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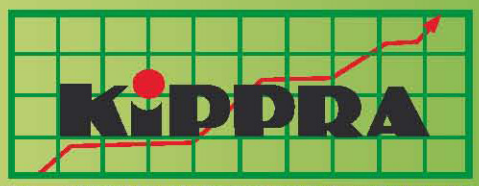

The KENYA INSTITUTE for PUBLIC POLICY RESEARCH and ANALYSIS

Effects of Forest Co-management on Adoption of On-Farm Tree Planting: Evidence from Selected Sites in Kenya

Joshua Laichena and John Nyangena

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Abstract

This paper investigates the effect of participation in forest co-management on adoption of on-farm tree planting in four forest sites in Kenya. In all sites, Aberdares, Cherangany, Kakamega and Arabuko-Sokoke, devolution of decisions on forest management to Community Forest Associations (CFAs) were tested under the forest reforms. The forest reforms implemented through the Forest Act 2005 assumed that co-management would deflate forest pressure by encouraging on-farm tree planting as an alternative source of forest products. The objective of the study was to examine the extent of forest co-management and the effect of co-management on adoption of on-farm tree planting in Kenya. The study draws on data collected from 475 households in 2015 to perform an Ordered Logistic Regression. The findings show that although co-management has enhanced community participation in forest management through CFA, much of the powers and authority on forest resources is retained by the Kenya Forest Services. Reluctance by KFS to cede power to CFAs constrains their effectiveness in managing forest resources. The OLR results show that education, training, extension service and age increase the likelihood of on-farm tree adoption, while participation in CFA does not. Analysis of Marginal Effects indicate that a unit change in extension service increased the likelihood of high adoption of on-farm tree planting by 20.6 per cent while education increased the likelihood by 3.6 per cent. Participation in co-management reduced the likelihood of high on-farm adoption by 28.4 per cent, implying high dependence on common forest resources by CFA members. These findings suggest that although current forest co-management arrangement offer opportunity for community training and extension, they do not facilitate adoption of on-farm tree planting. It is recommended that co-management be strengthened to ensure real transfer of decision-making to forest communities. In addition, CFAs should be encouraged to integrate training and extension services on on-farm tree planting as part of their regular activities.

Key Words: *Co-management, Forest reform, On-farm tree planting, Technology Adoption, CFA.*

Abbreviations and Acronyms

CBOs	Community-Based Organizations
CFA	Community Forest Association
CPR	Common Property Resources
DRSRS	Department for Resource Survey and Remote Sensing
EfD	Environment for Development
FGD	Focus Group Discussion
IDT	Innovation- Diffusion Theory
KFS	Kenya Forest Service
KFWG	Kenya Forest Working Group
KWS	Kenya Wildlife Service
NGOs	Non-Governmental Organizations
NTFPs	Non-Timber Forestry Products
OLR	Ordered Logistic Regression
PFM	Participatory Forest Management
SDGs	Sustainable Development Goals
TAM	Technology Acceptance Model
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
WMO	World Meteorological Organization

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1. Introduction

1.1 Background to the Study

Rural households in most developing countries mainly depend on forests for the provision of a variety of products that are critical for their livelihoods, such as fodder for animals, fuel wood for domestic energy, building materials among others. Forests can be regarded as "common pool resources", which create interdependencies among community members that may results from open access to the resource. Common pool resources which include open-access resources and common-property resources (CPR) are essentially characterized by divisibility aspect; that the use by one person diminishes benefits that others might enjoy especially if many of the community members use the resource. With open access, if the resources have got value, the community will overuse the resource and will eventually degrade the resource to the point it ends up being worthless. Thus, the classic example of the proposition by Hardin (1968) of the tragedy of the commons is as relevant today in the twenty first century as it was in the 1900. However, the problem of the common pool resource such as forests can be eliminated through appropriate institutional arrangement (Stavins, 2011; Mekonnen and Bluffstone 2017).

As Bluffstone and Mekonnen (2017) observe, most developing countries' forests are owned by the government, who typically have limited capacity to effectively manage and protect forest resources and as a result, government-owned forests are effectively open access resource. To reduce the open access problems, there has been a growing trend worldwide towards decentralization of forests management to communities with joint or co-management of the forests. Ideally, the decentralization through community participation has been driven by the belief that resting the decision making closer to where forest management and use occurs and involving communities will result in a more ecologically and socially desirable outcomes (Denoon, 2000; Harris, 2014).

It is now acknowledged by many scholars that community participation is a key policy discourse. Indeed, several international policy instruments have served to reinforce this consensus, such as the Dublin Principles for Water Governance (WMO, 1992) and Aarhus Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters, (UNECE, 1998). These instruments emphasize community participation as one of the key pillars for effective and equitable resource governance.

A key element of decentralization is the transfer of power over forest decision making from state to lower units such as provinces, districts, wards, villages, or user groups (Brown and Bosworth, 2007; Jens, 2018). The concept of co-management is one such form of decentralization that incorporates community participation conferring responsibilities and skills to local communities to undertake joint management of a given resource (Ballet et al. 2009 and Berkes, 2009). While there is no agreed definition of co-management (Armitage et al., 2007; Berkers, 2009), the term broadly refers to an approach where two or more social actors negotiate, define and guarantee among themselves a fair means of sharing the management functions, entitlements and responsibilities for a given territory, area or set of natural resources (Feyerabend et al., 2000). The term has been around for decades, and it has changed in theory, practice and terminology and the term now falls under many labels, including community-based forest management and conservation (Bahuguna, 1994; Cronkleton, 2011), community-based ecosystem and natural resource management (Khatun et al., 2015; McCall, 2005), sustainable forest management (Skutsch et al., 2015), joint forest management (Newton et al., 2016), and participatory forest management (Loaiza et al, 2016). Co-management enhances common property rights, leading to better resource management (Berkes, 1989; Bromley and Cernea, 1989 and Ostrom, 1990; McKean, 2000). Underlying co-management is the premise that sustainable forest management is likely to be realized when communities participate in the management of local forests and derive direct benefits from participation (Agrawal and Ostrom, 2001; Ostrom, 1990).

Co-management of forest through involvement of communities as a means of simultaneously keeping land forested and allowing activities that contribute to the livelihood of communities has been attempted to varying degrees of success. The co-management arrangements have resulted from the realization that local communities have roles to play in resource management, conservation, and development, but also on the reality that forest-dependent communities have demanded recognition of their rights and have been increasingly difficult to exclude (Cronkleton et al., 2011). Further, transferring rights to community level stakeholders provides access to detailed local knowledge necessary for good management decisions and involves local interest groups that could do a better job than forest bureaucrats, making standardized decisions in national or regional level offices.

Despite its widespread application in environmental policy, the practice of forest co-management has been criticised on account of its lack of effectiveness in delivering sustainable resource management outcomes and increasing benefits to the communities (Blaiker, 2006). This is attributed to inadequate legal provisions to guarantee the rights and responsibilities of communities and weak benefit

sharing arrangements (Lowe and Ombai, 2013). Other studies conclude that co-management has not materialized on the ground that substantive changes in rights and access to resources has not taken place in areas where it has been implemented (Chomba et al., 2015). These contrasting experiences point to gaps in the literature on the factors responsible for successful forest co-management.

1.2 Statement of the Research Problem

Previous studies about forest co-management have focused on traditional agroforestry practices and biodiversity conservation (McNeely and Schroth, 2006; Bhagwat et al, 2008 and Jose, 2012), analyzing potential effects of decentralization reforms and local community involvement in forest management (Getz et al., 1999). Others have concentrated on economic benefits of participating in forest co-management (Mogaka et al., 2001; Matiku et al., 2013; Ogada, 2012;) and impact of participatory forest management (PFM) on the wealth of households (Matiku et al., 2013). Very few or no studies have focused on the role of forest co-management in influencing farmers behaviour on on-farm tree planting for members and non-members of CFA. Those that have focused on on-farm tree planting (Meijer et al., 2015) lack empirical evidence on household participation in co-management and changes on on-farm trees planting. The Forests Act 2005, Section 57 restricts communities' access to forest products unless authorized by the Kenya Forest Service. Ideally, reduced access from the forest is expected to create a gap in forest products by the communities, thereby encouraging adoption of on-farm tree planting which eventually would result in overall improvement in forest health. Thus, it is not clear whether co-management and the expected reduction in access to benefits from the forest would influence adoption of on-farm tree planting by both members and non-members of Community Forest Association (CFA). Thus, arising from this lacuna, this paper contributes to the knowledge by examining the potential for forest co-management in incentivizing households to adopt on-farm tree planting on their own farms.

1.3 Research Objectives

The overall objective of this research was to examine the effect of forest co-management on adoption of on-farm tree planting in four forest sites in Kenya. The specific objectives are to:

1. Assess forest co-management practices across selected forest sites in Kenya.

2. Analyze the effect of co-management on adoption of on-farm tree planting among members and non-members of CFA.

1.4 Research Questions

The overall research question is "does forest co-management influence or facilitate adoption of on-farm tree planting among forest communities in Kenya?" specifically,

1. Which factors influence farmer's participation in forest co-management in Kenya?
2. To what extent does forest co-management influences farmers behaviour on on-farm tree planting?

1.5 Justification

Prior to the commencement of the forest reforms, the rate of forest loss in Kenya was a source of great concern to government and other stakeholders. The Forest Act, 2005 was developed to curb the menace by introducing forest co-management through formation of CFA to increase community's participation in decision making regarding the management and use of resources from the adjacent forest. The reforms and specifically forest co-management were premised on the basis that greater community participation in forest management would improve access to forest resources and benefit them from capacity building initiatives that would enable them to engage in other means of livelihoods, such as on-farm tree planting to improve their well-being, thereby deflating pressure from forest resources. However, participation in co-management is unlikely to bring about the intended outcomes because decisions on the use of forests products are retained at the government agency (Ming'ate et al., 2014), in case of Kenya the KFS. Where they may have succeeded, the benefits accruing to the communities are often limited to subsistence and Non-Timber Forest Products (NTFPs), which have low financial value (Mogoi et al., 2012).

Linking forest co-management and adoption of on-farm tree planting is an area of immense policy interest, yet few empirical studies have delved deep on this subject. The knowledge of the effect of co-management on farmer's adoption of on-farm trees is important in three respects. First, it enables policy makers and programme managers to evaluate the reform process in the forest sector. Second, it provides evidence-based understanding upon which programmes can be designed and evaluated on sustainable forest management. And third, adoption of on-farm

tree planting is important towards attainment of the 10 per cent government policy on tree cover target and achievement of the Sustainable Development Goals (SDGs) 12, 13 and 15.

The rest of the paper is organized as follows: The next section discusses forest reforms in Kenya and the practice of Community Forest Association. Section 2 presents the literature review related to forest co-management, drawing from empirical analysis. Section 3 describes the study sites, population, data collection, and the analytical framework. In section 4, we present the results and finally section 7 concludes and discusses policy implications of the findings and recommendations thereof.

1.6 Overview of Forest Reforms in Kenya

Kenya's forest sector operated without a formal forest policy until 1957 when the White Paper No. 85 of 1957 was published that outlined ten principles on forest management: Reservation; Protection; Management; Industry; Finance; Employment; African Areas; Private Forests and other forests not Under State Ownership; Public amenity and Wildlife Research and Education. The first principle was restated as a policy in 1968 through Sessional Paper No. 1 of 1968 and adopted as the Forests Act 385. The Act provided for the development of the Kenya Forestry Master Plan and establishment, control and regulation of central forests and forest areas in Nairobi and on unalienated government land under the Forestry Department. Under this governance regime, access to state forests was tightly controlled by forest guards who ensured continued forest health through exclusion, and only activities approved by the Forest Department were carried out. Forest neighbouring communities and other stakeholders were mere spectators in forest management. In the 1970s and 1980s, Kenya was rated highly alongside countries such as Chile in plantation development (Ogweno et al., 2009).

Most problems in the forest sector can be traced to the period 1990s and 2000 following extreme plundering and mismanagement of forests. The total area of closed forests, for example in 1962 was 6,500 square miles (1,683,500 ha), excluding internal grasslands, representing 2.7 per cent of the total land area (KFS, 2005). Estimates based on remote sensing indicate that Kenya's closed forest cover was 1.7 per cent in 2001 (UNEP, 2001). The problems facing the forestry sector are therefore partly due to historical load and general poor governance, which are not only forest sector problems. The rate of forest degradation and destruction is estimated at about 12,000 hectares annually, resulting from a combination of factors such as policy failure, corruption, expansion of agriculture and human settlement (Mogoi et al. 2012; Wass, 2000). The high rates of deforestation

combined with the exclusion of local communities from forest reserves motivated reforms undertaken in the sector over the past decades.

In response, radical reforms were introduced in the sector vide the Forests Act 2005 and became effective in 2007. Unlike before, the Act established the Kenya Forest Service (KFS), a semi-autonomous government agency managed by a board as the principal agency on forest matters. The Act provided for KFS to devolve powers to other stakeholders including CFAs to support protection and conservation efforts through a legal agreement (Republic of Kenya, 2007). Reforms in the Forest Act were emphasized in the Constitution of 2010 through devolution of natural resource management and the need to achieve 10 per cent forest cover. A similar target is set for on-farm trees through the farm forestry rules (Republic of Kenya, 2009). In Kenya, for example, until 2007, state forest management objectives mostly excluded local resource users from forest decision-making. There were minimal and stringent provisions for subsistence extraction and use of forest products. In general, the Forest Department (now the Kenyan Forest Service (KFS) has wielded tremendous power and authority over forest resources, with no accountability to local communities living adjacent to forest areas and decision-making in the Forest Department has been quite hierarchical.

The Forests Act, 2005 provides for Participatory Forest Management (PFM) as a framework upon which forest neighbouring communities participate in forest management through formation of Community Forest Associations (CFAs). CFAs are established to protect concession area from destruction and encroachment; ensuring forest area is maintained for the conservation of biodiversity, cultural or recreational use; maintaining the physical boundaries of the concession; and to take precautions to prevent occurrence and spread of forest fires (Republic of Kenya, 2005). In return, communities would benefit through improved access to forest resource and training on farm agro-forestry. Thus, co-management would be a channel for adoption of on-farm tree planting for participant members (Ajayi et al., 2009), ease pressure on the forest (Reyes, Quiroz and Msikula, 2005), and increase household income through sale of fruits, poles and firewood. Proponents of co-management argue that forest benefits to communities is contingent upon their participation level, although these benefits vary across countries and are location-specific (Mwangi et al, 2011). At times, the net benefits flow to a section of the community, leaving out others (Jumbe and Angelsen, 2007), therefore studies should incorporate the effect of location in the design.

1.7 Management, Practice and Membership into the CFA

The engagement of communities in forest management through CFA is provided for in the Forests Act 2005 Section 46(1). Accordingly, members of the forest community may come together with other residents in the same area and register a CFA under the Societies Act. The association so registered then applies to Kenya Forest Service for permission to participate in forest conservation and management in their local forest in accordance with the provision of the Forests Act. The membership into CFA may be through existing community structures e.g. community-based organizations that may be formal or informal. Association members pay user fees to access benefits from the forest. Paid up members are issued with a receipt as a proof of user rights. CFA's are managed by a committee whose membership is 9 persons, with 5 being officials (chairperson, vice chairperson, treasurer, secretary and vice-secretary) who are also signatories of the association's bank account. The association has by-laws that cover meeting attendance, election of officials and other rules that are followed by the members. The association also has guidelines for the activities that the group carries out in the forest. The motivating factor for CFA members to voluntarily participate in the management of the forest is the expected freedom to access forest resources for non-timber products and the hope of being allocated degraded portions of the forest land to farm.

2. Literature Review

2.1 Introduction

This section provides a review of literature pertinent to an understanding of adoption of on-farm practices through forest co-management practices. It is divided into sections. The first section describes the theoretical foundation underpinning adoption of farm technologies, while the second provides an empirical review of similar studies mainly from developing countries.

2.2 Theoretical Literature

Most literature on technology adoption analyze the factors influencing adoption from the perspective of inherent properties of the technology under consideration (such as complexity, cost, risk, stability and profitability) (Batz et al., 2003; Lee, 2005; Engler-Palma and Hoag, 2007). Adoption of on-farm tree planting by farmers through co-management is an innovation-decision process which fits within the Innovation-diffusion theory (IDT). IDT has been used in many disciplines to explain consumer acceptance and diffusion of technology (Amaro and Duarte, 2015, Hung et al., 2011, Jensen, 2009, Lee et al., 2011). IDT popularized by Roger (2003) holds that diffusion is a process in which an innovation is communicated through certain channels over time among the members of a social system, while adoption is the "full use of an innovation as the best course of action available" and rejection is a decision "not to adopt an innovation".

An innovation is adopted when a point of critical mass is attained. Within the IDT, the level of adoption is measured by the number of individuals who adopt the innovation in a given period categorized as either innovators, early adaptors, early majority, late majority, or laggards (Roger, 1995). Early adopters mainly comprise opinion leaders, who are role-models for other members of the social system and play an important role in getting an innovation to the point of critical mass, and hence, in the successful diffusion of an innovation. According to IDT, adoption of an innovation takes place in five stages:

Stage 1: Knowledge of the existence of the innovation, and some understanding of how it operates;

Stage 2: Persuasion to enable the individual form an attitude towards the innovation;

Stage 3: Decision-making when an individual engages in actions necessary to make a choice to either adopt or reject an innovation;

Stage 4: Implementation that involves putting an innovation into use; and

Stage 5: Confirmation which aims to buttress the decision already taken.

The second model, the Technology Acceptance Model (TAM) originally proposed by Davis in 1986 is widely used to explain why users accept or reject a technology. It holds that technology adoption and acceptance of a technology is influenced by perceived ease-of-usage and perceived usefulness (Bagozzi et al., 1992). According to Davis (1986), the earlier refers to "the degree to which an individual believes that adopting a particular technology or practice would be free from effort", while the later refers to "the degree to which an individual believes that adopting a particular technology or practice would enhance his or her job performance".

Further elaboration of TAM shows that social pressure can influence individual behaviour towards a technology (Ajzen, 1991). According to Park (2009), the factors influencing technology adoption fall into four categories: individual context; system context; social context; and organizational context. Social context means social influence on personal acceptance of technology adoption. Organizational context refers to level of influence or support an organization has on individual decisions on technology adoption. This depends on its relevance, visibility, and accessibility, and affects both perceived usefulness and perceived ease of use (Thong et al., 2002).

2.3 Empirical Literature

Co-management aims to contribute towards improved resource management and conservation of the environment. This study essentially attempts to understand how management of common forests affects outcomes achieved by CFA groups towards sustainable and manageable development of on-farm trees in reducing the impact of degradation and deforestation. In the study, co-management of forest resources is built on two main features of shared resources; first, subtractibility, which analyses the degree to which exploitation of a resource by an individual will subtract from another; and second, excludability, the ability to control the number of resource users in the production system. In the management of these two features, co-management of common forests is hypothesized to conserve/improve forest resources by encouraging forest users to use alternate sources for forestry-related products. The underlying assumption is that social networks, through Community Forest Associations, can have positive effects not just on community forest management, but also spillovers or externality effects through information flows that enhance private conservation effort, thereby enhancing on-farm tree planting.

In examining whether joint management of forest increases on-farm tree farming in Bolivia, Bluffstone et al, (2008) found that joint management at highest level of aggregation is positively correlated with more and high quality on-farm trees. Mekonnen et al. (2011) looks at tree planting in Ethiopia and finds that a variety of labour, asset and credit market imperfections affect on-farm tree planting. Hansen et al. (2005) highlight the importance of gender and marriage patterns in the tree planting decision. They find that unmarried women are associated with on-farm tree planting in Malawi. Studies by Nepal et al. (2007); Bluffstone et al. (2008), Hansen et al (2005) and Mekonnen et al, (2011) focus on incentives for planting and managing trees on households' own farms, and are therefore directly related to this study.

An assessment of co-management programmes in Kenya's Maasai Mara reveal that wealthier members of the community benefit more from wildlife income than the poorer members, with the top quartile (measured by household income) obtaining 60-70 per cent of overall wildlife income while the bottom quartile gets about 15 per cent (Thompson et al., 2009). Although the forest reforms have taken place in the recent past, there are concerns about whether the devolved forest management system is generating net benefits to the forest adjacent communities. While co-management increases community opportunities to engage in forest-based livelihood activities, such as bee keeping and butterfly farming, training opportunities seldom translate into changes in farm behaviour as funding for up-front investments are never provided (Himberg et al., 2009; Mogoi et al. 2012). Thus, community benefits are limited to subsistence and NTFPs with low financial value with wealthier members benefiting more (Thompson et al., 2009; Mogoi et al., 2012; Jumbe and Angelsen, 2006). On this basis, co-management practices would be evaluated on farmer behaviour and its implication on on-farm tree planting, an area that has so far received little attention.

A study by Oeba et al. (2012) found that household characteristics, farm attributes, management and marketability influenced farmer's decision on tree planting in Central Kenya. Other studies (Valdivia and Poulos, 2009; Arbuckle et al., 2009; Fabe and Grote, 2013) identified factors such as age, farm size, land value, erosion rate, land tenure, site description as important determinants of on-farm tree growing. A review of 120 cases by Pattanayak et al. (2013) found that farmer's capacity to adopt on farm technology can be explained by five factors: farmer preferences, asset endowment, availability of market, risk and uncertainty and biophysical factors. These factors can be measured by proxy variables of age, gender, education level, and social status. Thangata et al. (2002) concluded that farmer behaviour towards tree planting can be explained primarily by availability of land and farm labour.

In this paper, we define empowerment as the ability of local actors to carry out the directives from decentralization policies. Empowerment is concerned with "whether or not decision-making authority has actually been transferred (Samoff, 1990: 517)." Agrawal and Ribot (1999) differentiate between four types of powers: the power to create rules, the power to make decisions, the power to implement and ensure compliance to the new or altered rules, and the power to adjudicate disputes. Decentralization policies often do not empower local agents to autonomously meet decentralization objectives. Instead, decentralization often burdens local actors with additional responsibilities while either (1) withholding adequate funding to carry out these directives or; (2) failing to provide an institutional environment whereby local actors can generate such funding or create rules and make decisions themselves. Two key determinants of empowerment in terms of forest decentralization are capital transfers and the establishment of property rights (Agarwal and Ostrom, 2001).

3. Methodology

3.1 Description of Study Sites

The study was conducted in four forest sites (Aberdare, Cherangany, Kakamega and Arabuko Sokoke) in Kenya in the month of November to December 2015. The forests sites were selected to ensure representation of different agro-ecological zones of the country (See Appendix for detailed description of the study sites). The forest sites were also chosen because they were at different stages of implementing forest reforms. For example, Arabuko Sokoke is a coastal forest and was the first one where participatory forest management started prior to the Forests Act 2005 and, therefore, has a long history of community participation in forest management. Implementation of forest reforms in the Cherangany forest, on the other hand, only started about three years prior to this study in 2015.

3.2 Study Population and Sampling Procedures

Prior to the survey, boundaries of the CFAs were obtained from the KFS Station Managers and generally covered an area extending five (5) kilometres away from the forest boundary. A list of all households within each CFA was obtained from the village elders to constitute a sample frame. The information was verified by CBOs operating in the area. This information was used to distribute the sample size to the four study sites. In total, the entire sample size selected was 480 households distributed in the four study sites as follows: Kakamega and Cherangany 100 households; Aberdares 160 and Arabuko Sokoke 120 households. In each forest site, one to two CFAs was selected.

The study sample size finally interviewed comprised 475 households. Individual household was our focal unit of analysis. The household head or any member, 18 years and above with knowledge about forest reforms and farming activities, were chosen as respondents in each household. Specific households to be included as per the sample in each study site were determined using systematic random sampling technique by picking the first household unit in each CFA along a transect walk followed by the next 6^{th} household and so on. To ensure household homogeneity and to avoid error of bias due to geographical differences, we used a radius of up to two kilometres from the household to the forest. Those households who were members of CFA but dropped their membership were treated as non-CFA households. On average, the interview lasted for one hour. The distribution of the 475 households interviewed is as follows: Aberdares 156, Cherangany 93, Kakamega 103 and Arabuko Sokoke 124. Three households above the sample

in Kakamega and four in Arabuko Sokoke were interviewed. However, four (4) households in Geta CFA (Aberdares) were dropped because they were reported to have migrated to urban areas due to intense frost, and seven (7) households in Cherangany were also dropped because they could not be traced. Overall, the achieved sample was 475 households, 5 households less than the planned sample of 480 households.

3.3 Data Collection and Instruments

Primary data to evaluate the impact of forest co-management on on-farm tree planting behaviour was collected by use of semi-structured household questionnaire, with questions on respondents' observation of the changes in on-farm tree planting in and around their own farms in the preceding five years prior to the study in 2015. The questionnaire comprised three broad sections. Section one contained questions on personal and household characteristics, including age, gender, level of education, and assets. Section two contained information on farm size, crop enterprises, production, revenues and farm labour, while section three covered issues of membership to CFA, distance to the nearest edge of the forest, benefits and costs of participating in CFA and changes observed in on-farm tree planting. Secondary data was obtained through review of relevant literature such as policies and laws, journals, annual reports, books, and survey reports.

In addition, at least one Focus Group Discussion (FGD) per study site were conducted to clarify issues emanating from the household survey. Each FGD was attended by an average of 10 participants, carefully selected to represent various stakeholders from the CFA and the FDG were moderated by researchers from KIPPRA and EfD Kenya. Discussions were based on a pre-designed FGD guide that covered a range of issues on the effect of forest reforms, CFAs activities, relationship between CFA and KFS and KWS, and lessons and challenges in forest co-management. On average, each FGD discussions lasted two (2) hours.

3.4 Conceptual Framework

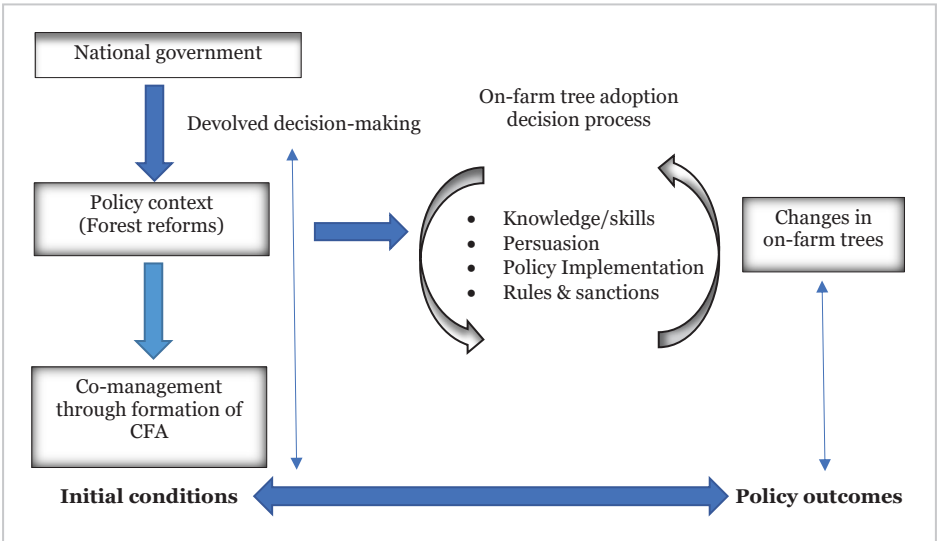
We used the theory of common property rights as our theoretical underpinning to understand the role of CFAs in contributing to sustainable management of forests and securing livelihood of the local communities. The term "common property regime" (CPR) represents a set of institutions, regulations and management practices subject to collective decision making. It is the regime that distinguishes common resources, such as forest resources from open access resources when it is unregulated and free for anyone to use. The theory provides an insight in the

analysis of the relationships, local people's participation, user rights and benefits from forest resource use. This theory sets the foundation for our study.

Conceptually, forest reforms are viewed as strengthening community participation in forest management through devolution of some decision-making powers to communities through CFAs comprising of community representatives. We note from the literature that institutions that exercise discretionary powers through elected representatives are bound to be responsive to the needs of their communities. Ensuring that local institutions have powers to make independent choices, or implement policies is an important milestone in forest management. Thus, CFAs are designed as avenues for promoting sustainable forestry and as instruments for innovative development. Individuals or forest user groups participating in CFAs are guided by a set of rules meant to promote sustainable forest management. The ability of CFAs to create knowledge, set rules, sanctions and rewards would influence individual farmers adoption and implementation of innovation on on-farm tree planting. Decisions to adopt or not to is reflected on changes in on-farm trees.

Evaluating the effect of CFA on farmer adoption of on-farm tree planting technologies should compare changes in initial and final conditions as elicited in the conceptual framework (Figure 1).

Figure 1: Conceptual framework on forest co-management



Source: Author's conceptualization

One of the expected outcomes of forest co-management was to ease forest pressure by promoting on-farm tree planting as an alternative source of livelihood. This

can be realized if decision-making on forest resources is devolved to communities and CFAs act as agents to facilitate adoption process.

3.5 Empirical Estimation

3.5.1 Empirical model

The factors determining on-farm tree planting were identified through literature review. The dependent variable (*On-farm trees*) is the perceived changes in on-farm tree planting by the respondents for the period prior to and after the establishment of the CFAs. The variable was categorized into three and assigned arbitrary codes, where 0=Less trees; 1=No change and 2=More trees (Table 1). We therefore specify our model in a functional relationship as follows:

$$Y = f(X) \quad \text{..... (1)}$$

Where Y is the perceived changes in *on-farm trees* and X is a set of explanatory variables.

Therefore, the empirical model to be estimated can be written as:

$$Y = \beta_0 + \beta_1(FARMSIZE) + \beta_2(GENDER) + \beta_3(CFA\_MEMBER) + \beta_4(EDUCATIONL) + \beta_5(TENURE) + \beta_6(AGE\_HHD) + \beta_7(AGE2\_HHD) + \beta_8(TRAIN) + \beta_9(EXTENSION) + \beta_{10}(REPLANT) \quad \text{..... (2)}$$

Where:

Y is changes in on-farm trees (the dependent variable)

Independent variables are:

FARMSIZE = farm size; GENDER = gender of the respondent; CFA_MEMBER = membership to CFA; EDUCATIONL = education level in years; TENURE = land tenure type; AGE_HHD = age of the household head; AGE2_HHD = square of the age of household head; TRAIN = training in tree planting; EXTENSION = extension services received; and REPLANT = replanting trees after cutting

The hypothesised relationship of independent variables in the model are:

a) Forest co-management practice, which is proxied by membership to CFA in which case membership to CFA can have mixed results. First, because the members can access resources from the forest, they may not have incentives to plant trees in their own farms. On the other hand, being a member of CFA

and having access to training and extension services can most likely motivate them to plant trees in their own farms. It is, however, expected that being a non-member and therefore not able to access benefits will most likely motivate them to plant trees in their own farms. Lastly, households residing away from the forest area are more likely to notice degradation and therefore trees in their farms to support their livelihood than those residing inside or near the forest.

b) Individual characteristics:

- **Age** of the household head: It is hypothesized that older household heads have long farming experience and are likely to engage in tree planting.
- **Gender** of the household head: It is assumed that male headed households are more likely to grow trees than their female headed counterparts.
- **Education** of the household head, where it is assumed that the more educated household are likely to embrace own farm tree planting than those with little or no education.

c) Skills in tree planting raises the probability of household's participation in tree planting in their own farms proxied by:

- **Training:** Access to information through short term training is assumed to positively influence the households to plant trees in their own farms.
- **Extension:** Access to advice from extension officers is assumed to motivate and influence households in planting trees in their farms.

d) Availability of space to plant trees including:

- **Farm size**, where households with large landholding are more likely to grow trees to conserve their own lands and the surrounding environment at large.
- **Tenure**, where state-owned land tenure system may lead to a decrease in the confidence of planting trees as opposed to individual land tenure.

Table 1: Description of the variables

Variable	Type of variable	Description and measurement	Expected sign
On-farm trees	Ordinal categorical	Changes in household on-farm trees resulting from CFA (0= less trees 1= no change 2= more trees)	Dependent
Farm size	Continuous	Size of household agricultural farm (acre)	+

Gender	Binary categorical	Gender of household head (M=1; F=0)	+
Age	Continuous	Age of household head in years	+
Age Squared	Continuous	Square of age variable	+/-
Education	Continuous	Number of years in formal education by household head	-
Membership to CFA	Binary categorical	Whether household belong to a CFA (yes =1; No=0)	+
Tenure	Binary categorical	Has land tenure (yes=1; No=0)	+
Training	Binary categorical	Member of household has received training on tree planting (yes=1; No=0)	+
Extension	Binary categorical	Household has received extension on tree management and planting practices (yes=1; No=0)	+
Replant	Binary categorical	Household replants / replaces cut trees (yes=1; No=0)	+
Forest location	ordered	dummy	

An Ordered Logistic Regression analysis was performed to fit a regression model. This model allows us to predict probabilities of changes in tree planting decisions (the outcome variable). Before model estimation, preliminary analyses were done to test presence of multicollinearity among explanatory variables. A tolerance value of collinearity diagnostics greater than 0.1 indicates no perfect multicollinearity between all the considered explanatory variables in the model.

4. Study Findings

4.1 Descriptive Statistics

The study elicited information from 475 respondents distributed as follows: Aberdares 32.9 per cent, Cherangany 19.6 per cent, Kakamega 21.6 per cent, and Arabuko Sokoke 26 per cent. Majority, 88.2 per cent were male while the rest 11.8 per cent were female. Most of the respondents interviewed were 36-60 years with 18.3 per cent aged above 60 years, who in Kenya are classified as elderly. None of the respondents were below 18 years of age. The distribution of respondents by age is summarized in Table 2.

Table 2: Distribution of respondents by age and study area (%)

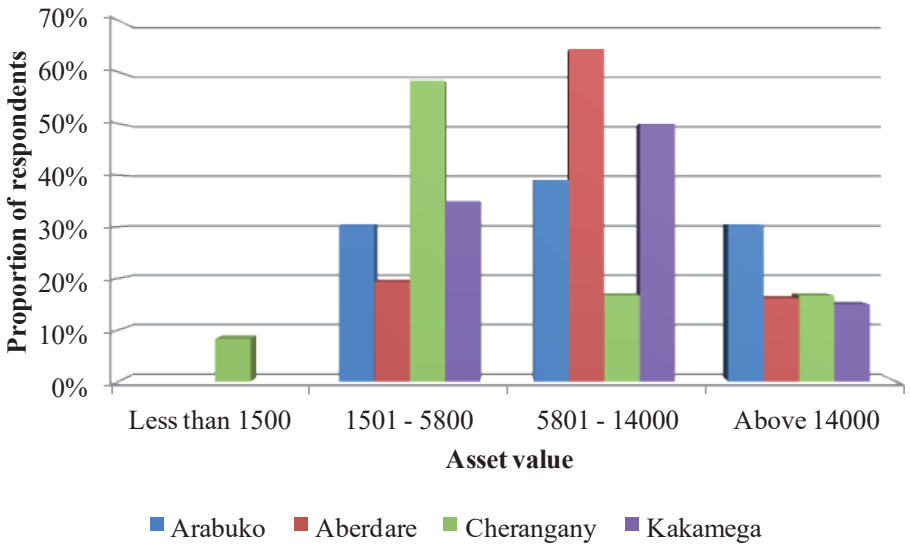
Age Category	Arabuko	Aberdares	Cherangany	Kakamega	Total
19 - 35	25.0	19.7	14.8	23.7	20.8
36 - 45	31.7	27.2	34.1	30.1	30.3
46- 60	33.7	32.0	27.3	28.0	30.6
Above 60	9.6	21.1	23.9	18.3	18.3
	100.0	100.0	100.0	100.0	100.0

Source: Computation from 2015 Survey Data

There were great disparities in levels of education across the study sites. In Arabuko Sokoke, 6 per cent of the respondents have no formal education, compared to 4.4 per cent in Kakamega, 3.8 per cent in Aberdares and 10.6 per cent in Cherangany. Arabuko Sokoke had the highest proportion of respondents with primary school education at 71.4 per cent, while Cherangany had the highest proportion of respondents with secondary school education at 35.5 per cent. A small number of respondents had tertiary level education in which Aberdares recorded the highest proportion, 9.1 per cent. It is worth noting that education is a key factor in adoption of technology, such as in agro-forestry.

Information on household assets obtained from respondents included radio, mobile phone handset and bicycle. The current price of each asset was estimated and the total value computed. These assets were included in the list because they were deemed basic items in many rural households. The results in Figure 2 show that none of the farmers in the regions had assets with value less than Ksh 1,500 except Cherangany which had 8 per cent of the farmers owning assets valued at less than Ksh 1,500. Arabuko Sokoke had the highest proportion of farmers (30%) with total assets exceeding Ksh 14,000.

Figure 2: Distribution of respondents' asset owned



Source: Computation from 2015 Survey Data

On-farm tree planting were the dominant livelihood activity practiced by 58.2 per cent of the farmers in all the study areas. It however varied from site to site, with 43.8 per cent in Arabuko Sokoke, 68.5 per cent in Kakamega, 54.5 per cent in Cherangany, and 62.9 per cent in Aberdares. The mean farm size for the study sample was 3.27 acres, with a minimum of 0 (for those referred as squatters living in the forest) and a maximum of 26 acre. The mean size, however, varied 2.30 acres for Kakagema, 3.38 acres in Aberadres, 2.23 acres in Cherangany and 4.99 acres in Arabuko Sokoke.

Farmers were asked to state if they belonged to any forest association. Majority at 43.2 per cent indicated that they were members of the CFA's and, therefore, participants in forest co-management, 10.5 per cent stated they belonged to a community-based organization, 18.8 per cent did not belong to any group and 6.3 per cent were members of a farmer group or cooperative. The remaining 21.2 per cent stated they had mixed membership in other community groups. In terms of CFA membership, Cherengany had the highest proportion at 67.1 per cent followed by Aberdares at 43.5 per cent, Arabuko Sokoke 41.9 per cent and Kakamega at 11.75 per cent of all the respondents.

These results show that CFA is yet to attain universal membership and more needs to be done. Mogoi et al. (2012) identified low incentives, power struggles, lack of goodwill from KFS, and weak leadership as the limiting factors towards universal CFA membership in Kenya. When asked whether CFA trained the

farmers on tree nursery management and tree planting, Cherangany returned the highest favourable response at 89.1 per cent followed by Aberdares at 81.1 per cent, Kakamega 80 per cent, and Arabuko Sokoke 72.2 per cent.

Information on benefits received from the forest was obtained from the respondents and the results show that 91.2 per cent received some form of direct benefits from the forests. Kakamega was the highest at 94.8 per cent followed by Aberdares at 93.9 per cent, Cherengany 90.9 per cent and Arabuko Sokoke 84.4 per cent. The type of forest benefits enjoyed by the communities are tabulated by forest sites and summarized in Table 3. The low access to a variety of benefits for Arabuko Sokoke may have been due to the fact that it is a conservation forest where exploitation is not permitted. Overall, firewood seems to be the highest benefit the community receives or access from the forest in all study sites.

Table 3: Type of forest benefits accessed by forest area (%)

	Forest Area				
Benefit type	**Arabuko**	**Aberdares**	**Cherangany**	**Kakamega**	**Total**
Firewood	92.10	80.00	69.10	78.20	79.70
Charcoal			1.20	1.30	0.50
Farmland	1.30	7.90	14.80	2.60	6.90
Timber		0.70	1.20		0.50
Medicinal herbs & aromatic plants		0.70	1.20	5.10	1.60
Fodder (cut and carry)				1.30	0.30
Grazing	3.90	6.40	12.30	9.00	7.70
Poles	2.60			1.30	0.80
Soil conservation		4.30		1.30	1.90
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Computation from survey data

To receive forest benefits, farmers were required to pay some fee and the survey data show that 87.5 per cent had paid some form of fee in the last 12 months preceding the survey. The mean fee was Ksh 2,061 per year but ranged from Ksh 1,081 in Arabuko Sokoke, Ksh 1,226 in Kakamega, Ksh 2008 in Cherangany and Ksh 3,388 in Aberdares. The maximum fee of Ksh 120,000 was recorded in Aberdares. Fee payment was cited as a constraint in accessing forest benefits, along with distance, forest degradation and bad relationship with KFS staff. In some cases, introduction of co-management has limited community benefits and access rights. This is because one cannot enter the forest to get resources at will as before. There is a price to pay unlike in the past. Collecting firewood for

commercial uses costs up to Ksh 600 per ton. However, no fee is paid for grazing and watering cows in the forest, but a permit or license is required for watering cows. Forest fires are very rare because of conservation efforts and monitoring of the forest by the CFA and the community. To mitigate forest fires, a curse is imposed by the community on the person who causes forest fires in the case of Cherangany forest site. In general, "the cost of accessing forest benefits is not easy to establish as the Act is not clear on the benefits from the forest", said one of the FGD participants in Kipkunus Beliomo, CFA in Cherangany.

Farmers who are participants in co-management receive training through their respective CFA to enable them discharge functions under the agreement signed with KFS. The trainings focus on fire management, tree nursery establishment, tree planting, and soil and water conservation. Civil society operating at local level were the main providers of these trainings, followed by KFS, and other government agencies such as the National Environment Management Authority and the Ministry of Agriculture. Members of the CFA who did not receive the training cited inadequate training providers, lack of awareness of the trainings and "don't think the training is necessary" as the main impediments to not receiving any training. Application of tree planting training was observed at the highest in Kakamega at 93.5 per cent followed by Aberdares at 90.7 per cent, Arabuko Sokoke 90.3 per cent and Cherangany with the lowest at 73.9 per cent. Lack of seedlings and/or cost of seedling and the time requirement for planting trees were the main reasons cited for non-application of tree planting. Similar studies have identified labour, implementation costs, and lack of know-how as factors hindering adoption of forest management (Gill et al., 2015).

Farmers were asked to state their observed changes in on-farm trees planted on and around their farms since they started participating in CFA activities. The results are shown in Table 4.

Table 4: Tabulation of changes on on-farm trees adoption (%)

Observed changes	Arabuko	Aberdare	Cherangany	Kakamega
More trees	54.8	42.3	61.5	42.9
No change	16.1	13.5	11.5	-
Fewer tress	29.1	44.2	27.0	57.1
Total	**100.0**	**100.0**	**100.0**	**100.0**

Source: Computation from 2015 Survey Data

Comparison of the perception on the observed changes in on-farm tree planting varied across the forest sites. These differences were found to be significant at ($P \leq 0.10$) with a Pearson Chi-square value of 10.78, which implied that there was

a significant association between forest sites and changes in on-farm tree planting since the respondents began participating in CFA activities. In other words, changes in on-farm tree planting were dependent on the study site. This was attributed to the unique challenges relating to co-management of forest resources across the four study sites and being at different levels of implementing forest reforms. This was confirmed with the discussions with community members during the FGD meetings.

However, four challenges were common to all forest sites. First, both CFA and non-CFA farmers complained of inequitable distribution of benefits from the forests between the community members and the state. Information from the FGDs show that the State received the greatest benefits, particularly arising from timber products. This situation has created tension between the Government agency (KFS) and the CFAs in the forest sites. It was reported that KFS personnel were no longer interested in CFA co-management of forests and at times they (KFS) engineer revolt of CFA executive committees. Political interference was reported as the other major challenge affecting the operation of CFAs. Where the CFA are perceived to be successful, some local politicians influence the leadership of the CFAs to gain political support during elections. Enforcement of the forest regulations was cited as another challenge. Although CFAs had provided community forest scouts to support KFS guards in monitoring and enforcing the forest regulations, weak collaboration affected the smooth operations between the two groups.

During one of the FGDs, one member noted poor collaboration between the KFS guards and the CFA scout as major challenge:

> *"When we were told to appoint the forest scouts from among ourselves, we thought they meant to assist the KFS to guard the forest since they possess good knowledge of the forest. But from what we have observed in the recent past there are problems in the way our scouts are being treated by the KFS guards. Whenever our scouts arrest offenders and hand them over to KFS, they are acquainted without conviction. The same people return to the villages and threaten the scouts. This has created mistrust between us and the KFS. KFS informed us that our scouts are not recognized under the law and so cannot prosecute offenders under the court of law. We are now not sure whether our scouts are no longer required"* FGD, Gede, 2015.

Similar findings were observed by Mutune and Friss (2016), where CFA scouts were limited to forest patrolling and reporting forest crimes to KFS who had exclusive power to arrest and prosecute.

4.2 Effect of Co-Management on On-Farm Tree Planting

Table 5 shows the results of the estimates and odd ratios for the Ordered Logistic Regression to explain the effect of co-management of forest resources on adoption of on-farm trees. Observed changes in on-farm trees was regressed on ten variables, namely: farm size (FARMSIZE), gender (GENDER), CFA membership (CFA_ MEMBER), education in years (EDUCATIONL), land tenure (TENURE), age of household head (AGE_HHD), square of age of household head (AGE2_HHD), training on tree planting (TRAIN), receiving extension services (EXTENSION) and replanting trees after cutting (REPLANT). Three dummy variables were included to capture any differences specific to the CFA which would not be accounted for by the model variables. Respondents with missing data were excluded, yielding 429 observations. The model was appropriately specified with a significant P-value of ($P \leq 0.05$) likelihood ratio and chi-square of 23.11, indicating that the variables included in the ordered logistic model best specified the functional relationship in the model.

CFA membership reduced the likelihood of having more on-farm trees and therefore adoption. With CFA membership, the odds of increased on-farm trees versus the combined no change and decreased on-farm trees was 0.31 times greater, given the other variables are held constant in the model. Likewise, CFA membership also increased the odds of the combined increased on-farm trees and no change in on-farm trees versus decreased on-farm trees by 0.31 times given other variables are held constant.

Table 5: Regression results

DEP treecover	Coef.	Odds ratio	P>z
Aberdare	-0.234	0.791	0.698
Cherangany	1.068	2.911	0.13
Kakamega	-1.108	0.33	0.189
CFA_MEMBER	-1.189	0.305	0.018
GENDER	-0.716	0.489	0.302
EDUCATION	0.146	1.157	0.032
TENURE	-0.880	0.415	0.082
AGE_HHD	-0.188	0.828	0.074
TRAIN	0.504	1.655	0.307
EXTENSION	0.839	2.314	0.081
FARMSIZE	-0.004	0.996	0.634
REPLANT	0.760	2.138	0.385
AGE2_HHD	0.002	1.002	0.057
/cut1	-3.892		
/cut2	-2.969		

Increased number of years in education of the household head increased the likelihood of having more on-farm trees and therefore adoption. An extra year of education of the household head, holding all other factors constant, increased the odds of more on-farm trees versus the combined no change and decreased on-farm trees by 1.157 times. Similarly, an extra year of education of the household head increased the odds of the combined increased on-farm trees and no change on-farm trees versus decreased on-farm trees by 1.157 times given other variables are held constant.

Having a title deed as a proxy for land tenure reduced the likelihood of having more on-farm trees and therefore adoption. With complete land ownership, the odds of increased on-farm trees versus the combined no change and decreased on-farm trees was 0.415 times greater, given the other variables are held constant in the model. Likewise, land ownership also increased the odds of the combined increased on-farm trees and no change in on-farm trees versus decreased on-farm trees by 0.415 times given other variables are held constant.

Visits from extension officers on the farms increased the likelihood of having more on-farm trees and therefore adoption. Extension visits increased the odds of increased on-farm trees versus the combined no change and decreased on-farm trees by 2.314 times, holding all other variables constant. Extension visits also increased the odds of the combined increased on-farm tree and no change in on-farm trees versus decreased tree by 2.314 times provided all other variables were held constant.

While insignificant, being in Cherangany catchment increased the likelihood of more on-farm trees compared to Aberdares. The likelihood decreases for Aberdares and Kakamega catchments. Marginal effects results for the ordered logistic regression are presented in Table 6.

According to these results, extension services increased the likelihood of a farmer falling within the category of declined on-farm trees by 15.9 per cent and increased the likelihood of increased on-farm trees by 20.6 per cent. Increasing a farmer's education by one year had a 2.9 per cent likelihood of reducing on-farm trees and 3.6 per cent likelihood of increased on-farm trees. Land ownership increased the likelihood of a farmer falling within the category of a decline in on-farm trees by 16.9 per cent but decreased the likelihood of falling within the category of more on-farm trees by 21.6 per cent.

A unit change in farmer's age increased the likelihood of falling in the category of decreased on-farm trees by 3.7 per cent and reduced that of falling within the category of increased on-farm trees by 20.6 per cent.

Table 6: Marginal effects

	Pr (DEP_treecover=1)		Pr (DEP_treecover=2)		Pr (DEP_treecover=3)	
	dy/dx	P>z	dy/dx	P>z	dy/dx	P>z
Aberdares*	0.046	0.703	0.012	0.684	-0.058	0.698
Cherangany*	-0.176	0.067	-0.075	0.205	0.251	0.091
Kakamega*	0.250	0.222	0.014	0.701	-0.263	0.140
*CFA_MEMBE	0.211	0.010	0.073	0.071	-0.284	0.010
GENDER*	0.156	0.339	0.019	0.258	-0.175	0.279
EDUCATION	-0.029	0.033	-0.008	0.128	0.036	0.032
TENURE*	0.169	0.075	0.047	0.152	-0.216	0.072
AGE_HHD	0.037	0.075	0.010	0.169	-0.047	0.074
TRAIN*	-0.105	0.329	-0.021	0.263	0.125	0.300
EXTENSION	-0.159	0.074	-0.046	0.153	0.206	0.072
FARMSIZE	0.001	0.641	0.000	0.617	-0.001	0.634
REPLANT*	-0.168	0.424	-0.017	0.425	0.185	0.354
AGE2_HHD	0.000	0.058	0.000	0.153	0.000	0.057

(*) dy/dx is for discrete change of dummy variable from 0 to 1

Membership in a CFA increased the likelihood of reducing on-farm trees by 21.1 per cent, increased the likelihood of having no change by 7.3 per cent and reduced the likelihood of increased on-farm trees by 28.4 per cent. This depicts a high degree of dependence on common forest resources by CFA members. Location marginal effects indicated being in Cherangany reduced the likelihood of a farmer falling within the category of reduced on-farm trees by 17.6 per cent but increased the likelihood of falling within the increased on-farm trees by 25.1 per cent.

These findings suggest that forest conservation is not necessarily seen as important by forest adjacent communities and that participating in co-management may go against villagers' preference for farmland. Issues of benefit sharing have remained contentious because the rules that govern benefit sharing are not well set out (Mogoi et al., 2012; Guthiga et al. 2014; Agrawal R, 1999). Contrary to the ForestsAct, co-management arrangement across the study sites gives KFS enormous power and authority over the forest resources without accountability to the local communities (Minga'te et al., 2014). This hierarchical arrangement creates mistrusts between KFS and communities and discourages adoption of on-farm tree planting. Ribot et al (2004) argues that co-management only helps mobilize local labour rather than empowering communities to make decisions.

5. Conclusions and Policy Recommendations

5.1 Conclusion

The Forests Act envisaged complete transfer of decision-making on matters related to forest management. The finding on this study shows that across the selected forest sites, CFAs have been created to increase community participation in forest management. A CFA is a voluntary association of forest users interested in forest resources. CFAs are assigned specific activities defined under an MOU with KFS. In practice, however, communities have limited user rights as much powers and authority is reserved by the KFS. Although communities have access to certain products, these are generally of low value and can be revoked by the KFS Director.

KFS retains powers to issue timber permits and licenses and powers to determine prices and retain all forest revenues. Even CFAs piloted under the forest reforms have not developed to take full responsibility of forest management. Reluctance by KFS to cede power to CFAs constrains their effectiveness in managing forest resources. Further, the fact that CFAs exist at the discretion of the Director of KFS suggests that current co-management arrangements do not represent full devolution, according to Ostrom's (1990) principles. This situation discourages farmers from investing in on-farm tree planting.

From the results of the OLR, it can be concluded that forest co-management has not facilitated adoption of on-farm tree planting. Although, they offer opportunities for community training and extension services, there is no evidence to show that they have facilitated adoption of on-farm tree planting by individual members.

5.2 Recommendations

Based on the results of the study, we make the following recommendations:

1. There is need for real transfer of decision-making to forest communities. This will require strengthening the role of CFAs to ensure that they have a greater say on forest management.
2. The requirements for issuance of timber permits are a hindrance on community participation in timber activities. A review of the regulations will give the community greater sense of ownership, increased revenue to CFAs and ensure sustainable harvesting.
3. The capacity of CFAs should be strengthened to promote training on on-farm tree planting. Strengthening governance of CFAs technical meetings and training sessions will facilitate on-farm tree adoption.

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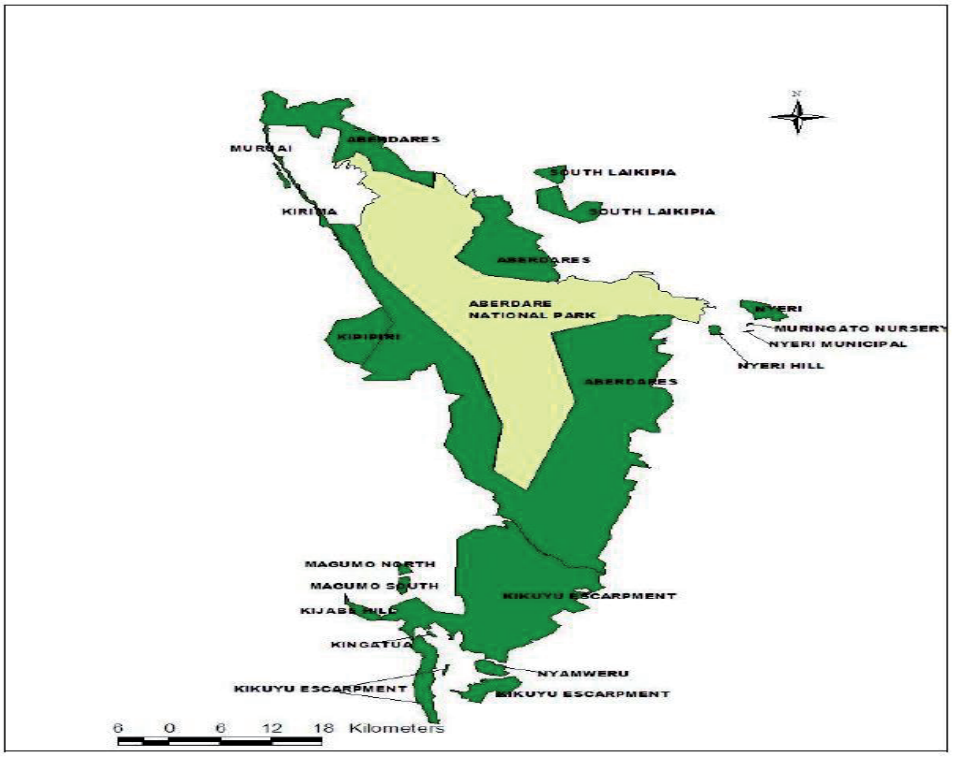
Appendix: Detailed description of study sites

1. Aberdares Forest Reserve

The Aberdares Forest Reserve is located to the east of the Great Rift Valley covering four counties of Kiambu, Murang'a, Nyeri and Nyandarua. It encompasses one of the five important water catchment zones in Kenya. It provides water to four of Kenya's six drainage basins. The major rivers from the Aberdares Forest are the Tana and Athi, which flow into the Indian Ocean, the semi-permanent Ewaso Nyiro, which drains into Lorian Swamp in northern Kenya and River Malewa that drains into Lake Naivasha.

Figure A1: Aberdares forest site



Participatory forest management was introduced in the forest in 2010 with the formation of GETA CFA. The CFA has 27 officials, 23 being elected and 4 being incorporated. An agreement devolving some functions to GETA was signed with the Kenya Forest Services (KFS) for a five-year period. The agreement articulated a framework for communities to collaborate with KFS. Under the agreement, the CFA is expected to collaborate with the KFS to ensure sustainable conservation of the forest while in turn benefitting from a wide range of non-timber forest

products such as grazing, firewood collection, agriculture, water abstraction, herbal medicine harvesting and eco-tourism. The members are also to benefit from training and capacity building to undertake tree planting in their own farms.

Membership to the CFA is through user groups. As at the time of the study in December 2015, the CFA had 17 user groups with 10 being active while 7 are inactive. To be a member of the CFA, one must belong to a user group. Those who are not members, however, do not have interests in the forests. Thus, they fetch water from other sources, get firewood and graze in their own farms. It is expected that being a non-member will motivate the households to practice tree planting in their own farms to draw the benefits that would have been available from the forest. Since there are no restrictions to non-members to join the user groups in order to participate in conservation of forests, there were attempts to reach out to non-members to belong to a user group. Membership in the CFA is through free entry and free exit. If a member needs firewood, a request is made to the user group through the office; a permit is given to the member by the CFA. The member is then sent to KFS to get their own permit, which the member presents to a forest ranger who is allocated to show the member where to harvest firewood or graze. Registration fee for membership is pegged on how the user group is performing. Normal registration fee is Ksh 500. The renewal for registration is Ksh 500 after every 3 months. Grazing is done on daily basis.

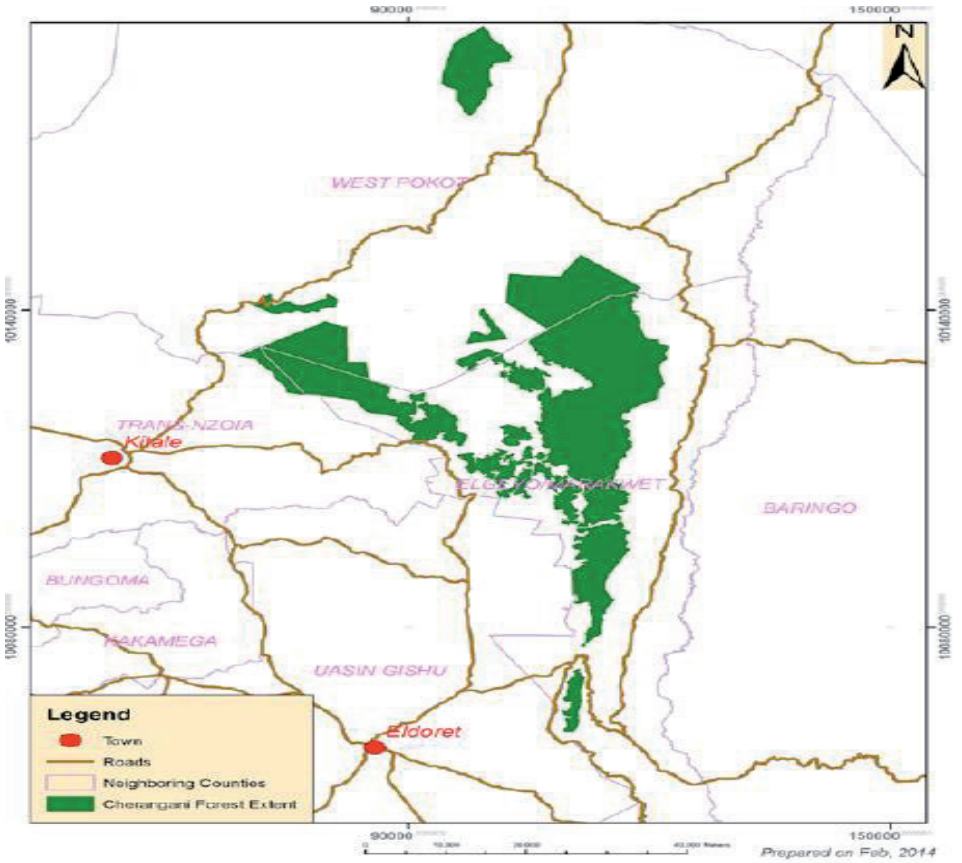
2. Cherangany Hill

Cherengany Hills forest complex is part of the upland (montane) forest found at an altitude of between 2000m to 3500m above sea level. The forest complex is located at the northern ridge of Kenya, crossing West Pokot, Elgeyo Marakwet, and Trans Nzoia, and covers an area of about 32,000 hectares. Cherangany Hills are important for water catchment, sitting astride the watershed between Lake Victoria and Lake Turkana basins. The forests form the upper catchments of the Nzoia, Kerio and Turkwel rivers. Streams to the west of the watershed feed the Nzoia river system, which flows into Lake Victoria and streams to the east flow into the Kerio river system. The hills are largely covered by a series of forest reserves, made up of 13 administrative blocks, totalling 95,600 ha in gazetted area. Of this, about 60,500 ha is closed-canopy forest, the remainder being formations of bamboo, scrub, rock, grassland, moorland or heath, with 4,000 ha of cultivation and plantations.

The forest is unique in nature, containing numerous plant species found nowhere else in Kenya and it is also an important habitat for several wild animals and birds. The Hills are particularly rich in endemism of the Lammergeyer, African Crown

Eagle, Red Chested Owlet, Sitatunga and Thick Billed Honey Guide. Indigenous tree species found in the forest form an important source of livelihood to the local communities, particularly the Sengwer Community. Apart from the Sengwer community, Cherengany forest houses three other minority indigenous groups: the Kariala (Ndorobo), a clan of Ogiek and the dominant Almo (Marakwet), the latter constituting the main forest adjacent community. Apart from Almo (Marakwet), who are agro-pastoralists, the other three are purely hunters and gatherers. In total, there are about 3000 families living inside the forest.

Figure A2: Cherangany hills forest



Traditionally, all the indigenous communities in the forest areas have developed elaborate systems for managing their natural resources and for regulating their use. However, with increasing pressure on forest resources, evictions to create space for sustainable forest management will be needed. These will be accompanied by creation of alternative livelihoods options for communities living in the forest.

There were three CFAs in Cherangany Hills as at the time of this study in 2015. The CFA members are involved in butterfly farming, beekeeping, farm forestry

initiatives, environmental awareness programmes and eco-tourism. The study covered Kipkunus Beliomo CFA.

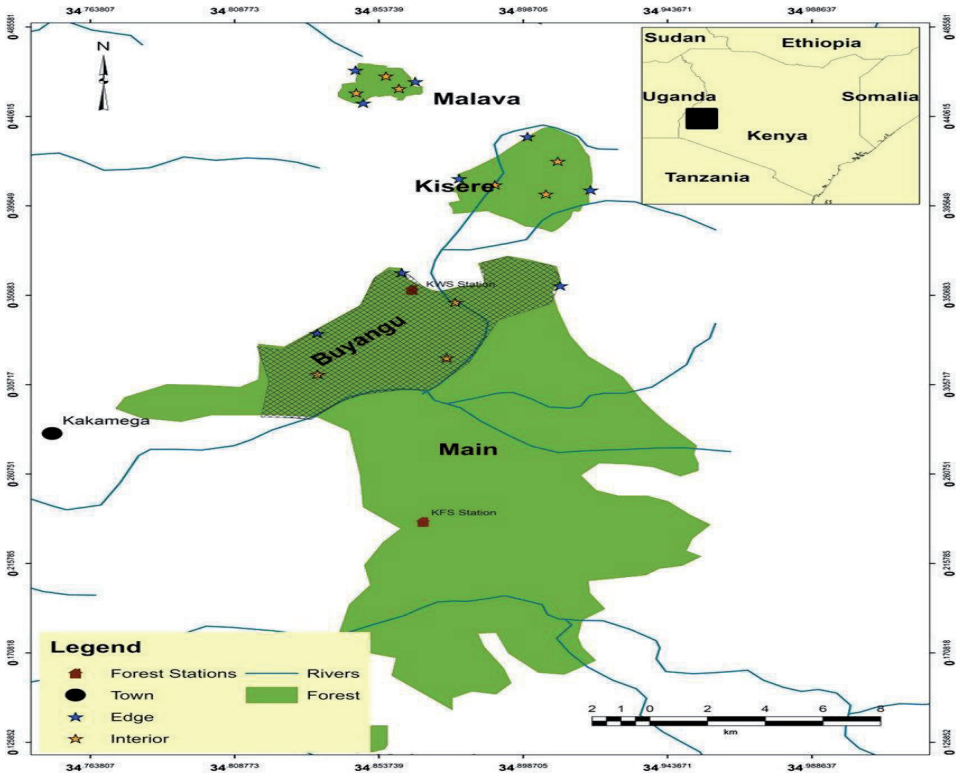
3. Kakamega Forest

Kakamega Forest is in Western Province of Kenya and lies between latitudes 08'30.5" N and 022'12.5"N and longitudes 34046'08.0"E and 34057'26.5"E at an altitude between 1500m and 1700m. The forest covers an area of about 240 Km^2 out of which about 10 per cent is plantation forest while the rest is natural forest. The forest is the easternmost extension of the great Congo Basin forest that once stretched across the middle of Africa but fragmented in the last century by human activity.

Kakamega Forest is a rainforest with a unique assemblage of species and is famous for its rich bird and insect life (Musila, 2006). It is an important bird conservation area in the country, hosting about 330 bird species, a number of which are endemic; several species of monkeys (the red-tailed, blue, de Brazza's and black-and-white colobus); antelopes (Duiker and Bushbuck); snakes (forest cobra, gaboon viper, rhinoceros-horned viper); about 400 species of butterflies and several moth species; and, over 390 species of vascular plants, besides other plant species. The rich biodiversity makes Kakamega Forest an important global conservation area. Thus in 1995, IUCN ranked Kakamega Forest as the third highest priority for conservation among Kenyan forests. The forest has a low density of small and large mammals mainly due to past and current human impacts especially through hunting and natural epidemics such as Rinderpest which is suspected to have decimated most large mammals from the forest in the 1920s.

The forest is an island of human dominated landscape and is in one of the world's most densely populated rural areas with an average population of 600 people per square kilometre. Over 200,000 people occupy areas adjacent to the forest and are greatly dependent on non-timber forest products as household items meeting basic livelihood needs. Land use activities around the Kakamega Forest region are mostly based on agriculture. Majority of the population living around the forest are poor, with little livelihood diversification. The benefits generated from ecotourism have not been exploited, hence are insufficient in sustaining positive community-forest interactions. Though Kakamega Forest was gazzeted in 1933 and prior to this, the forest was under trusteeship of the elders. Participatory Forest Management (PFM), which involves the community to participate in the management and utilization of forest resources is not being practiced in the forest area.

Figure A3: Kakamega forest



The survey was conducted in Muileshi an abbreviation for (Kakamega) Municipality, Ileho and Shinyalu divisions. Muileshi Community Forest Association (Isecheno forest station) is one of the four community forest associations around Kakamega rainforest. Others are Kibiri Community Forest Association in (Kibiri forest station), Bunyala Community Forest Association (Bunyala forest station) and Malava Community Forest Association (Malava forest station). The CFAs engage in forest conservation activities and are normally supported by Non-Governmental Organizations (NGOs). The CFAs also rely on membership annual contributions. Muileshi was formed in 2005 and registered in 2009 with the Registrar of Societies as per the Forests Act 2005. The CFA is supposed to co-manage the Kakamega Forest with the Kenya Forest Service (KFS) and Kenya Wildlife Service (KWS). Muileshi comprises six community-based organizations (CBOs) namely: MU-SHA – Musembe and Shamiloli; BU-SH – Bukhungu and Shihingu; SHA-MU – Shanderema and Mukomari; IKU-CHI – Ikuywa and Chirobani; KACOFA – Kakamega Community Associate and KEEP – Kakamega Environmental Education Programme.

Initially, there were several active groups that were engaged in forest conservation. However, subsidiary legislation recommended that one forest station should have one CFA. As a result, the active groups within Municipality, Ileho and Shinyalu divisions were merged, hence forming Muileshi CFA. Membership to Muileshi CFA can be through direct memberships, membership through CBOs or associate member. While Muileshi membership varies from time to time, there are approximately 2,000 households regarded as members to the CFA. Annual registration is Ksh 500.

The CFA is mainly involved in management and conservation of Kakamega Forest, which includes tree nursery establishment and afforestation. The association is also involved in sensitizing communities on conservation, monitoring the forest condition, re-afforestation, training groups in nursery management, assisting in forest policing and monitoring activities carried out by member groups.

4. Arabuko-Sokoke

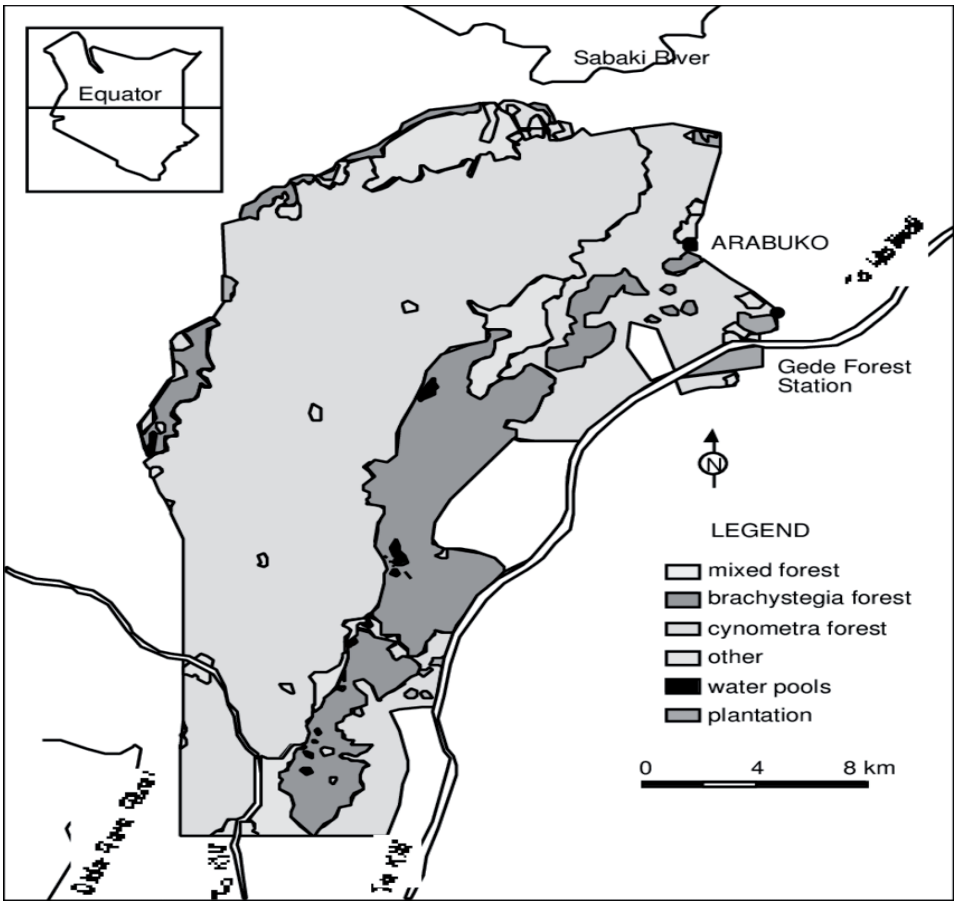
Arabuko-Sokoke Forest is located within the coastal forest complex of Kenya and covers 370 sq. Km. The forest is part of the East African coastal forest/Eastern Arc forest complex. It is the largest remnant of a coastal forest complex that once stretched from Mozambique to Somalia and ranks among the top 25 biodiversity hotspots on earth (Myers et al., 2000). The forest is home to six globally threatened bird species and an additional five bird species that are coastal endemics. Of the six globally threatened species, two, the Sokoke scops owl and Clarke's weaver, are known only from the Arabuko-Sokoke forest and one other site (East Usambara Mountains in Tanzania and the Dakatcha woodlands, respectively). A further eight bird species (of a total of 270 species) found in the Arabuko-Sokoke forest are regionally threatened. The Arabuko-Sokoke forest also has an exceptional diversity of amphibian fauna, including the coastal endemic Bunty's toad. There are three rare near-endemic mammals (Ader's duiker, golden-rumped elephant shrew, and the Sokoke bushy-tailed mongoose). A small population of around 100 elephants lives in the forest and there are six taxa of butterflies that are coastal endemics. An unknown number of other invertebrate species could also be forest endemics.

The forest is surrounded by 51 villages with a population of about 110,000, represented by 8,000 households (Gordon and Ayiemba 2003), translating to an average household size of more than 13. Small scale subsistence farming is the dominant livelihood activity that utilizes the forest for some of their livelihood necessities. This provides an eminent "threat" to the existence of the forest and a competing scenario between forest managers and local communities. Mutoko

et al. (2015) observe that co-management in Arabuko-Sokoke started prior to enactment of the Forests Act, 2005 through butterfly farming with funding from the Global Environment Facility. The main objective of the butterfly farming project was to reduce pre-colonial and post-colonial negativity among the local people by providing incentives for local communities to support forest conservation objectives. A study by Matiku (2013) showed that 96 per cent of forest-adjacent dwellers wanted the forest cleared for settlement.

After the Forests Act, a CFA was formed in 2005 upon consolidation of different interest groups, farmers' associations, forest user groups, and Village Development Forest Conservation Committees (VDFCCs). The management plan was developed in 2012 and an agreement signed with the KFS in 2013. There are 5 VDFCCs in 1 CFA, and 3 people from each of the 5 VDFCCs are elected into the CFA executive committee. The forest user groups are involved in activities such as butterflies farming, beekeeping, tree nurseries, aqua culture, tourism, carbon credit, etc.

Figure A4: Arabuko-Sokoke forest



Membership to the CFA is conditional on a member being in a forest user group. To be a member of a forest user group, one must be involved in conservation activities. Every forest user group has its own regulations. CBOs obtain a certificate of registration for Ksh 2,000 to join the CFA. To exit the CFA, the groups must give a 21-day notice. The CFA executive consists of 5 people, 3 of whom are women. In total, there are 15 members of the CFA, consisting of 5 women. Younger people are more likely not to join the CFA since they are more likely uninformed about forest conservation matters. The CFA administratively reports to the forest manager, zonal manager and ecosystem conservator. Farmers are free to register and be members of various forest user groups, depending on how they allocate their time for each group.

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