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# DETERMINANTS OF CLIMATE CHANGE ADAPTATION AMONG MALE AND FEMALE HEADED FARM HOUSEHOLDS IN EASTERN UGANDA

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## ABSTRACT

Adaptation is considered an appropriate response to climate change and variability, especially for the smallholder farmers. However, the response decisions and actions of male and female farmers may be influenced by various factor and factor combinations that are not adequately understood. We hypothesized that both male and female farmers are climate change conscious and responsive; and that there is a gender dimension to the choice of a climate change adaptation strategy. We utilised a combination of descriptive statistics and logistic regression analysis to study the factors that influence the choice of a decision to adapt to a climate change scenario. Using cross-sectional data collected from 136 households in eastern Uganda, we undertook the analysis at two levels; pooled sample analysis and a gender disaggregated analysis. Contrary to perceived wisdom and evidence from other empirical studies, the factors that influence the climate change adaptation decision vary considerably between male and female household heads. Climate change adaptation decisions of female heads depended on and were sensitive to more covariates compared to the decisions of male heads of household. Furthermore, climate change adaptation decisions of female heads were influenced by more liquid household assets, while those of male heads were influenced by real estate, especially land. Additionally, beyond gender, other demographic factors appeared to play no significant role in the decision to adapt to climate change.

*Key Words*: Adaptation decision, gender dimensions, liquid assets

## RÉSUMÉ

L'adaptation est considérée comme étant une réponse appropriée au changement et à la variabilité climatique, spécialement pour les petits fermiers. Par ailleurs, les décisions de la réponse et les actions entreprises par les hommes et les femmes seraient influencées par des facteurs variés et une combinaison des facteurs on encore adéquatement compris. Nous avons posés des hypothèses selon lesquelles les fermiers hommes et femmes sont conscients du changement climatique et y réagissent conséquemment. Aussi, il existe une dimension du genre face au choix d'une stratégie d'adaptation au changement climatique. Nous avons utilisé une combinaison de la statistique descriptive et l'analyse de la régression logistique pour étudier les facteurs qui influencent le choix d'une décision d'adaptation à un scenario de changement climatique. En utilisant des données transversales collectées dans 136 ménages à l'Est de l'Uganda, l'analyse était faite en deux niveaux : l'analyse des échantillons groupés et l'analyse du genre désagrégé. Contrairement à la sagesse et l'évidence perçues d'autres études empiriques, les facteurs qui influencent la décision pour l'adaptation au changement climatique varient considérablement entre hommes et femmes responsables des ménages. La prise des décisions par les femmes responsables des ménages dépendait de plusieurs co-variantes en comparaison aux décisions prises par les hommes. En plus, les décisions prises par les femmes étaient influencées par des biens liquides de ménages, la prise des décisions par les hommes était dictée par des avoirs tels que la terre. Additionnellement, au delà du

facteur genre, d'autres facteurs démographiques ont joué un rôle bien que non significatif dans la prise des décisions pour l'adaptation au changement climatique.

*Mots clés*: Décision d'adaptation, dimensions genre, avoirs liquides

## INTRODUCTION

The debate on climate change has recently shifted from high level advocacy on "the need to act" to regional, country and community level responses on "how to adapt" (Schiermeier, 2007; Wilby, 2007). African countries are said to be more at risk from climate change effects because of a number of factors including limited skills and equipment for disaster management, limited financial resources, weak institutional capacity and heavy dependence on rain-fed agriculture (Rockstrom, 2000). As noted by Scholes *et al*. (2006), climate change threatens to intensify development challenges already confronting the Sub-Saharan Africa region including food security. Hence many have argued the need for more detailed information on the likely impacts of climate change on agricultural systems (Moore *et al*., 2009; Seitz and Nyangena, 2009).

Men and women farmers in many developing countries experience different levels of vulnerability and adaptive capacity to climate change (Denton, 2002). Generally, agricultural activities of female headed households are under resourced and undercapitalised compared to male headed ones; a gap that reduces efficient investments in agriculture and constrains investments that enhance resilience to climate change and variability (FAO, 2011). In Uganda and many other African countries, access and control over land and complementary factors of production is lower in female-headed households compared to male-headed households (Doss and Morris, 2001; World Bank, 2001; Blackden and Wodon, 2006; Koru and Holden, 2008). A study by the Ministry of Finance, Planning and Economic Development (MFPED, 2002) in Uganda found that female headed households in Soroti district had inadequate access to or control and ownership of land, realised poor crop yields, owned fewer animals and had limited access to social services with negative implications on climate change response.

Women also face severe time constraints as a result of their heavier burdens of household tasks and large families, with long distances to move to and from their farms and market centers (Blackden *et al*., 2006). Time constraints are likely to be linked to inefficiency of resource use and constrained access to climate information and knowledge by women. Inefficiencies also result from restricted access to labour saving technologies such as animal traction and easy means of transport which again have a negative impact on climate change response. A study by Wanjiku *et al.* (2007) using multinomial logit found that gender, formal and informal training of the household head significantly influence the choice of mechanisation technology on small farms in Kenya. Generally, women household heads in Sub-saharan Africa have lower levels of education; they have smaller farms, less access to markets, credit and other inputs (Blackden and Wodon, 2006). These same factors directly affect agricultural productivity, and influence farmer response to the impacts of climate change on agriculture, which largely revolves around adoption of new technologies or improvement in existing practices. Therefore, while the exposure to climate variations may be the same for men and women in any given location, many argue that there are varied gender based differences in vulnerability and consequently adaptation and adaptive capacity (Adger *et al.*, 2005). However, it is not clear which factors are important for eastern Uganda and the magnitude of their influence in climate change adaptation decision making in male and female headed households. Understanding these factors would inform gender sensitive adaptation policies and strategies.

The aim of this study therefore was to gain a better understanding of the determinants of climate change adaptation decisions among male and female-headed smallholder farmers in eastern Uganda.

## MATERIALS AND METHODS

The study was undertaken in Soroti district, in eastern Uganda. The region was purposively selected owing to its fragility and sensitivity to climate variability. The terrain is generally flat, traversed by numerous swamps and other ravine wetlands. Annual rainfall averages 1100-1200 mm distributed between two seasons of March to July and September to November. Late November to late February or early March is traditionally the long dry season, and mid-June to late July is the short one; but this has become variable with frequent drought spells causing famine (MWLE, 2007).

The soils are of sandy sediments and sandy loams, well drained and highly friable with alluvium deposits in the bottomland.

The farming system is predominantly annual cropping and cattle Teso system. Small scale farming has been predominant in the area for long, which has greatly reduced vegetation cover, and is suggested to be a likely trigger for negative environmental effects such as intensity of floods and droughts, soil nutrient and biodiversity loss due to habitat conversion (Egeru and Majaliwa, 2009).

The region experienced severe flooding in 1976, 1996 and 2007 with the latest being the most intense. Incidents of strong winds and storms occur frequently in the region. The main farm level adaptation practices to the droughts and floods in the past include those practiced by both male and female heads such as adjusting planting time (early planting and change of planting dates) and use of drought tolerant, early maturing and disease resistant crop varieties. The more resource intensive practices including irrigation, tree planting, adoption of flood tolerant crops such as paddy rice and use of improved animal breeds were reported to be used by male heads. Women heads prefer vegetable growing in swamps and shifting cultivated fields to uplands or lowlands during floods and droughts, respectively. Notably, also is that land in the region is owned and controlled mainly by the clan, and by men within the clan. Women, therefore, seek permission on major decisions and changes to be made on the farmland (Mangheni *et al.* 2011).

A household survey was conducted in 2011 in the three parishes of *Aukot*, *Awoja* and *Dokolo* in Gweri sub-county, Soroti district to achieve an in-depth understanding of climate change response and adaptation drivers and their gender dimensions. Gweri Sub-County was selected in consultation with technical staff in the region including Agricultural Officers and National Agricultural Advisory Services coordinators, on the basis of representativeness of the characteristics of the region, among other things. The three parishes were selected based on prevalence of specific climate change adaptation practices (Mangheni *et al*., 2011).

In each parish, a community based facilitator, identified by the sub-county National Agricultural Advisory Services (NAADS) coordinator, helped to construct a sampling frame that included all male and female-headed households from which 50 farmers were selected. All female headed households in the sampling frame were considered because they were few compared to males; while the male-headed households were randomly selected using random numbers. A total of 150 households for the three parishes was obtained.

A semi-structured questionnaire was designed, informed by the stakeholder consultative workshop. Review of the questionnaire by experts ensured content validity; while pre-testing in a neighbouring parish that was excluded from the main study addressed issues of clarity. Data were collected on a number of household variables including demographics, socio-economic variables, land use and ownership, climate change impacts and responses. Only 136 households were used in the analysis; 14 households having been dropped on account of incomplete and/or inconsistent data. Ninety households were male headed with the balance of 46 households being headed by females. Data were entered in the Statistical Package for Social Scientists (SPSS) version 15 and analysed in STATA 9.

A logit regression was used to determine the factors influencing the farmers' decision to adapt to climate change. Gujarati (2004) provides an excellent theoretical exposition of the model that can be estimated as a probability. The specification of the empirical model or reduced form that was estimated is as follows:

$$Y_i=\beta_0+\beta_1X_1+\beta_2X_2+\beta_3X_3+\beta_4X_4+\beta_5X_5+\beta_6X_6+\beta_7X_7+\beta_8X_8+\beta_9X_9+\beta_{10}X_{10} \quad \text{..... (1)}$$

Where $Y_i$ is a dichotomous dependent variable (farmer using any climate change adaptation technology or not, specified as yes=1, 0=otherwise). $\beta_0$ is the Y- intercept whereas $\beta_1$-$\beta_{10}$ is a set of coefficients to be estimated. $X_1$-$X_{10}$ are explanatory variables hypothesised, based on theory and related emperical work, to influence adaptation to climate change. Table 1 presents a description of explanatory variables, their expected sign and reason for the sign expectation.

To adequately understand the gender dimension, regression analysis was performed at two levels namely; pooled sample and male-headed and female-headed households separately. The logit model was tested for multicollinearity and heteroscedasticity and both were rejected.

## RESULTS

**Descriptive results.** Cross tabulation results showed that majority of the male-headed households (72%) took some action to adapt to climate change compared to 59% of female-headed households (Table 3). For both categories, farmers who did not adopt any of these practices cited resource related constraints such as lack of money or credit, limited land, lack of knowledge of climate change adaptation options and lack of inputs including planting materials. Other farmers cited lack of reliable weather forecast as the reason for not adapting to climate change. The lack of sufficient time to implement the adaptation practices was highlighted by almost 18% of female-headed households compared to 5% of male-headed households.

Tables 2 and 3 show descriptive statistics of the variables hypothesized to influence the decision to adapt to climate change excluding gender of the household head, which is used as a classification variable for the categorical variables. Of these factors, ownership of land (P=0.07, Fisher's exact test =0.02), membership to farmer organisations (P= 0.02), land size (P=0.004), and access to credit (P=0.0907) were significantly different between male and female heads. Males owned more land, had better representation in

TABLE 1. Description of explanatory variables and the expected sign

| Variable | Description | Expected sign | Reason |
|---|---|---|---|
| $X_1$ | Gender of household head, 1 (female), 0 (male) | - | Female heads have less access to resources for adaptation |
| $X_2$ | Household size (number of family members of labour) | + | More family labour enhances adoption of labour intensive strategies |
| $X_3$ | Land holding/ size in acres | +/- | Land size increases adoption of technologies, or reluctance |
| $X_4$ | Access to modern inputs e.g. improved breed of crop and animals | + | Improved breeds more resistant to adverse effects of climate |
| $X_5$ | Education level (years of schooling) | + | More education favours adaptation due to faster knowledge acquisition |
| $X_6$ | Access to credit;1-yes, 0 otherwise | + | Facilitates adoption of technologies |
| $X_7$ | Land ownership1 owns the land, 0 otherwise | + | Fosters decision making on technologies to adopt |
| $X_8$ | Possession of bicycle(s)1 yes; 0 otherwise | + | Facilitates movement of harvest from field and quicker access to markets |
| $X_9$ | Possession of radio(s)1-yes, 0 otherwise | + | Facilitates access to information on weather/ climate, |
| $X_{10}$ | Possession of animals | + | Animals such as oxen are a labour saving technology in the field. They also shield against impact of climate change |

TABLE 2. Factors (continuous variables) hypothesized to influence the decision to adapt to climate change in eastern Uganda

| Variable | Group | Minimum | Maximum | Mean | Standard deviation |
|---|---|---|---|---|---|
| Years of education | Female | 0 | 11 | 3.2 | 3.218 |
| | male | 0 | 15 | 6.7 | 3.435 |
| Household size | Female | 1 | 16 | 7 | 3.31 |
| | male | 1 | 30 | 10 | 5.19 |
| Farming exp | Female | 7 | 58 | 26.53846 | 12.6675 |
| | male | 1 | 57 | 23.26744 | 13.66784 |
| Land size | Female | 0.5 | 7 | 3.045455 | 1.508958 |
| | male | 0.25 | 30 | 5.323336 | 5.409091 |

TABLE 3. Factors (categorical variables) hypothesized to influence the decision to adapt to climate change in eastern Uganda

| Categorical variables | Female (%) | Male (%) |
|---|---|---|
| Adapting to climate change | | |
| Yes | 58.58 | 71.91 |
| No | 41.46 | 28.09 |
| Land ownership | | |
| Household head | 42.22 | 52.81 |
| Both man +wife | | 10.11 |
| Clan or family | 55.56 | 37.08 |
| Children | 2.22 | |
| If household uses modern inputs | | |
| yes | 84.44 | 85.39 |
| no | 15.56 | 14.61 |
| Access to credit | | |
| yes | 22.22 | 36.67 |
| no | 77.78 | 63.33 |
| Possession of radio | | |
| yes | 38.64 | 73.33 |
| no | 61.36 | 26.67 |
| Posession of animals | 70.00 | |
| yes | 30.00 | 82.22 |
| no | | 17.78 |
| Possession of bicycle | | |
| Yes | 60.00 | 85.56 |
| No | 40.00 | 14.44 |

groups (a channel for informal training), owned larger land parcels and had better access to credit.

Over 50% of farmers who had access to credit borrowed from informal village banks, and used animals and land as security. The degree to which these factors influenced the decision to adapt to climate change varied as shown in the subsequent sections.

**Logit regression outputs.** The results from the logit regression analysis over the entire sample of households are presented in Table 4. Land ownership, use of purchased inputs, gender of the household head, total land size, access to credit and possession of a bicycle significantly influenced the decision to adapt to climate change. As hypothesized, gender of the household head was a significant factor and had the predicted negative relationship with the probability to adapt to climate change. The negative sign means that female headship reduced the likelihood of adaptation to climate change.

Hence, in the present analysis, gender of the household head and land ownership are negatively associated with climate change adaptation. Positive determinants of the decision to adapt included land size, use of inputs, access to credit, and possession of bicycles among others. Household size, level of education of the household head and possession of animals were nearly insignificant (with odds ratios of very close to 1).

When the sample was disaggregated into gender groups, different factors emerged showing that the adaptation decisions of male and female heads are influenced by a different set of factors (Tables 5 and 6). Three of the factors that influenced the climate change adaptation decision for the pooled data, namely possession of radios, possession of a bicycle, and use of purchased inputs also significantly influenced the adaptation decision of the female-headed household. However, the strength of their influence increased in the gender disaggregated model as can be discerned from the increased value of their coefficients and odds ratios.

TABLE 4. Determinants of adaptation to climate change (dependent variable is adaptation to climate change) in Eastern Uganda

| Explanatory variable | Odds ratio | Estimated coefficient | SE of coefficient | p>\|z\| |
|---|---|---|---|---|
| Gender of h/h head(GEN) | 0.340986 | -1.075914 | 0.5596936 | 0.055* |
| Household size | 1.002315 | 0.0023121 | 0.0570206 | 0.968 |
| Land size(LAND) | 1.153329 | 0.1426522 | 0.0815557 | 0.080* |
| Purchase inputs(PINP) | 3.12888 | 1.140675 | 0.5812253 | 0.050** |
| Education | 0.9047109 | -0.1001399 | 0.0719682 | 0.164 |
| Access to credit(ACRED) | 2.905061 | 1.066454 | 0.5170207 | 0.039** |
| Land ownership (LO) | 0.2562874 | -1.361456 | 0.4947219 | 0.006*** |
| Possession of bicycle(BI) | 2.192927 | 0.7450301 | 0.3961371 | 0.060* |
| Radio (RAD) | 0.5517722 | -0.5946199 | 0.3751707 | 0.113 |
| Possession of animals | 0.9888483 | -0.0112144 | 0.1107662 | 0.919 |
| constant | | 0.414683 | 0.9433912 | 0.395 |
| | | | | |
| Log likelihood | -66.009485(5 iterations) | | | |
| Number of observations | 125 | | | |
| LR Chi Square (11) | 24.70 | | | |
| Prob > Chi Square | | | | 0.0059*** |
| Pseudo $R^2$ | 0.1576 | | | |

*** P<0.01, **P<0.05, *P<0.1

TABLE 5. Determinants of adaptation to climate change among female headed households in Eastern Uganda

| Explanatory variable | Odds ratio | Estimated coefficient | SE of coefficient | p>\|z\| |
|---|---|---|---|---|
| Household size | 0.8157321 | -0.2036692 | 0.1713915 | 0.235 |
| Land size(LAND) | 1.076824 | 0.0740162 | 0.322621 | 0.819 |
| Purchase inputs(PINP) | 23.84587 | 3.171611 | 1.38516 | 0.022** |
| Education | 1.02113 | 0.02091 | 0.1807595 | 0.908 |
| Access to credit (ACRED) | 10.42749 | 2.344446 | 1.483389 | 0.114 |
| Land ownership (LO) | 0.3801092 | -0.9672967 | 1.092365 | 0.376 |
| Possession of bicycle (BI) | 19.11549 | 2.950499 | 1.268602 | 0.020** |
| Radio (RAD) | 0.0874773 | -2.436376 | 1.240582 | 0.050** |
| Possession of animals | 0.6562676 | -0.4211867 | 0.2414371 | 0.081* |
| constant | | -0.9476864 | 2.256896 | 0.675 |
| | | | | |
| Log likelihood | -18.338681 | | | |
| Number of observations | 39 | | | |
| LR Chi Square | 16.12 | | | |
| Prob > Chi Square | | | | 0.0643* |
| Pseudo $R^2$ | 0.3054 | | | |

***P<0.01, ** P<0.05, *P<0.1

TABLE 6. Determinants of adaptation to climate change among male headed households in Eastern Uganda

| Explanatory variable | Odds ratio | Estimated coefficient | SE of coefficient | p>\|z\| |
|---|---|---|---|---|
| Household size | 1.03609 | 0.0354537 | 0.0670126 | 0.597 |
| Land size(LAND) | 1.131967 | 0.1239571 | 0.0832019 | 0.136 |
| Purchase inputs(PINP) | 2.770402 | 1.018992 | 0.7857697 | 0.195 |
| Education | 0.8665459 | -0.1432402 | 0.0915734 | 0.118 |
| Access to credit(ACRED) | 2.634963 | 0.9688691 | 0.6215418 | 0.119 |
| Land ownership (LO) | 0.1116958 | -2.191977 | 0.7464539 | 0.003*** |
| Possession of bicycle(BI) | 1.07304 | 0.0704953 | 0.4722129 | 0.881 |
| Radio (RAD) | 0.7831291 | -0.2444577 | 0.4266639 | 0.567 |
| Possession of animals | 1.094864 | 0.0906301 | 0.1488075 | 0.542 |
| constant | | 1.265501 | 1.199354 | 0.291 |
| Log likelihood | -40.177942 | | | |
| Number of observations | 86 | | | |
| LR Chi Square (11) | 21.48 | | | |
| Prob > Chi Square | | | | 0.0107** |
| Pseudo $R^2$ | 0.2109 | | | |

*** P<0.01, ** P<0.05, *P<0.1

Possession of animals also became significant in the gender disaggregated model and it negatively influenced the climate change adaptation decision of female headed households.

Meanwhile, only land ownership was found to negatively and significantly influence the decision to adapt to climate change among male headed households (Table 6).

## DISCUSSION

Female-headed households were less likely to adapt to climate change compared to their male counterparts. A study by Tenge *et al.* (2004) found that female headship negatively influenced adoption of technologies because female heads have less access to land, and other resources due to traditional social barriers. Earlier gender studies (IFPRI, 2001; Meinzen-Dick *et al.*, 2010) also highlighted unequal distribution of assets between men and women in rural households, which favour or constrain their adaptive capacities. On the contrary, Nhemachena and Hassan (2008) found that female headed households were more likely to take up climate change adaptation methods in the Nile basin of Ethiopia. This seems to suggest that the influence of gender on adaptation varies among cultures and social structures.

The ease of mobility accorded by the presence of a bicycle (the main mode of transportation in the rural areas) and purchased farm inputs positively influenced the decision for female headed households to adapt to climate change. Besides productive resources, women own fewer working animals and are less likely to use modern inputs and mechanical tools (Blackden and Wodon, 2006). Also, because they spend a lot of time on time consuming activities such as fetching water and collecting fire wood, labour saving technologies such as bicycles and animal draft technology are of great relevance to the household both for the farm activities such as transporting harvest, and easing market access (Hill and Vigneri, 2009).

Contrary to other empirical evidence, land ownership had a negative influence on the decision to adapt to climate change for both pooled data and for male heads of household whereas it was not significant for female-headed households (Tables 4 and 6). This result underscores earlier observations and empirical findings linking land ownership and control to men than women. This result further suggests that as far as climate change adaptation is concerned, men seem to base their decisions on land, while female household heads base their decision on various other factors. What is less

clear is why land would negatively influence the climate change adaptation decisions of male heads of household.

A study by Advancing Capacity to Support Climate Change, (ACCCA, 2010), reported that large farm size positively influenced adoption of soil and water conservation, tree planting and use of improved varieties. Daressa *et al.* (2009) also reported that land size represents wealth, an argument also emphasised by Knowler and Bradshaw (2007) and Bashaasha *et al. (*2010). A possible explanation for our result is that land owners were most likely renting out their land to the land less in order to generate more income for the household.

Meanwhile, possession of both animals and a radio had a negative and significant influence on female heads' decision to adapt to climate change (Table 5). Although the radio was reported as a major source of climate information, farmers doubted the reliability of this information. The reason why possession of animals would negatively influence the decision of female heads of household to adapt to climate change is less clear.

Access to credit, which also represents the ability to purchase inputs, positively influenced the decision to adopt a climate change adaptation practice in the pooled data (Table 4). Access to credit increases financial resources of farmers, reduces cash constraints and allows farmers to purchase inputs (Benhin, 2006; Daressa *et al*., 2009; Gbetibouo, 2009) such as drought tolerant varieties. Although male-headed households were more inclined to borrow and purchase inputs possibly because of the ability to secure credit using collateral such as land and animals, this increase in credit access did not increase their probability to adapt to climate change. The borrowing could indeed be for other household needs.

## CONCLUSION

The study highlights the gender differences in climate change adaptation decisions in eastern Uganda. The research has shown that the factors that influence the climate change adaptation decisions of female heads are different from those that influence the adaptation decisions of male heads. The results suggest that the climate change adaptation decision of female heads is more sensitive (to factors) than that of male heads. Beyond gender of the head of the household, the climate change adaptation decision of female heads appear to be influenced by more liquid household assets compared to the decision of male heads which appears to be influenced by real estate, especially land. Other demographic factors appear to play no significant role in influencing climate change adaptation decisions for both female and male heads.

These results underscore the need for gender differentiated interventions to promote/ incentivise climate change adaptation. The results further suggest that the traditional aid interventions centered around enhancing the household asset base may have a higher propensity to encourage or foster climate change adaptation among female heads than male heads. The analytical approach of this study has also demonstrated the value of gender disaggregated analysis as an approach to achieving a more in-depth and better understanding of the climate change adaptation covariates.

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