

River Geomorphological Changes of the Duya-Inn and Surrounding Area

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Abstract

Duya-Inn is located in the southern part about 9.57 km of Hinthada, beside the Hinthada-Yangon Highway Road (N 17° 33' 38.27", E 95° 28' 59.85"). The Inn is an oxbow lake caused by river flow and river bank erosion. Duya, Bay Guang, Paya Gyi Gyan, Wha Tha La, Nat Kon, Kyon Du, Hton Bwe Gon, Hann Lone Kyaing, Pauk Yo, Yin Taik Kon and May Don villages are located around the Duya Inn. The main economy is fishing and agriculture. The area of the Inn is about 1576 acres, water body is about 900 acres and water depth is between 0.013 km and 0.114 km. The main factors of the Inn area changes are fishing, breeder, myth and economy. Geology of the study area is mainly composed of recent alluvium sediments underlain by Irrawaddy Formation. According to the soil profiles, most of the bedrocks are sand, sandy clay and silt. Main river flowing in north-south direction and, other streams are Thazi Chaung, Mwe Yet Chaung and Sun Pi Chaung. Hydro-dynamic processes are high and landslides can occur along river bends.

Keywords: oxbow lake, bank erosion, economy, alluvium, landslides

Introduction

Duya-Inn is located in the southern part of Hinthada Township (N 17° 33' 38.27", E 95° 28' 59.85") (Fig. 1), Ayeyarwaddy Region. It is also located beside Hinthada-Yangon highway road and about 10 km from Hinthada. The Inn is an oxbow lake (56 m above sea level) which occurred by river banks erosion and river channel changes. Duya, Bay Guang, Paya Gyi Gyan, Wha Tha La, Nat Kon, Kyon Du, Hton Bwe Gon, Hann Lone Kyaing, Pauk Yo, Yin Taik Kon and May Don villages are located around the Duya Inn. The area of the Inn is about 1576 acres, water body is about 900 acres and water depth is between 0.013km and 0.114km.

Methods of Study

Firstly, one inch map, Ayeyarwaddy Region map and Google Earth images are studied on desk. Sample collection, questions survey and local area data were collected during field observation. A drone was used for geomorphology study, to get high resolution overview images and topography of its environs. ArcGIS 10.1 GIS and Surfer 12 software are used for images analysis, topographic map and drainage map.

River System and Formation of Oxbow Lake

In the upper course of a river, water flow velocity is high, and V-shaped valley and vertical erosion are dominated (Fig. 2). Moderate velocity with vertical and lateral erosion occurred in the middle course. Meander stream and alluvial fans are also found in this course. In the lower course, water velocity is low. Lateral erosion, flood plains, braided channels, levees, oxbow lakes, meanders and delta are dominated.

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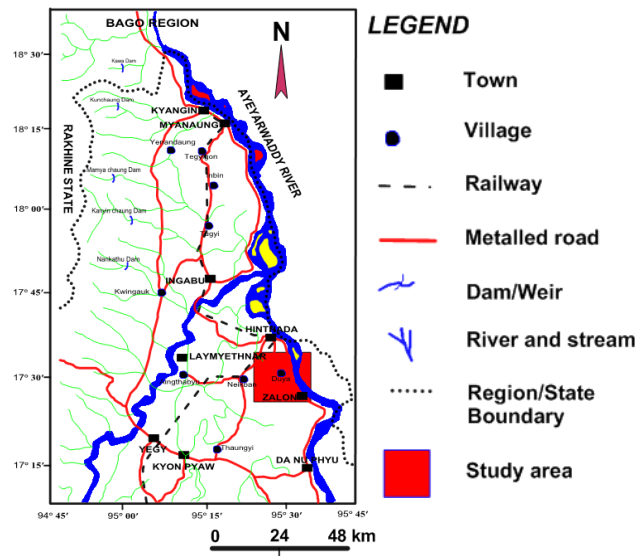


Figure (1). Location map of the Duya-Inn (Saw Ngwe Khaing, 2007)

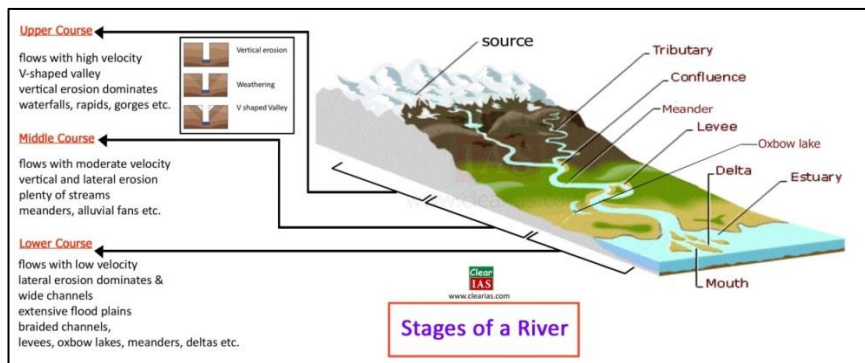


Figure (2). Stages of river (www.clearias.com)

Duya-Inn is an oxbow lake. Hydrodynamic process and river channel changes are strongly influenced in this area. Oxbow lake is a U-shaped lake and it is formed when a river creates a meander, due to the river’s eroding the bank. After a long period of time, the meander becomes much curved, and eventually the neck of the meander becomes narrower and the river cuts through the neck during a flood, cutting off the meander and forming an oxbow lake (Wikipedia.com) (Fig. 3).

Formation of Duya-Inn and River Channel Changes

Possible history of Duya-Inn can be studied on history images of Google Earth (Fig. 4). Firstly, lateral erosion of Ayeyarwaddy river caused meander channel in the area. Gradually, hydrodynamic process made channel cut off and formed Duya-Inn along western side of river. There are at least 3 Inns made by river banks erosion around the area.

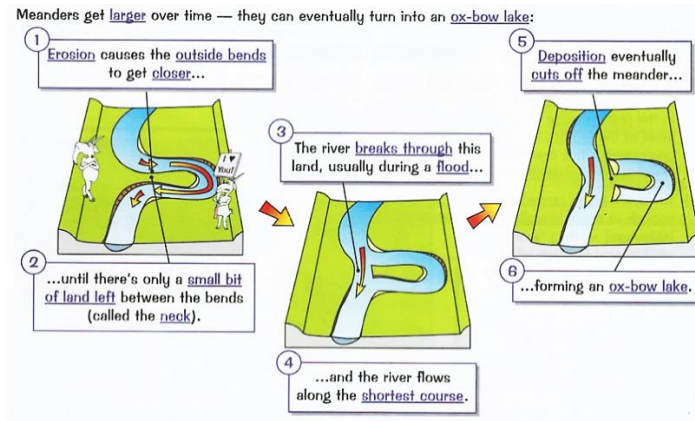


Figure (3). Formation of oxbow lake (Wikipedia.com)

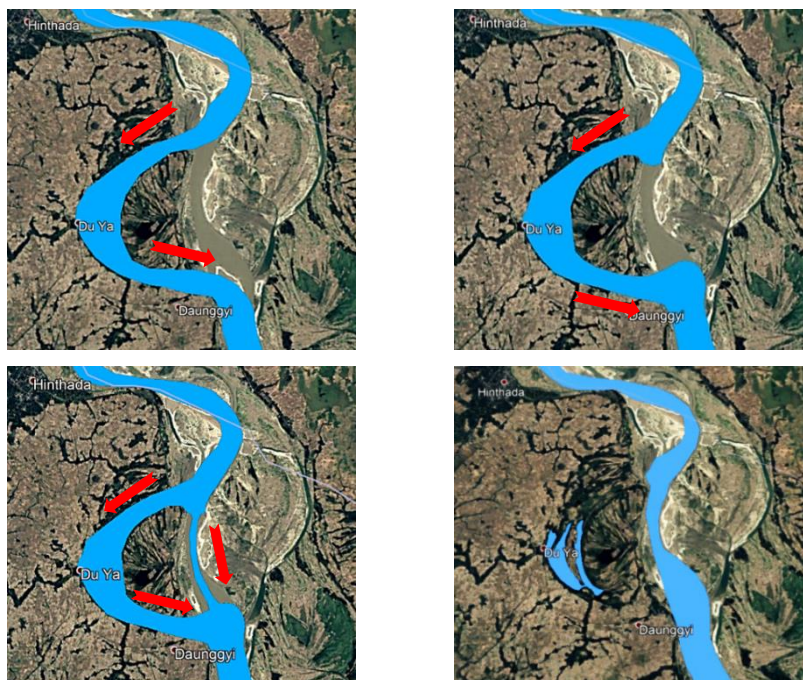


Figure (4). (a) First stage, (b) Second stage, (c) Third stage and (d) last stage and formed Duya-Inn (Google Earth, historical images)

In 1984 (Historical Image of Google Earth), Duya-Inn is located at about 4 km in the western part of Ayeyarwaddy river. River channel changes are highly affected by hydrodynamic processes. In 1990, the river channel changed about 280m towards west between 1984 and 1990. The changes gradually increased in 1995 about 1038m toward west as well. The river banks erosion made meander channels and occurred two river channels in 2000. In this year, west channel was progressed about 986m toward west. On the other hand, east channel also progressed about 370m toward east in 2010. In recent years, the western channel is closely located with Duya-Inn (far about 310 m). According to the historical images the major river channel changes occurred about 500 to 9932m east-west banks erosion (Fig. 5). The results indicated that the Inn area and its environs are influenced by strong erosion rate.

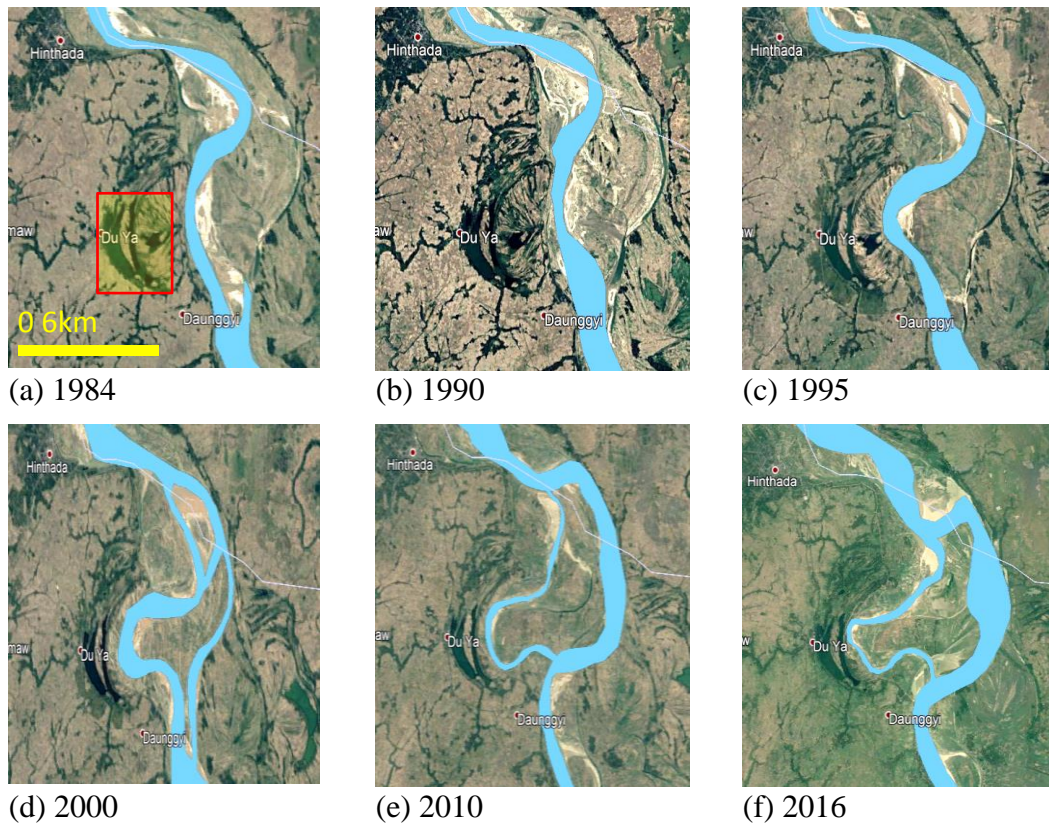


Figure (5). River channel changes in last 30 years, (a) 1984, (b) 280m toward west in 1990, (c) 1038m progressed toward west in 1995, (d) 986m toward west in 2000, (e) eastern channel moved 370m toward east, (f) western channel changed toward west about 490m in 2016.

Topography

The study area is located on the Ayeyarwaddy delta. Most are alluvial plain and crop lands. Duya-Inn is north-south trending curve lake (Fig. 6). Ayeyarwaddy River is flowing at the eastern part of Duya-Inn and far about 310m. Vertical cross sectional profiles are shown in figure (7).

The water depth of Duya-Inn is between 0.013km in summer and 0.114km in rainy season. According to the satellite images and field surveying, there are two channels separated by sand dune 431m wide but water body connecting with open place of southern part (Fig. 8).

Drainage System

According to the drainage map (Fig. 9), drainage system of the area is coarse dendritic pattern. Sun Pi Chaung, Mgwe Yet Chaung and Thazi Chaung are major streams of the Western part. There is no major stream in eastern part but Nyein-E Inn (0.27 sq mi), Kalaw Inn and In Swet Inn (0.1 sq mi) also occurred in eastern part. Major stream of the inn is Adar Chaung flowing from east to west through the Yangon-Hinthada highway road. However, this Chaung has no water in summer and work during the raining season only. Moreover, local people said that the water flow from Duya-Inn to that stream. Therefore, water table may be directly related with Ayeyarwaddy River and bedrock types of Inn.

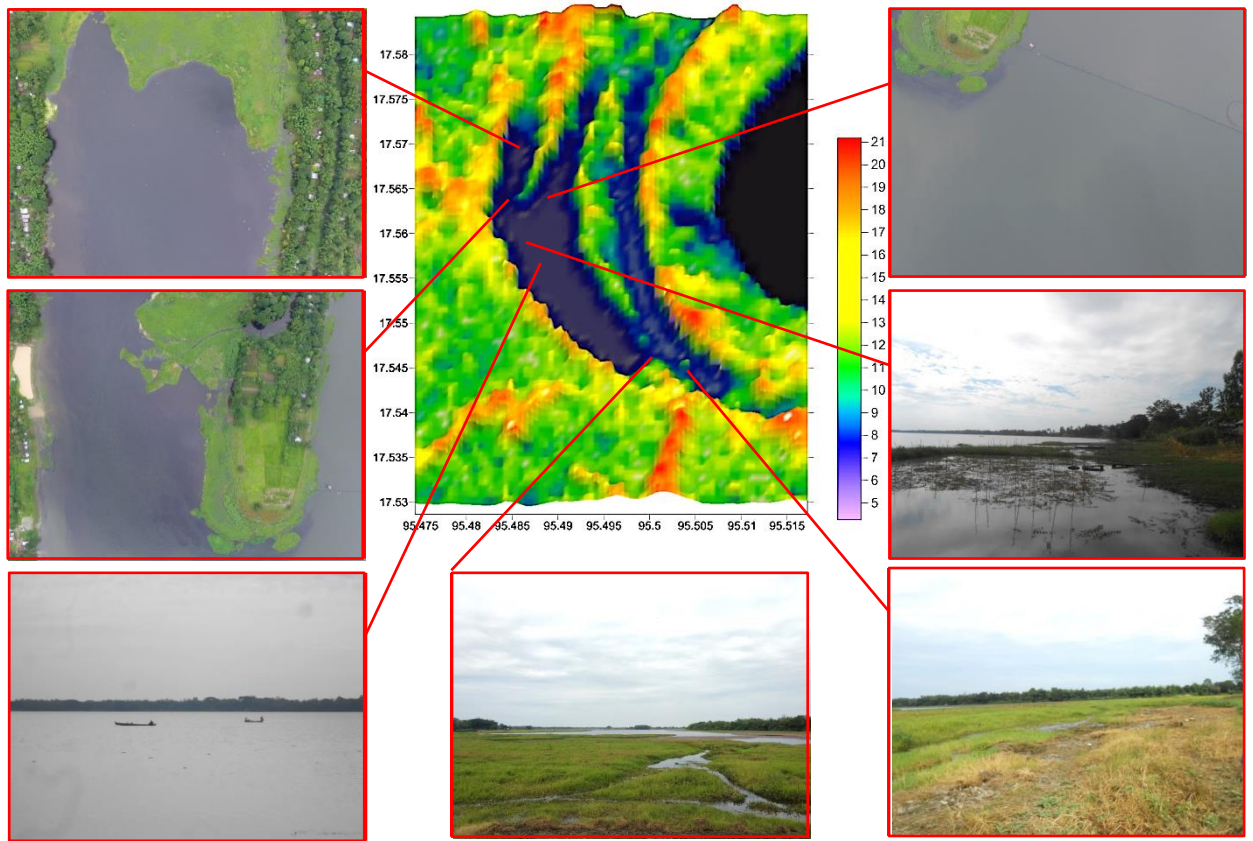


Figure (6). 3 D topographic map and surface features of Duya Inn

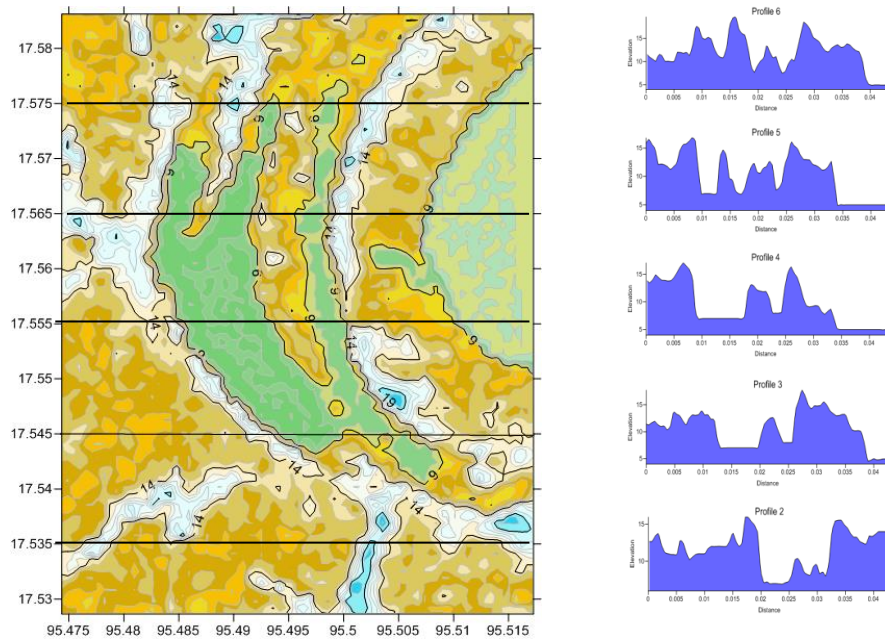


Figure (7). Contour map and vertical profiles of the Duya-Inn (elevation-meter)

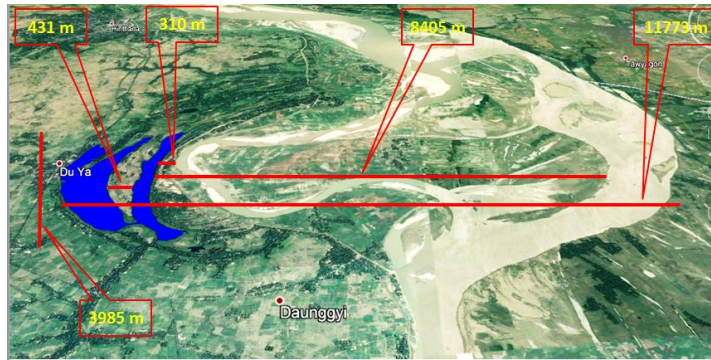


Figure (8). Lengths of the Duya-Inn and related river channels

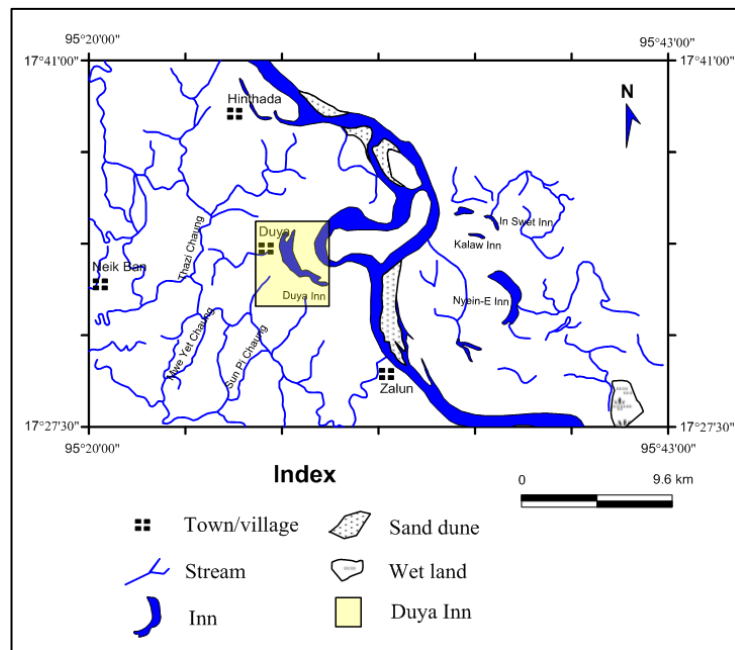


Figure (9). Drainage map of the Duya-Inn and its environs

Inn Area Changes

Supervised images classification of the Duya-Inn (2000 and 2017 Landsat images) clearly indicated river channel changes during 2000 to 2017 (Figs. 10 & 11). In 2000, the major river channel is flowing closely with Duya-Inn and it has only two river channels. Gradually other channels are formed by erosion and increase into three or more channels. In this classification, water bodies of river and Inn are also related with month of the taking of images. In summer, the area is slightly smaller than the raining season.

The total area of the Duya-Inn is 1576 acres wide and water body is about 900 acres. Water body may change during summer and local people have made agricultural land on exposed land surface. The total area of the Duya-Inn is about 1.27 sq mi in 1984. In 1990, the area is about 1.28 sq mi. However, the Inn area decreased to 1.24 sq mi in 1995. There is 1.25 sq mi in 2000 and was widened to 1.27 sq mi in 2005. Between 2000 and 2005 years Duya-Inn occurred more expand and had highly area changes. Today, the Inn area is about 1.28 sq mi (Fig. 12).

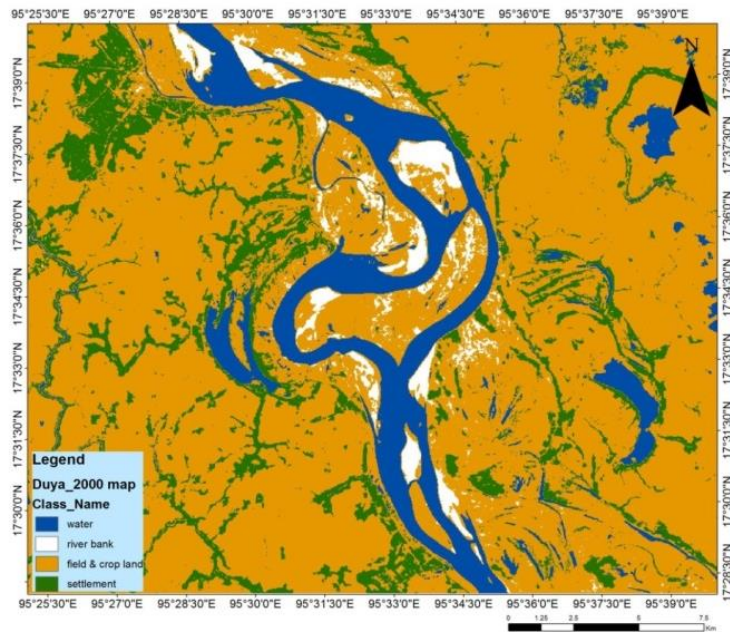


Figure (10). Image classification of Duya-Inn (2000) and (2017)

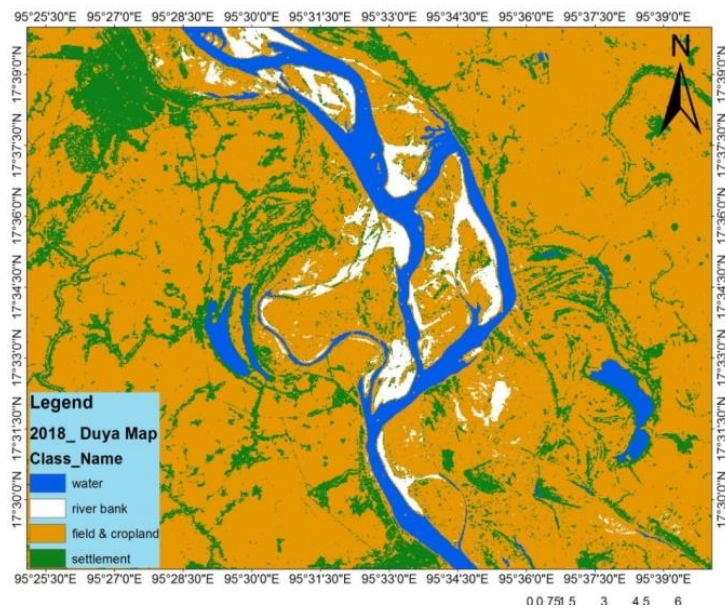


Figure (11). Image classification of Duya-Inn (2000) and (2017)

Inn area changes are mainly related with fishing, breeder and myth of the local people. Most of the people have been fishing since many years ago. Some are breeders in the Inn. However, breeders started during the last few years according to a myth. According to the question survey of local people (over 50 years), most are believed that the Inn have a devil. The belief of demonic concept inhibited the local people (e.g, using red or black attire, excretion, etc.). Therefore they can't do fishing and use well. In the last few years, above mentioned myth is missing link with the 21 century people. Local educated people modified their ancient myth and Inn area is more expanded by breeders and fishermen after 2000 (Fig.13).

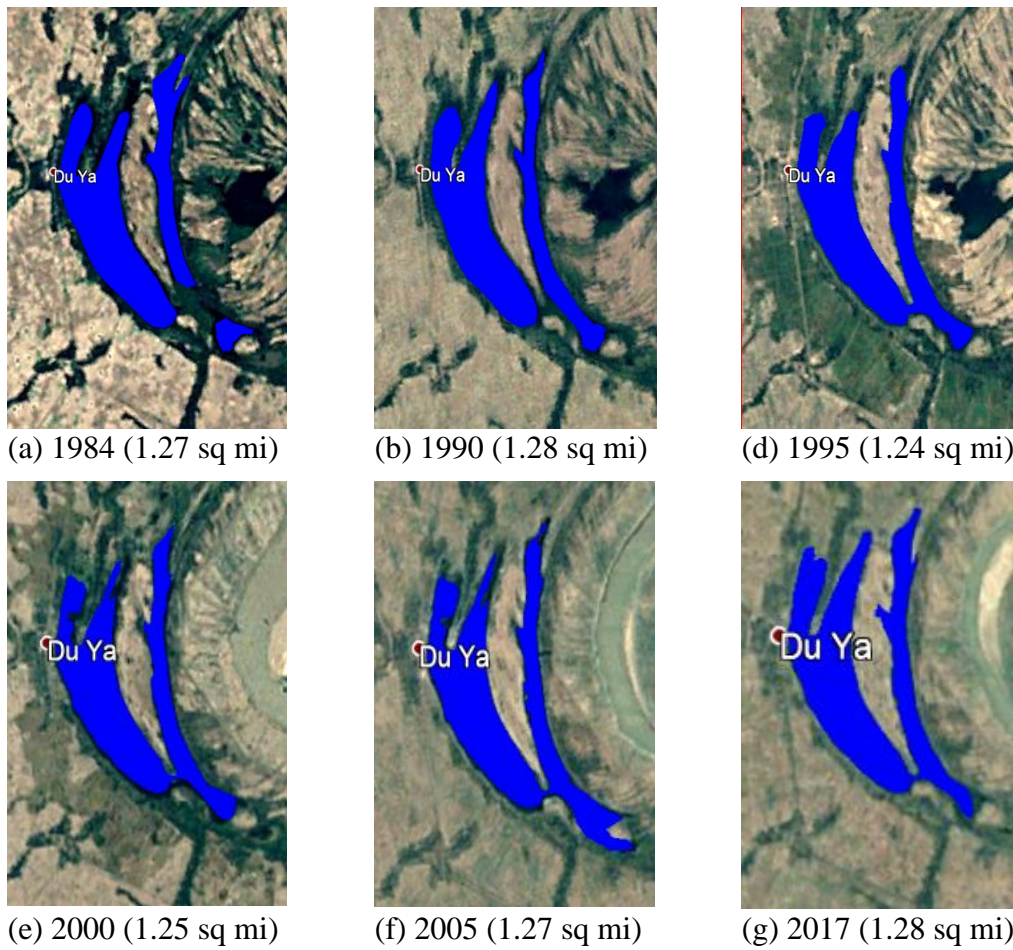


Figure (12). Duya-Inn area changes during last 30 years, (a) 1984, (b) 1990, (d) 1995, (e) 2000, (f) 2005, (g) 2017



Figure (13). Major factors of Inn area changes, (a) Fishing, (b) Breeder, (c) Economy of local people and, (d) Myth (question survey of age of over 30 years old about 50 people)

Geology

According to the geological map (MGS, 2014) (Fig. 14), Irrawaddy Formation is exposed at the eastern and western part of the area. On the other hand, sandy clay occupied along the central part. Duya-Inn is located at the Ayeyarwaddy Delta. Therefore most of the land cover is recent alluvium sediments (Fig. 15). Sandy clay, silt and clay are major constituents of the sediments.

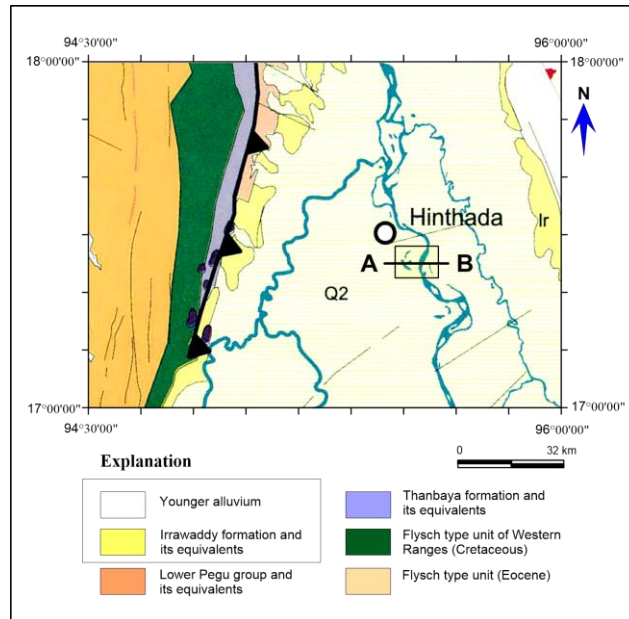


Figure (14). Regional geological map the Duya-Inn (MGS, 2014)

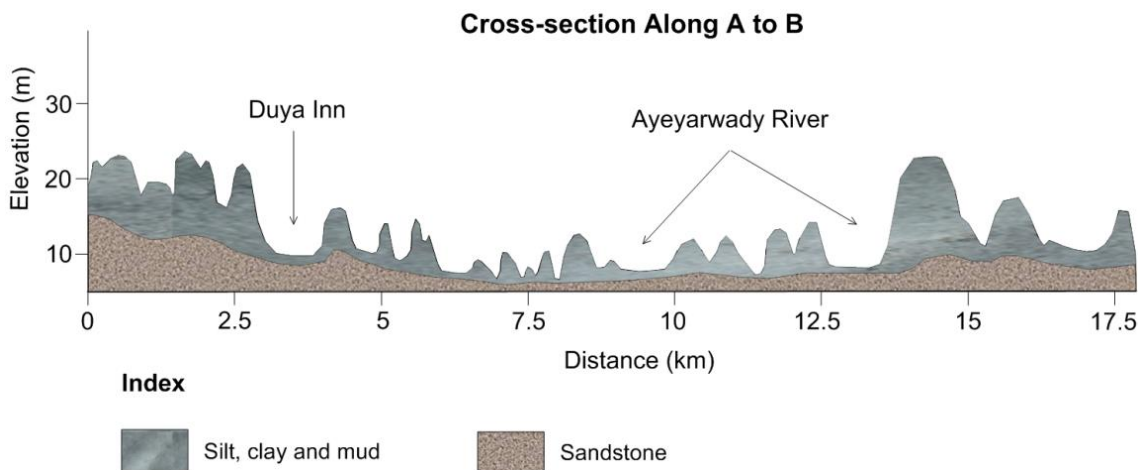


Figure (15) Cross section view of the Duya Inn

Conclusion

Duya-Inn is located along the Yangon-Hinthada Highway Road, Ayeyarwaddy Region. The Inn is an oxbow lake (56 m above sea level) which occurred by river banks erosion and river channel changes. The area of the Inn is about 1576 acres, the water body is about 900 acres and water depth is between 0.013 km and 0.114km. Lateral erosion of Ayeyarwaddy river caused meander channel in the area. Gradually, hydrodynamic process made the channel cut off and formed Duya-Inn along western side of the river. The water depth of Duya-Inn is between 0.013 km in summer and 0.114 km in the rainy season. Sun Pi Chaung, Mgwe Yet Chaung and Thazi Chaung are major streams of the Western part. Ada Chaung is the major stream but the water flows from Inn to outward. There are Nyein-E Inn (0.27 sq mile), Kalaw Inn and In Swet Inn (0.1 sq mile) also occurred in the eastern part. The total area of the Duya-Inn is about 1.27 sq mile in 1984 and about 1.28 sq mile in recent years. Inn area changes are mainly related with fishing, breeder and myth of the local people of the Duya-Inn area. Most of the land cover is recent alluvium sediments. Sandy clay, silt and clay are major constituents of these sediments.

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