

Land use changes (1990-2015) in Kalangala and Buvuma districts, southern Uganda



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Summary

Trends in land cover change were assessed for the Kalangala landscape, composed of Kalangala and Buvuma districts. Land cover has greatly changed in both districts but the type of change varies between them. In both districts, the dominant land use in 1990 was fully stocked tropical high forest, but by 2015, this had been reduced to less than half in Kalangala district, from 52% to 22%, whereas in Buvuma district high forest had been completely cleared, from 47% to 0% cover. In the same period in Kalangala district, uniform farmland which describes palm oil plantations had increased from 0 to 18%, whereas in Buvuma, subsistence farmland had increased from 8% to 52%. And whereas most of protected areas in Kalangala district had not

been cleared of tropical high forest, most land in protected areas in Buvuma district had already been converted to subsistence farmland. With these changes, both local livelihoods, and flora and fauna are being threatened. Both endemic and IUCN Red List species have been identified in this landscape, with some already threatened. There is therefore urgent need for action to halt further conversion of forest land within the framework of land use planning. Finer scale mapping of areas not allocated to oil palm plantations must also be a prerequisite for guiding land use planning land restoration interventions since the area is highly fragmented, including a full assessment of the drivers of land use change.

Introduction

The establishment of oil palm plantations is often associated with forest clearing (Koh and Wilcove, 2008; Block, 2009; Colchester et al., 2013). This results in reduction of wildlife habitats, exertion of more pressure on remaining forests by local communities for fuel, timber and non-timber products, increased wildlife poaching, and more competition for land for food production, resulting in the expansion of agricultural land onto marginal areas. Furthermore, there are specific issues related to island ecosystems in Uganda, such as draining of wetlands that serve as a buffer and runoff filter for Lake Victoria posing an additional threat to the aquatic wildlife. Land cover changes over a period of 25 years were assessed using classified GIS maps from 1990, 2000, 2005, 2010 and 2015, obtained from the Ugandan National Forestry Authority. Changes on the main islands of Kalangala and Buvuma districts were then assessed between 1990 and 2015, with the area gained and lost in each land use category calculated, with separate analyses for the two districts as drivers of change differ in each.

Kalangala district

Kalangala district land use maps show that fully stocked tropical high forest had the highest coverage in 1990. But

by 2015, 'uniform farmland' (synonymous with oil palm plantations) dominated the largest island (Bugala) and subsistence farmland had spread to the smaller islands where it did not exist in 1990. Most of the remaining tropical high forest was within protected areas. Due to the varying disturbance levels on different islands over the years, the direction of change in spatial coverage (increase or decrease) of the different land use classes varied greatly. In 1990, tropical high forest had the highest percentage coverage (52%) followed by grassland (24%). By 2015, tropical high forest had decreased to only 22%, and grassland had also reduced to almost half of its previous size (from 24% to 13%). Uniform farmland that did not exist in 1990 covered 18% by 2015. By 2015, most of the tropical high forest found on the smaller islands was either converted to subsistence farmland or degraded forest, which in most cases is a transitional land cover to other land uses. A similar but more exaggerated picture is seen on Bugala island alone (by far the largest island), where fully stocked tropical high forest also had the highest percentage cover in 1990, but with an equivalent decrease from 58% in 2000 to less than 20% in 2015. In contrast, uniform farmland increased from zero in 2002 to 31% in 2015. See Tables 1 and 2 and Figure 1, below.

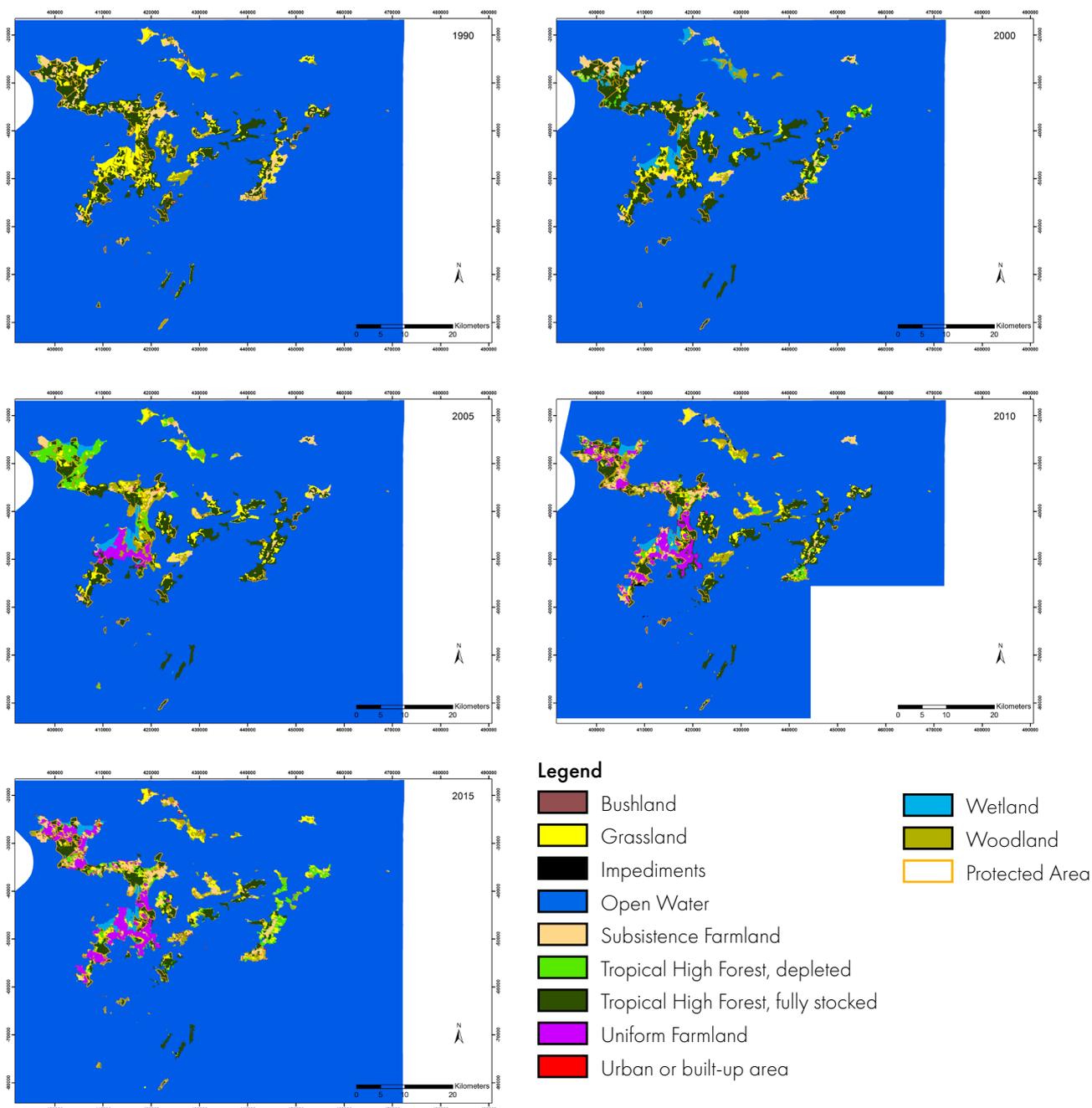
Table 1: Percentage land use/land cover, Kalangala district (1990-2015).

Land use %	1990	2000	2005	2010	2015
Tropical high forest, fully stocked	52	57	40	35	22
Tropical high forest, degraded	0	5	13	3	10
Uniform farmland	0	0	6.6	14.3	18
Subsistence farmland	15	12	8	12	14
Woodland	8	4	11	17	14
Bushland	1	0	1	2	2
Grassland	24	13	15	10	13
Wetland	0	9	5	5	6
Urban or built-up area	0	0	0	1	1
Impediments	0	0	0	1	0

Table 2: Percentage land use/land cover, Bugala island (1990-2015).

Land use %	1990	2000	2005	2010	2015
Tropical high forest, fully stocked	57	58	28	26	20
Tropical high forest, degraded	0	3	19	3	6
Uniform farmland	0	0	11	24	31
Subsistence farmland	15	12	6	15	15
Woodland	1	2	16	16	11
Bushland	0	0	1	2	2
Grassland	27	14	10	5	6
Wetland	0	11	9	9	9
Urban or built-up area	0	0	0	1	1
Impediments	0	0	0	1	0

Figure 1: Land use, Kalangala district (1990-2015)



Overall areas of gain and loss for each land cover in Kalangala district was assessed by comparing the 1990 and 2015 maps. Gain represents the increase in area of a specific land cover/use class between 1990 and 2015 irrespective of what land cover it came from. Loss indicates the area that a specific class lost to other classes. The greatest loss was seen with fully stocked tropical high forest, while the greatest gain was for uniform farmland (oil palm), which did not exist in 1990. Grassland also lost significant areas, most of which were converted to uniform farmland (oil palm). Subsistence farmland almost balanced out its loss and gain (Table 3 and Figure

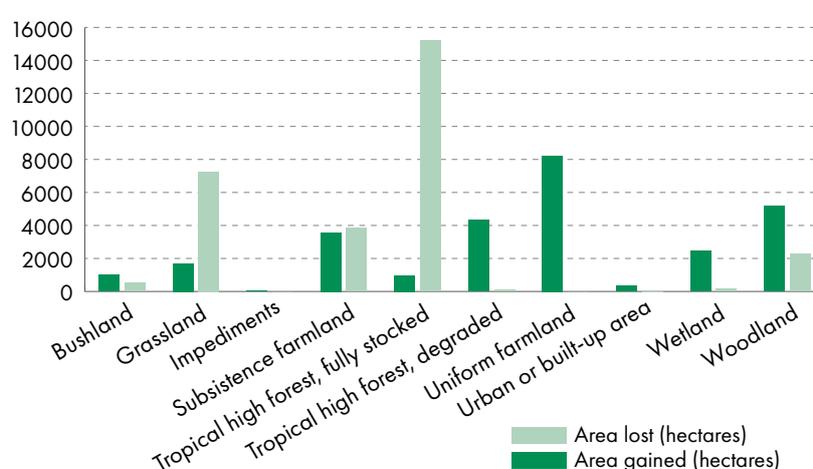
2). Most of the gain however was on smaller islands originally covered by tropical high forest.

Comparing 1990 with 2015, overall gain and loss of spatial coverage for each land cover/use class is observed. Whereas subsistence farmland gained the most, fully stocked tropical high forest lost the most to other land use types. Degraded tropical high forest depleted and wetland lost twice as much area as they gained, with major increases also for woodland and urban areas, which were almost non-existent in 1990.

Table 3: Area gained, lost or stable, by land use, Kalangala district (1990-2015)

Land use	Area gained (hectares)	Area lost (hectares)	Stable area (hectares)
Tropical high forest, fully stocked	972	15215	9066
Tropical high forest, degraded	4330	78	10
Uniform farmland	8231	0	-
Subsistence farmland	3574	3847	2848
Wetland	2464	175	21
Bushland	986	516	21
Woodland	5185	2268	1284
Grassland	1703	7259	4055
Impediments	46	-	-
Urban or built-up area	326	13	1

Figure 2: Area gained and lost by each land cover/use between 1990 and 2015 in Kalangala district



Buvuma district

In Buvuma district, land use has also changed significantly since 1990. Subsistence farmland used to be restricted to central and western parts of the main and largest island, Buvuma island. However, the eastern part which was mostly tropical high forest in 1990 was almost completely

converted to subsistence farmland by 2015, by which time there was no remaining fully stocked tropical high forest left in Buvuma district at all. See Tables 4 and 5, and Figure 3, below.

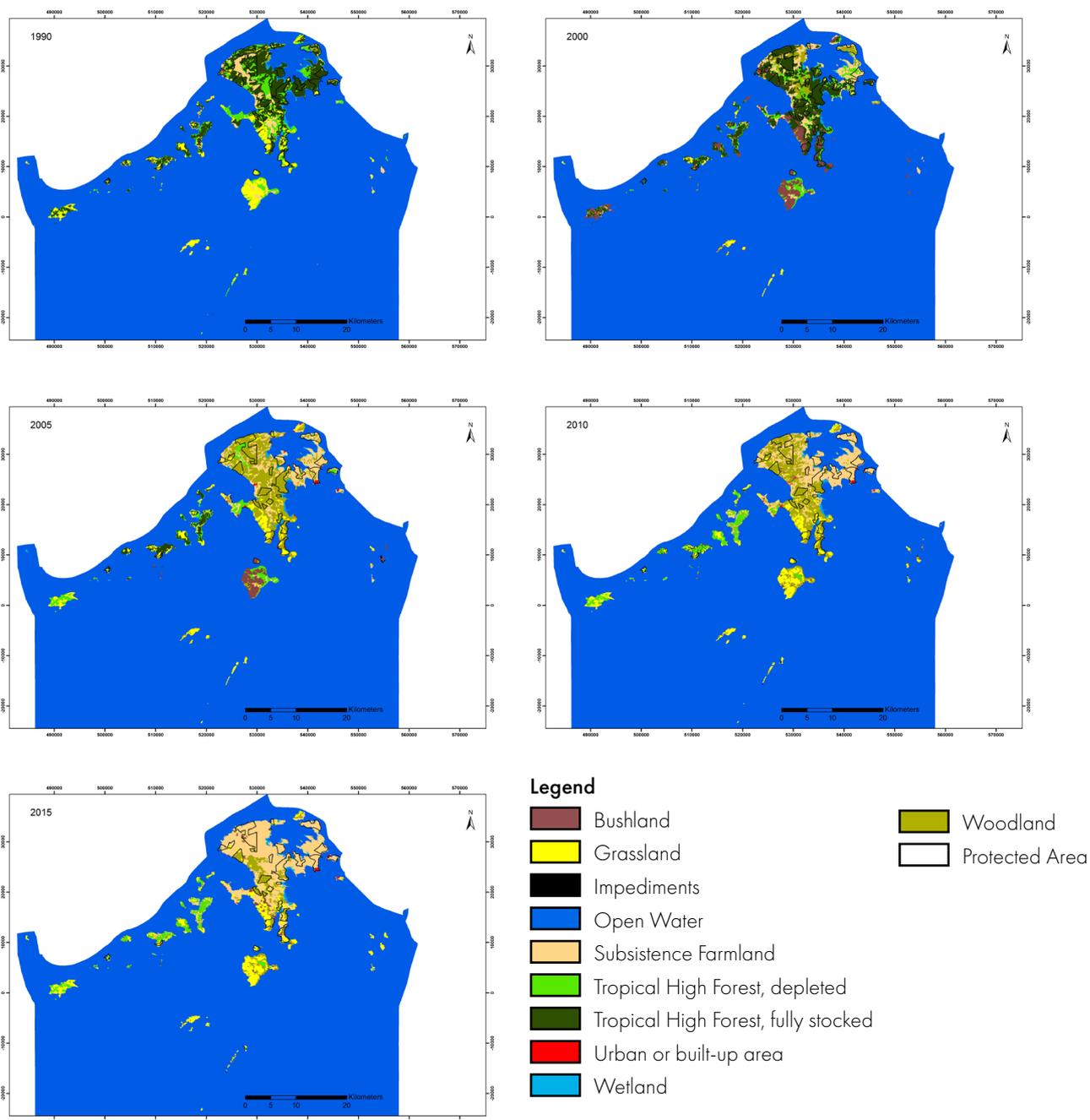
Table 4: Percentage land use/land cover, Buvuma district (1990-2015).

Land use %	1990	2000	2005	2010	2015
Tropical high forest, fully stocked	47	45	6	1	0
Tropical high forest, degraded	19	11	8	8	7
Uniform farmland	0	0	0	0	0
Subsistence farmland	8	15	22	32	52
Woodland	1	8	40	34	15
Bushland	0	15	5	2	3
Grassland	21	13	13	19	21
Wetland	4	3	4	4	3
Urban or built-up area	0	0	1	1	1
Impediments	0	0	0	0	0

Table 5: Percentage land use/land cover, Buvuma island (1990-2015).

Land use %	1990	2000	2005	2010	2015
Tropical high forest, fully stocked	53	50	0	0	0
Tropical high forest, degraded	19	9	4	1	0
Uniform farmland	0	0	0	0.1	0
Subsistence farmland	8	18	28	42	68
Woodland	1	10	54	42	15
Bushland	0	8	0	2	3
Grassland	12	10	10	10	11
Wetland	6	4	4	5	4
Urban or built-up area	0	0	1	1	1
Impediments	0	0	0	0	0

Figure 3: Land use, Buvuma district (1990-2015)



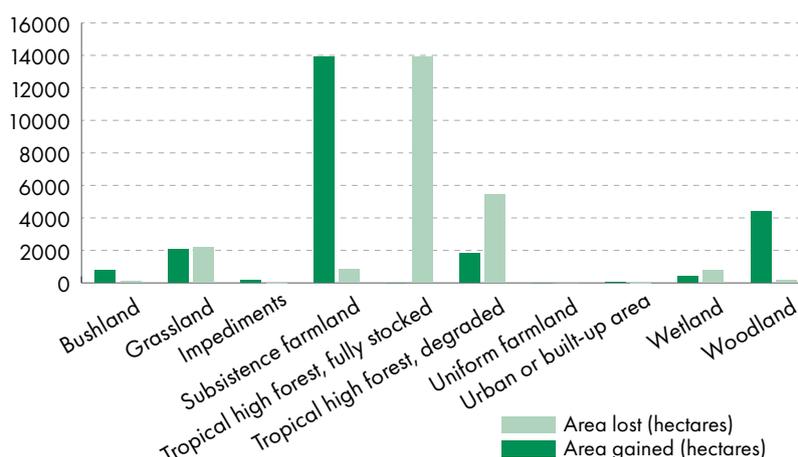
Comparing 1990 with 2015, overall gain and loss of spatial coverage for each land cover/use class is observed. Whereas subsistence farmland gained the most, fully stocked tropical high forest, lost the most to other cover types. Degraded tropical high forest depleted and

wetland lost twice as much area as they gained, with major increases also for woodland and urban or built-up areas, which were almost non-existent in 1990. See Table 6 and Figure 4.

Table 6: Area gained, lost or stable, by land use, Buvuma district (1990-2015)

Land use	Area gained (hectares)	Area lost (hectares)	Stable area (hectares)
Tropical high forest, fully stocked	0	13922	-
Tropical high forest, degraded	1810	5429	158
Uniform farmland	0	0	-
Subsistence farmland	13913	843	1509
Wetland	425	760	486
Bushland	763	94	-
Woodland	4382	154	3
Grassland	2053	2170	4106
Impediments	146	3	-
Urban or built-up area	32	6	-

Figure 4: Area gained and lost by each land cover/use between 1990 and 2015 in Buvuma district



Comparing Kalangala and Buvuma

Land use on both the main islands and the two districts/island groups is changing drastically, with important implications. In 1990, both districts were defined by extensive tropical high forest cover. But today, Kalangala district is defined by oil palm plantations that cover 31% of the main Bugala island. Buvuma, on the other hand, is defined by subsistence farmland that covers 68% of the island. Another contrast is whereas most of the forest reserves in Kalangala district are still covered by fully stocked tropical high forest, most of those in Buvuma district have been converted to other land uses, mostly subsistence farmland and woodland.

Although identifying, ranking and quantifying drivers of change will require further studies, some general

observations can be drawn from this analysis. The main driver of change in Kalangala district is clearly the expansion of oil palm plantations that have replaced tropical high forest, grasslands and subsistence farmland. And as oil palm plantations takes over the main island, communities are moving out to smaller islands for settlement and cultivation, thus leading to clearing of more forest there.

Buvuma island presents a different scenario. Fully stocked tropical high forest which in 1990 covered most of the district, has since been entirely replaced by subsistence farmland and woodland. The main drivers of change are the increase in subsistence farming, the harvesting of trees for timber, fuelwood and charcoal making. Planned

introduction of oil palm plantations on Buvuma island also appears to have indirectly influenced land cover change, because on learning that land has been set aside by the government for oil palm, the local community aggressively started extracting timber and non-timber forest products from all forested areas leading to deforestation and degradation.

Implications

For biodiversity conservation

Significant areas of natural vegetation have been lost in both districts leading to reductions in both plant and animal biodiversity. Koh and Wilcove (2008) describe similar impacts in Indonesia. The most affected species are those that require undisturbed vegetation as their main habitat. Chemical use in oil palm plantations may also be having a wider impact, but which would require confirmation from further research. In Buvuma district, all protected areas have been cleared, due perhaps to a lack of knowledge of protected area boundaries and/or lack of law enforcement. Some endemic and IUCN Red List species in these districts may now be locally extinct especially in Buvuma where all fully stocked tropical high forest has been converted to other land uses.

For food security

Conversion of high forest, other natural vegetation and agricultural land into oil palm plantations means that there is less land for food production and for the collection and use of timber and non-timber products. In addition, the population is increasing due to immigrant labour to work in the oil palm plantations, and food prices have already increased in Kalangala district (KADINGO, 2009). There is therefore a need for appropriate land use plans for both districts to guide sustainable oil palm production while ensuring food security. Buvuma district still has most land available for agriculture and is currently food secure, but this may not be the case in the future as half of the main island, the main agricultural area, has already been allocated for oil palm. Meetings with the local communities involved are urgently required to ensure that farmers refrain from converting all their land into oil palm plantations and that there is increased food production on remaining land.

For water quality

Negative impact on water quality include eutrophication, siltation, erosion and increased soil load and possibly also from agrochemical contamination especially where the lake buffer was cleared. These may not be immediately felt because of the large water mass of Lake Victoria that surrounds the islands, but cumulative impacts are likely especially in areas that easily silt. Smaller islands will need

special attention in terms of planning and management where there are higher risks of the magnification of environmental impacts from forest clearance due to the increased perimeter-area ratio.

For climate change

The loss of vegetation, especially tropical high forest which holds a high proportion of carbon stocks may have climate change implications. There is therefore a need to establish monitoring stations and also for preparing communities for any changes that may occur, especially by ensuring food security.

Conclusions

Land use in both Kalangala and Buvuma districts has changed greatly. The type of change, however, differs between the two districts. Whereas forest in Kalangala district has been converted to oil palm plantations, in Buvuma district it has been converted to other land uses, mainly subsistence farmland and woodland. Although the main island in each district has been affected the most, the changes are also spreading to the smaller islands. In Kalangala district, oil palm plantations have already been established on some of the smaller islands. In Buvuma district, the trend of land use change observed on the main island between 1990 and 2015 is beginning to manifest on the smaller islands. If this is not stopped, all of the natural vegetation could be eliminated in the next 5-10 years at current rates of conversion. Five main recommendations are proposed:

1. Undertake biodiversity surveys to ascertain which species of conservation concern still exist in the landscape.
2. Conduct fine-scale mapping as a prerequisite, as currently available maps are of too coarse a resolution for well-informed land use planning of areas not yet converted to oil palm plantations.
3. Carry out a full assessment of the drivers of land use/land cover change, this resulting information which will be essential for designing informed land restoration interventions.
4. Enforce laws and regulations that guide the management and use of protected areas, and increase their size.
5. Increase the provision of fuelwood, by working with local government to develop by-laws that enforce the establishment of household or community woodlots for domestic use, and encourage BIDCO to establish woodlot areas to supply future fuelwood needs for heating oil boilers.

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