

# A REGIONAL SPATIAL PLANNING FRAMEWORK TO OPTIMIZE PADDY SUPPLY CHAIN MANAGEMENT IN NORTH CENTRAL PROVINCE, SRI LANKA

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**ABSTRACT** – This research paper proposes a regional spatial planning framework based on the agropolitan concept to optimize the existing paddy supply chain in the North Central Province of Sri Lanka. The study uses primary and secondary data sources, root cause analysis, and geographic information systems to explore the paddy supply chain's spatial dimension and identify issues. A regional spatial plan is proposed that assigns agro community centers and smart warehouses per river basin, identifies village centers, and assigns the nearest railway stations as logistic centers. The proposed framework aims to address issues such as inadequate storage facilities, drying problems, weak information flow, oligopoly market control, and lack of value addition to paddy products. The proposed framework has the potential to improve the efficiency of the paddy supply chain in the North Central Province of Sri Lanka. By addressing the challenges hindering the smooth flow of the supply chain and improving the value addition to paddy products, the framework can benefit the farmers, consumers, and the economy as a whole. The framework also aligns with the agropolitan concept, which promotes sustainable development by balancing the rural and urban sectors' economic and social needs.

**Keywords:** Paddy; North Central; Agropolitan; Oligopoly; Logistic

## 1. INTRODUCTION

The paddy industry in Sri Lanka is an important contributor to the economy, with Anuradhapura and Polonnaruwa being the leading districts in providing a surplus of paddy. However, despite the high supply production in some areas, there are still significant obstacles in terms of storage facilities and information flow, which hinder the efficiency of the paddy supply chain [1]. This situation has led to price fluctuations, which have negatively affected both farmers and consumers. To address these issues, there is a need for regional spatial planning framework to optimize the existing paddy supply chain. The development of an agropolitan is one such popular regional spatial planning framework that integrates agriculture development and spatial planning [2]. Further this approach “builds up rural areas that have one or more centers of agricultural production and it has functional linkages and spatial hierarchies of settlement system units and agribusiness system” [3]. Accordingly, in this research article, we demonstrated the application of agropolitan concept as a regional spatial planning framework to optimize paddy supply chain management in the north-central province, of Sri Lanka.

## 2. METHODOLOGY

First, the study explored the paddy supply chain in the north-central province, of Sri Lanka and identified the issues. This was done based on published literature and interviews with people who are involved in the paddy supply chain. Stakeholders were randomly selected to represent sectors that have direct and indirect relationships with the paddy supply chain. The selection process was based on finding relevant contacts. Initially, 20 individuals were contacted across various fields. Subsequently, the snowball technique was employed, which enabled us to reach out to nearly 100 people from different areas of expertise within the district. The inclusion of stakeholders with diverse expertise made a significant contribution to the overall

engagement process. Furthermore, multiple authenticated sources, such as the Department of Agriculture (using AI officers), the Department of Census and Statistics, the Food and Agricultural Organization of the United Nations, government agencies, and World Bank reports, are utilized to collect secondary data. The study mapped the supply chain and analyzed the issues with spatial dimensions. For that purpose, the study utilized Root cause analysis (RCA) and Geographic Information System (GIS). The study review and study the concept of agropolitan region as a spatial plan for the region and its application to optimize paddy supply chain management. This was done based on a literature review and discussion with regional planners.

First, the river basins were identified using GIS mapping, and agro-community centers and a smart warehouse were assigned per basin. Then the village centers were identified with the help of the community. Further, the nearest railway stations were identified and assigned as logistic centers as they have the potential for transportation.

### 3. FINDINGS

Figure 1 indicated the conceptual diagram of the existing supply chain structure; Small- and large-scale farmers sell their harvest to various intermediaries such as MPCS, brokers, and collectors who then transfer the collected harvest to larger-scale millers in the absence of drying and storing facilities (Figure 2). The rice is then purchased by wholesalers, commission agents, and supermarket chains who sell it to retailers and customers with a profit after a long chain of intermediaries. This has led to an oligopoly market dominated by private millers who control the price of rice. Consequently, neither the farmers nor the customers have a say in price determination, and they remain as price takers at the end of the supply chain. In a recent study, it was discovered that there is a high demand for milling facilities in the region (Figure 1). However, the government purchasing mechanism only handles a small portion of production. On the other hand, large-scale traders manage between 80% and 90% of the supply chain, especially during the off-season. These traders can finance paddy procurement, transportation, storage, processing, and rice distribution, as well as determine the price. Large-scale traders benefit from economies of scale in terms of technological savings, management-related savings, quantitative savings related to marketing, financial scale savings, and quantitative savings related to risk.

To address these issues, a recent study proposed a regional spatial planning framework based on the agropolitan concept to optimize the existing paddy supply chain in the North Central Province of Sri Lanka. The proposed framework aims to assign agro-community centers and a smart warehouse per river basin, identify village centers with the help of the community, and assign the nearest railway stations as logistic centers. The study also highlights the lack of value addition to paddy products and the benefits intermediaries receive. Moreover, the availability of facilities in the region compared to the cultivated land is low, with a small number of rice warehouses and mills. However, there is a trend toward locating the highest number of mills and warehouses in Polonnaruwa. By implementing the proposed regional spatial planning framework, it is hoped that the efficiency of the paddy supply chain can be improved and the challenges hindering the smooth flow of the supply chain can be addressed; Agro Community Centers and Smart Warehouses serve as hubs for value-addition. They address limited value addition and promote direct marketing channels, reducing reliance on intermediaries. Strategically located railway facility streamlines transportation, reducing costs and addressing market oligopoly.

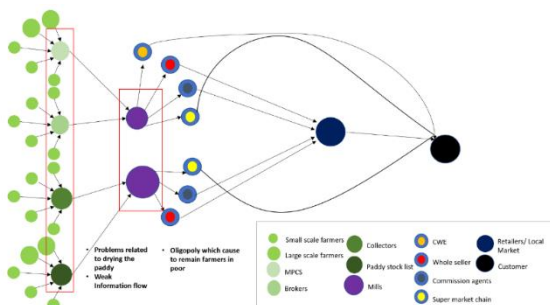


Figure 1. Conceptual Diagram of Existing Supply Chain Structure

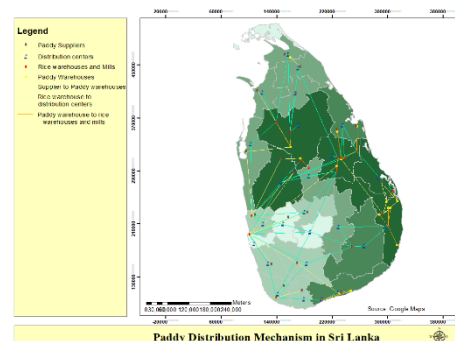
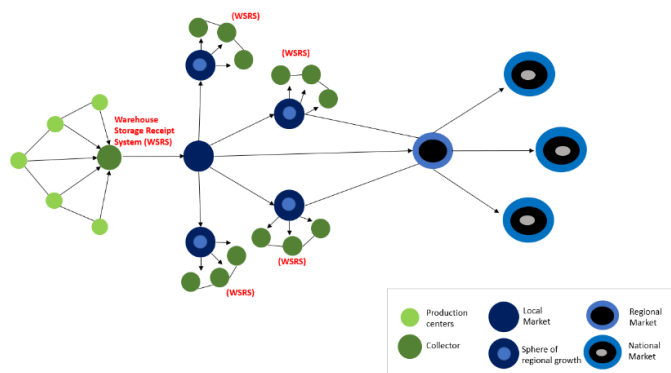


Figure 2. Paddy Distribution Mechanism in Sri Lanka

#### 4. CONCLUSION AND SUGGESTIONS

The study proposed a supply chain structure of paddy adopting agropolitan concept (Refer to Figure 3). Agropolitan regions are agricultural areas that have expanded and progressed employing agribusiness and have the capability to aid and promote agricultural development in the neighboring regions (Prasetiya et al., 2014). To devise the concept of agropolitan development, it is essential to examine the agribusiness system. The North Central Province agropolitan region has a spatial structure plan that involves the development of an agro-community center; which will be created considering the margins of the water basins, Further the smart warehouse facility will be provided to each agro-community center, at a micro level the smart village centers will be created and multi-model service center will be provided to each smart village center, and creation of logistic centers near railway stations confirming the transportation network access. This plan is integrated into the overall spatial structure plan for the NCP.

There are several challenges facing the paddy supply chain structure in the region, including inadequate storage facilities, drying problems, and weak information flow. The dominance of large-scale traders and private millers has led to an oligopoly market, where they control the price of rice. The government needs to



address these challenges to ensure a fair and efficient supply chain that benefits all stakeholders. In selecting the locations for the spatial structure plan of the North Central Province, the agro hierarchy was used considering the extent of farming lands, number of agrarian service centers, number of farmers, Number of paddy collectors, and number of mills by ranking them accordingly.

**Figure 3.** Proposed Supply Chain Structure of Paddy.

Addressing paddy supply chain challenges through marketing-based solutions. Introduce warehouse storage receipts to balance supply and demand. Provide credit facilities, identify buyers, and offer modern storage facilities for farmers. Minimal intervention from intermediaries enhances farmer assurance and productivity. Incentivizing agro-processing investments (policies), promoting value addition, and supporting direct market access for farmers. Develop infrastructure and involve stakeholders, ensuring their perspectives are considered. Establish market linkages (at the policy level), direct access, and fair-trade practices for farmers.

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