

# Sustainable Bamboo Farming to Mitigate Soil Degradation in Kinale Area, Kiambu County

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**Abstract** Increasing global attention towards the potentially devastating effects of climate change provides the need to focus on adoption of sustainable Bamboo farming to mitigate the effects of soil degradation. The objective of this study was to determine how sustainable Bamboo farming was adopted to mitigate the effects of soil degradation in Kinale area of Kiambu County. Data collection was done both quantitatively and qualitatively by use of questionnaires, focus group discussion and observations. Random sampling was used to select the interviewee of the study. Data was collected using questionnaire and focus group discussions, analyzed using SPSS versions 2.0 and results presented in percentages, frequency tables, charts. Pearson correlation with a significance of 0.05 was used to show relationship between the dependent and independent variables. The results of the study indicated that sustainable Bamboo farming was effective in curbing soil degradation with 93% of farmers stating it was reliable in averting the effects in their lands. The study recommended need for proper training to the farmers who are practicing on how to propagate Bamboo.

**Keywords:** *sustainable bamboo farming, soil degradation*

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## 1. Introduction

Studies have shown that the cause of deforestation differs from region to region depending on interaction of cultural, demographic, economic and technological, political institutional issues [1].

The decline in soil conditions caused by improper use and poor management is a serious environmental problem [2]. Soil degradation causes include: loss of arable land due to overgrazing, unsustainable agricultural practices and long term climatic change.

In the last four decades almost one third of the world's farmable land has disappeared. Hunger and poverty as a result of soil and land degradation has risen [3].

Sustainable Bamboo farming presents an approach to avert the effects of soil degradation and mitigate the underlying environmental degradation [4]. It's estimated that bamboo covers 37 million hectares or more worldwide, these translates to 727.08 tera-grammes of carbon. Bamboo is a versatile non-timber plant that belongs to Gramineae family, there are 60-90 genera of Bamboo with 1,200 species [2,4]. Kenya has a total bamboo growing area of 133,273 hectares concentrated in mountain ranges and forest areas managed by the government. [5] Yushania alpine is one of the indigenous species that is mostly grown in Kenya.

Most bamboo species grow to full height within a single growing season and over the following season the wall of each culm dry and harden [6]. Maturity is achieved within 3 to 5 years with high potential to tolerate poor soil thus useful in restoration of degraded land [7].

Bamboo is important in providing a number of ecosystem services that is: water, flow, purification, restoration of degraded land, control of soil erosion along river banks [8].

Ecological restoration is a process of assisting the recovery of an ecosystem that has been degraded. It is important to introduce bamboo as a fast growing species in order to achieve eco-restoration of degraded land [9].

In Kinale area farmers have planted the alpine bamboo, the giant bamboo for both commercial and domestic use. Major economic activity in Kinale area is food farming and production, Bamboo plantations have also been propagated in the area as a form of farming/ agroforestry.

Bamboo farming in Kinale area, has proven to increase income in households by a percentage of 52.6% have been able to generate income that range from 8000 ksh and above.

## 2. Statement of the Problem

Globally soil erosion can be enhanced by human related activities such as poor farming methods, overgrazing,

mono-cropping, farming along river banks which lowers soil functions.

Statistically it is proven that nearly 2 billion hectares of soil resources worldwide have been degraded noting that 22% of the total crop land, pasture, forest land and woodland have been eroded [10]. Global agricultural supply has been lost in the past five decades other than degradation, related problems include sedimentation, climate change and loss in natural habitats thus leading to loss of biodiversity.

In Kinale area deforestation and degradation continue to be a major setback for the farmers. Low productivity, increased pest and diseases have been a looming issue. Climate change related issues such as, change in rainfall patterns has been associated to a shift from crop farming to bamboo farming.

According to a study by [11] Human activity is not only producing more carbon dioxide but severely damaging the ability of the absorption of those emissions. High rates in deforestation results in loss of absorption. Bamboo farming minimizes carbon dioxide and generates up to 35% more oxygen than equivalent stands of trees. Bamboo forest has been proven more efficient in slope stabilization and soil erosion control compared to other land use practices such as forest and grasslands. [12]

Therefore presenting a viable solution to avert issues of degradation and moisture loss there is a need to come up with solutions to the immense degradation. Thus this study sought to present how sustainable bamboo farming is viable in mitigating soil degradation in Kinale area.

### 3. Objectives of the Study

The specific objectives of the study was to identify the use of sustainable Bamboo farming to mitigate effects of soil degradation in Kinale area, Kiambu County.

### 4. Literature Review

Reduction of deforestation, climate change and soil degradation is important for landscape change. Sustainable land use management practices can contribute to conservation of biodiversity, watershed protection.

Bamboo farming has proven more efficient in increasing the capacity to provide regulating services such as soil conservation, environmental rehabilitation and carbon sequestration.

It provide a visible solution to saving forest ecosystem and farmlands from degradation [13].

Bamboo functionality as a way of curbing deforestation goes hand in hand with its characteristics of rapid growth rate, high annual regrowth and regeneration after harvesting [14]. A study from [15] shows that bamboo has a massive absorption capacity than most plants. Countries around the world are using bamboo for purification purposes to clean sewage and to soak up heavy metals that cause pollution of water bodies. Further research has proven the effectiveness of Bamboo in controlling soil erosion and improvement of degraded land. Bamboo has a rhizome root system that can anchor topsoil along steep slopes and along river banks.

Another important characteristic is the shedding of leaves which promotes to soil fertility by creating a thick humus layer thus can be used as an indigenous soil management technique. Bamboos extensive root system provides a positive effect of soil stabilization and protection of the hydrological functions of catchments and rivers [16]. Bamboo has been used in reclaiming of degraded mined lands in order to restore the degraded soils. In India Bamboo plantations projects were established as part of a development project on reclaimed mining areas. This found famers resuming to farming on the rehabilitated areas [17].

### 5. Conceptual Framework

The study was guided by dependent and independent variables. The Independent variable, sustainable Bamboo farming to identify how soil degradation can be curbed to finally ensure policy change and sustainable land management. According to a study by [11] appropriately designed afforestation and bio-energy plantations can lead to land reclamation of degraded land.

The theory of sustainable land management aligns with purpose intended to manage land degradation related issues to retain soil carbon and ensure agricultural productivity.

### 6. Research Methodology

The study involved both quantitative and qualitative approaches. Descriptive research design was used in the study which involved description of data. Semi structured interviews (randomly selected farmers) which comprised of both open ended and close ended questions to avoid vague responses.

Focus groups discussions were carried out on the sampled community members practicing on farm Bamboo farming, those practicing with community groups.

Direct observation was used to watch and note any visual impact attributed by Bamboo farming to both environment and community livelihoods. It also helped in picking any information left out by respondents during interviews.

The target population of the study was 384 respondents. Two locations were randomly picked that is, Kenvo area and Kinale Village.

A group of ninety (90) respondents participated in the interview through questionnaires, two groups of respondents containing [18] participants in focus groups. Key informants were 4.

Collected data was analyzed and coded using SPSS version 2.0. Research findings were presented in terms of percentages, tables and charts. SPSS was used to calculate person correlation @ with significance 0.05 to determine relationship between variables to establish the objective of the study.

### 7. Research Findings

The study sought to show farmers involvement in Bamboo farming and how they mitigated degradation in Kinale area.

## 7.1. Sustainable Bamboo Farming in Curbing the Effects of Degradation

### 7.1.1. Effects of Degradation

Kinale area being within the aberdares, therefore the study sought to evaluate the effects of degradation how bamboo farming would be a viable solution in curbing this effects. Interviews conducted indicated that 93.3% had suffered the effects of degradation in their farms while only 6.70% had not experienced any effects mostly because among the 6.7% were not practicing bamboo farming as a source of livelihood.

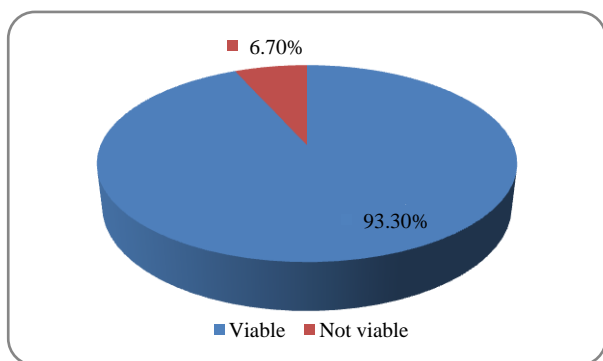


Figure 1. Effects of degradation

The farmers whom had seen the effects of degradation had realized bamboo's ability to restore their degraded land through its characteristics of self-regeneration even after continuous harvests. They further noted restoration of degraded soil through increased fertility and rising of water levels in springs or river banks this in agreement with the findings from [5] that explains how bamboo can rapidly restore degraded lands, restore landscape and bring back soil to life.

The farmers who though bamboo was a viable means for averting degradation also gave various benefits that accompanied the use of bamboo in a sustainable way. They had avoided tree cutting by the use of bamboo as an alternative in construction of granaries, fences, chairs, basket making and for forage. In comparison to this, is a study by [19] he states that Kenya has recorded up to 48 local bamboo uses and provided many raw materials for commercial activities such as support for commercial flower growing, making handcrafts and tea picking baskets.

## 7.2. Farmers Practice of Bamboo Farming in Kinale Area

According to data collected by interviews it was found out that majority of farmers in Kinale area practiced bamboo farming. 36.6% were involved in on farm bamboo farming as individuals while 30.0% practiced it as a community initiative. The rest 33.3% practiced both on-farm and group farming initiatives.

Table 1. Percentage on farmers practice in bamboo farming

Farming practice	Number farmers (n = 90)	Percentage
Community initiative	27	30.00
On farm	33	36.67
Both as community and on farm	30	33.33

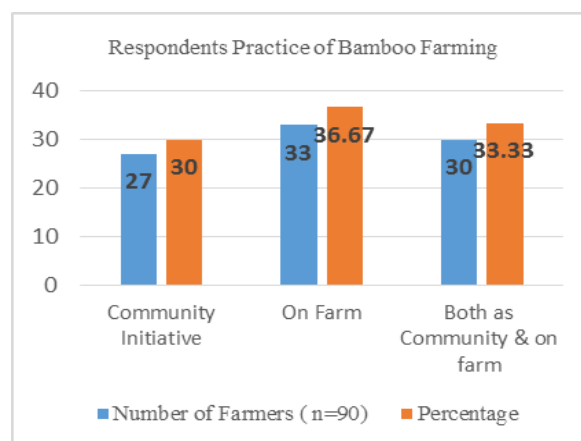


Figure 2. Farmers practising bamboo farming

During discussions the farmers further stated their knowledge on degradation and its effects on their farmlands. They stated that they had gathered their knowledge on these effects during trainings offered by the non-governmental organisations, Community based organisations, and agricultural extension officers. They stated that among the issue they had noted was that deforestation is a form of degradation which involves the cutting down of trees without replacements with the longrun effects been, land degradation, drying of seasonal rivers, reduced water levels, climate change and desertification. The initiatives also ensured that the farmers were given free Bamboo seedlings with some training on how to propagate the seedlings in their farms.

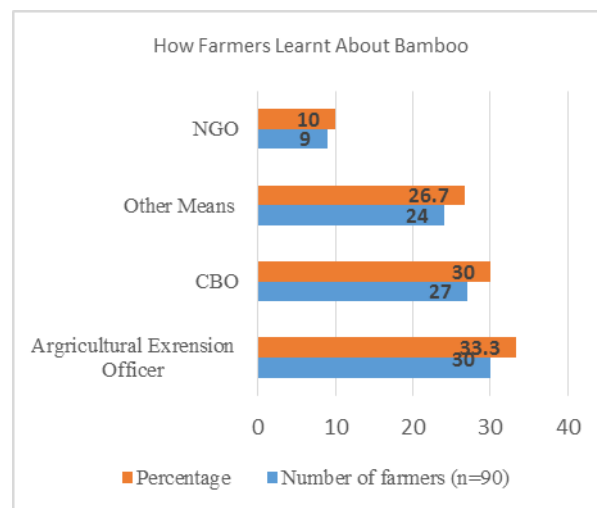


Figure 3. How farmers learnt about Bamboo

## 7.3. Bamboo Farming and Soil Fertility

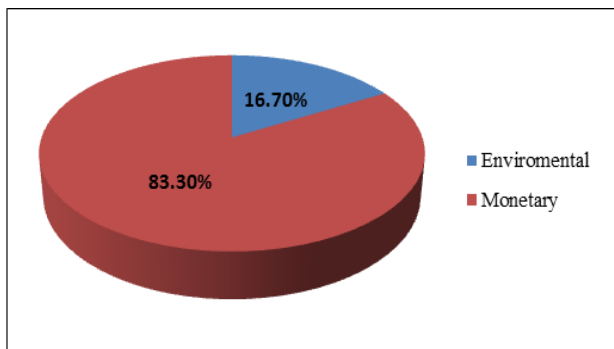
86.7% of Farmers in kinale area had noted changes and improvements in terms of soil fertility. They cited that the changes they had experienced was that Bamboo attracts water and ensures water retention thus improved water levels this therefore ensured vegetable farming in the area even during dry seasons. Bamboo improves soil fertility through manure, through the droplets of the bamboo leaves this promotes mulching and thus allowing the growth of micro-organism.

Kinale area is characterized by catchment area like Kereita River which is an important bird areas that

provides a home for different species thus preserving the habitats. Bamboo has ability to absorb toxins thus the purification of water for example: Bamboo was used to rehabilitate Nairobi river this is due to its enlarged canopy this is according to a research by [19] noted that Bamboo is beneficial to biodiversity and water conservation as well as mitigation of climate change. Most farmers noted that in areas where Bamboo has been planted there was greater fertility rates. The farmers used top soils where bamboo had been planted for planting seedlings for kales and other crops.

#### 7.4. Environmental Benefits of Bamboo Farming

Bamboo is classified under the Non-timber forest products which plays an important role in preservation of the forest ecosystem and the biodiversity [20]. Current emerging environmental issues indicate a need to diversify in better environmental friendly developmental patterns. Climate change remains a global environmental phenomena and according to [15] deforestation accounts to 20% of all anthropogenic emissions. In Kinale area the key informant's interview indicated that different authorities and government officials found the need to educate and to train the farmers in Kinale on bamboo farming. Seedlings were offered to the farmers to encourage them how to preserve their ecosystem especially the streams and rivers.



**Figure 4.** Pie chart on environmental benefit accrued by farmers in Kinale area

#### 7.5. Bamboo and Value Addition

According to a paper by [7] Bamboo is used for many industrial works as a raw material for pulp and paper and construction materials, food and pharmaceutical industries. In kinale area farmers used bamboo for construction of fences, granaries, bee keeping through construction of bee hives. They preferred bamboo in order to preserve tree species and alternatively improve their livelihoods. The farmers also used the plant as forage to feed their livestock's.

### 8. Summary of Findings

The study sought to find out the use of Bamboo farming in mitigating soil degradation in Kinale area. On bamboo and the effects of degradation, it was concluded that

bamboo was a viable option in curbing degradation and its effects. Among the farmers 93.3% were to the option of bamboo being used in the curbing those effects as an alternative for tree species. Environmental benefits named by the farmers were ability of Bamboo to sequester around four times of carbon dioxide than average timber and produce 35% more oxygen.

Soil fertility was also a major pointer in most of the farmers they were able to elaborate how soils fertility had increased drastically in areas which were covered by the Bamboo canopy. Fertility rates had increased by 60% due to the decomposing rates of the leaves droplets. The top soil was used in planting tree seedlings and also kale farming.

Restoration of catchment areas through the planting of bamboo along streams and river banks also acted as a way of preserving the biodiversity within the area. Mainly because the area is forested and has major rivers that waters the Aberdares.

Bamboo also provided both environmental benefits and monetary through its value addition. It was noted that 83.3% of the farmers, had used its raw materials to build their households fences, granaries, furniture and also used bamboo to rejuvenate their farms.

### 9. Conclusion

The study reviewed that involvement of farmers in Bamboo farming in Kinale area was a sustainable way of curbing soil degradation. In the area 98.80% were practicing Bamboo farming and had witnessed tremendous change in their farms. According to the farmers in the area Bamboo was a viable alternative to other tree species as it provided a means to eradicate soil degradation and also provide environmental benefits such as improvements in the land fertility rates through the droplets of the Bamboo trees, air purification and water retention in the soil.

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