6632
Research Article
Journal of Extension Education
Vol. 33 No.3, 2021
DOI: https://doi.org/10.26725/JEE.2021.3.33.6632-6646

Determinants Affecting the Adoption of Silvopastoral Production among Smallholder Farmers in Zimbabwe

C.T. Gadzirayi, J. Chimvuramahwe and A. Nhundu

ABSTRACT

The main goals of silvopastoral production are to increase the quality and production of fodder and promote the conservation of soil and biodiversity. Despite its achievements as an approach, it has not been fully practiced by small holder farmers. The study sought to determine the factors influencing the adoption of silvopastoral production in Chikwaka communal area in Goromonzi district of Zimbabwe. Simple random sampling technique was used involving sixty-six respondents. Factors that affect adoption were estimated by binary logistic regression model. Variables that significantly affected the adoption of silvopastoral were land size, number of cattle owned as well as household size. The results revealed that uptake level of silvopastoral is still low . Therefore, the continuous effort to improve livestock herd under smallholder farmers through silvopastoral, should be taken as a priority to encourage more farmers to adopt the system.

Keywords: *Silvopastoral; Adoption; Uptake level ; Farmer; Zimbabwe*

INTRODUCTION

Agroforestry is an integrated land use system that combines elements of agriculture (agro) and trees (forestry) in a sustainable production system (Briggs, 2010). With an emphasis on managing rather than reducing complexity it promotes functional bio-diverse systems that balance productivity with environmental enhancement and protection. Agroforestry systems are classified as agrosilviculture (trees and crops) or silvopastoral (trees and animals). Systems can combine production of a wide range of products including food, fuel, fodder and forage, fiber, timber gums and resins, medicinal products, recreation and ecological services. Tree species can be timber, fruit, nut, coppice or a combination, and the alleys in between tree rows can produce cereals, vegetables, fruit, forage and animals. Careful selection of crop components is required in relation to market outlets, local climate, soil, alley spacing, tree height, timing of planting and harvesting, tree leaf production and shading.

Faculty of Agriculture and Environmental Science, Department of Agricultural Economics, Education and Extension, Bindura University of Science Education, Zimbabwe

Received: 24-09-2021; **Accepted:** 13-08-2022

With both ecological and economic interactions between trees and crops and livestock, the total productivity within these systems is usually higher than in monoculture systems due to complementation in resource capture. This study focused mainly on silvopastoral (trees and livestock) in Goromonzi district of Zimbabwe.

Livestock are key components of African farming systems and are increasingly viewed as important pathways for rural households to escape poverty (Mandleni, 2011). Low quality and quantity of feeds are a major constraint limiting livestock productivity among smallholder farmers due to climate change. African farmers have fed tree foliage to their livestock for centuries, using wild browse or trees that grow naturally on their farms. New agroforestry systems for feeding livestock have emerged over the last three decades, involving the planting of mostly exotic species, grown most frequently in hedges along field boundaries or along the contours to limit soil erosion. Trials and demonstration farms were established in some rural communities of Zimbabwe such as Muzarabani, Mutoko, Mt Darwin, Sadziwa in Manicaland, and Masvingo in a bid to test and promote agroforestry adoption (Mutambara et al, 2012). The problem is that despite the benefits of agroforestry to smallholder farmers, there has been low and uneven adoption rate of agroforestry in Zimbabwe's smallholder areas.

Several studies that have been carried out in the wards particularly on silvopastoral system involving fodder production have shown the trend of farmers adopting agroforestry technologies, benefits of agroforestry as well as implication of silvopastoral system on livelihood of smallholder livestock farmers. However, little information is known about the factors that influence the farmers' decision whether to venture in silvopastoral production or not. This implies that the literature shows glaring gaps that demand urgent attention especially on the determinants which affect the adoption of silvopastoral practices. It is therefore important to understand the reasons behind this so as to influence policy makers on the allocation of scarce resources to facilitate improvement in adoption of agroforestry technologies among rural communities.

Given the profitability of agroforestry technologies (Ajayi et al, 2008) and the impact that they have on households, livestock and the environment Kwesiga et al., 2003), efforts are being made to scale up the adoption of the silvopastoral systems and enhance its acceptability among many more potential farmers who could benefit from the system. Results of studies conducted in the southern African region show that farmers do appreciate

agroforestry and its potential linkage to food security, livestock improvement and household welfare indicators, but they face some challenges to the widespread uptake of agroforestry including land constraints, property rights, availability of seeds, and knowledge-intensive nature of the systems.

A synthesis of the studies on the adoption of agroforestry in Zambia (Ajayi et al, 2008) revealed that the adoption of agroforestry is not a direct relationship based on the technological advantages of an agroforestry practice alone, but is influenced by several factors. The broad category of the factors are technology-specific (e.g. soil type, management regime), household-specific factors (e.g. farmer perceptions, re-source endowment, household size), policy and institutions context within which agroforestry technologies is disseminated (input and output prices, land tenure and property rights), and geo-spatial such as tree species performance across bio-physical conditions, location of village (Ajayi et al, 2008). This study, therefore sought to establish the variation of factors affecting adoption of silvopastoral system in Goromonzi of Mashonaland East Province in Zimbabwe.

Problem statement

Livestock rearing, cattle, dairy and goats, is quite common and fodder trees for supplementing livestock food during the dry season are very important. During the rainy season, these animals are tethered and their movements restricted. During the dry season, however the animals are left to graze on free range. This is the time when the grass is scarce and therefore supplementary feeding becomes necessary. There is then great need to encourage the establishment of fodder plots to help meet fodder demands throughout the year and to maintain reserves during dry periods. These systems can also help to maintain the stability and fertility of grazing lands. Bought – in commercial supplements to feed animals are so expensive to most rural farmers. In addition, some of the feed ingredients are no longer available on the market. Development of the livestock feeding systems that integrate tree fodder is a promising alternative to sustainable supplementation during lean period, but despite the well documented advantages, adoption is still low.

Objectives

The main objective of this study was to establish the determinants on the adoption of silvopastoral system by communal farmers in Chikwaka area of Goromonzi district in Zimbabwe.

Specific objectives

The specific objectives of this study were to:

- Identify socio-economic factors that influence smallholder farmers to adopt silvopastoral production system.

agroforestry and its potential linkage to food security, livestock improvement and household welfare indicators, but they face some challenges to the widespread uptake of agroforestry including land constraints, property rights, availability of seeds, and knowledge-intensive nature of the systems.

A synthesis of the studies on the adoption of agroforestry in Zambia (Ajayi et al, 2008) revealed that the adoption of agroforestry is not a direct relationship based on the technological advantages of an agroforestry practice alone, but is influenced by several factors. The broad category of the factors are technology-specific (e.g. soil type, management regime), household-specific factors (e.g. farmer perceptions, re-source endowment, household size), policy and institutions context within which agroforestry technologies is disseminated (input and output prices, land tenure and property rights), and geo-spatial such as tree species performance across bio-physical conditions, location of village (Ajayi et al, 2008). This study, therefore sought to establish the variation of factors affecting adoption of silvopastoral system in Goromonzi of Mashonaland East Province in Zimbabwe.

Problem statement

Livestock rearing, cattle, dairy and goats, is quite common and fodder trees for supplementing livestock food during the dry season are very important. During the rainy season, these animals are tethered and their movements restricted. During the dry season, however the animals are left to graze on free range. This is the time when the grass is scarce and therefore supplementary feeding becomes necessary. There is then great need to encourage the establishment of fodder plots to help meet fodder demands throughout the year and to maintain reserves during dry periods. These systems can also help to maintain the stability and fertility of grazing lands. Bought – in commercial supplements to feed animals are so expensive to most rural farmers. In addition, some of the feed ingredients are no longer available on the market. Development of the livestock feeding systems that integrate tree fodder is a promising alternative to sustainable supplementation during lean period, but despite the well documented advantages, adoption is still low.

Objectives

The main objective of this study was to establish the determinants on the adoption of silvopastoral system by communal farmers in Chikwaka area of Goromonzi district in Zimbabwe.

Specific objectives

The specific objectives of this study were to

- Identify socio-economic factors that influence smallholder farmers to adopt silvopastoral production

Data collection

A structured questionnaire was used to collect data; the questionnaire contained information on general socioeconomic characteristics, agricultural practices related to silvopastoral, factors affecting silvopastoral in the community and economic status of farmers. The local language "Shona" was used to conduct interviews and the responses were recorded and translated into English. The study considered various silvopastoral systems that include fodder trees (*Leucaena*, *Cajanas Cajan*, *and Sesbania sesban* and fruit trees), live fences and scattered trees in pastureland. A farmer was considered an adopter if he/she was practicing at least one of these systems and non-adopters, if not into any silvopastoral system.

The primary data that was used in this study was collected through household interviews. The questionnaires were administered to a total of 66 households comprising of two categories of farmers namely silvopastoral adopters, and non-adopters for the purpose of collecting both quantitative and qualitative data. The main aim of undertaking the survey was to solicit smallholder communal farmer perspectives on silvopastoral production and its sustainability. In addition, the survey sought to identify socio-economic factors that affect the adoption of silvopastoral system in the smallholder farming sector.

In addition to the primary data collection activities described above, secondary data from previously published studies and tabular datasets as well data from Forest Commission (file records) was collected on the general socioeconomic characteristics of the district.

Analytical tools

Descriptive statistics

All quantitative data was captured using SPSS 16 and summarized using descriptive statistics. The descriptive statistics were used to start the discussion on the research hypotheses. Frequency tables were used to analyze the demographic characteristics of farmers who adopted silvopastoral, and those farmers who never adopted the system. In addition, reasons for adopting or rejecting silvopastoral, land size and household size status were analyzed using frequency tables.

The Logistic Binary Regression Model

The logistic regression model was used to determine the variables affecting the likelihood of a household to adopt the silvopastoral system. This model was also used to assess the factors affecting the likelihood of a household to continue silvopastoral or reject the silvopastoral system. The logistic binary regression model was used to test the hypotheses that socioeconomic factors influence

smallholder farmers to adopt silvopastoral and continue or discontinue the agroforestry system. The logit model was selected because there are no conditions to be met by data collected for analysis and the tool is easy interpret. Logistic binary model was first carried out to analyze the factors that are significant in determining who practiced silvopastoral system or not.

The model used is represented by the equation:

$$\mathbf{Ln\{P_i/1\text{-}P_i\} = \beta_0 + \sum_{j=1}^{n} \beta\, jXij + vi}$$

The dependent variable is binary. In this specification, the dependent variable carries 1 if the household is an adopter and 0 = non adopter (adopter = 1, otherwise = 0).

$$Y^{*} = \mathbf{ln}\left(\mathbf{P_i/1\text{-}P_i}\right) = \beta_0 + \beta_1 CATTLE + \beta_2 EDUCLVL + \beta_3 MARSTATUS + \beta_4 HHSIZE + \beta_5 LANDSIZE + \beta_6 OCCUPATION + e$$

Where, β_0 is the intercept term, β_1 **to** β_9 are unknown parameters to be estimated and **Y*** is the adoption.**vi** is the error term, **βj** is the coefficient for the **jth** explanatory variable **Xj, Pi** is the probability of household who adopted silvopastoral.

A number of goodness of fit models can be applied to test significance of the logistic regression model. In the model three measures of goodness of fit were adopted. These were Hosmer Lemshow test, Cox and Snell‟s R-Square, Nagelkerke‟s R-square.

Independent Variables and their Relationship to the Dependent Variables

Symbol	Variable Description	Relationship with Dependent Variable 1, Agroadopter	Relationship with Dependent Variable 2, Agroadopter Continued
Cattle	Cattle owned	Households with more cattle are more likely to adopt silvopastoral	Households with more cattle are more likely to continue silvopastoral
Land size	Land size	Households with more land size are more likely to practice silvopastoral compared to their counterparts	Households with more land size are more likely to continue silvopastoral

Marital status	Marital status	Households headed by widows and divorced are less likely to practice agro forestry since the system is claimed to be labor intensive	Households headed by widows and divorced are less likely to continue silvopastoral since the system is claimed to be labor intensive
Educlevel	Education level	Households headed by heads that have spent more years in school are less likely to practice silvopastoral	Households headed by heads that have spent more years in school are less likely to continue silvopastoral
Hhsize	Household size	Households with more people involved in agricultural activities are more likely to practice silvopastoral	Households with more people involved in agricultural activities are more likely to continue silvopastoral
Occupation	Occupation	Formally employed households are more likely not to practice silvopastoral	Formally employed households are more likely to discontinue silvopastoral

FINDINGS AND DISCUSSION

Characteristics of silvopastoral system adopters and non-adopters

The characteristics of silvopastoral system adopters and non-adopters are presented in Table 1.

Silvopastoral Production

Reasons for Adopting and Rejecting the Silvopastoral Production

Results in the table disclose that most households who continued silvopastoral system are doing so mainly because it is a good and sustainable farming method as revealed by a high proportion of households (43.4%). Nonetheless there are some (39.1%) doing so simply because they are earning good yields from the silvopastoral system. The remaining figure of farmers identified that the system mitigates against climate change as trees provide shade, firewood as well as stabilizing soil erosion.

Table 1: Demographic Structure of Households

Gender of household head		Overall	Silvopastoral system status (SP)		
		% of total households	% of households never practice SP	% of households continued SP	% of households discontinue SP
Sex of household head	male	69.7%	78.9%	50%	70%
	female	30.3%	21.1%	50%	30%
Marital status of Household head	Married	71.2	78.9	50	80
	Not married	28.8	21.1	50	20
Education level of household	Primary	25.8	23.7	27.8	30
	Secondary	54.5	47.4	66.7	60
	Tertiary	19.7	29.9	5.5	10
Livestock ownership	cattle	100	100	100	100
	goats	87.9	53.4	24.1	17.2
Land size	Average land size	3.4	2.9	4.6	3.8

Table 2: Reasons for continuing and discontinuing Silvopastoral System

Sl.No.	Reasons for continuing SP	Proportion of household %	Reasons for discontinuing SP	Proportion of household %
1	Still receiving support from NGO	0	No longer receiving support	30
2	Good farming method	43.4	No benefits	15
3	Good yields	39.1	Labor intensive	50
4	Other	17.5	Other	5

The most important reason is that silvopastoral production is labor intensive (50%). This suggests that farmers should move from the cut and carry method to in-situ method of providing fodder to animals in a bid to lessen labor demands associated with harvesting of fodder. Secondly, some farmers who withdrawn silvopastoral system, did so because they are no longer receiving inputs from both government and NGOs (30%). While other farmers mentioned that there are no benefits one can derive from silvopastoral system, others highlighted that tree take time to mature. However, tree species that takes very short period of time to mature like calliandra, where fodder can be harvested within the period of 12 months, claims to sort out the problem. Additionally, to the reason given above for continuing/rejecting silvopastoral, households were further asked. The table below shows farmers" opinion for continuing silvopastoral.

Table 3: Farmers Opinion for Continuing Silvopastoral System

Reason for continuing SP	Proportion of households %
Conserves moisture, water, soil	4.7
Mitigate against climate change	14.3
Economically viable	31
High and stable yield	50

According to farmers' judgment, the central reason for continuing silvopastoral system is that of getting high and stable yield as revealed by 50% of farmers that continued silvopastoral system. Apart from that, economic viability, mitigating against climate change as well as soil, water and moisture conservation are some of the

details for continuing silvopastoral system as shown by small magnitudes of farmers. It is inspiring to note that most households that continued silvopastoral system appreciates that silvopastoral system allows farmers to realize high and stable yields (50%). A greater percentage, 83 % revealed that most farmers discontinue because they perceived the system as laborious. According to these farmers the practice requires the farmer to invest a lot of labor in cut and carry of fodder. The farmers suggested that for silvopastoral production to succeed there is need for rigorous trainings of fodder banks, pastures and live fences, and continuous support from extension as well as awareness campaigns on how silvopastoral farming mitigates against climate change. Thus, without these, it will be difficult to sustain silvopastoral production and consequently its cherished goals will not be realized.

Another group of farmers suggested that policy frameworks that support the silvopastoral system should not be ignored to up scale the uptake level of this agroforestry system. The policy should be in a position to guide the adopters towards achieving certain targeted millennium development goals which benefit the society, for example achieving food security through relying on agroforestry systems that mitigate against climate change, thus enhancing farmers to survive despite the socioeconomic and environmental challenges posed by climate change.

Factors Affecting Adoption of Silvopastoral system

Outcomes for the logistic regression on silvopastoral system are shown in Table 4.

Table 4: Silvopastoral System Adoption Logistic Regression

Sl.No.	Variables	B	S.E.	Wald	Sig.	Exp(B)
1	Household size	1.642	0.771	4.532	0.033	5.164
2	Land size	2.049	0.841	5.938	0.015	7.762
3	Livestock ownership	2.024	0.943	4.602	0.032	7.569
4	Male	1.321	2.047	0.416	0.519	3.747
5	Formal	2.902	4.409	0.433	0.510	.055
6	Married	-1.612	2.475	0.424	0.515	.199
7	Widow	1.260	4.138	0.093	0.761	3.525
8	Secondary	.327	4.208	0.006	0.938	1.387
9	Primary	-.539	4.909	0.012	0.912	.583
	Constant	-26.211	10.019	6.843	0.009	.000

From Table 4, number of cattle owned, household land size and household size significantly affect adoption of silvopastoral system. On the other hand, gender, occupation, marital status and education level do not significantly affect adoption of silvopastoral system.

Number of Cattle Owned

The variable number of cattle owned is significant at 5%. The coefficient of the variable which is positive indicates that households with more cattle have higher probability of adopting silvopastoral system than households with less cattle. The value of exp (B) is 7.569. This means that a unit increase in the number of cattle owned increases the odds of that household to adopt silvopastoral system. In other words, households with more cattle are more likely to adopt silvopastoral system than those with less or no cattle.

Household Size

The variable household size is significant at 5%. The coefficient of the variable is positive. This means that households with larger household size are likely to adopt silvopastoral system than households with less labor. The value of exp (B) is 5.164 implies that a unit increase in the household size increases the odds of the household to adopt silvopastoral system. More household members who are actively involved in agricultural activities means more labor under silvopastoral system especially under the cash and carry method of collecting fodder which is labor intensive.

Land Size

The variable land size is significant at 5%. The coefficient of the variable is positive. This means that households with larger land sizes are more likely to adopt and continue silvopastoral system than households with smaller land sizes. The value of exp (B) is 7.762 implies that a unit increase in the land size increases the odds of the household to adopt silvopastoral system.

Socioeconomic Attributes

The results exposed that number of cattle owned, household land size and household size significantly affect adoption of silvopastoral system. On the other hand, gender, occupation, marital status and education level do not significantly affect adoption of silvopastoral system.

Outcomes revealed that households with more cattle are more likely to adopt silvopastoral system than those with less or no cattle. Apart from that, households with larger land sizes are more likely to adopt and continue silvopastoral system than households with smaller land sizes. Land size had a positive influence on adoption of agroforestry practices. As the land size increases, the model advocates that adoption of agroforestry technologies also increases. This could be because farmers with extra land are likely to use it for experimenting new technologies. The findings of this study concur with the results of studies conducted in the southern

African region by Kwesiga et al., (2003) that revealed that farmers do appreciate agroforestry and its potential linkage to food security, livestock improvement and household welfare indicators, but they face some challenges to the widespread uptake of agroforestry including land constraints.

The results showed that households with larger household size are likely to adopt silvopastoral system than households with less labor. Throughout the household interviews and focus group discussions farmers expressed concern on various activities connected with silvopastoral production chiefly on fodder bank establishment, collection and tree fodder management. This is because more household members who are actively involved in agricultural activities means more labor under silvopastoral system especially under the cut and carry method of collecting fodder which is labor intensive, hence empowering households who have larger household size to adopt the perceived laborious agroforestry system. Similar findings also noted that families with larger household sizes are more likely to adopt agroforestry system (Muchinapaya, 2012).

It came out clear that gender, occupation, marital status as well as education level insignificantly affects adoption of silvopastoral system. This concurs with the findings of Ajayi et al., (2008) who found out that farmer's level of education was not a significant determinant of adoption of technology. However, this differs to the findings of Mutambara et al., (2012) who found out that the number of years in education had a positive influence in adoption of agroforestry practices, and this denotes that the more educated the head of household, the more the probability that the household will adopt. This suggests that adoption of certain innovations depends with the type of innovation under implementation, for example agroforestry entails use of indigenous knowledge systems where almost if not all Zimbabwean citizens do appreciate the benefits of trees, to include source of fuel wood and shade as well as cooling the surrounding environment. In Zimbabwe, each and every year, there is a tree planting day, this enhances awareness on how trees play a significant role in our lives. All these advocates use of indigenous knowledge systems which are different from other innovations like use of Information and Communication Technology which demands scientific knowledge. This implies that each and every Zimbabwean citizen do appreciate the positive interactions between trees and livestock despite gender differences, type of occupation, whether one is married or not, as well as the level of education attained, so despite the variations in level of education attained, the factors mentioned above insignificantly affect adoption of silvopastoral systems due to indigenous knowledge systems used by farmers.

Differences in Socioeconomic Attributes

As far as gender is concerned, the results revealed that 69.7% of the households are headed by males whilst 30.3% are headed by females. When the data was disaggregated by silvopastoral status, the same picture still persists with most households being predominantly headed by males. This depiction resonates so well with what is found in rural areas of Zimbabwe whereby headship of the household is bestowed to males by traditional laws or religious beliefs (Muchinapaya, 2012).

It arose out clear that, households who never adopted silvopastoral system is 52.4 years, and for those who continued with silvopastoral is 40.6 years whereas the households that discontinued silvopastoral is 40.2 years. However, this tallies with the concept that silvopastoral system is relatively labor intensive in terms of cutting and carrying fodder for livestock and hence the practice is employed by active and middle-aged farmers in the communal areas of Zimbabwe.

When equating the average number of household members who never adopted silvopastoral system to those who adopted the farming system, households that never adopted silvopastoral have less members (5 people) than households that adopted silvopastoral (6 people). This portrait resonates well with the assertion that silvopastoral farming practices (fodder collection) is labor intensive and henceforth it's undertaken by households that have more people involved in agricultural activities, which is in line with the findings done by Thangata (2003) who found that farmers went on to modify a familiarized agroforestry technology in Zomba, Malawi in response to low labor availability.

The results disclosed that the average land size of household members who never adopted the silvopastoral system against those who adopted the farming system, households that never adopted silvopastoral have smaller land size (2.9 hectares) than households that continued silvopastoral (4.6 hectares). This print resonates well with the assertion that silvopastoral farming demands more land size for pastures and fodder bank to sustain livestock with abundant supplements and henceforward it's undertaken by households that have larger land sizes (Muchinapaya, 2012). The results harmonize with related literature done by Ajayi (2008) in Zambia who found that land size has a constructive effect on adoption because farmers with more cultivatable land are more likely to set aside a piece of land for fodder trees without impacting much negatively on land available to grow food crops or disturbing household food security.

From the preceding analysis it can be briefed that there are differences and similarities in terms of gender, age,

household size and land size between households that never adopted silvopastoral system, continued silvopastoral and those that discontinued the agroforestry system.

Uptake level of Silvopastoral

It came out clear that adoption level of silvopastoral system is still low as revealed by 42% of households that adopted the agroforestry system. This agrees with the findings done by Mwase et al., (2015), who found that adoption of agroforestry practices is still low in Southern Africa. Low adoption due to land constraints, household size and cattle ownership implies that extension agents are of chief importance in changing the mindset of farmers towards adopting silvopastroral systems.

CONCLUSION

The conclusion to adopt silvopastoral system or not is mainly strong-minded by the number of cattle owned, household size and land size. It is concluded that silvopastoral production among smallholder farmers can be sustained if there is an increase in number of cattle owned by households. Land constraints reduce the adoption of silvopastoral production by communal farmers. The study established that, the decision to continue/discontinue silvopastoral production is mainly influenced by the education level of the household head, the number of cattle owned, occupation, household size, land size and marital status. The uptake level of silvopastoral system by farmers is still low (42%).

It is important to continue monitoring farmers who have adopted the technology since its inception, in order to ensure intensive support from both government and private stakeholders. In order to promote the adoption of silvopastoral system by the elderly farmers, it is advisable to resort from cut and carry method of collecting fodder to the in-situ method so as to reduce the labor demands. Fast growing tree species like leaucaena that only takes six months to mature should be used as compared to some species like calliandra that takes the whole year. Apart from that, players who are promoting silvopastoral production system like government departments (Forest Commission and AGRITEX), should collaborate with private players and other stakeholders who are promoting livestock production in a bid to improve livestock production as the results revealed that an increase in one unit of cattle results to an increase in adoption of silvopastoral system. Idle land in the community should be distributed to those households that are interested in silvopastoral production as this leads to an increase in adoption of the system. The silvopastoral practices recommended for farmers should be tailor-made to conforming to the prevalent socio-economic conditions of the particular community.

REFERENCES

Ajayi O. C, Akinnifesi F K, Sileshi G, Chekeredza Sebastian & Mgomba S (2008) *Payment for Environmental Services (PES): A Mechanism for Promoting Sustainable Agro forestry Land Use Practices among Smallholder Framers in Southern Africa*. Conference on International Research on Food Security, Natural Resources Management and Rural Development. ICRAF. 3p.

Briggs, D., (2010), 'Researching dangerous populations: Some methodological reflections', Safer Communities, *9* (3): 49–59.

Compendium of Statistics, (2012). Zimbabwe national statistics agency; Harare.

Kwesiga, F. Akinnifesi, & Mafongoya,P. (2003). Agroforestry research and development in southern Africa during the 1990s: review and challenges ahead *Agroforestry Systems 59* pp. 173-186.

Mandleni (2011) Climate Change Awareness and Decision on Adaptation Measures by Livestock Farmers in South Africa: September. *Journal of Agricultural Science 3*(3).

Muchinapaya (2012). *The sustainability of conservation farming in the Smallholder farming sector. A case of guruve communal Area in Zimbabwe*: University of Zimbabwe, Zimbabwe. Munyawiri Ward, Zimbabwe. A report through the Community Based Adaptation in Africa project, funded by IDRC and DFID.

Mutambara, J, Dube I.V & Mvumi B.M. (2012). Agro forestry technologies involving fodder production and implication on livelihood of smallholder livestock farmers in Zimbabwe. A case study of Goromonzi District.: *Livestock Research for Rural Development*, *24* (11).

Mwase, Weston, Abel Sefasi, Joyce Njoloma, Betserai, Nyoka, Daniel Manduwa & Jacinta Nyaika. (2015). Factors Affecting Adoption of Agroforestry and Evergreen Agriculture in Southern Africa: *Environment and Natural Resources Research*, *5*(2)

Thangata (2003). Agroforestry adoption in southern Malawi: The case of mixed intercropping of Gliricidiasepium and maize October 2003, *Agricultural Systems 78*(1):57-71.