PORT EXPANSION STRATEGY AT THILAWA AREA IN YANGON RIVER, MYANMAR

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Abstract - Ports are one of the essentialroles of regional economic growth in a country. Maritime transportation contributes to not only economic but also regional balance and significantly impacts national integration into the global economy. Yangon port has playedanessential role in the economic development of Myanmar by maritime trade and transportation for several decades, which handles about 90% of the country's trade volume by imports and exports. Yangon inner port has been restrictedin vessel calling for international ships because it is a river port that can accept vessels up to 15,000 deadweight tons (DWT)due to the narrow channel width and lower water depth. In addition, the port was adjacent to Yangon city, which has caused trafficcongestion by the port.Itfaces a high sedimentation rate and frequent dredging around the port terminals. The optimum site in the Thilawa region is for port expansion in future development. This study aimed to providestrategic guidelines for port expansionsuitable geographical characteristics, such as deep-water depth and wider water channel. Therewasamore appropriate location for future port expansionthat may increase cargo demand sharply for future country economic growth.Based onthe result,guidelines for sustainable site selection should be developed and appliedthat were more available in water depth, wider water channel, and more capacity to handlelarger ships. Thearea of the dumping site for dredgingwas closer than Yangon's inner port.On the other hand, a transportation network for port expansion,including roads and the railway,may be required to developto connect Yangon and other major cities with the Thilawa port area.

Keywords - Yangon River, Thilawa Area, Dredging, Sedimentation, Port Expansion

I. INTRODUCTION

Yangon, the former capital city of Myanmar, is a major economic center in the port region. [1]. Yangon Port comprises Yangon Main Port and Thilawa Port, roughly 30 km and 15 km, respectively, from the Yangon River's mouth. All ports in the country have been handled by Myanma Port Authority (MPA), which is the maritime transportation sector and in charge of port operations, seagoing vessels, port management, and developing local industries since 1989 [2]. Yangon port is situated along the Yangon River, a tidal river with high flow current velocity, turbidity, and increasedsedimentation rate with significant erosion. The shallow water regions of Yangon River, known as the Inner Bar and Outer Bar, are located in Monkey Point at the eastern end of Yangon Main Port and Elephant Point at the mouth of Yangon River[3].The Yangon River has been suffering from significant sedimentation problems for several decades; the annual dredging materials in the Yangon River were estimated to be roughly 2.4 million[4].Therefore,due to colossal sedimentation, the river led to a lower availablenavigable water depth and a narrow water channel for approaching international vessels entering the Yangon inner Port. Then, the vessel calling would be decreased shortly, affecting the country's economic development. In addition, port yard areas are highly constrained, vessel restriction and cargo handling productivitiesare extremely low. Furthermore, traffic congestion in the city is caused by land transport traffic generated by port cargoes.The objective of this research was mainly focused on how to handle port expansion in Myanmar in the future andrecommended guidelines for port expansion in the Thilawa area rather than Yangon's inner port region.We hypothesized that the physical location of the port in the Thilawa area might provide future port development and improve vessel calling to Yangon, which leads to a country's economic growth in Myanmar.

The target areas such as Yangon inner port area, Thilawa port area, and Yangon River were analyzed in this study to establish future port expansion in the Thilawa area, where were available in water depth. Moreover, waves, currents, and sediment transport all have a role in site selection at these areas were surveyed.The physical location of the Thilawa region in Yangon River, according to the results, was suitable hinterland, geographical condition, available deep-water depth, and broader channel width. However, the literature review showed that maritime transportation had grown dramatically in recent decades in Myanmar as one of the essential routes of international freight transport. Therefore, the Thilawa port region will be Yangon's principal port for future international maritime traffic in Myanmar in the following decade. On the other hand, the ships' growing number and size raise worries about balancing marine traffic safety and capacity. [5].

II. TARGET AREAS AND APPROACH

The part was introduced to research in this section, followed by research data and methodology.

2.1 Yangon Port's History

In figure (1), Myanma has nine necessary ports for maritime trade on its 2,300 kmcoastline. Yangon port was based in 1756 then became within the Myanma Port Authority (MPA) in 1980. Yangon Port has been in Myanmar's largest town and served because of the country's capital from 1948 to 2006. It handles around 90% of the country's economy. it's situated 40 km upstream from the Gulf of Martaban off the bay on the central shore, on the banks of the Yangon River. Primarily till 1989, it had been referred to as national capital on the international stage. Yangon Port is Myanmar's largest metropolis, economic and industrial center. Despite an outdated banking industry and communications network, the Yangon Port is the principal business center for commodities, industries, construction, fashionable offices, and a completely different political economy. Yangon Port facilities are dispersed out through Yangon Main Port and Thilawa Area Port, as well as the Yangon River. Port facilities at Yangon Main Port, which extend around 9 km in a small region near to Yangon City, are among these. [2].

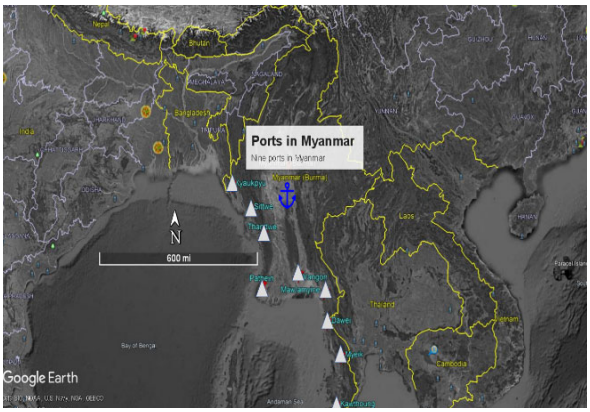


Fig. 1: Nine Ports in Myanmar (white colors)

2.2 Target Areas

Yangon is the country's most important port, handling around 90% of the country's export and import [6].Yangon Port is still major as a center of the country's economy. The target areas used in this study werethe geography of Yangon'sinner port, the Thilawa port area, and the Yangon River.

2.2.1 Yangon Inner Port

Yangon's inner port is located along with the Yangon downstream. Most of the terminals were inYangon'sinner port area. The Yangon internal port is approximately 32 kilometers from the Yangon River's mouth and extends for around 9 kilometers along the river's left bank. In addition, Yangon's inner port area was restricted vessel size to call Yangon internal port. According to recent information, the size of calling ships to Yangon inner port, which were limited to 167 m length overall (LOA) with 9 m draft for 15,000 deadweight tons (DWT),isacceptable[2], the Yangon port boundary is about 40 kilometers upstream from the Yangon River mouth.Container terminals, general cargo terminals, and coastal/inland waterway transit jetties handle the majority of Yangon Port's cargoes.

However, most of Yangon's inner port infrastructures were outdated, such as terminal facilities and cargo handling equipment. Moreover, The vessel calling Yangon'sinternal port for navigation during the ebb tide is challenging becauseof the shallowness of the Yangon River estuary, which is around 6 meters deep. It is required to wait until high tide, which is approximately six hours[4], delays the vessels entering Yangon inner port.



Fig. 2: Locations of Yangon Port facilities in Yangon Inner Port, Myanmar (yellow line)

2.2.2 Thilawa Port

Thilawa Area Port is about 16 kilometers downstream on the Yangon River's left bank.Thilawa Area Port is situated at the crossroads of the Greater Mekong Subregion's (GMS) economic routes, including the East-West Economic Corridor, Western Economic Corridor, and Southern Economic Corridor, as well as the Asian Highway.Thilawa Area Port is part of the Yangon Region, comprising 46 townships[4]. Thilawa port can accept up to200,000 (DWT) vessels with 10 m draft and 200 m in length overall (LOA). However, the YCDC (Yangon City Development Committee) has jurisdiction over 33 townships, Thanlyin Township and Kyauktan Township, where Thilawa Area Port is located.Thilawa Area Port currently operates Myanmar International Terminal Thilawa (MITT), which handles containers, lumber, and used vehicles, among other things, as well as various additional port services.

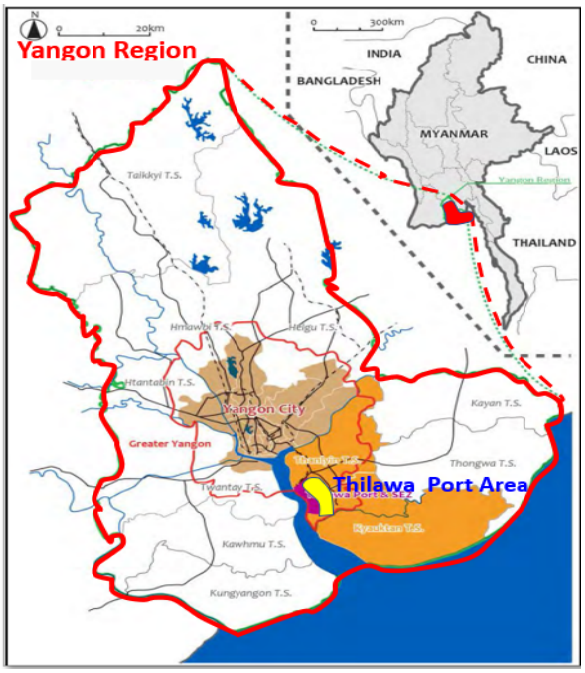


Fig. 3: Locations of Yangon region,(red line) including Yangon port and Thilawa port, Myanmar

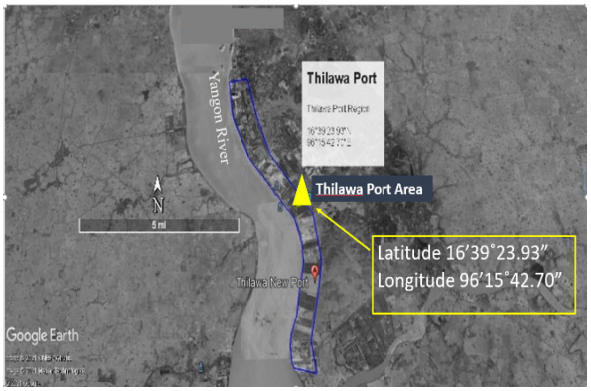


Fig. 4: Locations of Thilawa port area in Yangon, Myanmar (blue line)

Furthermore, because there is no available land or water in the Yangon inner port region to develop the port, the Thilawa area, where the necessary water and land can be obtained, will play a critical role in supporting port activities in Yangon. Therefore, Thilawa port is a deep river port on the Yangon River and the best way to extend ports which will be the biggest port in the Yangon region shortly.

2.3 DataEvaluation

2.3.1 Yangon River

The Yangon Port is a river portlocated 48 kilometers upstream from the Yangon River's mouth at north latitude 16°47' and east longitude 96°15'. The Yangon River is about 40 km long, one ofthe most important rivers in Myanmar, and it plays a vital role in port operations. The difference in water level between the rainy and dry seasons is approximately 1 m. The Yangon River has an average tidal range of 5.85 m at spring tide and 2.55 m at neap tide. The current velocity ranges from 4 to 6 knots. However, there has been a sedimentation problem throughout the Yangon River for many decades. In addition, dredging operations for port development usually result in considerable changes in the seabed and riverbed configuration. The currents, waves, and water quality in the port project region may be dramatically affected due to these changes[7]. There are two high tides and two low tides per day on the Yangon River. The water level reaches 5.85 m during high tide, and the stream reverses from the estuary to the Yangon region. At ebb and flow tides, the river current has a velocity of roughly 4 to 6 knots. Waves near the river's mouth are usually less than 2 mhigh and quiet. The passage at Monkey Point on the Rivermeasures roughly 100 m in width and 4 m in depth. Besides, the path from Monkey Point downstream to the Thilawa region is more profound in some places, although the average water depth is 6 m, and the passage width is around 400 m in narrow spots. About 5 km upstream from Thilawa, the passage narrows to a depth of 6 m.The path from Thilawa to Elephant Point is typically 6 to 8 m deep, with a breadth of over 1,000 m in various spots. Roughly 10 kilometers downstream from Thilawa. Outside of the Elephant Point, there is shallow water with a depth of approximately 5 m. The descent south of the Elephant Point to the open sea is relatively gentle, with a 10m depth 50 kilometers south of the Elephant Point[3].

2.3.2 The Channel's Natural Environment

The natural conditions of the Yangon River navigation channel are as follows.

Average sea level - 5.85 m,
A minimum sea level - 2.55 m
The current speed - 46 knots
Wave height- 2 m or height

2.3.3 Sedimentationand dredging maintenance on Yangon River

For several years, the Yangon River has been affected bycolossalsedimentation, especially areas known as Inner Bar and Outer Bar. As a result of the sedimentation, the river's minimum navigable depth isinsufficient to continuously allow the largestapproaching vessels to enter the Yangon Port[8].Trailing Suction Hopper Dredgers (TSHD) were used to maintain annual dredging of the Yangon River Channel, with volumes ranging from 1 to 2 million m^3 per year for Monkey point (Inner Bar), Yangon River[1],inwhere the seagoing vessels were needed to assess to enter Yangon inner port.On the other hand, the Outer Bar of Yangon River has been dredged around 0.2 to 0.4 million m^3annually. Therefore, annual dredging materials in the Yangon River were predicted to be about 2.4 million.

2.3.4 Container Handling Capacity

Table 1 and Figure 5 illustrate the result of container volume for Yangon port (Yangon inner port and Thilawa Port), which increased dramatically from

2011-2012 to 2016-2017 fiscal years. 2011-2012 had 413,377 (TEU) at the start of the fiscal year, but it had increased to 1,057,800 TEU by the year's conclusion. As a result, these consistent findings suggest that cargo demand may continue to rise consistently in the future.

No	Fiscal Year	Import (TEU)	Export (TEU)	Total (TEU)	Progression %
1	2011-2012	209,932	203,445	413,377	(+) 19
2	2012-2013	239,347	238,993	478,340	(+) 16
3	2013-2014	309,767	303,804	613,571	(+) 28
4	2014-2015	377,557	367,232	744,789	(+) 21
5	2015-2016	459,037	434,164	893,201	(+) 20
6	2016-2017	519,728	538,160	1,057,800	(+) 18

Table: 1 Container handling throughput in last six fiscal years for Yangon Port[4]

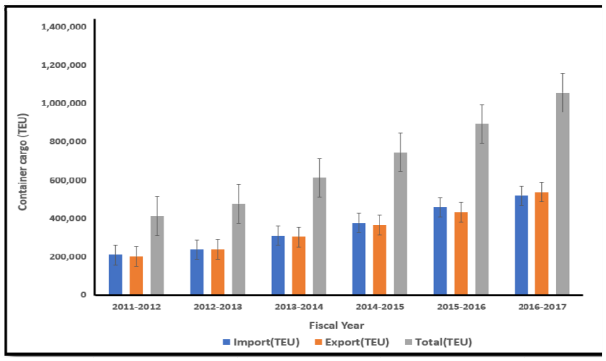


Fig. 5: Statistics container volume (TEU- twenty-footequivalent unit) throughput in Yangon main port[4]

III. RESULTS AND DISCUSSIONS

3.1 Challenging port extension for Yangon inner port

Nearshore and offshore options are suggested for Yangon as feasible sites. Shallow natural water depths and significant sedimentation rates limit nearshore and riverine alternatives near Yangon.As a result, these choices are less suitable for building deep seaports. Yangon is the country's major city and business district, and it is under a lot of pressure to become a deep seaport. Similarly, the nearshore option will be assessed to demonstrate its utility and performance during the site selection process. In addition, an offshore solution to the sedimentation and depth issues is presented. Because of the importance of Yangon as a potential port development site, this offshore alternative will go to the subsequent filtration despite the lack of sufficient land, connectivity, and shelter[9].

Furthermore, the seagoing vessels need to pass the restricted bar known as Inner Bar with serious sedimentation occurred to enter Yangon inner port and need to wait for high tide conditionsto accessYangon inner port. Besides, the city has been connected to the Yangon inner port, which may negatively impact the city due to port activity [10]. As a result, future port growth, pollution impact on Yangon city, channel access, and high sedimentation rates have been challenges for Yangon inner port.

3.2Acceptable deep draft vesselforThilawa port

Due to the narrow width of Yangon River passage and shallow water depth, the MPA places restrictions on vessels calling at Yangon Inner Port rather than Thilawa Area Port, as shown in table 2. Thilawa Area Port can accommodate larger ships than Yangon Main Port because it is closer to the Yangon River's estuary.Estuary of River system is most importantecologically and economically to provide ecosystem good and services [11]. Sea-goingvessels for Thilawa port don't need to pass through Monkey Point Channel because the Thilawa port areais situated outside of Inner Bar, which is the shallowest in the Yangon River channelwith a constant high sedimentation rate. Therefore, the Thilawa areais the moresuitable place for future port expansion in the Yangon Region, Myanmar.

Name	LOA	DRAFT	DWT
Yangon Inner Port	167 m	8.5 m (dry season) 9 m (raining season)	15,000
Thilawa Area Port	200 m	9 m	20,000

Table: 2Acceptable vessel capacity (DWT-deadweight ton) for Yangon inner port & Thilawa Port

3.3 Suitable geographical features for Thilawa Port Area [2]

A recent study showed thata soil assessment was conducted at seven (7) locations along the Yangon River in the Thilawa Area, near the Yangon port. Table 3 shows the locations and results of the soil survey.The soil survey revealed that the soil is mostly silt and clay, with a natural moisture content of about 60%.

No	Location	Clay (%)	Silt (%)	Sand (%)	Gravel (%)	Natural Moisture Content %	Soil Type
ST1	N16°4059.2" E96°13'50.09"	37.0	61.0	2.00	0.00	56.4	Solid clay loam
ST2	N16°39.36.0" E96°15'08.0"	21.5	76.5	2.00	0.00	69.4	Silty loam
ST3	N16°38'00.9" E96°15'28.08"	33.5	65.5	1.00	0.00	61.2	Silty clay loam
ST4	N16°36'.54.04" E96°15'28.08"	36.5	61.5	2.00	0.00	61.7	Silty clay loam
ST5	N16°39'38.0." E96°14'21.0"	56.0	43.0	1.00	0.00	51.1	Silty clay

Table: 3 Soil survey result in Thilawa Port Area [4]

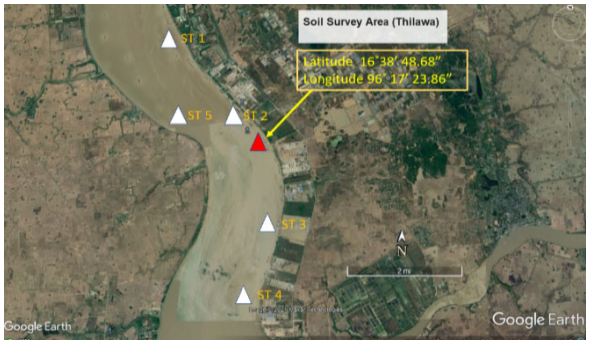


Fig. 7: Location of soil survey in Thilawa area [4]

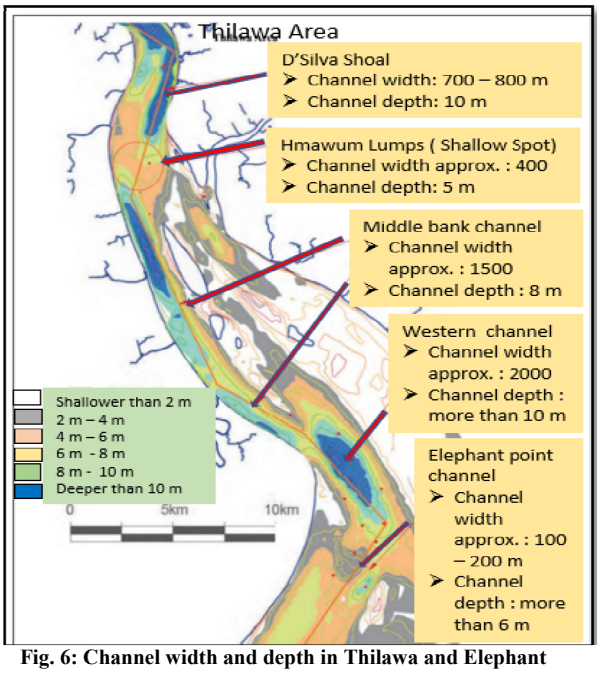


Fig. 6: Channel width and depth in Thilawa and Elephant point on Yangon River

Figure 6 describes the current state of the Yangon River's channel width and depth at the Thilawa and Elephant point areas. The depth and width of the available channel for port expansion are shown in these results.

Area	Item	Gross Tonnage
Yangon Main Port	Average	6,601
	Maximum	17,736
	Minimum	1,297
	No. of vessels	123
Thilawa Area Port	Average	14,080
	Maximum	43,810
	Minimum	2,986
	No. of vessels	26
Yangon Port	Average	7,906
	Maximum	43,810
	Minimum	1,297
	No. of vessels	149

Table:4 Vessel calling between Yangon inner port and Thilawa Port(source-MPA)

The average tonnage of the vessels that entered Thilawa Area Port was around twice as significant as the average of Yangon Main Port, as shown in table-4.

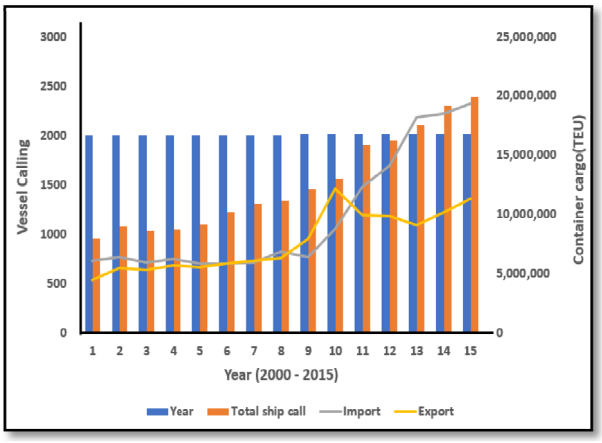


Fig. 8: Number of vessel calls(source-MPA)

3.4 Guidelinefor strategy port development plan

As stated in the research objective, the goal of this study is to develop a sustainable site section in Myanmar's Thilawa region. For extending port development, a complete case study should be conducted, including fieldwork in the Thilawa area of Myanmar, with data and insights from the case study being used to strengthen the guideline.Myanmar's port industry plays a critical part in the country's economic development. Ports play an important role in helping promote regional and international trade as well as economic development[12]. This study will provide MPA a port development strategy, as indicated in figure 9, which depicts a framework for improving a strategy port development plan in nearly futurein Myanmar. Therefore, MPA should carry out the future development ports to expand in Thilawa areaand implement to increase port main infrastructuresand cargoes terminal efficiency [13]based on the sustainable strategy guideline for the port development plan. Then aport master plan will be developed after further research into the various methods and engagement with a monitoring committee comprisedof plan stakeholder.Stakeholder involvement and participation in the formation of development policies are part of country legal and regulatory framework[14].

To be concluded,the alternative for the port extension in Thilawa area was deep more water depth, wider channel, suitable good environment, possible network transportation, public recreation areas and biological resources.

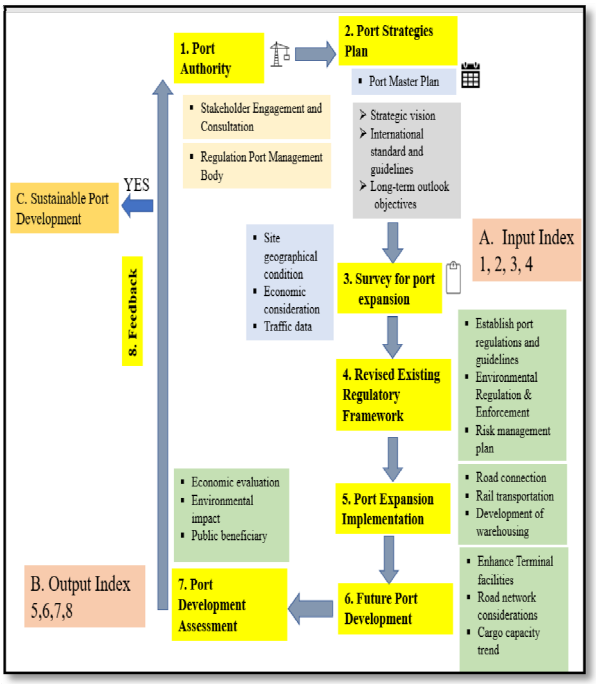


Fig. 9Guidelines for approaching strategy port development plan

IV. CONCLUSION

1) Based on the results of this research, the Yangon inner port area might not be futureexpanded easily due to the Yangon River's high sedimentation rate, restricted water channel, and shallow depth for international vessels.

2) The future port expansion would be carried out in the Thilawa area rather than the Yangon inner region because the river channel in the Thilawa area has suitable geography, as well as a broader and deeper depth for vessel calling, less dredging impact, and a beneficial economy for the country.

3) MPA may need to conduct a study in the Thilawa area to make amasterport planning for future port growth and development. For examining intents, processes, and impacts, further action research with an evaluation and monitoring framework would be required.

4) The strategy, these guidelines ofport development may provide MPA to build a port expansion in the Thilawa area shortly.It also has the best hinterland connectivity, as well as a number of planned infrastructure developments in the near future.

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