



Original article

Urbanization and land use change: A study in Vietnam

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ABSTRACT

Land-use change is a human process aimed at transforming the natural landscape and emphasizing the role and function of land for socio-economic activities. However, we do not know how the land transition in Vietnam has been proceeding recently. Thus, this article aims to examine the current urbanization process of land conversion in Vietnam. To explore the current situation and recent change of land use, the author analyzed standardized databases and maps from reports of the Ministry of Natural Resources and Environment of Vietnam (MoNRE), the General Statistics Office of Vietnam (GSO), and the land cover map of Japan Aerospace Exploration Agency (JAXA). Research results show that the land transition in Vietnam has been similar to the world trend. The highest land conversion rate occurs in the North Central and Central Coast regions, but conversion of agricultural land for urbanization is mainly in the Red River Delta and Southeast. The study also noted some negative socio-economic impacts of land conversion on the lives of suburban residents.

KEY WORDS: suburbanization, industrialization, land conversion, urban sprawl, land transition

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1. Introduction

According to the literature, land use is a land-based feature of what can be built and what the land can be used for. It identifies what types of communities, environments, or settlements can be used for a particular kind of ground (ABARES, 2020). Land use is also a manifestation of various human activities to exploit the landscape. Therefore, land-use change is seen as a human activity to change the natural landscape and emphasize the role and function of land for socio-economic activities (PAUL & RASHID, 2017). It is a complex process arising from much change to land conversion. Land-use change depends on the plans and policies of each government to pursue that country's development path. One of the development paths chosen by most countries, especially developing countries, is urbanization and industrialization (TUROK & McGRANAHAN, 2013; SUGIHARA, 2019).

Urbanization is a socio-economic process manifested by a rapid increase in the number and size of urban population characteristics. It is also defined as urban expansion, as the process of concentrating the population into cities, or as the rapid formation of urban population points based on production and life development (TUAN, 2021). Therefore, the concept of urbanization is very diverse because urbanization contains many different phenomena and manifestations in the development process. The various definitions make it difficult to compare the degree of urbanization in different countries. The government also tends to periodically re-classify rural and peri-urban areas into urban areas, allowing the urban population to grow with just a single stroke. This situation happens due to a change in rural areas that began to take on urban characteristics (PATEMAN, 2011). The same happens when agricultural land is converted into industrial and residential land and

then into urban land outside the existing urban boundaries.

Scientists also examine and observe urbanization from many different angles (LLOYD, 2012; HOFMANN & WAN, 2013; ASEAN, 2018). From an economic perspective, urbanization is a companion to industrialization. The urbanization process is a profound change in the structures of production, occupation, organization of social activities, and architectural construction space from rural to urban. From an environmental perspective, urban expansion has thoroughly exploited land resources. It reduces the area of trees and water. Since then, the phenomenon of inundation has taken place regularly in many big cities. Densely populated areas and development also increase the demand for water for domestic use by people and manufacturing industries. This demand is increasingly high, causing water degradation. From a social perspective, expanding urban space leads to the appropriation of agricultural land, affecting national food security and the lives suburban people. Therefore, this article examines agrarian land conversion for urbanization and industrialization in Vietnam and the effects of agricultural land conversion on human life factors in peri-urban areas. The main research questions for this article were:

- What is the trend of Vietnam's land conversion?
- Which regions are the focus of land conversion in Vietnam in the last 15 years?
- How are the impacts of the conversion of agricultural land affecting the lives of people in suburban areas?

Although the study's focus is on monitoring land conversion in Vietnam by urban space, it also attempts to overview the current state of land conversion on a global scale. The remainder of the article is assembled according to the following structure. First, the author reviews the literature to highlight the current state of land conversion around the world. Then, the author discusses the data collection method and how to divide the study country's socio-economic region. Next are the main findings of the study and discussion of the urbanization process in Vietnam. Finally, the author answers the research questions in the conclusions of the article.

2. Land use change in the World: a literature review

Land area of the world is estimated at 13 billion hectares, of which agricultural land accounts for 37.6%, equivalent to 4.9 billion hectares (RITCHIE & ROSER, 2019). Farming land accounts for about 10% of the world's land. The area of this land

type increased by 150 million hectares (about 11%) between 1961 and 2007 (BRINGEZU ET AL., 2014). The trend in the growth of cultivated land area is also different depending on the region. North America and Europe showed a decrease; growth was seen in Asia, Africa, and South America. A study of global land change 1982–2016 found a contradictory finding to most of the reduced forest cover claims. Tree coverage increased by 7.1%, equivalent to 2.24 million km² compared to 1982 (SONG ET AL., 2018). The increase in forest land area has been a critical factor in expanding agricultural land over the past 40 to 50 years, especially in the Tropics (GIBBS ET AL., 2010). However, LAMBIN ET AL. (2003) countered this argument when they observed that deforestation occurs more frequently in the Tropics. Temperate zones have better improvements in afforestation compared with the Tropics. The area of bare land decreased by 3.1% (1.16 million km²) and was mainly reduced due to the loss of agricultural land in Asia (SONG ET AL., 2018).

Built-up land occupied a relatively small area of about 1–3% in 2005, but it is expected to increase to about 260 to 420 million hectares (about 4–5%) by 2050 (ELECTRIS ET AL., 2009). As for urban land, this area could expand from 40 to 143 million hectares in about 45 years, from 2007 to 2050 (SETO ET AL., 2010). The annual increase in built-up land in developing countries is about 3.6%, while 2.9% is the average increase in industrial countries. The Pacific and Southeast Asia regions have witnessed considerable land conversion rates from 1990 to 2000, at 7.2% and 6.4%, respectively (ANGEL ET AL., 2005). This additional area has been converted from about 80% of agricultural land (HOLMGREN, 2006). Although the trend of land conversion from agriculture to non-agriculture is large, the global agricultural land area is estimated to increase by 10% by 2030 (OECD, 2008). The Netherlands Environmental Assessment indicates a similar calculation result, and the expansion will be concentrated primarily in Africa, Latin America, and Southeast Asia (VAN VUUREN & FABER, 2009).

Along with labour and capital, the land is a crucial factor for production in classical economics, and land use is considered the agricultural economy's backbone (WU, 2008). The difference in the extent, intensity, and trends of agricultural land use conversion varies between underdeveloped, developing, and developed countries. The loss of agricultural land increased most strongly in developing countries, with the lowest rates seen for developed countries (AZADI ET AL., 2011). The urbanization process is the reason for this difference. In developing countries, where urbanization is increasingly higher, the developed countries have

successfully managed urbanization many years ago. Therefore, it can be said that the conversion of agricultural land is considered to be the result of a combination of population growth and economic development (HAARSMAN & QIU, 2017).

Although land-use conversion is essential to promote social progress and economic development, it also has many undesirable effects. These impacts are divided into three main categories: displacement and loss of housing, loss of livelihoods, and environmental pollution thus degradation with (MENON, 2018). These effects seem to be individual, but they are closely related. Land loss is essentially a loss of livelihood, especially for those who rely on primary natural resources. After land conversion, people are either relocated to a new area or their chosen location. Nevertheless, these resettlement areas are usually close to industrial zones or developing areas facing daily pollution. Pollution leads to a degraded environment, and thus a loss of income for natural resource-dependent communities (MENON, 2018). Land conversion has had economic implications for some areas of the United States. The short-term trend of losing revenue can easily exceed \$ 30 million per year (SCHULTINK, 2009). On the other side of the globe, the conversion of land from agriculture to industry leads to the loss of jobs and income in Vietnamese households (NGUYEN ET AL., 2019; NGUYEN, 2021). A negative effect of this problem is also seen in

Indonesia, where a reduction in arable land is associated with a decrease in income (NURPITA ET AL., 2017). In Sub-Saharan Africa, people still prefer farming on their land rather than entering urban residential land markets (PICARD & SELOD., 2020).

3. Methodology

3.1. Research area

Vietnam is the centre of Southeast Asia and is located on the eastern edge of the Indo-Chinese peninsula. Vietnam's land border is 4,639 km long, bordering the South China Sea (in Vietnam known as the East Sea) and the Gulf of Thailand. In the north, Vietnam borders China; and in the west Laos and Cambodia. The length of the country from north to south is 1,650 km, while the narrowest position, east to west, is nearly 50 km. It is a tropical country, with most of the area being hilly (accounting for half of the territory), and where the terrain is mainly low mountains. With a coastline of 3,260 km, Vietnam is among those countries with a high coastline index compared with its territorial area. Accordingly, on average, there is 1 km of coastline for every 10 km² of land, six times higher than the world average. With an area stretching from north to south, Vietnam's zoning also goes through different historical periods.

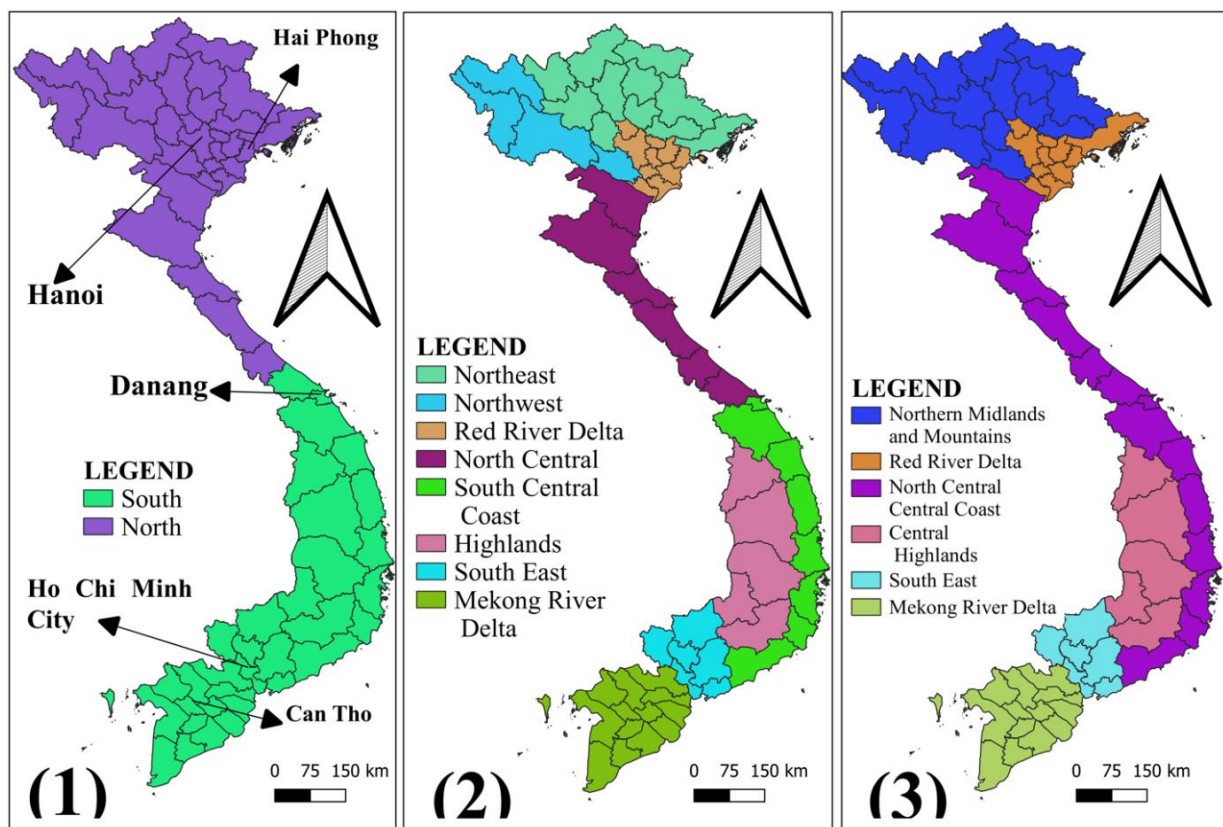


Fig. 1. Land use zoning in Vietnam (Source: author's compilation): (1) – from 1954 to 1975; (2) – before land law of 2013; (3) – current

During the French colonial period (1884–1945), Vietnam was divided into three separate regions with different policies: Tokin (autonomous), Annam (French protectorate), and Cochinchina (French colony), which are the current Northern, Middle, and Southern regions. By the time of the resistance war against the US (1954–1975), the country was temporarily divided into two regions (North and South). After unification of the two areas, having undergone many different divisions of its regions, Vietnam's territory was divided into six socio-economic regions (Fig. 1). These divisions ensure uniformity in terms of natural conditions and socio-economic linkages among localities in each region. However, intra-regional connections are still weak, and provinces in the region lack interaction. This problem leads to difficulties in the planning and economic development of its regions.

3.2. Data source

As this study's primary purpose was to evaluate land-use change, the author had to combine many different methods and data sources for comparison. First, raw land cover data were collected from the JAXA. These maps were computed in 2007 for all three regions, 2015 for the North (including Red River Delta and Northern Midland and Mountains), and 2017 for the Central and South regions (the remaining regions). While the North's area of spatial resolution is 15 m, this figure is 10 m for the other two regions. Overall accuracy is above 90% (kappa factor 0.9). This map data has a higher spatial accuracy and resolution than other overlay maps in Vietnam, ensuring user reliability

(DUONG ET AL., 2018). The data used in this study was collected from the annual land area statistics published by the MoNRE from 2011 to 2018. The statistics of previous years are synthesized from General Department of Land, and branches nationwide. QGIS 3.10 software was also used to create maps.

4. Results - land use change in Vietnam

Due to Vietnam's complicated location and topography, its land resources are very diverse and differentiated from plains to high mountains, from north to south, and from east to west. Land in this country can be classified into 13 main land groups and 31 categories. Almost all of the population lives in rural areas and works in the agricultural sector, so one-third of the land is used for agriculture (FAO 2019). According to land use purposes, the land is divided into three main land groups: non-agricultural, agricultural, and unused land. Agricultural land is divided into ground for production agriculture, forestry land, aquaculture land, salt-making, and other agriculture. Land for production agriculture includes annual cropland (paddy land and other short-term cropland) and perennial cropland. The forest land is divided into protection, production, and special-use forest land. Fig. 2 shows that the agricultural land area increased steadily during 1995–2018 from 18.3 to 27.3 million ha. The most significant difference is that unused land plummeted from 11.7 to 2.1 million ha in the same period. This shows that the exploitation and use of land resources for different purposes have been promoted.

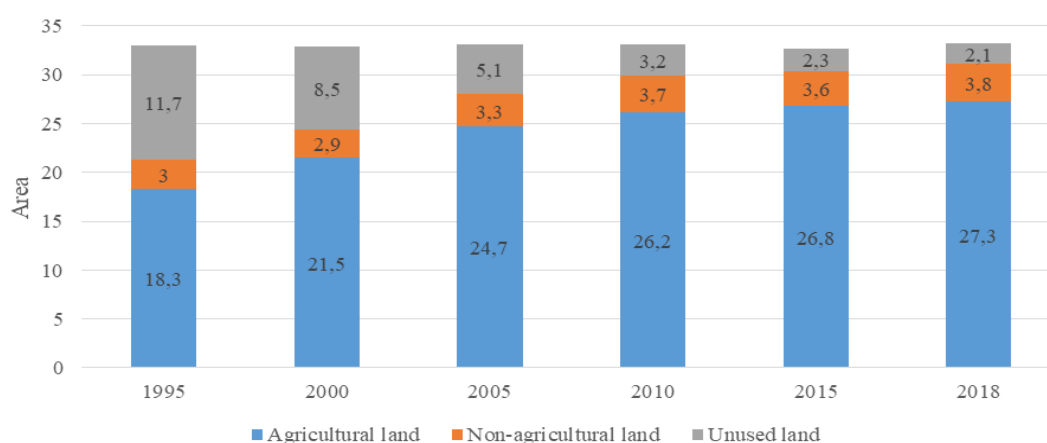


Fig. 2. Changes in the area of land uses in the period 1995–2018 (Unit: Million ha; Source: GSO Vietnam)

Moreover, three-quarters of Vietnam's area is mountainous and midlands, accounting for about 25 million hectares. The area of alluvial land is low, only about 3.4 million ha (accounting for more than 10% of the country's natural area). Today,

the types of land used in agriculture are mainly alluvial soils, grey soils, and acidic soils (MOARD, 2008). However, with the rapid trend in population growth, the demand for land exploitation and use will continue to be a worrying issue. Furthermore,

industrialization and modernization of the country also put much pressure on the land. The planning of many provinces and cities reveals the limitations and irrationalities in allocating land funds to sectors (VINH, 2020). The current common situation is the conversion of land use purposes. The ratio of non-agricultural land to agricultural land tended to increase between 2006 and 2013. It then declined over the next few year before showing signs of an increase as before (Fig. 3). It is forecasted that by 2030, the area of paddy land will be reduced to 3.8 million ha, and the need to convert paddy land for other purposes will continue to increase by about 500,000 ha (MONRE, 2015). This growth puts tremendous pressure on land resources and the environment, primarily on agricultural land.

Land conversion has different effects on the types of land use. Paddy land in Vietnam is concentrated in two main areas, the Mekong Delta and Red River Delta (Fig. 4). In the 2007–2017 period, the area of paddy land area has decreased by 2,572 km², equivalent to the

disappearance of more than 7% of this land type (Table 1) during which half of the rice land area was converted to built-up land. The total area of agricultural land (total area of the categories: rice; crops; orchards; grassland; forest; and mangrove) converted to built-up land is estimated at 9.3 thousand km² (this figure was calculated by the author through the change in the number of pixels of the land cover map). This transformation is also mainly concentrated in the Southeast and Red River Delta regions, which contain the two largest cities, Ho Chi Minh City and Hanoi. This change is also verified by statistics on population density in Vietnam in 2019. Accordingly, the Red River Delta and Southeast are the two regions with the country's highest population density, 1,060 people/km², and 757 people/km² respectively. These two areas are also the most attractive destinations for migrants. Up to 1.3 million people have migrated to the Southeast, accounting for more than two-thirds of the total number of inter-regional migrants nationwide (ASEAN VIETNAM, 2020).

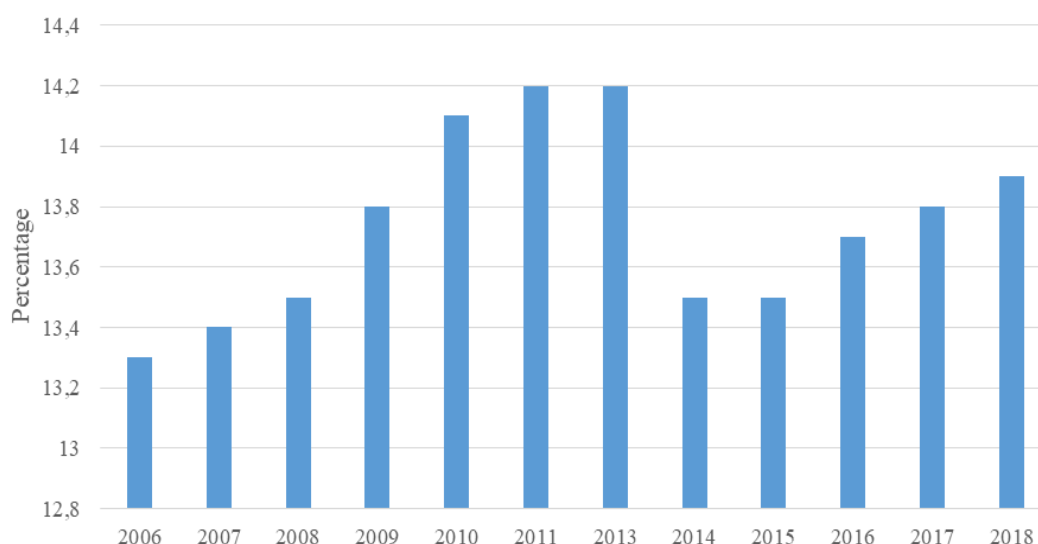


Fig. 3. Ratio of non-agricultural land to agricultural land (Source: GSO Vietnam)

Table 1. Land cover change in Vietnam by main categories, 2007–2017 (Source: Author's calculation from the pixel change of the GIS land cover maps)

No	Categories	2007 (km ²)	2017 (km ²)	Change (km ²)	Change (%)
1	Unclassified	14,827.6	13,926.6	-901	-6.1
2	Water	12,014.4	16,831.3	4,816.9	40.1
3	Urban	17,310.2	13,596.9	-3,713.3	-21.5
4	Rice	35,133.7	32,561.1	-2,572.6	-7.3
5	Crops	32,376.7	36,492.6	4,115.9	12.7
6	Grassland	28,599.2	34,487.5	5,888.3	20.6
7	Orchards	25,940.6	25,236.0	-704.6	-2.7
8	Bareland	25,013.6	17,398.6	-7,615	-30.4
9	Forest	127,820.7	135,925.3	8,104.6	6.3
10	Mangrove	8,570.3	4,727.1	-3,843.2	-44.8
11	No data	5.7	61.8	56.1	984

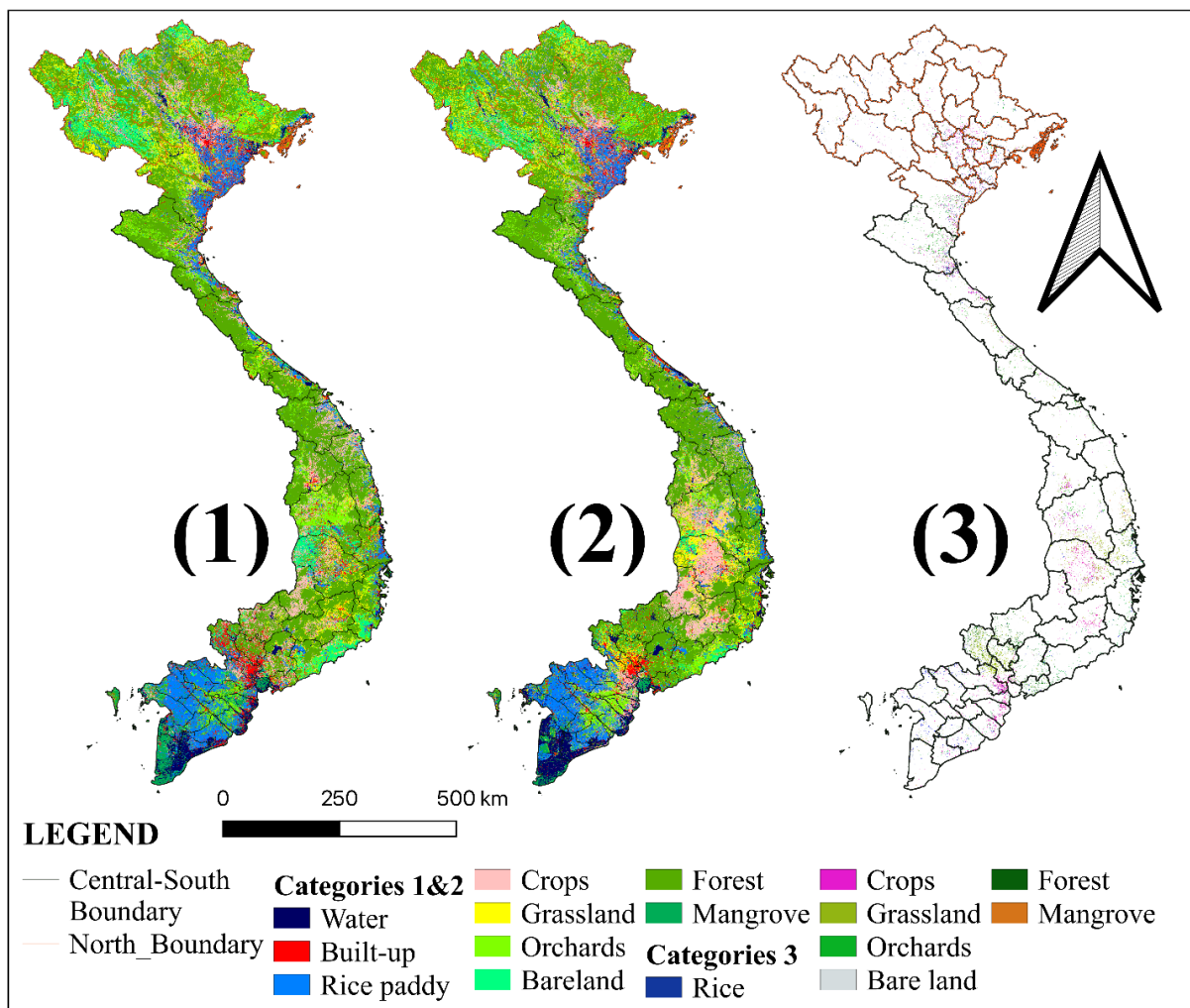


Fig. 4. Land Cover and Land Cover Change in Vietnam (2007, 2015 and 2017) (Source: Author's complication from JAXA):
 (1) – Land cover map of 2007; (2) – Land cover map of 2015 in the North and 2017 in the Central and South; (3) – Map of land cover change from agricultural categories to built-up land according to spatial distribution

Furthermore, these changes tend to concentrate in the east, which is adjacent to the East Sea. This development trend takes advantage of a long coastline. It helps to move to localities more convenient to trade, both domestically, and internationally. The expansion of urban centres in the east is also aimed at developing coastal tourist destinations. The number of coastal tourists annually accounts for 70–80% of the number of tourists (WORLD BANK, 2019). Income from this type of tourism also accounts for a high proportion of the country's tourism income. This figure also shows the vital role of coastal tourism in the economic development of the country.

There is a mismatch when comparing data published by the GSO with calculations based on land cover maps. While non-agricultural land is reported to have increased, the area of this GIS layer showed a 21.5% decrease when verified by the land cover map. Published figures are those used in the planning scheme for projects. However, slow progress, inefficiency, misuse, and waste still occur in many projects. In 2019, the progress of

1,878 projects were delayed. Land acquisition and land clearance were the main reasons for this delay (1,267 projects). 73,992.96 ha of land was found to be violated and delayed in project construction. In particular, construction in industrial zones is rampant, but the occupancy rate remains low, leading to a decrease in land-use efficiency. By 2019, Vietnam had established 373 industrial zones with a total area of 114.4 thousand hectares, accounting for 56.9% of the total planned land area. Of these, 280 Industrial Zones were in operation, and 93 are still in the construction and infrastructure stage. The occupancy rate in industrial zones is low, at about 57.4%. Some localities also have lower occupancy rates than the national average (Data collected from the reports of MoNRE). These figures indicate a waste of land resources.

According to the statistics, the evolution of land use purpose is occurring in all localities (Fig. 5). The current popularity land use change is converting forestry land to agricultural production land; converting agrarian land to developing urban areas and industrial zones; converting mangroves

to aquaculture, and converting barren land and hills to afforestation. The North Central and Central Coast regions have witnessed the most remarkable change in all three land use groups. The localities with increasing agricultural land area have mainly converted from unused land. The amount of agricultural land lost was concentrated at the north and south poles of the country. Surprisingly, the non-agricultural land area declined in two highly developed regions of

Vietnam, in the Southeast and the Red River Delta. The Mekong Delta region has shown a decrease in both agricultural and non-agricultural land in most provinces. The reason for this is that this area loses about 500 ha of land each year and erosion rates of up to 30–40 m/year occur in many places along the coast and river banks. This region currently has 265 riverbank and coastal erosion points with a total length of 450 km (MoNRE, 2015).

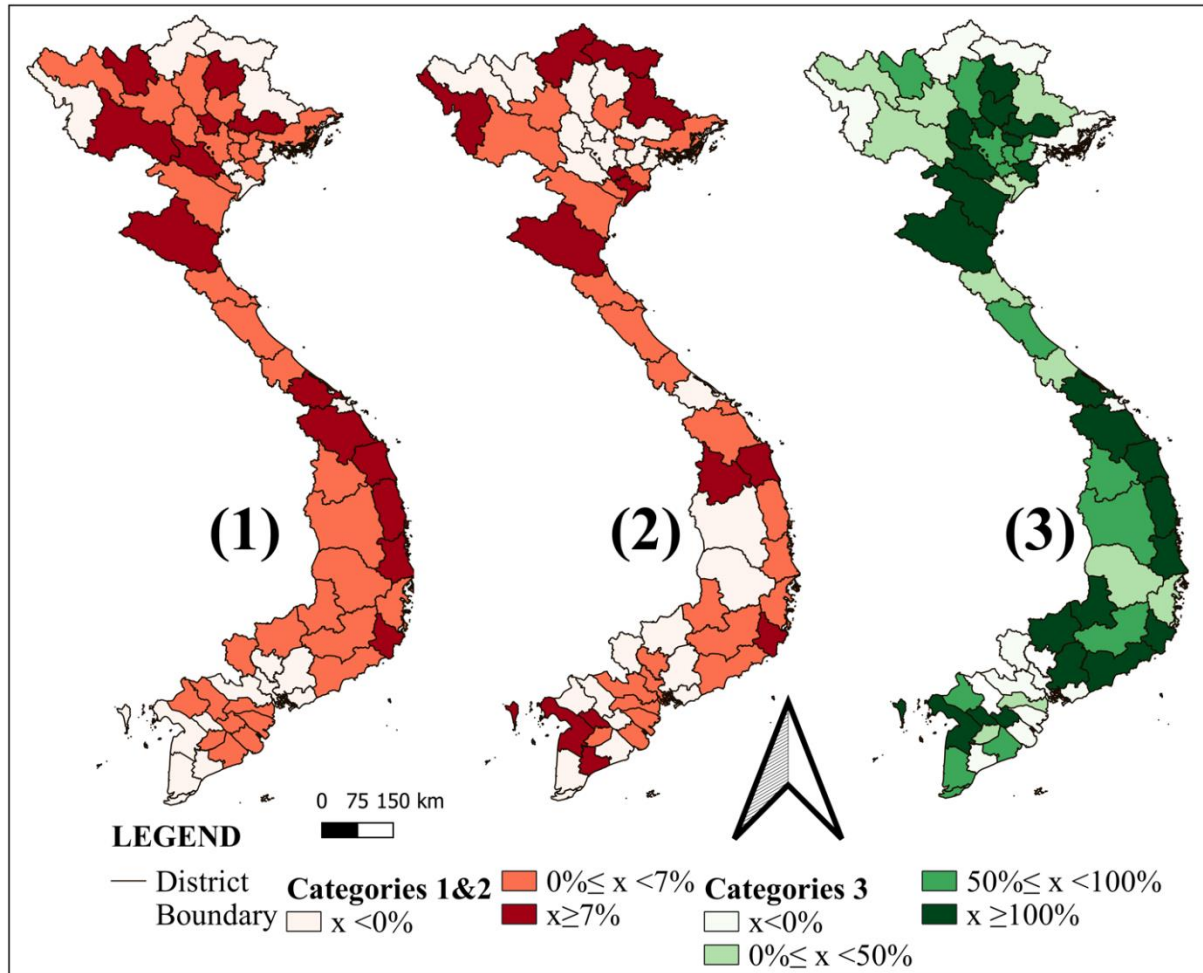


Fig. 5. Changes in land use area by provinces using statistics from the MoNRE (2011–2018) (Source: Author's complication from MoNRE): (1) – Agricultural land growth; (2) – Non-agricultural land growth; (3): Unused land decrease

5. Discussion

This study's main aim was to explore land use pattern changes, emphasizing the conversion of agricultural land to built-up land (urban land) in Vietnam. Moreover, rapid urbanization has been a significant highlight in the development process of Vietnam in recent decades. In 1990, the number of urban areas in Vietnam was about 500 and the urbanization rate was about 17%. By 2019, the number of urban areas in Vietnam had increased to 846 (MoNRE, 2019). In 1986, Vietnam's urban population was under 13 million, but by 2019, that number was 37 million (WORLD BANK, 2020a).

Urban economic growth is twice the national average, contributing over half of the gross domestic product (VAN TROTSSENBURG, 2015). However, the urbanization process in Vietnam is not happening evenly. The number of urban areas in the Northern Midlands and Mountains is the highest, but the Southeast has the most concentrated urban population. Vietnam's process of urban development and distribution is influenced by the country's socio-economic development and industrialization. The development of new urban areas is accompanied by the development of industrial centres. The five cities directly under the Central Government, Da Nang, Can Tho, Hanoi, Hai Phong, and Ho Chi Minh

City, play a crucial role in distributing the population structure of each geographic - economic region. Generally, urban residents in these five cities account for nearly 50% of the country's total urban population (MONRE, 2020).

According to the objective rule, urbanization must originate from non-agricultural economic development such as industry, commerce, and services (SATTERTHWAITE ET AL., 2010) to replace the agricultural economy gradually. However, unlike other countries in the region and the world, urbanization in Vietnam is characterized by rural urbanization. That is, it transforms agricultural villages and communities into urban districts and wards. Urban developments and growth in Vietnam are late and slower than in some regional countries (WORLD BANK, 2011). Urban development is not uniform across the regions, and there are many differences between areas in geographical features. For example, deltas and coastal regions develop faster than mountainous and upland areas (as shown in Fig. 4). In other words, urbanization in Vietnam is still subjective. Provinces want to increase the urban population to quickly upgrade urban areas, expanding their urban areas by merging villages and communities with 100% agricultural production into urban areas to form new wards/districts. This reality is why most inner-city areas still have agricultural land or are left unused for urban development. In urban land nationwide, agricultural and unused land accounts for 1,036.56 ha, accounting for 61% of urban land. Meanwhile, only 605.87 thousand hectares of non-agricultural land (including land for public purposes, production and business, offices, other specialized lands, and the remaining land) account for 37 % of urban land.

The trend of changing land use purposes in urban areas is to reduce agricultural land, unused land and increase non-agricultural land. Growth in the non-agricultural land area is mainly due to expanding urban land, land for industrial zones, and construction activities. The size of urban land increased due to the conversion from agricultural land, of which rice land was the primary type. In 2011–2015, following the data from MONRE, Vietnam converted 89.4 thousand hectares of rice land to urban land. In a broader view for the 2007–2017 period, the converted area is estimated at 125.9 thousand ha (data calculated by the author through the land cover maps). This transition is mainly concentrated in three regions: the Southeast, the Red River Delta, and the Mekong River Delta.

Conversion of agricultural land for investment in urban, industrial, and economic zone projects occurs in major urban areas like Binh Duong, Ho

Chi Minh City, Hai Phong, and Hanoi. This purpose-shifting activity has made a positive contribution to socio-economic development. The development of Industrial and Economic Zones has attracted domestic and foreign investment, including large and leading corporations globally. As a consequence, Industrial and Economic Zones contribute to synchronize and modernize the system of urban and rural infrastructure. However, many industrial zone projects have been affecting the environment, making agricultural land divided. These projects also cause agricultural land abandonment and land resource depletion due to many “suspended planning” projects. Until 2019, Vietnam had about 11 million hectares of land that were fallow and in danger of degradation. The quality of agricultural land decreases, reducing productivity and affecting rural development. This leads to the risk of national food insecurity and ecosystem imbalances.

The current status of such land conversion has a significant impact on people's lives, especially those living in peri-urban areas. This problem occurs in Vietnam and occurs in developing countries with high urbanization rates (KUSILUKA ET AL., 2011; AUTAM & ANDERSEN, 2016; NIKUZE ET AL., 2019). Socially, the lifestyle change from rural to urban residents has changed cultural standards and leads to a transformation in the social lives and behavior of each suburban resident. Urbanization also transforms kinship relationships, village communities have multidimensional social relationships, which are complicated by combining many classes of the population and the transformation of organizational models. This is one of the characteristics of urban communities (MINISTRY OF CONSTRUCTION, 2020). Land use change has also created social conflicts and intensified violence due to land contention and because the land is the primary source of livelihood for many peri-urban farming households. Land in the peri-urban area is becoming increasingly scarce, leading to higher land prices in this area, inadvertently creating psychological pressure on people. Consequently, the poor may be pushed further out of town/city or are forced into areas of land of little value or which lack public services.

In economic terms, urbanization creates a change in land use in the peri-urban area. The transfer of a large part of the agricultural land into the construction or industrial zones and urban residential areas has resulted in loss of the livelihoods of many farmers. This problem forces them to switch from agricultural production to non-agricultural activities (NGUYEN ET AL., 2019; NGUYEN, 2021). This reality is a challenge for farmers, especially for impoverished farmers, because it requires time

and investment in both money and intelligence to adapt to the new conditions. Countries with rapid and uncontrolled urbanization rates often have to deal with severe social and economic consequences such as unemployment, poverty, and social instability (COHEN, 2006).

6. Conclusions

Urban expansion and rural restructuring due to land-use conflicts are increasing worldwide (ZHAO, 2017). This phenomenon is also happening in Vietnam, a country in the developing stage and considered to be one of the fastest-growing countries (WORLD BANK, 2020b). The three research questions outlined in part 1 are answered here. This study has demonstrated that land-use changes in Vietnam tend to be similar to changes around the world. The agricultural and non-agricultural land area have increased, while unused land has witnessed a sharp decrease in area. The area of agricultural and non-agricultural land increased by 9 million hectares and 0.8 million hectares respectively, whereas the area of unused land decreased by 9.6 million hectares in nearly 25 years from 1990 to 2018. However, analysing the agricultural land types, the area of rice cultivation has decreased compared to previously. Most of the lost paddy land was converted to built-up land with about 125.9 thousand ha between 2007 and 2017.

The study data also showed that land conversion is mainly concentrated in the North Central and Central Coast areas. The percentage of agricultural and non-agricultural land in these regions' provinces has mostly increased by over 7%, while unused land decreased by over 100%. These regions contain many of Vietnam's cities. However, the conversion of land from agriculture to urban areas is concentrated in two regions: the Southeast and the Red River Delta. Furthermore, the transition trend has also shifted to the East of Vietnam to take advantage of the long coastline. This transformation aims to help the development of coastal tourism and facilitate domestic and international trade.

The study has shown the socio-economic impacts on the lives of peri-urban residents after converting agricultural land. Economically, urbanization and industrialization have left 11 million hectares of land abandoned and in danger of degradation and reduces the quality and productivity of agricultural products, thereby significantly affecting the income of farmers. In addition, the transformation of agricultural land to non-agricultural also forces farmers to switch to non-agricultural activities. It is a challenge for farmers because it requires time

and investment in both money and intelligence to adapt to the new conditions. Socially, people's lifestyles also require a transition from rural to urban. The change in land use has also created social conflicts and intensified violence due to land disputes.

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Appendix 1. The matrix of land area conversion of categories from 2007 – 2017

Unit: km ²		Land Cover 2017										
		Unclassified	Water	Urban	Rice	Crops	Grassland	Orchards	Bare land	Forest	Mangover	No data
Land Cover 2007	Unclassified	2281757.478	1.2355	0.551	0.2271	0.0755	0.0593	0.5573	0.6824	4.221	0.143	0.0256
	Water	13.9538	10424.2907	923.504375	749.43565	514.7645	166.52628	262.22615	710.58048	447.50635	2031.8577	0
	Urban	61.6252	369.041625	7476.3485	1361.54113	1620.223	424.84853	1222.7251	1341.6373	601.1623	274.15395	0
	Rice	125.2337	520.643075	1259.31785	24249.128	2439.49715	315.58528	1360.5262	951.1564	1441.6053	1321.8977	0
	Crops	332.0921	356.348525	2727.9181	3396.7656	14139.7603	3688.7278	5009.3509	1424.8289	7141.2813	442.97323	0.0327
	Grassland	233.5248	97.514825	2035.32403	1001.9759	3479.25735	12382.025	1907.0343	6183.66	7986.6629	163.97763	0
	Orchards	140.851	130.938925	1794.19408	2315.56815	3022.64358	1780.1528	10662.087	1438.9826	3302.8343	1340.2741	0.9947
	Bare land	4.9058	155.703875	994.677825	940.524575	1869.66943	2444.0183	505.327	8926.2209	2245.7303	90.7648	0
	Forest	462.2722	148.637775	1269.8449	1706.35038	7337.23588	9861.0458	5662.5877	4118.2537	114531.85	670.398	4.7495
	Mangrove	41.9745	294.983325	252.1407	666.226325	355.492075	285.9174	236.16265	158.91883	688.38768	2606.5697	0
	No data	0.1235	0.3568	1.9132	0.9031	1.2672	0.561	1.486	27.9532	12.5786	0.1485	0