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# Evaluating factors influencing heterogeneity in agroforestry adoption and practices within smallholder farms in Rift Valley, Kenya

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ABSTRACT

Understanding the structure, densities and utilization of tree populations in agricultural landscapes is useful in determining the species influencing agroecosystem function. Our study evaluated agroforestry adoption and practices within smallholder farms in a former large-scale maize growing area of Trans Nzoia County, Rift Valley Province, Kenya. This was followed by investigation of factors influencing heterogeneity in the adoption and practices. The factors include: household resource endowment, land tenure and time under current management. Five settlement schemes which were formerly large estates dominated by maize mono-cropping were selected for the current study. Tree inventories of the farms were obtained through transect walks across each settlement. A total of 123 farms were assessed representing households of different resource endowment levels, tenure and number of years under current management. Different analyses were carried out including farm size and tree number, tree density, tree diversity and utilization of the dominant tree species. In total, we identified 44 tree/shrub species, 24 of which were indigenous and the rest exotic. However, the exotic tree species dominated strongly in abundance with *Eucalyptus* spp. being the most frequent taxon and constituting 34.6% of all trees. Species richness was found to be low compared to other agricultural landscapes in the region. Resource constrained households were found to prefer fruit tree species and maintained high tree diversity on their farms. Households with secure tenure had higher tree diversity than those without who had higherspecies richness and opted for fast growing fodder and fertilizer/firewood trees. Younger farms had fewer trees but higher species richness than older farms. The study, therefore, explains heterogeneity in agroforestry adoption in terms of variation in household resource endowment, land tenure and time under current management levels.



## 1. Introduction

Agriculture is the backbone of the economies of East African countries and is dominated by smallholder farmers who occupy the majority of the land and produce most of the crop and livestock products (Salami et al., 2010). In Kenya, 75% of national agricultural share contribution to economy in 2007 was from smallholder farmers with mean farm size of 2.5 ha (FAOSTAT, 2009). This reality underpins the importance and prevalence of small-scale farming activities in the country whereby efforts aimed to increase the agricultural productivity is often directed to small-scale farmers.

One major challenge in managing the smallholder farms in the region is to meet the ever-growing demand for agricultural products while conserving biodiversity, providing critical ecosystem services, and maintaining rural livelihoods (Barrios, 2007; Harvey et al., 2008). However, agricultural landscapes where small-scale farming is significant have been noted for their potential for tree (Lengkeek et al., 2006; Kindt et al., 2007), soil biota (Barrios et al., 2012), bird (Komar, 2006), insect (Armbrecht et al., 2006; Perfecto et al., 1996), mammal (Gallina et al., 1996), and orchid (Solis-Montero et al., 2005) biodiversity conservation in the tropics.

Agroforestry can be utilized as an integrated approach which combines sustainable agricultural production and biodiversity conservation (Pretty et al., 2006; Mbow et al., 2014). It has also been recognized as a key natural resource management strategy in addressing the millennium development goals (Garrity, 2004). The

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decisions to adopt resource-conserving practices like agroforestry are largely driven by expected contributions to increased productivity, output stability through risk reduction, and enhanced economic viability compared to other land management alternatives (Mercer, 2004). The pattern of resource availability and allocation to different activities, however, is determined by household resource endowment and depend on household priorities and production strategies (Tittonell et al., 2005).

Land insecurity is a major problem in many countries in Sub Saharan Africa (Namubiru-Mwaura and Place, 2013). The constraints related to the tenure system, such as insecurity of land tenure, unequal access to land and lack of a mechanism to transfer rights and consolidate plots, have resulted in under-developed agriculture, high landlessness, food insecurity, and degradation of natural resources in East Africa (Salami et al., 2010). However, farmers have been reported to initiate long-term investments in farms such as tree planting where individualized rights are established (Deininger and Ali, 2007).

Furthermore, the available land in East Africa is overly subdivided into small and uneconomic units, resulting generally in fragmented production systems and low productivity (Salami et al., 2010). The fragmentation is an on-going process where settling of new landowners leads to differences in period of occupation by current household. This process is driven by population growth, local inheritance systems or/and government policy on land resettlement. As observed by Lengkeek et al. (2006), few studies are currently documenting the variation in number, diversity and utility of trees maintained on-farm during the development of agroforestry systems. Such information is important in supporting the design of agroforestry systems that are better adapted to face changing environmental challenges and farmer requirements.

The adoption and management of trees in agricultural fields, defined here as agroforestry, is therefore hypothesized to be largely influenced by household resource endowment, land tenure and also the period of occupation by current households. Differences in adoption levels are expected to contribute to various agroforestry configurations characterized by the number, density, diversity and utility of trees maintained on farms.

The specific objectives of this study were to: (i) assess the characteristics of agroforestry practices in smallholder farms representative of agricultural landscapes in Rift Valley, Kenya, (ii) evaluate the influence of household resource endowment on tree number, density, tree diversity, and utility of existing trees, (iii) investigate the influence of land tenure on tree number, density, tree diversity, and utility of existing trees, and (iv) establish the contribution of the period of time under current management on tree number, density, tree diversity, and utility of existing trees.

The study hypothesizes that: (i) small-scale farming results in increased tree density and diversity which is closely linked to their potential uses, (ii) households with low resource endowment have greatest tree density and diversity given the preferential planting of high value trees for timber and fruit to supplement their income and family nutrition, (iii) households with secure land tenure increase long term investment in their farms by maintaining more timber trees, and (iv) increasing time under current management of smallholder farms results in greater tree count and diversity, and increased number of species for each utility class.

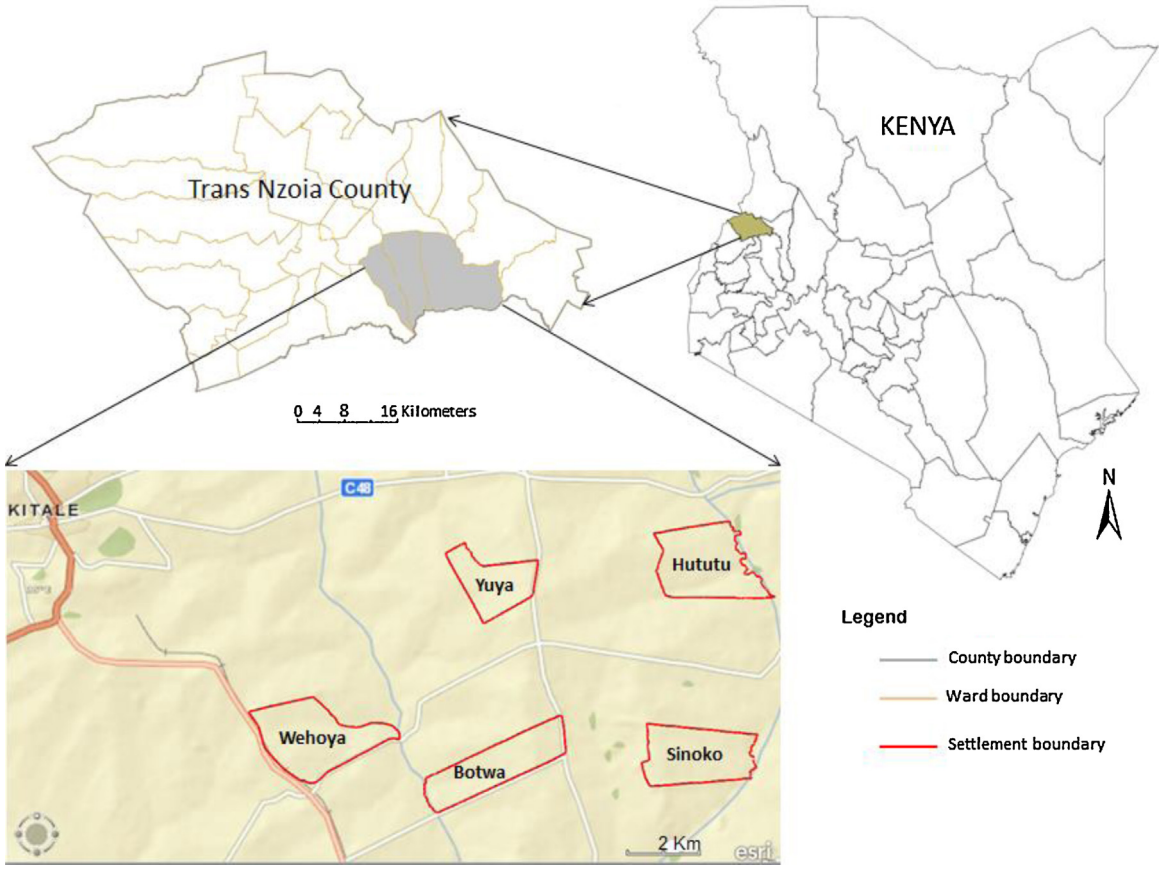


**Fig. 1.** Map of the study site of showing the five settlements in Trans Nzoia County in Rift valley Province of Kenya.