Abstract

1. Introduction

Rodrigue (2012) defines logistics as a range of activities spanning from transformation, value addition to distribution of goods in the consumer market. In today's globalized world, Logistics has emerged as an essential element of businesses, and developments in this sector have ushered in economic development and growth of the countries (Hayaloglu, 2015). According to World Bank Trade Logistics Report (2018), logistics performance is one of the key drivers for economic growth and competitiveness of individual countries and the global turnover generated by logistics networks exceeds US$4.3 trillion.

As per projections of a report released at LogiMAT India 2024, the Indian logistics market is expected to grow at a CAGR of 8.83% to reach 484.43 bn dollars by 2029. However, to handle this enormous growth, adequate investments and government initiatives are essential across all modes of transport- air, road, rail, water and pipeline. According to a World Bank Report (2017), freight movement within India happens primarily by road (67%) followed by rail (27%) but only a miniscule segment of 0.5% is done via waterways (as compared to 8.3% in US, 7% in Europe and 8.7% in China). The significance of water transport was highlighted way back by Ransdell (1927) where he had vouched for water transport over other modes claiming that it encountered relatively lesser friction and thus was much cheaper. Despite having nearly 14500 kms of navigable inland waterways, present day India is yet to capitalize fully on this cheaper and greener mode of transportation (CPPR Report).

Through this study, an attempt has been made to assess the current scenario of IWT and its supporting transport infrastructure in Assam along the two major waterways NW2- Brahmaputra and NW16- Barak. Besides ranking of the key inland water ports using Analytic Hierarchy Process (AHP) to justify infrastructure investment decisions and identification of dry port locations for string planning of shippers, an optimization model has been suggested for the port network system. The results of the study shall serve as inputs for decision support systems to aid government agencies, policy makers, funding bodies and related stakeholders in making justified investment decisions regarding infrastructure development as well as port operators and partners for port selection and supply chain network design decisions. The optimization technique is expected to have ease of replication for similar water transport scenarios in other regions of the country and globally as well.

2. Research Gap

In the Indian context of water transportation, evidences in the form of research papers are substantially lesser and mostly research work is found in the form of projects taken up by government agencies. Some researchers have worked on the role, viability and perspectives of the Inland Water Transport system in India (Rangaraj and Raghuram, 2007; Sriraman, 2010) but none on optimizing the transport system. Although evidence of port ranking is found for Indian Subcontinent (De and Ghosh, 2003; Wu and Lin, 2008; Chudasama, 2009), the evaluation has been restricted to seaports only and no significant quantitative studies have been done for inland water ports. Rangaraj (2007) and Sriraman (2010) have provided distinctive evidence of the significance of the Brahmaputra and Barak valley, however, studies are lacking to substantiate the potential that this region holds. Research work relating to inland water transportation till now has concentrated on the geological and ecological aspects. Therefore, in absence of concrete and quantitative research work in this domain of Inland Water Transport for the region of Assam, a substantial research gap exists.

2.1 Need of the study

In the last decade, government agencies and policy makers through initiatives such as Act East Policy, Advantage Assam has focused on drawing investor's attention by highlighting infrastructural requirements and areas of development for inland water transport. Although a large potential lies in Northeast India and Assam in connecting South East Asian trade and commerce to the mainland by means of water transport, research evidence concentrating purely on this subject matter seems to have not been undertaken. Despite the huge potential, Assam has limited freight transport supporting jetties along its main rivers with a single dry port at Amingaon, Guwahati. In this context, huge investments have been envisioned for developing the inland water infrastructure along rivers Brahmaputra and Barak. Thus, there lies an immense need for exploring Assam's inland water transport system along the operational and non-operational waterways of the region. Also, since the domain is in its nascent stage of development, significant work can be carried out with respect to supply chain network design and optimization models for proposed port infrastructure.

3. Objectives of the study

The basic purpose of the study is to explore the inland water transport potential of Assam in terms of infrastructure developments and come up with inputs for developing a robust decision support system for key stakeholders.

Objective 1: To identify and rank key inland water ports along the major waterways of Assam using Analytic Hierarchy Process (AHP)

Objective 2: To identify dry port locations through a hub and spoke network design facilitating string planning for the top inland water ports

Objective 3: To optimize the proposed port network system with the help of a location allocation network model

a.Scope of the study

The geographical scope of the study is limited to the inland water freight transport infrastructure along the two major waterways of Assam and North East NW2 Brahmaputra and NW16 Barak. Primary and secondary data for the research work has been collected during the period 2022-23. Passenger transport elements and the other waterways in Assam are out of scope of the study.

4. Methodology/approaches applied

For objective 1, the analytic hierarchy process has been used while for objective 2 and 3, the hub and spoke network model has been developed. The primary data component has been used for Objective 1 in establishing the criteria and sub criteria scores of AHP technique for inland water port ranking. The variables have been retrieved through a systematic literature review and the same has been validated by means of personal interviews with expert from the different stakeholder For Objectives 2 and 3, analysis has been carried out using data of secondary nature consisting of geographic and topological data, GIS data, and minor primary data in terms of carrier rates etc.

5. Results and Discussion

5.1 Objective 1

From the AHP standardized matrix of the main criteria, it has been found that Port Geographical Location (PG) has secured the highest weightage of 43.4% followed by Port Physical Conditions (PP) and Port Infrastructure (PI) at 29.8%. and 14.7% respectively. These three are corresponding to the tangible factors related to inland water ports while Port Costs (PC) and Port Efficiency and Performance (EP) have been accorded paltry weightage of 6.5% and 5.6% respectively. The weightages have been validated by calculation of the consistency as per the standard random index table (Saaty, 1977). Pairwise comparison has been carried out for each of the 20 sub-criteria under the main criteria and the results for each of the comparison has been found to be consistent. Thereafter, the global weights for the sub criteria have been calculated. From this, the significant factors for port selection and ranking emerge as proximity to import/export, closeness to multimodal facilities such as roadways/railways and water depth. Similar factors have also been substantiated by research studies done with respect to seaports (Ugboma et. al, 2006).

Based on secondary as well as primary data collected during the port visits, total weighted score of each inland water port has been calculated and ranked in descending order. This ranking has been arrived at considering the *as-is* scenario during the data collection period. The criterion weights and the ranks can be used as inputs for decision support systems in taking shipping and investment decisions.

5.2 Objective 2 and 3

To identify prospective locations for additional dry ports, simulations have been executed considering placement of dry port facilities at feasible locations supporting the hub and spoke network. The feasibility of the dry port alternates is based upon:

- Proximity to multimodal connectivity (expressways, rail junctions, airports)
- Market Accessibility
- Supply centres
- Presence of ancillary/support industries

Based on the above considerations, prospective dry port locations were identified as hub nodes and a distance matrix has been created using GIS locational data between the hubs and spokes (inland water ports). It has been found through iterations, a three hub network with the existing dry port at Amingaon to approach optimality in terms of cumulative distances between the spokes and shall lead to substantial cost savings for the transporters. This network model may act as guidance for policy makers in context of investment decisions for developing dry ports.