Chapter 2
Reconciling Community Livelihood Needs and Biodiversity Conservation in Taita Hills Forests for Improved Livelihoods and Transformational Management of the Landscape

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Abstract The fragmented forests of Taita Hills form an exceptional multi-functional socio-ecological production landscape with outstanding diversity of flora and fauna that provide ecosystem goods and services supporting human wellbeing and livelihood systems. However, these forests are threatened by illegal logging for wood products and encroachment for crop farming. A study was conducted in villages surrounding five forest fragments to establish the conservation programmes responsible for keeping these forests intact for provision of goods and services to the local communities. Semi-structured questionnaires were used to collect data from 250 respondents in 25 villages surrounding the five forest fragments. Twenty-five focus group discussions (FGDs) were held with key informants actively involved in conservation activities. Results showed that the Taita community conserves the forest fragments through management practices that integrate livelihood needs in conservation, such as butterfly farming, bee-keeping and eco-tourism. Additionally, community tree nurseries have been established to produce seedlings for restoring degraded areas, and agroforestry belts have been established on the forests' edges to provide wood products and protect the forests from encroachment. Likewise, village committees have been established to oversee conservation activities inside the village jurisdictional area. The integrated conservation and livelihood approach has reduced forest destruction, enhanced landscape connectivity for biodiversity conservation, increased incomes, enhanced capacity of the community to adapt to climate change, improved food security, enhanced carbon storage, strengthened traditional knowledge and practices, and ensured availability of clean water for the local population.

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2.1 Introduction

The Taita Hills forests form the northeastern part of the Eastern Arc Mountains, a mountain range with an exceptionally high degree of endemism and conservation value (Myers et al. 2000; Burgess et al. 2007; Hall et al. 2009). The forests are among 34 areas around the world considered global biodiversity hotspots (Omoro et al. 2010). The overriding conservation challenges in the Taita Hills forests are loss, fragmentation and degradation of indigenous forest cover. The indigenous forests have declined and become fragmented and degraded as a result of deforestation and planting of exotic tree species in degraded sites formerly part of indigenous forest (Rogo and Oguge 2000; Pellikka et al. 2009).

Currently, indigenous forests only cover about 430 ha, reflecting a 98% forest reduction over the last 200 years (Adriaensen et al. 2006). A recent study indicates that the deforestation rate stands at 0.5% annually (Wekesa 2018). The habitat reduction has led to increased isolation of the remaining forest patches, increased edge effects, soil erosion and negative hydrological effects. Likewise, the isolated forest fragments are embedded in the agricultural landscape, hence ranked among the most threatened biodiversity hotspots globally (Newmark 1998; Pellikka et al. 2009). Low to high levels of disturbance have been reported in the forest fragments. The forests of Mbololo and Ngangao, Chawia and Fururu, and Vuria have low, medium and high disturbance levels, respectively (Wekesa et al. 2016). The disturbances have altered the forest structure and reduced tree species diversity (Wekesa et al. 2016). Edge effects due to fragmentation of the forests have significantly affected the species diversity, distribution and abundance (Wekesa et al. 2018, 2019). Soil conditions such as moisture, nitrogen and potassium have also been affected by edge effects (Wekesa et al. 2018). Due to the small and highly isolated nature of forest fragments in Taita Hills, edge effects, and ongoing anthropogenic disturbances in these forests, a large proportion of the tree species is highly threatened, and is of immediate conservation concern. The occurrence of endemic species such as *Coffea fadenii* and *Afrocarpus usambarensis* is restricted to a narrow range, and their distribution is highly fragmented due to the fragmented nature of Taita Hills forests, threatening the two species with extinction. Hence, there is an urgent need to develop effective long-term conservation strategies that can save these species and other woody species growing along with them, namely *Macaranga conglomerata*, *Meineckia ovata*, *Memecylon teitense*, *Millettia oblata*, *Ocotea usambarensis*, *Psychotria petitii*, *Psychotria crassipetala* and *Prunus africana*.

Promotion of an integrated landscape management approach is urgently needed to sustainably manage the fragmented forests of Taita Hills and associated agricultural landscape in order to enhance ecological connectivity, conserve biodiversity and support local economies and livelihoods. This case study highlights practical

and innovative community-led conservation activities that are reconciling community livelihood needs and biodiversity conservation. These activities have resulted in transformative change, including reduced destruction of forests, enhanced connectivity of forest fragments to conserve the remaining biodiversity, increased income for the local population, enhanced capacity of the community to adapt to climate change, improved food security, enhanced carbon storage, strengthened traditional knowledge and cultural practices and ensured availability of clean water from the forests that serve as key catchment areas.

2.2 Materials and Methods

2.2.1 Study Sites and Communities

The study was undertaken in Taita Taveta County, mainly inhabited by the Taita, Taveta and Kamba communities, and included villages surrounding the five main forest fragments in Taita Hills, which exhibit a wide range of conditions (Fig. 2.1 and Table 2.1). These forest fragments are Mbololo, Ngangao, Chawia, Fururu and Vuria. The forest fragments are in close proximity to a densely populated agricultural landscape. The sites were selected because of their rich biodiversity and the diverse agro-ecosystems in the surrounding farmlands. Indigenous forests are being lost to encroachment for crop farming, resulting in remarkable changes in indigenous forest areas and declining populations of endemic flora and fauna species (Pellikka et al. 2009). Natural resource use and management practices are guided by the traditional 'mitengo'[1] management system administered by the village conservation committees, which restricts activities that impact negatively on biodiversity.

About 52.7% of the population lives below the poverty line (CIDP 2013). The rainfall pattern is bimodal. A long rainy season occurs from March to May, with a short rainy season between November and December, but mist and cloud precipitation is a year-round phenomenon. The annual average rainfall is 1132 mm, with yearly maximum rainfall of about 2000 mm. The average temperature in Taita Taveta County is 23 °C with variations between 18 °C and 24.6 °C, with the hills experiencing lower temperatures of 18.2 °C compared to the lower zones with an average temperature of 24.6 °C (CIDP 2013). The relative humidity ranges from 79% to 83% (CIDP 2013).

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[1]Small-sized community forests occurring in critical catchment areas and rich in endemic flora and fauna that are managed by community conservation committees for provision of ecosystem services, mainly water and biodiversity conservation, and are used as cultural welfare centers for the Taita community.
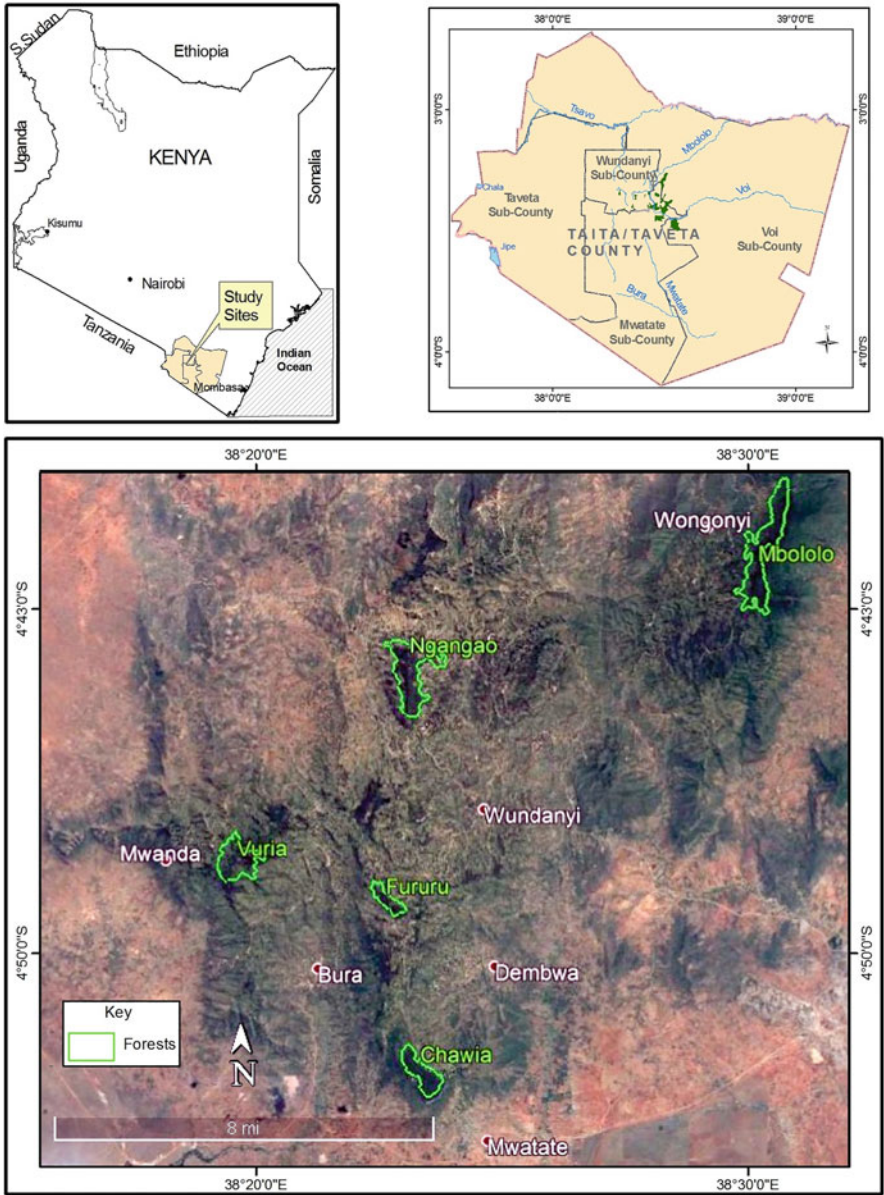
Fig. 2.1 Map showing the location of Taita Hills forests in Kenya (Source: KEFRI GIS Department)

Table 2.1 Basic information of the study area

Attribute	Description
Country	Kenya
Province	Coast
District	Taita Taveta
Municipality	Wundanyi
Size of geographical area (hectare)	1,708,390
Number of direct beneficiaries	9000
Number of indirect beneficiaries	137,618
Dominant ethnicity(ies), if appropriate	Dawida
Size of case study/project area (hectare)	769.8
Geographic coordinates (latitude, longitude)	3° 25′ 0.12″ S; 38° 19′ 60.00″ E

Table 2.2 Sampling design

Site	Number of villages	Population	Number of respondents	Number of respondents by socio-economic status			Respondents' representation (%)
				Poor	Middle income	Rich	
Chawia	4	12,098	35	18	11	7	14.1
Fururu	5	15,122	44	22	13	9	17.6
Mbololo	4	20,968	81	41	24	15	32.5
Ngangao	6	16,740	49	25	14	10	19.5
Vuria	6	13,990	41	21	12	8	16.3
Total	25	85,907	250	127	74	49	100

The number of respondents was proportional to the population size (Source: Field survey data, KEFRI research project)

2.2.2 Data Collection

Qualitative and quantitative surveys were used to establish the conservation programmes responsible for keeping the Taita Hills forests intact so as to ensure the provision of goods and services to the local communities. This approach provided breadth and depth of understanding and corroboration, while offsetting the weaknesses inherent in using each approach alone (Creswell and Plano Clark 2007). Participatory Rural Appraisals (PRAs) methods were used: key informant interviews were held in each community, and focus group discussions (FGDs) were conducted as part of both the qualitative and quantitative surveys.

Stratified random sampling was used to select respondents from different levels of socio-economic status based on income levels and general living standards which were determined by the communities during FGDs. The number of interviewees chosen was proportionate to the population of each of the sites (Table 2.2). Information on population in each of the villages was obtained from the 2019 Kenya Population and Housing Census report (KNBS 2019). Semi-structured

questionnaires were used to collect data from 250 respondents in 25 villages surrounding the forest fragments. Twenty-five FGDs, one in each village, were also held with key informants (including village elders, members of local CBOs and NGOs, youth, women and experienced indigenous farmers) who are actively involved in conservation activities.

2.2.3 Age and Gender Profile of the Respondents

The majority of the respondents were middle-aged, accounting for 44%, followed by youth (34%), while the elderly was the least interviewed at 4% (Table 2.3). The youth and middle-aged adults are crucial stakeholders in present and future natural resources management in the Taita Hills landscape. Overall, 64% of the people interviewed during the survey were women.

2.2.4 Settlement History of the Respondents

Four different groups of respondents were identified based on the number of years lived on their present farms and/or origin and settlement history. Most of the respondents had either lived all their lives on the same farm or moved within the same sub-location (Table 2.4).

Table 2.3 Age composition of respondents (Source: Field survey data, KEFRI research project)

Age	Number	Response (%)
Less than 21	15	6.0
21–35	85	34.0
36–50	110	44.0
51–70	30	12.0
Greater than 70	10	4.0

Table 2.4 Settlement history of respondents in the study area

Years lived on present farm/origin	Number	Response (%)
Less than 20/outside Taita Hills	15	6.0
All their lives on the same farm	75	30.0
Less than 20/same sub-location	95	38.0
Less than 20/different sub-location	65	26.0

Source: Field survey data, KEFRI research project

2.3 Results

2.3.1 Initiatives for Sustainable Conservation of Fragmented Forests of Taita Hills

The survey asked respondents about various initiatives being implemented by local communities to conserve the fragmented forests and associated biodiversity and support local livelihood systems. The most common responses were selected and listed (Table 2.5).

The most common conservation initiative found is the establishment of agroforestry belts on the forest edges to provide alternative sources of wood products and protect the forests from further encroachment, as reported by 34.8% of the respondents. The next most common was establishment of community tree nurseries for seedlings production (20.4%), followed by establishment of village conservation committees (16.8%), bee-keeping (15.6%), ecotourism (8.0%) and butterfly farming (4.4%).

2.3.1.1 Establishment of Agroforestry Belts

Ten-metre wide agroforestry belts have been established on private farmlands belonging to households adjacent to the forest fragments in order to ameliorate the adversarial micro-climatic conditions created on the forest edges by the edge effect. They provide an alternative source of wood products and protect the forest fragments from further encroachment. The amelioration of micro-climatic conditions on the forest edges has created favourable conditions for secondary forest growth, thus enhancing the resilience of the forest fragments to edge effect and contributing to the conservation of biodiversity, which could have otherwise been lost due to adversarial environmental conditions created by the edge effect. The belts are made up of mainly *Grevillea robusta*, an exotic tree species that was introduced in the area in the late 1970s and is a popular species for agroforestry because it grows very fast and, therefore, is intercropped with food crops such as maize and beans in the typical

Table 2.5 Initiatives developed by local communities to enhance conservation of fragmented forests of Taita Hills (Source: Field survey data, KEFRI research project)

Conservation initiative	Number of individual responses	Response (%)
Establishment of agroforestry belts	87	34.8
Establishment of community tree nurseries	51	20.4
Establishment of village committees to oversee conservation activities	42	16.8
Bee-keeping	39	15.6
Ecotourism	20	8.0
Butterfly farming	11	4.4

small farms owned by local communities. Moreover, the leaves of *G. robusta* provide abundant quantities of mulch, which accumulates to a depth of 30–40 cm and protects the soil in addition to enhancing soil fertility. Intercropping of food crops with *G. robusta* has improved crop yields due to enhanced soil fertility, thus ensuring food security. The belts have reduced illegal activities in the forests due to the availability of alternative sources of wood products such as firewood and timber, which prior to the belts' establishment were being extracted from the natural forests. *Albizia gummifera* is another tree species planted in agroforestry belts. Although *A. gummifera* is an indigenous species, some farmers prefer it for its ability to fix nitrogen in the soil and improve fertility, which is important in enhancing crop yields.

Related initiatives to conserve biodiversity in Taita Hills forests are also being undertaken by Nature Kenya, a local conservation NGO that has leased land from local farmers neighboring the Vuria forest and planted indigenous tree species that provide a favorable habitat for *Taita apalis* and *Taita thrush*, two bird species that are threatened with extinction, in an aim to save these bird species. Establishment of agroforestry belts has contributed immensely to provision of ecosystem goods and services that sustain local livelihoods, enhanced community adaptation to climate change, increased food production due to the net effects of agroforestry species on soil fertility, and enhanced biodiversity conservation, all of which have resulted in transformative change in the landscape as discussed later.

2.3.1.2 Establishment of Community Tree Nurseries

Community nurseries have been established in Chawia, Ngangao and Vuria to raise seedlings of native tree species for restoring degraded forest areas within the forest fragments (Fig. 2.2). The nurseries also raise seedlings of *G. robusta*, which is widely grown by local communities on their farmlands. The community nurseries produce about 50,000 seedlings annually, of which 10,000 are indigenous tree species while 40,000 are *G. robusta*. About 80% of the total tree seedlings produced are sold to stakeholders involved in conservation for planting in the forests and on farms, while 20% is planted by members of the community nurseries both in the forests (indigenous species) and on private lands (exotic species).

Indigenous species raised in community tree nurseries include *Prunus africana*, *Nuxia congesta*, *Ficus sycomorus* and *Albizia gummifera* because of their conservation and market value. These species are valuable for their timber and firewood, and the bark of *P. Africana,* which has medicinal value, can be sold for about 2.0 USD per kilogram. The species also have high conservation value as they protect water catchment areas. Other valuable indigenous tree species found in the community tree nurseries are *Ficus thonningii* for firewood and medicine, and *Newtonia buchananii*, *Syzygium guineense*, *Strombosia scheffleri* and *Maesopsis eminii* for timber. *Maesa lanceolata* and *Ocotea usambarensis* have potential market value as firewood or charcoal and therefore are also being raised in community nurseries for planting for fuelwood purposes. Seedlings of indigenous tree species are sold at 0.50 USD per

Fig. 2.2 Community tree nursery at Chawia forest (Source: Field survey data, KEFRI research project)

seedling, while exotic species are 0.10 USD per seedling. The community nurseries generate about 4000 USD from the sale of indigenous trees seedlings and 3200 USD from exotic tree species' seedlings per year. In total, the three community nurseries generate 7200 USD annually.

A proportion of the income (20% or 1440 USD) is ploughed back into conservation activities including increase of seedlings production and support for restoration of degraded sites within the forest fragments. The remaining amount of 5760 USD is shared among the 45 households with membership in the community nurseries. Consequently, each household receives 128 USD annually from the sale of seedlings raised in the community nurseries. Community nurseries contribute immensely to supplementing household income, conservation of natural forests through provision of seedlings for rehabilitation of degraded areas, provision of wood products including fuelwood thus reducing human pressure on natural forests, and preservation of indigenous knowledge associated with use of herbal medicine through propagation of herbal tree species.

2.3.1.3 Formation of Village Conservation Committees

The majority of the traditionally-protected small forest patches and sites that are important for conservation of water catchment areas are not gazetted. These small forest patches, traditionally known as *mitengo*, are located on private farms, trust land or on public land, for instance on riverfronts or roadsides. Thus, their management and conservation are mainly in the hands of local residents. Village conservation committees have been established to oversee conservation activities for the *mitengo*, and thus play an important role in forest management at the village level. The village conservation committees report incidences of destruction or encroachment into the small forest patches to administrative chiefs. Livestock grazing is not allowed in the *mitengo*; culprits are arrested and fined by local chiefs. The committees are also in charge of restoration of degraded areas within the *mitengo*. Thus, the committees spearhead the raising of seedlings in group and private nurseries and tree planting, in addition to raising community awareness on the importance of protecting and conserving these small forest patches, which are hubs for biodiversity conservation.

The committees also maintain and enhance social values traditionally attached to stable ecosystems, i.e. *mitengo*. The committees work with relevant authorities including the Kenya Forest Service (KFS)[2] and clan elders to ensure that the boundaries of the small-sized community forests are not altered. The traditional *mitengo* management system, which involves the village conservation committees' restrictions on activities that impact negatively on biodiversity, has safeguarded these fragile forests from illegal activities hence protecting many plant and animal species, most of which are endemic to these forests, and are endangered. Additionally, this traditional management system has ensured that the community forests are well conserved for provision of ecosystem services such as maintenance of water catchment areas and control of soil erosion, which is a challenge in the hilly terrain of the Taita Hills landscape. Employing traditional resource governance systems in the management of these *mitengo* has also resulted in preservation of cultural values key for sustainable management of the forests and their associated biodiversity.

2.3.1.4 Bee-Keeping

Bee-keeping is traditionally of considerable importance to the Taita community (Fig. 2.3). The main local use of honey is for the manufacture of traditional beer for important ceremonies. Honey is also used for medicinal purposes or taken with food. Bee-keeping as a modern enterprise was introduced in Taita Hills in the mid-1970s. Currently, there are 17 bee-keeping groups in the Taita Hills forests' landscape, with a total of 132 modern beehives installed in the five forest fragments.

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[2]A government agency responsible for the conservation, sustainable development, management and utilisation of Kenya's forest resources for the equitable benefit of present and future generations.

Fig. 2.3 Bee-keeping in the forest (Source: Field survey data, KEFRI research project)

Each of the modern beehives produces about 15 kg of honey per harvest, worth 60 USD. This is an increase as compared to the 3 kg per harvest of the traditional log hives that were being used before the groups switched to modern beehives. The traditional log hives fetched only 12 USD per harvest, about 20% of what the modern beehives are generating for the local community members engaged in bee-keeping. The total income from honey per harvest is 7920 USD per harvesting season. There are 85 households involved in bee-keeping, and hence the income per household generated from honey per season is 93.20 USD. There are three harvesting seasons per year; accordingly, this translates to a household income of 279.60 USD annually. This household income from honey is substantial considering the fact that bee-keeping is not a full-time activity, and the majority of households largely depend on small-scale farming as their main economic activity.

The honey produced in Taita Hills is in high demand in the local, regional and national markets, and has substantially increased the income of local community groups, enhanced their food security and created employment for many local people along the value chain including the producers and vendors. The community members adjacent to the five forest fragments have therefore embraced bee-keeping as a non-consumptive and deforestation-free forest use to generate alternative income instead of encroaching into the forests to undertake illegal logging that is detrimental

Fig. 2.4 Tourist campsite at Ngangao forest (Source: Field survey data, KEFRI research project)

to biodiversity conservation. Furthermore, maintaining the high population of bees in the Taita Hills landscape promotes efficient pollination in the agricultural systems where the forests are embedded, leading to conservation of agrobiodiversity for traditional crops such as sorghum, millet, pigeon peas, green grams, and cowpeas, which also enhances food self-sufficiency.

2.3.1.5 Ecotourism

The value of biodiversity in Taita Hills forests is harnessed to support livelihoods and conserve the forests through ecotourism. Taita Hills have good ecotourism potential due to the unique forest flora and fauna diversity, scenic views, interesting culture of the Taita people and central location within the coastal tourism circuit. Ngangao, Vuria and Chawia forests are the leading destinations for ecotourism due to the rich diversity of flora and fauna including endangered bird species (*Taita apalis* and *Taita thrush*). These forests have campsites owned and run by a local community-based conservation group called Dawida Biodiversity Conservation Group (DABICO), where the tourists come and stay and pay the community group fees for camping and tour guiding (Fig. 2.4). DABICO has selected, recruited and trained tour guides from the local villages who take tourists around the forests

and provide them with information on the flora and fauna diversity as well as the history and culture of Taita people.

Moreover, communities in Ngangao forest have constructed ecotourism *bandas* (traditional huts) and a restaurant through support from the Community Development Trust Fund (CDTF) (Fig. 2.4). The Ngangao forest has the highest ecotourism potential because it houses all the three endemic bird species and other avifauna that can easily be seen. The forest is also easily accessible. Plans to establish community-based ecotourism infrastructure in Mbololo forest are underway, where a community forest association (CFA) is in the process of launching an accommodation business in the form of homestays for tourists. The Mbololo forest hosts the endemic African violet (*Saintpaulia teitensis*) besides having unique scenic characteristics, and can offer great hiking experiences for nature enthusiasts.

Local communities consider ecotourism important as it generates income and offers the local youth job opportunities. A proportion of income from ecotourism is used to facilitate conservation and socio-economic development in Taita Hills. Tree nurseries have been set up using part of the income generated from ecotourism, and community groups are raising mainly indigenous tree species for replanting in degraded sites within the forest fragments. Income generated from ecotourism is also used to buy food for households during the dry season when there is insufficient food. Ecotourism has helped reduce non-sustainable uses of forests like cutting of trees for timber and charcoal production. Likewise, ecotourism has raised the value of the indigenous forests through improved conservation of biodiversity, and contributed to preservation of cultural heritage, one of the key attractions for tourists.

2.3.1.6 Butterfly Farming

The Taita Hills forests host diverse species of butterflies. A youth group in Chawia forest is engaged in butterfly farming (Fig. 2.5). The youth group, which consists of eight members, rears and sells butterfly pupae as one of its core livelihood activities. The group is also involved in the planting of indigenous tree species that are host to the butterflies. Conserving the forest by maintaining high flora diversity is important because the butterfly species found in the area are dependent on it. Likewise, the group considers conservation of Chawia forest a priority as it is directly linked to their livelihoods. The youth group has a tree nursery that raises about 5000 seedlings annually, mostly indigenous tree species preferred by butterflies that can host more than two butterfly species. The seedlings raised are planted in degraded sites within the forest as part of the group's forest restoration initiative. Additionally, each member of the youth group has to plant at least 50 trees annually on their farms to provide an alternative source of wood products.

The group raises butterflies starting with butterfly eggs, which hatch into caterpillars. The caterpillars are fed on the leaves of specific host tree species until they turn into pupae, which are sold to generate income for the group. More than 25 species of butterflies are found in Chawia forest, including *Cymothoe teita* and *Papilio desmondi teita*. These species are endemic to Taita Hills. Some species of

Fig. 2.5 Butterfly farming on the edge of Chawia forest (Source: Field survey data, KEFRI research project)

swallowtails and pansies are also found in Chawia forest. On average, the group sells about 200 butterfly pupae per month, translating to about 110 USD, or 1320 USD annually. Hence, each member receives 13.80 USD per month, an income that members of the community group use to supplement other income sources in order to meet their livelihood needs without engaging in destructive activities like illegal harvesting of trees for wood products such as timber and charcoal. The pupae are sold to the Kipepeo Butterfly Centre in Gede Kilifi County, which in turn exports to overseas markets, mainly in Europe, for live exhibits. Although the group rears two butterfly species endemic to Taita Hills forests (*Cymothoe teita* and *Papilio desmondi teita*), they do not sell their pupae. Rather they release the adults of the endemic butterfly species into the wild to increase their population and conserve the existing biodiversity of butterflies, which are important pollinators in the natural forests and agro-ecosystems in Taita Hills. Consequently, butterfly farming enables

the community group to earn income that sustains their livelihoods and also participate actively in the conservation of the Chawia forest, a win-win situation.

2.3.2   Indicators for Assessing Transformative Change

Five indicators have been developed by the local community to assess transformative change attributed to their conservation initiatives. In this particular case, transformative change refers to positive cultural change among local communities towards conservation of forests and associated landscape through sustainable utilisation practices that impact positively on local livelihoods and biodiversity conservation. The indicators are: capacity building; replicability; governance and social equity; livelihoods and well-being; and innovations (Table 2.6).

Increased capacity and capability of community groups to effectively participate in conservation activities provide the foundation for upscaling the activities to cover wider areas, and are used as a measure for long-term sustainability. Improved livelihoods and well-being of the local people in terms of income, food security, health and education are evidence for transformative change attributed to the robust conservation programmes put in place by the local community. Greater participation of women and youth in conservation activities enhances social equity and strengthens the local governance system. The increased number of women and youth involved in conservation and nature-based business ventures could be a good indication of improved governance and social equity in the management of the landscape. Local natural resources-based innovations incorporating traditional resource governance systems play a key role in supporting concrete conservation

Table 2.6 Indicators for assessing transformative change in the Taita Hills landscape (Source: Field survey data, KEFRI research project)

Indicators	Detailed description
Capacity building	The initiative has provided communities with skills and knowledge regarding conservation activities hence promoting the upscaling of best practices to the entire landscape
Replicability	The initiative has led to the increase in successful on-the-ground conservation and livelihood activities that are being replicated across the landscape
Governance and social equity	The initiative has ensured greater participation of women and youth in conservation activities and decision making on the way the landscape should be managed
Livelihoods and well-being	Income generated from the nature-based enterprises support the community in catering for health and education needs. Food security has also been enhanced due to improved crop yields attributed to better land management practices through agroforestry technologies
Innovations	Newly emerging locally-driven innovations have enabled the community to react to changes like climate change and discover new opportunities like revitalising traditional crop varieties

programmes. Newly emerging locally-led innovations that have high positive impact on the conservation status of the landscape and are likely to transform the landscape in terms of biodiversity conservation could also be evaluated to provide insights on the progress of transformative change of the people, forests and food security status. To upscale successful initiatives, replicability is paramount. The increase in successful on-the-ground activities that are being replicated across the landscape plays a pivotal role in bringing about transformative change, hence providing a good measure to assess the positive impacts attributable to these community-led conservation initiatives.

2.4   Discussion

The people-led conservation initiatives described herein are considered as a seed for transformative change with positive impacts on biodiversity and the livelihoods of local communities. However, there are several challenges for realising transformative change. These challenges include: the lack of conservation culture among the youth leading to high levels of deforestation; weak CFAs[3] with limited capacity to effectively participate in forest management; erosion of traditional knowledge systems that has led to destruction of shrines and other sacred sites within the landscape; poor attitudes towards conservation as some community members believe that conservation is a preserve of the government; and the lack of enabling policies, which encumbers communities' participation in conservation, e.g. limits on farmers who cannot harvest trees on their private farms without a permit from relevant government authorities discouraging communities to effectively engage in agroforestry. Consequently, to achieve transformative change in the management and conservation of the Taita Hills landscape, these challenges need to be addressed through institutional and policy changes that encourage active community participation in conservation initiatives within the landscape. Furthermore, youths should be given opportunities to take on leadership roles in CFAs to enable them participate in conservation matters, and to allow for traditional knowledge to be revitalised through inter-generational transmission of knowledge from the older generation to the youth. Moreover, the capacity of CFAs should be enhanced to equip community members with the requisite knowledge and skills to promote concrete conservation activities within the landscape.

There are existing opportunities that the local community are leveraging on to promote conservation and preserve biodiversity. The increasing market demand for deforestation-free nature-based products such as honey, herbal medicine and butterflies, whose sustainable production is dependent on the rich biodiversity of Taita Hills landscape, incentivises the local community to conserve the existing flora and fauna diversity. Moreover, there is increased capacity of the local community in tree

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[3]Community Forest Associations.

husbandry; youth and women's groups have acquired knowledge and technical skills on propagation of trees and agricultural crops, and established nurseries to raise tree seedlings for planting in the farms and forests. Declining soil fertility due to soil erosion, which is responsible for low crop productivity, is also encouraging farmers to venture into agroforestry in order to improve soil fertility and enhance crop productivity. The local community is also revitalising traditional knowledge systems associated with agrobiodiversity conservation to conserve both forest and agriculture biodiversity. Moreover, the local community is aware and sensitive to the impacts of climate change, and therefore several community-based organisations (CBOs) are actively engaged in tree planting as mitigation measures to climate change. Farmers are also reverting to cultivation of traditional crop varieties that are resilient to the impacts of climate change to ensure the yields are adequate for the food security of the local community.

Nonetheless, there were contrasting views among some stakeholders/community members that traditional knowledge is backward and should not be applied in the present times in the management of landscapes; instead, science-based knowledge systems should take precedence. However, the majority of the stakeholders supported integration of traditional resource governance systems into conventional conservation approaches for complementarity and synergy. Existing partnerships and networks bringing together government agencies, NGOs, CBOs and other stakeholders involved in the conservation of the Taita Hills landscape enhances synergy and complementarity, resulting in high impact of the conservation programmes at multiple levels. Through the partnerships and networks, successful conservation initiatives have been replicated in two more areas through a 'multiplier effect', greatly contributing to biodiversity conservation and improved livelihoods of the people. A series of multi-stakeholder and policymaker workshops have been conducted to share implementation approaches, lessons learned and success stories of integrated conservation and livelihood initiatives in the landscape with a view to upscaling these initiatives in other landscapes in Kenya and the wider East Africa region.

2.5 Conclusion

The interdependence of ecosystem sustainability and community livelihoods is demonstrated in the Taita Hills landscape through the multipurpose sustainable use of the forests by local communities. The local communities have developed integrated conservation and livelihood approaches which they employ to conserve the fragmented forests for enhanced biodiversity conservation and livelihood improvement. These include: establishment of agroforestry belts adjacent to the forest fragments to ameliorate the adversarial micro-climatic conditions created on the forest edges and provide alternative sources of wood products to reduce pressure on the forests; establishment of community tree nurseries to restore degraded sites within the forest fragments and generate income; bee keeping, butterfly farming

and ecotourism for livelihood improvement and enhanced conservation; and formation of village conservation committees to oversee conservation activities in the forest fragments. These approaches have been instrumental in conserving the fragmented forest patches while improving local livelihoods, and should therefore be promoted and upscaled for maximum benefits to biodiversity conservation and local economies, as well as for enhanced ecological and economic sustainability. The key messages and lessons learned from this particular study are elucidated below:

- Integrating nature-based microenterprises that support local economies in the management of the landscape and associated natural resources incentivises communities to participate in conservation activities.
- Enhancing the capacity of local communities through training on requisite knowledge and technical skills is key to sustaining conservation efforts in the long-term.
- Traditional knowledge should be integrated with scientific knowledge for complementarity and long-term effectiveness to deliver multiple societal benefits, including conservation, production, and livelihood benefits.
- Engaging policymakers to support community-led processes (bottom-up approach) in conservation initiatives promotes buy-in/ownership by the communities, hence ensuring sustainability of the activities.
- Multi-stakeholder engagement in conservation programmes that brings on board government agencies, CBOs, NGOs and local communities enhances synergy and complementarity resulting in high impact of conservation programmes at multiple levels.

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