forests which are used by smallholder farmers (TIMB, 2018). Thus, the expansion in tobacco production has increased the derived demand for energy sources to facilitate curing. Given that most smallholder farmers rely on natural forests for curing, deforestation and forest degradation have been on the rise in the country (Manyanhaire and Kurangwa, 2014).

Unsustainable harvesting of forests for tobacco curing continues to threaten the country's indigenous and commercial woodlands, which are of economic importance to the country. Alternative tobacco curing techniques such as solar barns, or coal have been suggested but these are expensive in the local context (Manyanhaire and Kurangwa, 2014). Woodlots are typically established by the TIMB, Sustainable Afforestation Association (SAA) and the Forestry Commission of Zimbabwe using statutory instrument 116 of 2016. Through the Forestry Commission of Zimbabwe, farmers are advised to grow exotic tree species characterized by high growth rates and shorter rotation ages so that farmers can exploit them as a way of conserving forests. Under this arrangement, every tobacco farmer is given tree seedlings after selling tobacco.

Currently, evidence shows that a low proportion of smallholder farmers have integrated woodlots on their farms (TIMB, 2018). Adoption literature indicates that various factors such as age, education, gender, access to extension, household income, livestock assets, farm implements assets, and farm size are important determinants in the long-term use of agricultural technology (Rogers, 1995 and; Adesina *et al*., 2000). Extant literature on adoption further suggests that various theories can be used to understand the adoption of agricultural innovations, Adesina *et al*. (2000). Given that few analyzes have been carried out in Motoko district, this study assesses those socio-economic and institutional determinants of tobacco woodlot adoption on smallholder farms.

In the past 20 years, the environmental footprint created by tobacco production has been enormous (Sacchetto, 2012). Through Statutory Instrument 116, the government-mandated the Forestry Commission of Zimbabwe and TIMB to promote the establishment of woodlots on smallholder farms. However, most smallholder farmers are not willing to adopt such innovations. Instead, they continually extract and depend on the dwindling indigenous natural forests. Not only does this process led to deforestation, but is likely to affect the long-term contribution of tobacco to Zimbabwe's economy. This study seeks to establish the factors that drive the adoption and integration of woodlots among smallholder tobacco farmers in Mutoko district, which has been experiencing lags in the reforestation efforts for curing purposes. Whilst adoption literature has observed that socio-economic, institutional, and political factors are critical in technology adoption, there is a need to evaluate context-specific factors that are unique to Mutoko district, which can be suggested to reduce the rate of deforestation. The major objectives of the study were as follows, to determine farmer's perceptions of woodlots as a source of energy for tobacco curing, secondly to determine if smallholder tobacco farmer's awareness of the statutory requirement to plant woodlots on their farms, thirdly to assess challenges that hinder the successful integration of woodlots on smallholder tobacco farms and finally to articulate socioeconomic factors that influence the adoption of woodlots. We have tested the hypothesis that the farmers have a positive perception of woodlots as a source of energy for tobacco curing. We also tested the hypothesis that smallholder tobacco farmers are aware of the statutory requirement to plant woodlots on their farms. After ranking challenges, water and mortality rates hinders the successful integration of woodlots and farm implements index, livestock assets index, family size and finally tobacco returns were socioeconomic factors that influence the adoption of woodlots.

Methodology

Study Area. Mutoko district is located in the southern part of Mashonaland East Province of Zimbabwe in natural farming region III. Mutoko district has a subtropical and predominantly dry climate with cool winter and hot rainy summers (Mutoko District Annual Report, 2018). The

mean annual rainfall ranges from about 700mm in the south to about 650mm in the north and south. The mean annual temperature ranges from 20 degrees Celsius to 22.5 degrees north. The mean monthly temperature is 14.5 degrees Celsius in July increasing to 22.3 degrees Celsius in October and most communal land is frost-free. Mutoko soils are also characterized by moderately shallow to deep, brown coarse-grained sands and loamy sands soils which have a medium water holding capacity. Due to the above condition, the production of tobacco is favorable. In the past, most smallholder farmers grew cotton as a cash crop. However, there has been a transition from cotton to tobacco production.

Sampling Procedure. The target population for this study is smallholder tobacco producers located in Mutoko district. Multistage sampling was adopted to aid in data collection. Theoretically, a multi-stage sample involves sequentially selection across two or more hierarchical levels (Lavrakas, 2008). Mutoko district was purposively selected because tobacco production is a major activity for smallholder farmers. From the District level, two wards were purposively selected based on the level of tobacco production and efforts made to introduce woodlots. Consequently, wards 28 and 29 were purposively selected using the same criteria. Five villages were purposively selected from each ward resulting in three (3) being selected in ward 29 while 2 villages were selected in ward 28. Proportionate allocation sampling was then used to divide the sample size by the number of tobacco farmers in each ward. To determine the desired sample size (n) from the total population (N), the following formulae were used:

$S = X^2NP (1-P)/d^2 (N-1) + X^2P (1-P)$ to collect data farmers are going to be visited to their farms.

Where: s is the sample size, N is the population size, p is the probability level,
1. Sample Size Calculation:
    Sample Size = (Distribution of 50%) / (Margin of Error% / Confidence Level Score) Squared)
2. Finite Population Correction:
    True Sample = (Sample Size X Population) / (Sample Size + Population – 1)
3. A total of 100 farmers were selected. These were selected using a list of names obtained from the extension officers.

Data collection instruments. A combination of data collection tools namely a structured questionnaire, key informants, observation was used. Structured interviews were conducted through the use of a structured questionnaire administered to sampled households. Key informants are people who have a good level of knowledge about a particular aspect of community life and development or have a range of links to people outside the community.

Results and Discussions

Farmer's perceptions of woodlots as a source of energy for tobacco curing. Findings suggested that the model was significant at 1% level. Above 50% percent of the farmers had a positive perception on the use of woodlots since the mean of the sample was 99% of the farmers. In connection with this result, Debre and Agitew (2018), found that farmers had a positive perception regarding the use of woodlots. These results have also been corroborated by findings from Ethiopia (Zenebe *et al*., 2007; Jenbere *et al*., 2012; Setiye and Mulatu, 2016). The positive perception may be related to the observation that farmers have limited alternatives to cure their crops and the decline in natural forest cover.

Smallholder tobacco farmer's awareness of the statutory requirement to plant woodlots on their farms. Farmers were generally aware of the regulation stipulating the need to establish woodlots on their farms (p < 0.01). While farmer awareness of the regulation is important, it should be considered as an initial step in the eventual adoption of the innovation. In 2005, the Forestry Commission of Zimbabwe developed the Tobacco Wood Energy Programme (TWEP) in 2005 that encouraged farmers to own a woodlot of Eucalyptus for tobacco curing (Forestry Commission, 2006). Under TWEP, tobacco growers were supplied with packs of Eucalyptus seeds at the auction floors for planting (TIMB, 2014). Knowledge of TWEP did not seem to affect their adoption decision given that forest cover declined by an average of 300,000 hectares per year in Zimbabwe.

Assessment of the challenges that hinders the successful integration of woodlots on smallholder tobacco farms. The t-test statistic of Friedman test was significant at 1% and p < 0.001. This implies that farmers rated challenges differently as they relate to woodlot establishment. High mortality rates and access to water were the most important factors that limited the establishment of woodlots among smallholder farmers. This is because water is critical at the initial phase of woodlot growth. Thus, infrastructure such as boreholes or dams is important. High mortality rates could be experienced in the winter season as the crop suffers frost damage due to low temperatures of below 0*C. Furthermore, during August, September and October, most of the woodlot's wilt because of the dryness of the soil. Access to seedlings is a limiting factor followed by pests and diseases. Earlier studies (Clarke, 1995) found out that most areas in Zimbabwe are subdued to very high temperatures. Therefore, water becomes a very important issue during woodlot establishment. In the drier areas, where soils are dry there is a concern over water availability and vulnerability to termites, and survival rates appear to be low. Studies have also shown that the rural afforestation Programme has not been very effective because of a lack of water (Grundy *et al*., 1993).

Table 1. Farmers' perception on the use of woodlots

One sample test					95% confidence interval	
	t	df	Significance	Mean diff	Lower	Upper
Positive percept	49.00	99	.000	.49000	.4702	.5098

Table 2. Awareness of the statutory instrument (116)

One sample t-test					95% confidence interval	
	t	df	significance	Mean difference	Lower	Upper
conservation regulations awareness	7.462	99	0.000	.300	.22	.38

Table 3. The t-statistics table

N	Chi-square	df	Asymp significance
100	345.8	4	0.000

FRIEDMEN RANKS

Table 4. Friedman ranks of challenges (non-parametric test)

Challenges	Mean rank
Does high mortality rates affect woodlots establishment	1.56
Does access to water affect woodlot establishment	1.56
Does access to seedlings affect woodlot establishment	3.84
Do pests and diseases affect woodlot establishment	3.96
Does lack of interest affect woodlot establishment	4.08

Socioeconomic factors that influence the adoption of woodlots. Results of the binary probit regression model showing factors affecting the adoption of woodlots are shown in Table 4. About 55% of the farmers had adopted woodlots on their farms. Adoption of the innovation was significantly affected by farm implements index, livestock assets index, family size and finally tobacco returns. The p-value for the livestock assets index was 0.004 which means livestock assets were significant at 1%. There was a positive relationship between the adoption of woodlots and the number of livestock assets owned by a farmer. If the index increases by 1 unit, the odds of adopting woodlots increase by 18%. This is because livestock contributes much in terms of manure for soil fertility, transportation of water for seedlings. Whereas the farm implements index was significant, it has a negative relationship with adoption. If the index increased by 1 unit, the odds of adopting woodlots reduced by 4%. This result seems to be inconsistent with expectations. However, observations from the field showed that mechanized smallholder farmers were hiring out their equipment for the exchange of wood with those who were not mechanized. The positive correlation between the farm implements and the choice to grow woodlots has also been found by several studies in Ethiopia (Bewket *et al.,* 2003; Ashfaq *et al.,* 2009). Under conditions of small farms, farmers do not grow woodlots; their choices are understandable because many households intensify agricultural production on small farms to feed their families (Bewket *et al.,* 2003). There was a positive relationship between the adoption of woodlots and family size. As the family size increased by one person, the odds of adoption increased by 10%, ceteris paribus. This may be linked to the need for transplanting, planting, management practices like pruning, pest and disease monitoring, and finally, the need for human labor on watering of timber until it develops permanent taproot. Tobacco returns were positively related to the odds of adopting woodlots. In this respect, a 1-unit change in the tobacco returns was associated with a 1% increase in the adoption of woodlots. Tobacco income plays a crucial role in the adoption of woodlots since money is required for ploughing, disking, payment of labor, buying chemicals such as termites' killer and knapsack sprayers (Brokensha and Riley, 1987).

Table 4. Socioeconomic factors

Variable	Coeff	Stnrd Error	Marginal Efects	P>|Z|
Age1	-0.05	0.32	-0.02	0.867
Education	-0.67	0.45	-0.26	0.111
Training status	-0.27	0.31	-0.11	0.385
Farming implements index	-0.10	0.05	-0.04	0.021
Livestock assets index	0.47	0.17	0.18	0.004
Family size	0.26	0.10	0.10	0.009
Regulation's awareness	-0.37	0.37	-0.14	0.333
Gender	0.23	0.36	-0.09	0.527
Farm size	-0.01	0.02	-0.00	0.525
Tobacco returns	0.00017	0.10	0.00	0.007

Dy/dx is the discrete change of dummy variables from 0 to 1

Conclusions

The main objective of the study was to assess the factors that affect the adoption of woodlots among smallholder tobacco producers in Mutoko district. The findings revealed that farmers had a positive perception towards integration in farming systems. They were also generally aware of the environmental regulations, particularly the SI 116 of 2016. The main sources of information were TIMB, AGRITEX and EMA. However, they felt that lack of access to water, pests and diseases as well as plant mortality was negatively affecting the use of woodlots on farms. Furthermore, income, household size and livestock ownership increased the likelihoods of adoption. There is need for follow-up to farmers after they received seeds or seedlings from TIMB and TRB (chemicals, boreholes, fencing). Create economic incentives to encourage farmers who have not adopted such an innovation for example tax reduction/holidays for adopters of woodlots. There is need for an integrative farmer contract which may tie the new loan or support to farmers' ability to demonstrate that they would have established woodlots in the previous season (young stands).

Acknowledgement

References

Adesina, A.A., Mbila, D., Nkamleu, G.B. and Endamana, D. 2000. Econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of southwest Cameroon.

Agriculture, Ecosystems and Environment 80: 255-265.

Ashfaq, M., Hassan S., Naseer Z.M., Baig A., and Asma, J., 2009. Factors affecting farm diversification in rice-wheat. *Pakistan Journal of Agricultural Sciences* 45 (3): 45-47.

Bewket, W. 2003. Household-level tree planting and its implications for environmental management in the northwestern highlands of Ethiopia: a case study in the Chemoga Watershed, Blue Nile basin. *Land Degradation and Development* 14 (4): 377–38.

Brokensha, D., and Riley, B., 1987. Privatization of land and tree planting in Mbeere, Kenya. pp. 193-199. In: Raintree, J.B. (Ed.) Land, Trees and Tenure. Nairobi and Madison: ICRAF and the Land Tenure Center.

Jenbee, D., Lemenih, M., and Kassa, H. 2012. Eucalyptus Woodlot production for smallholder farmers' livelihood in Wogera District in North Gondar Zone of Amhara National Regional State, Ethiopia. Published work.

Clarke, J.M. 1995. Building on indigenous natural resource management: forestry practices in Zimbabwe's communal lands. Zimbabwe Forestry Commission, Harare.

Derbe, T., Yehuala, S. and Agitew, G. 2018. Factors influencing smallholder farmers' adoption of eucalyptus woodlot in Wogera District, North Gondar Zone, Amhara Regional State of Ethiopia. *International Journal of Scientific Research and Management* 6 (07): 566–574. https://doi.org/10.18535/ijsrm/v6i7.em07.

Forestry Commission, 2006. Annual Report. Harare: Sable Press.

Grundy, I.M., Campbell, B.M., Balebereho, S., Cunliffe, R., Tafangenyasha, C., Fergusson, R. and Parry, D., 1993. Availability and use of trees in Mutanda Resettlement Area, Zimbabwe. *Forest Ecology References and Management* 56 (1-4) 243-266.