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Impact of Land Use and Land Cover Changes on Rural Livelihoods: The Case of Majang zone, Gambella Region, Ethiopia

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Abstract

This study aims to investigate the impact of land use-land cover changes on the livelihoods of the rural communities in the Majang zone, Ethiopia. The study has examined land use-land cover (LULC) changes for four consecutive study periods using Landsat imageries and GIS applications. The result of LULC changes shows that between the years 1985 and 2018, forest lands, shrub/grasslands, and water bodies declined by 49.7%, 80%, and 42.3%, while agricultural lands and settlement areas increased by 100.6%, and 413%, respectively. By employing a sustainable rural livelihood approach, the study also assessed the livelihood status of the farmer households. Thus, livelihoods were assessed through the selected livelihood indicators of each livelihood asset derived from the data gathered through household surveys, key informant interviews, focus group discussions, and field observations. The livelihood asset index result indicated a significant difference at $P<0.05$ within the groups in all livelihood asset indexes except human assets. Moreover, the finding confirmed that the highest livelihood index was obtained for the physical (0.71) and financial assets (0.50). Furthermore, finical and natural assets were identified as the main determinant factors in the livelihood of rural farm households. So, our findings suggest that a judicious combination of interventions will be helpful if they are accompanied by government policies that enhance rural livelihood assets. Although the livelihood asset index has been in progress, the provision of access to human and social infrastructure as well as microfinance institutions should also be emphasized to improve the livelihoods of the rural communities.

Keywords: /Livelihood Assets/LULC Change/Majang/Ethiopia/

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1. Introduction

Land is an important natural resource for both the survival and the wealth of humankind, and it is also useful for the preservation of all terrestrial ecosystems (FAO, 2005; Belay et al., 2014; Fikirte et al., 2017). Livelihood activities, such as infrastructure development, food production, and shelter depend on land resources (Lambin & Geist, 2008; Mengistu & Woldetsadik, 2012; Gessese, 2018). According to Hassan et al. (2016), humans have altered the earth's surface for incomes that support their livelihoods. Most of the recorded land-use dynamics were the outcomes of different practices made to fulfill the instant necessities of human beings (Serneels & Lambin, 2001; De Sherbinin, 2002). Nevertheless, the way of change in land use-land cover (LULC) and livelihoods of the people is not similar throughout the entire world.

Land resources and human beings are interrelated and interdependent for their sustainability (Dhas, 2008). The relationships between human activities and land use are complex, which is insufficiently studied, and poorly understood by the people (Anderson et al., 2002; Li et al., 2008). Without an understanding of the relationship between nature and society, we cannot examine the various ways in which diverse people in different places link LULC and livelihoods (Pensuk & Shrestha, 2008; Shiferaw & Singh, 2011). So, understanding the link between the two is significant for our sympathetic of and action to address, the resulting human suffering, and the pressures on the environment.

The impacts of land-use change on rural livelihood vary at a global, regional, and local scale based on the country's livelihood diversification strategies and level of development (Hu et al., 2008; Bryan, 2013). In influencing the livelihood of rural farmers, LULC change plays an important role in Sub-Saharan African countries particularly, in countries like Ethiopia, where a substantial majority of the rural population is under an on-farm livelihood strategy (Molla, 2014; Minta et al., 2018). According to Kruseman et al. (1996) land use acts as an interface between the rural livelihoods and the environment as it forms amalgamating concept in which socio-economic and ecosystem variables coincide. Moreover, Soini (2005), and Salisbury and Schmink (2007), noted that the change in land use can affect farmer livelihoods.

In Africa, particularly Sub-Saharan countries rain-fed cultivation is dominant and it supports the rural livelihoods (FAO, 2004). It is characterized by low crop yields, which results from far-reaching consequences of LULC change i.e., the exhaustion of valuable ecosystem services, unreliable rainfall amounts that associate with large-scale agriculture, and results in the loss of forests, wetlands, and grasslands (Eshetu, 2014). Hence, poverty and hunger are predominant, as above 50% of Africa's Sub-Saharan countries poorest people are concentrated on low agricultural potential lands that are susceptible to land degradation and become insufficient in food supply to cover their food demand (Holtz, 2008). So, this indicates that rural livelihood-based agriculture is directly connected with and reliant on land resources and the environment.

In the Ethiopian context, historical records depict the long existence of land resources and historical activities; the majority of its citizens earn their livelihoods from agriculture and agricultural products (Debay, 2012). Studies show that agriculture's contribution to this county's economy is immense. For instance, CSA (2005) confirms that in Ethiopia while agriculture accounts for 46.3% of the GDP, people working in this field account for 80% of the total employment. The changing patterns of LULC reflects its effect on the economic and social conditions of the communities (Vitousek et al., 1997). Thus, the dynamics in land-use practices affect the agricultural productivity and the livelihoods of the rural communities.

As in many areas of the Ethiopian regions, the Majang zone is also known for its alarming LULC change, environmental degradation, and food insecurity. Such problems are related to accelerated land grabbing combined with traditional land use and subsistence agricultural systems, which are characterized by low productivity (Asenake & Amare, 2019; Agumassie, 2020). As result, the rural communities of the study area are more vulnerable to undesirable changes in the land use system which fails to provide sufficient means of survival or agricultural productivity and created problems in their livelihoods.

However, having a clear understanding of the relationship between land-use change and its effects on the rural livelihoods can be an important input for formulating strategies to improve the livelihood of rural households

(Pensuk & Shrestha, 2008). To the knowledge of the author's survey on the nexus between land-use change and its effects on rural livelihoods was not given due attention in the study area. Due to this, the area was not endowed with enough information to provide important insights about the issues for a better land-use system, improved rural livelihoods, and decision making. Therefore, this study aimed to assess and show the impact of land use/cover changes on rural livelihoods in the Majang zone, Gambela Regional State, Ethiopia.

2. Theoretical and Conceptual Framework

When asked what a "livelihood" means, few would struggle to answer. For some of them livelihood means "making a living", and for others, it is to mean "supporting a family". Still, some others consider it as if it is "their job" all describe a livelihood. The term "livelihood" has been defined by different scholars in various ways based on different methodological approaches that attempt to represent its complex nature. One might have a narrower economic focus on production, employment, and household income, whereas others take the more holistic view which unites concepts of economic development, reduced vulnerability, and environmental sustainability (Shackleton et al., 2001). Despite differences in emphasis by different experts, a livelihood can be understood as "the capabilities, assets, and activities required for a means of living" (Chambers and Conway, 1990; Shackleton et al., 2001; Hulme and Shepherd, 2003). More explicitly, Ellis (2000) defined livelihood as "the assets (natural, physical, human, financial and social capital), the activities, and the access to these (mediated by institutions and social relations) that together determine the living gained by the individual or household." Concurrently, Ellis (2000) categorized land under natural capital, "the natural resource base that yields products utilized by human populations for their survival."

In this study, the Sustainable Livelihood Framework (SLF) of the Department for International Development (DFID) was applied in order to assess the changes in rural livelihoods due to the change in the land-use system. In this framework, livelihoods capitals are comprised of five different capitals, such as natural, financial, physical, human, and social capitals (DFID, 1999). The SLF indicates that the livelihood of the given household is dependent on its asset endowment which enables households to pursue a sustainable livelihood (Abafita & Kim, 2014). Moreover, Carter and May (2001) argued that people can be poor at any point in time because they possess too few capitals to generate sufficient income, or because of limitations on their ability to use the assets they own. However, changes that occur in time can create new opportunities for households to alleviate their poverty (Jiao et al., 2017).

Thus, in this study, the framework treats livelihoods and land use as different manifestations of the social processes by which individuals negotiate the everyday situations that shape their lives (McCusker & Carr, 2006). Furthermore, Gilling et al. (2001) and Attfield et al. (2004) addressed the mutual influence of land use on livelihoods in their sustainable livelihood literature. Therefore, livelihoods are often privileged in the livelihoods/land use nexus (see Figure 2 adapted from DFID, 1999 that neatly capture this relationship).

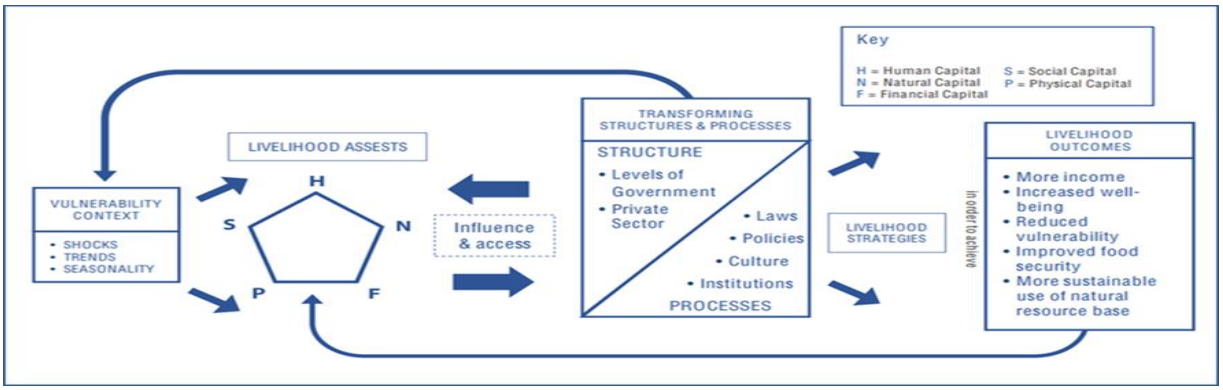

Figure 1: Sustainable livelihoods framework adapted from DFID (1999) and UNDP (2017)

3. Methodology

3.1 Study Area Description

Majang zone is part of the Gambella region, which is 628km away from Ethiopia's capital city, Addis Ababa. Being in the Southwest of the capital, it is bordered with Sheka and Bench Maji zones of the Southern Nations, Nationalities, and People's Region (SNNPR) in the south, Illu Aba Borra zone of Oromia region in the north and Agnwa zone of Gambella in the west. It is found between7º10'00"N-7º40'00"N latitude and 34º49'30"E-35º 22'00" E longitude, covering a total area of 156,032ha (Figure 2).

The mean annual temperature varies between 15°C and 27.5°C and the average annual rainfall varies between 1500mm and 2200mm. According to CSA (2007), the total population of the Majang zone was about 59, 248 of which male accounts for 51.6% and female accounts for 48.4%. The most common livelihood activities of the Majang zone are the production of food crops (maize and sorghum), perennial crops such as coffee, *khat*[3], and honey (UNESCO, 2017). The aforementioned food crops are used for consumption in a subsistence manner; whereas, coffee and *khat* are the main sources of cash

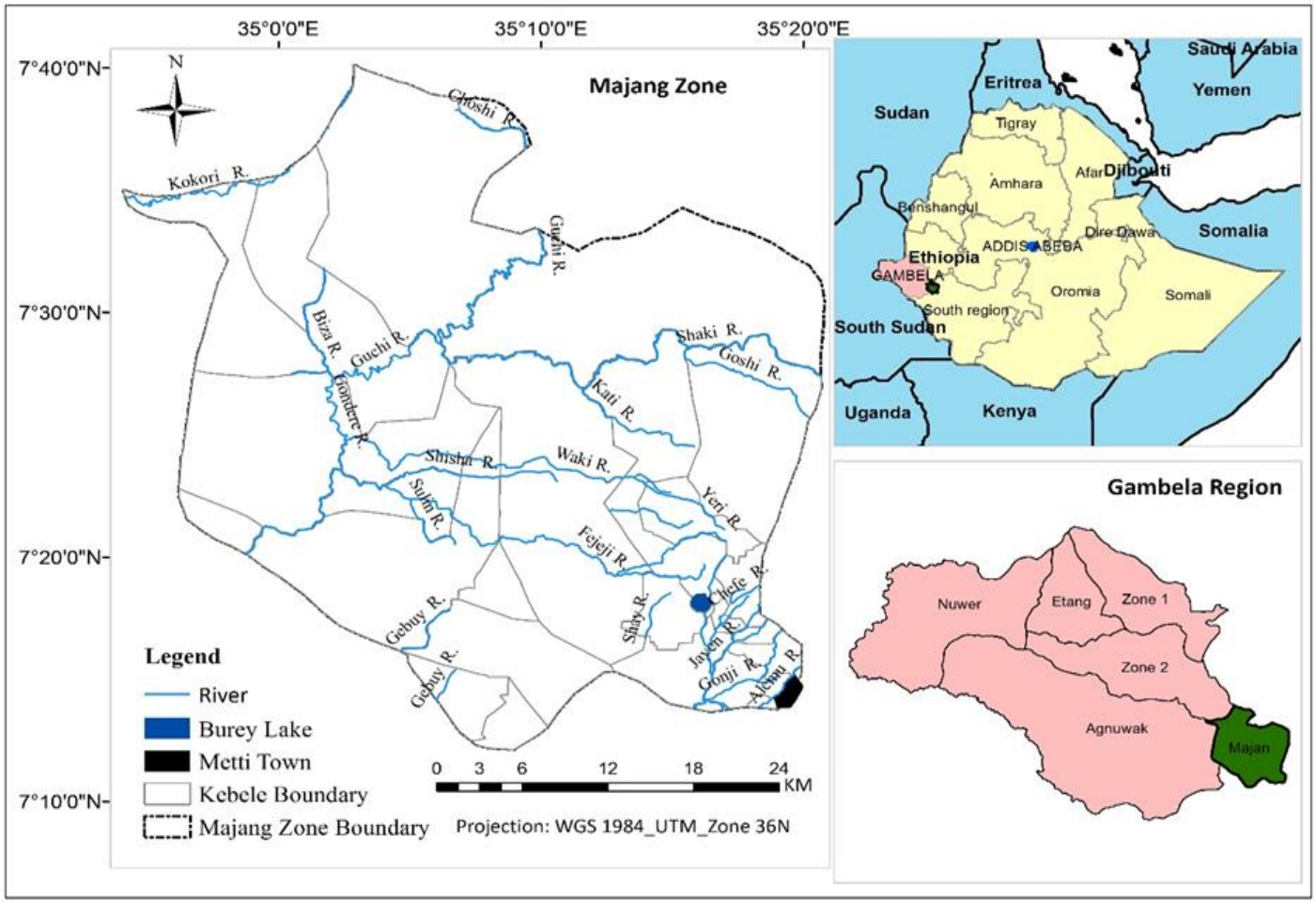

Figure 2: Location map of the study area (Source: Author, 2019).

[3] Catha edulis, a flowering plant or scrub whose leaf is stimulant, contains the alkaloid cathinone.

3.2 Sources of Data and Methods of Acquisition

The main types of spatial data used to investigate the land-use change were Landsat MSS, Landsat TM, Landsat ETM+, and Landsat 8 OLI of the year 1985, 1996, 2007, and 2018, respectively. These data sets were obtained from the United States Geological Survey (USGS) data center under the online Landsat archive. In order to obtain information on the socio-economic and livelihood of the rural community, both primary and secondary data sets were employed. The primary data were generated through household socio-economic and demographic surveys. However, data on population size and distribution were obtained and computed from the National Housing and Population Census reports.

In this study, different data collection instruments and techniques were used to generate and tabulate relevant data. Accordingly, data on basic livelihood assets (human, financial, natural physical, and social) and environmental implications were collected through structured questionnaires, key informant interviews (KIIs), focus group discussions (FGDs), and field observations. Structured questionnaires (both closed and open-ended questionnaires) were distributed to a randomly selected 364 sample household heads. To obtain detailed information about the stated problems, KIIs were also held with selected key informants: 6 kebele leaders, 3 government officials, and 3 experts. Moreover, 6 different FGDs composed of elders, youths and women ranging from 6 to 10 participants were also held to triangulate the reliability and validity of the data collected through other techniques. The discussions were held through the interaction of a purposefully formed small group of people, often ranging from 6 to 10 people (Marshall and Rossman, 2014). Furthermore, field observations were held to obtain insight knowledge about land use practice and life history narratives to supplement household data collection.

3.3 Population and Sample Size

To set the sample size, the study employed a multi-stage sampling technique, which involved the combination of more than two sampling techniques at different stages. Accordingly, out of the existing 29 kebeles in the study area, six kebeles were selected purposively because these kebeles are found in the area where high agricultural investment, illegal settlement, and deforestation took place and found near to the core zone. The required number of sample respondents from each targeted kebeles was selected through proportional sampling techniques, and sample household heads of each kebeles selected using a simple random sampling technique (Table 1). So, to select the sampled population, the study employed the formulae, which is often used in most social science researches for sample size determination (Yamane, 1967).

$$n = \frac{N}{1 + N(e)^2}$$

Where: n = Sample size; N = Total households; e = Significance level, which is 0.05

$n = \frac{3983}{1+3983(0.05)^2}$ =363.5 ≈ 364 respondents. Accordingly, the total number of sample household heads included in the study was 364.

Table 1: Selected sample household heads from targeted kebeles

Sample kebeles	Total No. of HHs	No. of Sample HHs
M.Metti	722	66
Akashi	985	90
Gumari	854	78
Yeri	361	33
Gubeti	657	60
Kumi	404	37
	3983	**364**

Source: CSA (2007)

3.4 Data Analysis

Land use and land change analysis. LULC change detection was conducted using the post-classification image comparison technique in which images of different reference years were first independently classified under supervised classification methods; particularly, maximum likelihood image classification techniques and afterwards change detection processes were performed. In addition, the change detection matrix of transitions between different LULC was evaluated to measure areas converted among the different land uses (Minta et al., 2018). The percentage of LULC change was computed by the following formula that was set by Kindu et al. (2013).

$$\text{LULC change}(\%) = \frac{(\text{Area final year} - \text{Area initial year})}{\text{Area initial year}} 100 \text{---------- (Eq.1)}$$

Livelihood assessment. In this study, livelihood assets (human, natural, physical, social and financial capitals) were derived from a total of twenty-one different livelihood indicators (Table 5). To avoid scale difference and generate livelihood asset index weight which represented the situation of rural livelihood, all indicators in each asset were normalized by using the minimum and maximum values linear scaling technique as shown in equation two.

$$Xi = \left[\frac{R_i - R_{min}}{R_{max} - R_{min}}\right] \text{---------- (Eq.2)}$$

Where, X_i - normalized value, R_i - raw value to be normalized, R_{min} - actual minimum value of the variable, R_{max} - actual maximum value of the variable.

The assessment of rural livelihoods can be achieved through the identification of what the rural people have and what they do not have (Moser, 1998; Allison and Ellis, 2001), which is more important for understanding the livelihood status of the people. So, to compute the surveyed household's data, quantitative statistical methods of data analysis and presentation were employed. Moreover, the qualitative data obtained from key informant interviews and focused group discussions were stated in the narrative form alongside the quantitative data. A compared mean with paired sample t-test was employed at $p<0.05$ level to examine the difference within selected livelihood indicators of the same households' groups with different time intervals. Thus, the second millennium (2000) was taken as a separation time to observe the differences within the group. Accordingly, the livelihood of the sampled HHs before the year 2000 (1985-2000) was represented by group I, whereas group II, denoted the same sampled HHs after the demarcation time (2001-2018).

4. Results and Discussion

4.1 Land Use and Land Cover Changes (1985-2018)

The LULC classes were classified and analyzed using the interpretation of satellite imageries supplemented with household heads and key informants' perceptions and the researchers' prior knowledge of the study area. The study found that the Majang zone has experienced noticeable changes in LULC at a different rate over 33 years. Thus, agricultural lands, forest lands, settlement areas, water bodies, shrub/grasslands were identified as major LULC classes in the study area (Figure 3).

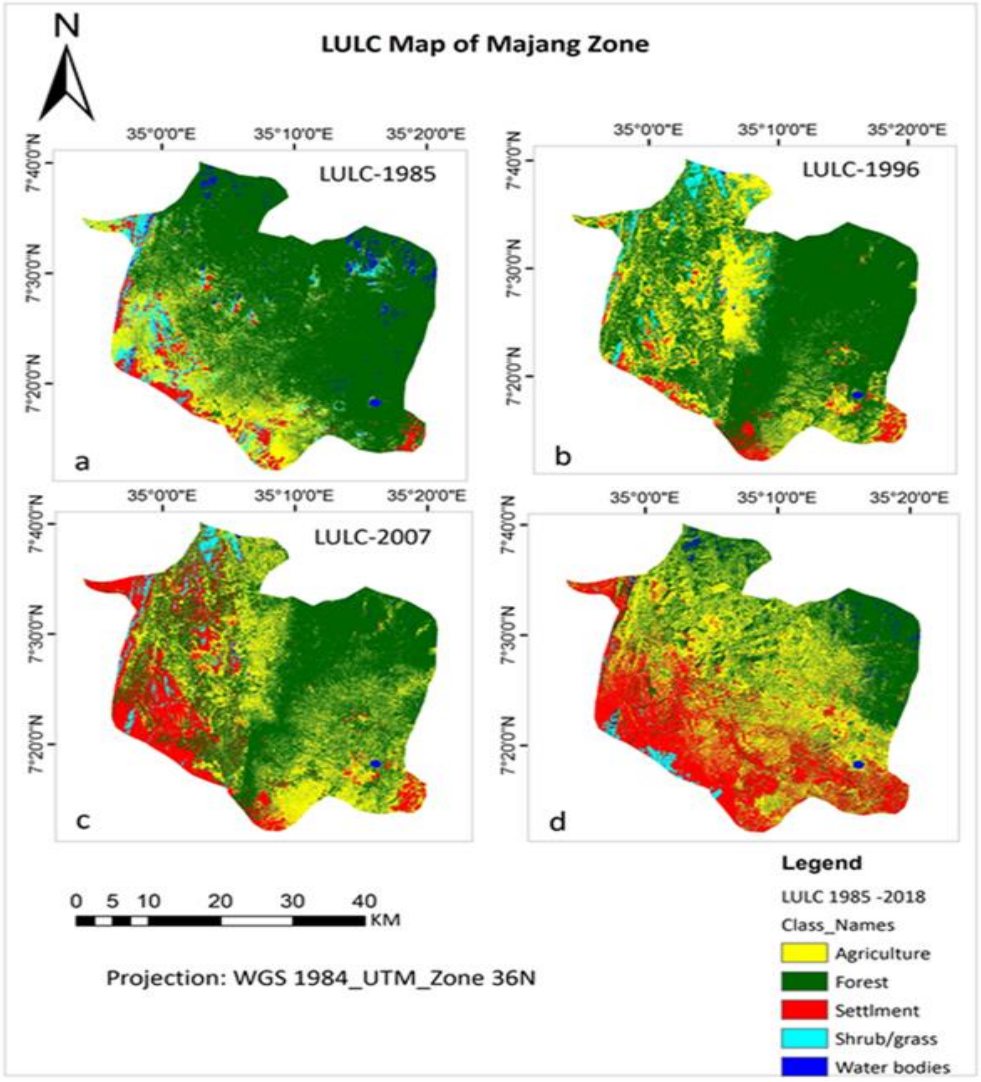

Figure 3: LULC map of Majang zone of the study periods from 1985 to 2018

The analysis of Landsat images revealed that agricultural lands, forest lands, settlement areas, water bodies, and shrub/grasslands were identified as the main LULC classes (Table 2). The LULC analysis conducted for four study periods (1985, 1996, 2007, and 2018) shows that agricultural lands and built-up areas progressively expanded and became dominant land-use types in all study periods. Settlement areas, which had one of the smallest coverages (only 5.5%) of the total area in 1985, have had alarmingly increased and covered 28% of the landscape in 2018. Similarly, agricultural lands that covered only 17.3% of the total area in 1985, increased to 34.7% in 2018. The findings of this study indicate that in the study area, agricultural land is expanding at the expense of forest cover, which is consistent with other findings (Fikirte et al., 2017; Kiros & Desalegn, 2019).

However, forest cover which accounted for 69.4% of the landscape in 1985 had decreased to 35% in 2018; this vividly shows the major change in the LULC of the study area. Similarly, the coverage of water bodies and shrub/grasslands of the landscape had decreasing throughout the study periods. Resettlement schemes in Ethiopia, both planned and spontaneous, involved environmental impacts and have also resulted in huge damage to forest areas (Jaleta et al., 2011; Messay & Bekure, 2011). Moreover, cultivated land expansion into wetlands, shrub/grasslands, and forest lands is an old phenomenon observed in many parts of Ethiopia (Minta et al., 2014;

Zeleke & Hurni, 2001). The settlement and cropland expansion into the natural ecosystems occupied by dense forest areas have resulted in widespread deforestation and LULC dynamics in the study area.

Table 2: LULC classes with area in hectare (ha) and percentage (%) share (1985-2018)

LULC Type	1985		1996		2007		2018	
	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%
Forest land	108353	69.4	96740	62	79576.3	51	54467.5	35
Agricultural land	26968	17.3	36355.4	23.3	42753	27.4	54105.5	34.7
Settlement area	8531	5.5	13106.7	8.4	26525.4	17	43759.6	28
Shrub/Grass land	8813	5.6	6865.4	4.4	4836.8	3.1	1756.7	1.1
Water bodies	3367	2.2	2964.5	1.9	2340.5	1.5	1942.7	1.2
Total	**156032**	**100**	**156032**	**100**	**156032**	**100**	**156032**	**100**

Source: Field survey, 2019

Evidence from this study showed that over the entire study period (1985-2018), the landscape of the targeted study area had experienced a remarkable change at LULC at a different rate of transformation. Table 3 shows the observed changes between the years 1985 and 2018 forestlands, shrub/grasslands, and water bodies significantly declined by 49.7%, 80%, and 42.3%, while agricultural lands and settlement areas increased by 100.6%, and 413%, respectively. This implies that the former has doubled while the latter has quadrupled in coverage as compared to that of 1985. The observed remarkable expansion of agricultural lands and settlement areas between 1985 and 2018 at the cost of shrinking forest lands, wetlands, and shrub/grasslands cover; is consistent with the research findings of Lemenih et al. (2005), Zeleke and Hurni (2001), Tekle and Hedlund (2000), who reported that cropland and settlement expansion took place at the expense of forest cover, wetlands, and shrub/grasslands reduction. As such, this is a common phenomenon in the Ethiopian highlands.

Table 3: LULC changes with area in hectare (ha) and percentage (%) share of the study area

LULC Types	1985-1996		1996-2007		2007-2018		1985-2018	
	Area(ha)	%	Area(ha)	%	Area(ha)	%	Area(ha)	%
FL	-11613	10.7	-17163.7	17.7	-25108.8	31.5	-53885.5	-49.7
AL	+9387.4	34.8	+6397.6	17.6	+11352.5	26.5	+27137.5	+100.6
SA	+4575.7	53.6	+13418.7	102.4	+17234.2	65	+35228.6	+413
SGL	-1947.6	22	-2028.6	29.5	-3080.2	63.7	-7056.3	-80
WB	-402.5	12	-624	21	-397.8	17	-1424.3	-42.3

Source: Field survey, 2019

Where: FL-Forest land; AL-Agriculture land; SA-Settlement area; SGL-Shrub/grass land; WB-Water bodies

The classification accuracy was assessed by examining the classified map against all available reference data and field information including the researchers' experience on the study area by constructing confusion matrices (Pensuk & Shrestha, 2008). Accordingly, the result showed that the overall accuracies computed for each of the considered classified satellite images were found between 83% and 92% with the Kappa coefficient of 0.80 and 0.90 (Table 4). Thus, the Kappa results of this study showed a strong agreement for each of the four classified images, and the overall accuracies were within the acceptable range for further LULC change analysis (Kindu et al., 2013).

Table 4: Overall accuracy and Kappa coefficient of satellite image of the study periods

	1985	1996	2007	2018
Overall accuracy	0.83	0.86	0.89	0.92
Kappa coefficient	0.80	0.83	0.85	0.90

Source: Field survey, 2019

4.2 The Nexus between LULC Change and Rural Livelihoods

Land is a crucial natural resource for people's survival, their wealth, and the maintenance of all the terrestrial ecosystems (FAO, 2010). The information acquired through KIIs and FGDs assured that in the study area the life of farmers depends on land resource son which agricultural activities were performed to satisfy the demand for their livelihoods. Therefore, as far as an attempt is made to possess capitals particularly land resources to generate sufficient agricultural income and satisfy the demand for livelihoods, there shall be cultivated land expansion which can result in a land-use change. By the same token in Majang zone cropland expansion particularly coffee plantation was held at the expense of decreasing forests, shrub/grassland, and water bodies cover (Garedew et al., 2012; Mengistu et al., 2012; Kindu et al., 2013; Molla, 2014). Accordingly, farmers in the study area believed that there was a strong relationship between land-use change and their livelihood since agriculture without land is untenable. Agriculture is, in fact, a human activity that affects the greatest proportion of the earth's surface. Of course, it is through land use that the interaction of farmers' livelihoods and the impact of agriculture on it is most clearly demonstrated (Gessese, 2018). Even though the land is crucial for farmers' livelihoods, it is a degradable and transferable entity that can only be sustainable when it is properly used.

The information obtained from the elders and key informants further noted that agricultural expansion and coffee plantations have been expanded considerably at the expense of forest cover. Most of the farm households in the study area expanded their agricultural land to get more agricultural land and agricultural production to meet the requirements and improve their livelihoods. The result of this study also is consistent with the findings of Mengistu et al. (2012), Garedew et al. (2012), who reported that expansion of cultivated land increases farmer's income and satisfies the demand of their livelihoods. Therefore, as one can see in the literature, land use has been considered as the most important factor that influences farmers' livelihood. For instance, Dhas (2008) claimed that land and people are the most important natural resources that are mutually interrelated and interdependent for their sustainable development. Similarly, land use and rural livelihoods-based agriculture are closely linked with and inseparable entities in the study area.

4.3 Impacts of LULC Change on Rural Livelihoods

The impact of land-use changes on rural livelihood was assessed by considering five basic livelihood asset categories. The five asset categories used as the criteria of the aforementioned assessment were identified as human, natural, financial, social, and physical. Accordingly, the result of the human asset index assessment indicated that there was no significant difference at $p<0.05$ within the group in human asset indicators; however, the computed index for group II (0.46) was slightly higher than Group I (0.41). On the other hand, the cumulative weighted result of the livelihood asset index confirmed that there was a significant difference within the groups in natural asset indicators. Thus, when we considered the individual variables of natural asset indicators, landholding size, and forest cover, one could see a higher score for group I (0.68) compared to group II (0.49). This in turn indicates that there was a significant difference at $p<0.05$ (Table 5).

Moreover, the result of the financial asset index revealed that crop production, access to credit and loan as well as, amount of household savings showed significant difference within the group. This also confirms the

presence of a significant difference at $p<0.05$. And this could happen because of changes in the expanded agricultural land and infrastructures. On the other hand, the other three variables, namely, livestock production income, off-farm income, and access to remittances scored slightly higher for group II compared to group I nevertheless there was no significant difference within the groups. In the case of social asset indicators, particularly, access to workshops participation, fund and labor assistance, group II (0.63 and 0.53) had higher scores than group I (0.49 and 0.43) respectively. This means there was a significant difference at $p<0.05$. However, the remaining variable of a social asset, namely, social association mobilization presented no significant difference within the household groups as well as the overall social asset index.

The statistical result showed that the physical asset indicators such as accessibility to market, access to road and transport, housing value, and access to other basic services infrastructure (communication, electricity, schools, and health centers) have a higher score for group II (0.71) than group I (0.50). This implied the existence of significant differences between the two groups (Table 5). However, the accessibility to basic infrastructures, for instance, roads, schools, health centers, electricity, water, and sanitation were considered an important physical asset indicator. Practically, the contributions of the aforementioned infrastructures to the better livelihoods of the subjects were given due attention in this study.

In general, when we compared the two groups, households in group II tended to be better-off in term of almost all livelihood assets (financial, human, social, and physical asset) compared to group I except for natural livelihood asset indicator, presented higher weight for a group I (0.68) than group II (0.49). Therefore, appears possible to say that there was a significant difference within the groups in the study area (Figure 4).

Our study identified that, household size, education level, landholding size, crop production, income, and access to infrastructure services found to have a significant difference within the livelihood of the rural communities. Moreover, the discussion with key informants and FGDs confirmed that access to education, health center, and other infrastructure services are improving from time to time but, it does not mean that all the livelihood assets indicators are improved. Though some indicators of physical and social livelihood assets are in better progress, still all basic livelihood asset indicators (financial, human, social, natural, and physical asset) need great attention for better income and improved well-being of the rural household livelihoods. Our findings are also consistent with the finding of Abafita and Kim (2014), Belay et al. (2014), Asmamaw et al. (2011), Shiferaw and Singh (2011) who have reported the significance of the identified livelihood asset indicators on the livelihood of the rural communities.

On the other hand, the variables working age, livestock production income, off-farm income, access to remittances, and social associations had not brought such a significant difference within the livelihood of the targeted groups in the study area. This is in line with findings of many other previous studies (Anisara and Feleke et al., 2005; Babulo et al., 2008; Rajendra, 2008). However, except for some variables, the comparison of the two groups indicated that the livelihood of the rural communities exhibited better improvements in the study area.

Table 5: Livelihood asset indicators and weights

Asset categories	Reference indicators	Group I		Group II		Sig.
		Average	SD	Average	SD	
Human asset(A_1)	Household size	0.3675	0.1845	0.3916	0.1907	0.117^{ns}
	Working age	0.4739	0.2164	0.5398	0.1453	0.583^{ns}
	Education level	0.3864	0.3103	0.4670	0.3505	0.242^{ns}
A_1 index		0.4092	0.2371	0.4661	0.2288	0.848^{ns}
Natural asset(A_2)	Landholding size	0.6473	0.4268	0.4791	0.3215	0.004^{*}
	Forest cover	0.7088	0.1720	0.5041	0.4170	0.046^{*}
A_2 index		0.6781	0.2973	0.4916	0.3693	0.031^{*}
Financial asset(A_3)	Crop production income	0.4119	0.3057	0.6495	0.3254	0.021^{*}
	Livestock production income	0.3833	0.3547	0.4038	0.3689	0.561^{ns}
	Off-farm income	0.3544	0.2790	0.4478	0.2980	0.432^{ns}
	Access to credit and loan	0.3407	0.2746	0.5659	0.2963	0.037^{*}
	Amount of household saving	0.3475	0.3903	0.5485	0.3461	0.043^{*}
	Access to remittances	0.3214	0.2677	0.4038	0.2913	0.213^{ns}
A_3 index		0.3598	0.3120	0.5032	0.321	0.022^{*}
Social asset(A_4)	Social associations	0.7321	0.3111	0.7940	0.2948	0.451^{ns}
	Workshop's participation	0.4876	0.2737	0.6332	0.2936	0.031^{*}
	Fund and labor assistance	0.4313	0.2639	0.5357	0.3151	0.042^{*}
A_4 index		0.5503	0.2829	0.6543	0.3012	0.047^{*}
Physical asset(A_5)	Access to market	0.4897	0.3956	0.5879	0.4929	0.031^{*}
	Access to road and transport	0.4865	0.3819	0.7143	0.4524	0.046^{*}
	Housing value	0.3489	0.2830	0.4766	0.3484	0.035^{*}
	Access to water	0.7005	0.2482	0.8434	0.3639	0.456^{ns}
	Access to communication	0.5742	0.4951	0.75	0.4336	0.023^{*}
	Access to school	0.5604	0.4970	0.7885	0.4090	0.039^{*}
	Access to health center	0.3654	0.4822	0.8214	0.3835	0.041^{*}
A_5 index		0.5037	0.3975	0.7117	0.4248	0.032^{*}
Over all livelihood index		0.4629	0.3054	0.6027	0.3290	0.021^{*}

Source: Field survey, 2019

Note: ns, probability values that are not significant at $P > 0.05$ levels, * significant at $p<0.05$

Group I - denoted the livelihoods of the sampled HHs between the year 1985-2000.

Group II - denoted the livelihoods of the same sampled HHs between years 2001-2018.

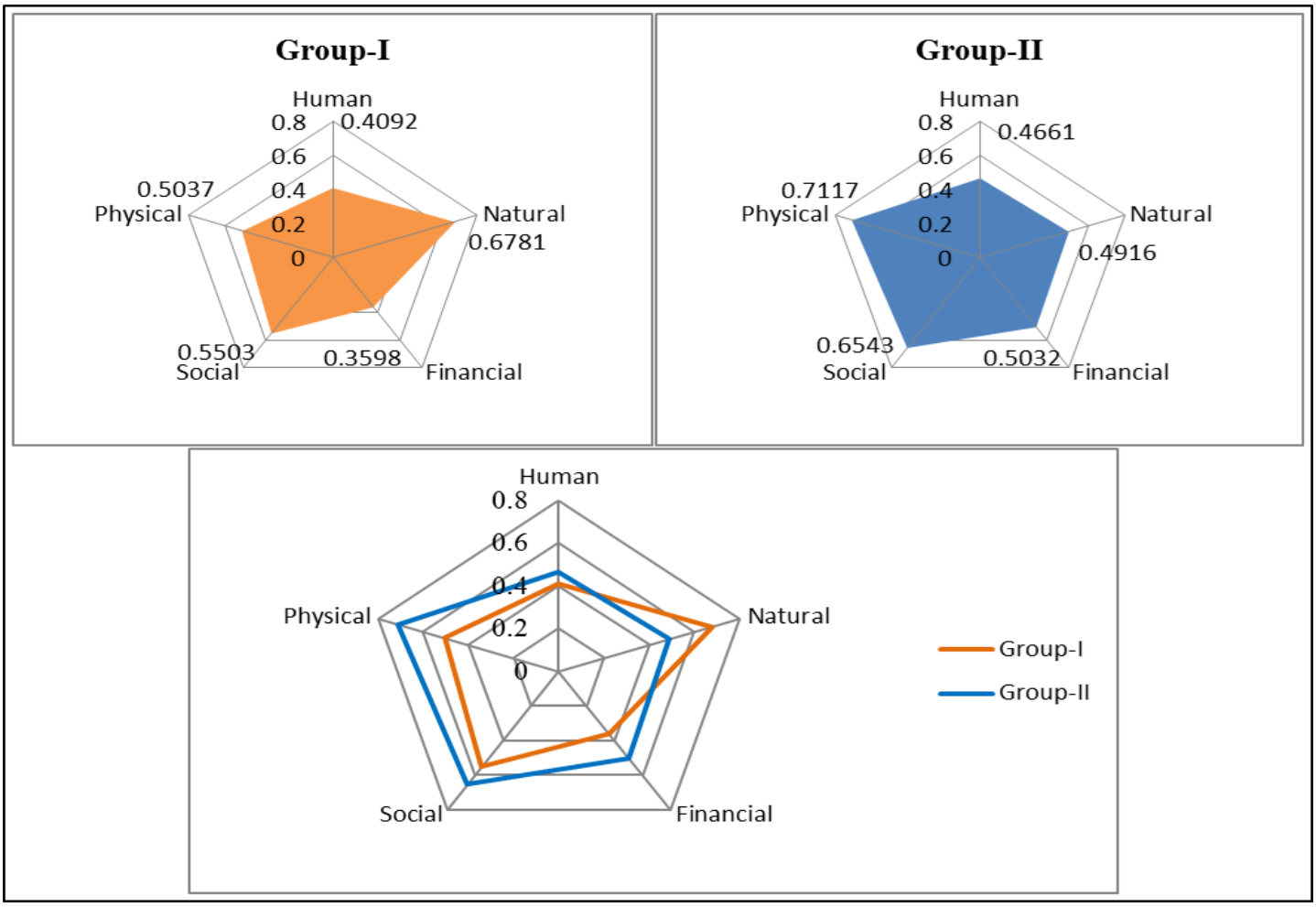

Figure 4: Livelihood pentagons of the household groups. Source: Field survey, 2019

5 Conclusion

Land is one of the main natural resources that could have determined the socio-economic status of a nation, its citizen's access to infrastructure, and their engagement in various human activities. Hence, the occurrence of changes in LULC has been a continuous phenomenon since the time man started its intervention in nature in the form of agricultural practice in the past. Such interventions and changes in the land use/cover have affected the livelihood of farmers in different ways. In this study, an attempt was made to assess the impact of land-use changes on rural livelihood in the area.

The quantitative evidence obtained through the interpretation of satellite imageries and analysis of surveyed household questionnaires indicated that the study area has undergone substantial land-use changes during the period (1985-2018). The finding confirmed that the changes observed in LULC have potentially influenced the livelihood of the local communities. Thus, as result, the rural communities of the study area have experienced some improvement upon their basic livelihood assets, even if some unchanged livelihood indicators still existed. Accordingly, basic infrastructure services such as access to the market center, bank and credit, water and sanitization, telecommunication, school, and health center were observed as motivating results of land-use changes on the rural livelihood of the study area during the recent past study periods. Thus, for further improvement, deliveries of infrastructure services need to get special attention from concerned actors who work in the area.

The study results also showed that the surveyed households observed to have above- average livelihood index which can be regarded as a moderate livelihood. But this does not mean that all farmers have had access to all livelihood assets (human, natural, financial, physical, and social assets). For example, households that grew coffee for the last 15 years were potentially better-off in livelihood assets in financial term (asset) than households which did not engage in a coffee plantation. This could happen due to the higher price of coffee than other crops in the area. As a result of this, maize and sorghum growing households tended to convert their land to coffee plantations due to the higher income they earned from coffee production in the recent past. Such market-driven land-use changes could have contributed to the livelihood of farmers, but overall resources required for a sustainable rural livelihood. Forest products have played a vital role to generate income and improve the opportunities of low-income surveyed households to sustain their livelihoods.

6 Recommendations

Based on the empirical observations, the study suggests that the rural livelihood could be improved through an inclusive and thoughtful combination of interventions aiming at enhancing the relationship between land use and rural livelihood through favorable government land-use policy and development interventions, off-farm activities, and promoting awareness creation on better utilization of land and land resources that can bring about better access to livelihood assets. However, further research is still needed to gauge the challenges of LULC changes on the rural livelihoods using additional relevant livelihood asset indicators across different socio-economic contexts of rural communities.

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Authors' Contributions

Girma Alemu Melka has originated the research idea, designed and shaped the research; conducted data collection, data analysis, shaped the first draft of the manuscript and produced the final version of the manuscript. Muluneh Woldetsadik Abshare has critically commented on the research (data collection instruments and data analysis techniques and the like), supervised the research, and commented on the first draft of the manuscript.

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Competing interest

There is no competing interest.

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