

**YANGON UNIVERSITY OF ECONOMICS
DEPARTMENT OF APPLIED ECONOMICS
MASTER OF PUBLIC ADMINISTRATION PROGRAMME**

**A STUDY ON ECONOMIC IMPACT OF TWANTE CANAL
REVITALIZATION**

**THEINGI LWIN
MPA – 66 (21st BATCH)**

JUNE, 2024

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REVITALIZATION**

**A thesis submitted as a partial fulfilment of the requirements for the degree of
Master of Public Administration (MPA)**

Supervised by:

Dr Khin Thu Thu Thein
Lecturer
Department of Applied Economics
Yangon University of Economics

Submitted by:

Theingi Lwin
MPA - 66
MPA 21st Batch
(2022-2024)

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**YANGON UNIVERSITY OF ECONOMICS
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This is to certify that this thesis entitles “**A Study on Economic Impact of Twante Canal Revitalization**” submitted as the requirement the Degree of Master of Public Administration has been accepted by the Board for of Examiners.

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Yangon University of Economics

Dr. Khin Thu Thu Thein
(Supervisor)
Lecturer

Department of Applied Economics
Yangon University of Economics

June, 2024

ABSTRACT

The Twante Canal is a canal that connects the Ayeyarwady River and the Yangon River in Myanmar. The Twante Canal plays a crucial role in Myanmar's economy, infrastructure, and community livelihoods, making its maintenance and revitalization essential for sustainable development and regional prosperity. This study examines the economic impacts of revitalizing the Twante Canal in Myanmar. The study conducts a survey among 151 respondents from Dala Township, Seikgyi Kanaungto Township, and Twante Township between January 2024 and March 2024. The study employs a descriptive method, revealing a significant dependence on the canal across diverse sectors such as manufacturing, services, and agriculture. Respondents overwhelmingly consider that the canal is vital to their business operations and has a significant economic impact. The residents, particular boating service providers, traders and agricultural produces receive their revenue by utilizing this canal. Furthermore, the study reveals fluctuations in revenue from canal tolls due to external factors, emphasizing the canal's economic sensitivity. Overall, it is also found that the Twante Canal is a critical role in regional economic development, and its revitalization is essential for sustaining growth and enhancing local livelihoods.

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LIST OF ABBREVIATIONS

DWIR	- Directorate of Water Resources and Improvement of River System
EDCF	- Economic Development Corporation Fund
ESIA	- Environmental & Social Impact Assessment

CHAPTER I

INTRODUCTION

1.1 Rationale of the Study

Navigable canals are essential for connecting lakes, rivers, and oceans because they provide better transportation routes and help in controlling intra-national water transportation. Hundreds of transport channels with different depths, widths, and lengths exist all over the world to facilitate the daily movement of different kinds of boats (Digital Marine, 2023).

A long, thin strip of water was created artificially, either for water transportation purposes or to facilitate boat movement. Additionally, in warm, sunny weather, water evaporation occurs in the canal system. In order to meet these demands, we must constantly top off the water levels; otherwise, vessels risk running aground. Water is pumped from underground source and obtained from a system of reservoirs, rivers, and streams. As long as the water level in the canal is higher upstream than downstream, water will really flow through the canal. A canal's gradient with a horizontal bottom can be defined as the head difference between the upstream and downstream locations.

Canals play a crucial role in facilitating transportation, trade, and economic development by connecting water bodies and bypassing natural barriers such as mountains or inefficient river routes. They serve as vital arteries of commerce, enabling the cost-effective and efficient movement of goods, raw materials, and passengers over long distances. Canals historically have spurred urban growth, industrialization, and agricultural expansion by enhancing access to markets and reducing transportation costs. Moreover, canals contribute to environmental sustainability by providing alternatives to road and rail transport, thus reducing carbon emissions and congestion. In regions with extensive canal networks, such as Europe and parts of Asia, these waterways continue to support tourism, recreational activities, and cultural heritage preservation, making them not just economic lifelines but also integral parts of local identity and heritage.

The Twante Canal in Myanmar is a historic waterway that connects the Yangon River (Hlaing River) with the Ayeyarwady River, stretching over 35 kilometers. Constructed during the British colonial period in the late 19th century, it serves as a crucial artery for transportation and irrigation in the Yangon region. The canal facilitates the movement of goods and people between Yangon, Myanmar's largest city, and the Ayeyarwady Delta, enhancing trade and commerce. Moreover, it plays a vital role in irrigation, supporting agriculture by providing water to fertile lands along its banks. Beyond its practical functions, the Twante Canal is a cultural and historical landmark, symbolizing Myanmar's engineering prowess and serving as a reminder of its rich maritime heritage. Today, the canal continues to be an essential part of Myanmar's infrastructure, contributing significantly to the economic and agricultural vitality of the region.

The Twante Canal in Myanmar has historical significance and potential economic impacts that are crucial for understanding its current and future role in the country's development. For improved connectivity and trade, the Twante Canal serves as a vital waterway connecting the Yangon River (Hlaing River) with the Ayeyarwady River delta region. By facilitating easier and more efficient transportation of goods, the canal reduces logistics costs and enhances trade between Yangon, Myanmar's largest city and economic center, and the fertile Ayeyarwady Delta. This connectivity supports agricultural exports (e.g., rice, fruits) and industrial goods, thereby boosting economic activities in both regions.

And then, for the infrastructure development: maintenance and development of the Twante Canal require ongoing investment in dredging, repairs, and modernization of related infrastructure (e.g., ports, terminals). Such investments not only improve the canal's operational efficiency but also create jobs and stimulate economic growth in surrounding areas. For the agricultural sector, the canal plays a significant role in facilitating irrigation and transportation for agriculture in the Ayeyarwady Delta, which is known as Myanmar's rice bowl. Improved water management and transportation infrastructure enable farmers to increase agricultural productivity and access to markets, thereby contributing to rural development and poverty reduction.

From the perspective of challenges and opportunities, despite its economic benefits, the Twante Canal faces challenges such as siltation, water pollution, and the need for continuous maintenance. Addressing these issues requires coordinated efforts from the government, private sector, and local communities to ensure sustainable

management and maximize economic returns. By systematically exploring social and economic information, stakeholders can develop a holistic understanding of the Twante Canal's sustainability challenges and opportunities. This comprehensive approach enables informed decision-making, effective resource allocation, and collaborative efforts to maximize socio-economic benefits while safeguarding environmental integrity for future generations. So to assess and promote the sustainability of the Twante Canal in Myanmar, it's essential to explore a range of socio-economic factors that can influence its long-term viability and benefits to local communities.

In summary, the Twante Canal serves as a critical artery for economic activities in Myanmar, particularly in facilitating trade, supporting agriculture, and fostering local development. Its strategic importance underscores the need for continued investment in infrastructure and sustainable management practices to harness its full economic potential. This study aims to analyze the economic impact of the Twante Canal using the collected and appropriate data.

1.2 Objectives of the Study

The main objectives of this study are as follows:

1. To describe the demographic and socio-economic characteristics of users along the Twante Canal.
2. To identify the economic impacts of the Twante Canal and gather essential socio-economic data to support its revitalization efforts.

1.3 Method of the Study

In this study, the descriptive analysis method was used with both primary and secondary data. For the primary data, a survey was conducted on 151 respondents who live in Twante Township, Seikgyi KaNaungto Township and Dala Township with a well-structured questionnaire. For the secondary data, necessary information is collected from the Directorate of Water Resources and Improvement of River Systems, the respective DWIR and internet websites.

1.4 Scope and Limitations of the Study

This study focused on primary and secondary data on the social-economic value of the Twante Canal. For the primary data, the study period ran from January 2024 to March 2024, and consisted of 51 participants from various backgrounds (such as;

marine workers, shipmen, and entrepreneurs) who fully completed the questionnaire. For the secondary data, economic information such as revenue and restoration costs of canal is collected from respective DWIR and from the internet websites.

1.5 Organization of the Study

This study is structured into five chapters. Chapter one introduces the study, covering its rationale, objectives, scope, methodology, and organizational structure. Chapter two reviews relevant literature on canal water resources, emphasizing their significance, canal revitalization efforts, water resource conservation, economic analyses related to canals, quality of life improvements attributed to canals, and previous studies. Chapter three provides an overview of the historical background, boundaries, and populations of Twante Township, Dala Township, and Seikgyi Kanaungto Township. It also examines the revitalization of the Twantay Canal, its social and economic effects, economic impacts, and future development projects. Chapter four presents the survey profile, design, findings, demographic characteristics of respondents, and analyzes the Twante Canal's role in generating business revenue, enhancing employment opportunities, assessing its economic impacts, identifying risks and threats, discussing restoration efforts, and proposing future improvements. Finally, chapter five concludes with findings and study recommendations.

CHAPTER II

LITERATURE REVIEW

2.1 Water Resources of Canal

Canals are engineered waterways or channels constructed for various purposes such as managing drainage (e.g., flood control and irrigation) or facilitating waterborne transportation (e.g., water taxis). A canal typically consists of a series of dams that create reservoirs to maintain a slow, controlled flow of water known as slack water levels or simply levels.

A canal is termed a navigation canal when it runs parallel to a natural river and its accompanying drainage basin, utilizing dams to extend its stretches of slack water levels within the valley. Additionally, a canal may traverse a drainage divide atop a ridge, often requiring an external water source located above the highest elevation.

Many canals are constructed at elevations above valleys and other waterways. Canals with water sources at higher elevations deliver water to destinations such as cities where it is needed. Historical examples of such water distribution systems include the aqueducts of the Roman Empire (referenced in "The Roman Empire's aqueducts, 2023").

Navigation refers to a series of channels that generally run parallel to the valley and stream bed of a natural river. A navigational vessel always shares the same drainage basin as the river it accompanies. Vessels utilize both the calm stretches of the river itself and any engineered improvements, navigating through changes in elevation.

In contrast, a true canal is a constructed channel that crosses a drainage divide, effectively connecting two distinct drainage basins via a navigable waterway. Both navigations and canals employ engineered structures to enhance navigation:

- i. Weirs and dams are utilized to elevate water levels in the river, ensuring usable depths for navigation.
- ii. Looping descents are created to form longer and gentler channels around areas with rapids or waterfalls.

- iii. Locks are constructed to enable ships and barges to ascend or descend between different water levels.

Canals are challenging to construct and often require additional enhancements such as viaducts and aqueducts to bridge over streams and roads, as well as mechanisms to maintain water levels within the channel. There are two main types of canals: waterways and navigations, both used for transporting goods and people. These can be further categorized into two kinds:

- i. Canals that connect existing lakes, rivers, other canals, seas, and oceans.
- ii. Canals integrated into urban networks, such as the Canal Grande in Venice, the canals of Amsterdam or Utrecht, and the waterways of Bangkok (Panama Canal, 2023).

Water resources for a canal typically refer to the sources of water that supply the canal with the necessary flow and volume of water. Canals are artificial waterways designed for various purposes, including irrigation, transportation, drainage, and water supply. The availability of water resources for a canal can vary widely depending on its purpose and location. Here are some common water resources for canals: Canals are often fed by nearby rivers or streams. Water is diverted from the natural water courses into the canal to provide a steady flow of water:

- i. **Reservoirs:** Certain canals are supplied with water from reservoirs, which are artificial bodies of water created by damming a river or stream. Stored water is released into the canal as required.
- ii. **Groundwater:** In some cases, canals can be supplied with groundwater by digging wells or using infiltration galleries. This method is common in arid regions.
- iii. **Rainwater Harvesting:** Canals in certain regions are supplemented by rainwater harvesting systems. Rainwater is collected and stored in reservoirs or underground tanks, then released into the canal when needed.
- iv. **Aqueducts:** Canals may be connected to aqueducts that carry water from distant sources, such as mountainous regions or springs.
- v. **Diversion Works:** Canal systems often have diversion works and control structures that allow operators to manage the flow of water from rivers and other sources.
- vi. **Wastewater Reuse:** In urban areas, treated wastewater can be used to supply canals for non-potable purposes, such as irrigation or industrial processes.

- vii. Desalination: In coastal regions, desalination plants may provide fresh water for canals by converting seawater into freshwater.
- viii. Water Trading: Some regions have established water trading systems, allowing users to buy and sell water rights, which can be used to supply canals.

The management and sustainability of these water resources are critical to ensuring that canals continue to function effectively and meet their intended purposes. Water conservation, efficient use, and environmental considerations are important factors when managing canal water resources.

2.2 The Canal Revitalization

Cities aspire to have waterfronts that are centers of public enjoyment. They desire waterfront areas with abundant visual and physical public access throughout the year, providing access to both water and land. Additionally, cities aim for waterfronts that serve multiple purposes: places to live, work, and play. In essence, they seek spaces that enhance the overall quality of life, encompassing economic, social, and cultural aspects (Seattle Department of Planning and Design, 2012).

According to the Cambridge Dictionaries Online, revitalization is defined as "the process of making something grow, develop, or become successful again" (Cambridge University Press, 2016). The Oxford Dictionary defines revitalization as "the action of imbuing something with new life and vitality." Additionally, terms such as "Waterway Restoration" refer to the activity of restoring canals or rivers, including special features like warehouse buildings, locks, boat lifts, and boats, as defined by the Princeton University Website. Other terms commonly used in such projects include waterway renewal, waterway redevelopment, and waterway reconstruction. In the context of this research, revitalization of the Bangkok khlong refers to the process of fostering growth, development, strength, and activity, ultimately ensuring success for Bangkok and its residents once again (Jiarakul, 2015).

Global tourism trends, including community-based tourism, ecotourism, and sustainable tourism, significantly influence the evolution of tourism activities in Bangkok. Since the early 1960s, planning and revitalization of urban waterfronts have been focal points in the United States. The revitalization efforts have also left a mark on numerous European cities, particularly during the 1970s and 1980s, and on Asian cities since the late 1980s and 1990s. Waterfronts have emerged as areas of interest for

urban management and developers alike. Many waterfront projects have been launched, expanding development strategies beyond immediate areas to address broader urban redevelopment issues. Environmental awareness plays a pivotal role in the restoration and revitalization of waterways.

The benefits of waterway revitalization or restoration have been extensively studied and documented in various sources. Several examples are presented here. “The restoration to navigation of canals and rivers has revitalized key parts of the country’s transport and industrial heritage, generated jobs and development, and increased opportunities for leisure, recreation, and tourism.” (Buckingham Canal Society, 2000)

2.3 Conservation of Water Resources

The conservation of water resources presents a significant challenge for the 21st century. With the world's population projected to exceed 9 billion by 2050 and climate change impacting water availability in many regions, it is crucial to enhance our efficiency in water usage. This post explores various methods to conserve water resources, ranging from simple actions such as fixing leaks to more intricate solutions like desalination. These measures are essential to minimize our global impact on water supplies (United Nations, 2013).

Water conservation involves the protection, development, and efficient utilization of water resources. It encompasses policies, strategies, and practices aimed at sustainable management to meet human needs and preserve ecosystem services, while also ensuring sufficient water for future generations. Conservation efforts span from individual actions like turning off taps while brushing teeth to large-scale initiatives such as constructing dams and desalination plants. By implementing water conservation practices, we can decrease our reliance on groundwater and surface water sources, reduce wastewater discharge, and safeguard freshwater ecosystems (Ward and Pulido-Velazquez, 2008).

Water conservation is crucial because it plays a vital role in preserving our most precious natural resource: fresh water. Only 3% of the world’s water is freshwater, with two-thirds of that locked up in ice caps and glaciers. The remaining freshwater is distributed among underground aquifers (1%), surface waters like lakes and rivers (0.3%), and the atmosphere (0.0001%). This leaves a mere 0.006% of the world’s total water supply available for human use. Given this scarcity, it is imperative that we take every possible step to conserve this invaluable resource. Water conservation not only

ensures a sufficient supply of fresh water for current generations but also safeguards it for future generations (Saurí, 2013). This approach is essential in mitigating the impact of water scarcity and securing our water resources for sustainable use.

Water conservation is essential because water is a finite resource. Despite covering 70% of the Earth's surface, only 2.5% of it is fresh water usable by humans and other animals. The majority is saline or otherwise unsuitable for consumption. Much of the accessible freshwater is locked in glaciers or otherwise unavailable. Consequently, only a small fraction of the world's water resources is actually accessible for human use.

Water is vital for life, supporting essential activities such as drinking, cooking, bathing, crop irrigation, and more. Given the high demand and limited availability, conserving water is crucial to ensure there is sufficient supply both now and in the future. There are various ways to conserve water at home, such as repairing leaks, reducing water usage during activities like showering or brushing teeth, and watering plants during cooler parts of the day to minimize evaporation. Utilizing efficient appliances and fixtures, such as low-flow toilets and showerheads, also contributes to water conservation efforts (Ward and Pulido-Velazquez, 2008).

Canals are utilized not only for transportation but also for transporting water for irrigation and other human purposes. Despite advancements in more efficient forms of transportation, canals continue to play a crucial role as conduits for transportation and in facilitating global commerce. There are two primary types of canals: waterways and aqueducts. Efficient and relatively cost-effective, transoceanic shipping allows for the efficient import and export of goods, supporting the livelihoods of billions of people (Mohammadi, 2021). The advantages of canals include:

- i. They are effective means of irrigation.
- ii. They generate income for the government.
- iii. They cover large areas for irrigation.
- iv. Canals are effective in sustaining agriculture during droughts.
- v. They carry sediment, enriching the fertility of the soil.

2.4 Economic Analysis of the Canal

The economic analysis followed ADB guidelines, assessing economic returns through measures such as the economic internal rate of return (EIRR). Sensitivity analysis was conducted based on various scenarios and switching values, while the poverty impact ratio was also estimated. The project's economic viability was assessed using domestic price as the numeraire. Non-quantifiable economic benefits were documented as well.

Economic parameters were calculated by adjusting incremental financial costs and benefits, net of transfer payments (taxes, duties, and subsidies). Import and export parity prices for inputs and outputs were used, and the prices of non-traded goods were converted using the Standard Conversion Factor (SCF). Prices from January 2021 were utilized to estimate the incremental costs and benefits.

A socio-economic analysis was conducted on the Baroda Branch Canal within the Som Kamla Amba Irrigation Project in Dungarpur, Rajasthan. The development of irrigation systems has significantly improved the economic conditions of farmers, resulting in enhanced livelihood sustainability, increased standards of living, and positive shifts in social attitudes. This study specifically examines the socio-economic status of farming families residing in the command area of the Baroda Branch Canal. The research employed a survey sampling method that covered 10% of the beneficiaries within the canal's command area, totaling 150 farming families and involving 787 individuals. Various socio-economic indicators, including family structures, employment patterns, education levels, livestock ownership, distribution of farm assets, cost of cultivation, and returns, were meticulously analyzed. The findings revealed relatively low education levels and living standards among farmers, which could hinder the adoption of modern farming technologies. Additionally, the area's productivity was reported as average, largely attributed to limited input usage (Makadiya,2021).

An economic analysis was conducted on canal lining, a critical component of irrigation projects that ensures efficient water delivery to fields. Many traditional earthen canals suffer from substantial water loss due to seepage, which can be mitigated by lining the canal bed and sides with impermeable materials. Canal lining serves to reduce operational and maintenance costs, prevent erosion, and enhance flow velocity. Various materials can be used for lining, including concrete, mineral, brick, asphaltic, and geomembranes. In our country, tile and cement concrete lining are

particularly favored due to their longevity, cost-effectiveness, and suitability across diverse environmental conditions. The primary objective of their study was to identify the most economical method of canal lining based on cost considerations and efficiency in reducing water wastage (Mistry, Khasiya, and Patel, 2016).

The economic impacts of the new Suez Canal are vital elements of Egypt's strategy to tackle economic challenges and integrate its economy with global leaders. This development aims to stimulate substantial domestic and foreign investments while bolstering the Suez Canal's role in global trade. Furthermore, the project is poised to establish itself as an international hub for logistics and industry, attracting key sectors such as transportation, logistics, energy, tourism, telecommunications, and information technology - some of the world's fastest-growing industries. Enhancing the canal's economic efficiency could be achieved through legislative reforms that enable exporters to collaborate more effectively in international trade (Kenawy, 2016).

The economy and livelihood of 34 million people depend largely on the inland waterways, which support the distribution of agricultural products and basic necessities in their daily lives. So, maintaining the navigability and improving the capacity of the inland waterways are indispensable infrastructure for the sustainable development of the region as an agricultural core of the country. The financial sources for management and maintenance after the completion of the project will be fully funded by the government, and the funds to be utilized will come from the toll imposed on the vessels passing through the Twante Canal. This canal will benefit some 2 million people in Myanmar, including ship operators, passengers on ships navigating the canal, and people living along the canal whose transportation means are mainly small wooden crafts.

2.5 Improving Quality of Life through the Canal

Waterway revitalization projects have the potential to significantly enhance the quality of life for residents and visitors in Worcester. Improved quality of life refers to the enhanced enjoyment that residents can anticipate from the revitalization of the Blackstone Canal. Similar enhancements in quality of life have been observed in other cities that have embarked on waterway revitalization or construction projects. For instance, the San Antonio River Walk, featuring a mix of restaurants, shops, entertainment venues, businesses, museums, historical sites, and recreation areas, has

had a profound impact on the quality of life for San Antonio residents, offering a vibrant destination for daily visits (Nivin, 2014).

A study was conducted on the Quality of Life as a Limiting Factor in the development of the region along the Great Bačka Canal in Serbia. The research focuses on the demographics of the region and the quality of life of the population in Central Bačka, covering five municipalities along the canal from June to August 2022. Despite the area's potential for high quality of life, it has faced socioeconomic stagnation. Therefore, the study analyzes how natural and human-made factors could mitigate these negative developmental trends in an economy centered around agriculture, formerly one of Serbia's most developed regions. The study aims to identify factors influencing the population's perception of their quality of life in Central Bačka and proposes measures for improvement. The hypothesis suggests that due to these identified factors, the population is dissatisfied with their quality of life, potentially affecting demographic trends. Results indicated varying levels of satisfaction across most indicators, supporting the hypothesis that subjective well-being perceptions differ based on sociodemographic characteristics among the studied population (Lalić, 2024).

The development of leisure facilities, prominently exemplified by the Providence Place Mall, and complemented by the scenic beauty of the newly developed Water Place Park, has significantly enriched the quality of life for both residents of Providence, Rhode Island, and visitors to the region. (Sheridan, 2014).

Canal-oriented development (COD) is a urban planning strategy focused on establishing mixed-use communities along canal banks, leveraging the waterfront's allure to stimulate social and economic activities. This approach offers landlocked cities without conventional harbors the opportunity to pursue waterfront development initiatives. (Buckman, 2016). The major advantage of COD is that it provides the luxury of developing numerous sites along the area it drains. The canals have been built or constructed for some specific purposes aiding COD, which are enlisted below:

- i. Transportation of goods
- ii. Recreational and tourism purposes.
- iii. Inland water transport—to commute passengers.
- iv. Sustain the ecological balance.
- v. Intermixing of socio-cultural zones.
- vi. Providing a perfect harmonizing backdrop for building sites.
- vii. Bolster the local economy for the people of the vicinity.

- viii. Control rising water levels if properly maintained (Sanghamitra Sarkar, 2020).

2.7 Review on Previous Studies

The Panama Canal is currently undergoing considerable expansion. Pagano, A. M., Light, M. K., Sánchez, O. V., Ungo, R., and Tapiero, E. (2012) investigated the impact of the Panama Canal expansion on the Panamanian economy. This study investigates the economic implications of extending the canal in Panama. Using a computational general equilibrium model, the study analyzes the interplay of various factors based on data from 2008. The findings have profound implications for Panama's canal, its administration, and the broader national economy. Understanding these economic impacts is crucial for Panama to effectively plan and budget for canal development. Moreover, the study offers valuable insights for developing countries seeking to forecast the potential economic benefits of enhancing their ports and maritime industries on overall growth and development.

Canals played a crucial role in the development of the United States during the first half of the nineteenth century by strategically increasing their number based on each region's comparative advantages, thereby fostering significant economic growth. The degree of economic specialization in a region is restricted by the size of the market, and one of the major limits on market size has been the cost of transportation between regions. Economic historians have consequently paid close attention to the development of an efficient transportation infrastructure in the United States. Historically, the development of the railroad has been indicated as the most essential driver for market expansion in America; however, recent research presents doubt on this conclusion. The discovery of the extensive system of canals prior to railroad construction raised interest in the significance of canals in economic development. This study examines the problems that arise when attempting to assess the impact of canals to the United States' economic development (Ransom, 1964).

Canals played a crucial role in American economic development between 1815 and 1890, with nearly 4,000 miles constructed—almost double the length of the British canal system. Despite eventually being surpassed by railroads, early canals offered substantial cost savings over wagon transport, which facilitated significant trade between eastern and western regions. This efficiency enabled Americans to utilize the vast interior of the continent, fostering the growth of a national market crucial for

industrial development. The economic benefits of canals outweighed their costs, contributing significantly to the rapid advancement of the American economy during this period (Segal,1961).

The study focuses on the revitalization of the Canal de Castilla, employing a community-centered approach for its long-term restoration. Built in the 18th century, the canal historically served as a vital transportation route and contributed to territorial unification. However, the deterioration of its locks has diminished its economic significance. The research utilizes questionnaires to assess the canal's impact across various domains. Over 85% of surveyed residents express strong support for comprehensive measures, particularly advocating sustainable enhancements that preserve historical heritage. One proposed solution includes installing axial turbines in cross channels, noted for their efficiency and minimal environmental footprint. This proactive strategy aims not only to identify challenges but also to devise sustainable solutions, demonstrating a commitment to responsible development (Rodríguez Pérez, 2024).

The revitalization of the Begej canal is a 32-kilometer waterway linking Timisoara, Romania, with Zrenjanin, Serbia. This study emphasizes the part of the canal that is located within Serbian territory. The research includes all of the activities required to complete all of the works on the rehabilitation and construction of the previously mentioned structures, including the production of complete technical documentation and equipment for the dredging process on the Begej canal in the Republic of Serbia. It is concluded that the project is viable with negative financial parameters and a positive economic impact, and that it has a high potential for affecting the economic development of Serbia's northeast region and improving ecological parameters (Kolaković, 2016).

CHAPTER III

OVERVIEW OF TWANTE CANAL

3.1 Historical Background of Twante Canal

The Ayeyarwady Delta is located in the southern portion of Myanmar's central plains. It encompasses three main regions: Yangon, Ayeyarwady, and a portion of the Bago region. The Ayeyarwady Division is where the Ayeyarwady River, known locally as the Irrawaddy River, bifurcates into numerous channels before emptying into the Andaman Sea. To the south and west of the Ayeyarwady Division lie the Andaman Sea and the Bay of Bengal, respectively. Additionally, the Gulf of Martaban is situated to the east of the division. The specific project area is located within Twante Township, Dala Township, Kyimyingdaing Township, and Seikkyi Khanaungto Township of Yangon South District in the Yangon Region.

Among the few navigable canals in Myanmar, the Twante Canal is the only canal under the Ministry of Transport and Communications. It is also an important waterway in the domestic waterway network. The construction of the Twante Canal was able to bring benefits to the affairs of the country. Since the construction started in 1873, it will be 150 years old in 2023. The activities carried out by the Directorate of Water Resources and Improvement of Rivers System in the Twante Canal are maintenance for the long-term sustainability of the canal. It is intended to present the collection of canal tolls and the supervision of large vessels passing through the canal, as well as other issues related to the canal.

Before the construction of the Twante Canal, the internal waterway network and Yangon were connected by two waterways. Among the two waterways, the one that can be used in any season is the one that flows downstream along the Toe River and flows through Kwon Hungkone Township and Kaw Nhu Township (also known by the names Pathein River and Wah Block Ping River) and goes upstream from the Yangon River to Yangon. The second waterway which can only be navigated during the flood season, is the waterway that flows down the Pa Hlaing River from Nyangtong.

The Twante Canal is in Maupin City; it connects the Toe River and the Yangon River, which flow through the town of Dedaye. Khnaungto Creek flows into the Yangon River through the Twante Canal; construction began in 1873. It is connecting the Pathi River and the small river of Ngpasu Ro, which flows into the river. Although the construction was simple, due to waterworks and the ability to irrigate farmland, the area where the canal is located gradually became a municipality.

In 1881, by the labor of the prisoners from 3.5 miles to 11 miles, 25 feet in width and 9 miles in length, the Twante Canal was excavated. Even after excavating, there was not enough width and depth in the waterway for large vessels to pass through, so only vessels of reasonable size could pass through. In addition, it was found that vessels cannot travel safely and smoothly because they have to pass through the narrow and winding Khnaungto River, waiting for the tide to rise. The Twante Canal can only be navigated by the tide. It was expanded and constructed over a period of 4 years from 1913 to reach a width of 300 feet and a depth of 9 feet so that it could be navigated in any season.

The Yangon Port Administrative Engineering Group objected to the construction of the 300-foot-wide stretch from (0) mile to (3.5) mile. At that time, there were large rice mills located on the left side of the KhaNaungTo creek. So, they had to use only the Khanaungto River to get in and out of these large mills. Due to objections, a 180-foot-wide canal was built across the Twante Canal from 0 miles to 3.5 miles. However, since the construction, the bank and the bottom of the bypass have been eroded, and the width has increased much more than the original width, so in order to maintain the canal, between 0 miles from Leppangone station, the canal bank was lined with laterite, and 4 stone dams were constructed in 1923.

According to the measurements taken in 1925, it was found that during the construction of the bypass, the banks that were not lined with laterite had almost doubled in width. Due to the widening of the canal, in order to prevent the Khnaungto Creek from becoming shallow, the bottom of the canal and the bank around the entrance of the canal were lined with stone slabs and maintained every year. However, the amount of water flowing from the Twante canal to the river could not be maintained; the banks of the canal eroded, and the water flow increased every year. Although efforts are being made to control the amount of water flowing into the canal and stabilize the canal bank, the technology and funding are insufficient, so the transfer to this

department is the reason for the transfer. According to the records, the head of state instructed that the Twante canal could only be preserved as a river.

According to the instructions of the President of the National Organization for Peace and Order, the operation of the Twante Canal administrative and maintenance matters were transferred from the Irrigation Department (Ministry of Agriculture and Irrigation, 1995). This department was transferred to repair and maintain the Twante Canal, with the transfer of the collection of canal fees. Control and maintenance operations for Twante Canal and Khnaungto River navigation were also included. Business employs buildings and rules governing maritime traffic. Furthermore, a canal includes any section of a river, stream, lake, natural body of water, or natural drainage channel. The Khnaungto Creek, which runs parallel to the Twante Canal, is considered part of the Twante Canal system.

3.2 Boundary and Population of Twante Township

Twante Township, situated in Myanmar's Yangon Region, lies to the west of Yangon, separated by the Hlaing River. It serves as the primary administrative center. The Twante Canal, Myanmar's longest man-made waterway, serves as a shortcut between the Ayarwaddy River and the Yangon River, dividing Twante Township. Stretching 35 kilometers, the canal is spanned by a single bridge known as the Twante Bridge. The township comprises 220 villages organized into 65 village tracts and 8 urban wards, with a total population of 227,953 people and 52,307 households as of March 2017. The majority of residents belong to the Bamar ethnicity (about 76%), with the Kayin comprising about 23%. The population practices predominantly Buddhism and Christianity, with smaller communities of Muslims and Hindus. Twante Township is renowned for its long-standing pottery industry, which has been passed down through generations in a few families. It is also known for fish farming within the Yangon region. Agriculture and fishing are the primary economic activities, supplemented by commercial enterprises related to the canal. Nearly 13,000 individuals are employed in canal-related industries (DWIR, 2019).

3.3 Boundary and Population of Dala Township

Dala is located on the southern bank of the Yangon River, directly across from Yangon city, spanning an area of one square mile. The township is delineated by the Yangon River to the north and east, the Twante Canal to the west and Twante Township

to the south. It stretches approximately 7 miles from east to west and 10 miles from south to north, bordered by the Yangon River to the north and Kawmhu Township to the south. As of March 2018, Dala Township comprises 23 wards and 23 village tracts, encompassing 50 villages, with a total population of 154,563 people and 35,223 households. The demographic makeup predominantly consists of Bamar residents, comprising over 95% of the population, followed by smaller percentages of Kayin and Rakhine people. The religious distribution mirrors that of Twante Township. Dala Township is comparatively less developed than Twante, with its economic infrastructure still in development. The tertiary sector, particularly services and retail, dominates the local economy. Canal-related industries are crucial for employment, with approximately 20,522 individuals engaged in these sectors—proportionally more than in Twante Township. Overall, Dala's economy relies significantly on canal-related industries compared to Twante Township, reflecting its current stage of economic development (DWIR, 2019).

3.4 Boundary and Population of Seikgyi Kanaungto Township

Seikkyi Kanaungto Township is a separate artificial island located on the southwestern bank of the Yangon River, directly opposite downtown Yangon. The township consists of eight wards and is bordered by the Yangon River to the north, the Twante Canal to the east, and Twante Township to the south and west. Despite its strategic location, the area remains predominantly rural and underdeveloped, primarily due to the absence of a bridge connecting it to downtown Yangon. Geographically, Seikkyi Kanaungto Township spans between North Latitude 45" and 16 48", covering approximately 1 mile from east to west and 2.3 miles from south to north. To the east, it is bordered by the Yangon River and Dala Township, while Kawmu Township lies to the west. Twante Township and Dala Township bound it to the south, and it meets the Yangon River and Kyimyinedine Township to the north. As of March 2017, the township is home to 33,944 residents distributed across 7,778 households. The majority are of Bamar ethnicity, comprising about 95% of the population, with smaller percentages of Mon, Kayin, Rakhine, and Chin ethnicities. The local economy largely revolves around sales and canal-related businesses, including shipyard operations. Despite higher unemployment rates, notably above 4%, compared to Dala and Twante Townships (each with around 2%), the average income levels in Seikkyi Kanaungto Township are notably higher. In summary, Seikkyi Kanaungto Township, despite its

small size and rural character, plays a significant economic role in the region due to its canal-related industries, though its development is hindered by the lack of direct connectivity to downtown Yangon (DWIR, 2019).

3.5 The Twante Canal Revitalization

When the Twante Canal was first constructed between (3.5) and (0) miles, it was only about 180 feet wide but between (3) and (0) miles, the width was widened from 500 to 1000 feet. In addition, it is a straight section, the water flow rate is high at 3.5 miles during the high tide and due to the erosion of the river bed, a large whirlpool is formed near the Leppangone waterway terminal. In order to avoid any danger to vessels due to the landslide, the Twante canal crossing was closed for about four hours when the water fell. It is closed twice a day for about 8 hours every day. When it was closed, they had to pass through the narrow and winding Khanaungto Creek.

In August 1995, 4,000 rock pits were filled in to reduce the water flow along the 3.5-mile stretch. Efforts are ongoing to reduce water flow. On October 3, 1995, a passenger ship owned by domestic shipping company Tym Nang sank. Local reports claimed that over a hundred people perished in the sinking of the Tym Nang vessel, while the official list accounted for more than thirty deaths. In 1996, operations continued with the filling of 4,000 Kyaukgyi pits, followed by a reduction in the original water flow rate from 3.7 meters per second (8.28 miles per hour) to 3.2 meters per second (7.16 miles per hour) during the 1997-1998 fiscal year. The speed of traffic around Palm Hill has slightly decreased, but due to its precarious position, the bypass must be closed as before during periods of low water levels.

The number of landslides increased due to the rotation of the palm hill and the large amount of sea traffic when the bypass was opened. The landslide occurred at the confluence of the Twante Canal and the Khnaungto Creek. The Lepankone concentration camp is situated at the tip of the chicken's tongue. If the edge of the chicken tongue erodes and collapses, it can have a big negative effect. So, in the fiscal year 1996-1997, 17 floating groins were built together with wave floats. As a result of these actions, it was found that the volume of water flowing from the Toe River increased in 2009 from the continuous monitoring of the Twante Canal, which was stabilized. According to measurements in 2008, the volume of water flow increased from 40,000 cubic feet per second to 47,000 cubic feet in 2009. In July 2009, the highest water flow rate in three years, reaching 3.53 meters per second (7.90 miles per

hour), resulted in landslides along the side of Lepankone camp due to the eddy created by the current.

On August 19, 2009, the day of the flood, another significant landslide occurred above the landslide area, followed by a 150-foot-long landslide on August 24. A three-room staff house was damaged due to the landslide and if maintenance is not carried out effectively, the end of the mid-point at the confluence of the Twante Canal and the KhaNaungto Creek could collapse. It was found that the width of the top of the 3.5-mile-long canal is only about 100 meters, but the width of the vortex is approximately 242 meters. The width of the top of the canal and the difference in height and the height of the bottom of the canal within about half a mile are dangerous for the canal's sustainability as well as for navigation.

Therefore, on September 5th, 2009, the top of the bypass was expanded to 100 feet wider than the original width, measuring 650 feet in length and approximately 10 feet below the original floor, using large machinery. As the narrowed section widened and eroded, the channel reached a width of 200 meters, resulting in a decrease in flow rate and the disappearance of the eddy. Subsequently, the canal, previously closed for eight hours a day, was opened around the clock starting January 2, 2010.

In 2009, the expansion of the canal near the 3.5-mile mark of the Twante Canal increased the water flow rate in the bypass between the 3.5-mile and 0-mile markers. At the confluence of the Twante Canal at 0 miles with KhNaungTo Creek, a water eddy formed near the peak of Seikgyi Island cape. In October 2009, landslides occurred on Seikgyi Island, necessitating urgent shoreline management efforts.

The Twante Canal Improvement Project is structured into two distinct phases. The initial phase focuses on Channel Training and Flood Embankment initiatives. This Environmental and Social Impact Assessment (ESIA) document exclusively addresses the first phase, while the detailed planning, components, geographical scope, and financing strategies for the second phase will be developed at a later stage. The first phase of the project includes essential measures to tackle critical issues such as bed and bank erosion, as well as flood damage mitigation. Channel training measures aim to decrease flow velocity caused by tidal currents and stabilize the flow patterns within the Twante Canal. At the same time, flood embankment measures are engineered to prevent breaches even during the highest spring tides, thereby ensuring protection against flooding that exceeds the design flood level. The project's components are delineated as follows:

1. Component 1 - Waterway Maintenance and Shore Protection:
 - i. Construction of embankments spanning 5.88 kilometers
 - ii. Implementation of bed erosion protection covering an area of 55,500 square meters
2. Component 2 - Flood Protection:
 - i. Construction of embankments for flood protection across three sections, totaling 39.5 kilometers

These measures aim to collectively reduce the physical, social, and environmental impacts of erosion and flooding, thereby safeguarding the lives, properties, and livelihoods of individuals affected within the project area (DWIR, 2019).

The following table (3.1) shows the cost of maintenance works from 2011 to 2022 for the long-term revitalization of Twante Canal. The table expressed the place of restorations and the cost (Kyats in Million) of restorations by financial year (from 2011 to 2022).

Table (3.1) The Cost of Maintenance for Revitalization of Twante Canal

Financial Year	Cost (Million Kyats)	Restorations Place
2011-2012	140.00	(1) Twante Canal (3.5 miles) bank Protection (2) Twante Canal (0) mile bank protection
2012-2013	182.40	(1) Twante Canal (3.5) mile bank protection
2013-2014	135.50	(1) Twante Canal Waterway Development Project (Twante Township, (21) miles near the city of Twante (shore maintenance work)
2014-2015	368.14	(1) (3.5 miles) shore maintenance of Twante Canal (2) "Twante Canal Waterway Development Work (Aung Pago)" (3) Twante Canal (0) mile shore maintenance work (4) Bank protection work near Twante Wa (21) mile station

**Table (3.1) The Cost of Maintenance for Revitalization of Twante Canal
(Continued)**

Financial Year	Cost (Million Kyats)	Restorations Place
2015-2016	-	-
2016-2017	998.29	(1) Operation of the retaining wall "House Moving Costs" (2) Twante Canal Mouth, near "Rural Health Center bank Protection Work" (3) Bank protection work near Min Bo Su Village, Karin Chaug Village, Min Bo Su Village, Tan Tay Township (4) Bank protection works near Shwe Vyachong (Taw) village
2017-2018	22328.11	(1) Tawnte Canal estuary (Tawnte Canal) embankment protection work (2) (Twante Canal and Toe River) Sonra Shwe Vyachong (Taw) Village landslide protection work" (3) 21-mile health medicine dispensary neighborhood control business (4) Twante Canal (3.5) miles and (6) miles "3.5 miles of nearshore bank protection work" (5) Twante Canal (Khan Naungto side)
2018-2019	4681.80	(1) Bank protection work near Uo Ye Kyaw Village (2) Bank protection work near Chaung Wai Gyi Village (3) Bank protection work near Karen Chaung Village (4) Adoon - Flood protection work

**Table (3.1) The Cost of Maintenance for Revitalization of Twante Canal
(Continued)**

Financial Year	Cost (Million Kyats)	Restorations Place
		<p>(5) between 3.5 miles and (7) miles landslide protection work</p> <p>(6) between 3.5 miles and (7) miles of Bank prevention work</p> <p>(7) Bank protection work between 3.5 miles and (7) miles</p> <p>(8) Bank protection works within 15.5 miles and 21 miles Between 19 miles and 20 miles Kunglamu village</p>
2019-2020	2884.26	<p>(1) Twante Canal (Twante side) Bank protection work</p> <p>(2) Bank protection work near Twante Township, Chaung Wian Gyi Village (school).</p> <p>(3) In front of Twante City Park, next to the retaining wall, carrying out foundation maintenance work</p> <p>(4) Sool Lamu Village, Bank Protection Work</p> <p>(5) Flood protection work</p> <p>(6) Bank protection work near Mau Pin Highway</p> <p>(7) Adun village group Adoon Village, Atka (sub-chain) in front of Tai School (Khattiya-Ye Kyaw River) Bank protection work</p>

**Table (3.1) The Cost of Maintenance for Revitalization of Twante Canal
(Continued)**

Financial Year	Cost (Million Kyats)	Restorations Place
2020-2021	2735.20	(1) Protection of landslides near Pathi Village Monastery (19 miles) (2) Bank protection work (3.5 miles) to (21) miles of Twante Canal (3) Bank protection work near Chaung Wiangyi village (4) Toe River water way near Makot Pagoda Bank Protection Project
2021-2022	694.00	(1) Twante Township, Chaok Wanggyi Village, Bank protection work (2) Twante Canal (0) miles Phegyi Kyung Cape shore maintenance work
Total	35147.7	

Source: Directorate of Water Resources and Improvement of River System

According to Table 3.1, maintenance activities from 2011 to 2022 required funds totaling 35,147.7 million Kyats. Currently, the water in the 3.5-mile Twante Canal flows steadily in a straight line, reducing eddies at the Khnaungto Creek junction and minimizing landslide risks. Shore protection works, including the placement of geobags, have been completed, with plans for embankment maintenance in 2022 during floods. The annual expenditure on Twante Canal maintenance from 2011 to 2022 is detailed in the table.

3.6 The Role of the Twante Canal in the Socio-Economic Development of the Region

Canals have historically played a crucial role in shaping the social and economic landscapes of regions. They have had significant impacts, profoundly influencing both social structures and economic development, contributing significantly to regional growth. Some of social and economic impacts are;

1. The reduction in navigation time passing through Twante Canal has been delayed by the dangerous turbulent water;
2. The reduction in navigation risk benefits fleet operators and transportation service users;
3. The protection of the land and houses of low-income urban dwellers whose lives have been exposed and threatened by progressing erosion of the banks of Twante Canal;
4. The drastic reduction in navigation risk of small wooden crafts that people living along Twante Canal use in their daily life.
5. The sustainable economic development of the north, central and delta regions through the encouragement of the growth of the domestic primary and secondary industries, especially the water transportation oriented industries;
6. The stable circulation of the agricultural products and necessities of people's life that will support the low-income farming population living in the central and delta regions;
7. The improvement in the living standard of the ethnic minorities in the northern border areas through promotion of border trade triggered by the effective transit service;
8. Socio – economic development of the ethnic minorities in the northern border trade with China; and
9. The improvement in the foreign reserves through the international trade triggered by the development of inland waterways distribution capacity.

In the Union of Myanmar, agriculture is by far the largest economic sector absorbing more than 60% of the employment. The country has such a demographic feature as more than 70% of the national population lives in the central agricultural region in the fertile Lowland regions of the Ayeyawady river valley and the southern delta. Thus, more than 200 vessels carrying rice, cements, agricultural and fishery products, gas and petrol, logs, general cargoes as well as passengers have to pass through Twante Canal daily. Also, the cargo flow of more than 1 million tones per annum funnels into Twante Canal making it the most densely used navigation channel in the country. Therefore, ensuring a smooth and safe flow of vessels and commodities in Twante Canal is the most important undertaking of the DWIR towards realization of

a well- balanced national development through promotion of the economic growth and improvement of the living standard.

Two custom offices are open for 24 hours a day at the intersection of the Twante Canal and Khnaungto River, at the (3.5) mile point of the Twante Canal, and the Lepangone Waterway Customs Office at the other end (21) miles, where to request canal tolls for boats entering and leaving the Twante Canal. In Twante Township, the Department of Land Administration and Statistics reports that the total canal land is about 2382.13 acres.

3.7 Navigation Chanal of Twante Canal

The Twante Canal project and its surrounding area represent pivotal elements in Myanmar's strategy to navigate its current economic challenges and elevate its economy to global standards. Central to this vision is the facilitation of unrestricted domestic and foreign investments, as well as the enhancement of Twante Canal's role in domestic trade. Revitalizing this area holds significant potential to attract diverse sectors and activities, particularly in high-growth areas such as transportation, logistics, energy, and communication. This revitalization effort also promises to generate numerous job opportunities, contributing to broader economic development goals. The following table (3.2) shows number of ships steering along the Twante Canal and net payload, which are to conduct marine trade.

Table (3.2) Evolution of the Number of Ships and Net Payload

Statement	2018	2019	2020	2021	2022	2023
Ships	126011	68497	49153	27146	32519	28986
(%)	-	-45.64%	28.241%	-44.772%	19.793%	10.864%
Net payload	13535387	12149915	6465641	6204610	5296841	5767349
(Millions of tons)	-	-10.23	-46.8%	-4.04%	-14.63%	8.9%

Source: Directorate of Water Resources and Improvement of System

Table (3.3) represents the number of ships and net payload to conduct marine trade per month from the year of 2022 to 2023. This table expresses both the total number of ships per month and the net payload, measured in thousands of tons per month.

Table (3.3) Number of Ships and Net Payload per Month (2022 - 2023)

Month	Total Number of Ships		Net Payload (In thousands of tonnes)	
	2022	2023	2022	2023
January	3533	2593	595562	468686
February	3201	2434	549375	423310
March	3700	2938	608371	621860
April	2853	2118	475020	430724
May	3522	2514	516253	460587
June	2952	2466	440334	460764
July	2858	2207	429728	365786
August	2876	2446	443469	207592
September	2679	2228	433043	386793
October	2406	2313	328480	428015
November	2348	2469	359350	501006
December	2333	2755	173653	668346
Total	35261	29481	5352638	5423469

Source: Directorate of Water Resources and Improvement of System

According to the above table, higher payload months like March and May might coincide with periods of increased economic activity or seasonal demand for certain goods in 2022. Lower payload months like December have reduced economic activity due to the marine traffic complex for lower water level. In 2023, the highest payload months like November might coincide with other factors like trade events, agricultural harvest seasons, and manufacturing cycles that could contribute to higher shipping volumes during that month. Lower payload months, like August, reduce economic activity.

3.8 Future Development Project of Twante Canal

The Twante Canal is a vital waterway in Myanmar, playing a crucial role both socially and economically. By linking the Yangon River and the Ayeyarwady River, it serves as a critical transportation shortcut, facilitating efficient movement of goods and people between Yangon and inland regions. This connectivity has significantly reduced transportation costs and travel times, leading to increased trade and economic

development along its path. Moreover, the canal enhances local agriculture by improving irrigation systems, thereby boosting agricultural productivity. Beyond its economic benefits, the Twante Canal fosters social cohesion by enhancing connectivity and cultural exchange among communities. Given its pivotal role, ensuring the long-term sustainability and revitalization of the Twante Canal is imperative to continue fostering economic growth, supporting agriculture, and promoting social integration in Myanmar.

To address the imperative of safeguarding floodwaters and maintaining the Twante Canal and its surrounding townships, the Directorate of Water Resources and Improvement of Rivers System entered into a memorandum of understanding with ISAN Corporation of Korea on December 16, 2013. This collaboration aimed to conduct a feasibility study for the project, which was funded through the Korea Economic Development Cooperation Fund (EDCF). Following the feasibility study, a loan amounting to US \$61.3 million was approved. The loan agreement between the two countries was finalized and signed on September 11, 2017.

The proposed project is anticipated to serve as a cornerstone for advancing social and economic development in Myanmar. Enhancing safe navigation through channel training is expected to attract traders to utilize inland waterways, potentially increasing freight volumes. As economic development progresses and transportation needs shift from other modalities, toll revenues are also projected to rise. Bank protection implemented through channel training will prevent land erosion, thereby enhancing safety against flooding in nearby residential and agricultural areas. Historically, the southwest region of Yangon, encompassing the Twante Canal, has faced annual inundation from tidal floods. The flood prevention measures of the project will cover four townships: Seikkyi Khanaungto, Dala, Kyinmyindaing, and Twante (Twantay), safeguarding these areas from flood damage and erosion.

Successful completion of the project will significantly improve living conditions in the affected inland areas, potentially attracting increased investment into the city. Moreover, the project is poised to stimulate the local economy by creating job opportunities associated with project activities and generating additional income. It is also expected to stimulate growth in the service sector, including retail, wholesale, hospitality, and real estate businesses, thereby further bolstering the local economy and enhancing local government tax revenues.

The project aims to mitigate unpredictable erosion and flood damages, thereby reducing the need for compensation and facilitating the restoration of livelihoods. This effort will contribute to better management of urban resources and infrastructure in Yangon, leading to improved services for its residents. These advancements are anticipated to attract increased foreign investment to the Yangon Region. The proposed project is expected to yield positive environmental and social impacts, enhancing the quality of life for communities, particularly in economically disadvantaged areas. It is anticipated to stimulate industry and commerce in the beneficiary townships of Yangon Region, creating a safer and more dependable environment for current residents and future generations alike.

For the construction, the project requires land acquisition and involuntary resettlement. The impacts as such would need to be minimized and handled sensitively through effective environmental and social management plans. Therefore, investing in the future development project of the Twante Canal is vital for unlocking its full potential as a driver of economic prosperity, social well-being, and environmental sustainability.

CHAPTER IV

SURVEY ANALYSIS

4.1 Survey Profile

In this study, a survey was conducted to examine the economic impact of Twante Canal revitalization. The survey involved 151 respondents from various backgrounds (marine worker, shipman, entrepreneur) who depend on Twante canal. The Twante Canal in Myanmar serves as a vital waterway linking the Ayeyarwaddy River and the Yangon River. Spanning 35 kilometers (22 miles), this canal is extensively utilized as a convenient shortcut connecting the city of Yangon with the Ayeyarwady Division. Situated across Dala Township, Seikgyi Kanaungto Township, and Twante Township, the canal covers 27 wards and villages with 2,989 houses. It plays a pivotal role in transportation, facilitating the daily passage of over 200 vessels carrying rice, cement, agricultural and fishery products, gas, petrol, logs, general cargo, and passengers.

4.2 Survey Design

The study is undertaken to analyze the economic and socio-economic situation of the Twante Canal using a qualitative research method. This study relies on both primary and secondary data. The primary data are collected from a survey questionnaire with a quantitative design. The data were obtained from the respondents who live in Twante Township, Seikgyi KaNaungto Township and Dala Township. The study period started from January 2024 to March 2024, and collected data from 151 respondents from various backgrounds (marine worker, shipman, entrepreneur). The questionnaires are divided into three parts. The first portion of the questionnaire is asked to obtain the background information from the respondents who work as transporting vessels, cargo and enterprises along the Twante Canal. The second portion of the questionnaire is about the importance of the canal on the economic status of respondents. For this study, a sample of 151 respondents from vessels, cargo, and local

and foreign investments was randomly chosen. This study used primary and secondary data on Twante canal revitalization to analyze the economic impact of Twante canal revitalization.

4.3 Survey Findings

This study employs descriptive methods to analyze the economic impact of revitalizing the Twante Canal, utilizing both primary and secondary data sources. Primary data collection involved administering questionnaires focused on vessel transportation, cargo transport, business development, and revenue generation through canal usage in the study area. By integrating primary survey data with secondary information sourced from Twante Canal records, this study presents its findings as follows.

4.3.1 Demographic Characteristics of Respondents

All respondents in this survey comprised a variety of backgrounds, including marine workers, shipmen, and entrepreneurs who depend on the Twante Canal. The study included 151 respondents from Dala Township, Seikgyi Kanaungto Township, and Twante Township. The demographic characteristics of the respondents which include gender, age, education, business activity, business operation, current location, canal for your business, business location and business previously located. Table (4.1) shows the demographic characteristics of these respondents.

Table (4.1) Demographic Characteristics of Respondents

No.		Category	Frequency	Percentage
1	Gender	Male	135	89.4
		Female	16	10.6
		Total	151	100.0
2	Age	18-25	22	14.6
		26-40	23	15.2
		Over 41	106	70.2
		Total	151	100.0
3	Education	Not Graduate	90	59.6
		Graduate	61	40.4
		Total	151	100.0
4	Business Activity	Service	61	40.4
		Manufacturing	69	45.7
		Agriculture	21	13.9
		Total	151	100.0
5	Business operation	5-10 year	75	49.7
		11-20 year	31	20.5
		Over 21 years	45	29.8
		Total	151	100.0
6	Current Location	5-10 year	72	47.7
		11-20 year	30	19.9
		Over 21 years	49	32.5
		Total	151	100.0
7	Business Location	Dala Township	17	11.3
		Seikgyi Khanaungto Township	37	24.5
		Twante Township	97	64.2
		Total	151	100.0
8	Previously located	Dala Township	17	11.3
		Seikgyi Khanaungto Township	37	24.5
		Twante Township	97	64.2
		Total	151	100.0

Source: The Survey Data, 2024.

Table (4.1) presents the demographic profile of the survey participants, totaling 151 respondents. The data reveals a significant gender disparity, with males comprising 89.4% of the sample compared to females at 10.6%. This skewed representation underscores a predominance of male participants in the study. Respondents include traders, business owners, and boat service providers spanning various ages, educational backgrounds, and work experience levels. They are employed across diverse sectors such as government, private industry, and academia, all engaged in activities related to the Twante Canal. The higher percentage of male respondents reflects the prevalence of male boat service providers in the sample.

A significant majority of respondents (70.2%, n=106) are aged over 41 years old, while younger adults aged 18-25 constitute 14.6% (n=22) and those aged 26-40 comprise 15.2% (n=23) of the sample. This age distribution is crucial as it underscores the demographic profile of the respondents, indicating a predominance of older adults. The findings suggest that older adults are prominently represented among marine workers, traders, business owners, boating service providers, and entrepreneurs.

In terms of educational background, the majority of respondents, totaling 90 individuals (59.6%), did not graduate. This percentage constitutes more than half of the total. Graduates, on the other hand, accounted for 61 respondents, comprising 40.4%. This data highlights a predominantly lower-educated sample, reflecting the occupation profile of marine workers, boat service providers, and farmers among respondents. The remaining respondents include traders, business owners, employees, and entrepreneurs.

Based on the types of business activities, three main sectors emerged: service, manufacturing, and agriculture. Manufacturing constituted the largest segment at 45.7% of respondents, indicating its predominant role in leveraging the Twante Canal. The service sector, encompassing providers of boating services, facilities, and repairs, ranked second with 40.4% of respondents. Agriculture accounted for 13.9% of businesses utilizing the canal, representing the smallest proportion among the sectors identified.

Regarding the business operation years of the respondents, 49.7% indicated that their businesses commenced operations between 5 and 10 years ago (2013–2023). The next largest group, comprising 29.8% of respondents, had established businesses prior to 2013. Approximately 20.5% of respondents reported a business age ranging from 11 to 20 years, representing the smallest proportion within the studied cohort.

Based on the survey findings, a significant portion of respondents, 47.7%, relocated their businesses near the Twente Canal within the past 5 to 10 years. Over 32% of respondents have established their businesses in proximity to the canal within the last 21 years. Additionally, 19.9% of respondents moved their businesses to the area between 11 and 20 years ago. These results indicate a notable trend where many respondents and their businesses have relocated to the vicinity of the Twente Canal following its restoration.

For the previous location, it is evident that the majority of businesses are situated in Twante Township, accounting for 64.2% of respondents, totaling 97 businesses. Seikgyi Khanaungto Township follows as the second-largest location for businesses, comprising 24.5% of the total. Dala Township has the smallest proportion of businesses at 11.3%. This distribution underscores Twante Township's proximity to the Twente Canal and its role as the primary hub for economic activities related to the canal.

4.3.2 The Role of the Twente Canal in business life

In this study, participants were surveyed regarding the importance of the Twente Canal in their business location decisions. They responded to questions designed to assess the canal’s impact on their operations, its enduring significance, and any perceived changes in its relevance over recent years. Table 4.2 illustrates the varying degrees of importance that respondents attribute to the canal for their businesses.

Table (4.2) The Importance of Twante Canal

	Number of Respondents	% of total
Very important	47	31.1
Important	97	64.2
Normal	3	2.0
Unimportant	4	2.6
Not Very important	0	0
Total	151	100.0

Source: The Survey Data, 2024.

According to the survey results in Table (4.2), the vast majority, 95.3% of respondents, considered the canal to be either 'very important' or 'important' for their business operations. Only 2.0% of respondents indicated that the canal was of average significance for their business location choice. Conversely, a mere 2.6% of respondents viewed the Twante Canal as unimportant, with none rating it as 'not very important'. These results underscore the canal's critical role as a key factor in the business locations chosen by respondents. Furthermore, they highlight its positive impact on both business performance and social well-being, as revealed by this study.

It was intriguing to investigate whether the perceived significance of the canal varies across different types of businesses. The businesses reliant on the Twante Canal include boating service providers, fishermen, farmers, ship traders, and other business owners. The majority of these businesses, constituting 95.3% of respondents, view the canal as crucial to their operations. Boat service providers, in particular, heavily depend on the canal for their daily income. Similarly, farmers rely on the canal for irrigation, highlighting its importance in agricultural activities. Thus, for boat service providers, fishermen, and farmers alike, the Twante Canal serves as a vital lifeline essential for their livelihoods.

Business enterprises engaged in trade between the Ayeyarwady region and Yangon region rely heavily on canals to establish shorter and more cost-effective shipping routes for their goods. Utilizing the Twante Canal, most trading firms aim to minimize both travel time and fuel expenditures. Access to canal routes plays a critical role in shaping their shipping logistics and cost structures. These enterprises strategically coordinate the movement of goods, frequently opting for canal routes to streamline delivery schedules and lower operational expenses. Consequently, ship traders depend significantly on the Twante Canal to facilitate their daily commerce activities.

Businesses that prioritize the Twante Canal include construction companies, rice mills, and fertilizer industries. Construction firms utilize the canal to transport materials such as bricks, lime, concrete poles, and cement, while also extracting sand, gravel, and shingle from the river. This makes navigation along the Twante Canal crucial for their operations. Farmers from Ayeyarwady Division and Twante Township also rely on the canal to transport their produce to nearby rice mills situated along its banks. Oil and gas companies utilize the canal for transporting crude oil, liquefied natural gas (LNG), and refined products. The canal's effective operation is essential for

maintaining a diverse range of businesses that depend on its accessibility. Therefore, ensuring the long-term sustainability of the canal is vital for their continued success.

4.3.3 Revenue from Twante Canal

The Twante Canal, a vital water route linking the Yangon River to the Irrawaddy River, plays a crucial role in regional transportation and commerce. This waterway generates diverse revenue streams for businesses and stakeholders. It would be insightful to examine how projected percentages of business revenue from canal users vary across different types of businesses. Table 4.3 presents the breakdown of business revenue derived from Twante Canal users.

Table (4.3) Revenue from Twante Canal Users

Income Level	Frequency	Percent
100%	121	80.13
75%	28	18.54
50%	2	1.33
25%	0	0
0%	0	0
Total	151	100

Source: The survey data, 2024.

Table (4.3) outlines the distribution of revenue derived from users of the Twante Canal. The majority of businesses, accounting for 80.13%, reported that 100% of their income is sourced from activities related to the canal. A smaller proportion, 18.54%, indicated that 75% of their revenue originates from canal operations. A minimal percentage, 1.33%, reported deriving 50% of their income from canal users, with no businesses reporting lower percentages. This data underscores the significant economic dependence of many enterprises on the canal, highlighting its pivotal role in sustaining local business activities and livelihoods tied to water transportation and commerce. Understanding these revenue patterns is crucial for policymakers and stakeholders involved in canal management and development planning, guiding efforts to enhance economic resilience and sustainability in the region.

4.3.4 Impact on Employment Opportunities through the Twante Canal

The Twante Canal, linking the Yangon River to the Ayeyarwady River in Myanmar, exerts a substantial economic influence on the surrounding region. The heightened traffic and trade facilitated by the canal stimulate local economies significantly. Small businesses, markets, and service providers located near the canal reap the benefits of increased economic activity. Ports situated along the canal see a surge in operations as ships and cargo flow through, leading to enhanced revenue for port authorities and the creation of employment opportunities in cargo handling, logistics, and associated services. Table 4.4 is a breakdown of respondents actively participating in the labor force along the Twante Canal.

Table (4.4) Labor Force Participant along the Twante Canal

Business Location	Business Activity	Labor Force
Dala Township	43	20522
Twante Township	125	13000
Seikgyi Kanaung To Township	105	5030
Total	273	38552

Source: DWIR 2019.

The table (4.4) provides a breakdown of labor force participation along the Twante Canal, categorized by business location and activity. In Dala Township, 43 businesses contribute to the canal's economic activity, employing a total labor force of 20,522 individuals. Twante Township, with 125 businesses engaged along the canal, employs 13,000 workers. Seikgyi Kanaung To Township shows 105 businesses involved, supporting 5,030 employees. Overall, these figures illustrate the significant employment generated by businesses operating along the canal, reflecting the canal's role as a vital economic lifeline in the region.

4.3.5 The Importance of the Twante Canal Sustainability

It is important to assess changes in the importance of the Twante Canal over recent years and its projected significance in the future. Therefore, Table (4.5) investigates the canal's impact on future business by comparing its importance over the past three years and expectations for the next three years.

Table (4.5) The Importance of Twante Canal Over Last 3 Years and Next 3 Years

	Last 3 years		Next 3 years	
	Number	% of total	Number	% of total
Become increasingly important	85	56.3	87	57.6
Remained the same	66	43.7	64	42.4
Become less important	0	0	0	0
Total	151	100	151	100

Source: The survey data, 2024.

Based on the findings from Table 4.5, a significant majority of respondents (56.3%) have perceived the Twantay Canal as increasingly important for their businesses over the last three years, with 57.6% anticipating further changes in its importance over the next three years. Conversely, 43.7% of respondents indicated that they expect the canal's importance to remain unchanged for their businesses, although two respondents revised their views, foreseeing significant changes in the canal's impact in the coming years. Notably, 42.4% of businesses foresee a growing significance of the canal in their operations within the next three years. Remarkably, none of the respondents anticipated a decrease in the canal's importance to their business. Therefore, it is evident that the Twantay Canal has increasingly become a vital asset from recent years into the foreseeable future.

4.3.6 Economic Impacts of Twante Canal

The Twante Canal, which connects the Yangon River to the Ayeyarwaddy River in Myanmar, plays a crucial role in the region's economy. It serves as a vital link for trade and integrated economic activities in Myanmar, enhancing efficiency in transportation and reducing costs between these two major rivers. By facilitating easier access and reducing transit times, the canal stimulates port operations, increases cargo handling capacity, and supports local economies by creating employment opportunities and bolstering small businesses. Its strategic location attracts investments in infrastructure and logistics, fostering regional economic integration and connectivity. The economic impact of the Twante Canal is assessed through its annual revenue generation and overall contribution to Myanmar's economic landscape.

Impact on the national income: Income from the Twante Canal comprises two primary types: vessel tolls and land use charges. Vessel tolls are determined by the tonnage of the vessel. The charges for each vessel are specified as follows:

i. > 100 tonnage = 1ton × 35 Kyats

ii. < 100 tonnage = 1ton × 50 Kyats

The following table (4.6) shows revenue received from vessels tolls through Twante Canal (2018 - 2023).

Table (4.6) Revenue from Vessels Tolls (2018 - 2023)

Financial Year	Revenue (Million Kyats)	Decrease or increase %	Decrease or Increase
2018 (6 Months)	211.67	-	-
2018-2019	376.70	+ 21.90 %	Increase
2019-2020	341.45	- 10.32 %	Decrease
2020-2021	245.69	- 38.97 %	Decrease
2021-2022 (6 Months)	120.97	- 51.55 %	Decrease
2022-2023	202.65	+ 20.15 %	Increase
Total	1499.13		

Source: Directorate of Water resources and Improvement of River System.

Table 4.6 presents revenue from vessel tolls along the Twante Canal for the period spanning 2018 to 2023. In the initial half-year of 2018, revenue amounted to 211.67 million Kyats. Subsequently, for the full financial year of 2018-2019, revenue increased by 21.90% to reach 376.70 million Kyats, indicating a positive trend in canal usage and economic activity. However, the following year, 2019-2020, saw a decrease in revenue to 341.45 million Kyats, marking a decline of 10.32%. This drop is attributed to reduced travel and trade activities amidst the global COVID-19 pandemic, which impacted canal operations and economic throughput. The downturn continued into 2020-2021, with revenue decreasing significantly by 38.97% to 245.69 million Kyats, reflecting ongoing economic challenges and restrictions during Myanmar's emergency period. The trend persisted in 2021-2022, where revenue decreased further by 51.55% to 120.97 million Kyats for the first half-year, underscoring continued economic strain. However, in 2022-2023, revenue rebounded notably to 202.65 million Kyats, representing a 20.15% increase compared to the previous year, driven by economic recovery and heightened trade activities. Overall, these fluctuations highlight the Twante Canal's sensitivity to external economic conditions and its crucial role in regional economic development, despite facing periodic challenges.

Impact on the national income: The second one is revenue from land use charges. It is derived from taxes collected from 98 enterprises situated along the canal route. The following table represents revenue received from land use charges through Twante Canal (2018 - 2023).

Table (4.7) Revenue from Land Use Charges (2018 - 2023)

Financial Year	Revenue (Million Kyats)	Decrease or increase %	Decrease or increase
2018 (6 Months)	472.92	-	-
2018-2019	789.20	+ 20.04 %	Increase
2019-2020	738.48	- 6.87 %	Decrease
2020-2021	693.49	- 6.49 %	Decrease
2021-2022 (6 Months)	378.79	- 41.54 %	Decrease
2022-2023	821.55	+ 26.95 %	Increase
Total	5393.48		

Source: Directorate of Water resources and Improvement of River System.

Table (4.7) illustrates the annual revenue collected from land use charges along the Twante Canal between 2018 and 2023, spanning a period of five years. In 2018, the revenue from land use charges amounted to 472.92 million kyats. The following year, 2018–2019, saw a 20.04% increase in annual revenue compared to 2018. However, in 2019–2020, there was a 6.87% decrease in revenue, attributed to reduced travel and trade during the global COVID-19 pandemic. Subsequently, from 2020 to 2021, revenue declined further by 6.49% during Myanmar's emergency period.

In the fiscal years 2021–2022, annual revenue from land use charges decreased by 41.54%. This economic decline was attributed to reduced income levels. Conversely, in 2022–2023, revenue from land use charges rebounded with a 26.95% increase, driven by higher incomes and increased travel and trade activities. Despite these fluctuations, annual revenue from vessel tolls consistently surpasses that from land use charges due to ongoing land utilization amid fluctuating travel and trade volumes. Thus, the Twante Canal significantly impacts national income, playing a crucial role in stimulating economic development, enhancing trade efficiency, and promoting sustainable regional growth.

4.3.7 Social and Economic Impacts on Marina Industry

The marina industry, involving the development, management, and operation of recreational boating facilities, is influenced by a range of social and economic factors.

Table (4.8) illustrates the social and economic impacts on the marina industry.

Table (4.8) Social and Economic Impacts on Marina Industry

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	Total	Mean
• It is vital that my business is located directly adjacent to waterways.	84	60	7	-	-	151	1.48
	55.6%	39.7%	4.7%	-	-	100%	
• Reliable and safe access to waterways via boat ramps and passage through the canal is vital to the success of my business.	46	89	13	3	-	151	1.78
	30.5%	58.9%	8.6%	2%	-	100%	
• The current good condition the canal (e.g. water clarity, level of pollution) is important in promoting water-based activities and generating business activity in my industry	49	69	32	1	-	134	1.87
	32.5%	45.7%	21.1%	0.7%	-	100%	
• More should be done to enhance access to waterways and reduce congestion in high-use areas	40	95	16	-	-	151	1.84
	26.5%	62.9%	10.6%	-	-	100%	
• More should be done to protect the natural aspects of waterways such as the cleanliness of water, healthy coastal vegetation, and the protection of wildlife.	45	104	2	-	-	151	1.72
	29.8%	68.9%	1.3%	-	-	100%	
• Climate change and the potential for greater storm activity and sea level rise is a risk to the long-term viability of my business.	19	84	48	-	-	151	2.19
	12.6%	55.6%	31.8%	-	-	100%	
• More should be done to protect and enhance the natural aspects of waterways such as the cleanliness of water, healthy coastal vegetation, and the protection of wildlife.	38	85	28	-	-	151	1.93
	25.2%	56.3%	18.5%	-	-	100%	
• I would support more resources being used for waterway management, even if that meant a very small increase in my property rates or rent.	35	43	73	-	-	151	2.25
	23.2%	28.5%	48.3%	-	-	100%	
• Waterways contribute to my personal health and wellbeing (e.g. fitness, relaxation, happiness, lifestyle, sense of place).	39	72	37	3	-	151	2.03
	25.8%	47.7%	24.5%	2%	-	100%	
• If waterway access, safety or condition declined significantly I would consider moving from this Canal to another location.	15	54	55	26	1	151	2.81
	9.9%	35.8%	36.4%	17.2%	0.7%	100%	

Source: Survey Data, 2024

Respondents strongly value proximity to waterways, with an average mean score of 1.48. This indicates that direct access to water bodies significantly influences business success, underscoring the strategic importance of location for enterprises reliant on water-based activities.

The mean score of 1.78 highlights the critical role of reliable and safe access to waterways via boat ramps and canals in business operations. This factor is crucial for ensuring smooth logistical operations and customer satisfaction, influencing the overall viability of businesses dependent on maritime infrastructure.

Respondents highly prioritize the good condition of the canal (mean score of 1.87), emphasizing factors such as water clarity and pollution levels. This aspect is pivotal in attracting water-based activities and fostering business growth within the industry, showcasing the direct correlation between environmental quality and economic activity.

With a mean score of 1.84, respondents advocate for improvements in access to waterways and congestion reduction in high-use areas. Addressing these concerns is essential for optimizing operational efficiency and accommodating growing demand, thereby supporting sustainable business development and customer satisfaction.

Respondents express strong support (mean score of 1.93) for initiatives aimed at protecting and enhancing natural aspects of waterways, including water cleanliness, coastal vegetation health, and wildlife conservation. This reflects the industry's commitment to environmental stewardship and its recognition of the intrinsic value of natural resources in sustaining business operations and community well-being.

Concerns over climate change, indicated by a mean score of 2.19, underscore the perceived risk to long-term business viability. This recognition highlights the industry's vulnerability to environmental shifts and the need for adaptive strategies to mitigate potential impacts on operational continuity and profitability.

Respondents express willingness (mean score of 2.25) to allocate additional resources for waterway management, even if it involves minor increases in property rates or rent. This demonstrates industry support for sustainable management practices and investments in infrastructure maintenance critical to maintaining operational standards and market competitiveness.

Waterway access positively impacts personal health and wellbeing, as indicated by a mean score of 2.03. This recognition emphasizes the role of water-based activities

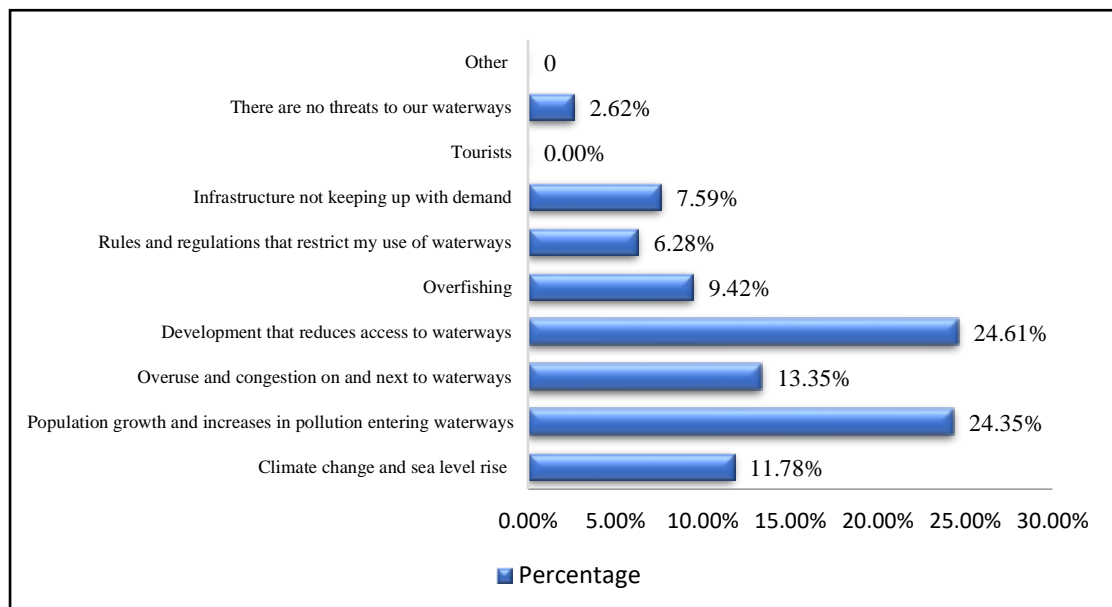
in enhancing quality of life, promoting physical fitness, and fostering a sense of community and belonging among stakeholders.

The mean score of 2.81 suggests that significant declines in waterway access, safety, or condition could prompt businesses to consider relocating to alternative locations. This underscores the pivotal role of maritime infrastructure quality in retaining businesses and sustaining economic activity within the industry.

4.3.8 Risks and Threats of the Twante Canal

The Twante Canal, despite offering substantial economic benefits, is susceptible to various risks and threats that could affect its operations and the surrounding area. Community members have expressed concerns about the deteriorating condition of their waterways, highlighting several potential threats. Through survey questionnaires, respondents identified these threats to the Twante Canal and assessed their significance to households and businesses along its banks. The following figure illustrates the numbers and types of threats that pose risks to the canal's ecosystem and the livelihoods of local communities and businesses.

Figure (4.1) Risks and Threats of the Twante Canal



Source: Survey Data, 2024.

Based on the findings of Figure (4.1), the primary threats to the Twante Canal waterways and their significance to households are as follows: Development projects that diminish access to waterways (24.61%) pose substantial risks, including habitat

degradation and loss due to urbanization and industrial expansion. Such developments restrict recreational opportunities, disrupt ecosystems, and exacerbate pollution issues. Population growth and the resultant increase in pollution entering waterways (24.35%) are also critical concerns. Industrial activities, urbanization, and agricultural runoff often accompany population growth, leading to water pollution that compromises water quality, harms aquatic life, and affects human health. These factors underscore the importance of safeguarding waterways for households reliant on them for drinking water, recreation, and livelihoods.

Restricting access to waterways can profoundly affect households dependent on them for fishing, transportation, or cultural practices, disrupting their traditional way of life. The survey revealed that 13.35 percent of respondents cited concerns about high levels of human activity, such as recreational boating, fishing, and tourism, which can lead to overuse and congestion along waterways. These activities contribute to habitat degradation, erosion, and disturbances to wildlife. Moreover, conflicts between user groups may arise, threatening the overall sustainability of the waterway ecosystem. For households reliant on these waterways for recreation or livelihoods, such congestion can diminish their experience and economic opportunities. These challenges highlight the intricate balance needed between human activities and natural systems, emphasizing the critical role of sustainable management practices and community involvement in preserving the health and integrity of the Twante Canal waterways.

Given the critical role of the Twante Canal in fostering economic development, its potential decline due to global economic downturns could result in reduced trade volumes and diminished revenue from canal tolls and port activities. Such operational changes could significantly impact local communities, potentially leading to displacement or shifts in livelihoods. Therefore, it is crucial to ensure equitable distribution of canal benefits and effective mitigation of negative impacts to maintain social stability. Proactive management, canal revitalization efforts, and collaborative stakeholder engagement are essential in sustaining the Twante Canal's positive contributions to both the regional economy and environment. Hence, revitalizing the Twante Canal stands as a pivotal initiative for advancing regional economic development.

4.3.8 The Revitalization of the Twente Canal and Future Improvements

The Twente Canal enhances connectivity between regions, promoting regional integration and cooperation. This facilitates coordinated economic development and enhances market access for local producers. Additionally, tolls and fees collected from canal users generate substantial revenue for government or canal authorities, further stimulating economic growth. Overall, the Twente Canal plays a pivotal role in fostering economic development, making its revitalization and sustainability crucial priorities.

The revitalization of the canal is anticipated to bring several benefits to regional communities, including increased employment opportunities, improved access to food supplies, fuel stations, and enhanced facilitation of inland water transportation for local distribution and regional trade. This project aims to bolster the regional inland water transportation system, ensuring safe navigation across the area. Such improvements are seen as pivotal for enhancing livelihoods through job creation and fostering regional economic development.

Table (4.9) Importance of Canal Restoration

Restoration Canal Effects	Frequency	Percent
Large Improvement	28	18.54
Improvement	120	79.47
No Effect	3	1.99
Worse	0	0
Much Worse	0	0
Total	151	100.0

Source: Survey Data, 2024

All 151 respondents (100%) were aware of the Twente Canal restoration project. When asked about its impact on their businesses, the majority (79.47%) reported positive effects. Specifically, significant improvements were noted by various sectors: boating facilities and ferry service providers (33 respondents), brick, sand, and stone traders (46 respondents), concrete pile manufacturers (7 respondents), rice mills (10 respondents), fertilizer mills (3 respondents), paddy cultivators (5 respondents), vegetable cultivators (4 respondents), and flower cultivators (12 respondents) credited the restoration efforts. Additionally, 28 respondents, primarily boating facilities and

ferry service providers (18.54%), reported considerable enhancements in their business operations post-restoration. Only a small fraction (1.99%) of respondents believed the restoration had no impact on their businesses.

These findings represent the positive impact of canal restoration on the community, highlighting its role in enhancing local infrastructure and economic opportunities. Such data is crucial for stakeholders and policymakers involved in canal revitalization projects, demonstrating the tangible benefits perceived by the community and supporting continued investment in similar initiatives aimed at regional development and infrastructure improvement.

CHAPTER V

CONCLUSION

This chapter serves as the conclusion of the study, offering a summary of the findings derived from descriptive analysis. It also provides recommendations based on these findings to guide future actions and initiatives related to the study's objectives.

5.1 Findings

This study aims to investigate the economic impact of the Twante Canal in Myanmar and to gather essential social and economic data to support its revitalization efforts. Descriptive methods were employed to analyze demographic and socio-economic characteristics along the Twante Canal.

The survey encompassed respondents from diverse backgrounds, such as marine workers, shipmen, and entrepreneurs reliant on the Twante Canal. The sample size comprised 151 respondents, with males predominating at 89.4% compared to females at 10.6%, indicating a notable male majority in the study. This gender imbalance is primarily due to the majority of respondents being traders, business owners, and providers of boating services across different age groups, educational backgrounds, and professional experiences within the Twante Canal region.

The age group over 41 years old constitutes the largest segment of respondents, likely due to their involvement in various roles such as marine workers, traders, business owners, boating service providers, and entrepreneurs along the Twante Canal. Regarding educational background, a significant majority of respondents are not graduates, indicating a predominantly lower-educated sample. Graduates comprise 40.4% of the sample, totaling 61 individuals. This suggests that many respondents engaged in roles such as marine work, boating services, and farming have lower levels of education. Conversely, graduates among respondents are primarily involved in roles such as trading, business ownership, employment, and entrepreneurship.

In terms of business activity, the study identifies three main sectors: service, manufacturing, and agriculture. Businesses generally expressed positive views

regarding the significance of the Twante Canal for their operations. Specifically, the manufacturing sector stands out as the primary beneficiary, with the canal serving as a major income source. Manufacturing activities are the most prevalent among businesses utilizing the Twante Canal. In contrast, agriculture represents the least represented sector among respondents, comprising 13.9%.

The survey revealed diverse business operation durations among respondents, with 49.7% starting their businesses between 5 and 10 years ago (2013–2023). Businesses established over 21 years ago accounted for 29.8% of respondents, while those operating for 11 to 20 years constituted 20.5%. This distribution highlights a significant portion of mature businesses along the Twante Canal, operating for more than a decade.

A significant portion of respondents (47.7%) relocated their businesses near the Twante Canal within the past 5 to 10 years. Additionally, more than 32% have maintained their presence near the canal for over 21 years, while 19.9% relocated between 11 and 20 years ago. These findings indicate a trend of businesses moving to the vicinity of the Twante Canal following its restoration efforts.

In terms of business location, Twante Township accommodates the majority of businesses, hosting 64.2% (97 respondents), thereby serving as the primary hub for business activities. Seikgyi Khanaungto Township follows with 24.5% of respondents, while Dala Township exhibits the lowest business presence at 11.3%. This distribution underscores Twante Township's role as the focal point for businesses, likely due to its proximity to the Twante Canal.

The canal emerged as the preferred business location for many respondents. Results indicate that a significant majority (95.3%) consider the Twante Canal either "very important" or "important" for their businesses. Only 2.0% expressed neutrality, and a mere 2.6% regarded it as unimportant, with none rating it as "not very important." This discussion underscores the canal's substantial economic impact on their choice of business locations.

Boating service providers, fishermen, farmers, and traders depend heavily on the Twante Canal. Boating services rely on it for operational access, while fishermen use its waters for daily catches. Farmers utilize canal water crucially for agriculture, essential to their livelihoods. Traders benefit from the canal's efficient routes, reducing travel time and fuel costs. Additionally, construction firms, rice and fertilizer industries, and oil and gas enterprises rely on the canal. Construction companies transport

materials and resources via the canal, farmers transport products to rice mills along its banks, and oil and gas firms use it for transporting crude oil, LNG, and refined products. In summary, the Twante Canal plays a vital role for a variety of businesses, underscoring the importance of its long-term sustainability.

The respondents who derive 100% of their income from the canal are primarily 'waterway dependent' individuals such as boating service providers, fishermen, and farmers, who rely entirely on the canal for their livelihoods. Those earning 75% and 50% of their income from the canal are mainly traders and business owners who utilize the canal to minimize travel time and fuel expenses.

This study examines the impact of the Twante Canal on businesses over the past three years and forecasts for the next three years. According to the findings, 56.3% of respondents reported an increasing importance of the canal for their businesses in the past three years, with 57.6% expecting this trend to continue into the future. Meanwhile, 43.7% of respondents indicated the canal's importance remained unchanged over the past three years, but among them, 2 respondents foresee a significant future impact. Additionally, 42.4% of businesses anticipate the canal becoming more crucial in the coming years. Importantly, none of the respondents foresee a decrease in the canal's importance. These results suggest that a majority of respondents recognize the growing significance of the Twante Canal in recent years and expect this trend to continue.

The economic impact of the canal is demonstrated by the annual revenue generated from vessel tolls and land use charges. Vessel tolls are calculated based on tonnage, with rates set at 35 Kyats per ton for vessels over 100 tons and 50 Kyats per ton for vessels under 100 tons. The revenue from vessel tolls fluctuated between 2018 and 2023, influenced by various factors.

Revitalizing the Twante Canal is pivotal for fostering economic development in Myanmar. Without such efforts, downturns in the global economy could diminish trade volumes, leading to reduced revenue from canal tolls and port activities. Moreover, the canal's operation significantly affects local communities, potentially resulting in displacement or shifts in livelihoods. Ensuring equitable distribution of benefits and mitigating adverse impacts is essential for maintaining social stability. Therefore, proactive management, canal revitalization, and collaboration among stakeholders are imperative to sustain the Twante Canal's positive contributions to the region's economy and environment. Thus, revitalizing the Twante Canal stands as crucial for regional economic development.

The revitalization of the Twante Canal is anticipated to yield significant benefits for local communities. These include enhanced employment opportunities, improved food supplies, expanded access to fuel stations, upgraded inland water transportation infrastructure, and enhanced distribution networks for goods. This initiative is poised to bolster the regional inland water transportation system, ensuring safer navigation and stimulating economic growth by generating employment opportunities and fostering livelihood improvements.

5.2 Suggestions

The revitalization of the Twante Canal and the development of its surrounding area mark a significant milestone in the government's economic development agenda. A comprehensive cost-benefit analysis supports the decision to restore the canal. Insights drawn from the economic, social, and historical impacts of similar waterway revitalization projects in other cities underscore the potential transformative impact of a revitalized Twante Canal on Twante Township, Dala Township, and Seikgyi Kanaungto Township. These efforts aim to unlock the canal's potential to drive regional development and foster prosperity.

The study conducted an assessment of the surrounding area to evaluate potential increases in tourism, private investment, property values, property tax revenues, and overall quality of life. It proposes the establishment of a unified vision and design for the Twante Canal to streamline discussions among decision-makers. Drawing on successful models from comparable waterway revitalization and construction projects, the revitalization of the Twante Canal is anticipated to bring substantial economic, social, and historical benefits to Twante Township, Dala Township, and Seikgyi Kanaungto Township. These improvements are poised to enhance the lives of residents, employees, and visitors alike.

To effectively enhance economic outcomes from the canal's revitalization, conducting a comprehensive economic analysis is essential to pinpoint sectors and businesses poised to gain the most. This approach will enable targeted improvements that maximize economic benefits and cater to diverse stakeholder needs. Investing in modernizing and expanding the canal's infrastructure is crucial for accommodating larger vessels and enhancing cargo capacity. Such upgrades will bolster the canal's efficiency, attract increased trade volumes, and thereby stimulate growth in local and regional economies.

To ensure the long-term viability of canal operations, the directorate should adopt sustainable practices. This involves prioritizing water quality maintenance, minimizing environmental impacts, and integrating green technologies to reduce ecological footprints. It is crucial for respective chiefs to actively engage local communities through regular consultations and participation in decision-making processes. This approach ensures equitable distribution of canal benefits and effective mitigation of any adverse impacts, thereby promoting social stability and garnering community support.

It is essential for the government to implement a robust monitoring and evaluation system to continuously track the progress and assess the impact of the canal revitalization. Regular assessments will pinpoint areas needing improvement and ensure the project stays aligned with its objectives. Additionally, advocating for supportive policies and regulations, such as favorable trade agreements, tax incentives, and streamlined bureaucratic processes, will be crucial to fostering a conducive environment for business activities along the canal. These measures aim to promote sustainable and inclusive economic growth through the Twante Canal revitalization, ultimately benefiting both the regional economy and local communities.

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APPENDIX A

Location of Twante Canal



Emergency Bank Protection Work Sa Pa Choi Ward, Dala Township



Condition before Starting Work



Project Completed

**Twante Canal, Near Aung Pagoda, Repair and Maintenance Work
Twante Township**



Condition Before Starting Work



Project Complete

Twante Township, Makok Pagoda Landslide Protection Work



Condition Before Starting Work



Project Complete

**The Cape of the Harbor (0) Mile Bank Protection Work,
Seikgyi Khanaungto Township**



Condition Before Starting Work



Project Complete

APPENDIX B

Questionnaires

The aim of this survey is to investigate the role of the canal within the local economy and to understand how it affects businesses.

We would be very grateful if you could spare 5-10 minutes to complete this form. Your answers will be treated in the strictest confidence and will not be passed on to any

Contact details

Name

Name of business.....

Contact Telephone number

Address.....

Background

1. Gender
 - Male
 - Female
2. Age
 - 18-25 years
 - 26-40 years
 - 41 years or above
3. Educational level
 - Lower than Bachelor Degree
 - Bachelor Degree
 - Master Degree
 - Higher than Master Degree
4. Which of this best describes your business?
 - Sole trader/ independent
 - Partnership
 - Private Limited Company
 - Public Limited Company
 - Crew services
 - Other (Please Specify)

5. If your business is agriculture
 - Beans
 - Paddy
 - Vegetables
 - Flowers
6. If your business is manufacture
 - Cocrete Pile
 - Rice
 - Fertilizer
7. How long has your business been in operation? () years, () months
8. How long has your business been at its current location? () years, () months
9. How important was the canal in your choice of location?
 - Very important
 - Important
 - Neither important nor unimportant
 - Unimportant
 - Very unimportant
10. If your business has moved within the last seven years, where were you previously located?

Town

County

Employment

11. How many people were employed at your business in in your first year of operation ?
 - Part-time
 - Full-time
12. And how many people do you employ now?
 - Part-time
 - Full-time

The role of Canal

13. How important would you say the Canal is to your business?
 - a. Very important
 - b. Important
 - c. Neither important nor unimportant
 - d. Unimportant
 - e. Very unimportant

14. Can you estimate how much of your business using the canal? Please tick the closest
- a. 100%
 - b. 75%
 - c. 50%
 - d. 25%
 - e. 0%
15. How has the importance of the canal to your business changed over the past three years?
- Become increasingly important
 - Remained the same
 - Become less important
16. How do you anticipate that the importance of the canal to your business will change over the next three years?
- Become increasingly important
 - Remain the same
 - Become less important
17. If your owner of the crew services
- Daily income.....
18. Do you think the seasonal variation income
- Yes
 - No

The restoration of the canal

19. There have been a number of restorations works along the canal. Are you aware of these projects?
- Yes
 - No
20. What difference has this restoration work made to your business?
- Large improvement
 - Improvement
 - No effect
 - Worse
 - Much worse

2.1 Marina Industry Survey & Social Value Survey

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
• It is vital that my business is located directly adjacent to waterways.					
• Reliable and safe access to waterways via boat ramps and passage through the canal is vital to the success of my business.					
• The current good condition the canal (e.g. water clarity, level of pollution) is important in promoting water-based activities and generating business activity in my industry					
• More should be done to enhance access to waterways and reduce congestion in high-use areas					
• More should be done to protect the natural aspects of waterways such as the cleanliness of water, healthy coastal vegetation, and the protection of wildlife.					
• Climate change and the potential for greater storm activity and sea level rise is a risk to the long-term viability of my business.					
• More should be done to protect and enhance the natural aspects of waterways such as the cleanliness of water, healthy coastal vegetation, and the protection of wildlife.					
• I would support more resources being used for waterway management, even if that meant a very small increase in my property rates or rent.					
• Waterways contribute to my personal health and wellbeing (e.g. fitness, relaxation, happiness, lifestyle, sense of place).					
• If waterway access, safety or condition declined significantly I would consider moving from this Canal to another location.					

21. Some members of the community have concerns that the condition of our waterways is declining, and a number of potential reasons have been identified. Please indicate what you believe are the three greatest threats to Twante Canal waterways and their importance to your household.

- Climate change and sea level rise
- Population growth and increases in pollution entering waterways
- Overuse and congestion on and next to waterways
- Development that reduces access to waterways
- Overfishing
- Rules and regulations that restrict my use of waterways
- Infrastructure not keeping up with demand
- Tourists
- There are no threats to our waterways
- Other (please specify)

Thank you for your assistance