Chapter

Effects of Rural Land Tenure System on Mangroves Management in Corentyne, Guyana

Linda Johnson-Bhola

Abstract

Mangrove forests in Guyana are recognized as the most important soft-engineering structure that protects the low-lying coastal areas against wave and wind actions. However, this vegetation has become severely degraded along some sections of the coast as a result of excessive exploitation and the dynamic nature of the coastline. In an attempt to protect and manage the mangrove ecosystem, the Government of Guyana has instituted a number of mechanisms, including the Guyana Mangrove Restoration Project (GMRP). However, the effectiveness of these instruments has been impaired by the different types of land tenure systems. The study aimed at exploring the inter-relationships between land use and tenure issues, and the sustainable management of mangroves in selected villages in Corentyne, Guyana with a view in determining plausible remedies. The study used a mixed-methods approach, involving Google Earth technology, observation, in-depth interviews, and questionnaire surveys. The results showed that while land use has not changed significantly over the past decade, the advancement and proliferation of mangroves on privately owned lands were quite noticeable. This has given rise to a new area of conflict between managers of coastal mangrove forests and land owners and small-scale traditional users, signifying an urgent need for policy reform.

Keywords: land use, land tenure, mangrove management

1. Introduction

Globally, mangroves occupy the upper tidal zones in the tropical and sub-tropical regions of Africa, Asia, Oceania, the Americas, and the Caribbean. Altogether, they account for about 15,642,673 hectares to 17,075,600 hectares of the earth's land [1]. The greatest diversity of species is found in South-east Asia where mangroves envelop more than one million hectares of land, representing about 7% of the global total land area coverage [2–4]. Mangrove forests perform a variety of functions and provide a wide array of services, ranging from ecological and protective to social and economic. They provide nursery ground for various marine species; create habitats for bees and other animals; [4] absorb pollutants;

stabilize sediments originating from sea-land interactions; and protect coastal communities from strong winds and waves [4, 5]. Their usefulness also includes the provision of food, medicine, fuels, and construction materials, as well as increasing biodiversity values for local communities [5].

However, while available data point to a variety uses of mangrove ecosystems, analysis of remotely sensed images shows that mangroves are recognized as the most important soft-engineering sea defense structure against erosion in low-lying coastal areas in Guyana [6, 7]. By virtue of more than 75% of the country's population residing along the coastal belt and within proximity of mangrove habitats, uncontrolled developments, economic activities [7–9], and erosion episodes [7, 9] have severely impacted the sustainability of mangrove ecosystems in some locations over the years. These trends, along with the prospect of sea-level rise [10–13], necessitate investigation of how changes in land use, land cover, and land tenure arrangements affect mangrove colony and distribution [6, 9, 12]. For close to a decade, there has been renewed interest in the protection and management of mangroves along Guyana's sea coast [12]. The establishment of the Guyana Mangrove Restoration Project (GRMP) in 2010 is one of the main responses initiated by the government to address these issues [14]. Also, at the policy level, mangrove restoration and management have been identified as two of Guyana's primary responses to the prospect of climate change and sea-level rise, and honoring of obligations to the United Nations Framework Convention on Climate Change (UNFCCC).

The primary objective—founded on three key principles adumbrated by the project document—of the GMRP is to promote the sustainable management of mangroves. These principles are ecological sustainability, economic sustainability, and social system sustainability. According to the GMRP, ecological sustainability suggests maintaining the ecological balance of mangrove ecosystems at its restoration sites while utilizing some resources. Economic sustainability identifies opportunities for satisfying some basic needs of the local communities by establishing mangrove reserves and producers cooperatives, for example; and sustainability of the social systems is directed to developing infrastructure, such as building common facilities for community activities, ensuring social justice, and sustaining local and national traditions that are enshrined in the national policy documents [6, 8, 15]. The different types of land tenure systems invariably have an influence on land use and mangrove management. The objectives of this study, therefore, were to determine the relationship between the dominant land uses and the extent of mangrove coverage in the study area, and to examine land tenure issues that impacted the conservation and sustainable management of mangroves using a case-study approach.

2. Study area, methods, and materials

2.1 Location

The study area is located on the Low Coastal Plain, which is a narrow strip of land on the north-eastern coast of Guyana, South America, and comprises nine villages in the East Berbice-Corentyne Administrative Region. These villages are Adventure, Limlair, Wellington Park, Kiltearn, Eversham, Java, Joppa, Good Hope, and No. 46 (See **Figure 1** for the location of the villages). They were randomly selected from a group of villages, where it was observed that mangroves have advanced on private land east of the public road.

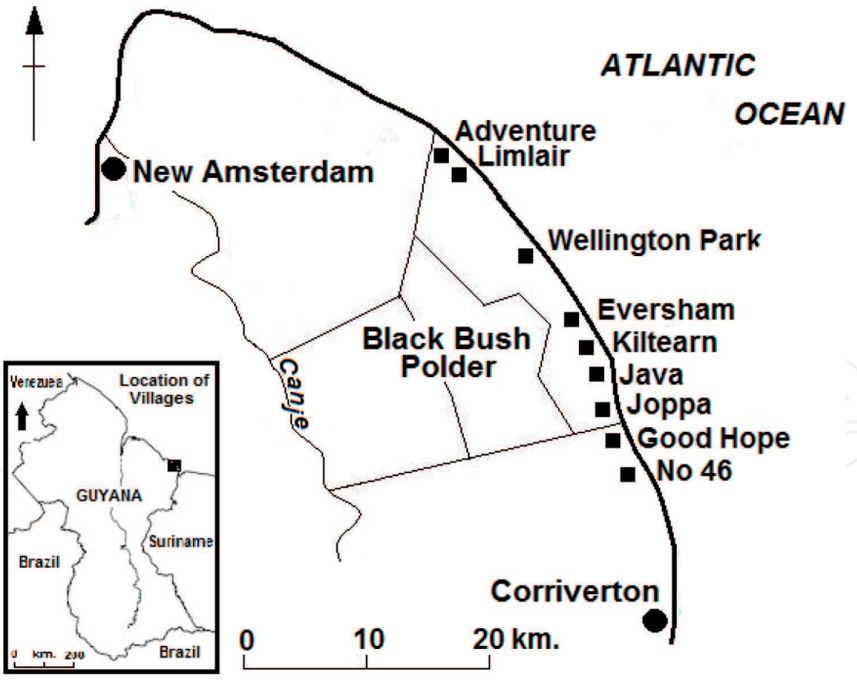

Figure 1.
Location of the study area. Courtesy: Claudette foo.

The study area is characterized by variable hydrological and meteorological conditions. Two wet (May–August and December–January) and two dry seasons (February–April and September–November) are experienced annually. Humidity is high all year round, and there is a narrow range of temperature (26–28°C). The ground surface to the south and east slopes gradually toward the Atlantic Ocean, which lies to the north. Due to the elaborate drainage network and mechanical drainage facilities, the area seldom floods from heavy and continuous rainfall. Although the area is periodically flooded as a result of saline water intrusion during above-normal spring tides, small-scale agricultural activities are carried out sporadically in the area. The relatively flat topography, fertile soils, and good accessibility facilitate agricultural activities. Soils found there originated from different types of parent materials, but they predominantly clays on the front lands and a type of tropical peat called pegasse—which occurs behind the coastal clays and along the river estuaries—in the backlands. The spongy nature of the peat soil allows for high moisture-retention capacity.

The study area consists of economically depressed communities that rely heavily on cash crop cultivation, fishing, and paddy rice farming (this is done on the leeward side of the public road and away from the mangroves). There was no marked change in land use over the past decade, except the expansion of residence in Eversham and surrounding villages, and some instances of the natural proliferation of mangrove on privately owned lands. The residential area is found on both sides—east and west—of the public road only, and it takes on the same linear arrangement as the neighboring communities.

2.2 Research design and approach

2.2.1 Selection of study sites

Three criteria were used in the selection of the study sites for data collection. These are:

a. Availability of data: the need to identify, for comparison purposes, sites for which information was readily available;

b. Socio-economic and ecological consideration: the need to identify sites with similar characteristics, such as employment and presence of mangroves; and

c. Accessibility of sites: the close proximity of the study areas to the main transport route and population allowed for relative ease of visits to the sites.

2.2.2 Land use data collection procedures

The study utilized four methods of data elicitation: Google Earth images for 2009, 2013, and 2016 to determine land use dynamics; observation of land use; in-depth interviews; and questionnaire survey. These methods were used to obtain and triangulate information on the type of land ownership, response to mangrove protection on private land, and strategies to address land tenure issues as it relates to mangrove management in the communities. The sample size consisted of forty-seven (47) households that exist in locations colonized by mangroves.

Various studies on land use or land cover mapping at large scale commonly used the low and medium spatial resolution imagery, such as NOAA, TERRA/MODIS, and Landsat TM or ETM+ [2], and some other global and regional land use or cover products such as FROM-GLC [16, 17] and GLC2000 [18] obtained from remotely sensed data. These advanced technologies have definitely improved our understanding of regional and global land cover distribution and their changes. Regrettably, the relatively low spatial resolution renders them inadequate for detailed land cover mapping in areas that have complex and high varied landscapes, such as cities that are usually featured by small-dimension elements, combined with intricate spatial patterns [18]. Changes in land use close to areas where mangroves exist are often reflected in the land use policy and tenure systems [19]. These changes, which can be determined using Google Earth (GE), are a basic indicator of mangrove coverage and extent [20].

The GE tool was applied to this study for a number of reasons. When used at small scales, it generates medium spatial resolution images. It is a free and open data source and it provides enormous support for the traditional land use/cover mapping [21, 22]. However, very few studies have been undertaken to use GE images as the direct data source for land use/cover mapping and opted for higher spatial resolution images, including QuickBird, IKONOS, and RapidEye [21–23]. If Google Earth images can achieve relatively satisfactory classification, they can provide some opportunities for detailed land use/cover mapping by costing little [19, 24], and is, therefore, quite suitable for use in this study. The three images generated from GE captured the spatial extent of mangroves from 2009 to 2016.

The data obtained from GE has been incorporated in the analysis and discussion section (Section 3.0) of this chapter to help in the understanding of the extent to which mangrove management is stymied by these issues. The Conceptual Framework in **Figure 2** outlines the requirements of and various issues associated with land use, tenure, and sustainable mangrove management.

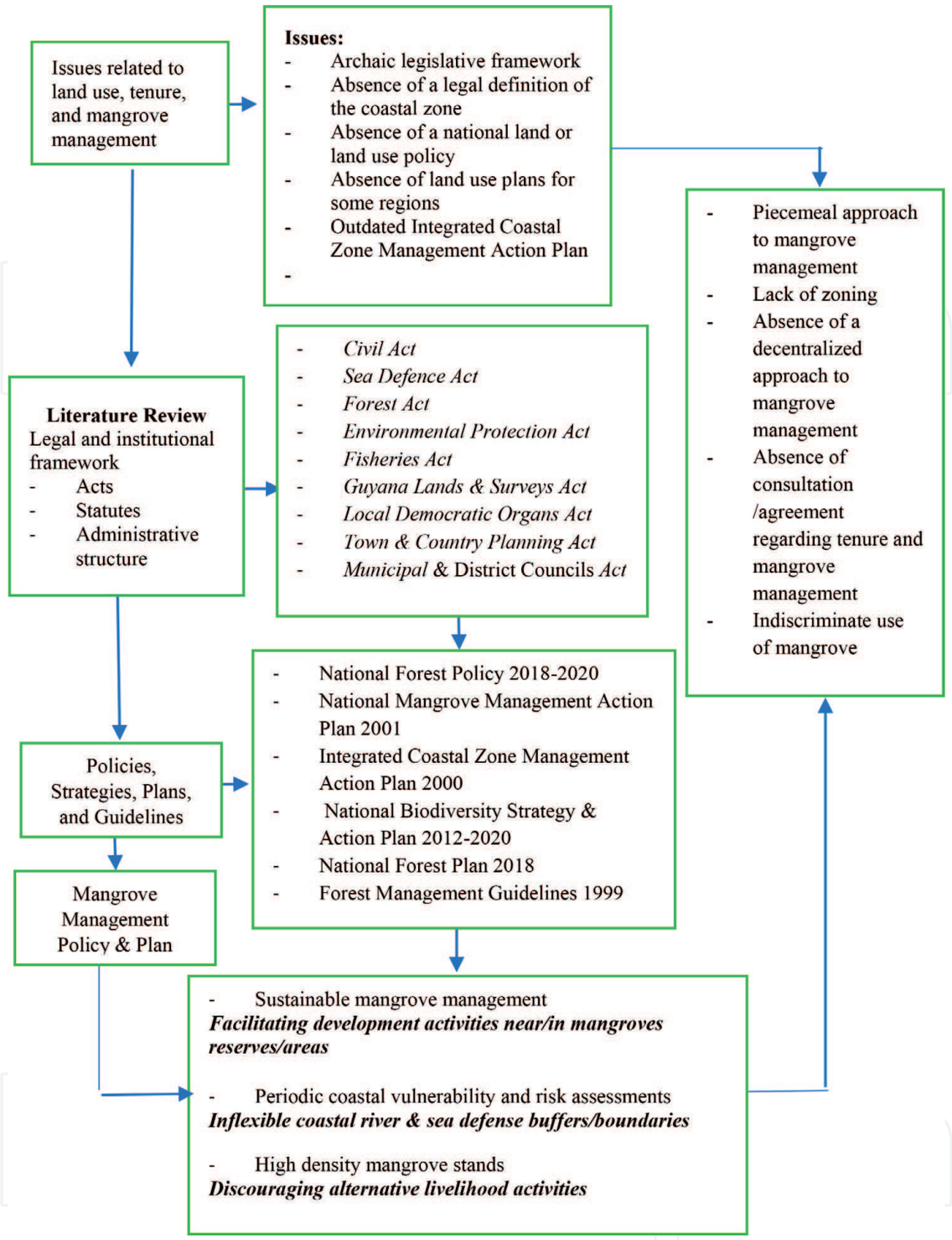

Figure 2.
Conceptual framework of the various issues associated with land use, tenure, and sustainable mangrove management. Data compiled by the author.

3. Effects of land use and tenure issues on management of mangroves

3.1 Land use in the communities over the past 10 years

As observed during the study, land within the study area was used primarily for the purposes of cultivation of mangroves and marshes; for establishment of residential area; for agriculture; and for recreation. Based on the data obtained,

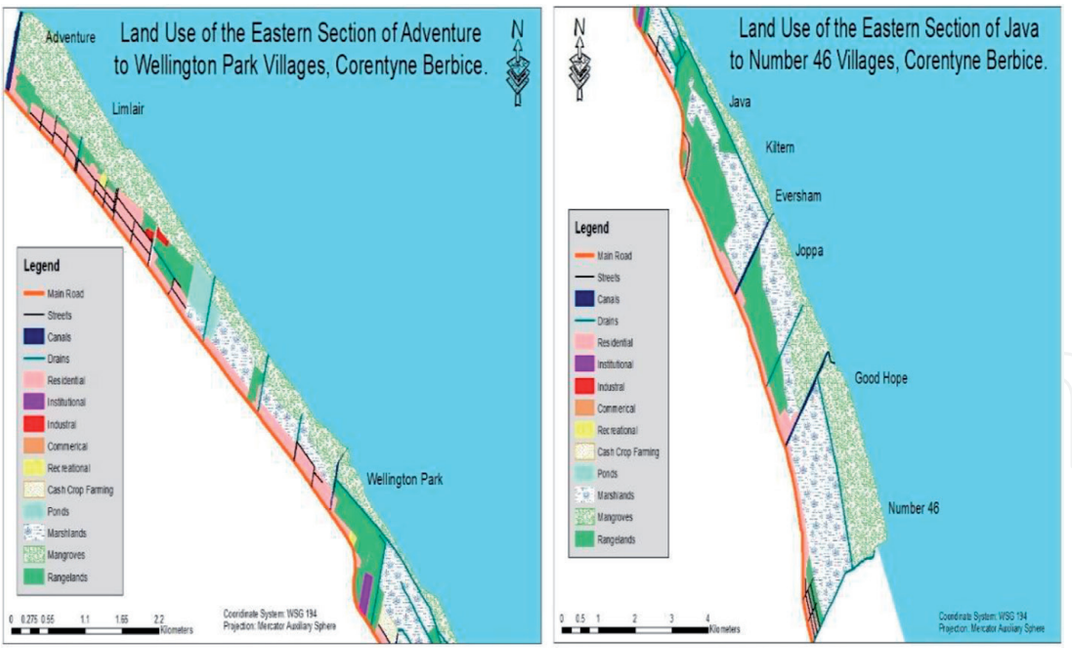

Figure 3.
Land use at the study area in 2016.

land use remained constant from 2009 to 2016. The illustration below (**Figure 3**), which shows land use in 2016—using GE and on-site observation and interviews in 2018—indicates that land use remained unchanged.

3.2 Mangrove coverage in the study area

The intent, initially, was to obtain and use GE images for five-year intervals, from 2009 to 2018, but the GE coverage for 2018 was unclear. For this reason, GE images for the years 2009, 2013, and 2016 were used. The images were obtained on the same date. The quality of the images allowed for the spatial coverage of mangroves at the study area to be determined and evaluated. The amount of land covered by mangrove fluctuated for the period under study. The spatial changes of mangrove coverage in the 8-year period are shown in **Figure 3**. In 2009, mangrove forest coverage was 77.5 hectares, while in 2013 and 2016, it was 91.8 hectares, and 79.08, respectively. A comparison of data for 2009 and 2013 revealed that there was an increase in vegetation coverage of 14.3 hectares—which represents 15 percent increase—with some notable gains along the mudflats around the centre of the study area, and to the southeastern coast closer to Wellington Park for 2013 (**Figure 4(a)** and **(b)**). From 2013 to 2016, figure decreased by 12.72 hectares, which suggest that mangroves were destroyed either naturally or by human activities, or a combination of both (**Figure 4(c)**). The changes in mangrove stock varied in a particularly spatial pattern. They increased constantly toward the extreme west and east of the area, as shown in **Figure 4**, for all of the years, but they fluctuated in the central part. The villages identified in this study are located west and east of the study area as well. Major growth was recorded at Limlair, Eversham, Joppa, Good Hope, and No. 46 Villages. The balance of natural mangrove increase and decrease from 2009 to 2016 could not be determined due to the replanting efforts that were undertaken over the study period. In summary, during the period 2009 to 2016, the cumulative change or net increase in mangrove coverage in the study area was about 1.58 hectares.

Remarkably, the change in residential land use and the sporadic small-scale agricultural activities particularly in the villages of Limlair and Eversham did not cause a corresponding loss of mangrove in the villages, and, therefore, presented no risk to the mangrove ecosystem. However, at Wellington Park, where there has been a systematic attempt to replant and monitor mangroves over the last few years, it was observed in 2017 and 2018 that large sections of the mangrove stand have been severely eroded as a consequence of wave action. This village remained exposed to the natural cycles of erosion and accretion, but the rate of erosion predominates and is accentuated by the presence of a waterway west of the village. The overall decline of and damage to mangrove forest in 2016 could have been attributed to the loss experienced in this village. The decline in mangroves is expected to have resulted in loss of biodiversity and reduction in fishing yield in the village. On the contrary, Java, situated immediately east of Wellington Park and also unprotected from the tides, has witnessed rapid mangrove advancement on private lands, resulting in the clearance of the vegetation by property owners in order to gain access to sections of their plots of land and the seashore.

The proliferation of mangroves in the other villages could only be possible as a consequence of the process of accretion, absence of competition from other vegetation, and protection by community members. The tides transport and deposit sediments and mangrove seeds along the windward side (area closest to the seashore) of the villages. The effect, therefore, has been the expansion of mangrove forests over the last decade. This explains why mangroves increased so rapidly in Adventure, Limlair, Java, Eversham, and No. 46 Villages. The reason for the two contrasting occurrences at Wellington Park and Java—both of which are in the same location only separated by a political demarcation—is still not clearly understood. Overall, the random peasant farming undertaken in some villages did not impact the mangrove ecosystem negatively, and the loss of the vegetation in some villages was appropriately compensated for by the natural regeneration of mangrove in other sites.

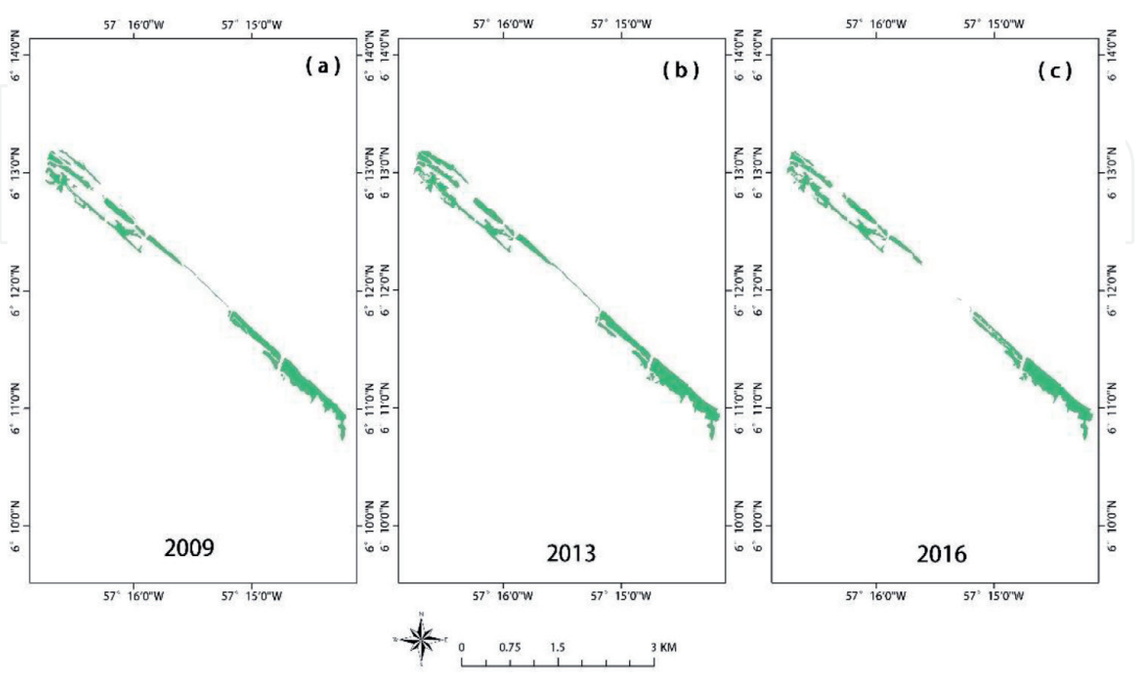

Figure 4.
The distribution of coastal mangroves over the study area in (a) 2009, (b) 2013, and (c) 2016. Courtesy Dina Benn.

3.3 Land tenure issues and mangrove management

In Guyana, land is owned under three distinct legal systems of tenureship: the public (state and government lands), Amerindians (Indigenous peoples), and private freehold/absolute grant arrangement. Interest, or what is commonly known as "ownership," is distributed as approximately 85, 14, and 1%, respectively [24, 25]. While the procedural requirements for leasing of state/public lands and allocation of Amerindian lands are relatively precise, private freehold arrangements and procedures are punctuated by ambiguity in the rules and regulations relative to a number of Acts and Statutes that set out the legislative and administrative frameworks for land management. The policies and regulations regarding private land owners' right to freehold property, which mangroves colonizes are not clear.

The ministerial proclamation was a response to the heightened level of vulnerability of the coast to sea level rise, threats to the protective and ecological functions of the vegetation, and associated issues. This proclamation has led to further hurdles prominently among which are overlapping and conflicting processes that do not represent best practices in tenure arrangements. It also resulted in a conflicting understanding, among policymakers and the local communities as well, of land ownership, and raised legitimate questions about the effectiveness of any mangrove management initiative, especially in those locations contiguous with the seashore. The tradition in some rural communities, including those where mangroves exist, is that individual property right is insecure and deemed by many owners as unnecessary; thus, a relatively large percentage of owners either do not register their property or keep their ownership rights updated. Effective and efficient mangrove management, therefore, requires a comprehensive set of legal and institutional reforms aimed at changing perceptions and understanding of the system at large, and attitudes toward property rights, enforcement, and the natural environment. It also requires a new set of procedures and written legal and institutional structures.

As stated before, in order to manage mangroves, the Government of Guyana, in collaboration with the European Union, established in 2010 the Guyana Mangrove Restoration Project (GMRP) administered by the Ministry of Agriculture and implemented by the National Agricultural Research and Extension Institute (NAREI). Since the commencement of the project, a number of other entities also worked closely with NAREI to undertake mangrove management activities. These include the Guyana Forestry Commission (GFC), the Sea and River Defense Department of the Ministry of Public Infrastructure (MPI), Fisheries Department of the Ministry of Agriculture (MoA), Environmental Protection Agency (EPA), Guyana Lands and Surveys Commission (GLSC), National Drainage and Irrigation Authority (NDIA) of the Ministry of Agriculture, and the Regional Democratic Councils (RDCs). The first four agencies cited have a more direct involvement in mangrove management. These agencies perform various functions, ranging from coordination and facilitation of mangrove activities to sea defense infrastructure development.

3.4 Effects of private land ownership on mangrove conservation and management

It is well established in the literature that the participation of local community members in mangrove conservation projects is imperative for its sustainability. In order to understand how private land ownership affects mangrove conservation and management, a case study was conducted and the results are presented below. The main objective of the case study was to obtain the views of the households in the ways in which private land ownership, as one of the main types of land tenure systems, is likely to impact sustainable mangrove management. The study showed that significant areas of private lands are colonized by mangroves which extend from about 0.5 km

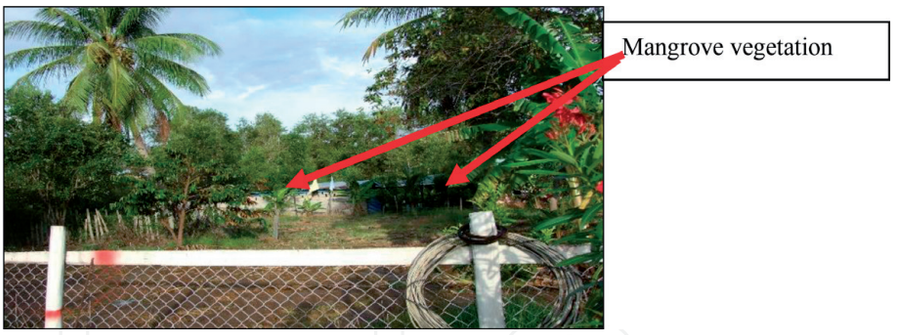

Figure 5.
Proximity of mangroves to household at No. 46 village. Courtesy of L. Johnson-Bhola.

		Aware that Mangrove is a Protected Species			Total
		Yes	No	Not stated	
Land Owner	Yes	5	26	1	32
	Not stated	1	2	0	3
	No	1	7	0	8
	Disputed land	1	3	0	4
Total		8	38	1	47

Source: Questionnaire Survey.

Table 1.
Awareness of the legal status of mangroves.

east of the main road to the reserve area or buffer zone near the sea shore. **Figure 5** illustrates sections of the vegetation located at the rear of the house lots.

Data collected on awareness of the status of mangroves as a legally protected forest showed that 80% of the households were unaware. Eighty-one percent of those who owned property had no knowledge that mangroves were protected by regulation (**Table 1**). This is a clear indication that there is a need for greater outreach focusing on education and awareness, particularly in areas where primary mangroves emerge.

A recurrent issue raised was statutory jurisdiction over mangroves on private territory without consultation with the local communities. Most of the households were aware of the legitimacy of freehold tenureship and vehemently defended entitlement to their property. **Table 2** illustrates that land tenure arrangements varied in the villages. Sixty-eight percent of the households indicated that the plots were held by transported and title, while 13% did not state the nature of land holdings. Land ownership, in this study, appeared to be one of the key issues linked to households' willingness to support the mangrove restoration project.

Data showed that the households were willing to allow the growth of mangroves on their property. This variable is considered significant as natural regeneration seemed to be less costly, and it showed that the households were ready to contribute to mangrove management. Despite being willing, many households did not understand that the mangrove project is a national initiative intended to benefit vulnerable coastal communities. **Table 3** shows that the majority of the households in the villages for over 10 years were happy that the mangroves were on their property because the vegetation assisted in protecting the property from the sea. While there was less likelihood that conflicts would emerge over the use of unclaimed land for mangrove protection, it appeared that absentee land owners, as well as the communal arrangements that exist in most of the villages, would present difficulty for the mangrove protection.

Many of the households stated that there is a need to address land tenure issues, for they are likely to affect mangrove management. **Table 4** indicates that 80% of the households with married couples required compensation if the lands were to

be converted to mangrove forest use. Altogether, approximately 64% of the households needed compensation. This variable is important because it is an indication of long-term land use change, which could limit other potential valuable uses. Fifty percent of the Indo-Guyanese households requested compensation, while 65% of the Afro-Guyanese households and 100% of the households of mixed ethnicity required compensation if they were to allocate parcels of their estate to mangrove protection. This data is significant because it points to the issue of unwillingness of the households to collectively relinquish interest in lands for mangrove protection. A critical factor for successful mangrove restoration and/or management projects is favoring community allocation over household allocation. For titled lands, the interest may be owned similarly, except in special cases such as where separate lots have been awarded to persons.

Type		Frequency	Percent
Valid	Titled	8	17.0
	Transported	24	51.1
	Disputed	2	4.3
	Transport pending	1	2.1
	Informal occupancy	2	4.3
	Not stated	6	12.8
	Leased	4	8.5
	Total	47	100.0

Source: Questionnaire Survey.

Table 2.
Types of land tenure.

Reasons/Period of Residence		Reasons for being happy with mangroves on private land			Total
Period of Residence	Less than 5 years	1	1	0	2
	5–10 years	9	3	3	15
	More than 20 years	17	8	5	30
	Total	27	12	8	47

Source: Questionnaire Survey.

Table 3.
Willingness to allow the growth of mangroves on private property.

	Compensation needed for Relinquishing Land			Total
	Yes	Do not know	No	
Not stated	5	0	1	6
Leased	3	0	1	4
Titled	3	2	3	8
Transported	16	2	6	24
Disputed	0	1	1	2
Transport pending	0	0	1	1
Informal occupancy	1	0	1	2
Total	28	5	14	47

Source: Questionnaire Survey.

Table 4.
Requirement for relinquishing land.

It has been recognized that local buy-in is necessary to support mangrove management. Additionally, awareness of the mangrove intervention project and proper timing of such intervention are important initial elements of a successful and acceptable mangrove management initiative.

3.5 Averting land use and tenure issues as it relates to the sustainable management of mangroves in the study area

A wide range of suggestions was put forward by the households as it relates to how the issue of sustainable management of mangroves at the community level could be addressed. The most important include:

- consulting with the communities with the view of encouraging mangroves on private lands that are not assigned for specific purposes;
- addressing issues, such as land tenure, particularly in Region 6: issues related to private land ownership in mangrove areas. This would strengthen coastal zoning activities for the most critical mangrove areas;
- identifying risks associated with changing policies and laws to protect mangroves;
- designing a framework for controlling change in land use in areas where mangroves exist;
- allocating unclaimed land, where mangroves exist to protective and productive mangrove forest;
- evaluating private land, where mangroves exist with the view to compensate owners;
- defining beneficiaries clearly in order to avoid the exclusion of certain households from mangrove areas; and
- facilitating traditional users of the area and those who need to go through the mangroves to access the intertidal flats and fishing grounds. This is particularly relevant for the poor who own no land.

These suggestions, in effect, form a list of recommendations to be evaluated and adopted by GMRP. It is suggested that the authorities place greater emphasis on improving local communities' knowledge about mangrove management, and their rights and responsibilities, through improved outreach programs. Further, reference was made to the need for consultations with the local communities before decisions that are likely to have great impacts on the land ownership are made. This suggestion is considered crucial because it can instruct the authorities to take precautionary actions and minimize conflicts. Some respondents suggested that—as a strategic approach to preservation of the vegetation—consideration be given to relocate some households that are found within proximity of locations where mangroves exist. However, after consideration of the extent of private lands, which ought to be brought under control for protection of the sea coast against the erosive action of the river current, the need to revisit the laws and regulations governing the 50 ft. extent from the shoreline for sea defense protection will have to be amended. The study has pointed to the fact that some residents are willing to commend portions of their private land toward mangrove protection—despite

competition with other potentially lucrative uses of the land, such as farming aquaculture—but they need to be compensated.

4. Conclusions

From the perspective of long-term development, the mangrove areas need to be considered as a multiple-use management area (MUMA) given the different interest groups that exercise jurisdiction over the area. As a MUMA, each stakeholder will be given an opportunity to have its interest addressed, while at the same time, the potential for conflict will be reduced. Sustainable management of mangroves is likely to be impacted by land tenure issues in the communities where the study was conducted. While the households expressed willingness to support mangrove protection, they were unaware of the legal status of the vegetation. Among the concerns raised was their right to deforest their private land whenever the need arose. The general trend was that most households showed willingness to transfer ownership of the land, which has mangrove if compensated accordingly. The effects of human activities and development and land tenure issues on the mangrove sustainability were in part compensated for by the natural growth of mangroves in the study area. So, with the support of local authorities and environmentally friendly use of the community forest, as well as appropriate management of stand structure, the coastal mangrove ecosystem in this area should be able to thrive successfully.

Conflict of Interest

There is no conflict of interest.

Thanks

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