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Dynamics of Population, Agricultural Land, and Vegetated Areas in the Central to Eastern Mountain and Hill Districts of Nepal

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Abstract

Depopulation and agricultural land abandonment are the common occurrences in rural mountainous regions worldwide. In Nepal increased wilderness is evident due to the conversion of cultivated land into forest, shrubs, and grassland. This study focuses on the central and eastern mountainous and Hill districts; where most districts have experienced negative population growth in the past two decades. Land use/ land cover maps were obtained from Lands at 8 image classification while population was collected from the National Statistical Office of Nepal. The Digital Elevation Model (DEM) was downloaded from the Shuttle Radar Topography Mission (SRTM) and topographic maps were also collected from the Survey Department of Nepal. A reality check Approach was adopted for ground verification. Maps of population, land use/ land cover, cultivated land, vegetated area, elevation, slope gradient, and slope aspect were developed. Based on these maps, changes in the spatial distribution of population, land use/ land cover, cultivated land, and vegetated area were identified and calculated. This study has revealed a significant decrease in population in higher altitudes and hill slope areas. This has resulted in large parts of cultivated lands being abandoned in this region and most excessive abandonment with the most extensive abandonment occurring in areas with marginal slop land. These lands are now converting into forests, shrubs, and grassland. It is concluded that agricultural land abandonment in the study area should not be considered solely based on physical marginality and accessibility but rather through a holistic approach that accounts for complex variability in these factors.

Keywords: Agricultural land abandonment, cultivated land, mountain and hill, population change, vegetated area

Introduction

Over the past fifty years, land use changes have impacted 32 percent of the world's geographical area. Globally, there has been a decline in the amount of land covered by forests and increased agricultural production. On the other hand, the Global North is witnessing the opposite trend, with forests expanding and crops and meadows declining (Winkler, Fuchs, Rounsevell, & Herold, 2021). A phenomenon evident throughout Europe is the abandonment of agricultural land despite an increase in the world population and the corresponding rise in the need for food (Latocha-Wites, Reczyńska, Gradowski, & Świerkosz, 2019; Levers, Schneider, Prishchepov, Estel, & Kuemmerle, 2018). Poverty and insecurity in rural areas are the major reasons behind migration (Todaro, 1994). The hardship of livelihood in the mountains is due to the limited suitable land for human habitation. Inversely suitable cultivated land is typically concentrated in the lower flat lands, where more human settlements, important transportation routes, and other services and facilities become available (Ehrlich, Melchiorri, & Capitani, 2021). In large parts of the world rural mountain areas face the challenges of depopulation because of outmigration and decreasing fertility due to the combined consequences of globalization, industrialization, changing lifestyles, political marginalization, and violent conflict (Susanne Wymann von, Anne, & Hans, 2007). Depopulation leads to mass-level land use/land cover changes due to agricultural contraction, abandonment of agricultural land, and increasing wild vegetation (C. L. Chidi, 2016) with far-reaching ecological consequences.

Concern about environmental deterioration in the Mountains and the Hills of Nepal arose due to the alarming population growth in the past. The environmental decline was due to the extension of cultivated land in the marginal steep hillslope areas, deforestation, and overgrazing. As a result, each year millions of tons of fertile soil have been eroded including landslide and flood occurrences due to these activities (P. Nepal, 1997). But in the last two decades, the population has declined in most of the mountains and hills parts of Nepal. The declining population is in the central and eastern districts from 2001 to 2021. In this region, the population has increased in some districts like Kathmandu Valley and Kaski districts where the largest cities like Kathmandu and Pokhara are located. Some other hill districts of the south have an increasing population because of the presence of the inner valley where the hill population has been concentrated.

Several pieces of literature have revealed that traditional agricultural land is shrinking in those mountain and hill areas, where the population has declined in the last decades (Benayas, Martins, Nicolau, & Schulz, 2007; C. L. Chidi, 2016; Chidi et al., 2021). As abandonment of agricultural land increased, areas of natural vegetation growth reclaimed those areas. As a result, natural vegetation areas like forests, shrubs, and grassland areas have increased. The study has revealed the large spatial variability of agricultural land abandonment due to the complex topographical and altitudinal variability. Most studies have proved that the major driver of land use/ land cover change in agricultural land abandonment in Nepal is due to decreasing population and the intensity of abandonment is highly variable based on their topographic factors. However, most of the literature is on land use/land cover change and agricultural land abandonment only in spatial and temporal dynamics. Literature on spatial linking with population change is still highly lacking in Nepal. Thus, this study aims to relate cultivated land and natural vegetation areas change with population change, which will be valuable insight into sustainable policies and further research.

The study area

A total of 38 districts in the Mountain and the Hill have been selected as the study area (Figure 1). They are from the central to the eastern region of Nepal. Most of these districts have a decreasing population from 2001 to 2021. Only a few districts have increasing populations like Kathmandu and Pokhara Valleys. Some southern districts have increased populations, where the populations are slightly increased because of the migration of the hill population to the inner valleys of these districts. The geographical extension of this area is from 82°45' to 88°12' east longitude and 26°41' to 29°20' north latitude. The study area consists of an altitude of less than 300 meters to the world's highest mountain area Mt. Everest 8848.68 meters above the average mean sea level. Most of the areas are high mountains and hill slopes, and some river basins and valleys are comparatively gentle slopes and flat lands. The climate in the study is highly diverse due to the altitudinal subtropical tundra. There is a subtropical hot climate in the lower part and a tundra climate at the higher altitudes, which always freezes higher Himalayas. Lower valleys and river basins have higher than (>30°C) temperatures in the summer season and less than 15°C in winter. Middle-hill regions have medium climates, which are neither very hot nor cold. Rainfall is also quite different both temporarily and spatially. Average annual rainfall ranges from 200 cm to 150 cm from east to the west but some areas just south of the higher Himalayas receive more than 300 cm annual rainfall. Over 80% of annual rainfall is in the summer (June to August). In general, the eastern region is wetter than the west. There is also significant variation in rainfall from the south to the north. Rainfall increases from south to north until the south of the greater Himalayas. The northwestern part of the study area i. e. Manang and Mustang districts are drier because they are north of the higher Himalayas. They receive less than 50 cm of annual rainfall.

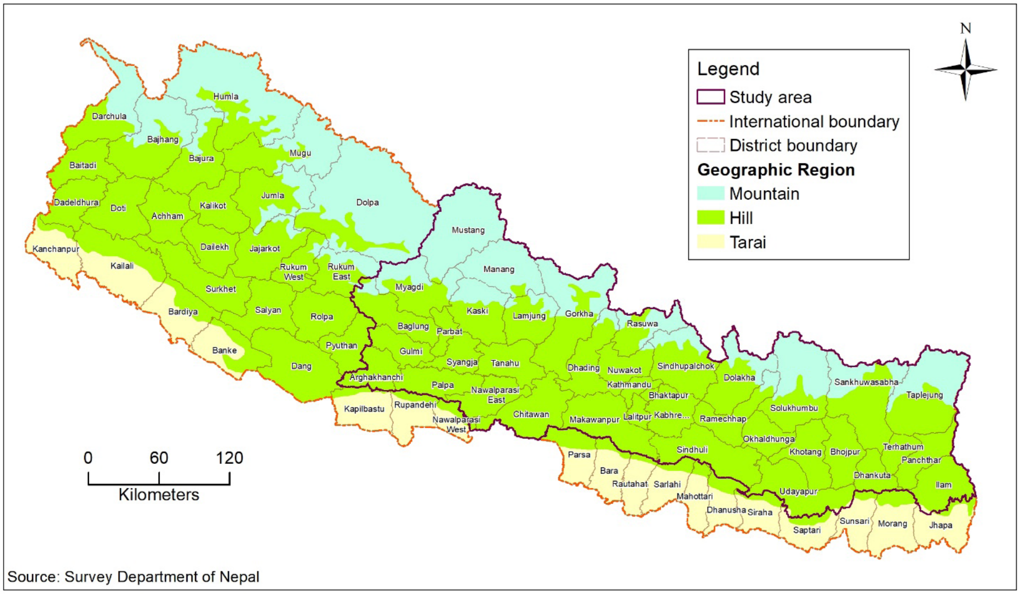

Figure 1: *Geographical region of Nepal and selected study area*

Large valleys like Kathmandu and Pokhara Valleys are within this study region, where the population growth rate is quite high due to one of the fastest urbanizing areas in Asia. The major source of livelihood for the majority of the people is traditional subsistence farming practice. There has been a transformation of dependency on subsistence agricultural practices in recent decades but more than 50% of the total population engaged in agriculture until the 2021 population census in Nepal (CBS, 2021).

Methods and Materials

This study is based on three secondary sources. The base map of the study area and boundary of administrative units, settlements, and transport network were taken from the source of the Survey Department of Nepal. Population data were sourced from the population census reports published by the National Statistical Office of Nepal (formerly the Central Bureau of Statistics). Topographic maps produced by the Survey Department of Nepal were used as base maps. Road network and built-up maps were collected from the latest open street map that can be freely downloaded from the webpage. Land use/ land cover maps were obtained from the freely available source on the International Centre for Integrated Mountain Development (ICIMOD) webpage https://rds.icimod.org/. This data was developed by the Forest Research and Training Centre (FRTC) of Nepal with the support of ICIMOD based on the Landsat image. Land use/ land cover maps of 2000 and 2010 were collected from this source. Additionally, digital elevation data (DEM) was derived from the Shuttle Radar Topography Mission (SRTM); It is freely available at https://dwtkns.com/srtm30m.

To understand the ground reality of the study area, some parts of Lamjung, Kaski, Tanahu, Syangja, Palpa, Ilam, Dhading, Sindhuli, Udayapur, Makawanpur, and Dolakha districts were visited. Observation of land use/ land cover, and informal discussions with local people in each visited part were the methods of field-level data collection. This study used a reality check approach (Shah, 2018) to identify the ground reality of population and land use/ land cover change including other related characteristics and their causes and consequences. More than 50 informal discussions with local people were conducted with semi-structured questionnaires in eleven districts. Maps, photos, and Google Earth images were used during the field study. Mobile app SW Maps were used to collect photos with coordinates.

Land use/ land cover data for 2020 was classified from Landsat8 image using supervised pixel-based image analysis. The level of accuracy was 82% with a kappa statistics value of 0.80. Population density was calculated based on the population density of the Village Development Committee (VDC) in 2001 and 2011 and the wards of the Municipalities in 2021. Maps of the elevation zones, slope gradients, slope aspects, and accessibility maps were also prepared. Based on these factors maps changes in cultivated land and vegetated areas in different categories were identified in GIS software. Tem kilometers grid maps of population density, cultivated land, vegetated area, elevation zones, built-up kernel density, slope gradient, and slope aspects were prepared. Grid-based population changes from 2001 to 2021, were calculated and grid-based changes in cultivated land and vegetated areas (forest, shrubs, and grassland) from 2000 to 2020 were calculated. The Geographically Weighted Regression model was used to identify the strength of the influence of population change on cultivated land and vegetated area changes in the ArcGIS software.

Tobler's first law of geography is a valuable concept in identifying spatial relationships of data (Tobler, 1970) and is incorporated in spatial statistics tools in GIS software. The GWR model helps to predict by fitting a regression equation to every feature of the data set. This model develops a separate equation for each observation incorporating the response and explanatory variables of features falling within the neighborhood of target features (Liu, Lam, Wu, & Lam, 2018). The regression equation is as follows.

$$Y_i = B_0(\mu_i, v_i) + \Sigma_k \beta_k \ (\mu_i, v_i) X_{ik} + \varepsilon_i$$

Where

Y_i is the dependent variable at the location *i*

X_{ik} is the value k^{th} explanatory variable at the location *i*

$B_0(\mu_i, v_i)$ is the intercept parameter at the location *i*

$\beta_k\ (\mu_i, v_i)$ is the local regression coefficient for the k^{th} explanatory variable at the location *i*,

(μ_i, v_i) is the coordinate of the location *i*

ε_i is the random error at location *i*

Free of spatial autocorrelation of standard residual value is the criteria for validation of the GWR model (Fu, Jiang, Zhou, & Zhao, 2014; Propastin, Kappas, & Erasmi, 2008) including condition number less than 30. Thus, this study has adopted all these processes.

Results and Discussion

Population distribution

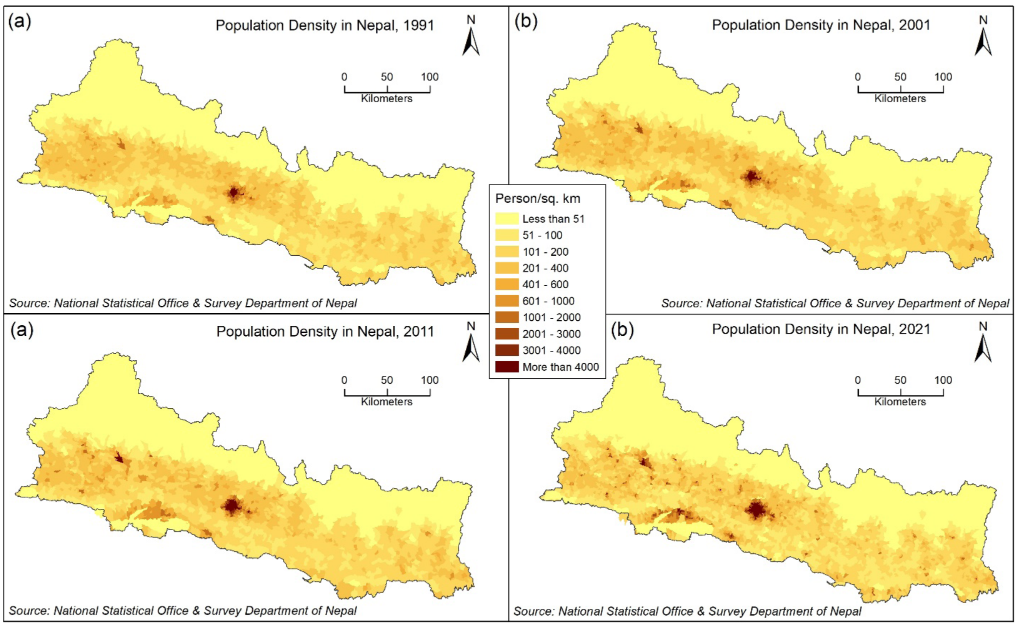

Figure 2: *Population density by VDCs in (a) 1991, (b) 2001, and (c) 2011, and (c) ward in 2021*

Population change

The annual rate of population change in the study area was 2.03 from 1991 to 2001, which is less than the national growth rate of 2.25. Similarly, the growth rate from 2001 to 2011 was 0.92 which is also less than the national figure of 1.35 during this decade. In the last decade, from 2011 to 2021 the annual change rate of the population is 0.62, which is also less than the national figure. The population growth rate in the study is lower than the national population growth because the study area is located in the Mountain and the Hill Region. Large cities like Pokhara and Kathmandu valleys have contributed to population growth in the study area because of the fast urbanization process.

Table 1: Annual change rate of population from 1991 to 2021.

Census periods	Study area	Nepal	Himalaya	Hill Valley	Hill Other	Total
1991-2001	2.03	2.25	1.12	4.56	1.58	2.10
2001-2011	0.92	1.35	-0.61	4.98	-0.03	1.04
2011-2021	0.63	0.92	-0.47	2.04	0.20	0.76

Source: Population census 2001, 2011 and 2021

Although the annual population growth rate in the study area is lower than the national figure, there are significant differences in different geographical locations. The population has been decreasing since 2001, in the Himalayan Region. The population growth rate is lower than the national figure and there is a significant difference in the valley and other areas of the Hill region. The population decreased from 2001 to 2011 outside the Kathmandu Valley and it further reduced from 2011 to 2021. (Table 1).

The population decreases with increasing altitude but significantly increases below 500 meters (Figure 3a). A similar result is also in the slope gradient. The increasing population in a lower slope gradient, the decreasing population at a higher slope gradient, and the constant at a 5°-15° slope gradient (Figure 3b). Most of the lower slope gradient areas are in lower altitude regions. Thus, it is also a similar result of increasing population in lower altitude regions.

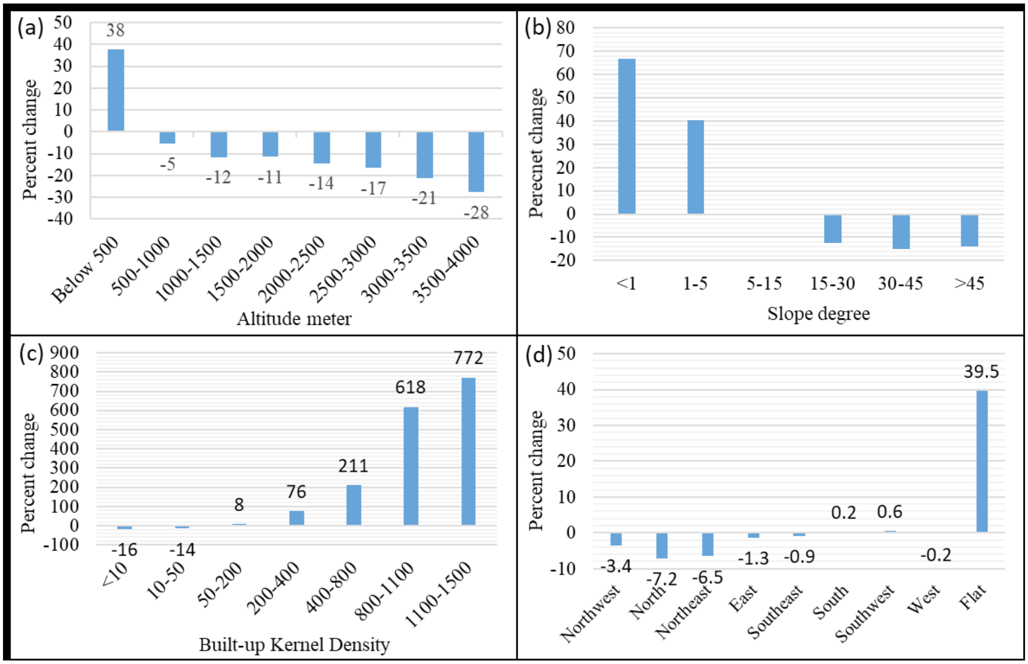

Figure 3: *Population change from 2001 to 2021 (a) by Elevation, (b) by Slope gradient, (c) by distance from settlement, and (d) by slope aspects*

Higher Kernel Density represents the higher concentration of human settlements or near the settlement, and inversely, the lower value represents remoteness from the settlement or dispersed settlements. Figure 3c reveals that there is an increasing human population in urban and large settlement areas, which are mostly in lowland areas. Areas with a Kernel Density value of less than 50 are remote and dispersedly populated with steep slopes and highlands. Flat land has a significant increase in population followed by southwest and south-facing slopes, which receive higher solar radiation compared to the areas with decreasing populations. The north face has the highest percentage of decreasing population followed by the northeast face (Figure 3d). Thus the population change rate is highly variable in the entire study area with the variability of altitude, slope gradient, settlement concentration, and solar radiation.

Distribution of land use/land cover

The general distribution patterns of land use/ land cover are highly variable in the study area, those are parallel to each other from east to west (Figure 3). High-altitude regions in the north, have been occupied by snow, glaciers, and bare rocks. Those areas are not changed by human intervention. Just south of this area, there is a high intensity of forest, shrubs, and grassland areas extending from the east to the west. Most parts of the cultivated lands are in the middle parts, which is extending east-west parallel. The higher concentration of cultivated land in the study areas is in the Mid-Valley between the Mahabharat Range. Then, parallel to the south of the concentration of cultivated land, forest areas are again increasing with some pocket areas of cultivated land in the Inner Tarai Regions of East Nawalparasi, Chitwan, Makawanpur, Sindhuli, and Udaypur districts. There is dense vegetation cover due to sparse human settlement in the Siwalik region in the south.

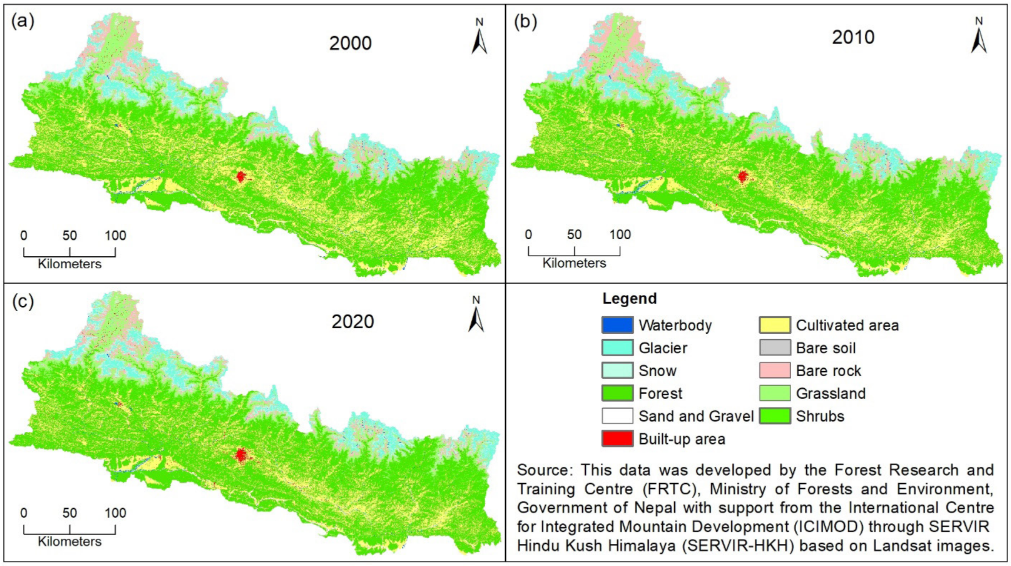

Figure 4: *Land use/ land cover in the study area: (a) land use/ land cover in 2000, (b) land use/ land cover in 2010, and (a) land use/ land cover in 2020.*

Figures 4a, 4b and 4c have revealed that there is a significant decrease in cultivated and an increase in vegetated (forest, shrubs, and grassland) areas in the study areas from 2000 to 2020. Shrinking of cultivated lands continued from 2000 to 2010 and from 2010 to 2020. Conversely, vegetated areas have occupied those cultivated lands because of the conversion of large parts of cultivated lands into forests, shrubs, and grasslands. The increasing built-up area, in the Inner Valleys of the Hill Region, is because of the urbanization in those areas. Population concentration from hill to lower plain, and rural to urban areas, are the major causes behind land use/ land cover changes in the study area.

Figure 5 shows the distribution of cultivated land in different elevation zones, slope gradients, and built-up density in 2001. The highest proportion of cultivated land is between 1000 to 1500 meters altitude. Nearly 93% of total cultivated land is below 2000 meters altitude and most of the remaining parts are below 3000 meters (Figure 5a). More than half (52%) of the cultivated lands have a 15°-30° natural slope surface, and 22% have a 5° to 15° slope (Figure 5b). Nearly 88% of cultivated land is within the built-up kernel density value of more than 10 (Figure 5c) indicating a large part of areas far from the settlements are without cultivated land.

Nearly 85% of the total vegetated areas are below 3000 meters and 91% are below 4000 meters. Of the total vegetated area, 93% is within a 5° to 30° slope (Figure 5d).

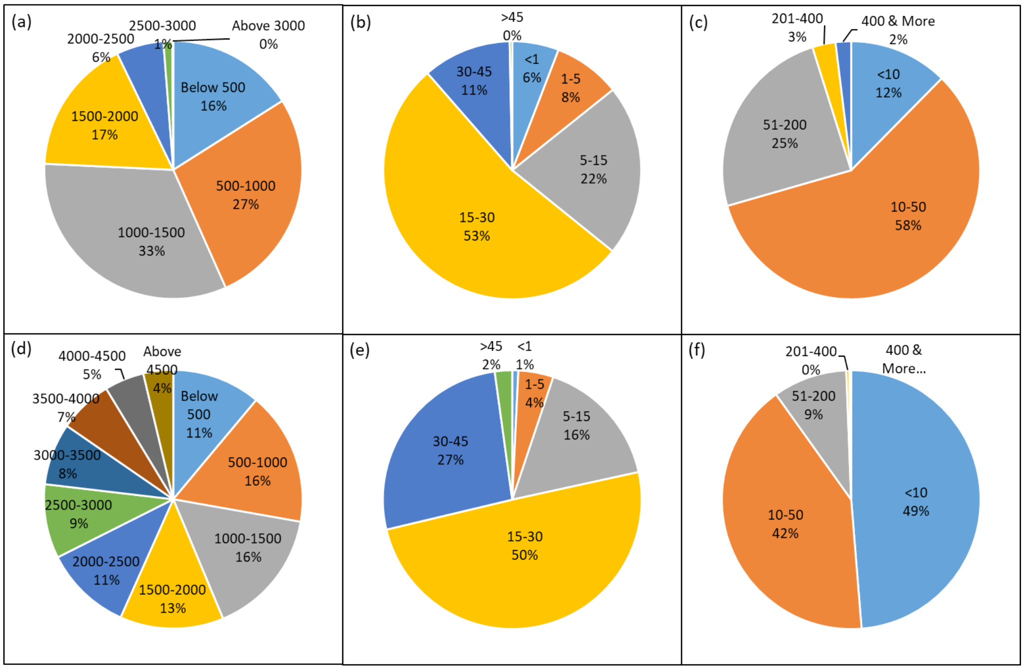

Figure 5: *These diagrams show the proportion of cultivated and vegetated areas (forest, shrubs, grassland) in 2000. Cultivated area proportions by a) elevation zones in meters, b) slope gradient in degrees, and c) built-up Kernel density. Vegetated area proportions by d) elevation zones in meters, e) slope gradient in degree, and f) built-up Kernel density.*

Land use/land cover change

Almost 84% of the study areas have been occupied by cultivated and vegetated (forest, shrubs, and grassland areas. There are no significant changes in these combined areas (cultivated and vegetated areas). However, there are important internal changes in individual land use/ land cover. Forest cover area increased from 45% to nearly 49% during the last two decades from 2000 to 2020. Inversely, cultivated land decreased from almost 22% to 18%. It is a 7.9% increase in forest areas during this period and a decrease in cultivated land is -16.9%. The transition matrix of land use/land cover change analysis revealed that almost out of total cultivated land in 2000, 19% was converted into forest, 2% shrublands, and 1% built-up areas. This proves that significant areas of cultivated land have been converted into vegetated areas during the last two decades. Grassland and shrubs have not changed more (Table 2). The built-up area has significantly increased from 0.22% in 2000 to 0.56% in 2020. The increasing trend of built-up areas is because of urbanization in major cities and emerging new compact settlements in lower plain regions. Built-up area increased by almost 159% during these two decades. The land use/ land cover changes are bare rock and snow, which depend on seasonal changes of snow cover or bare rock without snow and the period of detecting satellite images. Thus, it can not be confirmed whether these changes are real or seasonal variations of image detection or monsoonal variations during the time of detection.

Table 2: Land use/ land cover and their changes from 2000 to 2020.

Land use/ Land cover	2000 Area Km^2	2000 %	2010 Area Km^2	2010 %	2020 Area Km^2	2020 %	Percent change (2000- 2020)
Forest	30415	45.1	31964	47.4	32804	48.6	7.9
Cultivated area	14786	21.9	13621	20.2	12294	18.2	-16.9
Grassland	8215	12.2	8495	12.6	8458	12.5	3.0
Shrubs	3036	4.5	2806	4.2	2987	4.4	-1.6
Bare rock	4165	6.2	4846	7.2	3176	4.7	-23.7
Glacier	3270	4.9	3270	4.9	3266	4.8	-0.1
Built-up	147	0.2	180	0.3	380	0.6	158.5
Snow	2652	3.9	1582	2.3	3309	4.9	24.8
Sand and Gravel	519	0.8	439	0.7	471	0.7	-9.2
Waterbody	268	0.4	269	0.4	296	0.4	10.4
Bare soil	0.1	0.0	0.1	0.0	33	0.1	0.0
Total	67473	100	67473	100	67473	100	

Source: Forest Research and Training Centre (FRTC), GON, ICIMOD, and Landsat8 images

Changes in cultivated and vegetated areas

Figure 6 shows a significant variation in cultivated and vegetation-covered areas in different elevation zones. The cultivated land has decreased at the highest percent at 1500 to 2000 meters. There is a significantly higher decrease in cultivated areas from 1000 to 2500 meters in the middle and medium rates of changes below 1000 meters and lowest changes above 2500 (Figure 6a). There is a significant increase in vegetation cover (forest, shrubs, and grassland) in the same altitudinal region, where cultivated lands have significantly decreased because of the conversion of cultivated land into vegetated areas. Vegetated areas have increased from 3500 to 4000 meters (Figure 6b), which requires further verification.

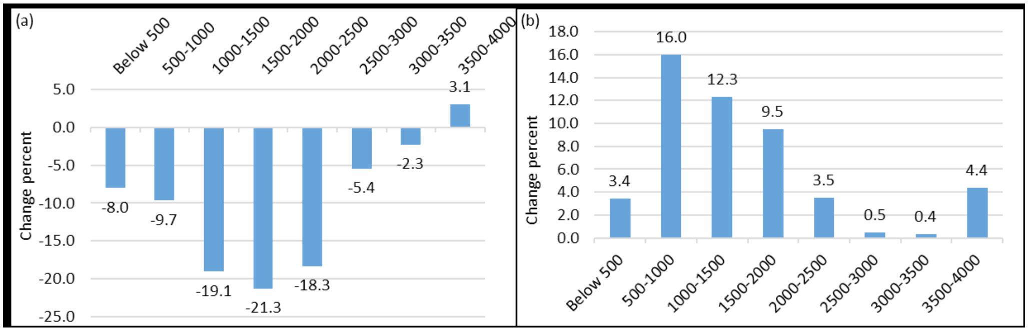

Figure 6: *Cultivated and vegetated area changes from 2000 to 2020 by altitude (a) percentage changes in cultivated area (b) percentage changes in vegetated area*

Figure 7 shows the significant decrease in cultivated land at steeper slope gradient areas from 15 to 45 degrees. These areas have steeper slope gradients and marginal land and are less suitable for cultivation rather than a lower slope gradient. More cultivated lands have been abandoned in these areas. The highest slope gradients have also been less abandoned, which might be due to the technical limitations of data (Figure 7a). Inversely, the highest percentage of vegetated areas have changed at the lowest slope gradient but have a lower proportion of the total. There is a clear sign of conversion of cultivated land, into vegetated areas at 15° to 45° slope gradients having a higher proportion of increase in vegetation-covered areas. (Figure 7b).

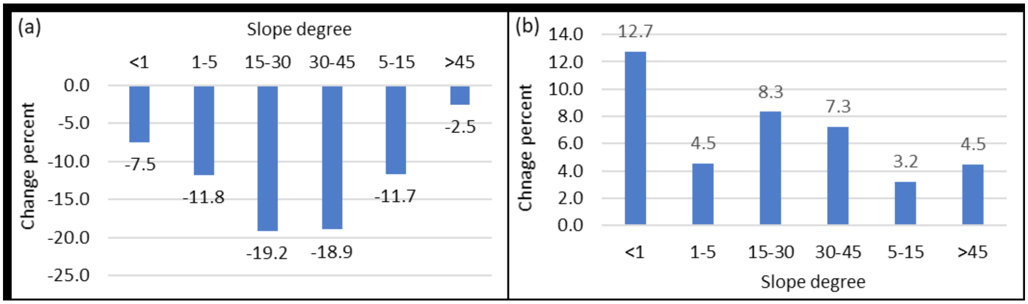

Figure 7: *Cultivated and vegetated area changes from 2000 to 2020 by slope gradient (a) percentage changes in cultivated area (b) percentage changes in a vegetated area*

Built-up kernel density is the location of settlement and its intensity. The higher the value of Kernel density, the higher the intensity of the settlement or the proximity to the settlement. Inversely, the lower value represents the remoteness of the settlement, which might be sparsely distributed or far from the settlement. The negative relation between built-up kernel density and changes in cultivated areas is because most of the cultivated lands are nearer the distance from the settlement (Figure 8a). Thus, there is a direct impact of settlement on cultivated land change than far away distance. Inversely, the changes in vegetated areas have a positive relation with kernel density values because vegetated areas increase nearby settlements because of the abandonment of the existing more cultivated land nearby settlement than far away from the settlement (Figure 8b).

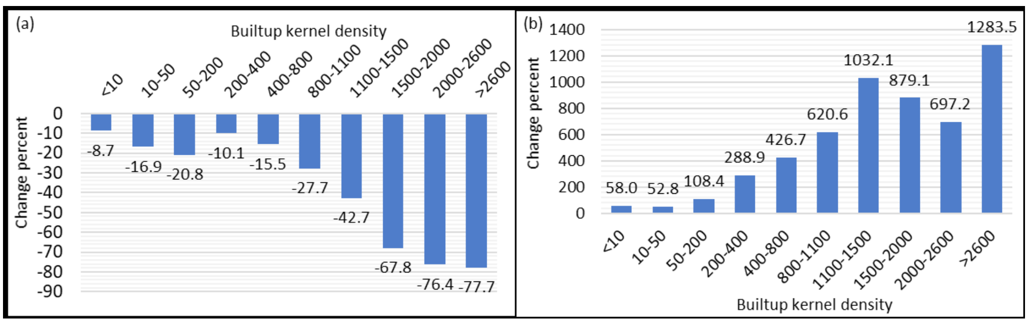

Figure 8: *Cultivated and vegetated area changes from 2000 to 2020 by built-up kernel density (a) Percentage changes in cultivated area (b) Percentage changes in a vegetated area*

Diagrams show the significant impact of slope aspects on changes in cultivated land and vegetated areas (Figures 9a and 9b). The highest rate of increase in cultivated land is in the north face followed by the northeast. A large part of these areas has already been covered by natural vegetation. Thus, the percentage increase in vegetation area is lower even though most of the cultivated areas in this region converted into vegetated areas.

The highest percentage increase in vegetated areas in flat, east, and south-facing slopes is because the lower portion of areas were covered by natural vegetation in the past, and a small increase in vegetation areas shows a higher percentage.

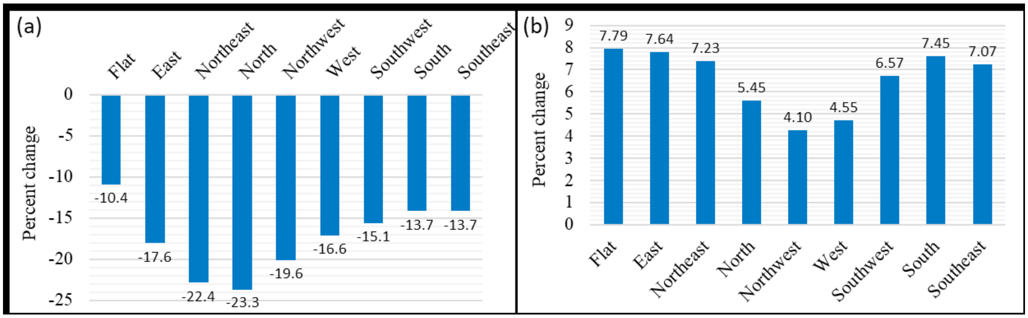

Figure 9: *Cultivated and vegetated area changes from 2000 to 2020 by slope aspects (a) Percentage changes in cultivated area (b) Percentage changes in a vegetated area*

Influence of population change on cultivated land vegetation areas

The population distribution of Nepal is characterized by a clustered pattern in limited lowland and urban areas and a large part of marginal hill slope areas are losing population. As a result of the decreasing population, cultivated land has been converted into vegetated areas (forest, shrubs, and grassland areas). The intensity of population decrease is in high altitudes, steep slopes, remote areas, and areas having lower solar radiation, i.e. north and west-facing slopes, where the conversion of cultivated land into vegetated areas is most intense.

Due to the complexity of spatial patterns of population changes, cultivated land, and vegetation cover, it is difficult to get a clear picture of detailed spatial relationships of change in cultivated land, and vegetation cover with population change. However, the Geographically Weighted Regression model reveals the significant impact of population change on changing cultivated land and vegetated areas. The coefficient of the determinant (R^2) value 0.60 of the GWR model, where the explanatory variable of cultivated land change was population change which reveals that 60% of changes on cultivated land have been determined by population change and remoteness from the settlement. The Z-score of Moran's I value less than 1.96 has validated the model results at a 5% significance level. Accordingly, 50% of changes in vegetated areas were determined by population change, which was also validated at a 5% significance level. This result reveals the significant impact of population changes on cultivated land and vegetated areas.

Discussion

Nepalese highlands were already overpopulated in the past and were more than the carrying capacity of marginal highlands. Thus, marginal land was under cultivation to feed the increasing population and natural vegetation was also overused because of increasing livestock and human population (P. Nepal, 1997). Thus, loss of productivity and land degradation further aggravated the livelihood of the mountain people. In the past out-migration of mountain people to foreign countries was mostly in India and internal migration to the Tarai region. It was mostly looking for a better livelihood than in the mountains. The large stream flow of migration to Tarai was after the malaria eradication in Tarai (Ojha, 1983) and the family of Gurkha soldiers after World War I (Kansakar, 1984; Libois, Muralidharan, Singh, & Eynde, 2020; R. M. Nepal, 2020). The Maoist movement further aggravated historical migration from the Hill and Mountain areas (Adhikari, 2013; Bhattarai, 2004). However, the population of Nepal was continuously increasing until 2001. The highest rate of population increase was in the census years from 1991 to 2001, leading to the maximum expansion of cultivated land and the degradation of forests.

Foreign Employment Act 1985 in Nepal (HMG, 1985) promoted foreign labor migration in different countries from Nepal. The new opportunity for unskilled labor of rural mountain people became an alternative to mountain agricultural labor. Slowly, the foreign labor migration increased and helped improve the household income of migrated families. Its multiple effects on lifestyle and child education increased rural families to city areas for better education for their children and better livelihood (Kharel & Kharel, 2020). Thus, internal migration from rural to urban and hill slopes to Tarai Plain dramatically increased in the last decades resulting in the dispersed population in the Mountain and Hill areas concentrated in the limited plain and urban areas.

The outmigration of rural farmers to foreign countries and city areas has created an agricultural labor shortage in rural hill slope areas. Thus, large parts of cultivated land have been abandoned in the Mountain and Hill slope areas. It is clear that agricultural land abandonment is the result of the outmigration of the population but the spatial pattern abandonment of agricultural land is highly variable based on altitude, slope, gradient, remoteness, and solar radiation. There is clear evidence that marginal land was extended in the last period and abandoned at first. However, in the recent past, some irrigated fertile land has also been abandoned which does not apply to the abandonment of only marginal land.

Various spatial scales of data sources have made it difficult to apply spatial statistical tools. However, ten grid data have given the direct relationship between cultivated land and vegetation areas changes with population changes with altitude and remoteness from the settlement. The GWR model results revealed the importance of the application identifying the dependency analysis of spatial data.

Conclusion

The population growth rate is lower in the Mountain and Hill regions than the national average in all census years from 1991 to 2021. Although the annual growth rate of this region is positive, most districts have a negative population in the study area. A positive growth rate is in Kathmandu and Pokhara valley including southern districts, which have inner valleys. The spatial dynamics of the population seem very high, the evenly distributed population in the entire Mountain and Hill areas has concentrated in the limited parts of lower plain areas and urban places in recent decades because of the highland-to-lowland and rural-to-urban migration. International migration is not a new experience for the Hill and Mountain people but mass-level international labor migration in recent decades has drastically changed the socio-economic and demographic characteristics. Because of the excessive lack of agricultural labor, mass-level agricultural land abandonment is everywhere in the entire study region, and most excessive abandonment of agricultural land is in high altitudes, steeper slopes, and remote areas from the village. Land abandonment is firstly the marginal hill slope, and, then, better land for cultivation. Thus, agricultural land abandonment should not be considered in a holistic approach rather than spatial diversity of the local environment, and geographical marginality.

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