Study on Urban Agglomeration in Hambanthota City based on Hambanthota Seaport: A Review of Planning Framework

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Abstract

Urban agglomeration involves clustering cities of various scales to form a metropolitan region, optimizing economies of scale and reducing transport costs by centralizing populations, economic activities, and infrastructure. Seaports are crucial in this process, acting as transport hubs and catalysts for urban expansion. In 2010, the National Physical Planning Department of Sri Lanka aimed to develop metro cities through seaport projects, with Hambantota being a key focus in Creating Hambanthota Metro Region. However, the outcomes of the development and associated costs have been the subject of significant debate and skepticism. Given the lack of comprehensive studies evaluating the planning efforts, this research investigates the relationship between the seaport and the development of a metro city in Hambantota. The findings indicate that, despite attempts to create a metropolitan region throughout the district, only 37% of urban agglomeration has been achieved in the Divisional Secretariat Division (DSD). If current trends persist, only a 1% increase in urban agglomeration is projected by 2050. Although there is a positive relationship between the seaport and urban agglomeration, the significance of each factor contributing to the growth of both the seaport and the city is less than 1%. This underscores the critical need to revise development strategies to effectively enhance urban agglomeration and achieve the initial planning goals.

Keywords: Urban Agglomeration; Seaport; National Physical Development Plans

Introduction

Global economic and spatial reforms, driven by globalization, have led to the emergence of competitive cities and the concept of urban agglomeration, which clusters cities to enhance economic development (Turok and McGranahan,2013). Ports are pivotal in this process, as they are not only a transport component in the global economy but also a key subsystem in production, trade, and logistics, fostering urban growth, inland development, and job creation while generating demand for various city services (Dwarakish and Salim, 2015). Theories such as James Bird's 1963 model, Port Regionalization, Port City Interface, and Asian Consolidation illustrate the complex port-city relationship, highlighting both its benefits and challenges.

To boost Sri Lanka's global economic standing, the National Physical Planning Department (NPPD) initiated a plan in 2007 to develop five Metro Regions and Cities from 2010 to 2030. This plan was later revised in 2017 to extend through 2050 and is currently undergoing further modifications, significantly altering the original metro region concepts. Under the National Physical Plan 2010-2030, the Urban Development Authority created the Greater Hambantota Development Plan, which included the construction of the Hambantota Seaport in 2010. However, the plan's success has been uncertain due to multiple revisions of the national plan as many sceptics arise about the development in Hambanthota.

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Additionally, the port was leased to China Merchant Port Holdings for 99 years in 2017 after facing significant financial losses that the Sri Lankan government could no longer sustain. Despite these developments, no comprehensive study has yet been conducted to evaluate the current status of Hambantota Metro City, particularly in relation to the seaport, and to assess how they mutually influence each other's development.

The Objective of the Study

In the context of development challenges in achieving Metro Hambanthota, this research seeks to address the following questions:

1. What is the current level of urban agglomeration in Hambantota City, and how does it align with the planned level?
2. What is the existing relationship between Hambantota Port and the city?

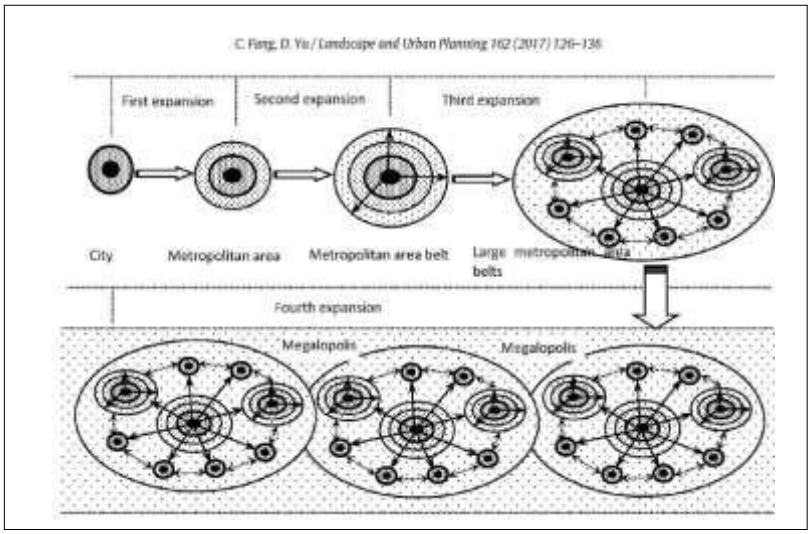
The aim is to assess the current level of urban agglomeration in Hambantota in relation to the seaport and to evaluate the interaction between the seaport and city agglomeration within the existing planning framework. This analysis will inform the development of more sustainable strategies for future planning.

Literature Review

Definition of Urban Agglomeration:

According to Fang and Yu (2017), the concept of urban agglomeration began with Ebenezer Howard in 1898 and evolved through Patrick Geddes's urban cluster model and W. Christaller's Central Place Theory in 1933, which offers a systematic definition based on distribution patterns of goods, services, population density, purchasing power, and transportation. However, after reviewing over 36 definitions from 1898 to 2015, Fang and Yu (2017) attempted to simplify the urban agglomeration as the concentration of cities and their surrounding areas that share infrastructure, economic activities, environmental systems, and cultural elements by providing following spatial expansion of Urban agglomeration.

Figure 1: Stages of Urban Agglomeration



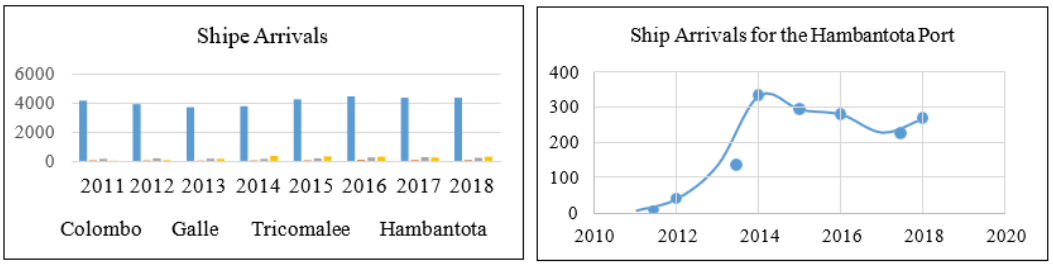
Source: Fang and Yu (2017)

Defining Ports

According to Dwarakish and Salim (2015), a port serves as the fundamental transport element linking a particular country with the global economy. Its primary task involves the transportation of goods and passengers across the world, as well as providing related services such as pilotage, towing and tug assistance, emergency repairs, anchorage handling, berth, and berthing services. Additionally, ports provide supporting services like warehousing, maritime cargo, and customs clearance services. However, in the present context, the role of ports extends beyond their traditional functions. They are now considered not only as service providers but also as hubs for value-added logistics, industries, trade, finance, leisure, and property development. As highlighted by Merk (2014), ports are not just elements of the global transportation network but also subsystems of production, trade, and logistic chains, with great potential for inland development.

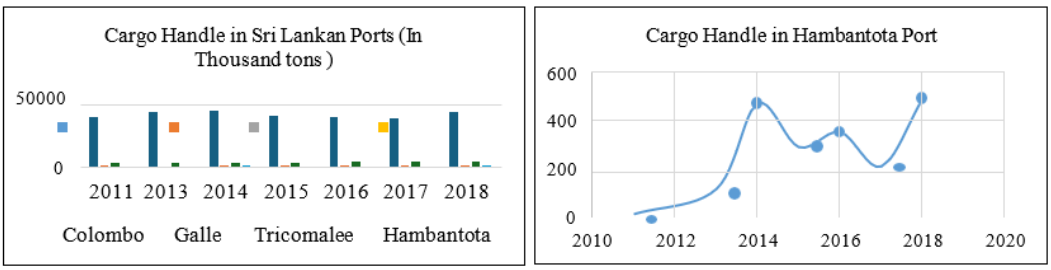
A further literature review involved examining the annual reports from the Port Development Authority of Sri Lanka to gain a comprehensive understanding of the Hambantota seaport's situation. Figures 2, 3, and 4 illustrate the challenges faced by the Hambantota seaport from its inception until its lease to China Merchants Port Holdings.

Figure 2: Pattern of Ship arrivals to Hambanthota Seaport



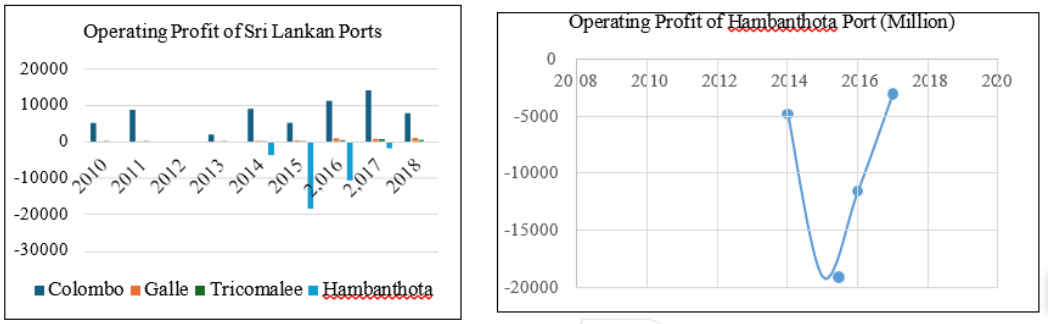
Source: Sri Lanka Port Authority 2011, 2011, 2013, 2014, 2015, 2016, 2017, 2018

Figure 3: Cargo Handling in Hambanthota Seaport



Source: Sri Lanka Port Authority 2011, 2011, 2013, 2014, 2015, 2016, 2017, 2018

Figure 4: Operating Profits of Hambanthota Seaport

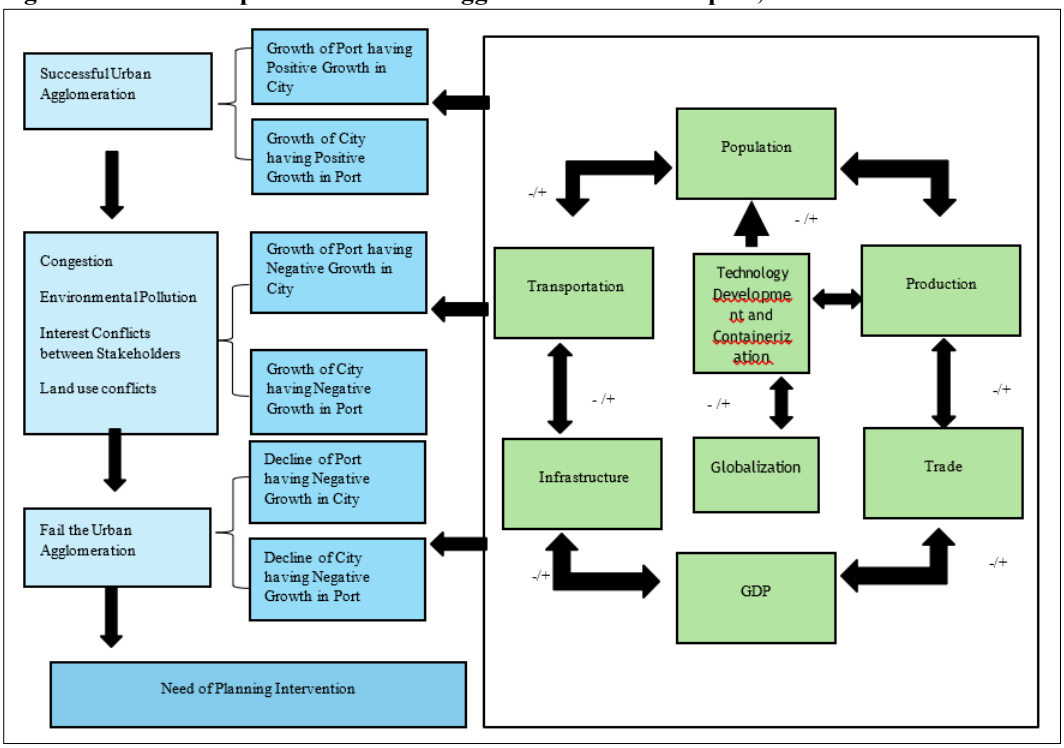


Source: Sri Lanka Port Authority 2011, 2011, 2013, 2014, 2015, 2016, 2017, 2018

Relationship between port and urban agglomeration

After reviewing more than twenty articles on the relationship between urban agglomeration and seaport, the following relationship has been identified as a framework to conduct the research.

Figure 5: Relationship between Urban Agglomeration and Seaport, Source: Author's work



Source: Author's work, 2024

Methodology

The study utilized MOLUSCE, a plugin for QGIS, to analyze the level of urban agglomeration for the years 2020 and 2030 and compare it with the proposed Greater Development Plan 2010-2030 developed based on the National Physical Plan for 2010-2030. Additionally, the analysis extends to urban agglomeration projections for 2040 and 2050, considering the current development scenario to compare the compatibility with the National Physical Plan. Secondly, it has equipped Regression analysis to evaluate the relationship between the Hambanthota urban agglomeration and the Seaport.

The following table provides a brief insight into the type of data, sources and the analysis used for the research.

Table 1 Methodology

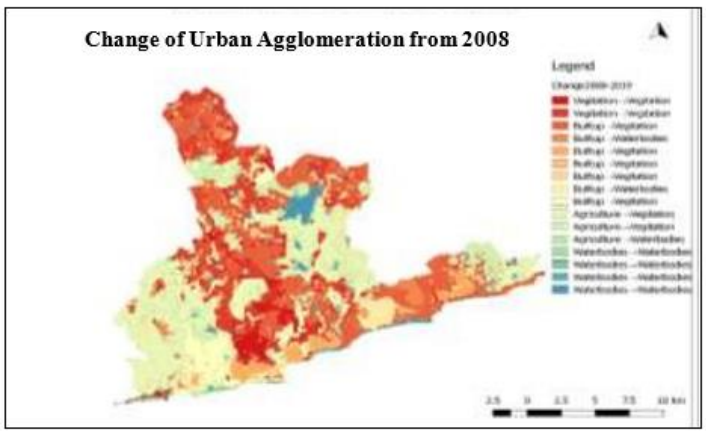
Specific Objective	Type of Data	Source	Data Analyzing Method
To analyze the level of urban agglomeration of Hambanthota city based on the seaport.	Vector type of Geo- Spatial layers. • Landuse (2008&2019), • Population (2008&2019), • Electricity • Water • Road	Urban Development Authority, Resource Profile of DS Ceylon Electricity Board National Water Supply and Drainage Board	MOLUSE of QGIS
To measure the relationship between the seaport and the city agglomeration	*Dependent variable:* • Results of Urban Agglomeration of MOLUSE *Independent variables:* • Migrated Population • Number of direct and indirect job opportunities • Number of industrial activities • Number of commercial activities • Number of Infrastructure supply increment	*Survey method* • Key informant *Questionnaire (people in sample area)* • Purposive Sampling • Sample Size 268 (90% confidence level)	Multiple Regression methods

Source: Author's work, 2024

Results and Discussion

Hambantota's strategic location between major shipping routes connecting Southeast Asia with Europe led the Sri Lankan government to designate it as a key site for a new seaport. This development has significantly impacted land use patterns. Agricultural land decreased from 41.01% in 2008 to 32.5% in 2019, reflecting an average decline of 8.47%. Similarly, vegetation areas fell from 44.75% in 2008 to 17.86% in 2019. In contrast, built-up areas surged from 9.41% in 2008 to 37.98% in 2019, with an average increase of 28.57%. Additionally, water bodies grew from 4.81% in 2008 to 11.60% in 2019, a change

Figure 7: Change of urban Agglomeration from 2008- 2020



Source: Author's work, 2024

attributed to port construction. Overall, while agricultural and vegetation areas have declined, built-up and water body areas have expanded significantly due to the port's development.

Table 2: Change of land use 2008- 2020

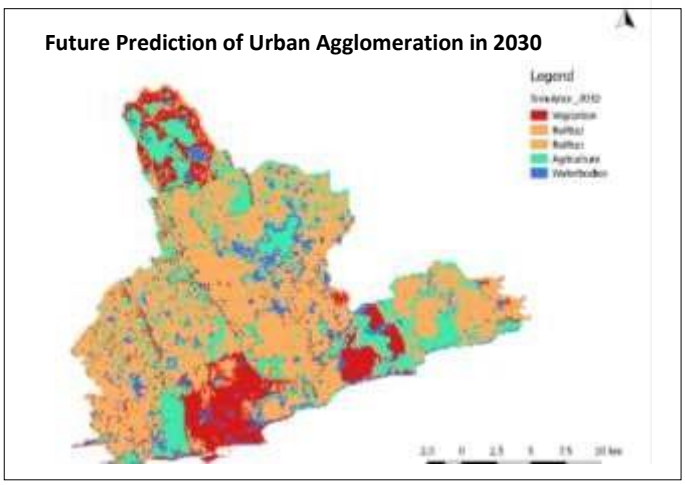
Class	colour	2008	2020	Δ	2008%	2020%	Δ %
Vegetation		0.00 sq. km.	0.00 sq. km.	-0.00 sq. km.	44.7591	17.8668	-26.892
Built-up		0.00 sq. km.	0.00 sq. km.	0.00 sq. km.	9.4194	37.9876	28.5682
Agriculture		0.00 sq. km.	0.00 sq. km.	-0.00 sq. km.	41.0101	32.5433	-8.4668
Water bodies		0.00 sq. km.	0.00 sq. km.	0.00 sq. km.	4.81142	11.6023	6.79088

Source: Author's work, 2024

However, to consider at least the first wave of Urban agglomeration of Fang and Yu (2017) and many other scholars non- agricultural areas need to be more than 50%. Accordingly, until the decade of implementing development strategies of the National Physical Plan 2010-2030, it was unable to achieve the expected development as shown in Figure 7.

Figures 8.1, 8.2 illustrate the land use simulation for Hambantota in 2030 compared to 2019. Built-up land is projected to increase to 54% in 2030 from 37.9% in 2019, while agricultural land is expected to decrease to 21% from 32.5%, and vegetation will fall to 16% from 17%. Maps 5.2 and 5.3, and Figure 4.10, show predicted land use for 2040 and 2050, indicating continued growth in built-up areas. Given the forecast, even Hambantota's non- agricultural areas, exceed 50% by 2030, and in line with Fang and Yu's (2017) criteria, to meet the Greater Hambantota Development Plan's target of over 70% built-up area, additional development strategies are needed (Figure 9).

Figure 8.1: Future prediction of Urban Agglomeration in 2030



Source: Author's work, 2024

Figure 8.2: Forecast of future Land use in 2030

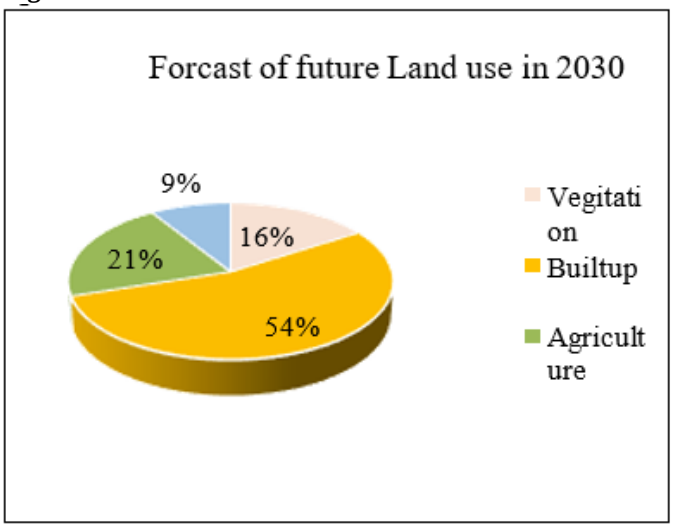
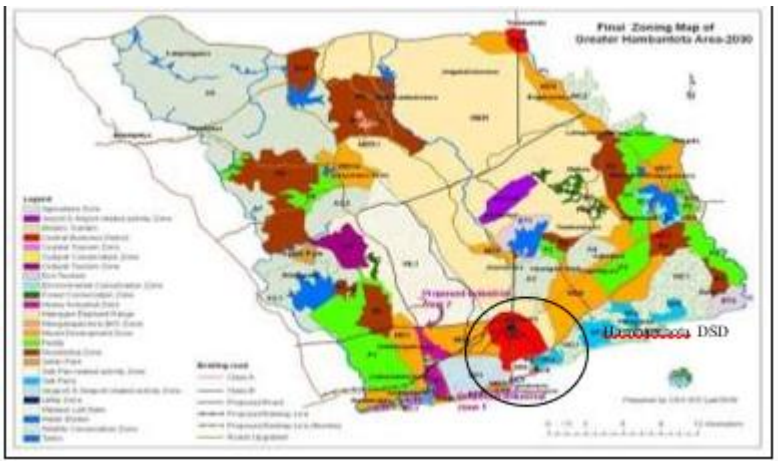


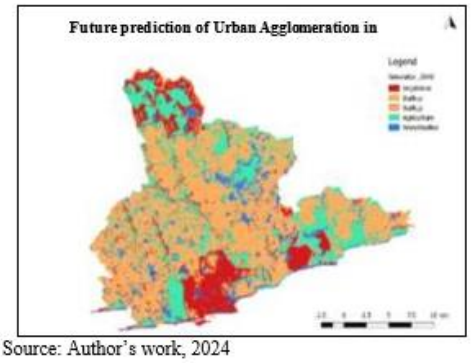
Figure 9: Expected Development of Greater Hambanthota Plan



Source: Greater Development Plan 2010-2030

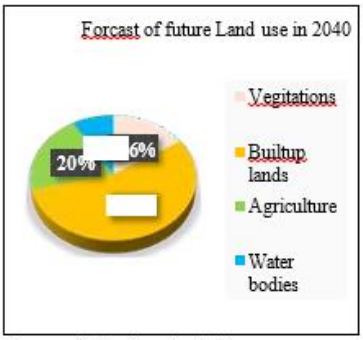
And it assumed that if the same development pattern will be continued for the next ten years from 2030, only 1% of agricultural land can be expected to change for the Built-up areas in 2040. And no change of urban agglomeration in 2050.

Figure 11: Projected Urban Agglomeration in 2040



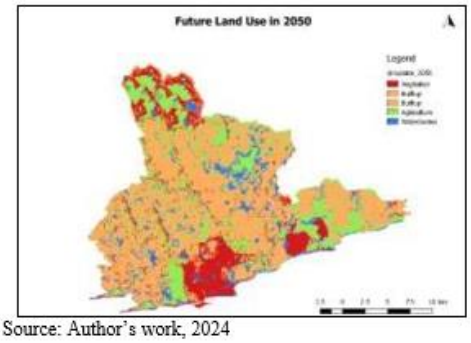
Source: Author's work, 2024

Figure 10: Projected land use Change 2040



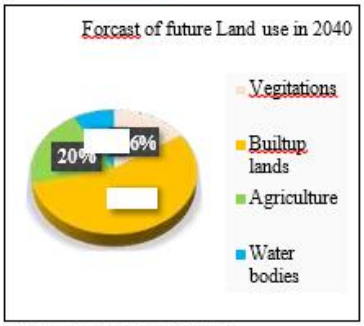
Source: Author's work, 2024

Figure 13: Projected Urban Agglomeration 2050



Source: Author's work, 2024

Figure 12:Projected land use Change 2050



Source: Author's work, 2024

Regression Analysis Results

Model summary presents a summary of the model in Table 5.7 which the item of interest is the R square statistics, which is .804 with a statistical significance of P<.05. This suggests that 84% of the variants in the urban agglomeration from the level of Population increment due to port, Direct and indirect job opportunities, Establishments of industries activities, Establishments of commercial activities, and Improvements in the infrastructure factors.

Table 3: Model Summary of Regression

Model Summary[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.566[a]	.804	.748	2.062	.804	62.365	5	262	.003	1.627

a. Predictors: (Constant), significant improvement in the infrastructure, Direct and indirect job opportunities, Population increment, SI of the establishment of industries, SI of the establishment of commercial meration

Source: Author (2024)

Table 4 of coefficients indicates that population growth, direct and indirect job opportunities, establishment of industries, and infrastructure improvements due to seaport development have a positive relationship with urban agglomeration. Conversely, the establishment of commercial

activities due to seaport shows a negative relationship with urban agglomeration. These coefficients also illustrate how changes in each independent variable impact urban agglomeration.

Table 4: Coefficients

	B	Std. Error	Beta		
1 (Constant)	.259	.348		.743	.458
Population increment	1.395	.441	.218	3.163	.002
Direct and indirect job opportunities	.951	.443	.151	2.149	.033
SI of the establishment of industries	3.864	.751	.562	5.143	.000
SI of the establishment of commercial	-7.442	.673	-1.105	-11.052	.000
significant improvement in the infrastructure	1.347	.524	.220	2.573	.011

. Dependent Variable: Urban agglomeration

Source: Author's work, 2024

Conclusion

The study attempts to assess the current and future level of urban agglomeration compared to the expected development by the National Physical Plan and Greater Hambanthota Development plan 2010- 2030 and to evaluate the relationship between urban agglomeration and Hambantota Seaport using QGIS and Regression analysis. The MOLUSCE model of QGIS analysis revealed significant land use changes from 2008 to 2019, with built-up areas increasing from 9.4% to 37.98%, while agricultural and vegetation areas decreased. Predictions for 2030, 2040, and 2050 indicate continued growth in built-up land, reaching 54% by 2030. However, this change is not adequate for the expected development by plans. Furthermore, the Multiple Regression analysis shows that population growth, job opportunities, and infrastructure improvements positively influence urban agglomeration with low significant value, while commercial establishments negatively affect it. Accordingly, the study highlights the importance of revising the current strategies for population, infrastructure and economic development of the area.

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