

Farmers' Perceptions on Pine Tree Plantations and Food Security in Kigezi Highlands Region of Uganda

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Abstract

This study evaluates peoples' perceptions on pine tree growing and food security by analyzing both questionnaires and group discussion to collect data. From analysis of respondents, the percentage of targeted respondents that actually responded to the questionnaire was 98%. From the preliminary analysis conducted in this study, majority of respondents have the following attributes, 1) diploma level education, 2) are males, 3) aged between 36-45 years, and 4) Had a negative attitude towards pine tree growing. Many aspects have been perceived as the major causes of food insecurity in the Kigezi Highland of Uganda. Perceptions of on-farm pine tree plantations and food security were measured by the rate they attribute to farmers' livelihoods. The attributes measured as variables, that is, population pressure, income disparity, biodiversity loss and ecological imbalance, tree-crop competition, soil and land degradation, gender consideration, tree diseases, labour requirements and food security conflicts. The study applied a mixed research method, where descriptive cross-sectional research design was adopted. Both the qualitative and quantitative approaches were employed. Primary and secondary data sources were used to acquire data to accomplish the study where 384 participants took part in the study. Data was analysed using SPSS where both descriptive and inferential statistics were used to determine the results. The findings of the study indicate that pine tree plantation have got a negative effect on food security in the Kigezi Highlands. Despite having carbon markets and other co-benefits from pine tree adoption, the findings indicate that minority are benefiting from this intervention. The study was to examine the Hypothesis H_{01} Farmers' perceptions of pine tree plantations do not have significant effect on food security in Kigezi Highlands Region. Hence, the null hypothesis of no significant effect of pine tree plantations on food security in Kigezi Highlands Region Uganda is rejected. The evidence of negative effect of farmers' perceptions of pine tree plantations on food security in Kigezi Highlands Region is also in accord with some extant literature. The study recommends the adoption on farm agroforestry where farmers will have co-benefit for food security and improved livelihood, and diversification of enterprises to improve livelihood of communities in the Kigezi Highlands.

Keywords: Pine tree plantations, Food security, Farmers perceptions, Livelihoods, Land resource

Introduction

Private investment has been identified as one of the solutions to global challenges to especially the third world countries in the global south. The African continent is one of the regions strategized for food, agriculture, timber, biofuels, and oil and mining sectors promotion backed by claims that promise strong economic returns and have become significant target for most private investment activities. Most international private sector investments as far as climate change have generated this as a way to have the green economy for African development. This has demonstrated the expansion of investment activities that make claims to environmental benefits and sustainable development, including carbon offset and other mitigation initiatives. Monoculture forestry plantations and carbon trading initiatives were identified to address the investment in economic activities associated with environmental claims. These green initiatives represent market-based responses to climate change that rely upon the implementation of mitigation strategies in the global south to offset industrial and polluting activities in the global north. Green Resources, the largest plantation forestry operator on the African continent. However this competes with the unceasing global institutional strategy global on food security

This Carbon colonization strategy known as the carbon economy has brought in economies inequalities as far as land is concerned. Their impact on communal livelihoods has brought farmers' different perceptions in decision making between food security and pine tree plantation adoption initiatives. This paper therefore evaluates farmer's perceptions on the two concerns that indicate competitive livelihoods for land occupancy. On the basis

of our findings, we conclude by arguing that pine tree plantations demonstrated is connection between carbon economy and the adverse local livelihood impacts associated with the land for food security. As a result, the livelihood impacts on this limited land are relegated to the margins as externalities in the burgeoning global carbon economy. Food security is still a big challenge for any initiatives like pine tree plantation adopting communities.

Background of the study

The current Sustainable Development Goal 17 global strategy addresses international finance flows in green development initiatives as the form and outcome of privatization as global phenomena. According to Mandani, 1987, Uganda has also explored the intervention by in the Uganda having foreign investment in its national strategic plan development and this has been championed and institutionalized via processes and policies at both the international and national levels. A numerous international and trade liberalization and privatization programmes have been adopted, facilitated and integrated under the international level, structural adjustment and trade liberalization programs to create an international and national economy. Wiegratz, 2010, also highlighted the lead to the new state forms of dependency and obligation addressed under the introduction of the 'Economic Recovery Program' in the mid 1980s, for example, aimed to transition Uganda from a peasant to modern industrial economy.

The global bio-economy (green economy) identified the investment in carbon-offset and other projects that frequently links investors from the global north with smallholder and peasant farmers in the global south. There is plenty of hype about bio economic forms of development, including by the World

Economic Forum, (ETC group, 2010) who predict biomass will generate \$300 billion in profits by 2020. In response to such estimates, there is rapidly expanding private sector investment in green bio-economy related development interventions.

The Republic of Uganda's international investment has been supported by a number of other institutional mechanisms, including the Constitution of the Republic of Uganda (1995, and amended 2005) which provides legal policy and infrastructure for private investment, as well as the Uganda Investment Authority and the Uganda Revenue Authority, each established to assist Foreign Investors (Bomuhangi et al., 2012). National commitment to foreign investment for development including investment in green development initiatives was articulated. In Uganda particularly the Kigezi highlands monoculture pine tree plantations have been adopted as the green development initiative under National Forestry Authority (NFA) a government initiative and through private investors. The research question to study is on farmers' perspectives about the effects monoculture pine tree plantations and food security?

The Study Objective is to examine farmer's perceptions on pine tree plantations and food security in the Kigezi highlands

The Kigezi Highlands are facing a food insecurity challenge brought about by land scarcity. Land is scarce in Kigezi which means the monoculture pine plantations have occupied the land that would have been used for food production. There is limited land for agriculture where households have to share the fragmented land and no more fallows for land regeneration which means there is they have low yields due to soil

degradation and land degradation. Population growth and high population densities have resulted in a drastic decrease in farm size and more intensive use of the land. Traditional inheritance protocols practiced in Uganda, and specifically in Kigezi, have contributed greatly to land fragmentation and degradation. Farmers have different perceptions about the adoption of pine tree plantations which have impacted on their livelihoods. Some have decided to shift to other areas, but still land is not enough. Many people have move to urban areas for jobs and they need to be fed upon. The urban workers and the rich all need food where will the food come from the limited land resource and where some of the land has been occupied the pine tree plantations.

Methodology

The data was analyzed using a SPSS where by both descriptive and regression analysis was used. The two analyses were used to respond to the research question (What is the farmers' perception of the effect of pine tree plantations on food security in Kigezi Highlands Region?) This was answered using ordinary least square (OLS) simple regression model. This model was considered appropriate where functional relationship exist between two or more variables (Sekaran and Bougie, 2014). The model for simple regression is specified in accordance with Lucey (1994) and Osuala (2009) thus:

Applying descriptive statistics

Questionnaires were administered to collect views from both the pine and non-pine growers. They were purposely pine tree growers and those who did not plant and their fields are near pine tree plantations. A questionnaire was designed to be answered by the two populations. The questionnaires were structured into four sections. The

section anticipated farmers' perceptions on pine tree growing with food security and food security policy adoption in the Kigezi Highland from the pine tree adopters. The questions tested the overall respondents' views on the concepts of the study. That is the influence of pine tree plantations adoption on the food security. The respondents had a choice of either filling in the questionnaire or granting an interview depending on their preferences. The likert scale of 3 (3=Agree, 2=Neutral, 1=Disagree) was used to measure the respondents views.

Table 1: Descriptive statistics on farmers' perception of pine tree plantation adoption in Kigezi Highlands Region. The table below illustrates the number of respondents who answered the questionnaires plus their respective responsibilities

Communities adopting pine tree plantation findings in addition to farmers' perspectives present different attitudes towards pine tree plantations. It was agreed upon that there is increase in farmer's source of income 225(59.2%), increased production of fuel wood by 246(78.7%): Farmers agreed that Pine plantations can assist in controlling soil erosion 104 (33.3%). Pine tree plantations contribution to proper utilization of the abandoned terraces 138(64.8%) and regenerate soils 135(43.3%). It was agreed upon that pine tree adoption was an institutional support to the community with 118 (37.8%) and lastly farmers agreed that there was more communal collaboration through pine plantation growing 114(36.5%).

However it was discovered that despite all these contributions there is a marginalized population suffering food insecurity and have not seen these attributes and hence food insecurity. Farmers agreed that pine

tree plantations contribute to population pressure 254(81.4%) they occupies land meant for communal livelihood food security, biodiversity loss shows 192 (61.5%). Farmers agreed that there is biodiversity loss because of the disappearance of some of flora and fauna beneath pine plantations; Farmers agreed that there is competition between pine tree and the crops grown 229(73.4%), the competition from other crops and tree species like tea and eucalyptus, and the neighbouring cultivated fields surrounded by pine plantations. The other negative perception from the pine tree planters are fire outbreak 124(58.2%) and pests and disease 156(73.5%) which bring loss to the community.

Validity of research Instruments

Face validity could be described as a superficial assessment of whether the instrument to be used in a study appears to be a **valid measure** of a given **variable or construct**. The study assessed face validity of the instruments using expert opinion. The instrument was validated by four experts: Two experts in measurement and evaluation and my supervisors. The experts in measurement and evaluation as well as my supervisors measured the face validity of the instrument, ensuring that the item/statements addressed the research purposes and questions, as well as the adequacy of the constructs used in the questionnaire. All their criticisms, corrections and suggestions were usefully taken in modifying and designing the instruments for the data collection.

Content validity is the extent to which the elements within a measurement procedure are **relevant and representative** of the construct that they will be used to measure (Haynes, Richard & Kubany, 1995). The Content Validity Index (CVI) was computed

to determine the content validity of the

Variable	Number of items	Alpha
Trend and magnitude	06	0.9356
Farmers perspectives	12	0.7242
Policy structures and frameworks	11	0.7044
Food security policy challenges	08	0.8423
Food security status	10	0.7700
Average	65	0.7953

instrument in this study. Amin (2005) noted that the overall CVI for the instrument should be calculated by computing the average of the instrument and for the instrument to be accepted as valid the average index should be 0.70 or above. The CVI was computed in equation below

The CVI = $\frac{\text{Number of items rated relevant by all judges}}{\text{Total number of items in the instrument}}$

$$CVI = \frac{54}{65} = 0.831$$

Notice from equation 3.2 that the CVI is greater than 0.70. Hence, the instrument was considered valid.

Reliability of the research Instruments

Data collected from the two intervals were estimated with correlation coefficients (Pearson r). Hence a reliability coefficient of 0.76 was obtained. This indicates that the instrument was reliable for the study. The reliability of the instrument was also tested using Cronbach’s Alpha (α) test so as to test their consistency (Allen and Yen, 2002; Amin, 2005). The authors stated that Cronbach’s Alpha (α) test is one of the most

commonly used measures of reliability of data collection instruments, because it is based on the internal consistence of the test. The role therefore is to minimize the errors and biases in data. A reliability of at least 0.70 at $\alpha=0.05$ significance level of confidence is acceptable (Gable and Wolf, 1993). With the aid of SPSS (Statistical Package for Social Scientist), Cronbach alpha (α) test was conducted on constructs with multiple items to ensure that the benchmark of 0.70 was adhered to, see the result is in table 3.5.

Notice from the Table 3 that the average Cronbach’s Alpha coefficient was above the benchmark 0.7. This result indicates that the research instrument is reliable as 0.795 is greater than 0.700.

Discussion from the related literature reviewed

From the literature reviewed basing ourselves on Hance’s (2008) comments, monoculture tree plantations are “green deserts” not forests, because they impacted a lot on the environment causing loss to the vegetation cover. For this reason, regardless of pine plantations growing meant for conserving environment, they increase soil and land degradation. The researcher tends to agree with his comment depending on the merits and demerits presented from the data and the responses from interviews information presented.

Similarly, the joint press release of World Rainforest Movement (2008), Friend of Earth International, and Global Forest Coalition listed a number of local environmental and social problems created by monoculture pine plantations, these were “the depletion of water sources due to changes in the hydrological cycle, deterioration of rivers and streams, air and water pollution due to the use of pesticides

and other agrochemicals, the displacement of entire communities when their land is occupied by plantations, violations of human, labour and environmental rights, differentiated impacts on women, the deterioration of cultural diversity and widespread violence” are presented elsewhere as reviewed literature ”.

Of course we do not forget from literature reviewed that planted as monoculture plantation forests, they provide product like timber, fiber, energy and food and environmental services such as carbon, land restoration and reclamation, hydrological regulation and biodiversity and genetic resource conservation. They can have multiple, positive and negative sustainability impacts environmental, social and economic impacts, which are strongly dependent upon the context in which they are planted and how they are managed (Evans 2009). Communal livelihoods of the non- pine growers are not compromised, if government are not able to consider the motives of public and private sector investors in planted forests vary significantly, and include increasing private sector economic activity, stimulating economic growth, (sustainable) profit generation, climate change mitigation and environmental benefits (Bellassen and Luysaert 2014).

The findings from the farmers’ perceptions of pine tree plantations do not have significant effect on food security in Kigezi Highlands Region provide support for the Boserupian theory, which shows how it is not inevitable that population pressure will lead to technological change. As Boserupian put it, increased populations will increase technology output. It is not a sufficient condition since each community has array of choice variable that is the distribution of its labour time between direct and indirect tasks

as well as the distribution of land between types of uses. Hopkins (1973) mentions, by the way of criticism, that it should not be evident though from the discussion above that Boserupian view should be qualified in that because different systems can be found in parts of West Africa which do not show marked demographic variations. Therefore from her argument, it is inevitable for communities with similar demographic features to be practicing the same mode of production. Different communities might be faced with different technological elasticity due to difference in soil and climates. Similarly, there possibilities of failure in Agriculture intensification the reason why some communities do not adopted certain technologies like pine tree plantation.

However, it is not population growth alone that will lead to switch in technology promotion. Population pressure brought about by new interventions like pine tree plantation growing can result in increasing hardships in meeting standards of living that cause the community to opt for more intensive agriculture. To preserve the land carrying capacity the society may then switch to a new technology that can offer the possibility of maintaining the quality of land to be cultivated despite the general reduction of its production and fallows times (Darity,1979). This means that to improve the livelihood of the non-pine adopters can introduce the intensive use of fertilizers or leguminous plants on a crop rotational scheme. The summary of our group discussion provide support for the empirical evidence from the inferential statistics.

Regression results and discussion on farmers’ perception of the effect of pine tree plantation on food security in Kigezi Highlands Region

Applying the inferential statistics

$$FSS = \beta_0 + \beta_1 FPP + \mu \dots \dots \dots I$$

FSS = Food security status in Kigezi Highlands Region

Bo = Constant term

FPP = Farmers’ perception on pine tree plantation in Kigezi Highlands Region

β_1 = Parameter of independent variable

μ = Error term

The sign of the slope coefficients (β_1) was used to evaluate the nature of effect of farmers’ perception on pine tree plantation in Kigezi Highlands Region, Uganda. If for example the slope coefficient is negative and significant, it would imply that farmers perceive pine tree plantation to have negative influence on food security status in Kigezi Highlands Region. Conversely, positive slope coefficients would imply positive influence of pine tree plantation on food security status in Kigezi Highlands Region, Uganda. The *a priori* expectation of the slope coefficient is as follows: $\beta_1 < 0$.

The assumption of the error term (μ) is absence of serial correlation. This assumption was examined using Durbin-Watson statistic. The Durbin-Watson test statistic tests the null hypothesis that the residuals from an ordinary least-squares regression are not auto correlated against the alternative that the residuals are auto correlated process. The Durbin-Watson statistic ranges in value from 0 to 4. A value near 2 indicates non-autocorrelation; a value toward 0 indicates positive autocorrelation; a value toward 4 indicates negative autocorrelation (Moses, 2018). The estimated regression model would therefore

be adequate if the Durbin-Watson coefficient approximates 2. The research question and hypothesis would be tested using *p*-value. The decision rule is to accept the answer as significant if the *p*-value is less than or equal to the 5% significance level (i.e., *p*-value $\leq \alpha$, then reject H_0).

The study presents the results of the regression model estimates of the effect of farmers’ perception of pine tree plantation on food security in Kigezi Highlands Region Uganda. Notice from the Table 2 below that pine tree plantation (-0.66) has significant negative effect on food security in Kigezi Highlands Region Uganda at the 5% percent significance level. This is clear from the significance of the *t*-statistic (-4.97) which is greater in absolute value than the theoretical *t*-statistic (-1.96), and the *p*-value (0.00) which is less than the study significance level (0.05). This inferential statistical evidence of negative effect of pine tree plantation on food security is in line with opinion expressed by the farmers through interview and also in agreement with the prior expectation outlined in Sub-section I. The estimates of the regression model further suggest that 17% of the total variation in food security is accounted for by farmers’ perception of pine tree plantation. The F-statistics indicate that all coefficients, excluding constant, are not zero. This is evident in the *p*-value (0.00) of *f*-statistics is less than the critical value (0.05). In addition, the Durbin-Watson coefficient (1.87) suggests that there is absence of serial correlation in the residual of the regression estimate. This is because the Durbin-Watson coefficient approximates 2, as stated in Sub section I.

Table 2 .Results of effect of farmers’ perception of pine tree plantation on food security in Kigezi Highlands Region Uganda

Variable	Coefficient	T-Statistic	Significance
Constant	4.651	14.800	0.000
Pine tree plantation	-0.660	-4.977	0.000

R=0.37; R²=0.17; F(1, 311) = 24.77 [0.00]; Durbin-Watson=1.87

Source: Author’s calculation (2018)

Hypothesis 1

H₀₁ Farmers’ perceptions of pine tree plantations do not have significant effect on food security in Kigezi Highlands Region.

Decision: Based on the decision rule outlined in the above Section, the above results are contrary to the stated null hypothesis (H₀₁) since the *p*-value of the effect of farmers’ perceptions of pine tree plantations on food security in Kigezi Highlands Region (0.00) is less than the significance level (0.05), there is significant negative effect of farmers’ perceptions of pine tree plantations on food security in Kigezi Highlands Region. Similarly, the computed *t*-statistic (-4.97) of the pine tree plantation coefficient is greater than the theoretical *t*-statistic at the 5% significance level (-1.96). Hence, the null hypothesis of no significant effect of pine tree plantations on food security in Kigezi Highlands Region Uganda is rejected. The evidence of negative effect of farmers’ perceptions of pine tree plantations on food security in Kigezi Highlands Region is in accord with some extant literature. Garberg (2012) for example argue that the rapidly growing pine and eucalyptus trees planted by the Norwegian company Green Resources in the Mayuge district, in eastern Uganda has resulted into complaints of hunger because there is no land where farmers can cultivate their crops. Farmers are only allowed to grow some vegetables, but not other foods.

The trees have significantly reduced the land where crops can be cultivated. Similarly, Bleyer, *et al.* (2016) in their study of the socio-economic impact of industrial forest plantations on rural communities in Niassa Mozambique show that private forest plantations have the potential to positively impact local people’s wealth and well-being, if enough emphasis is given to minimizing the negative impacts. They conclude that forest plantations have threatened the basis of traditional rural livelihoods by reducing the availability of natural resources and through the relocation of agricultural plots. But Kiyingiet *al.* (2016) in examining the impact of farm forestry on poverty alleviation and food security in Uganda conclude that adoption of on-farm eucalyptus woodlots is an important pathway for smallholder farmers to escape poverty and improve food security, and that adoption of carbon forestry woodlots under the planvivo system can improve food security.

Conclusions

Pine tree plantation growing has negative and significant effect on food security in Kigezi Highlands Region. The competitive livelihood dilemma exists among the farmers, as the pine tree plantation growers communities compete for the existing resources. This in turn reduces the intervention adoption rate, for example the drivers of pine tree plantations resistance are population pressure, biodiversity loss, long term investment, occupation of large land holdings, gender aspects, competitive conflicts, pests and diseases and the competition with agrarian intervention like other tree species for example eucalyptus. The Boserupian theory and the Tragedy of the commons theory were the chosen theories in support of this cause. The other analysis used from questionnaire and related

literature reviewed. They all supported the same decisions presented from both the descriptive and inferential statistics.

Recommendations

Given the findings and results from competitive livelihood dilemma between pine tree growers and food crop growers, there is need for policy measure to contain the crisis. Consequently, the Ministry of Agriculture in conjunction with National forestry Authority should formulate policies that will minimize the competition for land resources between any other intervention like pine tree growers and food crop growers in Kigezi High land Region. Several countries do have success stories that can be adopted by the vulnerable communities. Let the Kigezi highlands take an example of South African of the most world's producer soft woods like pine tree plantations. Not every good policy recommended for livelihood improvement can be adopted or taken up because of the available funds. Research must be undertaken to first test the intervention suggested.

Secondly, the National forestry Authority in formulating policies to address environmental concerns such as deforestation and climate change, should constantly monitor developments of on-farm forestry as well as formulate cushion policies to ensure that tree plantations do not occupy the land where food crops can be cultivated in Kigezi Highland Region. This is to ensure that food crop farmers do not complain of hunger because there is no land to cultivate their crops. From the researcher's observation, pine forest plantations have negative influence on the food security. There is need therefore for the Agriculture ministry to formulate policies that boost food accessibility, availability,

utility and stability in Kigezi Highland Region. Such policy thrust will reduce the threat of forest plantations on the traditional rural livelihoods of farmers in Kigezi Highland Region.

Payments for environmental services including carbon finance should be geared towards increasing the extent of tree on farms. More support is needed to increase the contribution of tree-based crops to smallholder incomes, thus diversifying income sources and increasing food security in the face of climate change. Increased adoption of agroforestry should be supported through finance for agricultural development and adaptation as well as mitigation.

As far as the adoption of pine tree plantation growing is concerned promoting the use of affordable and renewable energy resource such as wind and biogas should be encouraged. The non-governmental organizations and governmental institutions should do this to reduce the over dependency on fuelwood for cooking and heating. A lot of fuel wood is used for tea churning. They could use solar and ethanol as sources of energy. There is the need to accelerating rural electrification programmes should be promoted country wide. It should be identified by the class utilizing, this will enable farmers to be less vulnerable and reduce the dependency on the limited forest reserves.

There is need for the promotion of growing exotic, fast growing trees for use in curing tea leaves, construction and firewood. Also, there is need to promote conservation through local community leaders. Promotion of livelihood strategies that shift from direct exploitation from forest reserves to alternative income generating activities,

such as mining and other income generating activities that provide income to the poor should be encouraged. There is a need to improvise for appropriate livelihoods promoting the planting of woodlots of fast growing indigenous trees and use of them as alternative material for construction purposes. The promotion and establishment of fast growing Agroforestry and indigenous trees species such as acacia and grevillea should be encouraged. These trees are fast growing and have adapted to climatic and soil conditions and these will not perish in the event of adverse weather conditions being experienced. Local communities should be accorded a chance to name trees that are fast growing in their area and these should be established.

Organizational mission and coordination issues should target to meeting the organization goal, vision and mission and they should be revised. There is a need to strengthening and streamlining all sector levels as highlighted in relation to Agriculture and forestry. There is a need for institutional reforms, policy formulation and provision of regulatory services as far as food security is concerned. The policy formulation and strategic planning should be done through decentralization to the local level hence improved coordination mechanisms between implementing agencies which usually breakdown and confuses the services delivered.

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