

# **ANTHROPOGENIC PRESSURE ON URBAN DEVELOPMENT AND LAND USE CHANGE OF KYAUKPHYU TOWN, RAKHINE STATE**

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## **Abstract**

This paper presents the geographical analysis on urban development and land use changes of Kyaukphyu caused by human pressure. Kyaukphyu, a medium-size township located on Yambye Island, is less favourable for urban growth. But some rural areas closed to the town are upgraded to town. Therefore, rural population is shifted within kyaukphyu town and rural dweller area is displaced by some economic activity. Although most of the residential land use of the town area changed to commercial land use, some residential areas changed to unused land due to effect of human pressure. The main objectives are to study the land use changes by urban growth and to examine the future economic activities of Kyaukphyu Township. To analyze the urban growth and land use changes in the urban area of Kyaukphyu in 1958, 1996 and 2019, remote sensing technique and ArcMap GIS 10.3.1 software are used.

**Keywords:** Urban growth, land use changes, economic condition, Kyaukphyu Township

## **Introduction**

Urbanization is a process whereby populations move from rural to urban area, enabling cities and towns to grow. It is highly influenced by the notion that cities and towns have achieved better economic, political, and social mileages compared to the rural areas (Pawan, 2016).

The growth and the shape of Kyaukphyu Town are largely controlled by the existing physical features, particularly by relief and drainage. As it is bounded north, east and south by the Kyaukphyu and Ngalapway rivers, the extension of town area to these directions is hardly possible. However, there is a wide space of land between the southernmost settlement area and Ngalapway River. Thus, the spillover from the inner urban area and those who migrated from the rural area were mostly pulled towards the southwestern margin. The economic factor and accessibility have had greater effect over the placement of human settlement.

Population is also a critical factor in determining the rate of urban growth as well as economic development of an area. The number or the proportion of urban population which reflects the land use change and the stage of urbanization is interdependent with economic growth of an area.

This study bases on the three maps drawn in 1958, 1996 and 2019. The interval of the time periods is not equal, but these periods are chosen because of drastic changes in the town area and land use change as well as the availability recorded data of the town.

## **Study area**

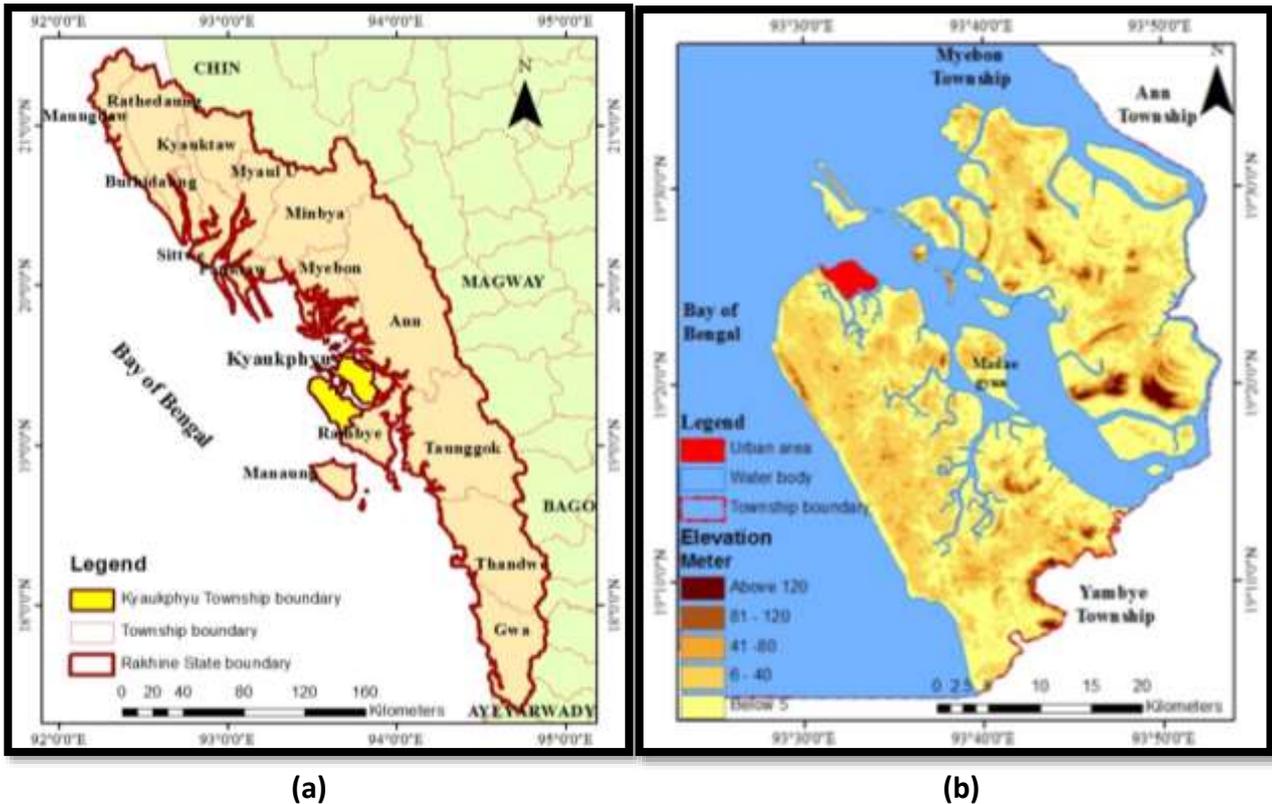
Kyaukphyu Township is situated in the western extreme of Myanmar. It occupies northern half of Yambye Island in the North Bay of Bengal. It has an area of 1757 square kilometers, comprising 52 villages and 17 wards in the town areas.

Kyaukphyu Township is composed of mountains, hills, low and level land, tidal marshes and streams. The elevation of lowland area is below 5 meters, and town area stands on the flat lowland of less than 5 metres above sea level.

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(a)

(b)

**Source:** Department of Agricultural Land Management and Statistic (Kyaukphyu), based on DEM

**Figure 1(a and b)** Location of Kyaukphyu Township in Rakhine State

The town area is latitudinally located between 19° 24' North and 19° 26' North and longitudinally between 93° 30' East and 93° 34' East. It occupies an area of 10.19 square kilometers representing 0.6 percent of the township area. The town comprises 17 wards. Kyaukphyu River locally known as Madekyun River near the Made Island flows towards the northeastern coast of Yambye Island.

According to the recent geological investigation, the Kyaukphyu Township area is covered with Miocene rock unit namely Leikkamaw Formation which is mainly composed of sandstone. They are massive thick bedded sandstones, inter-bedded with thin sandy shale layers. Therefore, Kyaukphyu area is a favourable region for urban development and construction works due to its high resistance of sandstone.

The mean annual temperature of Kyaukphyu Township is 25.3° C. The normal annual rainfall of Kyaukphyu Township is 4579.6 mm. According to Koppen's climate classification the township experiences tropical monsoon climate (Am). It is suitable for settlement.

## Materials and Methods

In order to get the township, wards, and village tract's boundaries, the study area is digitized based on Aerial photo (No. 113 and 114, scale 1:6000, date 14.2.58), UTM (2000) and Google Earth Images and elevation data are obtained from Digital Elevation Model (DEM).

Land use map is acquired from Agricultural Land Management and Statistics Department and climate data are acquired from the Department of Meteorology and Hydrology, Kyaukphyu.

The information data of urban changes are acquired through random interviews and discussion with local people and population data from Department of Labours, Immigration and Population, Kyaukphyu.

To examine the land use data, Landsat 8 image is also analyzed by using Remote Sensing and ArcMap GIS 10.3.1 software.

### **Research questions**

How do urban area changes in Kyaukphyu?

Which factors affect the land use changes in Kyaukphyu?

### **Aim**

The main aim of the research paper is to assess the relationship between land use changes, urban growth and trend of economic activity in Kyaukphyu Township.

### **Objectives**

The main objectives of the paper are

- To study the growth of urban background factors of Kyaukphyu
- To analyze the factors affecting the land use changes in Kyaukphyu
- To assess the trend of urbanization and economic conditions of Kyaukphyu

## **Finding**

### **Anthropogenic Pressure On Urban Growth**

#### **Historical background of the study area**

There had been no permanent group settlement over the present town area prior to A.D 18<sup>th</sup> century, although few, sporadic dispersed settlement based on fishing activity might have settled in some limited space. According to available evidence, the present Ceditaung Ward was under water by that time and it served as harbour of fishing boats.

In B.E (Burmese Era) 793 (A.D 1431), King Saw Mon Gyi of Konbaung dynasty sent Ananda Thuriya, the minister and Myin Si Par, the adviser to Yambye, Thandwe and Manaung to establish a village at the site of the present Seebokekay Village. Large quartz boulders existing beyond the village were so prominent that, the newly formed village was named Kyaukphyu Village.

After the British annexation of the Rakhine area, the scenic view of the Kyaukphyu coast, where a small group of the British settled, was able to attract some new settlers and thus it become a British East India Company's Village.

In 1837, the British government established Kyaukphyu town beyond the village where the land is higher. Kyaukphyu together with Yambye and Myanmaung was put under the control of district office located at Yambye. At that time Ann was also a centre of district administration. However, the district office was shifted to Kyaukphyu in 1845, as the physical environment of Ann was susceptible to fatal diseases. Again in 1852, Kyaukphyu and Yambye were integrated as an only district of the area with office in Kyaukphyu. The actual demarcation of Kyaukphyu Township was made in 1885 and a municipal body to govern the town was also formed. The main present town's plan was initiated by Sir Arthur Vontable in 1905-06.

## Population growth

According to the records available, there were 14447 persons within Kyaukphyu Town in 1958, with an urban area of 3.043 square kilometre (304 hectares). Thus, population density was 4748 persons per square kilometre. Although the town area remained unchanged, the population increased to 17899 people in 1973, representing a density of 5882 persons per square kilometer. The average annual growth rate of urban population was 1.0 percent for the 1958 – 1973 periods. As there was no extension in the town area, the residential buildings became more concentrated, thereby reducing open space between buildings.

By the year 1996, the total population rose to 23192 persons. Likewise, the town area has also grown to 3.53 square kilometres (353 hectares), representing a density of 6570 persons per square kilometer. The average annual growth rate was 1.3 percent for the 1973 – 1996 periods.

With the increasing population, the residential buildings gradually emerged, mostly on the open spaces of urban fringe, but not in orderly arrangement.

In 2019, the town area has grown to 10.19 square kilometres (1019 hectares) due to the rural areas such as Pinyinphumaw and remaining portion of Taungyin villages namely as Taungyin Group were upgraded to town level because of relative proximity to the commercial center and easy access to these areas. Although rural population decreased, the urban population increased to 34065 in this year, representing a density of 3343 persons per square kilometres. The average growth rate in that period was 2.0 percent which showed slight increase compared with the previous 23 years.

**Table 1 Urban and rural population in Kyaukphyu Township**

Year	Population			Urban population growth rate %
	Urban	Rural	Total	
1958	14447	77230	91677	
1973	17899	90121	108020	1.0
1996	23192	131530	154722	1.3
2019	34065	128843	162908	2.0

Source: Department of Labours, Immigration and Population, Kyaukphyu

## Urban extension

The growth of town is fairly systematic. The extension areas of the town are:

### Ceditaung Extension

This extension area is located on the eastern side of the road linking the town center and Kalabartaung Village and north of the Kalarbartaung-Kanyintaw Street. It forms as part of Ceditaung Ward. The aerial photos of 1958 reveal no trace of settlement in this area. It was in 1965 that plots of land for each family were systematically arranged over 32 hectares of land. In 1996, another 16 hectares were added to the area and it increased to 304 plots. In 2019, it occupied 49 hectares with 727 plots.

### Sanpya Extension

This extension area was once paddy land. In 1978, it was transformed into residential land as part of Officers Ward. It is located on the eastern side of Kyaukphyu-Ngalapway Road and on the western side of Kyaukphyu-Kalarbartaung Street. With an area of 47 hectares, it has 249 plots

for settlement units. It can be identified with the aerial photo taken in 1983, as it was established since 1978. In 2019, the total area of Officer Ward with Sanpya Extension was 86 hectares.

**Taungyin group**

**Taungyingyi and Taungyinnge Extension**

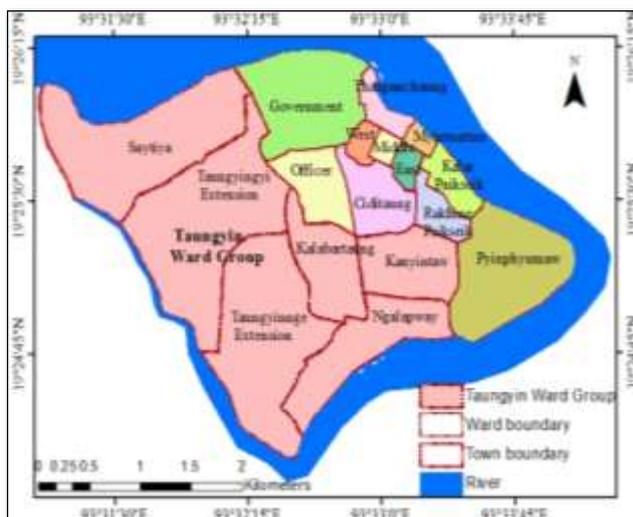
Formerly Taungyin Extension area was part of Taungyin Village and had no houses over it. When a plant site was chosen near the No. 2 harbour, part of the existing settlement was included in the project area. As a result, about 100 houses had to be removed to the open space of Taungyin Village. At the beginning, these houses were not in grid arrangement. In 1979, 390 plots were systematically demarcated, using over 61 hectares of land.

**Taungyinge Extension** is separated by one-hectare-wide bazaar called Zayaroo from Taungyingyi Extension. It is located beside the Kyaukphyu-Ngalapway Road and to the north of Fish Technical School. Its area is 20 hectares and was systematically divided into 192 plots in 1984-85.

For the benefit of service personnel, 225 plots over 9 hectares of land area were arranged near Kalabartaung Village.

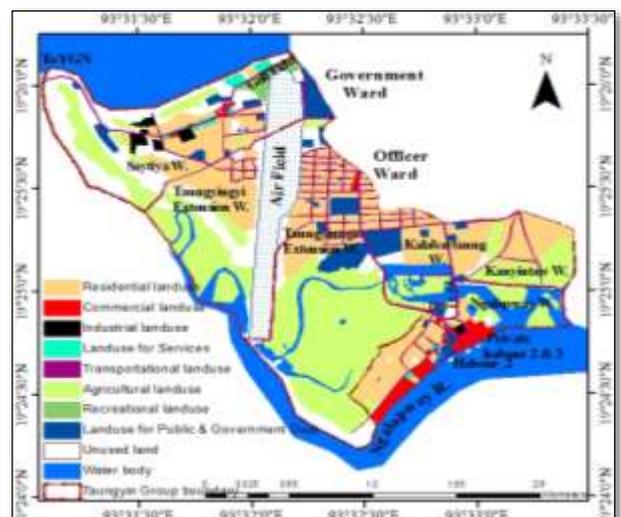
In 1996, plots of land were arranged over the suitable land of Gonechain Village and given to the families of the army personnel of 542 and 543 regiments.

In February 2019, Pyidaungsu Hluttaw approved the recognition of Taungyingyi, Taungyinnge, Saytiya, Ngalapway, Kanyintaw and Kalabartaung villages included in Taungyin Village Tract was included in the Kyaukphyu Town area under the name of Taungyin Ward Group. Besides, Pynphyumaw Village located on the eastern portion of the town was included in the kyaukphyu town area. Since then, the number of wards in Kyaukphyu Town has been 17 up till now (2019-2010)



Source: Department of Agricultural Land Management and Statistics (Kyaukphyu)

**Figure 2** Ward boundary of Kyaukphyu Town (2019)



**Figure 3** Land use of Taungyin Ward Group Town (2019)

**Land use change**

The urban land use of Kyaukphyu town comprises residential land use, commercial land use, industrial land use, land used for public and government department, land used for services, agricultural land use, transportation land use, recreational land use and unused land.

The land area occupied by residential building was 72 hectares in 1958 and it increased to 125 hectares in 1996 and 297 hectares in 2019 respectively. Among extension wards, Sanpya and Ceditaung wards have more concentrated houses due to their locations close to the business centre.

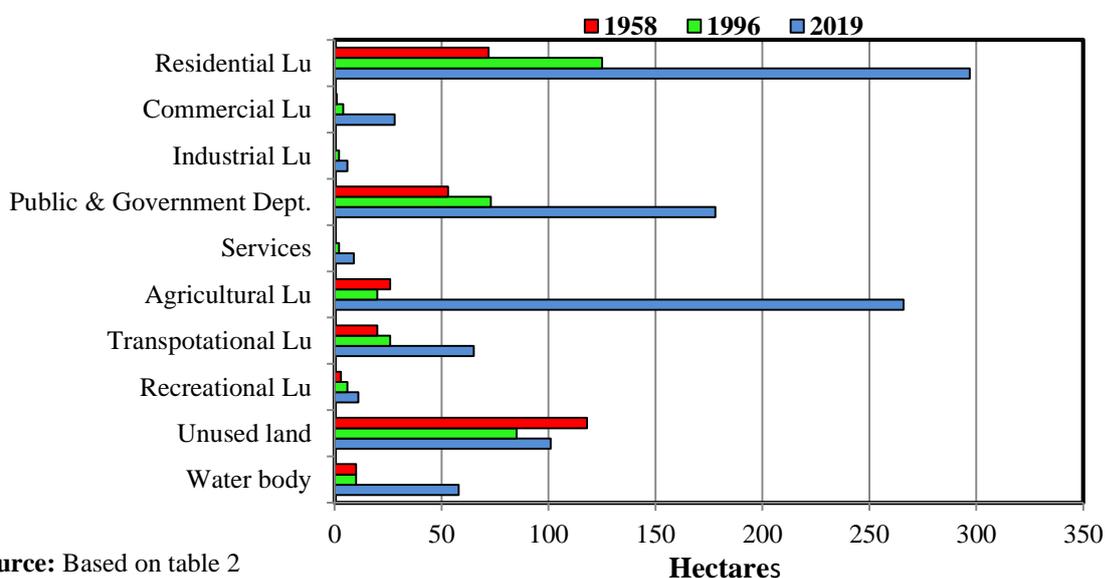
There was 1 hectare of land used by commercial purposes in 1958 it increased to 4 hectares in 1996. In 2019, the commercial land use covered 28 hectares, representing 2.7 percent of the town area. The commercial land use is manifested by two large markets, two bazaars, near the harbour no. 2 and 3 in Ngalapway Ward.

Industrial land use includes rice milling, food production, purified drinking water production, ice production, saw milling, paper recycling, printing and small cottage industries in Kyaukphyu. There was small cottage industrial land use in Thanpanchaung Ward occupying 0.5 hectares in 1958. The ice factory as industrial land use located on Kanner Road in Government Ward occupied 2 hectares of land in 1996. After 2000, ice production factory was ceased and it was converted to Fishery Department. In 2019, 6 hectares of industrial land uses are found along the Yangon-Kyaukphyu Road in Saytiya Ward.

The unused land of the town occupies the areas with bog soil, saline soils, and discarded lands not suitable for land use. This type of land is scattered all over the town. Other land use changes are shown in Table (2).

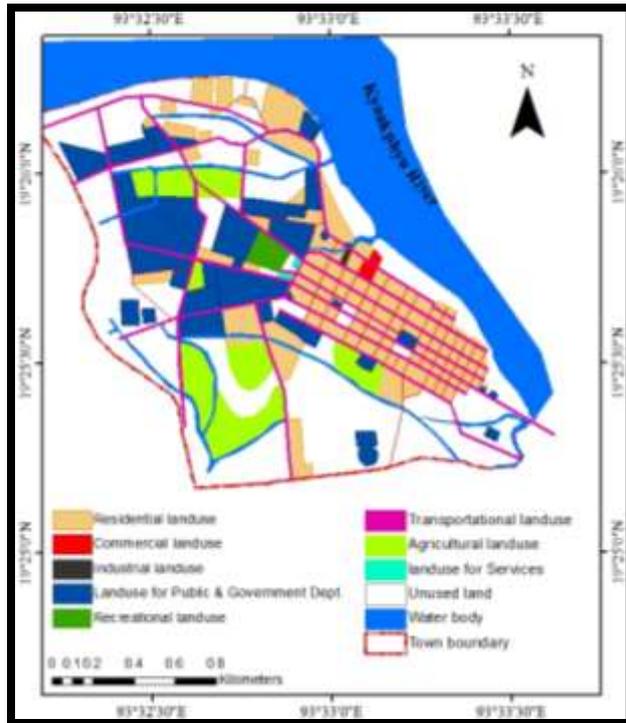
**Table 2 Land use type of Kyaukphyu (1958, 1996 and 2019)**

Land use types	1958	%	1996	%	2019	%
Residential land use	72	23.7	125	35.3	297	29.1
Commercial land use	1	0.3	4	1	28	2.7
Industrial land use	0.5	0.2	2	0.6	6	0.6
Land used for Public & Government Dept.	53	17.4	73	20.6	178	17.6
Land used for Services	0.5	0.2	2	0.6	9	0.9
Agricultural land use	26	8.6	20	5.6	266	26
Transportational land use	20	6.5	26	7.3	65	6.4
Recreational land use	3	1	6	1.6	11	1.1
Unused land	118	38.8	85	24.1	101	9.9
Water body	10	3.3	10	3.3	58	5.7
<b>Total Area (Hectares)</b>	<b>304</b>	<b>100</b>	<b>353</b>	<b>100</b>	<b>1019</b>	<b>100</b>

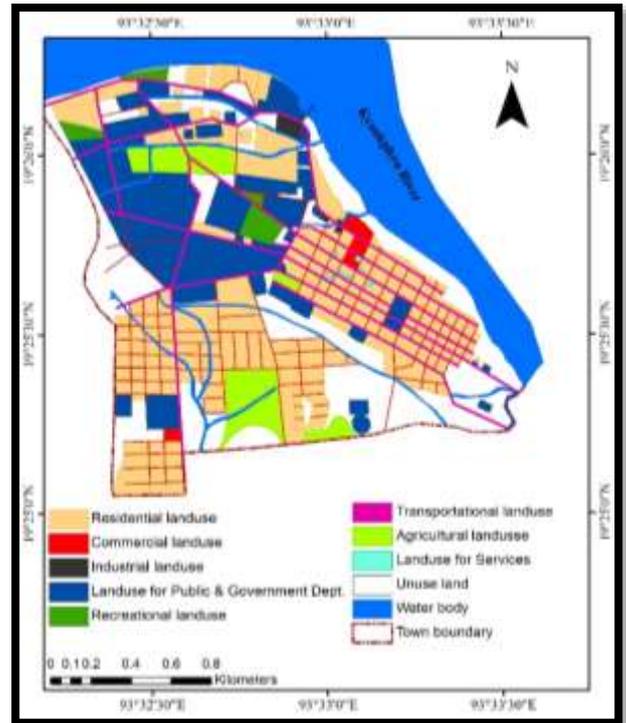


Source: Based on table 2

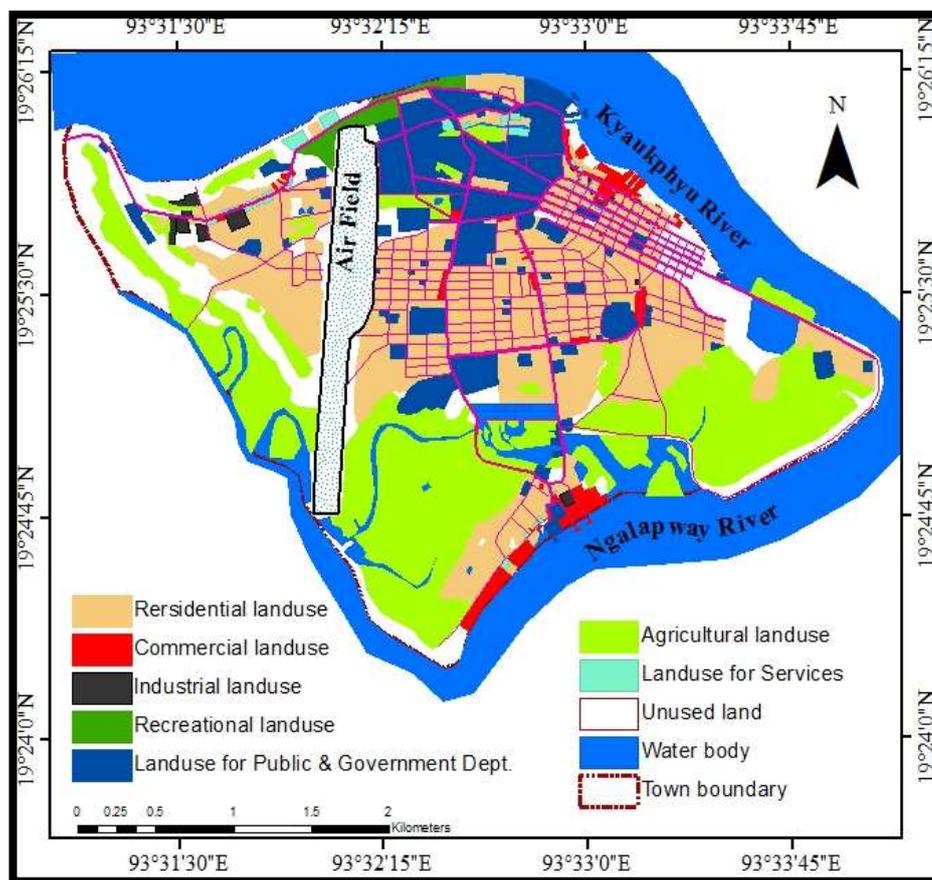
**Figure 4** Land use types of Kyaukphyu (1958, 1996 and 2019)



(a)



(b)



(c)

Source: Department of Agricultural Land Management and Statistics (Kyaukphyu)

Figure 5 (a, b and c) Urban Land use of Kyaukphyu Town (1958, 1996 and 2019)

## Anthropogenic Pressure on Landuse Change

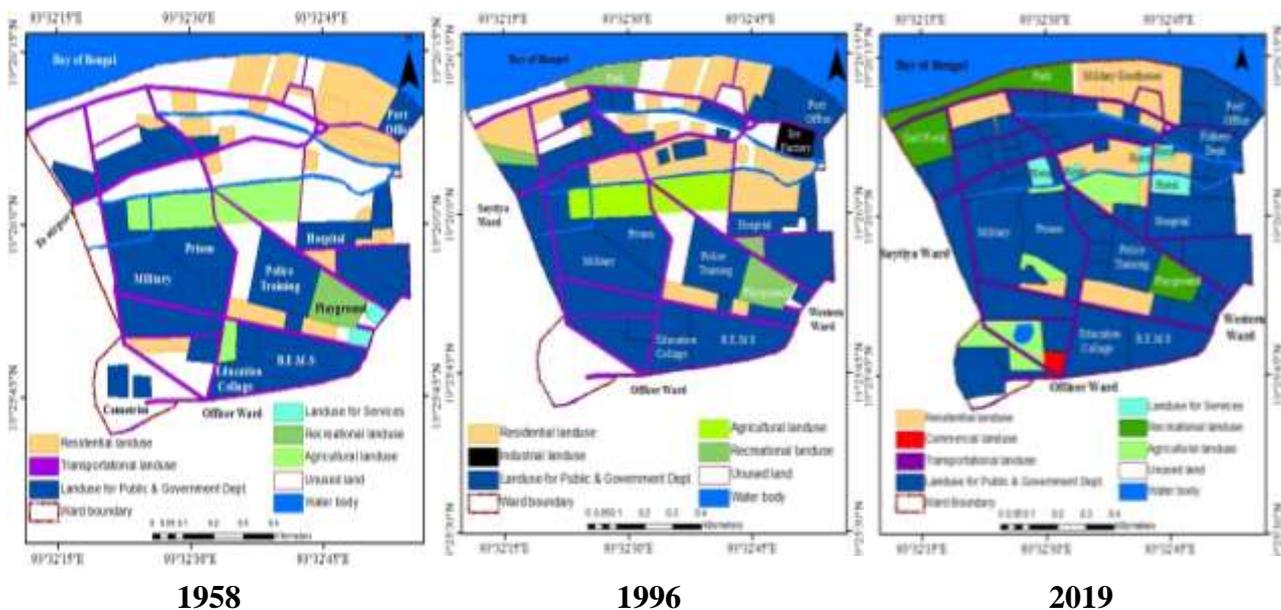
### Factors affecting the land use change

There are three main factors of anthropogenic pressures affecting the land use change in the study area. These are social factor, economic factor and political factor.

#### Social factor

All land use change due to social factor is more apparent in Government Ward. Government Ward has government offices, non-government offices, organizational buildings, banks, hospital, Educational College, schools, hotels, home for aged and guest-houses. The residential buildings gradually filled the vacant land. After the year 2000, some houses were removed from the ward, keeping only buildings related to government services. Some government service personnel reside at their respective offices.

The land area used for public and government was 31.8 hectares in 1958 and it increased to 43.2 hectares in 1996 and to 61.6 hectares in 2019, occupying 66 percent of the total Government Ward area.



**Source:** Figure prepared presenting data from Department of Agricultural Land Management and Statistics (Kyaukphyu)

**Figure 6** Urban landuse changing by social factor in Government Ward (1958, 1996 and 2019)

#### Economic factor

Among the land use change due to the economic factor, commercial land use is more obviously in the study area.

Commercial activities, trade and industrial growth are major cause of land use change in the study area.

The transportation of Kyaukphyu Town is facilitated by one airfield, two state-owned ports, 3 private-owned ports and Kyaukphyu\_Yangon Road. Trading business is the main economic activity of the town.

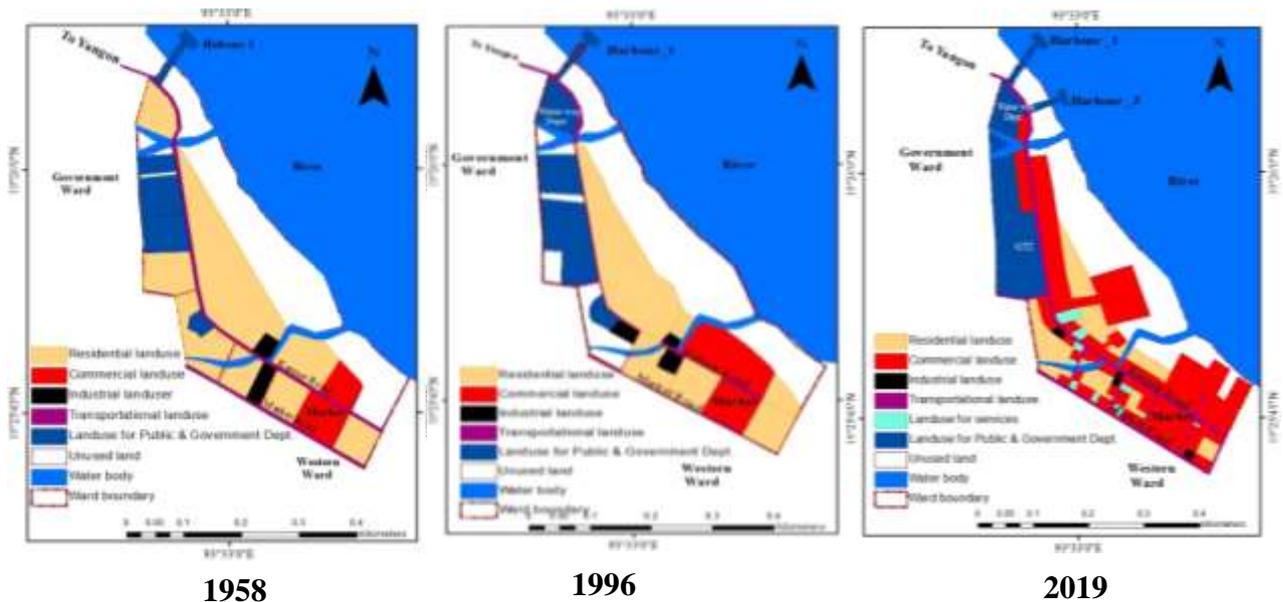
Myoma Market, the main distribution centre of foodstuffs and household goods, is located in Thanpanchaung Ward beside the bank of Kyaukphyu River. In 1992, Pyitharyar Market was open on the next road close to Myoma Market.

Fish and prawn farming have become more important having a number of streams and being close to the sea. There are various sizes of fish and prawn depots in Thanpanchaung Ward. As a result, commercial land use change is more pronounced in Thanpanchaung Ward.

In 1958, the land area used for commercial purpose was only one hectare, but it increased to 2.1 hectares in 1996 and to 5.9 hectares in 2019, representing 36.9 percent of the area of Thanpanchaung Ward.

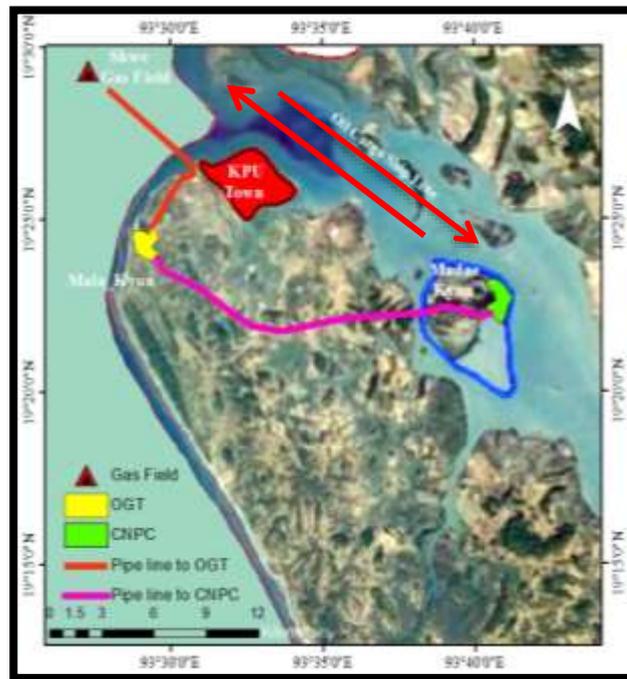
Ngalapway Ward, included in Taungyin Group has 3 ports. It is located by the Ngalapway Creek and one port is used for transportation of people and the other two for carrying consumer’s goods and construction materials. These are deep-sea ports and thus large ships can come and go into the docks, enhancing the change in the commercial land use.

The main change in commercial land use is related to “Shwe Natural Gas Field”. The site of natural gas field was discovered in 2000 and China National Petroleum Corporation (CNPC) has the right to produce the natural gas. The natural gas field is located 105 kilometres to the northwest of Kyaukphyu Town. The gas produced from the field is sent by underground pipeline to Onshore Gas Terminal (OGT) near Malakyun Village for purification. The purified gas is then sent to CNPC headquarter at Madae Kyun after crossing Kandi, Kyattain and Ookhin village tracts with underground pipeline from which it is sent to China by pipeline across central part of Myanmar. The production work is carried out mostly by Chinese workers and hotels and shopping centres have emerged for the employees, resulting in the change in the land use of commercial purpose.



Source: Figure prepared presenting data from Department of Agricultural Land Management and Statistics (Kyaukphyu)

**Figure 7** Urban land use changing by economic factor in Thanpanchaung Ward



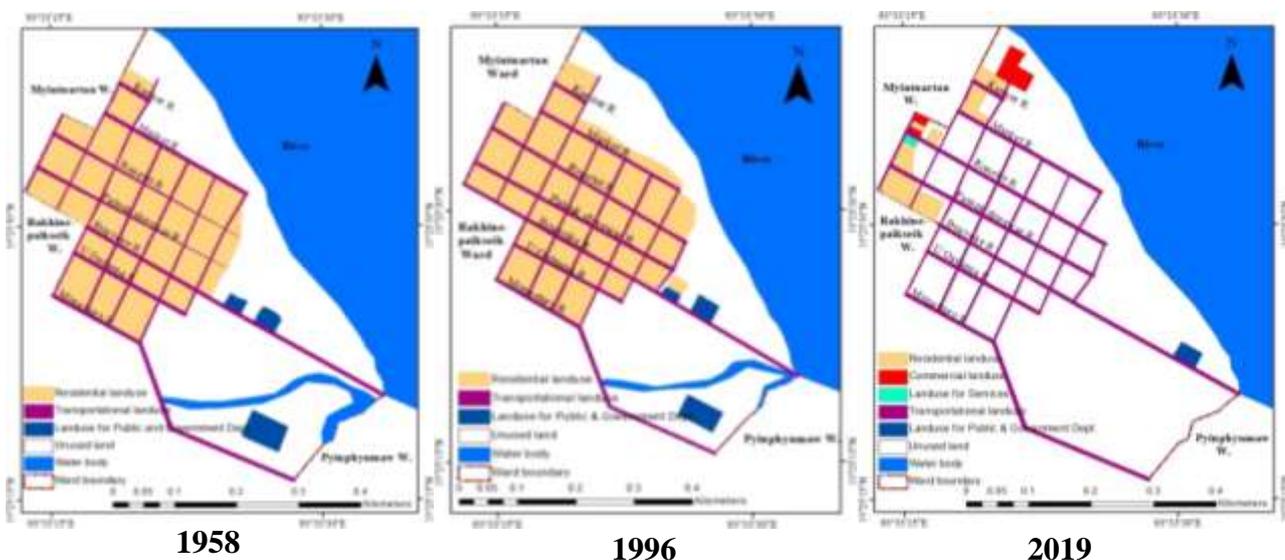
Source: Author observation

Figure 8 Location of Shwe gas pipeline in Madae Kyun, Kyaukphyu Township

**Political factor**

Residential land use change occurred in Kalar paikseik Ward located in the northeastern part of Kyaukphyu Town essentially due to political factor.

Due to disruptive event that occurred in April’ 2012, about 300 houses from the ward was removed to Gonechin Village outside the town area. Currently (2019), most of the area of the ward remained vacant with no buildings. The residential land area in Kalar paikseik Ward in 1958 was 8.5 hectares and it increased to 12.7 hectares in 1996, but was decreased by about one hectare in 2019 due to the above-mentioned event. The remaining houses in the ward belong to the ethnic nationals.



Source: Figure prepared presenting data from Department of Agricultural Land Management and Statistics (Kyaukphyu)

Figure 9 Urban land use changing by political factor in Kalarpaikseik Ward

### **Land Value of Kyaukphyu Town**

The process of urbanization in Kyaukphyu town based on its infrastructures, type of building and proximity of central commercial area. The central commercial area of Kyaukphyu is situated between Bogyoke Aung San Road, Kanna Road, Cross Road No.1 and Cross Road No.5. A plot of land having an area of 40' x 60' is worth 20 lakhs in 1996 and it increased to 3300 lakhs in 2019.

The land area that lies between Bogyoke Aung San Road, Monastery path, Education Office Road and Cross Road No.8 ranks second in value. Each plot of land within the area costs 5 to 10 lakhs in 1996 and it rose to 2400 lakhs in 2019.

The third most valuable land area is between Monastery Road, Market Road, Cross Road No.8 and Cross Road No.10. The price of a plot of land in this area was 3 to 6 lakhs in 1996 and the current price of this area is 1800 lakhs.

The land along the Kyaukphyu- Ngalapway Road, particularly from the town towards Ngalapway Ward are at present commercial area and plot of land are relatively large. The value of each plot of land is about 1000 lakhs.

Excepting such special case, the land value of Kyaukphyu Town gradually become lower away from the central commercial area.

### **Trend of Urbanization and Economic Development**

The area of Kyaukphyu Town has been increased with the increasing number of populations. Some areas of residential land were converted to commercial, services and industrial lands, and agricultural land to residential land.

The development of an area depends on the economic progress. In 1997, Myanmar, in cooperation with Japan Development Institute (JDI), presented 8 suitable places for the establishment of Special Economic Zones (SEZ), including Kyaukphyu.

In October, 2012, Kinmyauk (Zinchaung Village Tract) area was prioritized in Kyaukphyu Township. Kyaukphyu Special Economic Zone includes Deep Sea Port Package, Industrial Package and Integrated Residential Project Package.

For the implementation of these projects, 1736 hectares of land have been fixed. The industrial zone is to be established at 8.5 kilometres south of Kyaukphyu Town comprising Kandi, Thaichaung, Kyattain, Katthapyay and Chaungwa village tracts.

The chosen area for integrated residential project is 12 kilometres south of Kyaukphyu Town including Chaungwa and Minpyin village tracts.

For deep sea port, the area near Thitpoketaung Village to the north of Madae Kyun is chosen. However, having no transparency in petroleum port of Madae Kyun and Shwe Natural Gas Pipeline Project leading to conflicts with the locals, land confiscation, and destruction of crops all hinder the implementation of SEZ in Kyaukphyu Town until now. It is hoped that the implementation task may start soon.

### **Impacts of Urban Growth and Economic Development**

The urban growth and economic development of Kyaukphyu Town can be taken for granted, based on the expansion of Kyaukphyu town area, the increase in the area of commercial land use, the emergence of 3 private ports, the annual export of 12 million billion cubic metres of natural gas to China, the sending of petroleum to China from Madae Kyun by pipeline across Myanmar since April, 2017.

**Positive impacts**

The above-mentioned economic activities can create more job opportunity to the local inhabitants and the country earns more foreign exchange. The number of service activities, hotels and retail shops has increased.

**Negative impacts**

The following negative impacts are pronounced due to urban growth:

- The rise of residential land price
- Less job opportunity for the locals, as more Chinese workers are being employed in the construction work of natural gas pipelines
- The confiscation or the grabbing of lands from farmers without paying compensation
- The invasion of salty seawater into the croplands due to the break of embankment in laying gas pipelines
- Conflicts between the local people and Chinese as the latter neglect the social customs of the local people
- Fire breaks out two time at waste dumpsite in 2018
- The quality degradation of natural environment and marine resources due to the possibility of oil spill. Crude oil from Middle East is sent to China by pipeline through Madae Kyun Port of Kyaukphyu Town. The large oil tanker with a carrying capacity 300,000 tons usually passes near Kyaukphyu Town so far, such tanker has passed 119 times. In 2018, oil spill event occurred near Madae Kyun, but the amount of spilt oil was limited and the pollution of seawater around the area was not conspicuous.

**Conclusion and Suggestions**

Kyaukphyu Town is located in the northern extreme of Yambye Island. The area of the town has expanded in response to the increasing population. The main economic activities of the town are trading, commercial activity and serving as the centre collection and distribution of prawn and fish.

As a result of the economic activity of oil and natural gas production and shipping to China, commercial land use change has occurred in the urban area of Kyaukphyu.

The project for implementation of SEZ in Kyaukphyu has been prepared and more land use change may result in after the completion of the project.

SEZ can generate more wastes and toxic materials and thus it is necessary to include the systematic waste disposal arrangement and treatment of industrial waste water at the respective industrial sites. Therefore, awareness raising talks should be carried out and discuss with the local inhabitants before the materialization of the SEZ project to maintain the quality of environment.

**Acknowledgement**

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ကျောက်ဖြူမြို့နယ်ဖြစ်စဉ်မှတ်တမ်း၊ မြို့နယ်ပြည်သူ့ကောင်စီ (၁၉၆၂) ခုနှစ် ။

ကျောက်ဖြူမြို့နယ်ပထဝီဝင်အနေအထား၊ ကျောက်ဖြူမြို့နယ်အုပ်ချုပ်ရေးမှူးရုံး ။

စိုက်ပျိုးရေးနှင့်လယ်ယာမြေစီမံခန့်ခွဲရေးနှင့် စာရင်းဇယားဦးစီးဌာန ။ ကျောက်ဖြူမြို့နယ်။

တင်တင်မြင့် မ၊ ၁၉၈၆ ။ ကျောက်ဖြူမြို့နယ်၏ ဒေသန္တရပထဝီဝင်၊ ရန်ကုန်တက္ကသိုလ် ။

မြကျွန်းသန္တာ (၂၀၁၈), ကျောက်ဖြူမဂ္ဂဇင်း၊ အမှတ် ၅၊