

Peri-Urban Land Use/Cover Change in Songea Municipality, Tanzania

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Abstract

Peri-urban land cover change in developing countries is taking place at a rapid rate following an increase in population in urban areas. This paper assessed land cover changes in peri-urban areas in developing countries. It specifically focuses to determine land cover changes which have occurred between 2003 and 2016 and exploring causes of land cover change in Songea peri-urban areas. The study applied a mixed research design as it involved quantitative and qualitative approaches. 132 heads of households were randomly selected and used in the study as a sample. Data were collected using questionnaires and interviews. Arc-Map 10.1 was used to analyse Google earth downloaded images of 2003 and 2016. Other data were analysed using SPSS version 20 based on descriptive analysis and content analysis was used for collecting qualitative data. Findings revealed that land cover changed from farm, grassland, and swamp into the built-up area following population increase in Ruhuwiko. The built-up area increased from 31% to 61 % while the cultivated area decreased from 31% in 2003 to 15% in 2016. 82% of the respondents pointed out that population increase in peri-urban areas were the main cause of land cover change. The study concluded that peri-urban land cover is changing toward built up areas and population increase is the main cause for peri-urban land cover change unlike climate change and infrastructural development. The study recommends enforcing urban planning regulation to avoid unplanned settlements.

Keywords: Land cover, land cover change, land cover detection, Songea Municipality

1.0 INTRODUCTION

Peri-urban land cover change in developing countries is taking place at a rapid rate following an increase of population in urban areas (Winkler *et al.*, 2021). Land cover change has been taking place since human being discovered fire and gained momentum when the establishment of permanent settlements came into practice (Feurden *et al.*, 2020; Wang *et al.*, 2020a, Wang *et al.*, 2020b). The rate of changing land cover increased as the number of people increased and so does to technological advancement (Ochola, Nyamai, and Owuor, 2019; Minale, 2013; Winkler *et al.*, 2021). Human needs such as food (Wang *et al.*, 2015), shelter, transport, and raw materials to mention a few pushed changes in land

cover following the clearance of the existing vegetation by introducing farming areas, road routes, and settlements. Peri-urban areas, especially in developing countries, play the role of accommodating most urban dwellers who cannot afford cost of living in the central part of the urban area. Peri-urban is the area is considered to be a transition area where transformation of land use/cover manifests (Mortoja *et al.*, 2020). Normally these areas are found in suburban areas where agriculture economy is dominant. Built up land use is mostly favoured at the expenses of agriculture, bush land, forests, and wetlands.

Globally land cover change continues to take place. Land reclamation done in the Netherlands is a good example of land use/cover change whereby portions of sea and lakes filled up with soil whereby land for urban expansion (settlement and commercial centres), recreation, and agriculture was obtained. More than 1650 km² of the new land portion was obtained after the reclamation of the Zuiderzee, Beemster and Haarlem lakes (Hoeksema, 2006 & 2007). The situation of land cover change in peri-urban areas is quite different between developed countries and developing countries. The difference is manipulated in terms of direction and magnitude, causes, and impact. Factors such as level of technology, government priorities, and migration (Abhishek, Jenamani & Mahanty, 2017) have also been enlisted among causes of land cover change particularly in developing countries.

Land use cover change in African countries reported in many countries. Urbanization, population increase, construction of infrastructure and agricultural improvement influence land cover change in peri-urban. Rawat & Manish (2015) in Welde and Gebremariam (2017) reveal impact of land cover change occurring peri-urban areas of Ethiopia particularly adjacent Tekeze dam. Again, a study done in Kenya highlighted that 97.5% among factors that encourage transformation of peri-urban area associates with land use/cover change (Mwangi *et al.*, 2016). Built up areas increases in many per-urban areas of mega cities, municipal and towns in African countries at the expenses of agriculture land (Follmann *et al.*, 2021), urban forest (Belay *et al.*, 2014; Kukkonen & Kayhko, 2014), urban wetlands (Welde & Gebremariam, 2017; Ntongani, 2014) and shrubs and grasslands (Midekisa *et al.*, 2017; Bullock *et al.*, 2021). About 18,154,000 ha have changed its land cover in the period of three decades since 1998 to 2017 in cumulative of areas in Ethiopia, Malawi, Uganda, Zambia, Rwanda, Kenya and Tanzania (Bullock *et al.*, 2021). Provided data indicate that peri urban areas in African countries including East African are in dynamic state of cover change to build up areas.

In Tanzania, the National land use policy of 1997 mentioned urbanization, and population growth being among factors affecting land use cover change in the country (United Republic of Tanzania [URT], 1997). Further, the demand for land for settlement is quite large (Aribigbola, 2007; World Bank, 2012). Referring to the Tanzanian census report of 2012, World Bank estimates that

more than 38 percent (approximately 28 million) will be living in urban areas by 2030 of the total population in the country (World Bank, 2012). Such estimation highlights an increase in land cover change in peri-urban areas where most people might focus on them establishing their settlements.

Songea urban is growing at a rate of 2.5% per annum (Songea Municipal profile, 2010). The Census report of 2022 confirms an increased population as a result there was an expansion of urban areas through the extension of municipal boundaries (URT, 2013). This made Songea municipality increase the number of wards from 17 wards in 2002 to 21 wards in 2012. Kironde (1995) critically pointed out that peri-urban areas of small and large towns are ingested up to enlarge the boundaries of urban areas. Four wards that were not part of Songea municipality before 2012 were Tanga, Lilambo, Mwendemshindo, and Mletele. These wards depended on agriculture as the main economic activity. After being included as part of Songea municipality slowly change from depending on agriculture activities to different activities for their economy. Many people purchased land portions and developed them in wards located in the periphery of Songea municipality including Ruhuwiko because cost is low (Haule, 2014). It is, therefore, this paper focuses to assess land cover change in Ruhuwiko ward as part of peri-urban area of Songea municipality. It specifically focuses to examine land cover change that occurred between 2003 and 2016 and explaining the causes of land cover change.

2.0 METHODOLOGY

The study was conducted in Songea municipality specifically Ruhuwiko ward. The ward is located on the western side of Songea municipality headquarters. It is one among peri-urban area wards where mixed economy of agriculture and trade activities is being performed. Being located in peri-urban areas, the ward experiences an increase in population which enhances changes in land cover. Figure 1 indicates the position of Ruhuwiko ward in Songea municipality. The study used google earth images of 2003 and 2016 to detect land use-cover change and a sample of 132 from households in Ruhuwiko ward involved in filling questionnaires. In the process of analyzing data, the two images were analyzed using ArcGIS whereas supervised classification was used to identify land use-covers. On the other hand, questionnaires' collected data were analysed by using descriptive statistics where frequency and percentage were involved and content analysis was used for qualitative data. Finding of the study were presented by using tables, maps, pie charts and narration text.

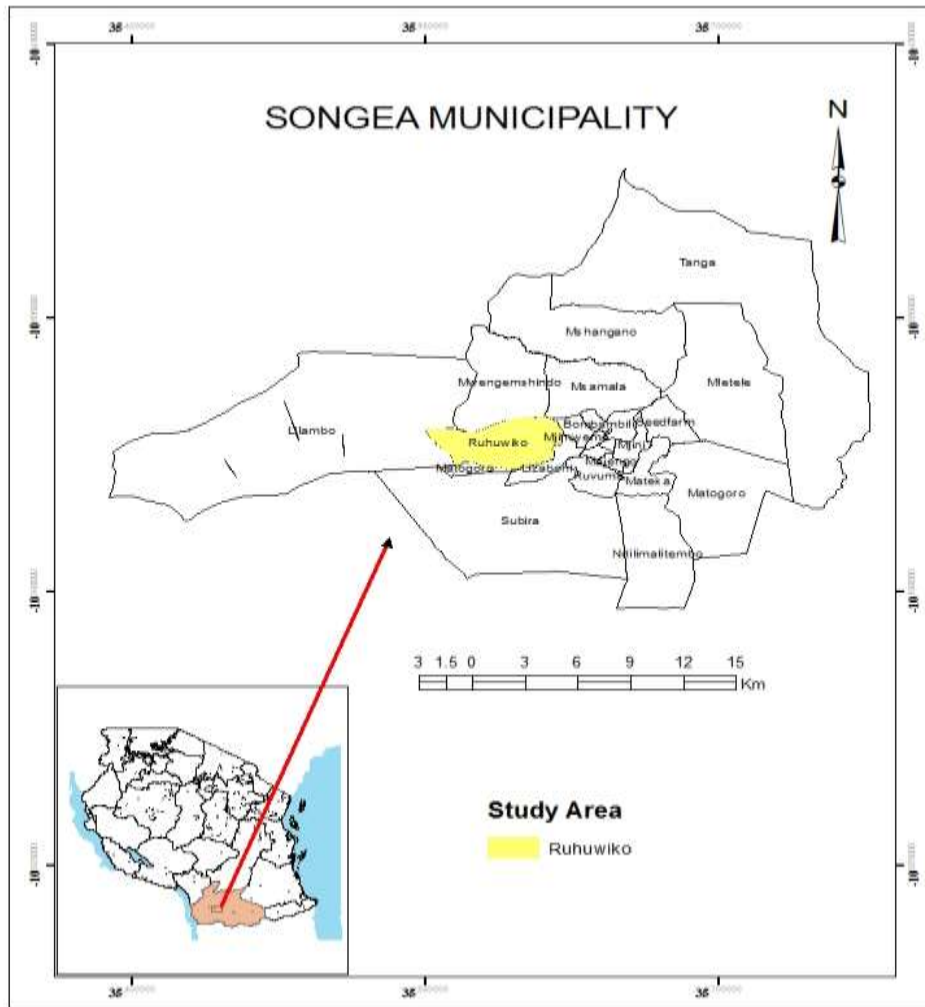


Figure 1: Songea Municipal Map of the study area
Source: Modified from National Bureau of Statistics 2012

3.0 FINDINGS AND DISCUSSION

3.1 Change in Land use/land cover between 2003 and 2016

Supervised classification through ArcMap 10.1 indicated that Ruhuwiko ward had several land covers including swampy, built-up area, cultivated area, and bushland which changed over time. Table 1 shows the distribution of land cover into four classes in 2003 and 2016 with a total of 1339.41 hectares. A cultivated area dominated in Ruhuwiko ward whereby 35% of the land was used for cultivation, this was followed by built-up area which covered 30.8%, swamp 19.1%, and bushland 15.1%. This implied that in 2003 Ruhuwiko ward was part of Songea municipality peri-urban area where urban agriculture was dominant. Figure 2 shows the land cover in Ruhuwiko for the years 2003 and 2016.

Table 1: Land Cover of Ruhuwiko in 2003 and 2016

2003			2016		
Land cover	Area ha	Percentages	Land cover	Area (ha)	Percentages
Swampy area	256.36	19.1	Swampy area	249.17	18.6
Built-up area	412.33	30.8	Built-up area	812.32	60.7
Cultivated land	468.94	35	Cultivated land	200.07	14.9
Bushland	201.78	15.1	Bushland	77.85	5.8
Total	1339.41	100	Total	1339.41	100

Source: Analysis by ArcMap, 2022

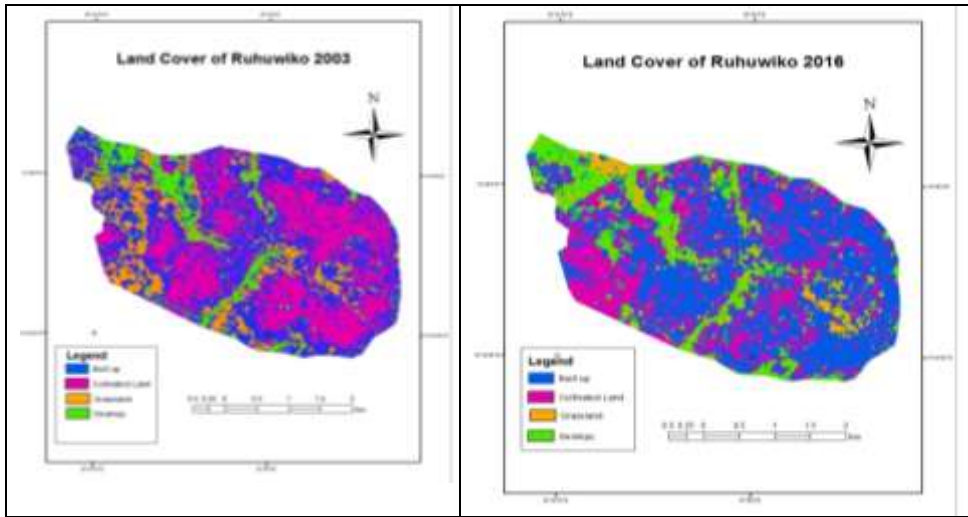


Figure 2: Land Cover of Ruhuwiko in 2003 and 2016

Source: Analysis by ArcMap 10.1, 2022

In 2016, supervised classification by ArcMap 10.1 detected a change of land cover from grassland, cultivated land, bushland, and swampy to built up between 2003 and 2016 (Figure 2; Table 1). Built-up area increased by 29.9% from 30.8% to 60.7% which is more than half of the total land of Ruhuwiko ward swampy area follows having 18.6%, cultivated land 14.9%, and bushland was 5.8% (Table 1). This finding reveals that Ruhuwiko ward is under transformation. Peri-urbanization drives land cover change in Ruhuwiko ward. This situation has affected community livelihoods in both positive and negative ways. Further, an increase in built-up area in the study area caused an increase in land value as an asset as result many residents sold their land plots/portions to migrants and moved outwards.

Table 2 shows differences between land cover between 2003 and 2016 indicating that only built-up area got a positive value of 399.99 ha which implies it had increased from 30.8% to 60.7%. Swampy slightly decreased from 19.1% to 18.6% which is equal to -7.19 ha, cultivated area decreased to 14.9% from 35% in 2003 and bushland decreased tremendously from 15.1% in 2003 to 5.8% in 2015.

Table 2: Land Cover Change in Ruhuwiko ward between 2003 and 2016

Land Cover/use	2003		2016		Land-use Change (t2- t1)	
	Area (ha)	Area %	Area (ha)	Area %	Area (ha)	% change
Swampy area	256.36	19.1	249.17	18.6	-7.19	2.8
Built-up area	412.33	30.8	812.32	60.7	399.99	97
Cultivated land	468.94	35	200.07	14.9	-268.87	57
Bushlands	201.78	15.1	77.85	5.8	-123.93	61
Total	1339.41	100	1339.4	100		

Source: Analysis by ArcMap 10.1 (2022)

Land cover change revealed that cultivated land, swamp (waterlogged), and bushland had decreased following the increase in built-up areas. Bushland decreased following their clearance to acquire land for building, and laying bricks and trees were cut down for burning bricks. A decrease in the swampy area was associated with the increase in built-up area and horticultural activities. The result of this study concurs with Dekolo (2015) who found that in Ikorodu a metropolitan area of Lagos there was consistent loss of forest and agricultural land with the increase of built-up area.

Findings from questionnaire conform to findings of land cover change from GIS as they indicate that built-up area had increased. 67.3% of respondents changed their plots of land from farms, bush land, and swamps into the built-up area and 32.7% did not change the land cover of their plots. 47.3% of land portion changed to the built-up area for family houses, 10% for renting, 8.2% shops, 0.9% building for keeping cattle, and 15.4% did not change while 18.2% did not own land portions between 2003 and 2016.

The result of this study supports what Masanja (2003) pointed out that rapid growing urban population is the central driving force for land cover change as it gives rise to two major constraints namely housing to accommodate the growing population and improving the existing environment. This implies that buildings dominated the process of changing land cover over time in Ruhuwiko. Construction of commercial/residential buildings is noted to provide higher returns compared to agriculture.

3.2 Causes of land cover change in peri-urban areas

Table 3 indicates that 89.1% of respondents regarded the increase in population in the study area as being responsible for land cover change while 10.9% of respondents opposed it. 70% of respondents denied that construction of infrastructure was one of the causes of land cover change while 30% accepted it, 76.4% of respondents said that construction of social services centres was not a cause of land cover change and 23.6% of respondents said it was a cause of land cover change. Concerning climate change as one of the factors for land cover change found that only 27. 2% accepted it and 76.8% said no. Table 3 indicates questionnaire responses on causes of land cover change.

Table 3: Causes of land cover change

Causes	Frequency		Percentage		Total
	Yes	No	Yes	No	
Population	117	15	89.1	10.9	100
Infrastructure	40	92	30	70	100
Social services	37	95	23.6	76.4	100
Climate change	36	96	27.2	72.8	100

Source: Field Data, 2022

The findings presented in Table 3 revealed that land cover change of Ruhuwiko ward, in general, depended much on the increase of population as peri-urban residents struggled to earn their livelihoods. The results of this study support what Jelili (2012); Lambin *et al.* (2001) and Maro (2010) pointed out that the population has been increasing at a different rate for different regions. This implies that the population increase in Ruhuwiko ward highly facilitated land cover change to occur. However, infrastructure and social services had a very low contribution as there were only two tarmac roads, three primary schools, and 2 secondary schools. Figure 3 presents the causes of land cover change in a study area.

On the other hand, it was revealed that the population increase in the study area was caused by the immigration of people from various places in Ruvuma region and outside Ruvuma region; 29.1 % of respondents came from Mbinga District, 14.5% of respondents came from Songea District, 22.7% of respondents were natives of Songea Municipal, 5.5% of respondents came from Namtumbo District and 2.7% from Tunduru District while 25.5% of respondents came from outside Ruvuma region such as Dar es salaam, Mbeya, Iringa, Mtwara and Tabora. Figure 4 indicates the places of birth of respondents. This is supported by Jelili (2012) and Lawi (2013) who found that urban population growth results from uncontrolled rural-urban migration.

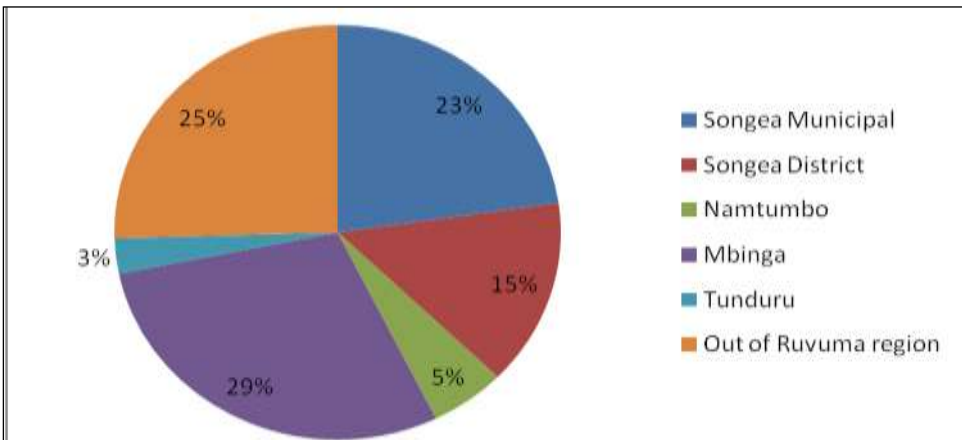


Figure 3: Birth Places of Head of Households in Ruhuwiko

Source: Field data, 2022

The rate of land cover change into built-up area increased with the increase in the human population. For example, the population of Ruhuwiko was 2583 in 2002 and 3565 in 2013 (URT, 2011; 2013), and 6732 people in 2016 according to the village executive officer of Ruhuwiko. The built-up area covered 30.8% in 2003 and 60.7% in 2016 in the study area. Swampy area, cultivated land, and bushland decreased from 19.1%, 35%, and 15.1% to 18.6%, 14.9%, and 5.8% respectively.

On the other hand, peri-urban areas showed an increase in population densities over time which contributed to land cover change. Following the increase in the number of people, some wards had to be divided to form new two wards. For example, in 2002 Mwingemshindo ward was a part of Ruhuwiko ward with a population density of about 125 – 160 people per kilometre. In 2012, Mwingemshindo became a separate ward with about 93 – 126 population density and Ruhuwiko ward had 408 people per kilometre square. Also, parts of Songea rural areas had been transferred to Songea municipality. For instance, Lilambo, Ndilima-Litembo and Tanga wards were parts of Songea rural district council in 2002 had been transferred to Songea municipality hence became peri-urban area (Figure 5). This is supported by Masanja, (2003) and Kironde, (1995) who maintained that the urban population grows and towns expand outwards, hence rapid growing urban population is the central driving force for peri-urban land cover change. This is supported by Brovkin, *et al* (2012) and Jelili, (2012) claimed that about one-third to one-half of the land surface has been modified by humans and the extent is likely to increase in the future to accommodate a growing demand for land.

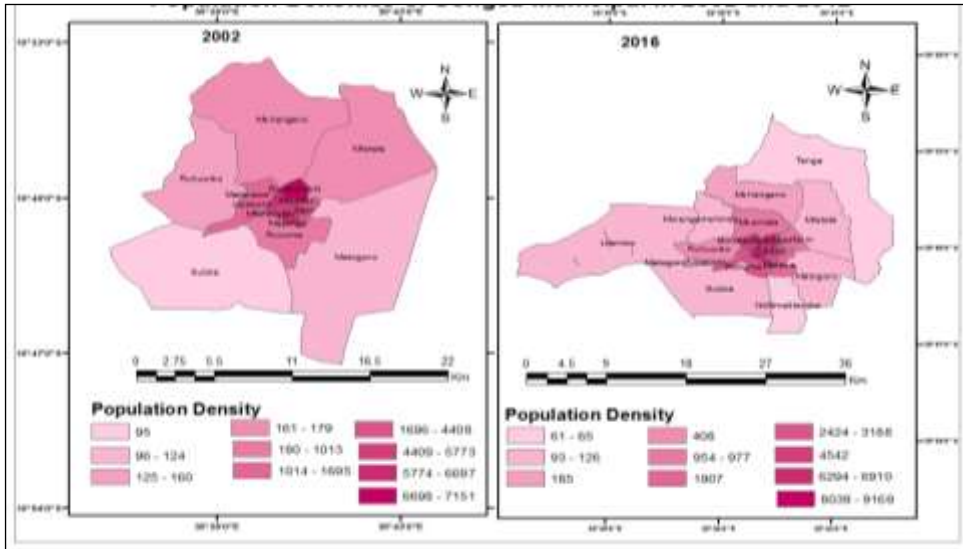


Figure 4: Population Density of Songea in 2002 and 2012
 Source: NBS census 2002 and 2012 shape files

4.0 CONCLUSION AND RECOMMENDATIONS

Peri-urban land cover change in developing countries is taking place at a rapid rate following an increase of population in urban areas. The finding of the study revealed that land cover in peri-urban areas transforms very rapidly. It changes to the built-up area at the expense of bush lands, agricultural areas, and swampy areas. These changes in land covers are highly connected to the increase of population through immigration to peri-urban areas. Other factors such as climate change and construction of infrastructures have insignificance contribution to the occurrence of land cover change in peri-urban areas. The study recommends that there should be enforcement of urban planning laws to avoid development of unplanned sub-urban area. The impact of peri-urban land cover change on natural resources management is recommended for further research.

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