INTERNATIONAL CONFERENCE OF AGRICULTURAL ECONOMISTS
ICAE
29th | Milan Italy 2015
UNIVERSITÀ DEGLI STUDI DI MILANO AUGUST 8 - 14
AGRICULTURE IN AN INTERCONNECTED WORLD

What Do Farmers Want in the Design of Biofuel Investments in Kenya? A Choice Experiment Approach

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Abstract

Emerging forms of investment such as biofuels have intensified pressure on scarce land especially in developing countries. This has implications on household enterprise choice and food security. However, biofuel investments in Sub-Saharan Africa are often undertaken without adequate stakeholder consultations on priorities and preferences. In order to provide insights for managing potential resource conflicts, this study assessed farmers' preferences on the design of biofuel investments in Kenya. Choice Experiment was used to elicit survey data from 342 farmers, and random parameter model applied in analysis. Results indicated higher positive preferences for short contract lengths, leasing of a quarter of their land, permanent employment and renewable contracts. Compensating surplus estimates showed that farmers who already practice mixed crop-livestock systems required higher compensation to accept biofuel investments. These findings offer insights on the design of biofuel investments as a potential livelihood diversification option.

Keywords*: Biofuel-investments, Farmer preferences, Livelihood diversification.*

1. Introduction and Problem Statement

The need to increase the share of renewable energy is a high priority issue in the policy agenda of most countries in the world. Several governments have set ambitious targets to implement support schemes aimed at promoting alternative energy. In a world where the agricultural sector has increasingly become interconnected to various sectors such as the biofuel industry as well as in countries where farmers have continued to fall into poverty, the biofuel industry has been shown to be an alternative source of livelihood by assisting in addressing the twin problems related to poverty and rural development. For instance, in Brazil, the biofuel industry has been shown to have the capacity to promote rural development, alternative market for crops and offer opportunities for job creation (Darkwah *et al.,* 2007).

In the Kenyan context, challenges such as high population, land productivity and failed markets have necessitated the search for an alternative stable source of livelihood. Of particular interest is the poverty situation in Western Kenya where about 32% of the residents are hardcore poor compared to about 20% in other rural areas; a situation that is exacerbated by reliance on a narrow range of economic activities such as maize and sugar cane that face market failure. As a result, various forms of livelihood diversification have emerged; for example, shifting from rural to urban areas in search of off farm wage employment. However, there are limited resources to cater for the growing population in the urban areas (Unwin *et al.,* 2010). At the national level, Kenya has been exploring investments in the biofuel industry. Also, there are recent investments aimed at producing fuel ethanol from tropical sugar beet in Western Kenya among other investments. In addition to this, biofuel investments are being explored in this area and could possibly serve as an alternative livelihood activity without requiring farmers to migrate from their rural homes. Though various studies have indeed shown that the biofuel industry has the potential to help farmers exit poverty, they have also become more controversial. Divergent opinions on biofuels arise from: inconclusive scientific research; media exaggeration of potential hazards such as climate change and water pollution and; more recently the fear of land grabbing through foreign land leases (Otieno, 2014).

In this respect, farmers in Western Kenya are familiar with lease of land arrangements but mostly for traditional crops between neighbours and sugar cane companies. However, these farmers are not familiar with lease of land for biofuel, which could come with a lot of restrictions in terms of land use and access rights that may disrupt their rural livelihood patterns. Further to this, there is lack of empirical insights on whether these investments would fit in the context of the farmers' livelihood patterns in terms of their preferences. Programs or investment projects that fail to consider local people's needs and aspirations tend to collapse or lead to disruption of rural livelihood patterns (Upham and Shackley, 2007), hence the need to analyze farmers' preferences for bio fuel investments. This paper therefore seeks to analyze smallholder farmers' preferences in terms of how much they would be willing to accept as compensation for them to participate in biofuel investments as an alternative livelihood source in Kenya.

2. Conceptual Framework

As indicated in Figure 1, the poverty situation in Western Kenya calls for the need of an alternative livelihood strategy. Biofuel investments being promoted in that area could be a possible poverty exit strategy for these farmers. According to Karttunen (2009) this concept is based on the Agricultural Household Model (AHM) which provides a theoretical rationale for income diversification. In their quest to maximize their utility, which could be in the form of ensuring sustainable income and rural livelihoods, households would be expected to constantly search for economically fulfilling alternative livelihood sources.

[Figure 1 here]

This study linked households' decision to diversify and how emerging investments such as biofuel could serve as an alternative livelihood strategy. This study therefore attempted to look at how these biofuel investments can be designed in order to fit the enterprise mix of the rural farmers. Hence, their preferences towards these emerging biofuel investments were analyzed and this was based on the Lancaster theory of consumer choice (Lancaster, 1966). It is envisaged that, appropriately designed biofuel policies would lead to enhanced poverty reduction and improvement of livelihoods.

3. Materials and methods

3.1 Study sites, sampling procedure and data

This study focused on Bungoma and Kakamega Counties. These areas were chosen because they represent areas where livelihood options face major economic challenges, biofuel investments are being promoted and climatic conditions favour the growth of various biofuel crops. The multi stage sampling approach was applied because it allows for sequential sampling across two or more hierarchical levels such as administrative units as in the Kenyan case. In Bungoma County, three districts, namely Bungoma East, Bungoma South and Bungoma West were selected. From these districts, four divisions were selected. Subsequently, a total of 10 locations were randomly selected. Finally, a total of 20 sub locations were randomly selected from which 180 households were randomly drawn and household heads interviewed. In Kakamega, five districts were selected based on economic challenges, poverty effects of straddling and to represent areas where biofuel investments have not yet been proposed. Then one division from each district was selected, to make a total of five divisions. From these divisions, 7 locations were randomly selected. From these 7 locations, a total of 20 sub locations were randomly selected and from these, a total of 162 households were also randomly drawn and household heads interviewed.

Following average sample sizes in recent studies on preferences, the present study intended to capture 200 respondents in each of the study areas (Hanley *et al.,* 2001). However, during the survey period there were various challenges experienced such as time and cost constraints. Therefore, only 162 and 180 respondents were interviewed successfully in Bungoma and Kakamega, respectively implying an 80% response rate that was sufficient in eliciting farmers' preferences. The data was collected using semi-structured pre-tested questionnaires through face to face interviews. The survey began with a Focus Group Discussion (FGD) that was meant to validate the biofuel investment attributes. In summary, the survey data covered: farmers' current livelihood activities, awareness of biofuel investments and their preferences for biofuel investments as an alternative livelihood activity.

3.2 Choice experiment design

The Choice Experiment (CE) design process began by identifying the policy relevant biofuel investment attributes or features. The emerging biofuel industry was conceptualized to have two types of attributes or features, that is, compulsory features and optional features. The compulsory features are those that must be adhered to by all farmers who may prefer to participate in the biofuel investments. According to the codes of ethics for business in Kenya and the Companies Act, Chapter 486 of the laws of Kenya, any business investments that are to be set up should adhere to the relevant laws. The compulsory features included in this study are:

a) Disclosure of the origin of the biofuel investors: this would be useful to policy to ensure that the biofuel investors are indeed genuine investors.

b) Legal means of negotiations by investors especially when entering into contracts with farmers is another compulsory feature: this will be useful to policy to ensure that the design of the biofuel investments would be in such a way that farmers are effectively protected from extortions.

c) Full disclosure of identity of the investor and the legal registration of the biofuel industry to be established among others: these were deemed necessary in the design of policy to ensure that farmers and the biofuel industry enter into legally binding agreements.

d) Dispute resolution: once the contract is signed, legal means must be followed by farmers to settle any post contract disputes that may arise was also included as a compulsory feature (GCNK, 2012).

The optional or voluntary features are those that give the farmers a chance to make a decision (Louviere et al., 2003; Louviere and Woodworth, 1983). The optional features are key in the CE design because they assist people with different views and opinions to work together towards eliminating a problem that affects each of them (Ostrom, 1996). An emerging biofuel industry is considered to be a collective concern to the community since it may threaten their collective livelihoods through, for instance, taking away their land. In coming up with the optional attributes it was envisaged that there could be three categories of farmers based on how they

would want to participate in biofuel investments. That is, those farmers who may want to *sell their land* to the biofuel investors, those farmers who may want to *lease out their land* and those farmers who may want to *grow the biofuel crops* in their own farms. However, the scope of this study was limited only to those farmers who may be willing to participate in biofuel investments through leasing out part of their land to a biofuel company. This is because most biofuel investment companies engage in investments in form of foreign land leases. The optional attributes included *lease contract length* in years, *land size* to be leased out as a percentage of total land owned, *employment* type either none, permanent or casual, *renewability of contract* and *price* per acre. The process of identifying these policy relevant biofuel investment features began through a review of literature on biofuel policy design. To supplement this, in-depth interviews with key officials at the Ministry of Agriculture and a FGD were also carried out to validate these attributes and their levels in the CE design. Table 1 shows the biofuel investment attributes for those famers who may opt to participate in biofuel investments by leasing out part of their land as an alternative livelihood activity.

[Table 1 here]

Farmers in Western Kenya majorly depend on sugarcane farming as their source of livelihood. This sugarcane is majorly grown in form of contracts between the farmers and the sugarcane companies (KSB, 2011). *Contract length* was therefore included as an attribute in the CE design. Hence, they would be more familiar with livelihood activities that are carried out in form of contracts. The levels chosen were two years, five and ten years. Two years was included to cater for the current situation in Western Kenya where farmers already grow sugar cane that has a cropping season of between 18-24 months. Further, as noted from the FGD, currently the farmers mainly grow sugarcane which has a minimum contract length of about two years because the crop takes about 18 months from planting to harvesting. Five years and ten years were chosen as other levels for the contract length to cater for multiple cropping seasons. It was generally expected that farmers would prefer longer contracts to shorter ones because longer contracts are assumed to be cheaper and more convenient for the biofuel investment companies so as to enable them to recoup their start up costs, ensure continuous supply of the biomass and to ensure continuous operation of the investments.

Land is a limited factor of production and as reported by KNBS (2011), *land sizes,* in various parts of Kenya including western Kenya, are on a declining trend due to population pressure. Therefore, since biofuel investments are land based, it was therefore deemed important to include land in the CE design given the rising population, issues related to food security and culture. The levels chosen were 25%, 50% and 75% of the total land owned. The size of land that could be leased out could be at least 25% of the total household land and at most 75% of the total household land owned. People may want to lease out all their land, but due to cultural issues, food security issues and increased population issues, at least a quarter of the land should be left for these purposes. Previous deals that have involved lease of entire pieces of land for very long periods of time, for example, 10 years have resulted to constant conflict between the land owners and their investors. Therefore, the threshold/limit was put at 75% of the total land owned to be leased out. This would allow some land to be available for the household's own production and other socio-cultural purposes such as traditional home construction and preservation of shrine areas.

The population in Western Kenya faces a high poverty incidence according to KNBS, (2011). This is further compounded by the near sole dependence on sugarcane farming which faces challenges of delayed and low payments as discussed earlier. Majority of the farmers depend only on a narrow range of livelihood activities as earlier discussed and majority of them depended on the Webuye Pan Paper industry which was recently shut down. Barret *et al.* (2006) highlights that livelihood diversification could help poor farmers exit poverty. *Employment* in the biofuel company was therefore included as an attribute to bring in aspects of diversification and to act as an incentive to participate in the biofuel investments so as to broaden the range of income sources available to the farmers. The levels included were no employment (none), permanent employment depending on the length of contract and casual employment depending on the length of the contract. *Renewability* of contract was also included as an attribute because it would offer a possibility of continuous flow of income for these resource poor farmers.

Lease price per acre was also included as an attribute so as to enable estimation of the marginal rate of substitution (MRS) between the attributes in CE design and money (Hanemann, 1984). For the lease of land option, the lease price levels were 10,000, 15,000 and 20,000 Kenya Shillings (KSh). It is known that there is a difference in the market price levels of lease of land based on the purpose of lease. That is, lease of land for agricultural purposes, lease of land for

public utility purposes and lease of land for industrial purposes. Therefore the price levels are based on the average market lease prices. An amount of KSh 10,000 represents 50% of the average market price of lease of land, KSh 15,000 represents 75% of the average market price and KSh 20,000 represents 100% of the average market price of lease of land.

The levels of KSh 10,000 and KSh 15,000 alongside KSh 20,000 of the average market price of lease of land were included as the levels. This is because, in as much as farmers would be willing to accept 100% of the average market price of lease of land, a rational farmer is expected to consider the trade-off between price and other biofuel attributes. This is in tandem with the completeness axiom of consumer choice. Therefore, it is practical to include levels such as 50% and 75% as the price levels. Following the recommendations from the FGD, three levels were chosen for each of the attributes except renewability of contract which had two levels.

3.3 Fundamental points in the design of Choice Experiment

Experimental design is a fundamental tool in choice modelling. It provides the benchmark for running the CE. Choice designs are built from factorial design that can either be full factorial or fractional. Factorial designs are used to study the effects of two or more factor attributes on a dependent variable. Full Factorial designs are those that consist of all possible combinations of the levels of the factors. However, the problem with full factorial design is that practically, it is too cost prohibitive and tedious to have respondents consider all possible combinations (for example, biofuel investments alternatives). For this reason, researchers often use fractional factorial designs which have fewer runs than the full factorial design (Kuhfeld, 2005; Hedayat *et al.,* 1999).

Fractional factorial designs could either be orthogonal or efficient. Orthogonal design refers to the relationship between factors and other factors and it ensures that estimates across factors are independent (Bliemer and Rose, 2010). Another aspect in the design is efficiency. This refers to the measure of the information content of a design. The more efficient a design is, the more information the researcher gets for each question asked. In the present study, a fractional factorial design was used in a pre-test survey of 42 farmers to obtain a priori coefficients. These were later used to generate the efficient design that was used in the actual survey. The efficient design had a D-efficiency measure of 89.3% and a utility balance (B-estimate) of 80.12%. The CE design was generated using the NGENE software.

In this study, the respondents were randomly assigned to one of the six choice sets in the biofuel investment through lease of land option. Each choice task constituted three alternatives, that is, biofuel investment A, biofuel investment B and a neither option/alternative as shown in Table 2.

[Table 2 here]

Also, all the biofuel investment attributes were set at the zero level. During the interviews, respondents were asked to consider only the attributes present in the choice tasks when making their decisions. Also, they were asked to treat each task independently.

3.4 Analysis of Choice experiment data

The analysis of CE is based on the Lancaster theory of consumer choice (Lancaster, 1966). This states that preferences for goods/services are a function of the attributes of the goods/services rather than the goods themselves. According to McFadden, (1974), CE data is based on random utility theory whereby discrete choices are described in a utility maximizing framework. In CE, there are various models that can be used for analysis. These include Multinomial logit (MNL), Random Parameter Logit (RPL) and the Latent Class Model (LCM).

In the specification of the MNL, the choice of an alternative represents a discrete choice from a set of alternatives. These entire alternatives are represented by an overall utility function specified as follows:

$$U_{in} = V_{in} + \varepsilon_{in} \quad \ldots\ldots (1)$$

In this overall utility function, each alternative is represented with a utility function that encompasses a deterministic component (Vi) and a stochastic component (εi). The deterministic component is specified as a linear index of attributes of the different alternatives for example, biofuel investment alternatives. The (εi) represents unobservable influences on individual choices.

$$\text{Prob}\{I \text{ chosen}\} = \text{Prob}\{V_i + \varepsilon_i > V_j + \varepsilon_j, \forall\ j \in C\} \quad \ldots\ldots (2)$$

Where, C is the set of all possible biofuel investment alternatives. In this case there are three alternatives; biofuel investments alternative A, biofuel investment alternative B and the neither option representing the status quo.

Assuming that there is extreme value distribution for the error terms and that there is independence between choice scenarios and the individual, the probability of choosing an alternative can be represented by:

Prob {i} = $\frac{\mathbf{e}^{svi}}{\sum_{i=c} \mathbf{e}^{Vj}}$ ……………………………………………………………………...... (3)

The RPL model was applied in this study because it accounts for preference heterogeneity among respondents. The RPL is preferred in the analysis of preferences as it allows the coefficients of the model to vary among individuals in a random manner (Revelt and Train, 2008). Also, according to Train (2003), it eliminates the Independent from Irrelevant Alternatives (IIA) property of the MNL which is restrictive.

Therefore in the RPL, the utility Uint derived by person 'n' from alternative 1 in choice set t can be given by:

Uint = βnXint + ɵint ……………………………………………………………………… (4)

Where: Xint is a vector of policy attributes (biofuel investments attributes) and βn is an individual-specific vector of parameters in the population density function (pdf) f(βn θ), θ are the parameters of the distribution of βn, ɵint is the Independent and Identically Distributed (IID) random term independent of βn and Xint.

In the estimation of Willingness to Accept (WTA) biofuel investments as an alternative livelihood activity, the following equation is used as suggested by Hanemman, (1984).

WTA + 1*$\frac{\beta k}{\beta p}$ ……………………………………………………………………………….. (5)

Where βk is the coefficient for an attribute/attribute level (in this case, contract length, size of land, employment type, and renewability of contract) and βp is the price attribute.

The overall compensating surplus (CS) was computed using the following equation:

$$CS = \frac{1}{Bp}(V_1 - V_0) \quad \ldots\ldots (6)$$

4. Results and Discussions

4.1 Description of variables

The variables used in the model are shown in the Table 3.

[Table 3 here]

A likelihood ratio test was done and the utility parameters for all biofuel investments through lease of land option were entered as random parameters assuming a normal distribution, except the price attribute that was specified as fixed (Train, 2003).

4.2 Empirical estimation

The results of the RPL models for the preferences for biofuel investments through lease of land option for the two study areas and the pooled sample are reported in the Table 4.

[Table 4 here]

The results revealed that compared to medium length contracts of 5 years and contrary to what was expected, farmers in Bungoma and Kakamega have a positive preference for short contract lengths of 2 years and have negative preference for long contract lengths. This may be due to the fact that the biofuel investments are a new venture and due to this, farmers may only want to participate in short contracts for a start as they monitor the progress of their investments before they can decide to venture in such investments over a long period of time. These results are similar with those of Fewell *et al.* (2011), which also indicated that farmers prefer shorter contracts with biofuel companies as opposed to long contracts.

Compared to leasing half of the land that they own, farmers in both Kakamega and Bungoma had higher preference to lease out only a quarter of their land compared to leasing out three quarters of their land. This result could be attributed to the fact that the biofuel investments

are still a new venture and the farmers would want to start by leasing out a small portion of their land first as they monitor the progress of their investments. Compared to being offered no employment in the biofuel companies and as expected farmers in Bungoma and Kakamega have a higher preference to be offered permanent employment compared to just being offered casual employment. This result may be due to the fact that people generally prefer permanent employment because one is guaranteed of the stability of income as compared to casual employment where one can be terminated at any time hence risks of unstable income.

Also, compared to non renewable contracts, farmers prefer renewable contracts. The parameter estimate for lease price per acre is significant and positive in sign as expected for WTA studies. This therefore allowed computation of tradeoffs between each attribute and money. These results indicate that in both study areas, farmers have similar preferences for the attributes in the proposed biofuel investment attributes. The estimated RPL models for both study sites and the pooled sample all exhibited good fitness of the model. They all had pseudo R squared values above 18%. In the pooled sample, all attribute coefficients had highly significant standard deviations except three quarter size of land. This showed that there is heterogeneity in the preferences for the biofuel investments through lease of land attributes.

Table 5 indicates farmers' WTA compensation for various biofuel investments attributes for them to participate through lease of land as alternative livelihood activity as indicated in equation 5.

[Table 5 here]

The WTA values also clearly indicate that farmers have heterogeneous preferences for the biofuel investments through lease of land option attributes. In the pooled sample, farmers are willing to accept compensation ranging between KSh 1,443 and 6, 295 for the inclusion of short contract length of 2 years in order for them to participate in biofuel investments through lease of land. Even with compensation, farmers would not want long contract lengths of 10 years to be included as an attribute in the biofuel investments.

This could be attributed to the fact that farmers may be sceptical towards new ventures such as those of biofuel. For this reason, they would prefer shorter contract length at first as they monitor the progress of the investments. Also, farmers would be willing to accept compensation

ranging between KSh 6,265 and 16, 853 for the inclusion of leasing out a quarter piece of their land as an attribute in biofuel investments. In addition to this, farmers are willing to accept compensation ranging between KSh 5,761 and 12,767 and a range of KSh 3,369 and 8,131 for the inclusion of permanent employment type and casual employment type respectively as attributes in biofuel investments design. Lastly, farmers are willing to accept compensation ranging between KSh 1,153 and 3,627 for the inclusion of renewable contracts as biofuel investment through lease of land attribute. Based on the WTA values the attributes can be ranked as follows: quarter piece of land to be leased out, permanent type of employment, casual type of employment, short contract length and lastly renewable contracts.

The results of the study showed that farmers are WTA a higher compensation for leasing out quarter piece of land to be included as an attribute in the biofuel investment program design. Also, results of the study also revealed that they prefer to lease out only a quarter piece of their land as compared to giving out three quarter of their piece of land. This could be attributed to the fact that a great deal of uncertainty surrounds participation in biofuel investments which are just emerging with no well structured markets. Also, the uncertainty is further compounded by the fact that most of the biofuel investment companies may establish contracts with clauses which may state that in case the biofuel crops are damaged by natural climatic causes, then there would be no payment to the farmers for the land they lease out. Such clauses bringing more uncertainty on whether the net returns will continually be forthcoming (See for example, Fewell *et al.,* 2011). This high compensation amount could be attributed to the fact that farmers in this region mainly engage in livelihood activities that are land intensive (crop and livestock farming or crop farming only) and land is a limited factor of production. Since the biofuel investments would require them to lease out some portion of their land, however small, this would trigger them to want more compensation to cater for the foregone income they normally get from the use of that land which will be leased out.

Also, farmers are willing to accept a relatively high compensation for permanent employment type and casual employment type to be included as an attribute in the biofuel investments program design. This could be attributed to the fact that farmers have narrow range of livelihood activities which they depend on and would be willing to be offered employment in the biofuel investments company so as to supplement the income they get from the narrow range of livelihood activities that are faced by major economic challenges as highlighted earlier. The

results of the study also indicate that farmers would also require some moderately low compensation for short contract length to be included as an attribute. This shows that farmers are more comfortable engaging in short contracts as opposed to long contracts. This can be attributed to the fact that, longer contract lengths are deemed to be undesirable particularly in the early stages of a developing market such as the biofuel investments in Kenya. Also very long contract length of, say 10 years, brings more hesitation due to uncertainty with regard to opportunity costs of not growing traditional crops/food crops. As a result, farmers are reluctant to enter into such long term contractual arrangements explaining why they would be willing to enter into short term contracts of, say 2 years, as shown by their willingness to accept a moderately low compensation for such an attribute to be included in biofuel investment program designs.

The results of the study also show that farmers are willing to accept a relatively low compensation for renewable contracts to be included as an attribute in the biofuel investments program design. This could be attributed to the fact that since biofuel investments are a new and emerging venture, farmers would not be really keen on whether the contract is renewable or not because they may first of all want to try it out before they would fully decide to continue participating in it or not. Hence whether they would want a renewable contract or not would not be such a major issue since they do not know how the biofuel investment would progress in order for them to decide on whether they would want renewable contracts or not.

To assess the possible sources of heterogeneity in preferences, interactions were carried out between the mean estimate of the utility parameters and farm/farmer characteristics in a RPL model estimated on the pooled sample of smallholder farmers. After extensive testing of various interactions with farm/farmer characteristics that were collected in the data collection, the models that interact mean preference for long contract length of 10 years, casual type of employment and permanent type of employment with these covariates, were found to fit the data best. Therefore, the interaction effects of long contract length of 10 years, casual type of employment and permanent type of employment are shown in Table 6. These are variations in the mean preference of contract length occasioned by the relevant farm/farmers characteristics.

[Table 6 here]

The results of the study indicate that access to credit, size of land and household size are significant sources of heterogeneity in preferences for long contract length of 10 years, casual

type of employment and permanent type of employment respectively. The standard deviation for casual type of employment as indicated in Table 7 is insignificant. This indicates that preference for casual type of employment does not vary more than is captured by the farm and farmer characteristics that were interacted with it. However, the standard deviations of long contract length of 10 years and permanent type of employment, are still highly significant, which indicates that preferences for long contract length of 10 years and permanent type of employment vary more than is captured by the farm and farmer characteristics that were interacted with them. [Table 7 here]

Although farmers on the whole had a negative preference for long contract length of 10 years, this negative preference was majorly among farmers who seek credit facilities. This could be attributed to the fact that farmers who constantly access credit would not be willing to lease out their land for a long period of time of, say 10 years, perhaps due to the fact that their land usually serves as security/collateral so as to enable them to access credit which they use to finance their agricultural production and other financial obligations which they may have. Therefore, leasing out their land to biofuel investments would mean that their land is tied to the biofuel company and this therefore would deny them the chance to use it as collateral in case they need to access credit in formal financial institutions. This explains the negative preference for long contract length of 10 years to be mostly among farmers who mostly seek credit facilities.

Also, farmers who mostly seek credit facilities were found to have a positive preference for casual type of employment. This could possibly be due to the fact that, most financial organizations that offer credit facilities usually require that, for example if the credit seeker does not have an asset to serve as security/collateral, they could attach their pay slips showing that at least they have some form of employment which would guarantee the repayment of the loan. This therefore could possibly explain why the positive preference for casual type of employment was mostly among farmers who mostly seek credit facilities.

Generally, farmers were found to have a positive preference for permanent type of employment. However, results from the interactions indicate that this positive preference was mostly from farmers who generally had smaller land sizes compared to other farmers. This could

be explained by the fact that farmers who had smaller land size would mostly prefer permanent type of employment to enable them to supplement the income which they get from their small pieces of land. This would enable them to have a guaranteed and reliable source of income given the declining land sizes that generate little or no income from agriculture. In addition to this, although farmers on the whole had a positive preference for permanent type of employment, this positive preference was mostly among farmers who had larger household sizes. Larger household sizes could prompt households to search for alternative sources of income, for example, permanent type of employment in the biofuel investment companies so as to ensure constant reliable income to comfortably cater for the household members' needs. This therefore could be an explanation as to why the positive preference for permanent type of employment was mostly among farmers who had larger household sizes.

4.3 Policy scenarios

To better implement biofuel policies in Bungoma and Kakamega counties, it was deemed necessary to characterise farmers based on their enterprise mix as indicated in Figure 2.

[Figure 2 here]

Farmers in these regions can be categorized into three distinct groups based on their current livelihood activities. These include those farmers who derive over 75% of their monthly income from crop farming (category 1), those farmers who derive over 75% of their monthly income from crop and livestock farming (category 2) and those farmers who derive over 75% of their monthly income from off farm activities such as trading, motorcycle business, tailoring and welding among other (category 3).

Results of the study indicated that in Bungoma, 21%, 49% and 30% of the farmers belong to category 1, 2 and 3 respectively. In Kakamega, 35%, 40% and 24% of the farmers belong to category 1, 2 and 3 respectively as shown in figure 2. Based on these categories of farmers three policy scenarios were developed so as to facilitate the implementation of biofuel investments policies that would better target the population in the study areas. Also, this would assist to formulate policy recommendations regarding farmers' WTA biofuel investments through lease of land option.

Based on the three possible farmer categories, policy scenarios were developed to help in implementation of biofuel investment designs. For the first category of farmers, a policy scenario was developed with suggested attributes such as such as short contract length of 2 years, 50% of owned land to be leased out, casual employment type, and a renewable contract. For the second category of farmers, a policy scenario was developed with suggested attributes such as contract length of 5 years, 25% of owned land to be leased out, no employment provided and a non renewable contract. Also, for the third category of farmers, a policy scenario was developed with suggested attributes such as contract length of 10 years, 75% of owned land to be leased out, permanent type of employment and a renewable contract.

In the policy scenario targeting the first category of farmers, a 2 year contract length was included so as to target short cropping seasons which farmers are already familiar with. Currently, the farmers grow crops that have a maximum cropping season of approximately 18 months for the case of sugarcane which they currently grow. Therefore, they would expect that when they lease out their land to the biofuel company to grow the biofuel crops, the maximum cropping season would be about two years before they get the returns from the land that they have leased out. Also, 50% of owned land is to be leased out is included as an attribute. This is because, since this category of farmers mostly utilize their land for crop farming only, it would be practical for them to lease out about half of their land to the biofuel company without substantially disrupting their livelihood activities.

Compared to crop and livestock farming, crop farming only is less land intensive. In addition to this, casual employment type is included as an attribute because, with casual employment, farmers in this category will also have time to attend to their crop farming activities. Hence this type of employment would be suitable for this category of farmers because it would not lead to a total neglect of their current livelihood activity which is crop farming. A renewable contract type is included as an attribute because it was envisaged that this category of farmers, since they only majorly depend on crop farming, they would want renewable contracts with the biofuel company to as to have an additional source of income.

In the policy scenario targeting the second category of farmers, a 5 year contract length was included so as an attribute to cater for the gestation period of livestock and to also allow for planning purposes on how to use the land. 25% of land to be leased was included as an

attribute because crop and livestock farming is land intensive compared to crop farming only. Therefore, it was seen fit to only require these category of farmers to lease out only a quarter of their land because this would not have an adverse effect on their current livelihood activity. Also, it was realized that since crop and livestock farming is already labour intensive, it would be ideal to offer this category of farmers no employment so that even though they would participate in biofuel investments by leasing out their land, they would still be available to carry out their crop and livestock farming which is an important source of their livelihood. Finally, a non renewable contract was included as an attribute because, since these farmers already have multiple sources of income therefore, they may not be very keen on whether the contract is renewable or not.

For the third category of farmers, the policy scenario included, a 10 year lease of land contract because this category of farmers already derives over 75% of their monthly income from off farm activities. Hence, even though they engage in such long contract length, their livelihood activities would not be destabilized. Also, 75% of owned land to be leased out, was included as an attribute since this category of farmers already derive over 75% of their income from off farm activities which are not land intensive, hence would be comfortable to lease out three quarters of their land. A permanent employment type was also included as an attribute because this category of farmers are already accustomed to carrying out off farm activities and therefore offering them permanent employment would better suit them compared to the other category of farmers. Lastly, a renewable contract type is included as an attribute for this category of farmers because they already normally derive over 75% of their monthly income from off farm activities hence may want to broaden their range of off farm activities so as to increase their income.

To illustrate how these farmers with different enterprise dynamics/enterprise mix might respond to different combinations of attributes, CS estimates were derived following equation 6. The CS estimates were computed for the three policy scenarios as shown in Table 8.

[Table 8 hear]

These scenarios include policy scenario for those farmers who derive over 75% of their monthly income from crop farming, those farmers who derive over 75% of their monthly income from crop and livestock farming and those farmers who derive over 75% of their monthly income from off farm activities such as welding, motor bike business, trading, tailoring, and carpentry among others. The CS estimates for all the three scenarios were positive. This suggests that

farmers prefer a change from the baseline of no biofuel investments through lease of land option as an alternative livelihood activity. The CS estimates are however significantly different in that farmers who derive over 75% of their monthly income from crop and livestock farming had higher CS compared to those who derive over 75% of their monthly income from crop farming. Those farmers who derive over 75% of their monthly income from off farm activities had the lowest CS.

Given that farmers who derive over 75% of their monthly income from crop and livestock farming have the highest CS, this implies that for them to accept to participate in biofuel investments through lease of land option, they would require higher compensation to cater for the foregone income they normally earn from crop and livestock farming which is land intensive. Those farmers who derive over 75% of their monthly income from off farm activities have the lowest CS implying that even though they lease out their land, they would not be greatly destabilized in terms source of income because most of their income comes from off farm activities which are not land intensive. This therefore explains why they would be willing to accept little compensation in order for them to participate in biofuel investments through lease of land option.

It is worth noting that though the CS for farmers who derive over 75% of their monthly is the lowest, the results also show that it is insignificant. This could be explained possibly by the fact that probably most of these farmers who derive over 75% of their monthly income from off farm activities are not residents of these areas and hence are not the owners of the land they reside on. Also, the results indicate that the CS estimates for Kakamega are higher than those of Bungoma. This implies that farmers in Kakamega are WTA higher compensation for them to participate in biofuel investments through lease of land option compared to their counterparts in Bungoma. This could be attributed to the fact that land sizes in Kakamega are relatively smaller compared to those in Bungoma as discussed earlier.

This therefore could explain why they would only be willing to participate in biofuel investments through lease of land option if they are offered higher compensation. This is because, also as the results indicate, most of their livelihood activities are land based and if they would opt to lease out their land, they would only be left with very little land to carry out their current livelihood activities. In terms of implementation, scenario 2 would be the most applicable

because it is the most preferred. Also, for implementation purposes, it would be more practical to start with this kind of policy scenario because the results of the study showed that a majority of the farmers already fall into this category in terms of their enterprise mix.

5. Conclusions and Policy implications

Poverty continues to be a problem among numerous smallholder farmers. In response to this, various ways have emerged to offer farmers an alternative source of income, for example, biofuel investments, so that they may exit poverty. This study therefore shed light on smallholder farmer's preferences for biofuel investments in Kenya. The study used data from 342 smallholder farmers spread across Bungoma and Kakamega counties. Findings from the preference analysis indicated that farmers in both study areas had high preference for short contract lengths compared to long contract lengths, leasing out a quarter of their land as opposed to leasing out three quarter of their land, permanent type of employment in comparison to casual type of employment and renewable contracts compared to non renewable contracts.

Although farmers in both regions had similar preferences for the biofuel investments attributes, there was a difference in the amount of compensation that they would be willing to accept. Farmers in Kakamega were willing to accept higher compensation compared to their counterparts in Bungoma. This study contributes to the few existing literature on farmers' preferences for biofuel investments as an alternative livelihood strategy. Indeed, it is worth noting that biofuel investments have received considerable interest worldwide. However, much of the information available about biofuel is based on speculations and politics. Little empirical evidence exists in terms of what farmers (who are the major stakeholders) really want in terms of the design of the biofuel investments programs and policies especially in the Kenyan context. Future research could focus on how biofuel investments could be designed based on other aspects other than enterprise mix which was the basis of this study.

References

Barrett, R. D. H., MacLean R.C. and Bell. G. 2006. Mutation of Intermediate Effect are Responsible for Adapation in Evilving Pseudomonas Populations. Biol.Lett., 2, 236-238

Bliemer, C., and Rose, J. 2010. Construction of Experimental Designs for Mixed Logit Models: Allowing for Correlation across Choice Observations. Transportation Research Part B, 44,720-734.

Darkwah, L., Hammond, A., Ramde E., Kemausuor, F. and Addo, A. 2007. Background paper on Biofuels development in Africa.

Fewell, J., Bergtold, J. and Williams, J. 2011. Farmers' willingness to grow switch grass as a cellulosic bio energy crop: A stated choice approach. Selected paper prepared for presentation at the 2011 Joint Annual Meeting of the Canadian Agricultural Economic Society & Western Agricultural Economics Association, Banff, Alberta, Canada, June 29-July 1, 2011.

GCNK. 2012. Codes of Ethics: Codes for Business in Kenya. Global Compact Network Kenya www.globalcompact.or.ke/index.php?r=page/shows&id=18 Last accessed in July, 2013

Hanemann, W. M., 1984. Welfare evaluations in contingent valuation experiments with discrete Responses. American Journal of Agricultural Economics, 66, 332–341.

Hanley, N., Mourato, S., Wright, R. 2001. Choice Modeling Approaches: A superior Alternative for Environmental Valuation? Journal of Economic Surveys. 15(3): 435-62.

Hedayat, A.S., Sloane, N.J.A., and Stufken, J. 1999. Orthogonal Arrays, New York: Springer.

Kamau N.C (2011). Kenya Sugar Annual- Kenya sugar annual report : Global Agricultural Network.

Kenya National Bureau of Statistics (KNBS). 2011. Kenya Economic Survey 2011 highlights.

KSB .(2011). Annual Report Kenya Sugar Board. www.ksb.com/.../ksb-en/.../Annual-report-2011-KSB-GROUP-data.pdf last accessed on 1st August, 2013

Kuhfeld, F. 2005. Experimental Design, Efficiency, Coding, and Choice Designs in Marketing Research Methods in SAS: Experimental Design, Choice, Conjoint, and Graphical Techniques. eds. W.F. Kuhfeld. TS-694, Cary, NC: SAS Institute.

Lancaster, K. 1966. A New Approach to Consumer Theory. Journal of Political Economy, 74, 132-157.

Louviere, J.J. and Woodworth, G. 1983. Design and Analysis of Simulated Consumer Choice of Allocation Experiments: A Method Based on Aggregate Data. Journal of Marketing Research, 20 (November), 350–367.

Louviere, J.J., Hensher, D.A., and Swait, J.D., 2003. Stated Choice Methods: Analysis and Application, Cambridge University Press, Cambridge UK.

McFadden, D. (1974). Conditional Logit Analysis of Qualitative Choice Behaviour in Zarembka, Paul ed., Frontier in Econometrics, Academic Press: New York, 105-142

Ostrom, E. 1996. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press.

Otieno, D.J., 2014. More inclusive decision-making processes in foreign land leasing: policy insights from Kenya. Center for International Governance Innovation (CIGI) Policy Brief. No. 8

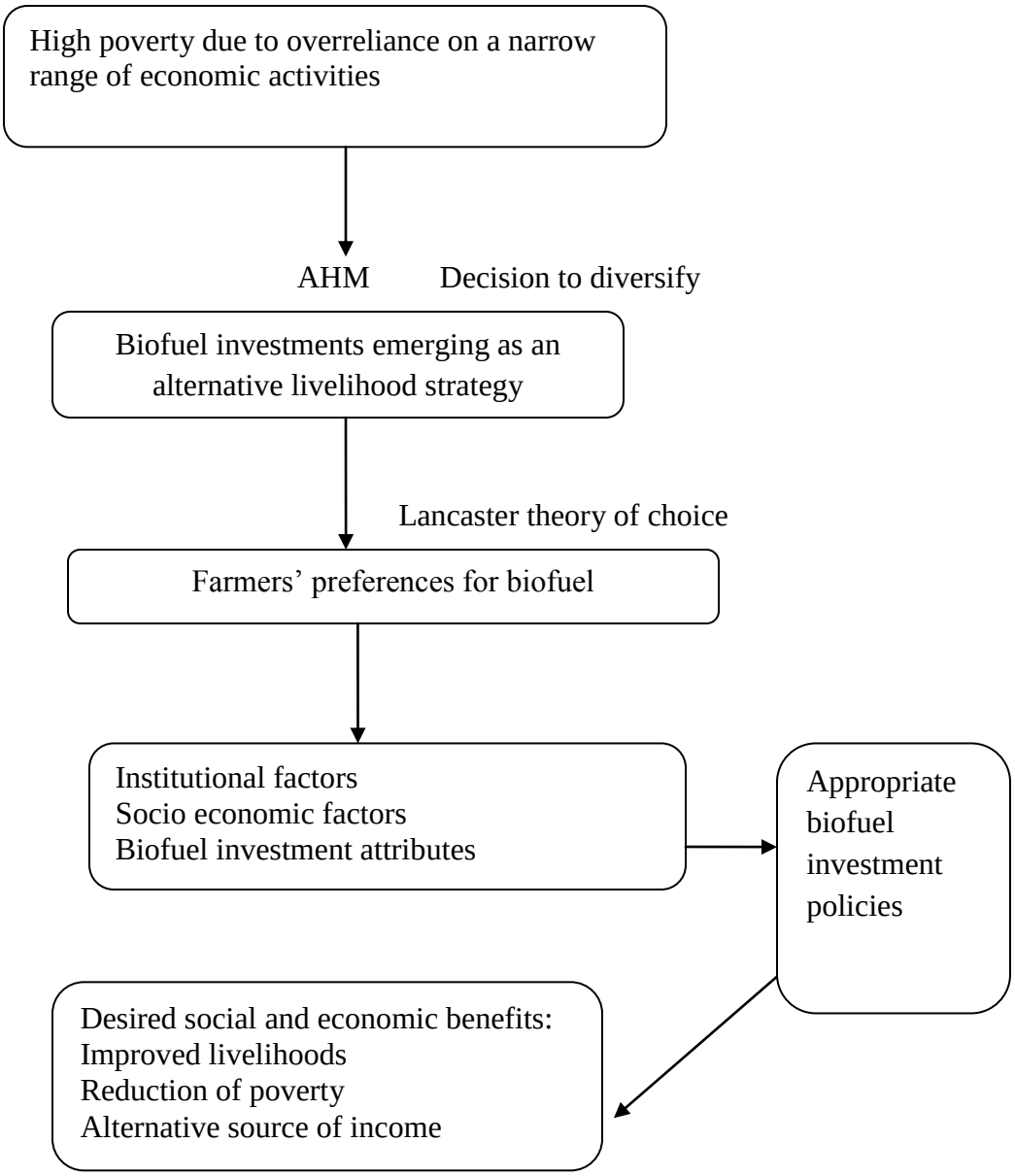
Revelt, D. and K. Train. (1998). Mixed Logit with Repeated Choices: Households' Choice of Appliance Efficiency Level, *Review of Economics and Statistics*. 4, 647-657

Train, K. 2003. Discrete Choice Methods with Simulation (New York: Cambridge University Press).

Unwin, N., James, P., McLarty, D., Machybia, H., Nkulila, P., Tamin, B., Nguluma, and McNally., R. 2010. Rural to Urban migration and changes in cardiovascular risk factors in Tanzania: a prospective cohort study.

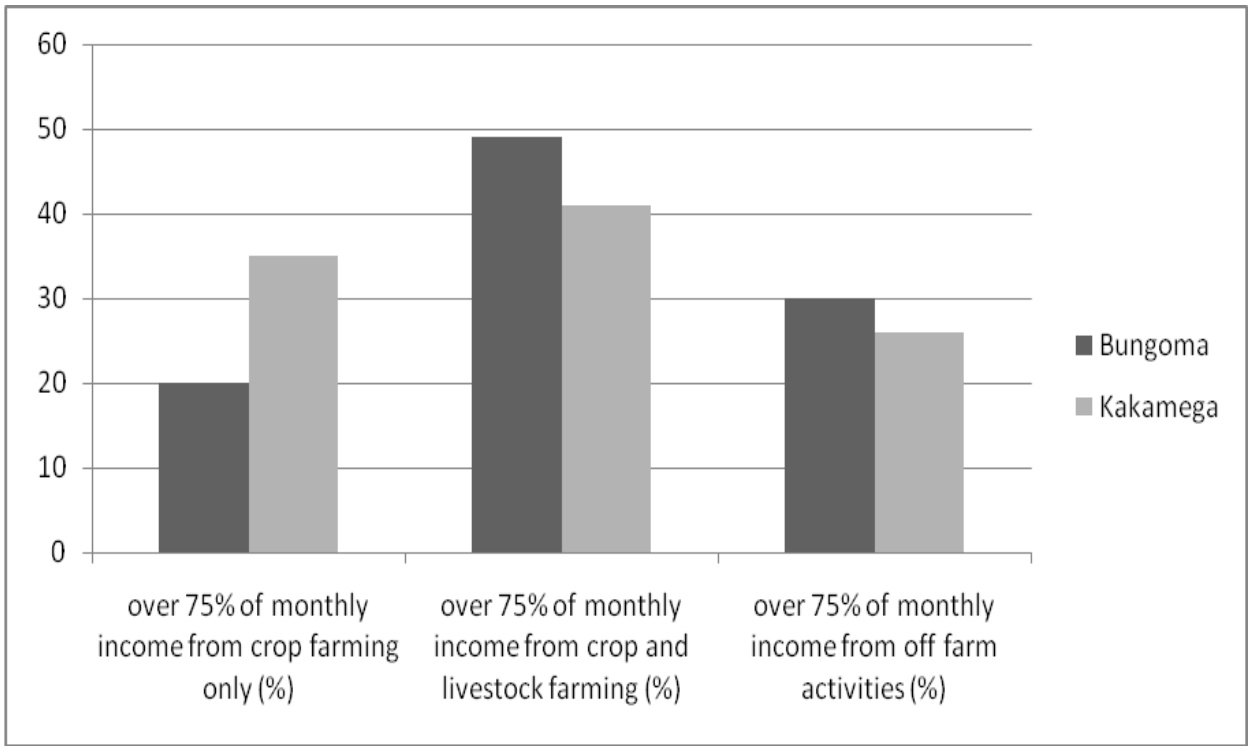
Upham, P. and Shackley, S. 2007. Local public opinion of a proposed 21.5 MWe biomass gasifier in Devon: Questionnaire survey results. Biomass and Bioenergy, 31, 433-441.

Figure 1: Conceptualization of biofuel investments as an alternative livelihood strategy for smallholder farmers in Kenya



Source: Authors' conceptualization

Figure 2: Categories of farmers based on their enterprise mix



Source: Authors' survey, 2013

Table 1: Biofuel investment attributes for lease of land option

Biofuel investments attribute	Attribute levels
Contract length	2years,5years,10years
Land size	25%, 50% ,75%
Employment to household members	None, Casual, Permanent
Renewability of contract	Yes ,No
Lease price per acre	10,000, 15,000, 20,000

Table 2: Example of biofuel investment choice set

Now I will show you different biofuel investment options that can be made by combining these features, Please compare the different biofuel investment types shown to you each time and indicate which one you prefer.			
	Biofuel investment alternative A	Biofuel investment alternative B	Neither
Contract length	10 years	2 years	
Size of land	25%	75%	
Employment to household members	casual	none	
Renewability of contract	no	yes	
Price per acre	10,000	20,000	
Choice question: Which biofuel investment would you prefer?			

Table 3: Description of variables used in the choice analysis

Variable	Description
SHORT	contract length of 2 years (1=yes, 0= otherwise)
LONG	contract length of 10 years (1=yes, 0= otherwise)
QUARTE	size of land to lease out 25% (1=yes, 0= otherwise)
THREEQ	size of land to lease out 75% (1= yes, 0= otherwise)
PERMAN	employment type permanent (1= yes, 0= otherwise)
CASUAL	employment type casual (1=yes, 0= otherwise)
YES	renewable contract (1=yes, 0=otherwise)
PRICE	lease price per acre (50%, 75%, 100%)

Table 4: Random parameter estimates for preferences for biofuel investments

	Coefficient (standard error)		
Variable	Bungoma	Kakamega	Pooled sample
SHORT	1.86(0.76) ***	1.68(1.22)	1.47 (0.48) ***
LONG	-3.52 (0.96) ***	-13.45(6.17) **	-3.56(0.76) ***
QUARTER	4.66(1.45) ***	13.17(5.81) **	4.41 (0.97) ***
THREEQUA	2.00(1.23)	4.97(3.05)	1.26 (0.72)*
PERMANEN	3.74 (1.07) ***	10.34 (3.94) ***	3.54 (0.71) ***
CASUAL	2.06 (0.60) ***	8.86 (4.06) **	2.19 (0.47) ***
YES	0.95 (0.37) **	0.47 (0.611)	0.91 (0.26) ***
PRICE	0.036 (0.007) ***	0.06 (0.166)	0.038(0.005) ***
Standard deviations of parameter distributions (standard error)			
sdSHORT	1.49(1.44)	5.03 (2.13)**	2.43 (0.59)***
sd LONG	3.68 (4.25)***	15.19 (6.14)**	4.41(0.95)***
sdQUARTER	1.35 (1.73)*	12.59 (5.01)**	2.99(0.55)***
sdTHREEQUA	2.46 (2.61)***	11.43 (4.59)**	0.27(0.57)
sdPERMANEN	3.08 (3.11)***	6.50 (2.41)***	3.47 (1.03)***
sdCASUAL	1.62 (2.09)**	6.00 (2.40)**	1.77 (0.70) **
sdYES	2.37 (3.54)***	5.11 (2.17)**	1.75 (0.38) ***
Log likelihood	-336.13	-711.90	-1502.0
Adjusted R2	57%	59%	56%
N respondents	180	162	342
N choices	720	648	1368

Note: Statistical significance at 1%, 5% and10% are shown by ***, **, and * respectively

Table 5: Marginal WTA values for biofuel investments through lease of land option in Kenya shillings (KSh)

Marginal WTA (95% confidence interval)			
Variable	Bungoma	Kakamega	Pooled sample
SHORT	50.77	29.06 d	38.69
	(14.98 to 86.56) c	(-11.83 to 69.95)	(14.43 to 62.95)
LONG	-95.74	-232.72	-93.39
	(-144.19 to 47.29)	(-375.23 to -90.21)	(-127.06 to -59.72)
QUARTE	126.54	227.91	115.59
	(39.48 to 213.60)	(71.42 to 384.40)	(62.65 to 168.53)
THREEQ	54.46 d	85.97	32.96 d
	(-19.04 to127.96)	(-8.54 to 180.48)	(-7.38 to 73.30)
PERMAN	101.61	178.98	92.64
	(48.53 to 154.69)	(85.33 to 272.63)	(57.61 to 127.67)
CASUAL	56.18	153.29	57.50
	(23.90 to 88.46)	(57.62 to 248.96)	(33.69 to 81.31)
YES	25.87	8.05d	23.90
	(6.60 to 45.14)	(-13.53 to 29.63)	(11.53 to 36.27)

Note: Confidence intervals have been calculated from standard errors.

c indicates confidence intervals which have been computed using the standard errors

d insignificant at 10% level

Table 6: RPL with interactions estimates for biofuel investment attributes

Variable	coefficient (standard error)
SHORT	1.33 (0.40) ***
LONG	-3.62(0.84) ***
QUARTER	5.71 (2.39) **
THREEQUA	5.76 (2.64) **
PERMANEN	4.07 (1.36) ***
CASUAL	2.05 (0.59) ***
YES	0.97 (0.32) ***
PRICE	0.04 (0.32) ***
THQGEN	- 0.49 (0.79)
PERMGEN	- 1.37 (0.95)
LONGCRED	-4.18 (1.87) **
CASLCRED	1.74 (0.85) **
THQLAND	-0.67 (0.63)
PERMLAND	0.68 (0.31) **
QUATLAND	0.16 (0.63)
QUATHHZS	0.10 (0.29)
THQHHZS	-0.26 (0.26)
PERMHHZS	0.36 (0.17) **

Note: Statistical significance at 1%, 5% and10% are shown by ***, **, and * respectively

Table 7: Derived standard deviations (sd) of parameter distributions

Variable	SD (Standard errors)
sdSHORT	0.25 (0.45)
sdLONG	4.57 (0.87) ***
sdQAURTE	3.65 (0.89) ***
sdTHREEQ	0.66 (0.95)
sdPERMAN	1.95 (0.69) ***
sdCASUAL	0.99 (0.83)
sdYES	2.52 (0.51) ***
sdTHQGEN	2.73 (0.79) ***
sdPERMGE	2.54 (1.05) **
sdLONGCR	4.76 (1.53) **
sdCASLCR	0.96 (0.68)
sdTHQLAN	0.45 (0.18)***
sdPERMLAN	0.85 (0.28) ***
sdQUATLA	0.19 (0.12)*
sdQUAHH	0.14 (0.13)
sdTHQHHZS	0.28 (0.11) ***
sdPERMHH	0.13 (0.07)*

Note: Statistical significance at 1%, 5% and10% are shown by ***, **, and * respectively.

Table 8: Attribute levels and compensating surplus for biofuel investments through lease of land option policy scenarios (KSh)

	Attributes											compensating surplus		
	Contract length			size of land			employment			renewability				
Scenario	short	medium	long	quarter	half	three quarter	none	permanent	casual	yes	no	Bungoma	Kakamega	Pooled sample
1.	√				√				√	√		13,281.7***	19,040.6***	12,009.8***
												(29.39)	(57.25)	(19.59)
2.		√		√			√				√	20,858.9***	38,925.9***	19,699.5***
												(55.11)	(117.73)	(34.74)
3.			√			√		√		√		6,031.9a	3,223.0a	3221.61a
												(43.16)	(36.94)	(26.83)

Note: standard errors are in parenthesis

√ indicates that the attribute is present in the policy scenario at the non zero level

*** indicate that the CS estimates are significant at the 1% level

ACKNOWLEDMENTS

The authors are grateful to the Government of Kenya, African Economic Research Consortium (AERC) and the AFRINT III Research Project that provided financial support for data collection towards this paper.