Original Research Article

# CHALLENGES AFFECTING THE ADOPTION OF AGROFORESTRY PRACTICES AROUND CHEPALUNGU FOREST IN BOMET COUNTY, KENYA


## ABSTRACT

Anthropogenic activities around Chepalungu forest has lead to its reduction in size and has resulted in its degradation. Continued dependency on this forest may result in its total depletion despite its high biological diversity and natural resource conservation value. There have been low levels of adoption of agroforestry practices (less than 33% of farmers) around Chepalungu. This study identified challenges affecting the adoption of agroforestry practices around Chepalungu forest in Bomet County, Kenya. The researchers adopted descriptive survey research design in this study. The study was done in 2016. Study sites were four locations (Bing'wa, Siongiroi, Ndanai, and Abosi) which were selected within a distance of 5 km from the forest edge using simple random sampling method. A total of 377 household questionnaires were administered in the four locations proportionately. Chi-Square and Mann Whitney U tests were used in the analysis of the results. Significant levels were expressed at $P<0.05$ using SPSS version 17 software. The results showed that there was a significant association ($\chi^2= 530.8$; $P <0.01$) between the types of agroforestry practices and challenges affecting the adoption of agroforestry practices. Notable challenges were: damage by animals, damage by man, tree nursery problems, inadequate capital, natural calamities, competing land uses, managerial problems and seed acquisition problems.



**Key words: agroforestry, challenges, Chepalungu, adoption**


## 1. INTRODUCTION

Over 60% of forest dependent people in the world are farmers [1]. A significant number of these farmers depend heavily on forest resources for their livelihood [2]. Due to this high dependence on existing forest resources, natural forests are being depleted and the supply of future forest products is becoming uncertain [3].

Natural forests in Kenya stand at about 1.2 million hectares, mostly being in high potential areas where they are facing intense competition with other land use practices [4, 5]. The growing population is exerting immense pressure on the forest resources with about 80% of forest dependent people in these areas being farmers [6, 7]. Forest ecosystems are fast dwindling in the high potential ecological zones, forcing people to move into forests and other areas which are less endowed in biodiversity [8].

The role of forests in the livelihood of the forest adjacent communities is diverse. Rural forest adjacent communities derive food, medicine and fuel-wood in addition they enjoy non-wood benefits such as spiritual, aesthetic and environmental services provided by forests. Therefore, continued degradation of forests is likely to reduce forest resources capacity to support environmental conservation and people's socio-economic livelihood [5, 9, 10].

Chepalungu forest is very important to people living near and far from it by providing both timber and non-timber forest products, but it is highly degraded due to grazing, settlement and farming. In addition, forest excision at Chepalungu cleared important tree species such as *Olea capensis* (Olea) and *Juniperus procera* (Cedar) [11]. Agroforestry, which involves incorporation of trees on farms for subsistence and commercial purposes, is an important land use option that has the potential to take over a substantial part of the functions of indigenous and plantation forests and to reduce pressure on natural forests [12].

Agroforestry offers many benefits to both landholders and to the wider community. In the short term, it can provide many private benefits, such as increasing the visual amenity of the farm, improved soil stability and in some cases improved productivity of other farm activities [12]. Over the longer term, agroforestry provides landholders with a source of income and a means of diversifying the farm business [5, 13]. Agroforestry also offers many potential benefits to the wider community by improving catchment water quality, reducing stream-bank erosion, and increasing landscape biodiversity. A well managed agroforestry system can also improve the economic and social sustainability of a region [14].

In early 2000s, Green Belt Movement initiated conservation programmes that included agroforestry initiatives to reduce continued encroachment and destruction of the remnant forest. However, [15] reported a low level of adoption of agroforestry practices (less than 33% of farmers) around Chepalungu Forest but they did not provide detailed account of the challenges affecting agroforestry development in the area. Moreover, communities adjacent to Chepalungu forest are still dependent on this forest as source of products accessed through destructive activities [15]. This study aimed at identifying challenges affecting the adoption of agroforestry practices around Chepalungu forest.

## 2. MATERIALS AND METHODS

### 2.1 Study area

Chepalungu Forest lies on latitude 00° 53' 00" S and longitude 35° 10' 00" E. The study was carried out around Kapchumbe and Siongiroi blocks of Chepalungu forest, Bomet County, Kenya. Chepalungu forest is administratively divided into two management blocks, Kapchumbe (in the South-West) and Siongiroi (in the North-East) (Fig. ~~ure~~ 1).

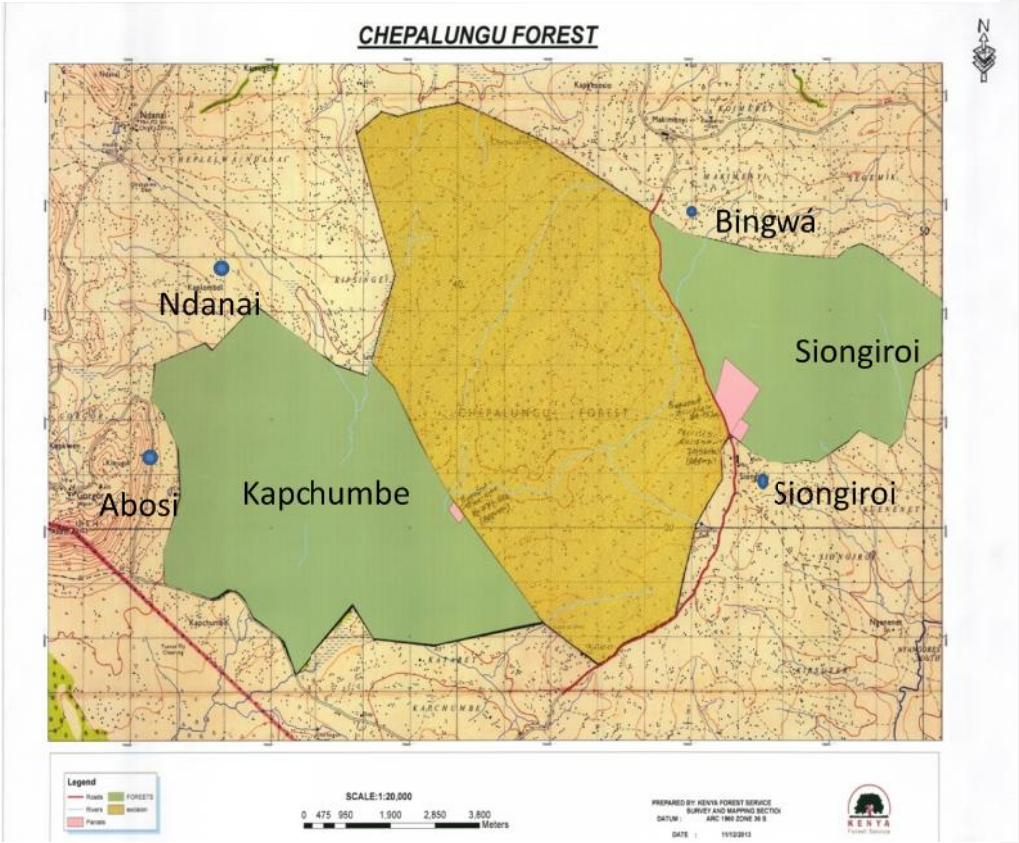


**Figure 1: Chepalungu forest and adjacent sampled settlement ~~L~~locations [8]**

The area has medium to long cropping season followed by a medium to short and intermediate rains. The mean annual rainfall is 1200 mm – 1350 mm per year with an altitude range of 1550 m – 2000 m above the sea level. The mean annual temperature ranges from 17.9°C – 20.5°C.

The soils are predominantly loamy black cotton soils. Maize and marginal coffee crops are the main crops in the area which occupies almost 18.72 ~~K~~km² of the agricultural land [16].

## 2.2 Target Population

Kapchumbe and Siongiroi blocks of Chepalungu forest are adjoined by six settlement ~~L~~locations. These locations are Abosi, Bingwa, Siongiroi, Makimenyi, Ndanai and Kongasis. These locations have a total of 80,673 persons occupying approximately 15,849 households [11, 17].

## 2.3 Research Design

The study employed the use of descriptive survey research design in establishing the challenges affecting agroforestry development among the communities living adjacent to Chepalungu forest.

### 2.4 Sample Size and Sampling Procedures

Simple random sampling technique based on random numbers generated on a scientific calculator, was used to select four Llocations and households adjacent to Chepalungu forest for the study. The Llocations selected were Bing'wa, Siongiroi, Ndanai, and Abosi.

The household sample size in each location was calculated based on formula equation 1 at 0.1 margin error [18]:

$n = [\frac{N}{(1+Ne^2)}]$..... 1

Where

N= population size

n = sample size

e = margin error

Therefore the sample size in each Location was calculated based on the Location's available households. According to [19], there were 2010, 1820, 2003, and 1157 households in Bing'wa, Siongiroi, Ndanai and Abosi Locations respectively.

Therefore, using equation 1. the sample size in:

Bing'wa = $n = [\frac{N}{(1+Ne^2)}] = [\frac{2010}{(1+(2010*0.1^2)}]$ = 95.67 households = 96 households

Siongiroi = $n = [\frac{N}{(1+Ne^2)}] = [\frac{1820}{(1+(1820*0.1^2)}]$ = 94.79 households = 95 households

Ndanai = $n = [\frac{N}{(1+Ne^2)}] = [\frac{1459}{(1+(142003*0.1^2)}]$ = 93.58 households = 94 households

Abosi = $[\frac{N}{(1+Ne^2)}] = [\frac{1143}{(1+(1143*0.1^2)}]$ = 91.95 households = 92 households

### 2.5 Data Collection Procedures

The study used semi-structured questionnaires containing both closed and open ended questions that were administered to sampled households. The questionnaires were divided into two sections. Section A: Sought information on types of agroforestry practices in the area while Section B: captured information on the challenges affecting the adoption of the various agroforestry practices. The questionnaires were administered to the respondents within a distance of 5 km from the forest edge.

The researchers first explained to the respondents the purpose of the research before giving out the questionnaires which were then filled by the respondents and collected back.

### 2.6 Data Analysis and Presentation

The responses from household questionnaires were coded and analyzed by identifying relevant qualitative activities and outcomes. The quantitative data was cleaned, coded and analyzed with the help of SPSS version 21 software and using both descriptive and inferential statistics as described below.

The test for variations in challenges hindering agroforestry development was carried out using Chi-Square test of association. Chi-Square Test of association was used to identify factors that are significantly associated with the various agroforestry practices. The null hypothesis was rejected if the computed P was less than or equal to 0.05.

## 3. RESULTS AND DISCUSSION

### 3.1 Results

It was found that inadequate capital and competing land uses are the most notable challenges facing adoption of agroforestry practices among farmers living around Chepalungu Forest. Damages by animals affect home-gardens, riparian planting, wind breaks, scattered trees and shade trees. Destruction by human man was associated with home-gardens and wind breaks (Table 1).

**Table 1: Challenges affecting adoption of agroforestry practices in Chepalungu**

| Types of Agroforestry practice | Response (%) on Major Challenges | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Damaged by animals | Damaged by man | Seed acquisition | Tree nursery problems | Managerial problem | Inadequate capital | Competing land use | Natural calamities |
| **Home-garden** | 52.9 | 5.9 | 0.0 | 0.0 | 0.0 | 23.5 | 5.9 | 11.8 |
| **Riparian Planting** | 50 | 0.0 | 0.0 | 0.0 | 0.0 | 25.0 | 25.0 | 25.0 |
| **Wind breaks** | 0.0 | 40.0 | 0.0 | 0.0 | 0.0 | 0.0 | 21.4 | 40.0 |
| **Hedgerowing** | 0.0 | 0.0 | 0.0 | 42.9 | 0.0 | 28.7 | 0.0 | 0.0 |
| **Scattered Trees** | 64.3 | 0.0 | 0.0 | 21.4 | 28.6 | 7.1 | 0.0 | 7.1 |
| **Shade Trees** | 66.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 33.3 | 0.0 |
| **Boundary planting** | 0.0 | 0.0 | 28.6 | 0.0 | 0.0 | 21.4 | 28.6 | 0.0 |
| **Woodlot** | 0.0 | 0.0 | 0.0 | 0.0 | 87.5 | 0.0 | 12.5 | 0.0 |

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Chi-Square test of association indicated that there was a significant association between types of farm forest practices and potential challenges affecting adoption of farm forest practices (Table 2).

**Table 2: Chi-Square tests of association**

| | Value | df | Exact Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 5.308E2[a] | 63 | 0.000 |

It was also found that seed acquisition had no significant association with any type of agroforestry practice. Tree nursery problems were significantly associated with hedgerawing, scattered trees on farms and woodlot practices (Table 3).

**Table 3: Chi-Square tests on individual challenges in Chepalungu**

| Types of agroforestry practice | Response on Major Challenges | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Animal damage | Mandamage | Seed acquisition | Nursery | Managerial | Capital | Competing land use | Natural calamities |
| **Home-garden** | $X^2$= 23.54, P<.001 | $X^2$= 18.097 P=.045 | $X^2$= 4.042, P=.050 | $X^2$= 12.762, P=.077 | $X^2$= 45.500, P=.094 | $X^2$= 17.225, P=.002 | $X^2$= 3.752, P=.453 | $X^2$= 24.798, P=.<.001 |
| **Riparian Planting** | $X^2$= 41.017, P=.001 | $X^2$=9.007, P=.134 | $X^2$= 5.223, P=.091 | $X^2$= 8.073, P=.067 | $X^2$= .318, P=.980 | $X^2$= 41.017, P=.001 | $X^2$= 17.717, P<.001 | $X^2$= 15.517, P=.037 |
| **Wind breaks** | $X^2$= 21.401, P<.001 | $X^2$= 22.500, P<.001 | $X^2$= 1.755, P=.670 | $X^2$= 8.276, P=.292 | $X^2$= 45.500, P=.094 | $X^2$= .947, P=.824 | $X^2$= 17.342, P=.040 | $X^2$= 27.423, P=.020 |
| **Hedgerawing** | $X^2$= 6.802 P=..301 | $X^2$= 4.544 P=.395 | $X^2$= 8.229 P=.327 | $X^2$= 45.401, P=<.001 | $X^2$= 6.766, P=.330 | $X^2$= 10.541 P=.001 | $X^2$= .545, P=.946 | $X^2$= 9.171, P=.411 |
| **Scattered Trees** | $X^2$= 44.870 P=.031 | $X^2$= 9.155 P=.467 | $X^2$= 1.053 P=.818 | $X^2$= 10.111 P=.011 | $X^2$= 67.300 P=.025 | $X^2$= 16.855, P=.770 | $X^2$= 3.333, P=.102 | $X^2$= 11.001, P=.067 |
| **Shade Trees** | $X^2$= 9.870 P=.007 | $X^2$= 1.041 P=.820 | $X^2$= 1.261 P=1.000 | $X^2$= 3.709 P=.308 | $X^2$= 91.500 P=1.000 | $X^2$= .705, P=.970 | $X^2$= 132.900 P=.001 | $X^2$= 8.760, P=.094 |
| **Boundary planting** | $X^2$= 2.238 P=.556 | $X^2$= 3.709 P=.900 | $X^2$= 13.350 P=.029 | $X^2$= 4.012 P=.206 | $X^2$= 2.715, P=.096 | $X^2$=26.981 P=.009 | $X^2$= 51.500 P=<.001 | $X^2$= 4.981, P=.100 |
| **Woodlot** | $X^2$= 8.602 P=.547 | $X^2$= 1.494E2 P=.390 | $X^2$= 73.018 P=.623 | $X^2$= 3.720 P=.717 | $X^2$= 10.955, P=.360 | $X^2$= 14.900 P=.290 | $X^2$= 12.271 P=<.001 | $X^2$=11.759, P=.075 |

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The majority of farmers practicing different types of agroforestry practices in the four locations obtain seedlings from tree nurseries (Fig.~~ure~~ 2).

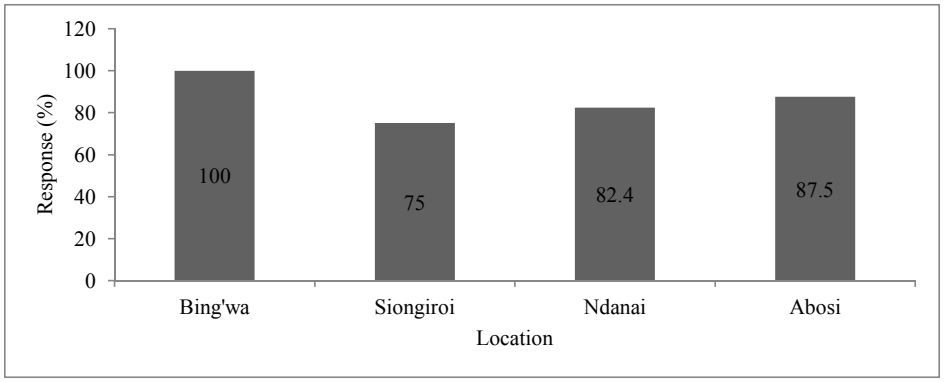


**Figure 2: Respondents obtaining seedlings from tree nurseries**

Tree nurseries around Chepalungu forest were found to be small in size (Plate 1) due to unavailability of essential production factors like water supply, quality soils, poor road network, and distance to the planting site. The experience of seed collectors is also low, eventually jeopardizing the quality of seedlings supplied to farmers.

**Plate 1: A tree nursery in Bing'wa Location in April, 2016**

**Managerial Problems**:~~;~~ Tree Managerial problems were significantly associated with woodlot and scattered trees on farms (Table 4). Over 36% of respondents in the four locations were unaware of silvicultural practices like pruning, thinning and pollarding (Fig.~~ure~~ 3).

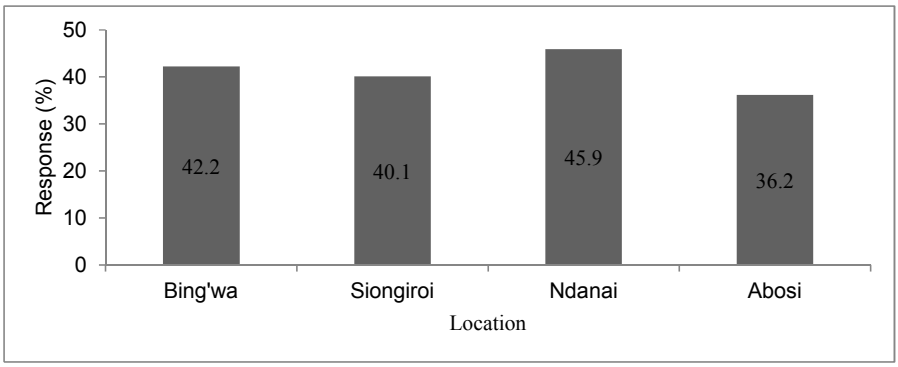


**Figure 3: Unawareness level of silvicultural practices in Chepalungu as at 2016**

**Inadequate Capital**: Inadequate capital was significantly associated with home-garden, riparian Planting, wind breaks, shade trees, and boundary planting.

**Competing Land Use**: Competing land use was significantly associated with riparian planting, wind breaks, shade trees, boundary planting, and woodlot practices.

**Natural Calamities:** Natural calamities were significantly associated with home-garden, riparian planting, and wind breaks.

## 3.2 Discussion

The most notable challenges facing farmers practicing agroforestry could be categorized into Damages by Animals and Human beings, Seed Acquisition and Tree Nursery Problems, Managerial Problems and Inadequate Capital, Competing Land Use, Natural Calamities.

### 3.2.1 Damages by animals and human beings

Domestic animals including sheep, goats and cattle destroy farm forest trees through mechanical means like stepping on them and or feeding on shoots. On the other hand, human beings engage in various activities that either affects the on-farm trees either directly or indirectly. Direct destructions include cutting of trees for various purposes, —and use of mechanical cultivation like tractors and combined harvesters. Indirect destruction of farm-trees entails making the soils unsupportive to trees through soil pollution by using chemical fertilizers, herbicides, and insecticides. The results concur with [20] that some chemical fertilizers make it difficult for micro-organisms in the soil to produce nutrients naturally; hence making soils unsupportive to plant growth. Globally, farmers are clearing scattered trees on their farms to ensure easy mechanized farming [21].

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### 3.2.2 Seed acquisition and tree nursery problems

Seed acquisition is not a significant challenge because above 82% of farmers obtain planting materials from locally established private nurseries. The significant challenge emanates from tree nursery production problems like inadequate water supply, poor road network and inexperienced seed collectors. Such challenges emerge because privately established tree nurseries in Chepalungu Forest neighborhoods are small in size, implying that owners have inadequate capital to institute all necessary conditions that will ensure production of quality seedlings. According to [22], agroforestry in developing countries experience the supply of low quality seeds, seedlings, cuttings or propagules, resulting to unsatisfactory benefits in terms of fruit, timber and shade quality. [23] adds that inadequate experience among local seed collector in Africa is alarming, and eventual results is low quality planting materials that lowers the survival rates of trees and effectiveness of agroforestry initiatives.

### 3.2.3 Managerial problems and inadequate capital

Inadequate managerial knowledge on silvicultural practices like pruning, pollarding, and thinning is a significant challenge facing agroforestry programmes in Chepalungu Forest neighborhood. This is coupled with inadequate capital to undertake adequate land preparation, and disease control among other tree management practices. The results are coincides with [24] that the level of practicing silvicultural practices varies from one location to the other as some farmers practice better silvicuture than others. This is because of variations in the understanding of silvicultural practices. Poorly managed on-farm forests, affects the quality of output products and services that eventually discourages farmers from engaging in agroforestry [23].

### 3.2.4 Competing land use

Agroforestry faces significant competition from other profitable land uses like crops. Therefore, since agroforestry practices like scattered trees on-farm competes with crops for limited resources water and nutrients, farmers prefer cutting trees to maximize their yields on farm crops. These findings concur with that of [25] who found that on-farm forestry was reducing in Trans-Nzoia County as farmers preferred maize production that was perceived to be more profitable. Also [26, 25, 28] found that adoption of agroforestry was hampered by preference of other profitable land use activities like crop farming.

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### 3.2.5 Natural calamities

Natural calamities including strong winds and pests like aphids which attack Cypress are significantly challenging the existence of trees on farms in the study area. This is because they destroy already established trees on farms resulting in huge losses. These losses therefore discourage farmers from establishing new farm forest practices. According to [29], natural disasters including fires, droughts, cyclones & typhoons, and diseases have both direct and indirect impacts on agroforestry. Floods make land unsuitable for vegetation growth, while diseases and hurricanes destroy trees on-farms.

In general, the findings of this study raveled that education, capacity building and training is very important in enhancing the success of agroforestry programmes. This is because some of the challenges like competing and use, managerial problems and inadequate capital can be curbed through education, capacity building and training on the proper arrangement of trees on farm and cheapest practices available.

## 4. CONCLUSIONS AND RECOMMENDATION

The main challenges affecting the adoption of agroforestry by communities living adjacent to Chepalungu Forest include: damages by animals and human beings, seed acquisition and tree nursery problems, managerial problems and inadequate capital, competing land use, natural calamities. If these challenges are left unaddressed, they will threaten the conservation and regeneration efforts directed to Chepalungu Forest. This is because such challenges will discourage adoption of agroforestry practices, leading to a situation where the community will entirely depend on Chepalungu Forest. Total dependence on the forest will lead to unsustainable harvesting in the forest that will eventually lead to forest degradation.

Since tree nursery is a significant challenge affecting adoption of agroforestry, the study recommends that forest extension officers should educate private tree nursery owners on the best nursery practice, while the Bomet county government should improve the road network into the rural areas to enhance ease of movement these officers.

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