

AN ENVIRONMENTAL APPROACH: IMPACT OF CHANNEL BANK CHANGE OF SITTAUNG RIVER IN KAWA TOWNSHIP

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Abstract

Severe bank erosion on the western part of Sittaung river mouth, especially the eastern part of Kawa and Thanatpin Townships of Bago Region has caused the economic and social problems since 2015. This paper is to identify the eroded eastern part of Kawa Township from 2015 until 2017. Moreover, it is to clarify the economic and social problems of the eroded eastern part of study area. Kawa is one of eight townships in Bago district that occupies the low-lying area of Sittaung and Bago rivers. The area of Kawa Township is about 1677 square kilometers (647.68 square miles) or 167667 hectares. The lost land area was during the seven years from 2010 to 2017 was about 163.16 square-kilometers (16317 hectares) which consist of waste land, le land and settlement area. The affected area due to bank collapse included 754 households and 3965 persons. Shifts in settlement area have resulted in the negative impacts on education, agriculture, animal husbandry and fishing industry and some households had to sell their cows, buffaloes and others to build their houses in the new places.

Keyword: bank erosion, collapse of land area, loss of Le land and shifts in settlement

Introduction

Bank erosion is the wearing away along banks of a stream or river. This is distinguished from erosion of the bed of water course, which is referred to as scour. After 2014, severe bank erosion on the western part of Sittaung river mouth originated, especially in the eastern part of Kawa and Thanatpin townships of Bago Region. The river bank erosion at the Sittaung river downstream area in Bago region can be found as mass failure. Therefore, in May, 2017, Kawa and Thanatpin Townships of Bago Region and Kyaikto, Bilin and Thaton townships within Mon State along the Sittaung river mouth were recognized as Ramsar Site of wetland area. Ramsar site is very

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important to erosion and flood controls and fisheries habitats. Aung Naing Gyi, War Taw, Kan Myint, Mamauk, Malauk and Sar Phyu Su villages in the eastern part of Kawa Township were identified as Ramsar site.

Research Problem

Severe bank erosion of Sittaung River mouth occurred in the eastern part of Kawa Township from 2014 until present time. Therefore, most of the land, pasture, settlement and other lands were destroyed due to severe mass erosion. Most of the villagers have to live in a hazardous area facing vulnerable loss of the land, shift to residential unit and other social problems.

Aim

This paper is to identify the eroded eastern part of Kawa Township from 2015 until 2017 and to reveal the economic and social problems of the eroded eastern part of the study area.

Research Methodology

Satellite images (Land sat TM 7 and TM 8) are used to study the increasing bank erosion rate in the study area during the period from 2010 to 2017. After studying the changes of Sittaung river mouth on satellite images, the ground check was done at fifteen points along the old Mamauk village. The secondary data including population data, rainfall data, the distribution of village tracts in township, bank eroded land and settlement areas and migrated population and villages are collected from Man Power Department and Department of Agriculture and Land Management Statistics in Kawa Town and relevant thesis. After collecting data, pilot field study to Mamauk village was conducted on 30.5.2017. The fifty questionnaires were distributed and field observation was done to get necessary information in old and new Mamauk and Sar Phyu Su along the Sittaung river mouth on 22.6.2017. The questionnaires were distributed by using Random Sampling Methods. Personal interviews with village leaders and head of the village concerned, Department of Agriculture and Land Management Statistics (Kawa Township) were conducted during the field study period. Qualitative and quantitative analysis method are used.

Background of Study Area

Kawa is one of eight townships in Bago district that occupies the low-lying area of Sittaung and Bago Rivers. It lies between 16° 46'23" and 17° 11' 22" north latitudes and between 96° 22'48" and 97 ° 03' 46" east longitudes. The boundary lines follows along Bago river in the west and Sittaung river in the east. The township is bordered by Thanatpin Township on the north, Khayan Township on the south, Kyaikhto Township on the east and Hlegu Township on the west. The area of Kawa Township is 1677 square kilometers (647.68 square miles) or 167667 hectares.

Relief and Drainage

Being the southern part of Sittaung river valley, the land is flat and low with no significant relief. The general elevation is about 3- 4.57 meters above sea level and the land gently slopes towards the south and the west. It is essentially built by the sediments deposited by the Sittaung and Bago rivers.

The Bago River serves as the western boundary of the township. Two main creeks namely Kawa and Paingkyon creeks flow into Bago River from the east.

The Sittaung River serves the western boundary of the township. Thandin and Takawkanat creeks flow from north to south in the middle of study area. Ngazin creek runs from east to west and enters the Thandin Creek. Waypadan Canal is the artificial canal, which can be used for local water transportation during the rainy season.

Climatic Condition of the Study Area

As Kawa has no weather station, the climatic data are taken from Bago station. The mean monthly temperature is highest in April with 31° C (75° F) and lowest in December 23.7° C (74.66°F).

Table 1: The Temperature and Rainfall in Bago Station (from 2003 to 2017)

| Months | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Average/ Total |
|-------------------------------|-------|------|------|-------|--------|-------|-------|--------|-------|-------|-------|------|-------------------|
| Maximum Temperature (° C) | 31.50 | 33.7 | 36.4 | 37.5 | 34.8 | 30.5 | 29.9 | 29.4 | 30.8 | 32.1 | 32.1 | 30.7 | 32.45 |
| Mean Mini Temperature (° C) | 16 | 16.9 | 20.5 | 23.5 | 24.3 | 23.5 | 23.6 | 23.5 | 23.7 | 23.1 | 20.9 | 16.7 | 21.35 |
| Mean Annual Temperature (° C) | 23.75 | 25.3 | 28.4 | 30.50 | 29.50 | 27 | 26.4 | 26.7 | 27.1 | 27.6 | 27.5 | 23.7 | 26.95 |
| Rainfall (mm) | 0.51 | 7.11 | 7.62 | 38.86 | 319.53 | 631.7 | 771.7 | 756.67 | 497.8 | 449.8 | 52.58 | 9.4 | 3543.08 |

Source: Meteorology Department, Bago

The maximum daytime temperature often reaches 40° C in the later part of hot dry season. The total annual rainfall from 2003 until 2013 was 3543 mm. The heavy rainfall received in June (631 mm), July (771mm) and August (756 mm) from 2003 to 2017. The severe erosion occurred in these month after 2015, especially in the high spring tide period.

Vegetation and Soil

The soil types in the western part of this township are classified as Meadow and meadow alluvial soils (*Gleysol and Fluvisol*), the Saline swampy and Meadow gley soils dominate in the eastern part of township occupying about 50 percent of township area. The mangrove forest soils are found on some area along the Sittaung river bank.

The vegetation types in most area of Kawa Township are wet tropical evergreen forest and tropical evergreen forest. But most of the forest area has been cleared for human uses. Teak plantation has been introduced on the Phalay Mountain.

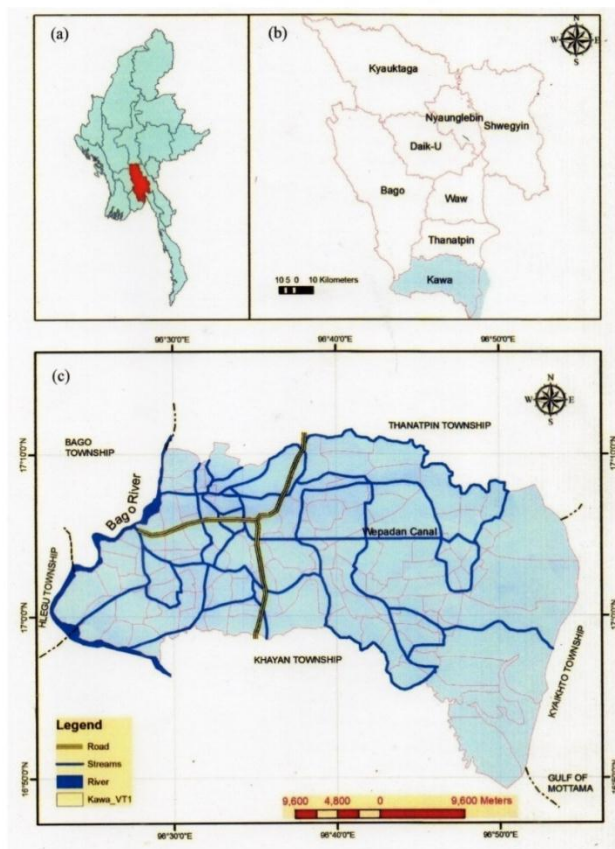


Figure 1: The Location Map of Kawa Township

Source: MIMU, Myanmar

Human Factors

Population, consumers as well as producers in primary economic activities especially paddy cultivation, is one of the most important social factors. According to 2014 census, the total population was over 197000 in Kawa Township. The number of households was over 46000 in 2014. . There were 4.2 persons living in each household and it indicated slightly less than the Union average. The proportion of productive working population between 15 and 64 years of age constituted 60.8 percent of total population. Compared to the union level, the percentage of working age-group (15-64) was smaller. The majority of the people in the township live in rural areas with only

8.8 percent living in urban area. The population density of the whole township was 118 persons per square kilometer. In Kawa township, 72.7 percent of employed persons were agricultural, forestry and fishery workers and highest in proportion. The second highest occupation was wholesale and retail trade, repair of motor vehicles and motorcycles representing 5.0 percent of the total workforce.

Findings and Discussion

Severe Erosion of Sittaung River Mouth in Kawa Township

The lost land area of Kawa amounted to about 62.15 square kilometers (6215,98 hectares) for five- year period from 2010 and 2015 .River bank sheet erosion seriously occurred and headed towards Kawa until present time, especially during the period of spring tide in one month.

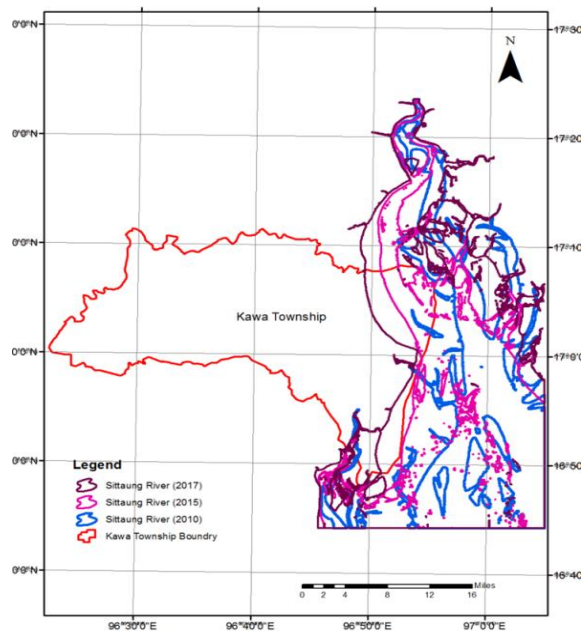


Figure 2: Extension of River Mouth Area in Kawa Township From 2010 to 2017

Source : Satellite Image (Landsat TM 7+ and Landsat 8)

The weather-beaten area by bank erosion seriously increased until present period. The eroded area was 101 square kilometers (14147 hectares) during three- year period from 2015 to 2017. Therefore, the total loss of land area during seven-year period from 2010 until 2017 was about 163.16 hectares (16317 hectares) which consisted of waste land, le land and settlement area.



Plate 1 and 2. Eroded Bank of Sittaung River Mouth in Mamauk Village, Kawa Township

**Social Factors effected by the Collapse of Land
Relocation of Settlement Area**

There were one monastery, one primary school and 235 households in **Shwe Tasok** village before the severe bank erosion in 2015. This village occupied about 29 hectares .This village faced with the Sittaung river bank erosion problem that eroded the settlement area during the rainy season in 2015. They had to shift to the western part of the village, where

Table 2: Shifted Households and populations at Kawa Township in 2017

| Villages | No of Houses | No of households | No. of people | Monastery | Church | School |
|-----------------|---------------------|-------------------------|----------------------|------------------|---------------|---------------|
| Shwe Tasok | 235 | 239 | 1160 | 1 | | 1 |
| Sar Hpyu Su | 89 | 89 | 415 | 1 | 1 | 1 |
| Mamauk | 426 | 426 | 2390 | 1 | | 1 |
| Total | 750 | 754 | 3965 | 3 | 1 | 3 |

Source: Department of Agriculture and Land Management Statistics (Kawa Township)

there was no erosion because it was one mile four furlong away from the Sittaung river bank. In 2017, 120 houses had been relocated in Aungmingalar village (Present Shwe Tasok Ywathit), 60 houses in Ngwe Taung Payarlay villlage and others in other areas because the resettlement area in 2016 disappeared by serious bank erosion.

Sar Hpyu Su village of Shwekan Village Tract had been relocated before 2016. One monastery, one church, one primary school and 89 homesteads were located in main Sar Hpyu Su village and 20 houses had been moved to surrounding area of Ta Dar U village. The effected settlement area in this village was 8.9 hectares.

Mamauk village had 426 homesteads, one monastery, one middle school and it was located along the western bank of Sittaung river mouth covering an area of 68 hectares. The le land and settlement area of Mamauk was damaged by the impact of severe river bank erosion after 2015. In 2017, 170 households of Mamauk village were moved to Mamauk Ywathit. The covering area of Mamauk Ywathit is 6.42 hectares which is located on le land along the Weapatan canal, in Ohnne Village Tract. In 2017, 150 households were still remaining in Mamauk village because these houses are located far from the river bank, but they are likely to be moved due to serious bank erosion. About 40 houses shifted to Aung Tha Byay Village, the southern part of main village. Only 15 households shifted to Bago city because they owned homes in Bago city before bank erosion and some rich persons bought houses in the city as they are under condition to move. New location of village is characterized by improper streets, unacceptable condition as settlement area, poor water quality and unavailability of sufficient portable water and so on. Low quality of lifestyle and very poor living conditions are not uncommon.

Le land and settlement area of **Bandar village** with about 300 houses with 950 populations was eroded in 2017. Loss of le land comprised about 2428 hectares, possessed 270 households. But these households moved to other location, along the Thanatpyin- Ohnne road within Ohnne Village tract, Kawa Township in March, 2018. It is called **Bandar Pin** village. Other 30 households remains at main Bandar village because their le land is good for cultivation. New area has good accessibility, fair earth roads, but in poor water quality with water shortage problem.

Aung Kan Kyaw village was established and named after combining three villages namely Aung Zayya, Kanya and Hngat Kyaw in 2018. It is located on the other road-side of Bandar Pin Village. The village is located on le land and its roads are fair earth roads constructed by landfill system. A pond for drinking water was dug up around the village.

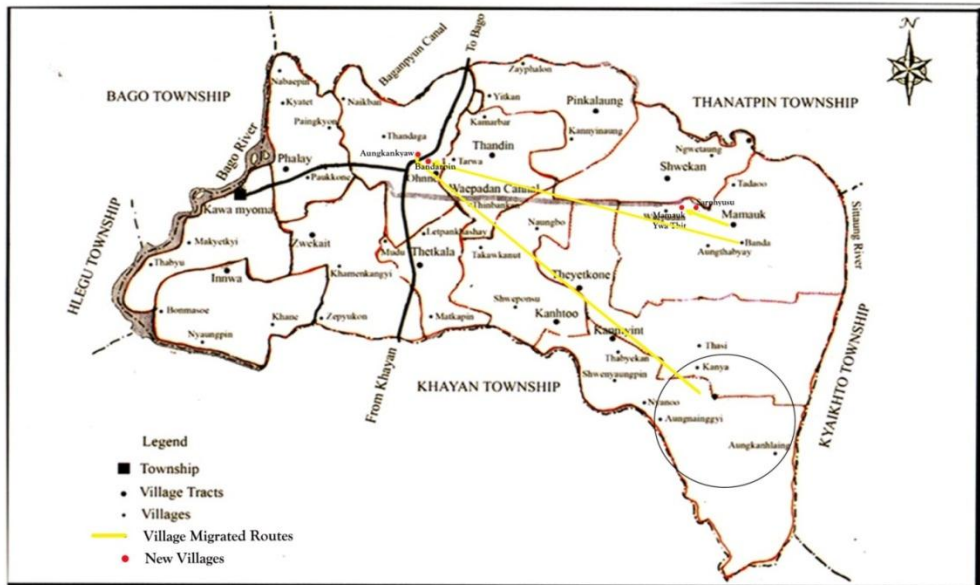


Figure 3: Locations of Relocated New Villages and Old Villages in Kawa Township

Source: Field Observation (30 .5.2017)



Plate (1) Shifting of destroyed home to new location

Plate (2) Sharing rice to Mamauk's Villagers by donors



Plate.3 Destroyed House moved to other Relocation Area

Plate.4. New houses built on the Le Land (Mamauk Relocation Area)



Plate 5 Infrastructure (Bridge) in Main Mamauk Village

Plate 6 Infrastructure (Phone Tower) in Main Mamauk Village

Education Condition

Case Study of Mamauk : Although the main Mamauk village has one state middle school with ten teachers and about 470 students before bank erosion, one teacher has to control one class from KG to grade.8. After moving to new location, these ten teachers were shared into three schools, due to the separation main Mamauk Village into three parts. One teacher teach about 50 students from Aungthabyay village. Another two teachers teach about 190 students from new Mamauk village including from primary to seventh standard. At present, four persons who passed matriculation help in teaching at this branch school. The main area has seven teachers and 226 students.

Plate-7 and 8 show that school buildings' condition within main Mamauk and newly located Mamauk. The major State primary school of main Mamauk is located not far from the site eroded by the Sittaung river and is facing the problem of flooding during rainy season. Therefore, this school is likely to be moved to new Mamauk village. The major education problem of Mamauk village is insufficient number of teachers and school infrastructures.



Plate -7 State Primary School Building in Main Mamauk Village (22.6.2017)

Plate -8 State High School Building in Mamauk- Ywa Thit After Moving on (22.6.2017)

Economic Conditions

Villagers of the study area were engaged mainly in the primary sector, particularly farming and fishing, around the Sittaung river mouth and surrounding area before bank erosion. After bank erosion, occupations were changed to general work, water transport related work (small boat owners and workers), sewing, sharecropping and so on.

Loss of Le Land

Agriculture is an important factor for economic development of rural village in the study area. Before 2014, Agriculture was dominant economy of this area because most kaing -kyun appeared along the Sittaung River mouth. But, after 2014 the Le Land had been damaged by severe bank erosion on the western part of the Sittaung River mouth.

According to the data from Department of Agriculture and Land Management Statistics, loss of le land area was witnessed by all village tracts, the eastern part of Kawa Township along the Sittaung river bank. Le lands of Shwetasok and Bandar Village tracts within Kawa Township were lost by the bank erosion in 2014, which increased seriously in the southern part of this township. Up to 2015-16, the le land area damaged by Sittaung river bank erosion was 304.72 hectares, possessed by belong to 91 farmers of Shwetasok

village. The damaged le land area was 382.83 hectares belonged to 49 landowners of Aungmyektha village. About 492.5 hectares of le land (194 landowners) in Mamauk, 231.88 hectares (owners 63 persons) in Tadaroo and 510 hectares (466 owners) in Bandar were also destroyed. The total loss of le land area was 1817 hectares which were owned by 453 farmers.

According to questionnaires to 25 head of households in Mamauk village, the farmers faced so many problems for life survival due to lack of income and having no work and they have to keep on waiting donors. Some members of farmer families went and engaged in jobs as sharecroppers and wage-earners in Thaton Township in order to get income during the rainy season, especially during the paddy growing period. Some family members went and worked at sewing industry in Intakaw Town and provide money to their family. Some ventured to go to foreign countries mainly to Malaysia and China. Most of le owners have no jobs and live in poverty. Some have become fishermen.

According to questionnaires to 25 heads of households in Bandar and Aung Kan Kyaw new villages in July, 2018, the main economy of the 96 % of villagers depended on agriculture. The land tenure patterns differed from 1.21 hectares to above 12.14 hectares and grew paddy during the rainy season and pulses in dry season. Five households or 20% had above 12.14 hectares, 16% owned above 8.3 hectares (20 acres), 24% possessed above 4.05 hectares and other 36 % owned under 4.05 hectares. But at present time (interview and questionnaire distribution), the farmers who own no land have various work because all le land were destroyed by bank eroding. About 63% are engaged to general works to get income but this area is difficult to get work. They work only seven days per month as general work, especially by raising ducks and chickens stocks, earning a daily income of 8000 kyats. Some went to Thaton and Naypyitaw for job and cash.

Livestock Breeding

Before 2015, according to questionnaires survey to 25 Mamauk villagers, 22 households or about 88 percent earned their living not only on farming but also on livestock breeding. Livestock agri-business comprises such animals as cows, buffalos, goats, ducks and chickens. The largest

numbers of cows and buffalos were owned by three households with only 20 cows and buffalos. Six households ranked second in the numbers of livestock with less than ten. Other households had two or three cows and buffalos.

Table 3: Damaged *Le* Land by Sittaung river bank erosion at Kawa Township(2015-16)

| No | Village Name | Land use pattern | No of land holders | Damaged hectares |
|----|--------------|------------------|--------------------|------------------|
| 1 | Aungmitha | Le | 49 | 382.83 |
| 2 | Shwetasoak | Le | 91 | 304.73 |
| 3 | Mamouk | Le | 194 | 456.48 |
| 4 | Tadaroo | Le | 58 | 144.47 |
| 5 | Bandar | Le | 61 | 509.9 |
| | Total | Le | 453 | 1798.41 |

Source: Department of Agriculture and Land Management Statistics (Kawa Township)

But after shifting to other location, 70 percent of households sold their cows and buffalos because they needed money to move and rebuild their house and other difficulties related to livestock raising.

Before shifting to other location, the numbers of duck raising households was six and each household had about 100 to 800 ducks. After moving to the relocated area, these duck were sold off to get money needed. The new area is not favorable for duck raising.

Fishing Industry

According to questionnaire's result, the major economy of 15 households or 62.5% of total households operate fishing industry. But two households depend solely on fishing and other 13 households not only on fishing but also on agriculture. After moving to new Mamauk village, fishermen from new village go on foot to main Mamauk, which is about 3.22 kilometer or two miles away. Therefore, fishermen sometime stay and catch fish for two or three days at main Mamauk because of rough linking road and they come back if they get fishes. Their income decreased due to the above mentioned problems. Average income of one fisherman per day is

about 5000 kyats. But the income of fishermen is still large than farmer is income after moving to new Mamauk.

Conclusion and Suggestions

Severe bank erosion of Sittaung River mouth again took away the eastern part of Kawa Township from 2015 to the present time. Therefore, most of le land, pasture and settlement and other lands were destroyed due to severe mass erosion. The total loss of land area during seven-year period from 2010 until 2017 was about 163 square kilometers (16316.9 hectares). The villages along the Sittaung River in Kawa faced not only the destruction of the le land but also settlement area of village. Therefore, villagers witnessed the shifting of houses to new location, new school construction and other negative impact on social and economic factors. The total number of households destroyed by bank collapse was 754 with 3965 effected persons in 2017.

Villagers of study area were occupied with primary sectors especially farming and fishing, around the Sittaung river mouth and surrounding area before bank erosion. After bank erosion, occupations of the local inhabitants changed to general work, water transport related work (small boat owners and workers), sewing, sharecropping and so on.

Suggestions for development of land loss rural area in Kawa Township include both difficult and easy solutions. The following facts may solve problems of study area.

The settlement area is located over le land and it should be modified by landfilling the le land to become an area suitable for residing.

For sufficient availability of drinking water, pond should be dug and above mentioned information should be shared to attract donors and NGO by using Facebook and other social network.

The villagers want to have adequate teachers for effective teaching at schools and local authorized persons should consider and propose the department corned to appoint more teachers.

Weapatan canal is a major water transportation route for new location area and motor road should be constructed to connect Weapatan Village that has the hospital and high school for supporting education, health and other social needs.

Most villagers have no permanent job and income is low. Therefore, fish and prawn culture and duck breeding should be carried out by co-operative and companies supported by entrepreneur, local community and government.

Silviculture should be practised around the new villages and along the Weapatan canal for quality environment and firewood horticulture should be materialized within home compound to obtain some income and vegetable for dish.

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