

# The development of Decision Support Systems using Neural Networks and Geographic Information Systems for water transportation in Chai Nat province.

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**Abstract--**This research aims first to study water transport factors, second to study locations and transport data using geographic information technology and Third to develop the decision support program to promote water transportation using geographic information technology and neural networks. The research results were found, first in the survey conducted on water transportation from Manorom District, the beginning point of Chao Phraya River in Chai Nat province border with the Uthaitani province was a trade center antiquities. Steamer boats from Phi Chit province go down to Nakhon Sawan province and flow with the Chai Nat River Cruise along the Chao Phraya River. The boat's breakpoint was called "Khung Samphao", which had a shrine called "guan-oo" for worship by the boat owner, the crew and the passengers. Boats across the Chao Phraya River loaded buses, cars, motorcycles and people. It saves many times traveling the Chao Phraya riverside. Because Chai Nat province has three bridges across the Chao Phraya River, some water transport has small boat owners that can not exceed 15 persons. Second, record GPS of 35 water transport places carried out in the past, and now usage and water transport potential is assessed using an assessment form. Third, Implementing neural networks helps in the grouping of water transport. The evaluation, water transports have seven groups and three water transport because they have a high score of potential for water transport and analysis cost, time, distance and government office service using the ArcGIS desktop.

**Keywords--**Water transport, Neural network, evaluation of water transport

## I. INTRODUCTION

Thailand's planting is diverse in many regions. It is an agricultural country that creates a farming community that includes the cultivation of perennial, herbaceous, plant seasonal, plant non-seasonal, and field crops because Thailand has many fundamental factors such as equatorial area, soil, water, and weather conditions suitable for plant production. There were processes of planting that began with finding planting areas, organic water sources, soil, fertilizer, and appropriate plant species until the time of harvesting according to the age of the plants. The Thai government has a policy to promote agriculture continuously and the consumption and market demand for agricultural products increases with the increase in the world population.[3] As a result, rural productions have been transported to consumers in different locations, regularly considered utility services to buyers and sellers. Responding to the lives of the people towards the economic development of the country transportation, which includes both domestic and international delivery routes (Road, Water, Air), delivery

locations, vehicles and entrepreneurs (government or private, service providers), the government's need to supervise transportation activities and create cooperation, control, help, and subsidize various matters to continually facilitate activities at all times to ensure standards and safety and prevent economic loss and control the rate of fair service, prevent exploitation and excessive competition.[4] The water transportation system in Thailand has had an essential role in agricultural exports in the past. But at present, the development of road transport networks has increased. As a result, it has sent many products to consumers faster. The Chai Nat province develops water transport beneficial between the Chao Phraya River and the Pa Sak River. The utilization of water transport still exists because it is a model that can transport many agricultural products at a lower cost than road transportation. Suitable for many agricultural products, it results in a price per unit being down and not perishable [1]. Moreover, traders have warehouses to stock it along the waterfront. Therefore, the waterway used as an alternative for agricultural products exported. It saves costs even though it takes longer to transport [2]. The Chai Nat province has the Chao Phraya River, the Noi River, and the Tha Chin River flowing through the houses where people live in the river. There is a career in agriculture, especially rice planting because it is an irrigation area that can cultivate rice three times a year, producing rice and other commodities produced yearly by many farmers.[8] Therefore, the merchant or entrepreneur has agricultural products transported to consumers domestically and internationally by the river to reduce transportation costs, inventory costs and outcomes management.

## II. RELATED THEORY AND RESEARCH

### A. THEORY

- *Geographic Information System (GIS)*

It works on spatial data with a computer system to define data and information. That is related to the spatial position relative to the location on the map, latitude, longitude, data, and maps in geographic data. It is an information system in the form of a table of information.[5] The GIS helps users understand patterns, relationships and geographic context. The benefits include efficiency, improved communication and management and decision-making.

This research the GIS used for the location point of water transport on the Chao Phraya River and had four main clauses (Potential to support water transport, transportation management, The attraction of water transportation, and water transportation service for evaluation to 35 water transport stations

- *Neural Network*

The system was the component with inputs and weights (input x weight) into outputs, and weights were defined with

random numbers and adjusted when using the model for evaluation. The model has many functions, such as sigmoid, linear, hyperbola, and stepwise. The learning Neural Network's learning rate may be the most essential hyperparameter when configuring your neural network. Therefore, it is vital to know how to investigate the effects of the learning rate on model performance and to build an intuition about the dynamics of the learning rate on model behavior.[11]

**B. Methodology**

The researchers study the condition of water transport and explore to find factors for it. On the agricultural community area along the river that flows through Chai Nat Province, there are three rivers, namely the Chao Phraya River, the Noi River and the Tha Chin River, divided into natural waterways and created by man.[6][7] In-depth interviews with agriculture, marine transport entrepreneurs, Marine Departments, and ten people using specific interview methods and study policy for decision-making city, provincial, and national policies help to reduce road congestion and disaster management. They study and collect geographic locations such as ports and agricultural production areas. Maritime entrepreneurs highlight the importance of transportation traffic density.

**D. Data**

This survey water transportation was available and points where it developed for tourism, such as harbors, pontoons, or areas near essential places. The first survey of Manorom District is the starting point of the Chao Phraya River that flows into Chai Nat Province and is adjacent to Uthai Thani Province. It was a trading center for ancient products. There is a rice steam from Phichit Province and Nakhon Sawan Province, Chai Nat, traveled along the Chao Phraya River. The boat resting point has been called Kung Sampao. There was a Guan Yu Shrine worshiped by boat owners, crew and passengers.



Fig. I. The start of Chao Phaya River Ports.

- The collection data ports on the Chao Phraya River
1. Chao Phraya Dam. Bang Luang Subdistrict (15°9'29.73" N ,100°10'49.38" E)
  2. The raft of the raft restaurant (15° 9'19.04" N,

- 100°10'12.79" E)
3. The pontoon in front of Wat Pa Chao Phraya(15° 9'48.01" N,100° 9'15.84" E)
4. Tha Nam of Wat Pruan (15°10'2.60" N,100° 8'28.42" E)
5. The crossing point behind the office Chai Nat Province (15°11'4.79" N,100° 7'22.10" E)
6. The Wat Thammamun Worawihan Port (15°14'51.66" N, 100° 4'55.96" E)
7. Wat Si Maneewan Port (15°17'50.04" N,100° 4'49.27" E)
8. Khung Samphao Port (15°18'29.68" N, 100° 4'55.27" E)
9. Wat Phra Prang Luang Port (15°25'15.55" N, 100° 8'9.60" E)
10. Wat Tha Chai Port (15°10'3.71 N, 100° 7'27.39" E)
11. Tha Mai Port (15°10'59.30" N, 100° 7'13.40" E)
12. Wat Huay Yang Port(15°11'39.43" N ,100° 6'54.33" E)
13. Wat Khongsawat Wattanam Port(15°13'15.72" N, 100° 5'22.61" E)
14. Wat Pak Klong Makham Thao Port (15°15'41.98" N, 100° 3'30.78" E)
15. Sri Prasert car ferry(15°18'13.37" N,100° 4'59.53" E)
16. Chao Phraya Thara Hotel Port(15° 9'56.72" N, 100° 7'57.68" E)
17. Suwanna Resort Port (15° 9'57.32" N,100° 8'3.54" E)

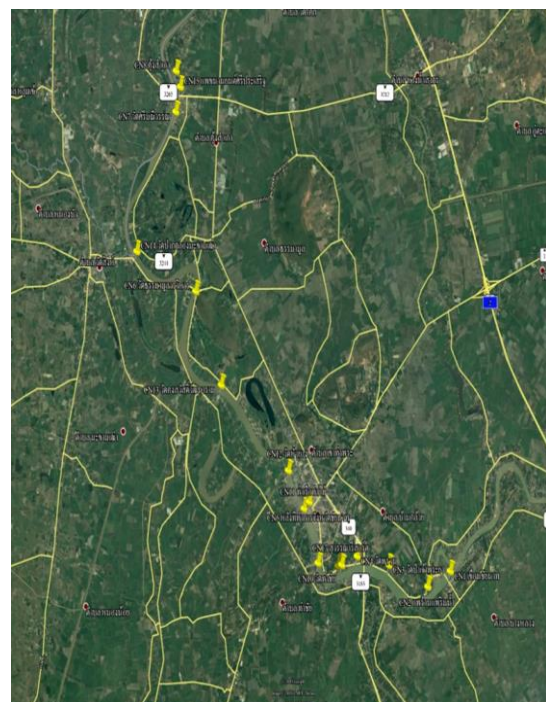


Fig. II. Survey points for water transportation in the Chao Phraya River in Chai Nat Province and nearby areas by overlaying it onto the map of Google Earth.

- The collection data ports on the Noi River

1. Noi River, Ban Pak Phraek(15° 9'25.22" N, 100° 9'15.15" E)
2. Ban Wang Yang(15° 9'7.42" N, 100° 8'49.75" E)
3. Luang Pho Khao Temple( 15° 8'47.62" N,100° 8'39.96" E)
4. Fang Temple(15° 6'39.32" N,100° 9'0.86" E)
5. Wat Saraphi Monastery (15° 5'54.68" N ,100° 8'25.69" E)
6. Wat Sangkharam( 15° 5'17.50" N,100° 8'27.05" E)
7. Photharam Temple(15° 4'26.58" N,100° 8'54.21" E)
8. Wat Nok(15° 4'20.48" N,100° 9'10.00" E)
9. Mahe-Yong Temple (15° 3'33.89" N,100° 9'54.97" E)

- 10. Mahathat Temple(15° 3'1.45" N,100° 9'48.32" E)
- 11. Wat Wihan Thong(15° 1'56.71" N,100°12'20.27" E)
- 12. Pho Thong Temple(15° 0'15.21" N,100°12'35.00" E)
- 13. Wat Phrao(14°59'44.39" N,100°12'57.81" E)
- 14. Thammikawas Temple(14°59'5.70" N,100°13'55.93" E)
- 15. Wat Pho Ngam(14°58'41.47" N,100°14'32.99" E)
- 16. Wat Bost(14°58'24.82" N,100°14'55.64" E)
- 17. Chan Charoensri Temple (14°58'3.40" N, 100°15'51.29" E)
- 18. Sanamchai Temple(14°57'24.87" N,100°15'32.79" E)



Fig. III. Exploring water transportation in the Noi River in Chai Nat Province by Overlaid onto a Google Earth.

- The collection data ports on the Tha Chin River According to the survey of Mae Nam Noi in Chai Nat Province, It did not transport.

E. Evaluations

Table I. Factors for evaluating a water transport

Evaluation	Score (100)
potential to support water transport (A)	30
transportation management potential(B)	40
the attractive potential of water transport (C)	10
potential for water transportation services (D)	20

- Potential to support water transport  
The factors have 15 items (A1-A15)
- A1. Adequate accommodation (tents/reception sites) to meet the needs of water transport.
- A2. A bathroom that allows use. (public restrooms/ villagers' restrooms) sufficient to meet the needs of water transportation.
- A3. food service points (restaurant, food trading point, food supply service point) sufficient to meet the needs of water transportation
- A4. parking.
- A5. product centers were distributed within the water transportation facility.
- A6. The specific facilities for disabled people.
- A7. public utilities such as electricity and water to support

- their needs.
- A8. road signs and signs. Conveying meaning according to important areas.
- A9. travel service points. (land and water) located not far from water transportation facilities.
- A10. accommodate the number of water passengers Appropriately.
- A11. roads to easily access water transport locations.
- A12. water transport activities have a positive impact on the environment.
- A13. water transport activities have a positive impact on culture.
- A14. water transport activities have a positive impact on society.
- A15. water transport activities have a positive impact on the economy.

- Transportation management potential  
The factors have 16 items (B1-B16)
- convenient and safe dimension (30 points)
- marketing dimension (10 points)
- B1. media information on water transport.
- B2. There are measures to maintain safety for water transportation from possible dangers.
- B3. There is a clear division of areas for use in water transportation.
- B4. There is the readiness of water transport personnel to follow security measures strictly.
- B5. A group or committee has been formed using a participatory process in managing water transport.
- B6. A guideline for the community's water transport development established.
- B7. The variety of water transport activities is an interesting water transport activity.
- B8. The water transport links with other local tourist attractions.
- B9. personnel with knowledge and ability to convey water transportation information.
- B10. regular improvements to the landscape within water transportation sites.
- B11. The transparent and fair pricing for water transport.
- B12. The wide range of distribution channels for water transport programs.
- B13. There is a variety of forms of sales promotion.
- B14. A water transport network created to conduct marketing activities with other parties.
- B15. prepared a ready-made water transportation program (tour package)
- B16. planned water transportation marketing.

- Attractive potential of water transport  
The factors have 5 items (C1-C5)
- C1. complete ecosystem.
- C2. The interesting in terms of the plants and animals found there.
- C3. The beautiful surrounding scenery
- C4. The interesting agricultural way of life.
- C5. The interesting transport activities within the water transport hub.

- Potential for water transportation services  
The factors have ten items (D1-D10)
- D1. water transportation service.
- D2. water transportation service attitude,

- D3. communication with water transportation service users.
- D4. knowledge and skills in providing information services to service users.
- D5. politeness, kindness in providing services to water transportation users,
- D6. creating reliability in water transportation,
- D7. equality in providing services.
- D8. The service process has a sequence of steps,
- D9. service techniques to impress service users,
- D10. understanding the needs of water transport users and responding on time

### III. RESULTS

The results of the research have *evaluated the potential of water transportation* and the use of neural networks to classify 35 ports.

Table II. The evaluation of the potential of water transportation locations

No.	Points	Score (100)
1	The front of Chao Phraya Dam.	16
2	Rafts of Phae Rim Nam Restaurant.	18
3	Pontoons in front of Wat Pa Chao Phraya.	17
4	port in front of Wat Phuan Ban Kluay.	18
5	boat crossing port behind the Chai Nat Provincial Office.	90
6	Pontoon at Thammamun Worawihan Temple.	60
7	Wat Srimaneewan Thanam (Wat Tai).	42
8	Kung Sampao Port.	35
9	Wat Phra Prang Lueang port.	51
10	Tha Chai Temple Port.	29
11	Tha Mai Port, Ban Tha Mai.	29
12	Huai Yang Temple Port.	29
13	Wat Khong Sawat watthanaram port.	29
14	port in front of Pak Khlong Makham Thao Temple	63
15	Sri Prasert Car Ferry Ban Kluay.	66
16	Chao Phraya Thara Hotel Port.	66
17	Suwanna Resort Port.	66
18	The beginning of the Noi River.	66
19	Ban Wang Yang.	29
20	Luang Pho Khao Temple.	29
21	Fang Temple,	29
22	Wat Saraphi Monastery.	29
23	Sangkharam Temple.	29
24	Photharam Temple.	29
25	Wat Nok.	29
26	Wat Mahe-Yong	29
27	Mahathat Temple	29
28	Wihan Thong Temple	28
29	Pho Thong Temple	29
30	Wat Phrao	29
31	Thammikawas Temple	29
32	Wat Pho Ngam	29
33	Wat Bost	29
34	Chancharoensri Temple	29
35	Sanamchai Temple	29

- The Neural Network Model.

Scheme: weka.classifiers.functions.MultilayerPerceptron -L 0.3 -M 0.2 -N 500 -V 0 -S 0 -E 20 -H a  
 Relation: total evaluation  
 Instances: 35  
 Attributes: 5  
     A = potential to support water transportation  
     B = management potential of water transportation  
     C = attraction potential of water transport  
     D = potential for water transport services  
     Score = sum of evaluation  
 Test mode: 5-fold cross-validation  
 Classifier model (full training set)  
 Linear Node 0  
 Inputs Weights  
 threshold 1.5777802192765673  
 Node 1 -1.4920633615507268  
 Node 2 -1.6871612496597865  
 Sigmoid Node 1  
 Inputs Weights  
 Threshold -0.10092815035378204  
 Attribute A -0.25315507022350653  
 Attribute B -0.8290542169507068  
 Attribute C -0.07453271133923364  
 Attribute D -0.396068524198712  
 Sigmoid Node 2  
 Inputs Weights  
 Threshold 0.05077248134878896  
 Attribute A -0.29513882563878446  
 Attribute B -0.7691137663758465  
 Attribute C -0.1632889811483908  
 Attribute D -0.45845340095530906  
 Class  
 Input Node 0  
 Time taken to build model: 0.12 seconds  
 === Cross-validation ===  
 == Summary ==  
 Correlation coefficient 0.9993  
 Mean absolute error 0.3152  
 Root mean squared error 0.5522  
 Relative absolute error 2.941 %  
 Root relative squared error 3.7867 %  
 Total Number of Instances 35

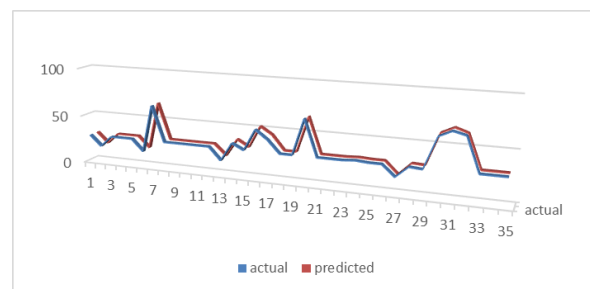


Fig. IV. The predicting water transport assessment results using artificial neural networks.

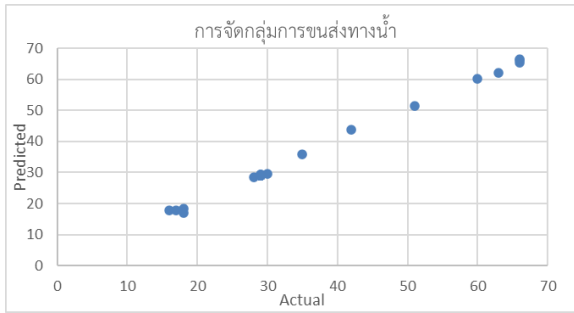


Fig. V. The Clustering of Water Transportation.

- Classify water transport

The data grouping using the artificial neural network model resulted from seven groups. Three port locations are currently providing work, which is small-scale transport.

1. port behind the district office of Mueang Chai Nat District Chai Nat Province.
2. The port of Wat Pak Khlong Makham Thao Wat Sing District Chai Nat Province.
3. The port of the Sri Prasert car ferry Khung Sampao Subdistrict, Manorom District Chai Nat Province.

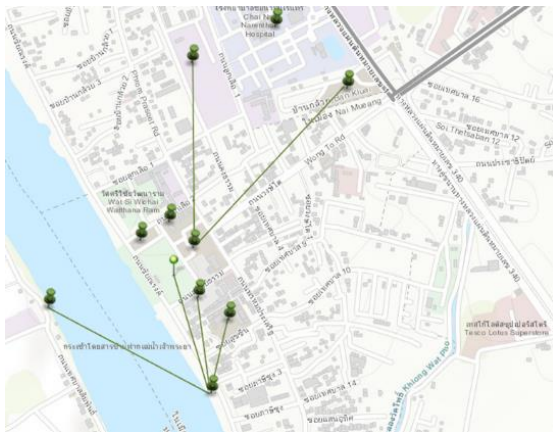


Fig. VI. Many ports were across the Chao Phraya River behind the provincial office. Mueang Chai Nat District.

The potential port for developing the water transportation behind Chai Nat Provincial Office, Mueang District, Chai Nat Province. This port has a width of the Chao Phraya River of 268 meters for the crossing point to Tha Chai Subdistrict. The distance is approximately 606 meters and takes 5 - 6 minutes.[9][10] This port is still essential to developing water transportation because the road created across the Chao Phraya River, currently under construction, is far from the boat ramp in Mueang District. The road is 1.24 kilometers, and the boat landing point in Tha Chai Subdistrict and the bridge under construction are 2.98 kilometers apart. If traveling by car from one side of the port to the other, you will have to travel in a detour of at least 3 - 4 kilometers, which the villagers who live there. Further into this area, a detour of more than 5 kilometers may be required, with a total round trip distance of more than 10 kilometers each way. Therefore, maintain and develop the water transportation system will be even more advanced and traveling saves time.



Fig. VII. The Wat Pak Khlong Makham Thao Port Wat Sing District Chai Nat Province.



Fig. VIII. The Wat Pak Khlong Makham Thao Port Wat Sing District Chai Nat Province

A potential point for developing the water transportation system has been Wat Pak Khlong Makham Thao, Wat Sing Subdistrict on Wat Sing district in Chai Nat Province. This area has a width of the Chao Phraya River of 175 meters. Currently, the point used to cross back and forth from the temple port to the opposite side has a distance of 243 meters and takes no more than 2 minutes to travel. This area supports passengers who wish to connect between Main roads number 3183 and number 3244 including U Thong Makham Thao Road in this area, the closest crossing point is the bridge over the Chao Phraya River at Wat Thammamoon Worawihan, which is 3.2 kilometers away by road, which is a long detour. Therefore, there is still a need to develop the water transportation system, including developing for water tourism in the future.

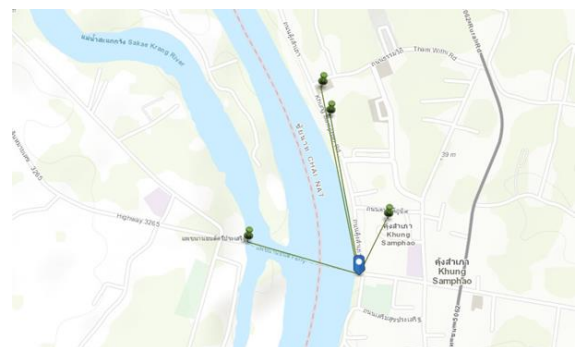


Fig. IX. The Sri Prasert Ferry Port, Manorom District, Chai Nat Province.

## Conclusion

A potential point for developing the Khung Sampao water transportation system in Khung Sampao Subdistrict, Manorom District, Chai Nat Province. This area has a width of the Chao Phraya River of 227 meters and a width of the Sakae Krang River of 125 meters. The roundtrip distance from Kung Sampao to the landing port in Tha Sung District, Uthai Thani province is about 680 meters and the point used to cross the river by the Si Prasert ferry to the Uthai Thani Province other side distance of about 453 meters and 3 - 4 minutes to travel. At this point, a bridge was built across the Chao Phraya River and supports passengers traveling to connect to main road number 3265 from Uthai Thani province to come to Chai Nat province.

networks/

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