Tanzanian Journal of Population Studies and Development, Vol. 28 No. 1, 2021: 109-132

The Role of Participatory Geographic Information Systems in Conflict Resolution: A Case Study of Ngezi Forest in Pemba, Zanzibar

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Abstract

This article discusses the problem of forest change and how it can lead to resource use conflicts. Specifically, it examines change in Ngezi Forest, in Pemba, Tanzania, and assesses how forest fragmentation in the area can cause resource use conflicts. It also investigates the nature and extent of the conflicts, and proposes conflict resolution strategies for better management of the forest. Data was collected from ten villages surrounding the forest. The target groups comprised of local communities, NGOs, as well as local and central government officials in and around the forest. Data was collected through focus group discussions, participatory mapping, and field observation. Data obtained through participatory mapping was exported to the Geographical Information Systems software for further analysis. The results revealed that there is a considerable decline of the forest area and other vegetation types in the forest. The forest cover declined by 116.1ha (2. 3%) between 1952 and 1989, and between 1989 and 2015 it declined by 47.3ha (0.94%), with an annual rate of decline of 3.1ha/year. The decline in forest cover triggered conflicts between the government and the local communities who harvest forest products for their livelihoods. The high demands of forest products were exacerbated by limited agricultural land, increasing economic hardships, lack of alternative sources of living, rapid population growth, poor management, and illegal exploitation of forest products. Therefore, the study recommends that peoples' livelihoods and conservation initiatives outside the reserve be considered when searching for a sustainable forest resource management plan.

Keywords: *forest change, resource use, conflict, PGIS, conflict management*

1. Introduction

Conflicts over land and other natural resources such as water and forests are universal problems (Ortiz, 1999). People everywhere have competed for land as they need to sustain their livelihoods. Mohamed and Ventura (2000) elaborate that conflicts over land and other natural resources are a result of disputes inside and outside the communities, such as dispute on resource use between members of a certain local community and outsiders. This means that conflicts over land uses and other natural resources are associated with opposing interests over land uses, and the increasing demand on forest

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resources because of population growth, depletion of forests in both quantity and quality due to degradation, over-harvesting, and external factors such as climate change and commercial pressure (McCall, 2004). Unequal benefits, coupled with the lack of transparency and clarity in the systems of sharing benefits, have been frequently mentioned in literature as contributing factors to conflicts in resources management initiatives (Kaswamila & Macokecha, 2008; Sachedina, 2008). The increasing trend of land use conflicts and the decline of forest species in many areas call for alternative thinking about the conservation process to move towards some more inclusive and people-based conservation interventions (Kidegesho, 2009).

In Tanzania, there are frequent conflicts among government institutions on the one hand, and between government institutions and local communities on the other. Decisions by government institutions to convert village lands into protected zones in areas surrounding national parks have increasingly become the source of tension between and among communities and natural resource actors (Kengera, 2003, 2016; Goldman, 2001). In Pemba, conflicts over boundaries within and between villages are also common forms of land use conflicts in most villages forming the Ngezi Forest Reserve. As a result of the increasing trend of migrants in the area, conflicts over the use of resources between farmers and forest officers are becoming more frequent (Kaswamila, 2012; Kaswamila & Makokecha, 2008). In 1959, the Ngezi Forest was formally declared a forest reserve comprising the areas of Kigomasha, Tondooni, Verani and Makangale peninsula. Despite this formalization, the forest was still used for commercial purposes (Nahonyo et al., 2005).

One major and costly mistake made by the government was to allow a few residents to live in the forest reserve areas without looking for alternative shelters for such inhabitants. Since then, the population has increased and migrants from different places have moved into this area in search of new farmlands and settlements (Nahonyo et al., 2005). There have never been village regulations or measures to guide landownership, or tracking and monitoring of the activities conducted by new immigrants in the villages. Individuals are left to identify unoccupied areas or parts of the forest where they can start clearing and establishing settlements and new farms, which in turn brings high pressure into the Ngezi Forest Reserve, and leads to forest loss and overall psychosocial stress. These significant forest losses in Ngezi have resulted in conflicts between local communities and those concerned about biodiversity loss (Mchenga & Ali 2015). This is one of the serious land use problems that needs to be addressed (Van der Sluis et al., 2016).

Kyem (2006) conducted a study on forest conflict management by using the Geographical Information Systems (GIS) in southern Ghana. The results demonstrated the capability and significance of GIS in creating maps of resource use conflicts, which could facilitate the resolution of resource

conflicts. There is also a clear need of resolving resource use conflicts in Pemba, but the available data needs to be combined with other types of information such as knowledge of local communities to manage tensions arising from negotiating joint values. Participatory Geographical Information System (PGIS) is an important tool that can be used to break down communication barriers and minimize the psychological and emotional pressures that hinder stakeholders' free expression of their viewpoints. It can be applied to create opportunities for stakeholders to jointly collect and analyse data, share resources, and exchange ideas about a conflict condition (Carnevale, 2006). When used effectively in the negotiation process, the PGIS technology can promote discussions that may lead to a deeper understanding of a conflict situation, and help prepare stakeholders for mutual agreement.

Conflicts between forest conservation groups and local communities over the utilization of natural resources are well documented. However, studies on conflict prevention in many conservation areas are limited. In addition, studies on mixed traditional and modern approaches to resource conflict assessment and transformation are also few (Fagerholm & Käyhkö, 2013). The PGIS has proved to be a useful tool for assessing conflicts and their distribution. It has helped in generating a better understanding on why and how people live in line with natural resources dependency for livelihoods; information that can hardly be captured through conventional approaches. But the use of maps to facilitate consensus building is not new, and PGIS applications alone might not bring a conflict to a final resolution (Carnevale, 2006). The most important initiative that is missing in many studies is the essential parameter of participation, including the choices made by those participating in the negotiation process, and how the decisions are made: these are the things that have been strongly considered in this study as essential components in a conflict prevention strategy.

2. Materials and Methods

2.1 Location of the Study Area

The study was conducted in the Ngezi Vumawimbi forest area. The Ngezi Forest Reserve lies between 39° 40′ and 39° 44′ E and 4° 58′ and 4° 54′ S. It is found in Micheweni District, North Region of the Pemba Island. It covers an area of approximately 20km^2 and it is bordered by the sea in the north and southwest (Figure 1). The reserve is surrounded by ten villages, with a total population of around 12,000 inhabitants (URT, 2012). It is bordered by the Mkia wa Ng'ombe, Kiuyu Kipangani, and Bandari Kuu villages in the south; Kibatini, Kiuyu kwa Manda and Gombani villages in the east, and Tondooni, Makangale, Jiwe Moja and Kijiji villages in the west. It is the largest remaining forest in Pemba, with a concentration of biological diversity.

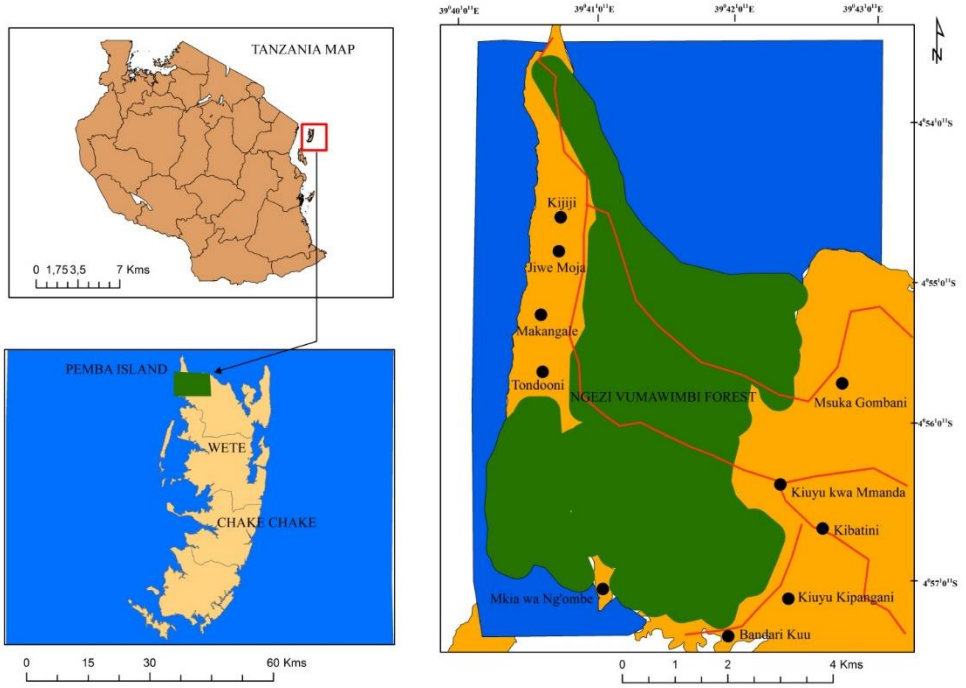

Figure 1: ***Location of the Study Area*** **(DoSup 602)**

Source: Field Survey 2017

2.2 Sampling Frame and Sample Size

The study was conducted in Micheweni District in Pemba. The district has 13 wards and 23 villages. The Ngezi Forest is surrounded by 4 wards and 10 villages. The study was conducted in all the 4 wards and 10 villages that surround the Ngezi Forest. The selection of the said wards and villages was influenced by their close proximity to the forest. Physical proximity in this dimension was vital because the people who live near the forest often have unique and useful knowledge based on their accumulated experience over time. Their insights could serve as a tool to enhance communication between them and other stakeholders in elucidating the status and trend of resource use conflicts in their areas. A total of 52 key stakeholders, 10 from each ward, participated in the study. The composition also included 20 local community members, 8 local village leaders, 8 representatives from NGOs, 8 members of the village conservation committee, and 8 participants from the central government (Table 1). The key informants (skilled and unskilled) with knowledge and experience of the study area were selected for the purpose of acquiring rich information to supplement and help corroborate the existing data about the sources of resource conflicts, and trends and strategies for conflict management in the area.

Table 1: Distribution of the Sample Size in the Study Area

Wards	Village	Sample	Women	Men
Makangale	Local community	5	2	3
	Local government	2	1	1
	NGOs	2	1	1
	Conservation committee	2	1	1
	Forest officers	2	1	1
Kifundi	Local community	5	2	3
	Local government	2	1	1
	NGOs	2	1	1
	Conservation committee	2	1	1
	Forest officers	2	1	1
Konde	Local community	5	2	3
	Local government	2	1	1
	NGOs	2	1	1
	Conservation committee	2	1	1
	Forest officers	2	1	1
Msuka	Local community	5	2	3
	Local government	2	1	1
	NGOs	2	1	1
	Conservation committee	2	1	1
	Forest officers	2	1	1
Total		**52**	**24**	**28**

Source: Fieldwork, 2017

2.3 Types and Sources of Data

2.3.1 Land Use/Cover Maps

Most recent aerial and satellite imagery were used to map and explore changes in the forest. Information was gathered from aerial photographs of 1952, 1989; rapid eyes satellite images of 2015; Sentinel1 2019; land use map of 2012; a map of forest types; population size; district and forest boundaries; and other socio-economic data that covered the whole study area. This information was obtained from the Department of Survey and Urban Planning (DoSUP). Details about aerial images, including their acquisition date, source and purpose, are provided in Table 2.

Table 2: Data Types and Purpose

Data type	Data Source	Purpose
Aerial photographs of 1952, 1989 and rapid eyes satellite images of 2015	Department of Survey and Urban Planning (DoSUP) - Zanzibar	To detect the status and trends of change in Ngezi Forest, and to assess the rates of deforestation and degradation
Sentinel1 2019	https://search. earthdata. nasa. gov/ search (open-source data)	Data verification

Land use maps of 2012	Department of Survey and Urban Planning (DoSUP) - Zanzibar	To compare information from classified images with existing information
Forest types map and forest boundaries	Forest Department, Zanzibar	To simplify data analysis, interpret and understand conflicting zones
Population size	NBS 2012	To study the influence of population (especially migrants) on forest change and resource use competition

Source: Author, 2017

2.4 Data Collection Methods

2.4.1 Focus Group Discussions and Participatory Mapping

Four group discussion sessions were conducted at the shehia level: one group discussion was conducted in each of the shehias of Makangale, Kifundi, Konde, and Msuka. These discussions involved key stakeholders from five different sectors, namely, the local community, the Village Conservation Committee, NGOs, local government authorities, and forest officers. Each group discussion session comprised 13 participants.

The discussions were guided by the following themes: people's attitude regarding their participation in forest management; disagreement, if any, between management plans and implementation; whether the implementation of programmes would improve local peoples' livelihoods and meet their needs; land use conflict; ways that local people consider as effective for sustainable management of forests in their communities; challenges facing forest management in implementing their plans; and ways that would considerably motivate villagers to effectively participate in forest management activities and resolve conflicts. Participants were also asked to list their three important needs in relation to the forest and their livelihoods. The overall goal was to select the best strategy for the improvement of peoples' livelihoods and guarantee sustainable forest management. Moreover, members from each category were given the opportunity to discuss group priority areas either jointly or individually. The participants then marked on the satellite imagery three areas that they found to be most important according to the given criteria.

2.4.2 Observation

Observation as a scientific method of collecting data was employed, whereby the researcher investigated personally the pertinent issues in the study area, with the supervision of the local leader in the respective shehia. The researcher was guided by a set of definite items listed in the field observation sheet. These included the current state of the forest, both in high and low protected zones; villagers' past and current land use activities in utilization zones and protected zones; socio-economic status of the villagers; conflict areas; and forest reserve

boundaries. Field observation took place after group discussion sessions in each ward to verify issues raised during the discussions. During the observation, the researcher recorded some important points by using the Global Positioning System (GPS) for documentation.

2.5 Data Analysis

To show the trend of change of the Ngezi Forest, the data of different time points (1978; 1989 and 2015) were accurately digitized into 8 land use categories: coastal thicket, mangrove forest, moist forest, grassland, swamp, agriculture and settlement, sand extraction, and rubber plantation. To determine the forest change over time, the intersection tool was used to overlay three digitized maps of different times. The output from such analysis was a transition map showing land cover change, and tables showing the quantity of land cover change such as the degree of change, net loss, and net gain of each land cover (Figure 2).

The data about peoples' perceptions on the causes and extent of conflicts was analysed through content analysis. This approach was employed to identify categories, themes and patterns emerging from the collected data. The data on perceptions was then classified and grouped accordingly. The data obtained from the participatory mapping exercise was exported to the GIS software for analysis. Thereafter, the data was overlaid with the village's shape files and data from the GPS for map-making. Through a categorized map, visualization style, forest conflict zones, and potential conflict areas were demonstrated (Figure 2).

Later on, the advanced method of the Ngezi Forest conflict management was scientifically determined and group priorities were identified using the GIS. The GIS was used to digitize the borderline for the priority areas acknowledged and agreed by key informants. The buffer size was estimated depending on the agreement among key informants in the field. The buffering process was successful due to great support from knowledgeable and experienced people, and with the aid of the GIS scientific tool. This was the discipline of setting spatial priorities, which subsequently yielded benefits to all stakeholders.

3. Results and Discussion

3.1 Current Status of Ngezi Forest

Aerial and satellite images of different years 1952, 1989 and 2015 were analysed to find out the spatial-temporal change in forest covers in the Ngezi area. The study showed that a vast area of Ngezi Forest Reserve was covered by dense forest vegetation (1880.7ha) in 1952. The forest area started to decrease and was converted into other land uses in subsequent years. The analysis reveals a considerable decline in forest area and forest vegetation in the forest between the year 1952 and 1989 by 116.1ha (2.3%), and between the year 1989 and 2015 it decreased by 47.3ha (0.94%) with annual rate of decline of 3.1ha per year (Table 3).

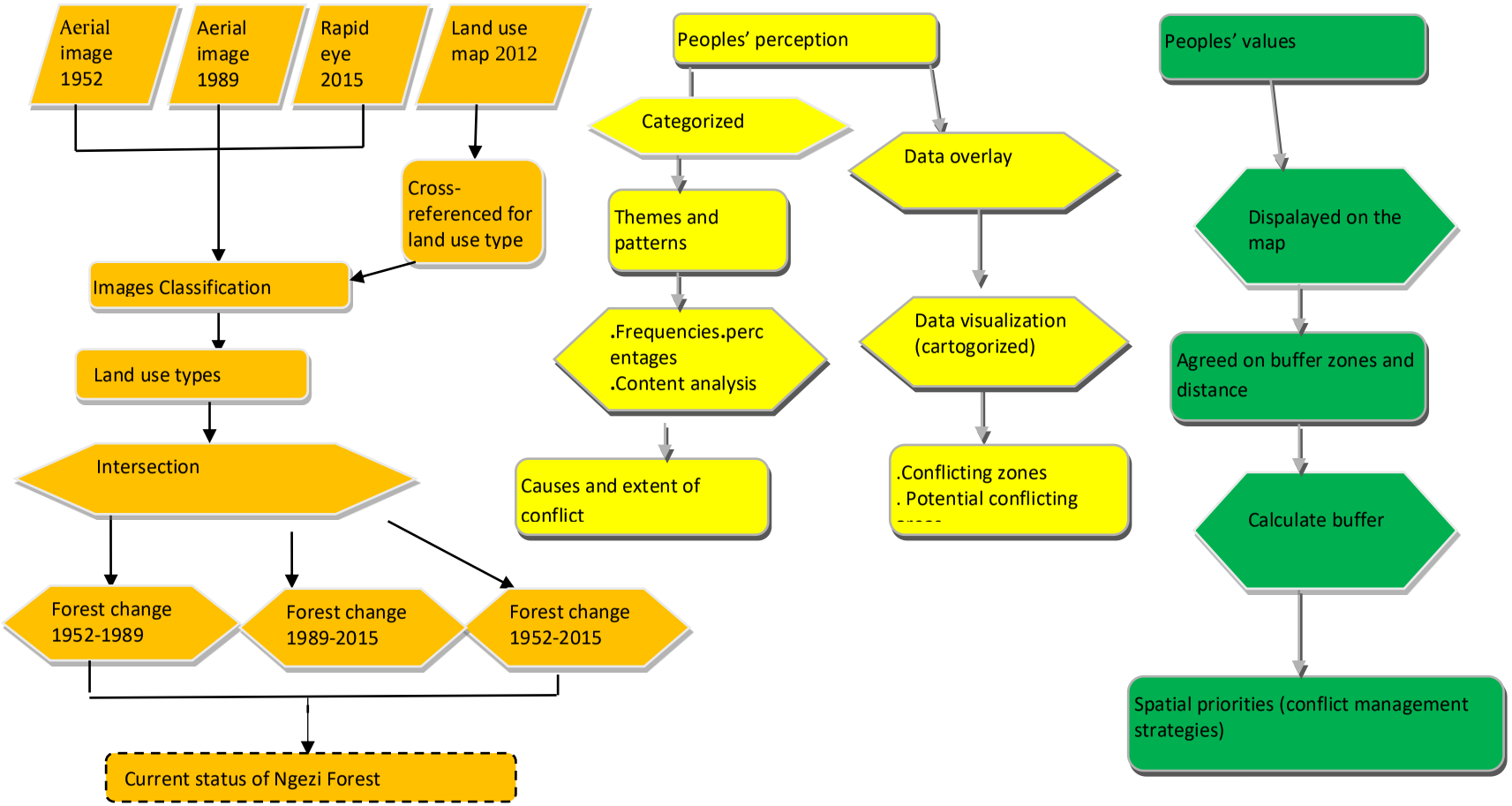

Figure 1: *Flow of Data Analysis*

Table 3: Ngezi Forest Change (1952-2005)

Forest and Land Use Types	1952		1989		2015		1952-1989	1989-2015	1952-2015
	Area /ha	*%*	*ha*	*%*	*ha*	*%*	*Difference*	*Difference*	*Total Increased/ Decreased (+/-)*
Coastal thicket	320.6	6.4	265.6	5.3	247	4.9	55ha (1.1%)	18.6ha (0.4%)	-73.6ha (1.5%)
Mangrove forest	154.3	3.1	135.2	2.7	141	2.8	19.1ha (0.4%)	5.8ha (0.1%)	-13.3ha (0.3%)
Moist forest	1180.9	23.6	1134.8	22.7	1115	22.3	46.1ha (1%)	19.8ha (0.4%)	-65.9ha (1.3%)
Grassland	167	3.3	165.1	3.3	151.3	3.03	1.9ha (0.04%)	13.8ha (0.3%)	-15.7ha (0.3%)
Swamp	57.9	1.2	63.9	1.3	63	1.3	6ha (0.1%)	0.9ha (0.2%)	+5.1ha (0.1%)
Agriculture and settlement	942.4	18.8	1846.2	36.9	2352	47	903.8ha (18.1%)	505.8ha (10.1%)	+1409.6ha (28.2%)
Sand extraction	2.3	0.05	4.2	0.1	18	0.4	1.9ha (0.04%)	13.8ha (0.3%)	+15.7ha (0.3%)
Rubber plantation	0	0	49.8	1	47	0.9	49.8ha (1%)	2.8ha (0.1%)	+47ha (0.9%)
No forest	0	0	0.8	0.02	22	0.4	0.8ha (0.02%)	21.2ha 0.4%	+22ha (0.4%)
Forest outside Ngezi	2175.6	43.6	1333.5	26.6	844	16.9	842.1ha (16.8%)	489.5ha (9.8%)	-1331.6ha (26.6%)
Grand Total	**5001**	**100**	**5001**	**100**	**5001**	**100**			

Source: Field survey, 2017

For the extended interpretation of the findings, the study shows that until the early 1950s, Ngezi was covered by thick forests, and was home of many flora and fauna. However, spatial and temporal mapping of forest conditions in the area suggests that the forest cover and forest types have been continuously declining due to forest degradation and deforestation. This means that the Ngezi forests are deteriorating at an alarming rate, and their multiple ecosystems are threatened. Many studies have linked deforestation in Sub-Saharan Africa to population growth, in-migration, urbanization, over-exploitation of agricultural and forestry products, economic development, poor land policies, and foreign debt (Geist & Lambin, 2001). Elsewhere, in Africa, deforestation is increasingly being caused by small-holder farmers and domestic demands for livelihoods (DeFries et al., 2010; Fisher, 2010; Ryan et al., 2014).

The findings further show that arable land and settlement areas have significantly increased compared to the forested area, which decreased between 1952, 1989 and 2015. The increase was from 942.4ha in 1952 to 1846.2ha (903.8/95.9%) in 1989; and 1846.2ha to 2352ha (505.8ha/ 27.4%) between 1989 and 2015. Visual interpretation of the classified map (Table 4) reveals that the dense forest in Ngezi Forest Reserve in 2015 remained only within the inner part of the reserve, while forest patches in all other areas outside the forest remained dispersed. The forest outside the Ngezi Reserve, which is very important for preserving the reserve, is extremely deforested. For example, in the western zone, in 1952 the forest cover outside the reserve was about 559ha, while in 1989 it decreased to 186.4ha, and further down to 71.6ha in 2015. A total of 1331.6ha (62.2%) of the forest outside Ngezi has been deforested since 1952, as it has been replaced by agricultural activities and human settlements (Table 4). Outside the forest reserve, forest losses have been more permanent than within the inner part of the reserve. Natural population growth, along with urbanization and in-migration has led to increased pressure on land outside the reserve forest (Thomas, 1968; NBS, 2004, 2013). This means that government land delivery systems have been inadequate in meeting the needs of the rapidly growing population.

Table 4: Change of Forest Outside Ngezi Reserve (1952-2015)

Forest outside Ngezi Reserve (ha)				**Agriculture and Settlement Areas (ha)**			
Year	*Western*	*Eastern*	*Southern*	*Total*	*Western Area*	*South+ Eastern*	*Total*
1952	559	1299.3	317.3	2175.6	133.5	808.9	942.4
1989	186.4	875.1	272	1333.5	489.5	1356.7	1846.2
2005	71.6	562.4	210	844	645.3	1706.7	2352
Changes	-372.6ha	-424.2ha	-45.3ha	-842.1ha	+356ha	+547.8ha	+903.8ha
1952- 1989	(17.1%)	(19.5%)	(2.1%)	38.7%	37.8%	58.1%	95.9%
Changes	-114.8ha	-312.7ha	-62ha	-489.5ha	+145.4ha	+319.6ha	+465ha
1989-2005	(8.6%)	(23.4%)	(4.6%)	36.7%	(7.9%)	(22.7%)	17.3%

Source: Field survey, 2017

The expansion of settlements has also been reported by Mwavu et al. (2008), and Mundia and Aniya (2006). They found that the growing human population surrounding the forest reserve through indigenous and migrant communities has led to deforestation. Likewise, in the Ngezi Vumawimbi Forest Reserve, the edges of the forest reserve have been cleared, cultivated and settled in. This population pressure in the western part of this forest, in particular, will continue to surface in other protected areas if there are no measures in place to reverse the trend.

The study quantified and mapped the spatial and temporal degradation and deforestation of the forest cover. In doing this, 8 major forest types were identified in the area. Furthermore, the maps presented in this study (Figure 3) support an understanding of where and how much forest land cover and land use patterns changed. It may also be used to prioritize limited human and financial resources in forest resource management and conservation of forest diversity. This provides resource managers with the basis for making practical land use decisions.

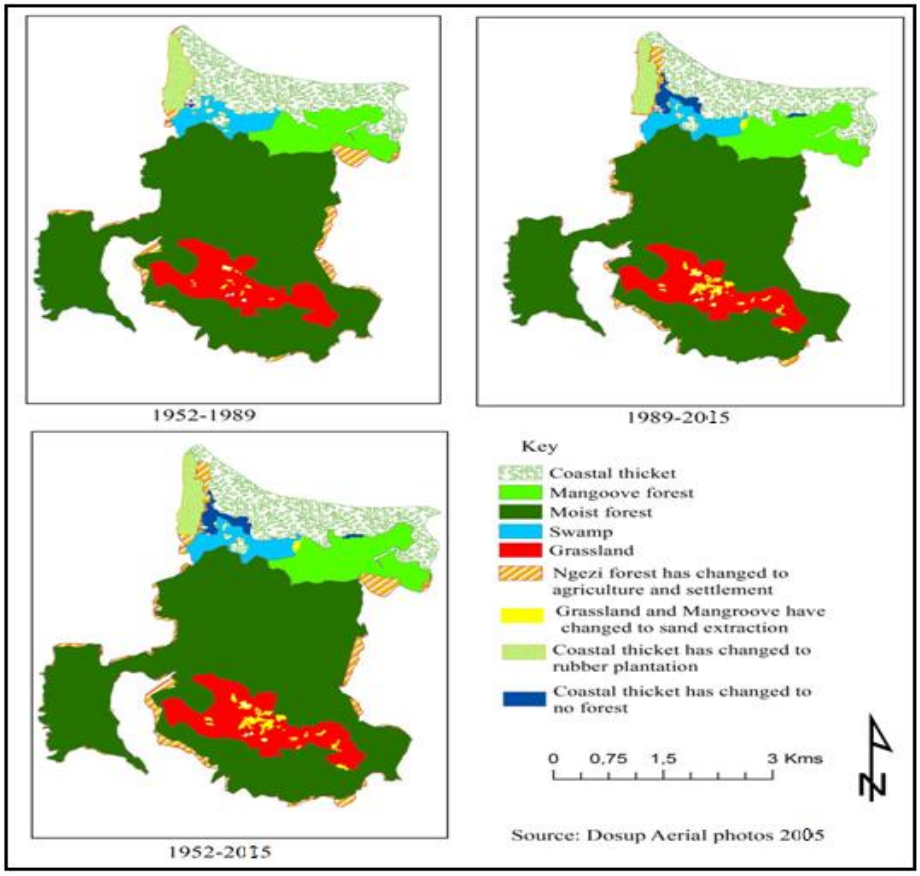

Figure 3: ***Change of Forest Inside Ngezi Reserve (1952-2015)***

According to the maps in Figure 3, the changes that occurred in Ngezi Forest during this period have been caused by the increase in agricultural activities, especially the clearing of forests and opening of new land for growing crops, timber harvesting, charcoal burning, and the exploitation of poles for construction. This finding is similar to observations by Boucher et al. (2011), who is of the opinion that the most important causes of deforestation in tropical Africa are subsistence agriculture and extraction of trees for fuel wood. This decreased forestation has resulted in poor quality vegetation cover.

According to Ryan et al. (2014), the causes that have intensified deforestation during recent decades are quite similar in East Africa. Urban expansion, spread of permanent agriculture and shifting cultivation are the most typical proximate causes of forest clearings; while population growth, urbanization, in-migration and growing demand of agricultural and forestry products are intensifying the loss of forests.

3.2 Nature and Extent of Conflict in Ngezi Forest

The conflicts between villagers and the government continue to affect the Ngezi Forest Reserve. The forest department prevents forest exploitation activities such as the collection of firewood, building materials, as well as logging: all of which are interpreted as hostile by the villagers. This has reinforced the blaming and accusing of each other. Generally, the findings indicate that members of the local communities are not satisfied with the current forest management system. The level of dissatisfaction by community members stands at 80%. In contrast, the central and local government authorities have a higher level of self-satisfaction with the forest management strategy in terms of their control and supervision (governance). The central government reports 70% satisfaction with the current management approach, while local government authorities report a 60% level of satisfaction. The satisfaction rankings conducted during FGDs also show that the majority of people are dissatisfied with the existing restrictions in using the forest to support their livelihoods.

Table 5: Stakeholder Perceptions on the Current Forest Management Strategies

Proposed Indicators proposed	Satisfied or Dissatisfied with Current Forest Management	Local Community Members	NGOs	Local Government Authorities	Central Government Authorities
Governance	Satisfied %	20	35	60	70
	Dissatisfied%	80	65	40	30
Sustainable	Satisfied%	10	40	45	60
Livelihoods	Dissatisfied%	90	60	55	40
Conservation	Satisfied%	50	55	60	65
	Dissatisfied%	50	45	40	30

Source: Field Survey (2017)

This claim is acknowledged by the local government authorities, but is opposed by the central government. The majority (90%) of local community members are dissatisfied, followed by 55% local government authorities. Central government rates its own satisfaction with Ngezi Forest at 60% since it claims to support livelihoods of the people in the surrounding communities either directly or indirectly.

When highlighting the importance of employing participatory management activities, Kangas et al. (2010) and Matose (2006) argued that the participatory approach can help to shift the involvement of local communities from passive to more active collaboration. This can improve rationality and transparency in decision-making processes, which are recognized as the most important features of policy making for some stakeholders. In the research area, the Forest Department has thus become another form of justification for retaining sole control of the forest, vis a vis threats from local people around forest reserves. In this role, it has excluded the surrounding communities. Therefore, in this study, participatory forest management would hatch a solution for complex underlying power-relation problems between forestry officials and local people. In line with the findings, studies by Giovanni et al. (2012), Ripu et al. (2010), Adams and Attiwill (2008), Walters et al. (2008) and Quincey et al. (2007) show that forest conditions improve in areas where participatory community forestry management is practised.

Among the different social groups during discussions, women strongly criticized the governance of the forest, given their limited access to the Ngezi Forest in sustaining their livelihoods. The trust level between local communities and the government is on the decline because the community members feel deprived of a major income source. Speaking of the Forest Department, one study participant gave the following complaint:

> *"The department has developed the tendency of making decisions without consulting the communities. And if there is something the department needs to accomplish, it simply instructs the villagers without seeking their opinions or objective inputs. The rights of the communities have been taken away by the government, which has pushed them away from managing the forest."*

The majority of the local community members (90%) expressed dissatisfaction with the manner in which they were involved in planning and management of Ngezi Forest Reserve (see Table 6). The villagers are required to seek permission from the Forest Department to use forest products. Under this condition, the villagers complained that they have been excluded from being part of the forest management. Therefore, the lack of participation in decision-making has degraded cohesion and escalated conflicts between the stakeholders in the area. Nautiyal (2011), and Ramakrishnan and Koohafkhan (2010) counsel that ecosystems are a part of people's life; and that is why, in most cases, 'top-down' approaches to conservation have failed to achieve the desired goals as they are blindly copied from other regions without any regard to the local social, ecological, and cultural contexts.

Table 6: Level of Local People Participation in the Forest Management

Proposed Indicators	Level of Participation in Forest Management	Local Community Members	NGOs	Local Government Authorities	Central Government
Governance	Active %	10	40	60	80
	Passive %	90	60	40	20
Sustainable	Active %	30	45	45	80
Livelihoods	Passive %	70	55	55	20
Conservation	Active %	50	60	70	90
	Passive %	50	40	30	10

Source: Fieldwork, 2019

The Forest Department does not seem to follow any kind of known policy in its collaboration with the villagers and other stakeholders. For example, the villagers cited historical examples when rubber plantations were introduced in the villages of Kijiji, Jiwe Moja and Makangale. They maintained that villagers lost almost all their farmlands without compensation. In this regard, the Forest Department needs to be able to distinguish policies on paper and things to be implemented on the ground. Moreover, the community members complained about the lack of incentives to the villagers. They mentioned that the only powers transferred to them were the obligations to apprehend and fine people who break the 'rules on paper', as well as the right to fully retain forest revenues.

Actually, a majority of participants in FGDs admitted to have lost trust in the way the government was managing the forest. In most cases, this view was communicated cautiously—blaming nobody in particular. However, the complaints were targeted at laws and regulations governing the use of the forest resources. The people felt they were being unfairly treated and deprived of the right of accessing their resources. During group discussions, a majority of the participants clamoured for a '*people-first*' approach in the management of the forest. This implies that sustainable forest conservation can only be achieved when the *well-being* of the surrounding community is ensured. The findings emphasized that, to achieve economic sustainability in forest-dependent communities, forest managers and planners need to consider the ecological and environmental services of the forest ecosystem.

Indeed, one respondent criticized conservation for increasing people's hardships, and likened it to 'preserving one's food while the children are starving'. According to the participants, the state should take care of the people before considering forests. They retorted that 'people were more important than trees'. The opinions of the local community members were that conservation, subsistence, and their livelihoods are interrelated and compatible. This can be explained through their indigenous knowledge in an attempt to understand aspects of life that are not perceived as compartmentalized but integrated and

harmonious. This people's perception has led to increased conflicts with the Forest Department officials who rely on a scientific ecological approach in the management of the forest. These study findings are in line with many others, such as by Adhikari et al. (2010) and Walters et al. (2008), who established that forest loss is being caused by the failure of the state to recognize the roles played by forests in helping the rural poor keep poverty at bay.

Furthermore, participants from communities living adjacent to the forests declared openly that there was no need of collaboration with Forest Department officials. According to one of the respondents:

> *"Villagers are perceived as adversaries and officials from the Forest Department would only meet the villagers when they are trying to evict them from their homes, or confiscate forest products and other belongings from them."*

Studies conducted by Kumar (2007) show that most protected areas in developing countries are characterized by strict conservation laws enacted by the state. During the said conservation regime, the state and local communities often play a cat-and-mouse game. The state do not formally decentralize any role to local communities in the management of these resources, and uses intimidation measures to keep local participation at a distance. This management strategy, which is based on fences and fines, and which aims at keeping human beings far from protected areas, has created conflicts between local communities and forest management authorities, and has contributed little to resource conservation.

Previously, the Ngezi Forest was a major source of income for the surrounding communities in the western zone. For instance, people sold forest products such as mats, enfolds, and baskets to supplement their income. Money generated from such activities was used to pay for school fees, food during food crises, health care, local transport, marriages, rituals related to births and deaths, and as pocket money. The amounts earned appeared to be significant and increased the role of forest income as an important component in promoting rural development and improving household welfare. Although these activities generate low returns for the producers in many situations, they are still important in terms of contributing to the overall household income. Currently, villagers are unhappy with the cash amounts they generate from forest-related activities because this money is not enough to meet their needs. As such, they do not see the benefit of conserving and protecting forests.

On the other hand, the central government representatives argued that the Ngezi Forest Reserve was established primarily for protection; and that the government's principal policy objective was to ensure that these areas remained under forest cover for environmental protection. Therefore, local communities were not expected to use the reserve for personal benefits. Moreover, some of the government representatives claimed that the conflicts occurred because they had stopped the villagers from vandalising the forest. On behalf of the central government, the head of the Forest Department advised:

"Enforcement of property rights through access restrictions, remains the most widely-used tool to slow or prevent deforestation and forest degradation. Without such enforcement, the reserve would exist on paper alone and forest degradation would continue."

The government representative blamed the villagers and private organizations that deliberately ignored the law. They complained that when the government was supplying plant seedlings in the 2000s, many villagers would not plant any, while others would plant them upside down just to frustrate the forest officers. The government representative was surprised why this was happening while in the past the villagers used to obey forestry rules and regulations. The Department of Forest claimed that it is very difficult to control farmers from extending their farming activities into the reserve. Again, they argued that farmers are no longer planting trees, and they are no longer taking advice on sustainable farming methods.

In the Ngezi Forest Reserve, the edges of the forest reserve have been cleared, cultivated, and settled in. It is likely that the frontiers of the remaining Ngezi Forest will be pushed further in the near future, and the local communities will only read about some of the unique species in history books, such as the *Pemba flying fox* and Pemba *monkeys,* instead of physically seeing them. Natural habitats will be largely replaced by farming activities for food production.

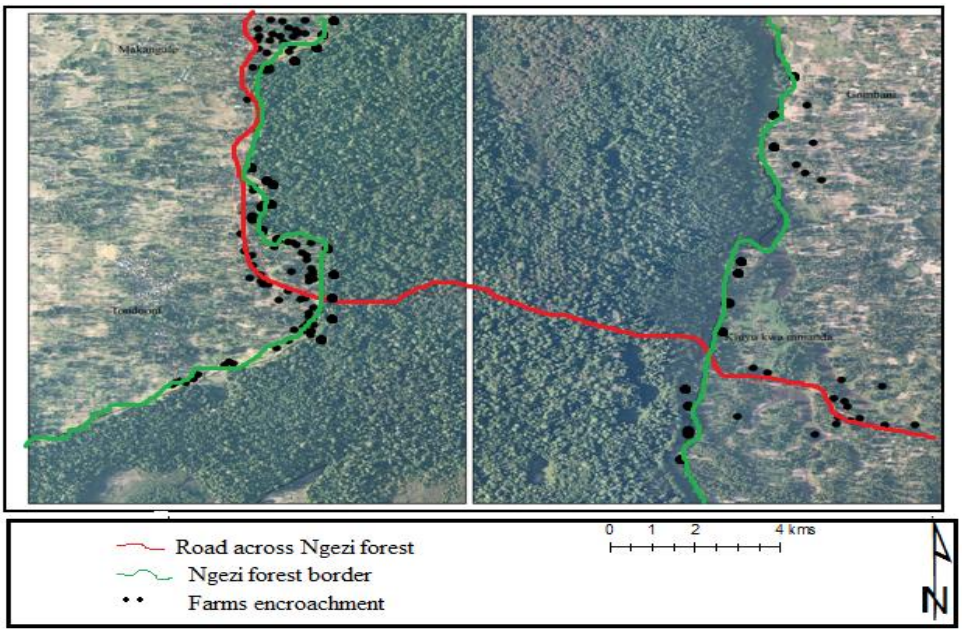

Figure 5: ***Farms Encroachment in Ngezi Forest***
Source: Field data, 2017

3.3 Locations Under Pressure in the Study Area

The study has shown that western and southern zones areas are prone to frequent and chronic conflicts. The local representative said that the main reason for the existing poor cooperation between the people and the Forest Department, making community members to violate forest regulations in these areas, is the declining income that people generate from activities conducted in the Ngezi Forest reserve and the government's side-lining of the people in decision making. Also contributing to the conflicts between local communities and forest management is the high demand for agricultural land, decrease in the number of tree species of high value, agricultural encroachment into the forest reserve, and land shortage. This conflict in particular emerged in the western areas because the members of the local communities have a higher rate of demand for forest materials and high expectations of financial returns from the Ngezi Forest Reserve. The higher demand was around low-income areas with poor employment, scarce agricultural land, and distant from administrative centres; as compared to the eastern areas where income is generally higher, and which have plenty of fertile agricultural land outside the reserve. The findings of this study are in line with many other studies, including those of Adhikari et al. (2010), as well as Shackleton et al. (2008), who submitted that wealthy households consumed much less from forests than middle-income and poor households.

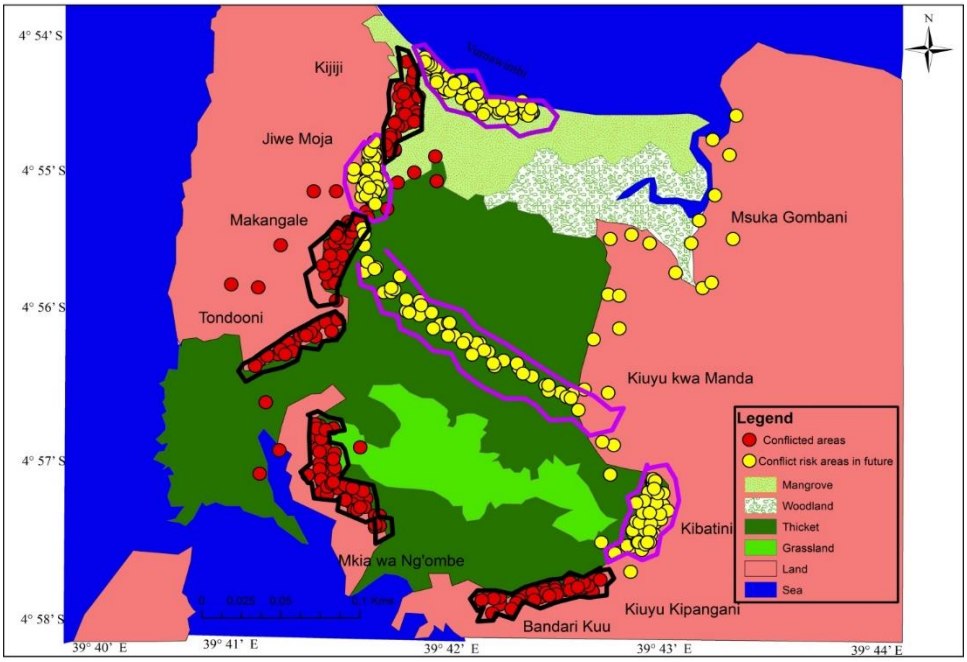

Figure 6: ***Areas Under Resource Use Conflict***
Source: Field survey, 2017

Interestingly, information collected from the study areas also shows that there are some areas with no conflicts yet, but which are reported as potential areas for conflicts in the near future. All these areas were found in the northern area, along the road; and in some parts of the eastern areas where afforestation and tree-planting programmes were less strongly implemented. The pressure in the western and southern parts of the Ngezi Forest, in particular, will continue to characterize these areas if there are no measures put in place to reverse the trend. It was noticed during field observation that migration into these areas was ongoing, and hence the pressure on the reserve is predicted to increase as more migrants come into the area. The forest will be largely be replaced by farming activities for food production. Government planers should take into consideration that every extra person in the reserve not only diminishes the quality of life of the residents present in the area, but also reduces their share of available natural resources. In this aspect, it is obvious that increasing population and the resulting demographic pressure has an impact on the people living in the area, and the environment as a whole, because additional resources have to be tapped from the environment to meet the ever-increasing needs of a growing population. This has an adverse impact on the resources found in reserve and will increase conflicts over resources use and scarcity.

On the western and northern parts, the land is bordered by the sea and there is a lack of arable land. Therefore, the allocation of land outside the reserve—whether public or private—has allowed an increase in farming areas into the forest reserve. In addition, the allocation of lands outside the reserve without any regulations for use can have severe environmental costs because it may be accompanied by an increase in human population, leading to a further increase in demand for forest products. As a result, this unregulated rule may aggravate the loss of biodiversity and people's livelihoods, and will also increase conflicts.

3.4 Conflict Management and Resolution Strategies in the Study Area

In general, the study shows that there are a number of causes of conflicts in the study area. Economic hardships of the people and the lack of alternative sources of living, rapid population growth, poor forest management, and illegal exploitation of the forest reserve, and agricultural expansion have led to environmental changes in the reserve. Therefore, there is a need to regulate human pressure in the reserve to reduce conflicts over resource use. To achieve this, during FGDs, a sustainable method (buffer zone approach) of Ngezi Forest management was applied to assess the viability of a sustainable management approach whereby stakeholders arbitrarily located borderlines for the areas agreed by key informants. Six forest management zones were identified as the most preferred in the Ngezi areas. These included the core forest zone, tourism and recreation areas, non-timber forest products, minimum use, and areas for intervention and road sites.

Currently, farming and settlements are unevenly distributed in the Ngezi Forest area. Some people cultivate close to the forest while others are located inside the reserve forest. During FGD sessions held for this study, some areas were proposed by key stakeholders to have been reserved intentionally for agricultural activities and settlements. Despite a heated discussion, the key informants ultimately decided that agricultural fields and settlements should be allocated at least 100m from the reserve border (Figure 7).

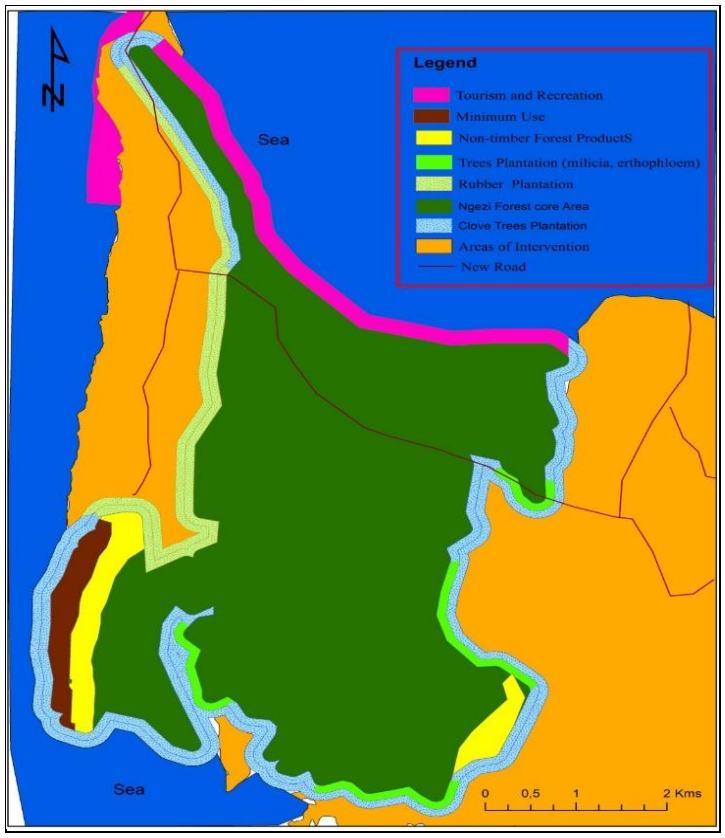

Figure 7: ***Conflict Management Strategies***
Source: Field survey, 2017

Key stakeholders were of the opinion that it was necessary to indicate priority areas for exploiting forest products such as areas of firewood, building materials, handicraft and fruits. Before this proposal, the area located in the north-west of Ngezi Forest Reserve was the one officially reserved for community use. However, the high population pressure from neighbouring villages and from other areas across the country have heightened the demand for forest products, overwhelming the area's ability to sustain the livelihoods of all the people in need.

Therefore, stakeholders were of the opinion that the acquisition of a larger portion of forested land for their livelihoods was necessary (see Figure 7). Moreover, stakeholders proposed that the northern and western parts (coastal line areas) be used for cultural purposes, particularly recreation.

Moreover, another debate was on forest road sites, whereby the majority of key informants suggested that the existing road should be shifted to the northern part, where there are no dense forests, as this could protect the forest from unnecessary human contact. However, this suggestion was opposed by the people from the western side of the reserve where Makangale, Tondooni, Jiwe Moja and Kijiji villages are located. Participants from the mentioned areas preferred the current position of the road, and further proposed that the current road should only be improved.

The study also proposed that there should be areas for further intervention, where rubber and clove plantations should be established. Afforestation would also be necessary. These initiatives outside the forest reserve will contribute in reducing pressure in the inner parts of the reserve. The main intention of this buffer zone method is to reduce negative impacts caused by local communities on protected areas. The buffer zone method supports conservation of biodiversity by providing alternative livelihood and income generation opportunities. It is also expected to compensate the local communities for the losses they incurred when the reserved area was declared in 1950s. We believe that this strategy would be useful in poverty reduction and in efforts to improve the quality of livelihoods in the communities bordering the forests. However, accomplishing the above is not a simple task: it requires strong commitment, teamwork and trust on the part of both government and the local communities. On the other hand, this implies that there cannot be a uniform joint management across each forest site, but rather partnerships have to be developed for each different set of people according to the values they place on specific resources, and taking into account their own historical context.

Studies conducted by Walters et al. (2008) and Wu et al. (2014) report that the discipline of setting spatial priorities is a good approach of managing forests under severe conflicts of use, a method that would consequently yield benefits to all stakeholders. In many cases, the communities seem to be interested in managing forests. However, most of them emphasize the economic bases while the ecological aspects remain secondary; so biodiversity issues were not always taken into consideration. As a result, this can lead to economic failure in the future in terms of both livelihood generation and recovery of capital investments. Therefore, careful selection of appropriate sites and caution in the implementation of such policies are important aspects for successful forest management.

However, this observation differs considerably from the experience encountered in Ngezi whereby participants during agreed that apart from the selected sites, the rest of the forest areas should be rigorously conserved.

Furthermore, study participants suggested that those areas proposed for agricultural activities should also be considered for forest plantation (agro-forest) activities, so that the approach considers both people's livelihoods and ecological aspects. The stakeholders knew that this technique could only become economically sustainable in the long run if ecological livelihood factors are given due consideration.

Studies by Aicher (2014) and Chomba (2016) have confirmed the relationship between sustainable resource conservation and interests of the local communities. In India, for example, where forests are managed by a forest department, and for a long period, authorities experienced conflicts related to resource use. This approach was applied to solve conflicts between the Forest Department and other stakeholders, including the local communities, over access and use of forest resources. The studies advise that if an organization is determined to find a workable solution regarding issues of resource management, action should be accompanied by realistic strategies that recognize the needs of the multiple actors with differentiated resource interests. The usefulness of this approach is again corroborated by Khatri (2010) who discloses that Nepal has taken various strategies in its bid to conserve and manage its forests without success. However, recently, this conservation approach has proved to be the most instructive and successful. To date, after twent-eight years of experience with the buffer zone technique, conservation has been rewarded and has provided local communities with the motivation to manage and use the forest sustainably. It is expected that the same strategy in the Ngezi Forest Reserve could change the desire of the people for better services and delivery, improve livelihoods, resolve conflicts, and thus increase its role in the conservation and management of Ngezi protected areas.

4. Conclusion

In general, the local communities in Ngezi area are not happy with the Ngezi Forest management system in terms of overall control and supervision. Among the respondents, women insisted that they were not satisfied with the governance of the Ngezi Forest, which did not seem to have plans in place for sustaining their livelihoods. The main reason is that local communities are denied freedom from accessing supplementary benefits. The local community made it clear that their means of livelihood should be clarified for them to obey orders related to use of Ngezi Forest. Thus, there is a need of assisting villagers to design a clear livelihood action plan that they could implement and regularly monitor themselves. The study believes that this buffering strategy will contribute greatly to poverty reduction, improve the local people's livelihoods, and ensure sustainable conservation of the Ngezi Forest Reserve. However, the accomplishment of this is not simple: it needs strong commitment, teamwork, and trust on both sides—the government and the local people.

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