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Suitability of major agricultural land uses around Kibale National Park

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The current agriculture land uses around Kibale National Park forest have been expanding towards the forest area threatening its conservation efforts and this has contributed to crop raiding and destruction to the neighbouring agricultural communities. This study was conducted to identify and assess the suitability of major agricultural land uses around Kibale National Park. The major agricultural land uses included; Banana (Musa spp), Maize (*Zea mays*) and Tea production (*Camellia sinensis*) and these were identified using three randomly selected transects of 5 km per transect, and obtaining information using a structured questionnaire administered to 30 key farming households near Kibale National Park. Soil samples were also taken within the identified major agricultural land uses at the depths of 0-15 and 15-30 cm. Physical suitability of the major agricultural land-uses was assessed by matching their requirements with existing land qualities extracted from the Uganda soil memoires. Results showed that, western part of Kabarole District is highly suitable for tea production, the southern part is highly suitable for maize and the northern part is highly suitable for banana. The central part of Kabarole was found to be highly suitable for both banana and maize. The study finally recommended a buffer zone of 3.5 km from the national park planted with tea and eucalyptus around the national park boundary for crop defense separating agricultural communities and Kibale National Park since there not affected by animal raids and destruction.

Key words: Major agricultural land use, land qualities, land suitability.

INTRODUCTION

Agricultural land suitability assessment is a key process to ensure sustainable crop production in particular agro-ecological zone in relation to the environment (Elsheikh et al., 2012). Assessment of agricultural land suitability in this context is defined as the process of land performance when used for alternative purposes of agriculture to predict potential and limitations of the land for crop production (Pan and Pan, 2012; He et al., 2011; Mu, 2006). Agricultural communities neighbouring protected areas like forests and national parks often disproportionally accrue the costs and challenges of conservation, though they also benefit from the existence of a protected area. Protected areas which have for long served as centre pieces of conservation and priority areas of biological and cultural attachment have always been encroached and converted into agricultural land

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uses because their landscapes are often regarded highly suitable for agriculture production (Goldman et al., 2008; Howard et al., 2002). This has contributed to various migrations of animal population, crop raiding and destruction of the animal habitant leading to conflicts between the neighbouring communities and wildlife national park management authorities (UWA, 2009; Owoyesigire, 2007).

Oftenly, conflicts between communities and wildlife exist as people argue that, wild animals trespass and vandalize their crops on their lands (Laudati, 2010; Sifuna, 2005). On another hand, environment conservationists assert that the ever growing human population has encroached on wild life existence in search of highly suitable agricultural land, where crops are raided and damaged by animals (Sitati et al., 2005; Oerke et al., 1994). Such incidences contribute to approximately 86 and 88% of farmer's loss in Africa (Mackenzie and Ahabyona, 2012; Naughton-Treves, 1997; Newmark et al., 1994; Weber et al., 2007). This as a result makes communities retaliate by killing animals to destroy and destruct their habitat a commonly observed crisis in protected areas across sub Saharan Africa.

The surrounding communities in areas of Kibale National Park (KNP) in Uganda are experiencing crop raiding and destruction due to wild animal raids as a result of the past encroachment by agrarian communities. According to Mackenzie and Ahabyona (2012), five major wildlife species account for crop damage events namely: 85% baboons (*Papio cynocephalus*), 42% bush pigs (*Potamochoerus procus*), 69% red tail monkeys (Cercopithecus ascanius), 15% chimpanzees (*Pan troglodytes*), and 79% elephants (*Loxodonta africana*).

Crop farms are dominated by annual and perennials crops within a distance of 500 m of the forest boundary and 4 to 7% of the crops per season are destroyed though the distribution of damage was highly skewed during the study such that maize and cassava fields were on occasionally reported raided and completely destroyed. The farm communities have resorted to tree planting notably eucalyptus and pines as a mitigation strategy for crop raiding and income generation to compensate on the crop seasonal loss. Other various crop raiding defense mechanisms are namely; human guarding, fire, sounding drums, scare shooting by UWA rangers, elephant trenches, Dogs, Dung spread on maize and among others (Mackenzie and Ahabyona, 2012).

Factors towards expansion to protected areas like KNP are due to population pressure and the search for highly suitable lands are due to the decline in soil fertility, horizontal expansion of agricultural land including; forest conversion which has aggravated the tension between the surrounding community and the national park (Majaliwa et al., 2010; Chapman et.al, 2000; Bekunda and Woomer, 1996). This is threatening social and environmental benefits provided by the forest reserve (Banana and Sembajjwe, 2000; Brown and Lugo, 1990).

Since the late 1980s, declining soil fertility has been recognized as an important cause for low agricultural production in sub- Saharan Africa leading to land conversions (Sanchez et al., 2002; Palm et al., 2001; Henao and Baanante, 1999; van der Pol, 1992; Stoorvogel and Smaling, 1990). Primary causes of soil fertility decline include; poor land use practices, over-cultivation, inadequate land use allocation (poor land use planning and management). The declining soil fertility has contributed to conversion of forest lands as they are regarded highly suitable for agriculture production hence encroaching on the protected areas which conserve and act as habitats for wild animals.

Furthermore, over cultivation and continuous cultivation of land is responsible for continual loss and removal of s oil nutrients by the harvested produce every production season (O.S.Bello et al., 2010). Farming activities without proper management practices, such as replenishment of nutrients using organic matter applications, rainwater harvesting for moisture retention measures to reduce soil losses lead to land degradation of farmlands (Bodhankar et al., 2002; Krishna, l996). Poor agricultural land use practices affect the distribution and supply of soil nutrients by directly altering soil properties and influencing biological transformations in the rooting zone (Murty et al., 2002). For instance, the conversion of forest to crop land has been associated with reduction in organic matter content of the top soil (Singh and Singh, 1996; Ross, 1993), and subsequent decline in productivity. Since organic matter content is responsible for the productivity in soils (Sanchez et al., 2002; Palm et al., 2001). Islam and Weil (2000) reported an increase in bulk density and a reduction in porosity and aggregate stability following the conversion of forest lands to crop lands. Similar findings were reported by Motavalli and McConnell (1998) and Riezebos and Loerts (1998). Such changes in soil properties predispose the soil to soil erosion, a major soil degradation process in Uganda (Tukahirwa, 2003).

In an agricultural context, land suitability and evaluation is an assessment for a specified kind of land utilization form and the final result of agricultural evaluation is a map which partitions the landscapes into suitable and unsuitable land areas for a particular land-use of interest (Triantafilis et al., 2001). Land evaluation analysis determines whether the requirements of land-use are adequately met by the properties of land characteristics. The objective of land suitability potential evaluation is to predict the inherent capability of land in order to support the specific land use for long periods of time without deterioration (Bandyopadhyay et al., 2008).

This study was therefore, carried out to identify the major agricultural land uses and determine the overall suitability of identified agriculture land uses around KNP. This information is useful for agricultural planners and wildlife conservation authorities in order to reduce the conflicts between the communities, and KNP authorities.

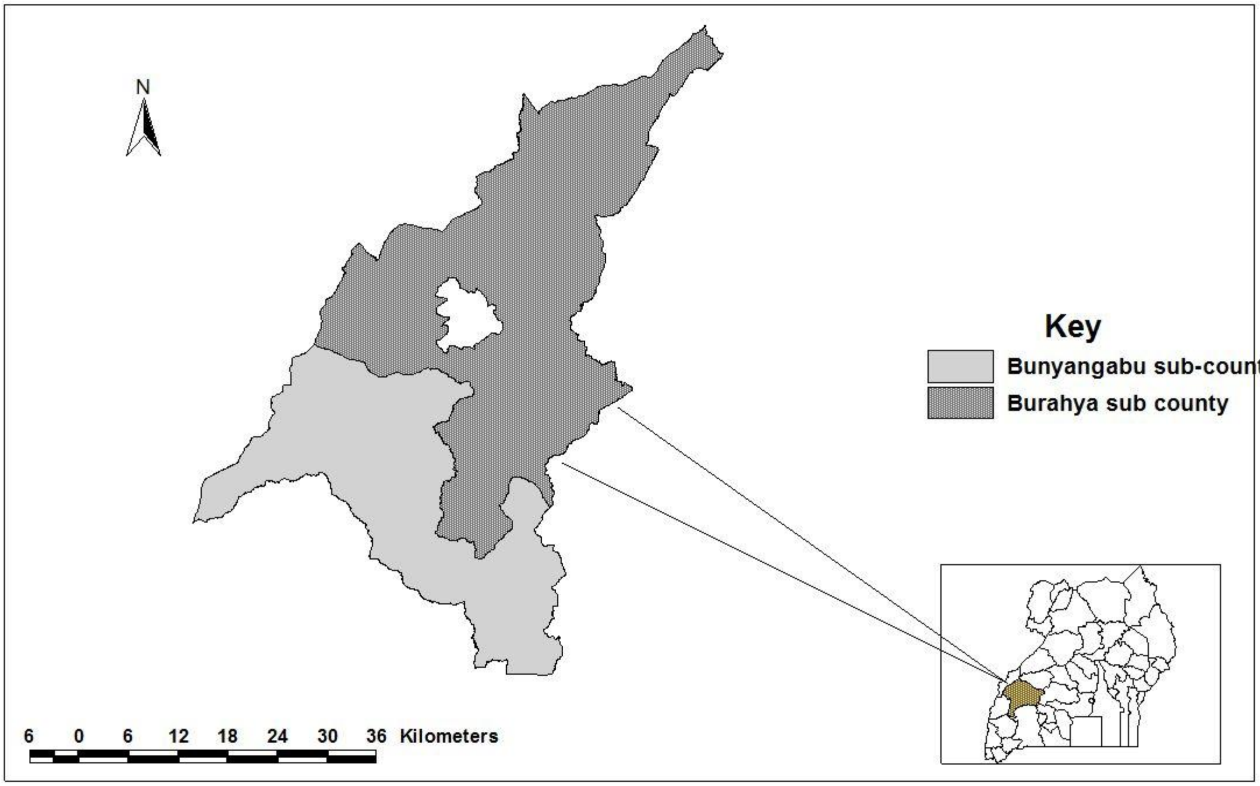

Figure 1. Map showing the study area.

Description of the study area

This study was conducted around Kibale National Park (KNP), located in western Uganda near the foothills of Rwenzori Mountains. It contains moist evergreen forest with a remnant of a transitional forest between savannah and mid-altitude tropical forest surrounded by a large agricultural population. It is also a home to one of the largest populations of chimpanzees in East Africa and to 12 other primate species (UWA, 2009; Plumptre et al., 2003; Chapman and Lambert, 2000). The population around KNP increased by more than 300% between 1959 and 1990 (Naughton Treves et al. 1998), and in 2006 the population density within 5 km of the park boundary was estimated to be over 260 individuals/km^2 (Hartter, 2010), ranging as high as 600 individuals/km^2 in some locales by 2009 (Mackenzie and Ahabyona, 2012).

The study was undertaken in three different locations, Kasenda sub-county, Busoro sub-county, in Burahya county and Buhesi Sub-county of Bunyangabu County, in Kabarole district (Figure 1). The three sub-county are located at coordinates 207631 m E, 71876 m N, and 201985 m E, 52118 m N, 191856 m E, 60231 m N (UTM Zone 36N, WGS 84 Spheroid) in western Uganda .

Currently, KNP is moist evergreen forest surrounded with tea plantation, small scale agriculture, and woodland plantations as the dominant land-use/cover in the area (Chapman and Lambert, 2000; Chapman et al., 2000).

Soils and climate of the study area

Generally, the soils are classified as Lixic Ferralsols. The area receives bimodal rainfall occurring from March to May and September to November. The mean annual rainfall in the region is 1750 mm whereas the mean daily minimum and maximum temperatures are 15.5 and 23.7°C respectively. (Majaliwa et al., 2009).

METHODOLOGY

Identification of major agricultural land uses

Major agricultural land uses were determined through field observations and conducting 30 Household interviews using a semi-structured questionnaire. The observation method was used to check for the accuracy of the information got from the interview method (Mulhall, 2003) as well as validation of the identified land uses, their location, pattern and spatial outlay. The interviews were also aimed at establishing the major agricultural land uses, their economic viability, sizes and yield output of crops grown around the park. Observations and interviews were carried out following three pre-determined transects of 5 km cutting across the different landscape positions [summit (>152 cm), back-slope (1465 to 1520 m), and valley (<1465 m)], on both Eastern and Western facing slopes, with an average inclination of 10°. A total of 30 household

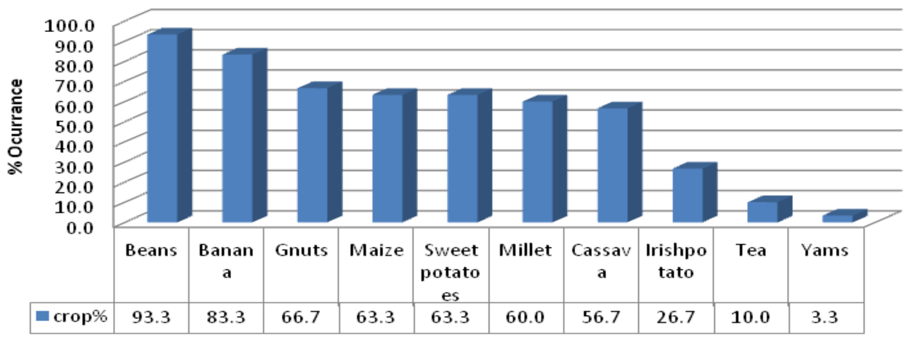

Figure 2. Different agricultural land uses around KNP.

heads were randomly selected and interviewed using a semi structured questionnaire developed by the research team during the study.

The data collected from interviews was entered, analyzed using SPSS version 17.0. The two data generated included; frequency and average plot sizes for the major agricultural land uses in the study area.

Determination of the overall suitability of major agricultural land uses around KNP

The overall land suitability was determined by matching the land-use requirements of the crops with land qualities. The requirements of the identified major agricultural land-uses were obtained from FAO framework (FAO, 1975). The land qualities were obtained from soil memoires and field soil data collected, with soil Information obtained from the different soil units of the western province soil memoire (Harrop, 1962). Composite soil samples were collected from the different identified land uses at different landscape positions (summit, back slope and valley), and soil depth was taken at 0-15 and 15-30 cm because it is the major agricultural layer for tillage and rooting zone (Tenywa, 1998).

Soil samples were collected, air dried, analysed for texture, pH, P, N, K, OM, and the bases following adhoc procedures (Okalebo et al., 2002). Soil pH was measured using pH meter (1: 2.5 soil: water), SOM and total N were determined using Walkley and Black method and Kjedhal method respectively. Soil texture was determined using Bouyoucos hydrometer method (1962) and their textural classes according to the FAO classification (FAO-UNESCO-ISRIC, 1990).

Matching the requirements with Land qualities was done in a GIS environment by use of multi-criteria analysis with Integrated Land and Water Information System (ILWIS v3.3) software. Kabarole soil map was used as a base map and key relevant land qualities and their characteristics were extracted from the soil memoires (Harrop, 1962) with the field soil data collected during the study. Attribute maps for the different land characteristics were created using ArcGIS software. Land qualities were inferred from the land characteristics with the following Land qualities; nutrient availability (P, K, pH, OC, % saturation), rooting condition (depth 0-30 cm), nutrient retention capacity (CEC), and moisture availability (Rainfall).

Suitability maps (with four classes: s1-Highly suitable, s2-Moderately suitable, s3-Marginally suitable and N-Unsuitable) for the three major agricultural land uses were generated by combining the different land qualities using map calculation function in ILWIS v3.3. The maps were normalized and sliced using factor rating values provided in the FAO framework (1975).

Two scenarios of possible distribution of the three major land uses were generated based on their suitability classes and labeled (scenario 1 and 2). Under scenario 1, only the highly suitable class was considered for the three major land uses by overlaying the three individual physical suitability maps (Banana, Maize and Tea). To consider the distance and conservation factors between KNP and farm communities, a buffer zone of 3.5 km was created using the spatial analyst in ArcGIS (3.1) software. The forest was clipped out from the land use map of Kabarole and exported as a shape file to ArcView-GIS, and the distance was determined. The "forest buffer map" was imported back to ILWIS, crossed and glued with the highly suitable generated map to form scenario 1 which included soil suitability, distance factor against animal raiding and conservation area of the forest.

Scenario 2 map was generated following the same procedure (scenario 1) though included moderately suitable class and the highly suitable class for each agriculture land use type.

RESULTS

Major agricultural land-uses around Kibale National Park

The major agricultural land uses around KNP identified included; perennial crops (Banana and tea) and other annual crops (beans, ground nuts, maize, sweet potatoes,millet, cassava, Irish potato and yams) as show n in Figure 2. Beans were generally intercropped (93%) with other crops like; maize, bananas and cassava. It was also observed that banana which is a major staple food, was grown around homesteads with other annual crops as indicated below;

The area covered by each agricultural land use type is shown in Figure 2. Tea is grown on large scale of land (140,000 ha), it is followed by maize (11, 309.5 ha), banana (11, 302.8 ha), groundnuts (8500 ha), beans (7,321 ha), cassava (7, 205.9 ha), sweet potatoes (5, 126.8 ha), yams (5, 000 ha), Irish potato (4, 218.8 ha), and millet (4, 027.8 ha).

Selected characteristics of the soils under the different agricultural land-use types are presented in Table 1. Generally banana was found on sandy clay soils, tea on

Table 1. Soil analysis results.

Soil properties	Agricultural land use			P<0.05
	Maize	Tea	Banana	
pH	4.75	6.0	5.82	
SOM (%)	6.82	7.52	7.95	Ns
Total N (%)	0.33	0.32	0.30	Ns
Av. P (ppm)	46.0	84.0	48.16	Ns
Ca (cmol(p+)/kg)	8.75 [a]	12.4 ±4.5[b]	11.52[a]	>0.001
Mg (cmol(p+)/kg)	2.48	5.38	4.30	Ns
K (cmol(p+)/kg)	0.83	2.00	1.74	Ns
Na (cmol(p+)/Kg)	0.40	0.10	0.04	Ns
Sand (%)	72.0	64.0	67.00	Ns
Clay (%)	28.0	26.5	24.00	Ns
Silt (%)	16.0	24.0	23.00	Ns
Textural class	Sandy loam	Sandy clay loam	Sandy clay	

sandy clay loam while maize on sandy loam. Although the soil under which the three crops were found were acidic, maize tended to be on strongly acidic soils compared to tea and banana. The organic matter and TN levels were very high for the soil under the three agricultural land-use types. The soil under banana and tea tended to have a relatively high amount of Ca, Mg, and K compared to the soils under maize.

Suitability of the major agricultural land use types in Kabarole district

In Figure 3a to c, the suitability of individual crops in Kabarole district. The central region of Kabarole is highly suitable for both maize and banana; with 67% maize-suitability area (122,427 ha) and 61% banana-suitable area (110,004 ha). Tea is marginally suitable to be grown in Kabarole District. The area which can be dedicated to tea with improved management represented 56% of the district area (100,000 ha). Only 15% (27,171 ha) is, the highly suitable for tea and is located in the south-western parts of Kabarole.

Figure 4a to c show the combined suitable area for all crops (Scenario 1), combined suitable and moderately suitable areas for all crops (scenario 2) and the current land-use map of the district. Scenario one represents the ideal distribution of agricultural land use types in different areas with in Kabarole district. The intercroping of Banana and Maize had the highest percentage (30%), Tea (25%) and Maize (10%) the highly suitable class. Under scenario two Banana, Maize and Tea occupied (75%) area coverage. By comparing the current distribution of the agricultural land-use with the distribution provided in scenarios 1 and 2 we observed the current agricultural land use distribution in Kabarole district is very close to that provided under scenario 2.

DISCUSSION

Agricultural land-use types in Kabarole district is dominated by Banana, tea and annual crops. This in line with findings by Nuwategeka et al. (2013). The dominance of banana is due to the fact that it is a highly valued food crop and is grown around the homesteads (Nkwiine et al., 2002) and it perform well on rich top soil layer (0-15 cm), moist cool climate and on deep fertile volcanic ash soils (Chapman and Lambert, 2000). The high frequency of occurrence of Beans (93.3%), ground nuts (66.7%) and maize (63.3%) was due to the fact that they are considered as sources of protein and carbohydrates (Eltayeb et al., 2011) by the community. Maize is also considered as one of key cash crop for communities. Beans and ground nuts are leguminous crops which improve soil fertility through Biological Nitrogen Fixers (BNF) and act as cover crops (Okito et al, 2004). Maize is grown in rotation with other crops (groundnuts and beans), which improve the soil fertility (Rossing et al., 2002). Maize is a gross feeder (exhausts), soil nutrient therefore intercropped with beans and ground nuts will reduce on nutrient losses and hence reducing the need to apply nitrogen fertilizer (Environmental issues-WWF, 2009; Okito et al., 2004). Ground nuts are grown due to their commercial value that is appealing to farmers since they fetch high market value (Emerging Markets Group, Ltd, 2008). Tea plantations seem to be immune to damage from animal raiding since few wild life species seem to directly go through the tea (Kirya, 2005). The tea is unpalatable to the wild animals that would be crop raiders originating from the park. However, elephants continue to use tea company road and path for passage to raid neighboring cultivated fields (Warner, 2008; Mugisha, 2002).

The similarity between scenario 2 and the current agricultural land-use spatial distribution is an evidence of

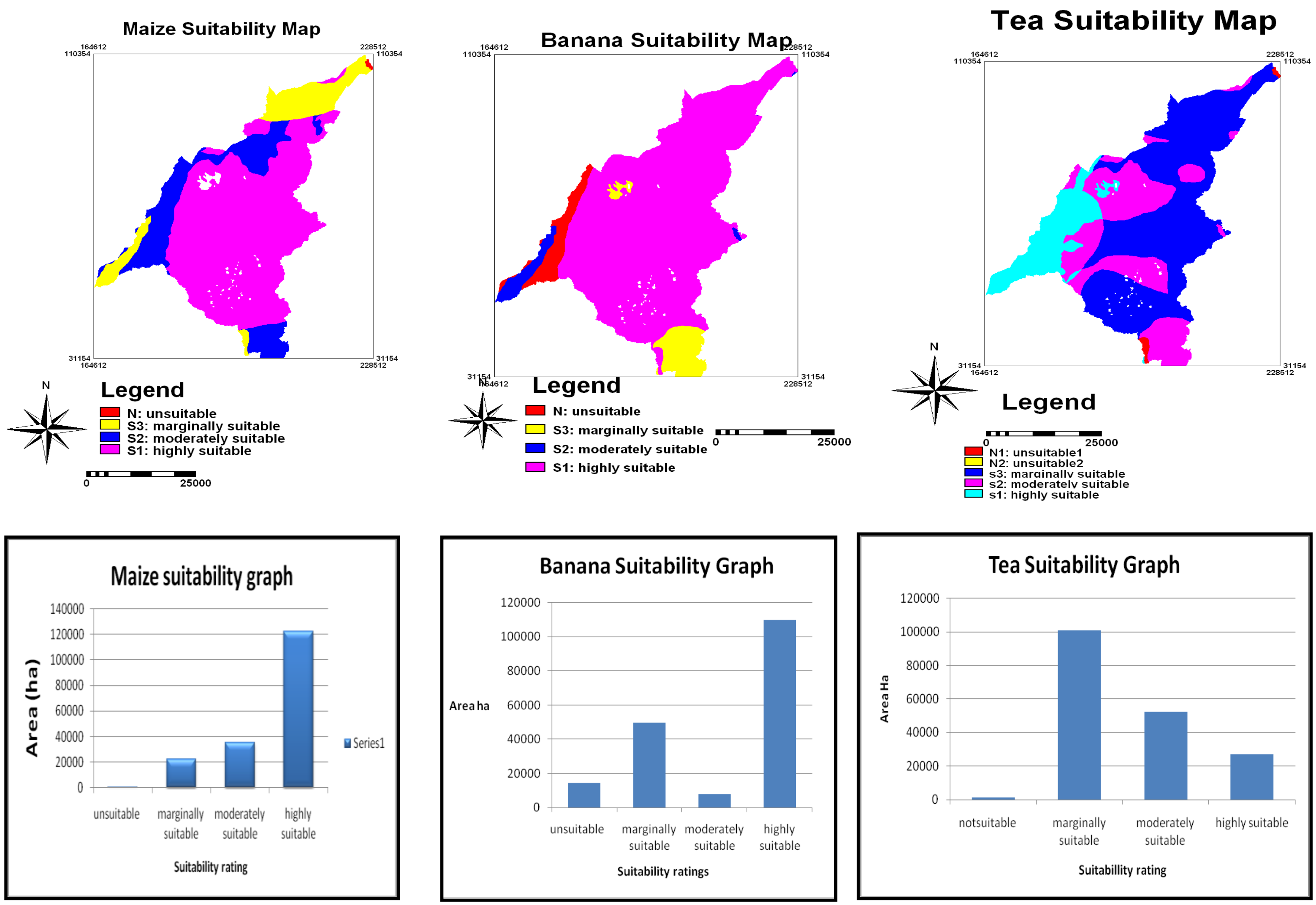

Figure 3. Suitability maps and bar graphs for major land uses.

the demographic pressure exerted on the existing natural resources. It is also explain the low resilience observed on certain soils of the district and need for more soils for the agricultural production (Bekunda and Woomer, 1996; Sseguya et al., 1999). Recent studies also demonstrate that declining yields observed on most banana plantations is largely explained by poor adoption of agronomic practices, poor soil

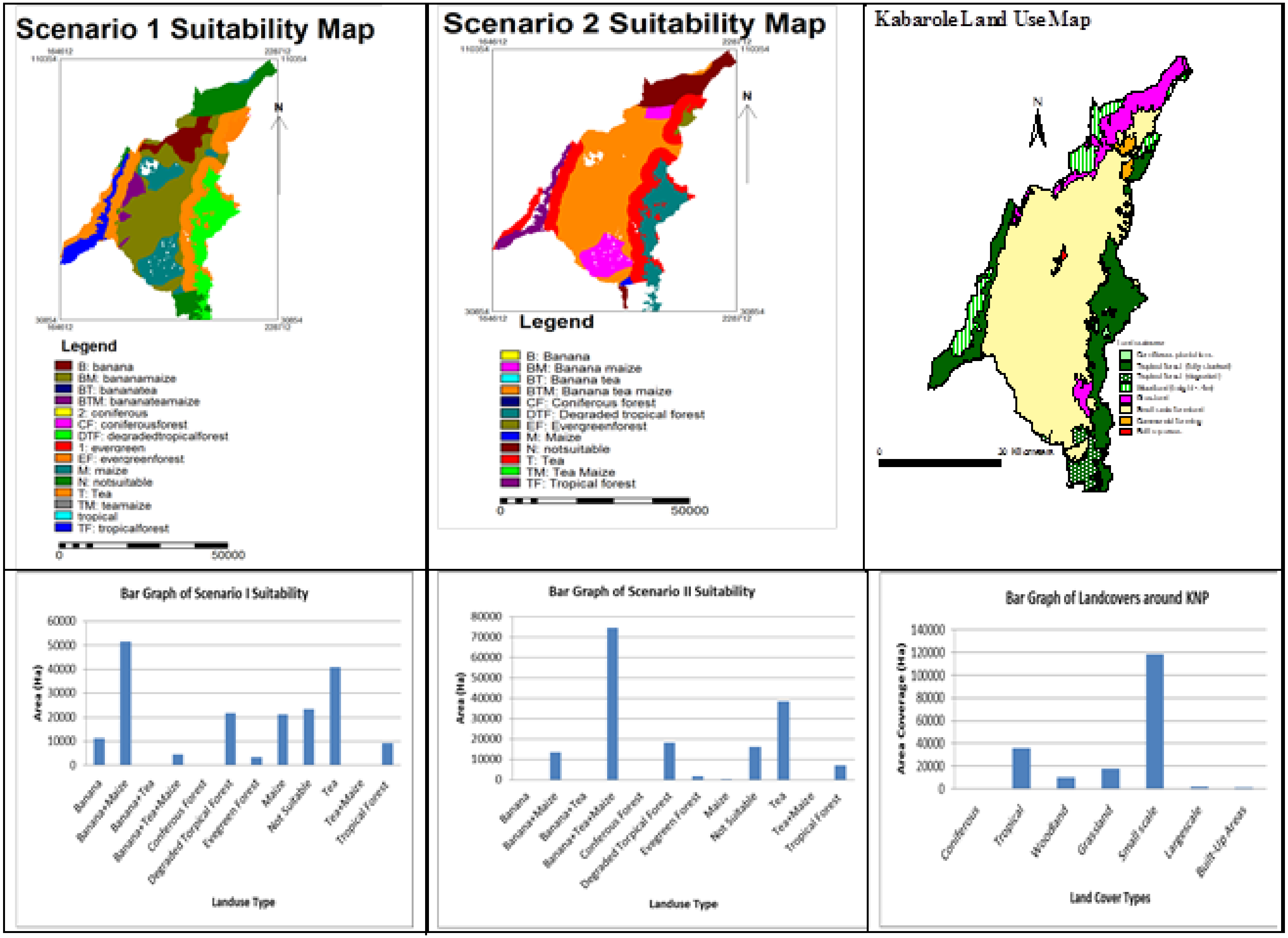

Figure 4. Suitability scenario and current land use maps and graphs.

organic matter management, mulching, weeding and diseases mainly Banana bacterial wilt, Sigatoka and inadequate extension services available to the farmers (Gold et al., 1999).

CONCLUSION AND RECOMMENDATIONS

The western part of Kabarole district is highly suitable for tea, the southern part is highly suitable for maize and the northern part is highly suitable for banana. The central part of Kaborole was found to be` highly suitable for banana and maize. There is a need therefore to grow crops according to scenario one (the highly suitable scenario) and improve crop management in the district. Scenario two (the current land use practices) should only be continued with external inputs like NPK fertile or compost manure. Tea should also be grown within a recommended buffer zone of 3.5 km with additional inputs, However efforts should be made to control pollution associated with pesticides and fertilizer application.

Conflict of Interest

The authors have not declared any conflict of interest.

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REFERENCES

Banana AY, Gombya-Ssembajjwe W. S. (2000). Successful forest management: The importance of security of tenure and rule enforcement in Ugandan forests. In People and forests: Communities, institutions, and governance, eds. Clark Gibson, Margaret A. McKean and Elinor Ostrom, eds. Cambridge, MA: MIT Press pp. 87-98.

Bekunda MA, Woomer PL (1996). organic resource management in banana based cropping systems of the Lake Victoria Basin, Uganda. Agriculture, Ecosyst. Environ. 59:171-180

Bodhankar RM, Srivastava R, Saxena RK, Prasad J (2002). Integrated approach of RS and GIS in characterization and evaluation of land resources for watershed management-a case study. In Resource conservation and Watershed Management; Technology options and and Future Stratergies, S.K. Dhyani (Ed.) (Dehradun, India: IASWC).

Chapman CA, Lambert JE (2000). Habitat alteration and the conservation of African primates: case study of Kibale National Park, Uganda. Am. J. Primatol. 50:169-185.

El-tayeb ARSM, Ali AO, Arab AAA, Salem FMA (2011). Chemical composition and functional properties of flour and protein isolate extracted from Bambara groundnut *(Vigna subterranean)*. Afr. J. Food Sci. 5(2):82-90.

Gold CS, Karanura EB, Kiggundu A, Bagamba F, Abera AMK (1999). Monograph on geographic shifts in highland cooking banana (Musa, group AAA-EA) production in Uganda. Afr. Crop Sci. J. 7(3).

Islam KR, Weil RR (2000). Land use effects on soil quality in tropical forest ecosystem of Bangladesh. Agriculture, Ecosyst. Environ. 79(1):9-16.

Krishna AP (1996). Remote Sensing approach for watershed based resources management in Sikkim Himalaya – A case study Photoninicrvachak. J. Indian Soc. Remote Sens. 24:69-83.

Laudati AA (2010). The encroaching forest: struggles over land and resources on the boundary of Bwindi Impenetrable National Park, Uganda. Soc. Nat. Resour. 23:776-789.

Mackenzie CA, Ahabyona P (2012). Elephants in the garden: Financial and social costs of crop raiding. Ecol. Econ. 75:72-82.

Mulhall A (2003). In the field: notes of observation in qualitative research. J. Adv. Nurs. 41(3):306-313.

Murty D, Kirschbaum MUF, McMurtrie RE, McGilvray H (2002). Does conversion f forest to agricultural land change oil carbon and nitrogen? A review of the literature. Glob. Chang. Biol. 8:105-123.

Naughton-Treves L (1997). Farming the forest edge: vulnerable places and people around Kibale National Park, Uganda. Geogr. Rev. 87:27-46.

Naughton-Treves L, Treves A, Chapman C, Wrangham R (1998). Temporal patterns of crop-raiding by primates: linking food availability in croplands and adjacent forest. J. Appl. Ecol. 35:596-606.

Newmark WD, Manyanza DN, Gamassa D-GM, Sariko HI (1994). The conflict between wildlife and local people living adjacent to protected areas in Tanzania: Human density as a predictor. Conserv. Biol. 8:249-255.

Oerke EC, Dehne HW, Schonbeck F, Weber A (1994). Crop Production and Crop Protection: Estimated Losses in Major Food and Cash Crops. Elsevier, Amsterdam.

Okalebo JR, Gathua KW, Woomer PL (2002). Laboratory Methods of Soil and Plant Analysis: A Working Manual; 2nd Edition. Sacred African Publishers, Nairobi, Kenya.

Palm CA, Gachengo CN, Delve RS, Cadisch G, Giller KE (2001). Organic inputs for soil fertility management in tropical agroecosystems: application of an organic resource database. Agric. Environ. 83:27-42.

Sanchez PA, Jama BA (2002). Soil fertility replenishment takes off in Eastern and Southern Africa. In: Vanlauwe B, Diels J, Sanginga, N., Merckx, R. (Eds.), Integrated Plant Nutrient Management in Sub-Saharan Africa: From Concept to Practice. CAB International, Wallingford. pp. 20-40.

Sseguya H, Semana AR, Bekunda MA (1999). Soil fertility management in the banana-based agriculture of central Uganda: farmers constraints and opinions. Afr. Crop Sci. J. 7:559-567.

Sifuna N (2005). Providing compensation for damage caused by wildlife: a case study of Kenya with particular reference to elephants. J. Soc. Dev. Afr. 20:7-39.

Singh S, Singh JS (1996). Water-stable aggregates and associated organic matter in forest, savanna and cropland soils of a seasonally dry tropical region, India Biology and fertility of soils 22:76-82.

Sitati NW, Walpole MJ, Leader-Williams N (2005). Factors affecting susceptibility of farms to crop raiding by African elephants: using a predictive model to mitigate conflict. J. Appl. Ecol. 42:1175-1182.

Stoorvogel JJ, Smaling EMA (1990). Assessment of soil nutrient decline in Sub-Saharan Africa, 1983-2000. Report no. 28, Winand Staring Centre-DLO, Wageningen.

Tenywa MM (1998). Agricultural potential in the Rwenzori Mountains; special reference to the lower slopes in Bwamba. In: H.Osmaston, J.Tukahirwa, C. Basalirwa and J. Nyakaana (Eds.). The Rwenzori Mountains National Park, Uganda. Copyright: Department of Geography, Makerere University. Published by Fountain Publishers LTD, pp. 180-189. ISBN 9970-429-01-9.

Triantafilis J, Ward WT, MCBratney AB, Triantafilis J, Ward WT, McBratney AB (2001). Land suitability assessment in the lower Namoi valley of Australia. Aust. J. Soil Res. 39(2):273-290.

UWA (2009). Visitor Statistics. Kampala, Uganda, Uganda Wildlife Authority. van Orsdol, K. G. 1986. Agricultural encroachment in Uganda's Kibale Forest. Oryx 20:115-117.

Van der Pol F (1992). Soil mining, an unseen contributor to farm income in southern Mali. Royal Tropical Institute, Amsterdam.

Weber AD, Hill CM, Reynolds V (2007). Assessing the failure of a community-based human-wildlife conflict mitigation project in Budongo Forest Reserve, Uganda. Oryx 41:177-184.