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Household's socio-economic factors influencing the level of adaptation to climate variability in the dry zones of Eastern Kenya

E.W. Mugi-Ngenga [a, c, *], M.W. Mucheru-Muna [a], J.N. Mugwe [a], F.K. Ngetich [b], F.S. Mairura [a], D.N. Mugendi [b]

[a] Kenyatta University, P.O. Box 43844-00100, Nairobi, Kenya
[b] Embu University College, P.O. Box 6-60100, Embu, Kenya
[c] International Plant Nutrition Institute, P.O. Box 30772-00100, Nairobi, Kenya

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ABSTRACT

Climate variability has a negative impact on crop productivity and has had an effect on many small-holder farmers in the arid and semi-arid lands (ASALs). Small-holder farmers in Eastern Kenya are faced with the constraint associated with climate variability and have consequently made effort at local level to utilize adaptation techniques in their quest to adapt to climate variability. However, documentation of the factors that influence the level of adaptation to climate variability in the study area is quite limited. Hence, this study aimed at assessing how the household's socio-economic factors influence the level of adaptation to climate variability. The study sites were Tharaka and Kitui-Central sub-Counties in Tharaka-Nithi and Kitui Counties of Eastern Kenya respectively. The data collected included the household demographic and socio-economic characteristics and farmers' adaptation techniques to cope with climate variability. Triangulation approach research design was used to simultaneously collect both quantitative and qualitative data. Primary data was gathered through a household survey. Both random and purposive sampling strategies were employed. Data analysis was done using descriptive and inferential statistics. Multinomial and Binary logistic regression models were used to predict the influence of socioeconomic characteristics on the level of adaptation to climate variability. This was done using variables derived through a data reduction process that employed Principal Component Analysis (PCA). The study considered five strategies as measures of the level of adaptation to climate variability; crop adjustment; crop management; soil fertility management; water harvesting and crop types; boreholes and crop variety. Several factors were found significant in predicting the level of adaptation to climate variability as being either low or medium relative to high. These were average size of land under maize; farming experience; household size; household members involved in farming; education level; age; main occupation and gender of the household head. Household socio economic factors found significant in explaining the level of adaptation should be considered in any efforts that aim to promote adaptation to climate variability in the agricultural sector amongst smallholder farmers.

1. Introduction

Climate variability has negative effects on agricultural productivity according to Manneh et al. (2007); Rarieya and Fortun (2009), thus the need for small-holder farmers to devise adaptation measures (Omoyo et al., 2015). As was noted by Chang'a et al. (2010) small holder farmers suffer the adverse effects of climate variability. These farmers have characteristically adopted adaptation strategies at local level. In sub-Saharan Africa, adaptation is critical as highlighted in IPCC (2013) not only because of the existing poverty but also because of the large uncertainty on the effects and the magnitude of climate variability.

The ability of small-holder farmers to adapt to the effects of climate variability is influenced by many factors which include socio-economic characteristics, IPCC (2014) of a household such as household size, age, gender, education level and marital status of

* Corresponding author. International Plant Nutrition Institute, P.O. Box 30772-00100, Nairobi, Kenya.
E-mail address: mugiesther@gmail.com (E.W. Mugi-Ngenga).

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the household head (Opiyo et al., 2015). These factors vary between individuals and within communities, countries and regions (Eriksen et al., 2011). For instance, education of the household head increases the probability of adapting to climate variability Deressa et al. (2009) due to the fact that exposure to education increases farmers' ability to access, process and use information relevant to adaptation to the effects of climate variability (Nkonya et al., 1997). It has also been shown that more educated farmers are more exposed to understand new ideas and concepts related to climate variability (Nkonya et al., 1997). Gender, especially of the household head is also considered to influence the uptake of adaptation strategies (Nhemachena and Hassan, 2007). In respect to gender of the household head, Asfaw and Admassie (2004) asserts that male headed households are more likely to access information on the availability of new technologies than female headed households. In addition to this, having a female heading a household may have negative effects on the adoption of coping strategies to climate variability such as soil and water conservation measures. This is due to the fact that women may have limited access to information, land and other resources due to traditional social barriers Tenge et al. (2004). Conversely, Nhemachena and Hassan (2007) argue that female headed households are more likely to adapt to climate variability by taking up coping strategies because they are responsible for much of the agricultural work thus have greater experience.

Age also appear to be a significant determinant of the level of adaptation to climate variability conditions (Roncoli et al., 2001). This varies with some studies showing a positive relationship between age and the level of adaptation to the effects of climate variability. According to Ziervogel et al. (2008), Ziervogel and Zermoglio (2009), older farmers are perceived to have a high decision making autonomy thus giving them added advantage when it comes to adaptability. However, a study by Shiferaw and Holden (1998) depicted a negative relationship between age and level of adaptation to the effects of climate variability, suggesting that older farmers may be less willing to take the risks associated with new technologies in regard to adaptation. Due to changes in the times, younger farmers also have access to education and exposure thus making them receptive to change (Roncoli et al., 2002 and Vogel and O'Brien, 2006). Household size is also a determinant of the level of adaptation to climate variability by small holder farmers. Tizale (2007) and Yirga (2007) noted that households with large families may be forced to divert part of their labor force to off-farm activities in an effort to earn extra income so as to ease the consumption pressure that is known to be imposed by a large family. On the other hand, large family size is associated with a higher labor endowment which would enable a household to accomplish various agricultural tasks that would serve as coping strategies to climate variability since they have large pool of labor during peak times (Croppenstedt et al., 2003; Dolisca et al., 2006; Anley et al., 2007; Nyangena, 2007).

A better understanding of how small-holder farmers in Eastern Kenya perceive climate variability and the ongoing adaptation measures was found crucial in promoting their successful adaptation since they rely mainly on rain-fed agriculture (Smithers and Smit, 2009). This is so that reliable adaptation options can be appropriately targeted. Small-holder farmers in the study area (farmers who produce relatively small volumes of produce, rely on rain-fed agriculture, are generally less well-resourced and may depend on family labor only) have tried to adapt to such conditions caused by climate variability such as drought and prolonged dry spells through the use of preparedness techniques in combination with conventional approaches. In this context, adaptation focused on maximizing yields by changing farming management practices through the use of various agricultural technologies which are aimed at increasing the growth of agricultural output. This was guided by Doward (2009) where poverty is stated to constrain farmers to move out of agriculture as the scope for stepping out of agriculture requires that farmers should move out of poverty first before moving into other enterprises (off-farm activities).

The technologies used in adapting to climate variability in Kenya includes adjusting the planting dates, crop varieties, crop spacing, and crop types, increasing the use of manure, water harvesting, digging boreholes, agroforestry, crop rotation and post-harvest management (Bryan et al., 2010) and are similar to those identified by Liebenstein and Marrewijk (2000); Mapfumo and Giller (2001); Eriksen et al. (2005); Stringer et al. (2009); Lin (2011); Milgroom and Giller (2013); IPCC (2014); Rurinda et al. (2014) in other countries. However, the factors that influence the use of these strategies as adaptation measures are not adequately documented.

Consequently, the objective of this study was to assess the influence of household's socio-economic factors on the level of adaptation to climate variability. Studying the factors that influence the level of adaptation to climate variability in the dry zones of Eastern Kenya was necessitated by the fact that small-holder farmers' responses to climate variability are dictated by a host of socio economic factors. Household characteristics for instance are known to influence the day to day farm operations and decision making. Knowledge of key socioeconomic factors influencing farmers' adaptability to climate variability can play a role in policy formulation to mitigate the effects of climate variability on small-holder agriculture (Deressa et al., 2009). Also, knowledge of these socioeconomic factors can play a role in assisting policy makers to strengthen adaptation by investing on them.

2. Material and methods

2.1. Description of the study area

The study was carried out in Tharaka and Kitui Central sub-Counties in Tharaka-Nithi and Kitui Counties respectively, in Eastern Kenya (Fig. 1).

Tharaka Sub-County lies in the Lower Midland 4 and 5 (LM 4 and 5) and Inner Lowland 5 (IL 5) agro-ecological zones (Jaetzold et al., 2006; Smucker and Wisner, 2008). The area experiences a bi-modal pattern of rainfall with mean annual rainfall of 200–800 mm per annum. The area has a mean annual temperature of 11–25.9 °C. During the 2009 Population and Housing Census, Tharaka Sub-County was recorded with a population of 130,098 persons and 27, 393 households (GOK, 2010). The predominant soil type is Ferralsols, highly weathered and leached acid infertile soil (Jaetzold et al., 2006). The major cropping enterprises are; millet (*Pennisetum glaucum*), cowpeas (*Vigna unguiculata*), pigeon peas (*Cajanus cajan*), green grams (*Vigna radiata*), sorghum (*Sorghum bicolor*), cassava (*Manihot esculenta*), maize (*Zea mays*), beans (*Phaseolus vulgaris*), mangoes (*Mangifera indica*), pawpaws (*Asimina triloba*) and bananas (*Musa* spp.).

Kitui-Central Sub-County lies in the Lower Midland 4 and 5 (LM 4 and 5) and Upper Midland 3 and 4 (UM 3 and 4) and Inner Lowland Ranching Zone (IL 6) agro-ecological zones (Jaetzold et al., 2006). The area experiences a bi-modal pattern of rainfall with mean annual rainfall of 500–1050 mm per annum. The area experiences a mean annual temperature of 16 °C–34 °C. It has a population of 447,613 persons with 38,377 households (GOK, 2010). The predominant soil types are Acrisols, Luvisols and Ferralsols (Jaetzold et al., 2006). The major cropping enterprises are; cassava (*M. esculenta*), pigeon peas (*C. cajan*), cow peas (*V. unguiculata*), maize (*Z. mays*), beans (*P. vulgaris*), green grams (*V. radiata*), finger millet (*Eleusine coracana*), cotton (*Gossypium hirsutum*) and mangoes (*M. indica*).