

Analysis of Recurring Flooding Areas in Thung Song District, Nakhon Si Thammarat Province by using DEMs: Wang Heep Canal and Dam case study

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Received: 5 November, 2021; Revised: 12 December, 2021;

Accepted: 21 December, 2021; Published online: 29 December, 2021

Abstract

Digital Elevation Models (DEMs) are the altitude data of the terrain which are utilized to study and simulate hydrological models. The research objectives are creating terrain with Mathematica and creating hydrographic simulation with Arc GIS to analyze the numerical altitude of Thung Song District, Nakhon Si Thammarat Province. It was carried out by using the DEM data of the Royal Thai Survey Department on a scale of 1:50,000. According to the Universal Transverse Mercator (UTM) coordinate system, the resolution of subcells is 30X30 m². The simulation results indicate that Thung Song Town Municipality area has been experiencing repeated flooding, due to the fact that the type of the landform is mostly a basin which is surrounded by hills in steep slopes of the Nakhon Si Thammarat Range and there are 3 main streams flowing through the town; Tha Lao Canal, Perk Canal, and Tha Lone Canal. Consequently, drainage failure occurs every year. Furthermore, the confluence of these canals and Wang Heep Canal is the cause of flooding undoubtedly because the overflow of water from Wang Heep Canal submerges land of Thung Song Town Municipality and Chamai Subdistrict Municipality until these areas become the inundated land particularly at the banks of Tha Lao canal and Tha Lon canals. In addition of the urban growth and the structures of the waterway obstructions are all factors of flooding. Despite a construction of Wang Heep Dam crossing Wang Heep Canal which is the main waterway of Trang River Basin can reduce the flood level in Thung Song Town Municipality, the prevention of flood problem cannot be solved directly. Therefore, the researchers would like to present the guidance of water management by building the dam in “Monkey Cheek Concept” to store and control the excess water which flow through Thung Song Downtown. Moreover, dredging a canal is indeed a way to improve the water flow and to reduce the submerging land in the area which the 3 main streams go through. In addition, building the dam at the downstream of Tha Loa Canal is suggested because it can restrict the flow of water before it flows through Trang River during the drought.

Keywords: Flooding; Thung Song District; DEMs; Wang Heep Canal

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Introduction

Flooding problems have disturbing effect on economic and social Wikipedia (2018) Referring to the severe flooding in Thailand during the 2011, Thailand was confronted with a large flooding problem impact on Chao Phraya River Basin and Mae Khong River Basin from the end of July 2011 – 16 January 2012. More than 12.8 million people was affected. The World Bank has estimated that the damage from this flooding was around 1.44 trillion, Phukseng (2020) has defined the flooding into 4 types as following 1) The flash floods is the condition of heavy rain in the area with steep slopes that the water flows downhill at high speed. 2) The river flood is the condition of extensive rainfall over an extended period of time which is unable to drain and causes of the overflow the banks. 3) The urban flood usually happens in the lowland and in the community where the drainage system failed to drain the water from the heavy rain which occur in both a short term and a long term. 4) The coastal flood is the condition of the severe storms, The coast is flooded by the sea water because of the from the heavy rain for many days. According to the area information of Thung Song District river basin

Wikipedia (2019) indicates that the estimated area of Thung Song District is about 7.17 km² with approximately 30,513 population. The density of population is 4,300 per km². It is located in the west of Nakhon Si Thammarat city. Referring to the statistic of Sirindhorn Botanic Garden Climate Monitoring Station indicates that the climate of the rainfall throughout the year particularly the precipitation during the northeast monsoon season is higher than the southwest monsoon season. The least rainy month is February with the average rainfall of 0.06 mm. while the annual mean rainfall is 2,364.2 mm.year⁻¹ and the annual mean temperature is 27.32 - 36.4 °C. Due to the location of the east coast which is influenced by the northeast monsoon that covers the Gulf of Thailand leads to high steam and humidity. The highest temperature is in April with the average of 36.4 °C while the lowest temperature is in December about 20.4 °C.

On 3rd December 2020, Mr. Songchai Wongwacharadamrong, who is Thung Song Mayor's revealed to msn.com that the highest level of the flooding in this year was 1.50 meters and effected 12,000 families with 30,200 persons (see figure 1)



Figure 1. Flood condition in Thung Song Town Municipality, 2020

(a) Ekawat Village on Thung Song-Surat Road

(b) Phadung Rat Road in Pak Phraek Subdistrict

(c) Agricultural Market Intersection on Thung Song-Surat Road

The Royal Irrigation Department has planned to build the reservoir for trapping the water before flowing down to the residential area and for using in the agriculture purposes. Klong Wang Heeb Dam is His Majesty King Bhumibol Adulyadej's Royal Initiative Project which is located in Moo 1 and Moo 5, Naluangsen District, Nakhon Si Thammarat Province where the characteristic is the slope land and the foothills. The majority of land is belonged to the national reserved forest where is connected to Yong waterfall National Park which is the famous tourist attraction in Thung Song. Thung Song Town Municipality has experienced flooding annually which has occurred over 20 times in the past decade even it has submerged land for 1-2 days, it causes the worse impact to the economic.

Referring to the report of Royal Irrigation Department 2018, reveals that on 18 December 2018 the cabinet approved the Wang Heeb Dam construction

project due to the Royal Initiative Project of King Rama 9 as the mid-scale irrigation project. The core of structure is embankment dam at 71.00 meters high and 360.50 meters long with capacity of 20.10 m³. The irrigation system is useful for the agriculture area around 13,014 rai that profitable to the economic (EIRR) 8.22 %. The project plan is 5 years in a role (Fiscal year 2018-2022) total budget at 2,377.644 million baht. The exploration and design had been done since 2013 but the project need to be decelerated because it was opposed by the local people and Nakhon Si Thammarat – Pattalung Soil Protection Network. The researchers have visited the site to do the survey with the local people in Thung Song Town Municipality. Most of answers from local people reveal that the people in community want to continue with the Dam project, as they realize that the dam would help solving flooding problems in Thung Song Town Municipality.



Figure 2. Map illustrates the construction site of Wang Heeb Canal: Royal Irrigation Department (2009).



Figure 3. Area of flood boundary, agricultural area of villagers: msn.com (2021).



Figure 4. the condition of the construction of Wang Heep Dam on July 12, 2021

(a), (b) The stream around the dam wall construction area

(c) The housing of the group protesting the construction of Wang Heep Dam

Nikolakopoulos & Chrysoulakis (2006) said that DEM is the geographic database model of the land surface and the layer of height in digital character. The data collecting creates DEM mostly would be collected from the remote recognizing. DEM would be used the most in geographic information system. DEM in the form of raster and in the form of square grid that stand for height level or polygon of combined triangles. DEM is the main information that use for studying the hydrological features by analyzing the characteristic of topography. Cirbus & Podhoranyi (2013) said that DEM is widely used to demonstrate the process and the feature of hydrological which are including the humidity in soil (catchment area), the unstable of geographic (depends on the steep and catchment area), the erosion and power of the water (depends on the steep and catchment area). Generally, the Remote Sensing techniques would be used in the data collection procedure to create DEM (Light Detection and Ranging, LIDAR) as the elementary condition which is very important for multiple purposes for instant building three dimensions GIS map, the environmental monitoring and the spatial analysis. However, it is able to create from the research data collection which DEM accuracy of calculation is related to the resolution of DEM. US Army Corps of Engineers (2010) indicates the efficiency of the combination of using Streamburning

technique with the Geographic Information System to adjust the data of DEM could make the studying of topographic and hydrology procedures more accuracy. Thai researcher such as Prasit Maksin (2011) who studies about the impact of grid size and source of digital elevation model to calculate the parameter of hydrography. Barnes (2016) et al. indicate that the current data set is in GB level increasingly while the computer processing unit has more memory effectiveness significantly. Isares Kakarndee and Eakkasit Kositsakulchai (2021) have proposed the writing procedure program to create the flow direction model and flow accumulation on DEM. Luo (2011) et al said that hydrographic model is the model that illustrates the water flow of the surface water, the flow direction, the flow accumulation, the water level changing and the catchment which could be used in many areas such as the water management plan for the agriculture purposes and the forest purposes. In terms of the flow direction, algorithm is used to estimated widely which is called algorithm D8 model. This model able to find the border of river basin and Wallis (2009) illustrates that the using of D8 algorithm method to find the water flow direction providing the satisfied result in the foothill area where is the natural river basin. On the other hand algorithm D8 model is restricted in flat land. The D8 is used widely because of the effectively, simply,

and correctly, therefore all-commercial software such as Arc GIS are used to calculate the water flow. The method of calculating the water flow accumulation of every cells to others cells that have lower steep which currently is the cellular water distribution that has high cumulative and may use to consider the water route in providing the correct water flow information which is supported by multi applying. In the plan of water drain network for agriculture sector and construction planning that concern with flash flooding protection which Jung & Jasinski (2015) and Imran (2019) et al. provide satisfying result in the foothill area of natural basin but there is the restricted result in the flat land. However, DEM is the main data of studying in hydrography by analysing the topography to find the border of the water basin and the water flow direction. Ilachinski (2001) creates Cellular Automata (CA) which is the cells status in the time limit and depending on self-status from previous time process and illustrates the neighboring cells status in the previous time process. All the cells on the network get updated together in parallel. The status of network will be progress discontinuity. The water surface flow model provides the direction of water flow and current water level changing able to utilize in water management plan to solve the problems of flooding and drought. In generally the water flows from the high land to the low land and flows to the cells. US Army Corps of Engineers (2010) illustrates the flow direction as the calculation of water flow from one cell to another cell in the form of raster. The flow direction calculated by DEM data which there are 8 ways of flow direction. Boxall (2008) illustrates the calculating the information of cumulative flow from every cells that flow to the lower steep cells which is the outlet point of the water. Moreover the cells that have high cumulative rate may be used in the consideration to be the water path in the opposite way. The cells that have cumulative rate equal "0" is the high altitude area which can be considered as the ridge. The watershed is the area of low steep which the water flows though the outlet.

Dyckman (2020) said that Mathematica is the high-level symbol and is the high effective number program which is easy to study, to learn and is not com-

plicated and also is the powerful calculator that able to use for both academic and research. Juraj Cirbus & Podhoranyi (2013) said about the outstanding features of the program is the ability in calculative complicated equation, the characteristic of building the model by using stimulation of Cellular Automata and Mathematica and the program writing by using the Mathematica to demonstrate. Wolfram (2013) and Kelly & Giambastiani (2009) said that DEM would explain the variant of geographic that concern with the height in the studied area that has two-dimension landscape (2D) and three-dimension landscape (3D). DEM ables to organize as the lists make these data conform to the arrangement by using algorithm to write the functioning program. Kelly et al. (2010) indicates the script that write with the language of work that concise and similar to the original math notation. Furthermore, DEM ables to adjust all the conditions according to the context of the area that have been changed to be the data base for the water management and still stimulate the risk area to disaster that similar to the real condition of the area when use the form of functioning program writing in symbolic Mathematica program with 3D graphic.

Research team is interested in studying the topographic from the DEM data of The Royal Thai Survey Department to develop the topography model and hydrography that have effective in dividing the water distribution network and basin border by using Arc Hydro tools in the Arc GIS program to create the model which is the closest to the real condition of the area to be the data base of the water management, the water path data and the watershed. This model is useful to analyse the risky area to flood and to analyse flooding problems that happened in Thung Song Town Municipality as well as indicate the benefit of the dam to prevent the flooding.

Equipment and Methods

Research border and Equipment

This study has chosen some area of Thung Song District and Ronpibul District in Nakhon Si Thammarat Province. The study indicates the analysis of the characteristic of topography and hydrography in the area of

1,458 km² which are including two sections of section 49252 and 49253 of The Royal Survey Department, the square area data ABCD that could be divided into small cells (see Figure 5).

Purchasing of the DEM from the Royal Thai Survey Department for 2 sections, grid cell amount at 1,200

Columns and 1,600 Rows or 1,920,000 cells which the data is stored as pair of row and column (Row, Column), image resolution size is 5 pixels and is stored in the form of raster (Filename .img) and approximate file size around 2 MB per section which the research procedure as the following details (see Figure 6).

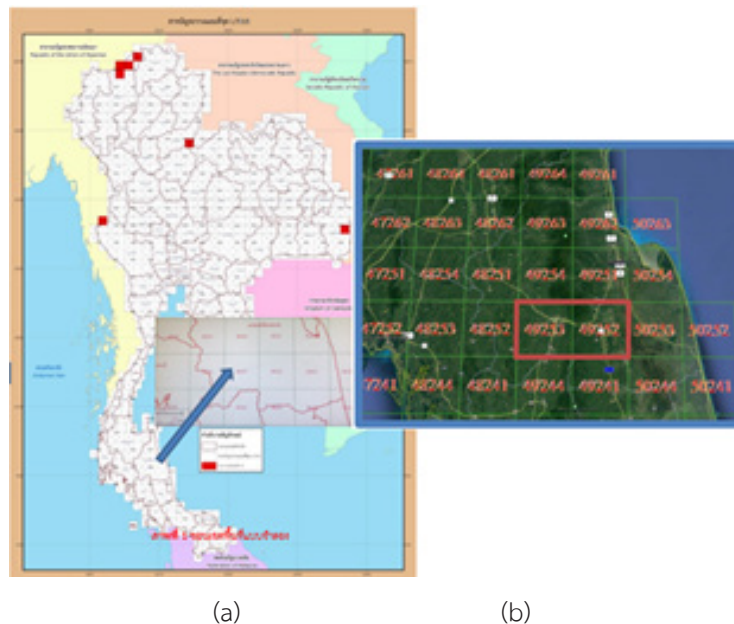


Figure 5. (a) A Map of Thailand of the Royal Thai Survey Department.
(b) Research area scope

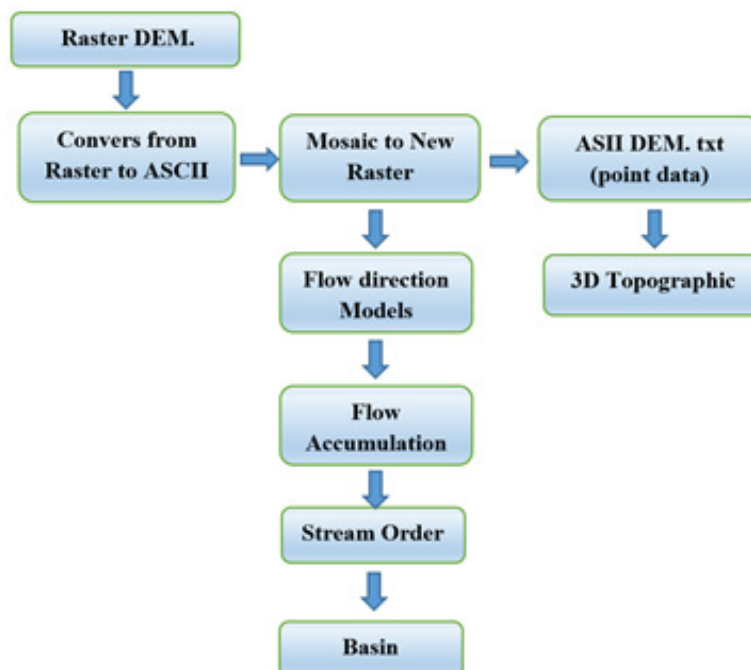


Figure 6. Research procedure

Referring to the water flow data and the water flow way provide the comprehension of the entry and exit characteristics of the waterway.

1) Analyzing the geography with the 3D geography model. Juraj Cirbus & Podhoranyi (2013) uses the Mathematica program, in Thailand, Panjit Musik (2018) has indicated the analysis method of the 2D, 3D Topographic and flow direction model and the flow accumulation model by using DEM data. 3D Topographic in this article used function

"ListPlot3D[data, DataRange \rightarrow {{...,...},{...,...}} and defined color by function "RelifPlot [data, ColorFunction \rightarrow "GreenBrownTerrain", Mesh \rightarrow None] ", the result for the sample in figure 8 and 10, "ListPlot3D[data, DataRange \rightarrow {{...,...},{...,...}} and defined color by function "RelifPlot [data, ColorFunction \rightarrow "GreenBrownTerrain", Mesh \rightarrow None] ", the result for the sample in figure 9 and 11.

2) Analyzing fill method to improve DEM. Abnormal value of any cell is very high Z-factor in comparison to average values of DEM and are commonly known as pits. The removal of sinks/pits from DEM is the pre-processing phase which is important to obtain continuous stream network

3) Analyzing the hydrographic with hydrographic model Arc GIS program, which consists of the flow direction model which there are 8 flow directions referring to direction coding. Jenson & Domingue (1988) illustrates in the figure 4 as orange stands for color code 64 north, yellow stands for color code 128 northeast, green stands for color code 1 east, dark green stands for color code 2 southeast, blue stands for color code 4 south, dark blue stands for color code 8 southwest, Navy blue stands for color code 16 west and purple stands for color code 32 northwest. Then analyze the flow accumulation

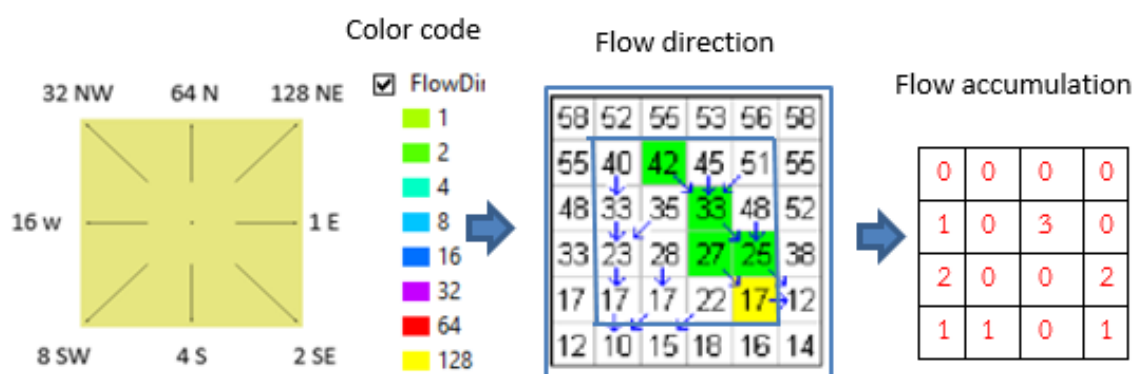


Figure 7 (a) Specifying the color code of the flow direction, the water flows from high to low and accumulates in the catchment area.

4) Analyzing the Stream Order data and scoping the watershed in order to calculate flow accumulation of the data unit that flow from the higher land to the lower land and analyzing the main stream of Thailand. Supatra Putnaowarat (2015) indicates the flow direction analysis for stimulating the hydrographic. Chanasak Seangsakul (2020) analyzes flooding from iRIC Model. The flow direction is applied to bring about the stream order. The upstream segments are always assigned an order of 1.

5) The drainage basins are created by locating the pour points at the edges of the analysis window

(where water would pour out of the raster), as well as sinks, then identifying the contributing area above each pour point.

Results

Case study: Writing the Thung Song geographic model program with DEM ratio 1: 50,000 of the Royal Survey Department by using the Mathematica program

The consideration of the geographic simulation result from figure 8-9 found that Thung Song Town Municipality has majority of the landform as a basin and surrounded by four low mountain; Mount Jam, Mount

Chumpol, Mount Pridi and Mount Rab and raining through the year. There are three watersheds in Thung Song Town Municipality; Tha Lao Canal, Tha Lhon Canal and Puek Canal. The information from the Royal Irrigation Department (2009) there are total watershed including water outlet above the Kuan Krok wire around

123 km² and highest great flood amount in 50 years during November to January around 219 m³.s⁻¹. While the ability to drain of each canal have only 60 m³.s⁻¹ which will cause the exceed water amount up to 159 m³.s⁻¹ and rapidly flood to Thung Song and Chamai Municipality.

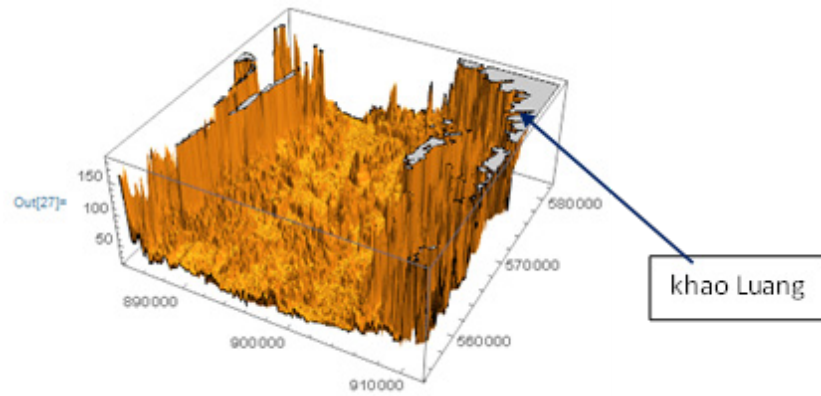


Figure 8. The results of the simulation with Mathematica program, the tonnage area no 49253 at the Mean Sea-Level

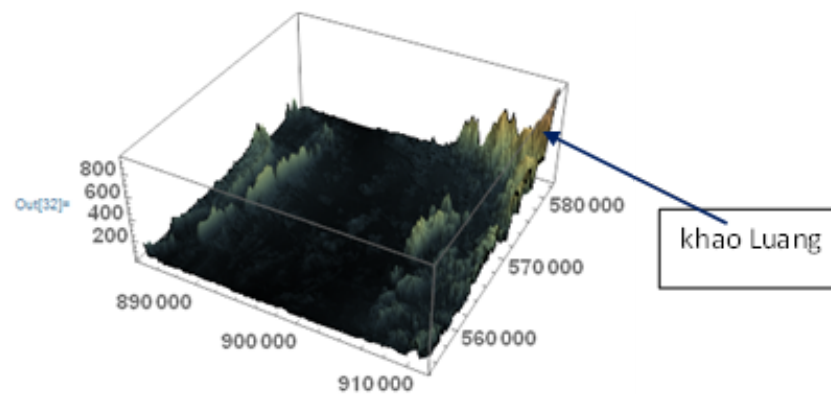


Figure 9. The results of the simulation with Mathematica program, the tonnage area no 49253 in the overview

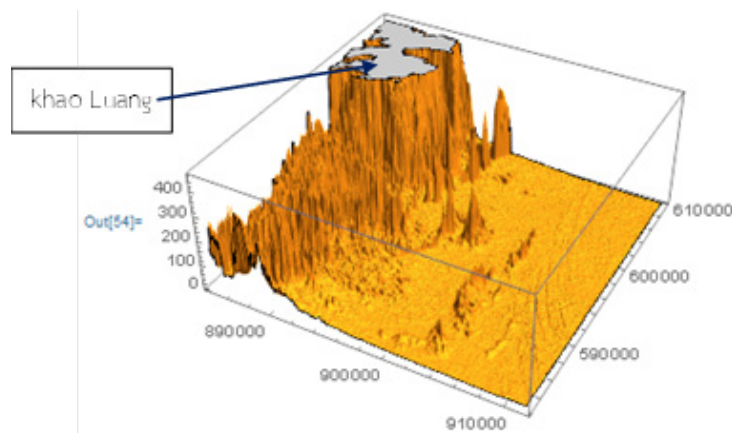


Figure 10. The results of the simulation with Mathematica program, the tonnage area no 49252 at the Mean Sea-Level

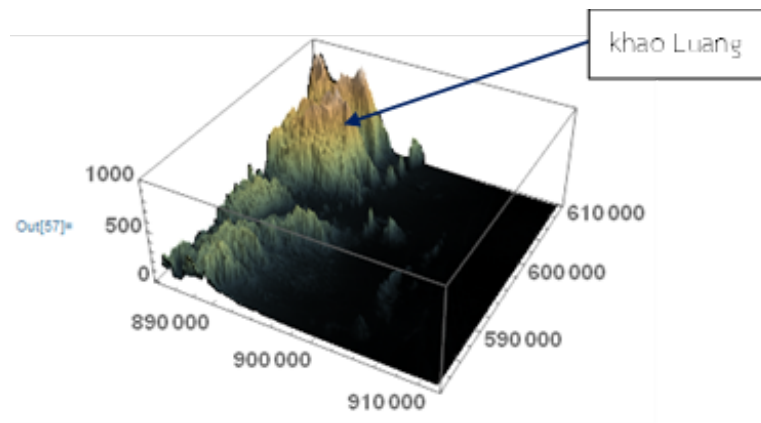


Figure 11. The results of the simulation with Mathematica program, the tonnage area no 49252 at the Mean Sea-Level

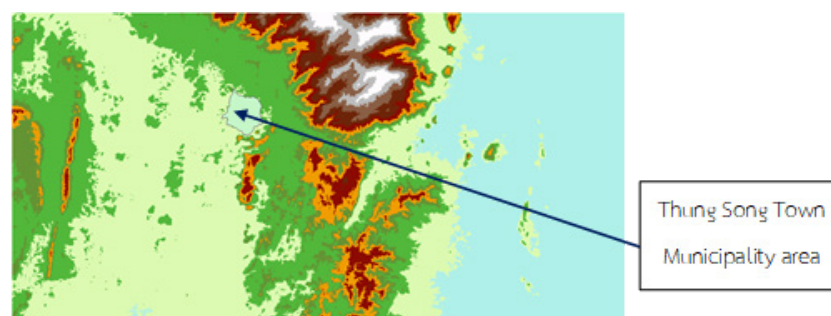


Figure 12. DEM data of No.49252 and No.49253

Figure 10 and 11 illustrates Nakhon Si Thammarat hillside separate Thung Song District from Ronpibul District as the natural border. The creation of geographic model from figure 12 found that Thung Song

municipality majority has the characteristic of its land as foothill. The highest mountain peak in Thung Song and Ronpibul District is around 980 meters above the sea level.

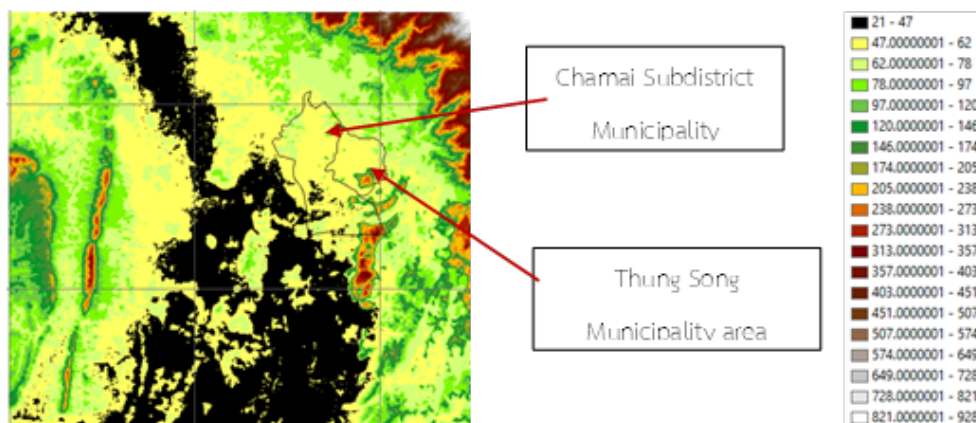


Figure 13. DEM data layered into 20 layers of No.49252

DEM stimulation result divided by height

Referring to the figure 13 layered the high level with DEM into 20 layers. This clearly see that the majority area of Thung Song and Chamai municipality located at the layer yellow that is around 62-78 m above

the sea level. Which is the high land when compare with the area outside the municipality. The characteristic of the flood is the problem from the flash flooding from mountain peak of Nakhon Si Thammarat and surrounding foothill. Due to the figure 14 found that, when

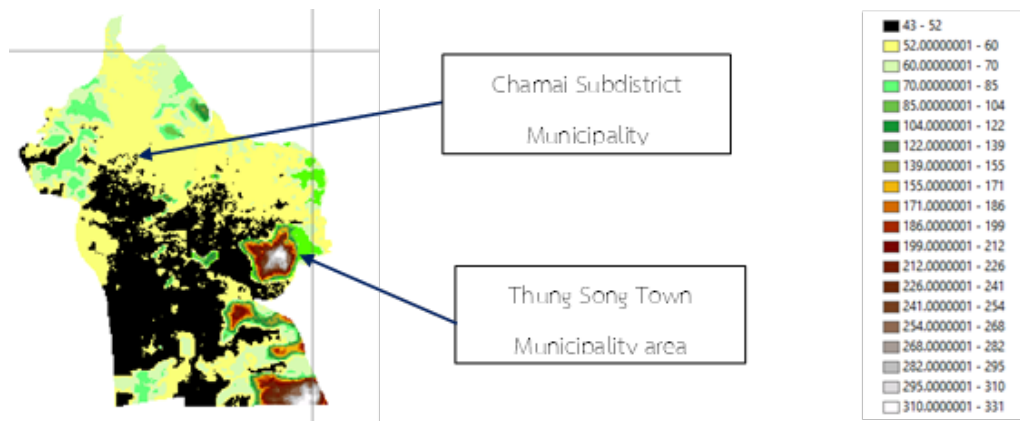


Figure 14. Illustrates DEM data layering into 20 layers in Chamai Subdistrict Municipality and Thung Song Town Municipality.

scope only Thung Song and Chamai municipality and layers high level with DEM into 20 layers, able to clearly see the lowland that possible to have higher flood than other area at the connection between Thung Song Town Municipality and Chamai Sub-District. It is the location at the black high layer or between 43-52 high above the sea level.

Mostly the area is the lowland when compare with the area outside the municipality which is similar to the small Kaemling – Monkey Cheek Concept (The flooding protection system according to His Majesty the

King Rama9's Royal Initiative Project) in both municipal areas. The flooding characteristic is the problem from the flow direction of Nakhon Si Thammarat Mountain peak and surrounded foothills but cannot drain out in time due to the watershed area of the basin become the construction as the expanding of city area. The construction has encroached and obstructed the water ways and canals cause the unable to drain out the flooding water in time especially the shore area of Tha Lao and Tha Lhon canal.

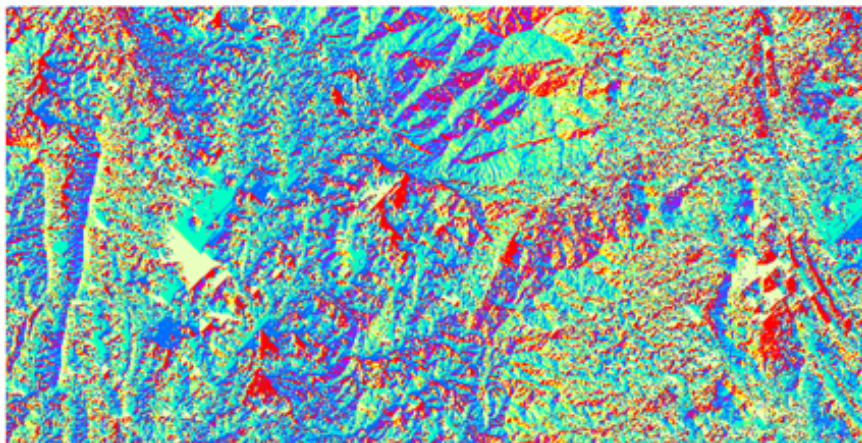


Figure 15. Flow direction model of DEM 49252 and DEM 49253

Flow Direction Information

During the high level of flooding in Wang Heeb canal, it would cause some part of the water flow over Thung Song and Chamai municipality.

Referring to the Figure 15 and 16, observing the flow direction. The flow direction has flow from the northeast to the southwest and west from Nakhon Si Thammarat Mountain through Thung Song municipality out to Chamai district.

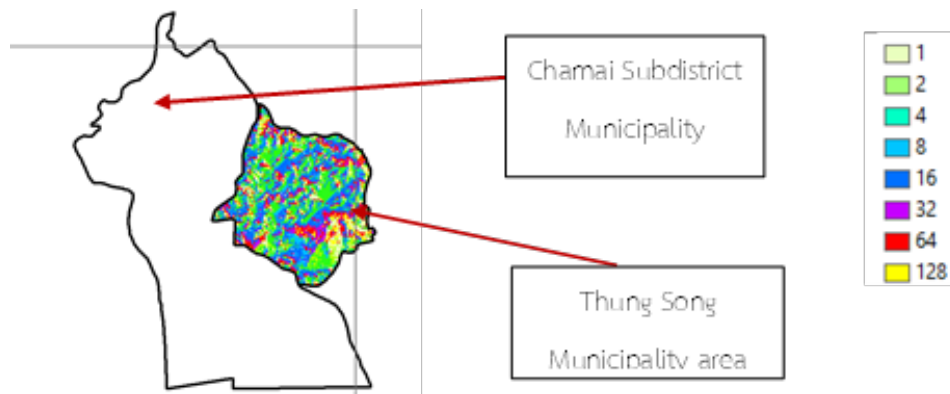


Figure 16. Flow direction model in Thung Song Town Municipality

Flow Accumulation Information

Referring the figure 17, indicates all three main streams that have flown directly through Thung Song Town Municipality which are Tha Lao canal, Tha Lhon canal and Perk canal. The confluence of these 3 canals is meet around Khao Krai Temple in Chamai Municipality. Whenever there is the overflown in these canals during the rainy season particularly in November – Jan-

uary which casues the overflown of water submerges land in the total area of Municipality, Chamai Junction, Talad Nai community and Thung Song Town Municipality, Agricultural Market Thung Song – Surat Rd.

Stream Order Information

Stream order is the layers of the stream line that make the ability to forecast the flow amount which able to flow through the area (see Figure 18 and 19).

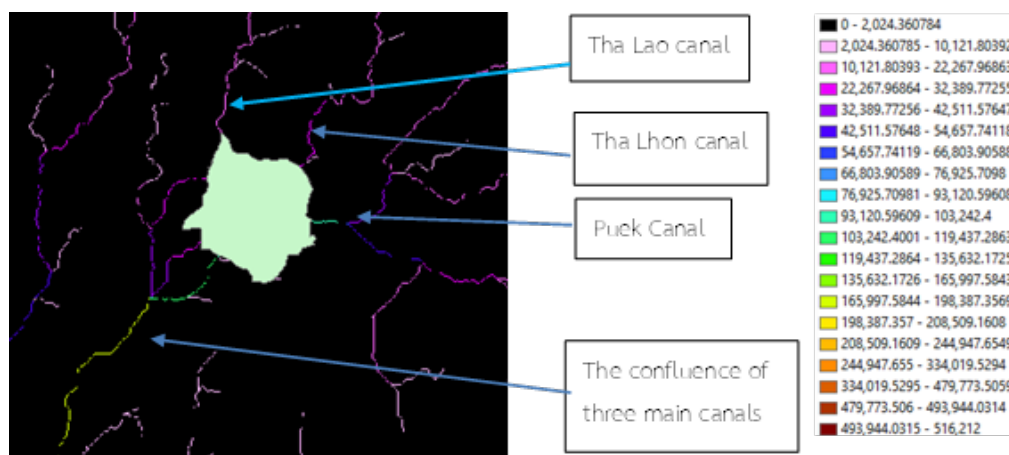


Figure 17. Flow Accumulation model of N0. 49253

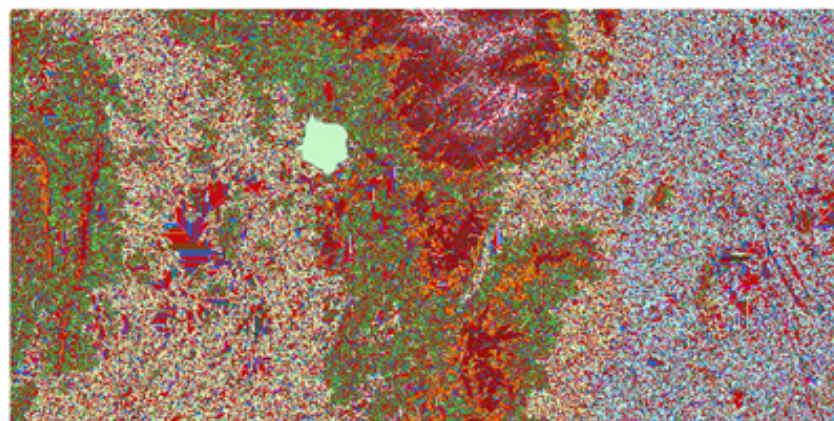


Figure 18. Stream Order of DEM 49252 and DEM 49253

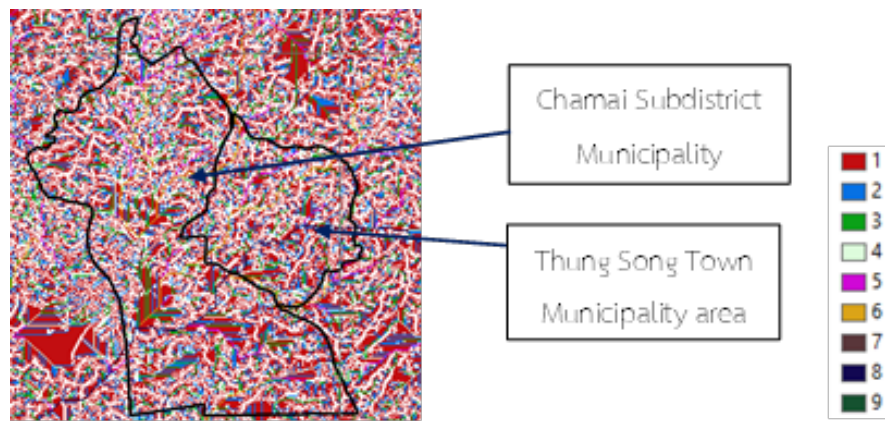


Figure 19. Stream Order of Chamai Subdistrict Municipality and Thung Song Town Municipality.

Referring to the Figure 19, the small streams are connected and spread through the area of Thung Song Town Municipality and Chamai Municipality. (see Figure 19) Referring to the figure 18, indicates the position of Thung Song Town Municipality where is located in the foothill and the stream order in the area of DEM 49252 and DEM 49253. The figure 18 indicates the main streams on the Nakhon Si Thammarat Mountain Range which flow through the area by having stream brunch at level 4 white color. It flows through Thung Song Town Municipality and to Chamai Municipality all over the area which is a type of the medium flow accumulation stream.

Due to the figure 20, indicates the watercourse which are connected throughout the Thung Song Town Municipality and Chamai Municipality. The building of Wang Heeb Dam is building across Wang Heeb canal

which is the main steam of Trang basin. While the over-flow of water which submerge and flood in Thung Song Town Municipality are the watercourse from Tha Lao, Perk and Tha Lhon canal. However, all the mentioned canals have the branches which are confluent in one point and join with Wang Heeb canal again at Na Maipai district, Kao Ro District and Tee Wang District. The construction of Wang Heeb Dam at Na Luangsen sub-district Thung Song District would be useful in agriculture during the drought. Moreover, might be able to control the water level that rapidly submerge to Thung Song Town Municipality and restrict the water level too high.

Referring to Figure 18, 19 and 20 indicates that the watercause which originated from the main canal; Tha Lao, Tha Lon and Perk are tightly connected around the area which refer to the landform type of basin. (see Figure 18-20)

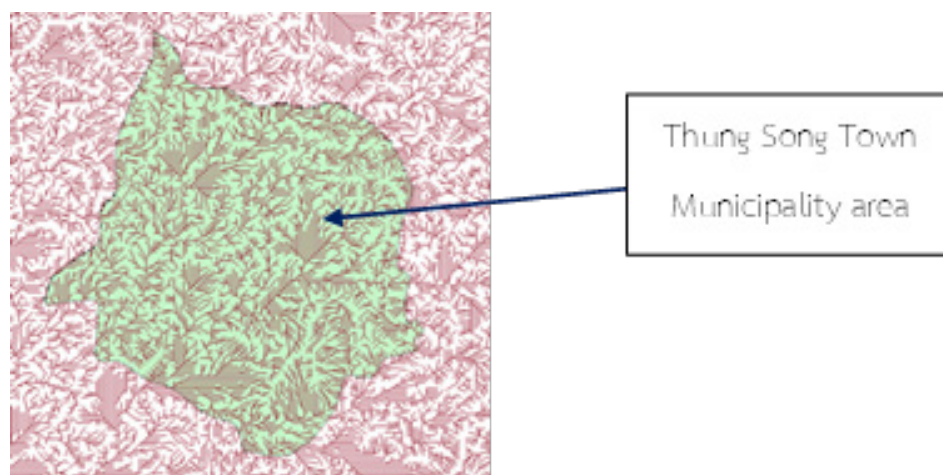


Figure 20. The tributaries in the Thung Song Town Municipality area are interconnected networks.

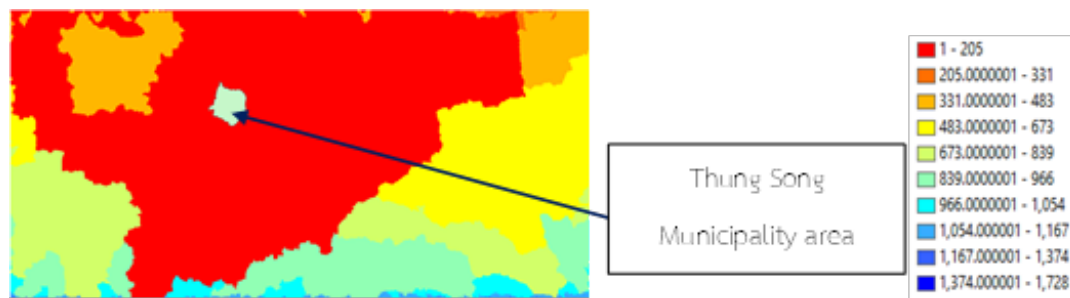


Figure 21. Trang Basin

Basin Information

Referring to the figure 21, clearly see that Thung Song Town Municipality is located in the middle of the Trang River Basin. Due to the central database system and the standard of Marine and Coastal resources information (2021). Trang River Basin has two main basin which are Trang River and Pralean River. Trang River has the origin from Wang Heab Mountain, Kao Luang Mountain Range, Nakhon Si Thammarat province, have a length around 175 km. has catchment area around 3,449.27 km². Pralean River is originated from Bantad mountain range, Pralean district, Trang province that has total length around 77 km. and catchment area around 1,047.15 km². According to the information from the Royal Irrigation Department (2009) found that the basin area of Wang Heab Canal is located in Luangsen sub-district, Thung Song district. The characteristic of the landform is the steep mountain and the high mountain range in the east, the north and the northwest. In addition, the height around 1000-1300 meters, such as Menh Mountain, Thong Mountain, Wang Heeb Mountain, Pra Mountain, Yong Mountain. The plain area is in the southwest around Nong Hong sub-district, Kraun Krod Sub-district and Na Maipai Sub-district with the average height about 30-50 meters. The area approximately sloped from the northeast to the southwest.

The Wang Heeb Canal is the watercourse that has many of small brunches join together by having watershed total 305 km² and has amount of the annual average natural water from the basin around 267 x10⁶ m³ and the amount of the annual average water of Wang Heeb canal basin about 136.97 x10⁶ m³. The total average runoff amount during the raining season and drought season of Wang Heeb project and apply this

water to use in each activity will cause the decreasing amount of average water from the rear end of Dam, from the original at 23.53 x10⁶ m³ to remain only 17.68 x10⁶ m³, (Decrease 24.86%). During the raining season decrease for 40.67% and increase during drought season for 5.90% at the outlet in the Tha Lao area. Which cause of the decreasing of the water level in Tha Lao canal. Referring to the interview of Mr. Chaichana Deshdechcho and Mr. Prakob Rattanapant (The Member of Parliament of Nakhon Si Thammarat Province, Democrat Party) after the meeting on 21 September 2021 at Trang River Basin Water Management Centre, Thung Song District, Na Khon Si Thammarat Province with all concerned parties as follow, The Acting Sub Lieutenant Kittipop Roddon (Thung Song Marshal), Mr. Songchai Wongwatcharadamrong (Thung Song Mayor), Mr. Jomkrai Sawasdiwongse (Deputy Chief Executive of the PAO Nakorn Si Thammarat), Mr. Preecha Prompech (Deputy of PAO Council) and the representative from the Royal Irrigation Department. The meeting was set up to find the integration and permanent solutions for flooding problem in Thung Song Town Municipality. The concerned parties have invited the Royal Irrigation Department to listen to the problem that happened in the area. From the interview statement in online media of Baan Meung (2021) reveal that the flooding solution of Thung Song municipality have been announced. Mr. Chaichana Dechcho said that the primary problem in Thung Song district at the present is the amount of mass water is 195 x10⁶ m³.s⁻¹, the ability to drain out is 95x10⁶ m³.s⁻¹ or the inlet flood always come from the surface water accumulation that cannot be drained out in time and cause all the area covered by water. All said previously is because of the inefficiency drainage system. These situations always

happen in the city community area when there are extended of heavy rain for many days. The analysis of problem solution guideline from the meeting of Trang basin water management Centre are 1) Building the Dam 2) Building the Floodgate 3) dredging the canals.

Discussion and Conclusion

The applying of Digital Elevation Model (DEM) by remoting research of the Royal Thai Survey Department to develop geographic model. The case study of Thung Song Town Municipality and Chamai Municipality with Mathematica program, the result of 3D DEM model reveal that Thung Song Town Municipality river basin give the result consist of the realistic and the geographic. The development of hydrographic model indicates the watercourse from the high land flow to the basin in Thung Song Town Municipality and Chamai Municipality with three main canals including Tha Lao canal, Perk canal and Tha Lhon canal flow directly through Thung Song Town Municipality. However, the main canal that flow directly to Wang Heeb Dam is Wang Heeb canal. Therefore, the construction of Wang Heeb Dam could decrease the level of the water that submerge through Thung Song Town Municipality during the severe floods which has the water outlet drain to Tha Lao canal. Although this solution could prevent the water reversing back to the main waterway, it could not protect from the floods directly. Thung Song flooding problems is the flooding characteristic that happened due to the accumulation from large amount of precipitation which cause flooding from Nakhon Si Thammarat Mountain Range flow down to Thung Song municipality area, which is the hillside slope area and has the basin in the middle surround by low-rise mountain. Those are

the sources of flooding problem and waterlogging of the city that keep expanding. It is the flooding problem that recurring repeatedly. Also dangerous from the river overflowing to the banks. The method to solve flooding problems need to complete all the circle of building the dam, building the watergate and expanding the canals.

Therefore, the researchers would like to propose the solution of preventing the flooding problem recurring repeatedly in Thung Song Town Municipality as following; 1) building the Low-Head-Dam which the purpose does not for permanent storing of water but for temporary storage as "Monkey Cheek Concept" which the watergate would be opened all the time and would be closed in case of overflow only. Regarding to this solution the amount of water would be controlled from the origin of the waterway down to the middle of the waterway where water flow through Thung Song down town until the end of the waterway around Khao Krai Temple where is the confluence from the three main canals; Tha Lon Canal, Tha Lao Canal and Perk Canal. 2) dredging canal by expanding widely and deeply which could reduce the overflow submerge land in Thung Song Town Municipality and Chamai Municipality because the characteristic of the confluent joint of these 3 canals at Khao Krai has the shape of bottleneck which cause to reverse of the water to town. 3) building the downstream dam due to the dredging canal deeply, the water would flow rapidly and would be drought eventually which cause of the water supply system. Therefore, the downstream dam at Tha Lao could be the water storage and could restrict the water before flown down to Trang River.

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