**Strategic Planning of Vegetable Horticulture-Based Regional Development to Enhance Food Security and Local Economic Growth in Deli Serdang, Indonesia**

**Abstract**

The growing demand for vegetable commodities and the strategic position of regional agriculture in food policy call for spatially-integrated development approaches. This study explores the potential of vegetable horticulture as a driver for regional economic growth and food security in Deli Serdang Regency, Indonesia. Using a descriptive-quantitative method, the research applies Location Quotient (LQ) and Shift Share Analysis (SSA) to identify leading commodities, alongside R/C ratio and marketing margin assessments for economic feasibility. Furthermore, the A’WOT method, combining Analytical Hierarchy Process (AHP) and SWOT analysis, is used to formulate strategic development directions. The results indicate that red chili (Capsicum annuum) and bird’s eye chili (Capsicum frutescens) are dominant commodities with both comparative and competitive advantages. The farming systems are financially viable (R/C > 1), yet the marketing chain remains inefficient, with intermediaries capturing the majority of profit margins. Strategic recommendations include institutional empowerment of farmer groups, adoption of spatial cultivation zoning, and application of modern cultivation technologies. This research highlights the importance of integrated planning that aligns agroecological potential with institutional support and market access to strengthen local food systems and stimulate sustainable economic development.

**Keywords**: regional planning, vegetable horticulture, food security, agribusiness, Deli Serdang

1. **Indtroduction**

Regional development strategies have increasingly shifted towards leveraging local economic potentials to achieve sustainable growth, particularly in agrarian economies. In the context of Indonesia, this shift aligns with national efforts to reduce disparities and stimulate rural productivity by emphasizing endogenous assets, notably agriculture (Rustiadi et al., 2011). The role of spatial planning is critical in this transformation, as it ensures the efficient utilization of land and natural resources. By incorporating spatial, institutional, and economic perspectives, local governments are better equipped to design development pathways that reflect regional strengths and limitations.

Vegetable horticulture is among the most promising agricultural subsectors due to its rapid production cycle, high market demand, and capacity to support food security agendas. Despite this, the development of the vegetable horticulture sector in many Indonesian regions remains suboptimal, hindered by fragmented supply chains, low technological adoption, and market access constraints (Soekartawi, 2005). In regions like Deli Serdang, where agroecological diversity is favorable, vegetable horticulture remains an underutilized pillar of local economic resilience. Thus, integrating this subsector into regional planning frameworks becomes both a developmental and strategic imperative.

National food security remains a persistent challenge, with vegetable consumption per capita in Indonesia significantly lagging behind the FAO-recommended minimum. Currently, the average consumption is only 45.2 kg per capita annually, far below the 75 kg per capita standard, creating a substantial gap in national vegetable supply and demand (FAO, 2025). This discrepancy highlights both the nutritional vulnerability of the population and the untapped potential of domestic horticultural production. Bridging this gap calls for spatially nuanced interventions that are responsive to regional agroecological and socio-economic dynamics.

Indonesia’s reliance on vegetable imports further reflects structural inefficiencies in domestic production systems. In 2024 alone, the nation imported over US$957 million worth of vegetables, including staples like garlic, onions, and carrots, while exports totaled only US$224 million (Ditjen Hortikultura, 2025). Such a negative trade balance underscores the limited competitiveness of local production, often attributable to inconsistent quality, limited post-harvest infrastructure, and weak market linkages. Regions like Deli Serdang, rich in both lowland and upland ecosystems, present strategic opportunities for reversing this trend.

Horticulture development is also closely tied to broader goals of rural transformation. In agrarian regions, vegetable production offers not only food but also employment, income diversification, and resilience against climate-induced crop failures. Studies have shown that the success of such development hinges on a synergistic approach involving spatial zoning, institutional empowerment, and market integration (Widiatmaka et al., 2015). Without this synergy, productivity gains tend to be short-lived and fail to translate into systemic improvements in farmer welfare.

The potential of Deli Serdang in North Sumatra as a vegetable production hub has gained increasing academic and policy attention. Characterized by varied altitudes, sufficient rainfall, and established farming culture, the region presents conducive conditions for growing high-value vegetables such as red chili and bird’s eye chili (Handayani et al., 2024). Yet, these natural advantages are often undermined by fragmented value chains and minimal innovation in cultivation and post-harvest practices. Consequently, a strategic development framework is necessary to guide policy, investment, and farmer support in a coordinated manner.

A major shortcoming in regional horticultural planning is the absence of robust data-driven frameworks for identifying commodity priorities and optimizing land use. Traditional planning often fails to capture the complex interaction between agroecological suitability and market feasibility. Approaches such as Location Quotient (LQ), Shift Share Analysis (SSA), and farm feasibility analysis can offer actionable insights when integrated with participatory tools like SWOT and Analytical Hierarchy Process (AHP) (Hendayana, 2003). These tools enhance the scientific basis for decision-making and support more targeted interventions.

Another critical aspect is the efficiency of marketing and distribution chains. Even when farm-level productivity is high, weak logistics, limited price transparency, and intermediary-dominated trade often suppress farmer income. Recent research emphasizes the importance of calculating marketing margins and identifying leverage points within the supply chain to ensure value is fairly distributed (Rahim & Hastuti, 2008). Without such analysis, development efforts risk reinforcing existing inequalities rather than correcting them.

This research responds to the above challenges by evaluating the regional development potential of vegetable horticulture in Deli Serdang using an integrative framework. It assesses the competitiveness of specific commodities, analyzes farm viability, and identifies supply chain inefficiencies while synthesizing these findings into a spatial and institutional development strategy. The study is grounded in quantitative and spatial analysis but enriched by stakeholder engagement and participatory tools, making it both empirically robust and practically relevant (Buzadjija et al., 2017).

In doing so, this paper aims to contribute to the discourse on region-based agricultural development by offering a replicable and adaptable model. The findings are relevant not only for local planners in Deli Serdang but also for other regions facing similar agroecological and institutional contexts. Ultimately, it proposes a strategic, data-informed pathway to elevate vegetable horticulture as a central component of regional food security and economic development strategies (Yüksel & Dağdeviren, 2007).

1. **Methodology**
	1. **Research Design**

This study employed a **descriptive-quantitative** approach to assess the strategic potential of vegetable horticulture in supporting food security and economic development in Deli Serdang Regency, Indonesia. The research framework integrated spatial, economic, and institutional analyses to identify leading commodities, assess feasibility, and formulate development strategies. A combination of statistical, geospatial, and decision-making tools was applied to ensure analytical rigor and multidimensional insight (Widiatmaka et al., 2015).

**2.2 Study Area and Duration**

The research was conducted in Deli Serdang Regency, located in North Sumatra Province, covering an area of approximately 2,497 km². The study focused on selected subdistricts known for significant horticultural activity, including Beringin, Lubuk Pakam, and Sibolangit. Data collection and fieldwork were conducted over a three-month period from April to May 2025, encompassing both planting and post-harvest phases to ensure representative data across production cycles.

**2.3 Data Sources and Types**

Two primary types of data were used:

* Primary data: Collected via structured questionnaires and in-depth interviews with key stakeholders, including local government officials, extension officers, farmers, and agricultural experts. The stakeholder selection was conducted using purposive sampling to ensure expertise relevance (Buzadjija et al., 2017).
* Secondary data: Gathered from official sources such as the Central Bureau of Statistics (BPS), the Department of Agriculture of Deli Serdang, and relevant academic publications. These datasets included information on land use, crop yields, prices, population demographics, and spatial zoning maps.

**2.4 Commodity Identification Analysis**

To determine regional horticultural commodity advantages, the study utilized two main tools:

* Location Quotient (LQ): Measured comparative advantage by comparing the share of vegetable crop production in a specific subdistrict to that in the broader regency. LQ values greater than 1 indicated a comparative advantage (Hendayana, 2003).
* Shift Share Analysis (SSA): Evaluated competitive growth by decomposing regional production change into national, industrial, and differential effects. Commodities with positive differential effects were classified as competitively advantaged.

**2.5 Farm Feasibility and Marketing Chain**

Economic viability was assessed using the R/C ratio, which compares total revenue (R) to total production cost (C). An R/C ratio greater than 1 implies a profitable enterprise (Soekartawi, 2005).
To examine market dynamics, marketing margin analysis was conducted across the distribution chain—from farmer to final consumer. This analysis revealed price spread and intermediary gains, identifying inefficiencies or value bottlenecks (Rahim & Hastuti, 2008).

**2.6 Strategic Planning Using A’WOT**

A combined A’WOT method (Analytical Hierarchy Process + SWOT) was used to formulate development strategies. In the first stage, SWOT factors were derived from expert input and field analysis, identifying key internal strengths and weaknesses, and external opportunities and threats.
Next, AHP pairwise comparisons were applied to prioritize SWOT elements, using consistency ratio (CR < 0.1) as an acceptance criterion (Yüksel & Dağdeviren, 2007). Final strategies were developed by matching weighted SWOT components into SO, ST, WO, and WT strategy matrices.

1. **Results and Discussion**

**3.1 Identification of Leading Vegetable Commodities**

The analysis using Location Quotient (LQ) and Shift Share Analysis (SSA) identified red chili (Capsicum annuum) and bird’s eye chili (Capsicum frutescens) as the primary horticultural commodities in Deli Serdang. Red chili recorded LQ values ranging from 1.32 to 1.76 in key subdistricts, indicating a significant comparative advantage. Similarly, bird’s eye chili showed consistent positive SSA values across a five-year production window, confirming its competitive growth trajectory.

These findings align with prior studies emphasizing chili’s suitability for tropical agroecosystems and its growing market demand, both locally and nationally (Handayani et al., 2024). The spatial distribution of these commodities suggests clustering in both lowland (e.g., Beringin) and upland zones (e.g., Sibolangit), which offers year-round production possibilities and reduces seasonal vulnerability.

**3.2 Farm Feasibility and Economic Viability**

The R/C ratio analysis showed that red chili cultivation yielded values between 1.82 to 2.13, while bird’s eye chili ranged from 1.57 to 1.95, indicating strong economic feasibility. Despite higher input costs for hybrid seeds and pest control, gross margins remained attractive due to favorable market prices and short harvest cycles.

These results corroborate Soekartawi’s (2005) benchmarks for viable seasonal cropping systems. However, variations in R/C values between subdistricts were often linked to access to irrigation and extension services. Subdistricts with better institutional support (e.g., Batang Kuis) exhibited higher profitability per hectare, illustrating the interplay between technical efficiency and enabling environments.

**3.3 Marketing Chain and Value Capture**

Marketing margin analysis revealed significant inefficiencies in the distribution chain. Farmers received only 48–56% of the final consumer price, with intermediaries (collectors, wholesalers) absorbing the remainder. The highest margins were observed in red chili, primarily due to perishability risks and lack of cold storage infrastructure.

This pattern reflects findings by Rahim & Hastuti (2008), who noted that high intermediary margins often persist in horticultural markets lacking cooperative networks or centralized auction systems. In Deli Serdang, the absence of organized marketing institutions or price information systems limits farmer bargaining power, leading to asymmetric price-setting dynamics.

**3.4 SWOT-AHP-Based Strategic Planning**

To identify key leverage points for regional development based on vegetable horticulture, this study applied a SWOT-AHP approach that quantifies internal and external strategic factors through weighting and scoring. The results are synthesized in the Internal Factor Analysis Summary (IFAS) and External Factor Analysis Summary (EFAS), as shown in Tables 1 and 2.

**3.4.1 Internal Factor Analysis Summary (IFAS)**

The IFAS matrix (Table 1) evaluates internal strengths and weaknesses that affect the region’s ability to develop its horticultural sector. The highest-weighted strength was *high agroecological diversity* (weight = 0.15; score = 0.60), reflecting Deli Serdang's ability to grow a variety of crops across both lowland and upland ecosystems. Another significant strength was the *potential for year-round production* (weight = 0.10; score = 0.40), enabled by favorable climate and established cropping cycles.

On the other hand, internal weaknesses were also notable. *Fragmented farmer institutions* (weight = 0.12; score = 0.24) indicate organizational inefficiencies, while *limited access to finance and inputs* (weight = 0.13; score = 0.26) hinders productivity improvements. The total weighted score of 1.50 suggests that internal strengths slightly outweigh weaknesses, providing a foundation for positive development if key gaps are addressed.

**Table 1. Internal Factor Analysis Summary (IFAS)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Internal Factors** | **Weight** | **Rating** | **Score** | **Description** |
| 1 | High agroecological diversity | 0.15 | 4 | 0.60 | Strength in varied climate & soil zones |
| 2 | Year-round production potential | 0.10 | 4 | 0.40 | Consistent supply across seasons |
| 3 | Fragmented farmer institutions | 0.12 | 2 | 0.24 | Weak cooperative structures |
| 4 | Limited access to finance and inputs | 0.13 | 2 | 0.26 | Low access to credit, fertilizer, etc. |
|  | **Total** | **0.50** |  | **1.50** |  |

**3.4.2 External Factor Analysis Summary (EFAS)**

The EFAS matrix (Table 2) captures opportunities and threats originating from the external environment. The most promising opportunity is the *rising national demand for chili* (weight = 0.15; score = 0.60), driven by increasing consumption patterns and market growth. *Government support through policy and incentives* also presents an opportunity (weight = 0.10; score = 0.30), although its influence is moderate and often limited by implementation capacity.

Conversely, external threats must be mitigated. *High post-harvest losses* due to inadequate handling and storage systems (weight = 0.15; score = 0.30) significantly affect farmer incomes. Additionally, *climate variability* (weight = 0.10; score = 0.20) poses a risk to seasonal stability and planning. The total external score of 1.40 suggests a competitive external environment that can be exploited with the right strategies but requires risk reduction measures.

**Table 2. External Factor Analysis Summary (EFAS)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **External Factors** | **Weight** | **Rating** | **Score** | **Description** |
| 1 | Rising national demand for chili | 0.15 | 4 | 0.60 | Strong opportunity in domestic market |
| 2 | Government support (policy/incentives) | 0.10 | 3 | 0.30 | Moderate enabling regulations |
| 3 | High post-harvest loss | 0.15 | 2 | 0.30 | Major barrier to profitability |
| 4 | Climate variability and crop risk | 0.10 | 2 | 0.20 | Risk of erratic rainfall or drought |
|  | **Total** | **0.50** |  | **1.40** |  |

**3.4.3 SWOT Strategic Quadrant Matrix**

Based on the weighted IFAS and EFAS matrices, a strategic quadrant analysis was developed (Table 3). This matrix provides tailored directions for each SWOT intersection:

**Table 3.** SWOT Strategic Matrix Quadrant

|  |  |  |
| --- | --- | --- |
| **Category** | **Strategy Type** | **Strategic Direction** |
| SO | Strength-Opportunity | Use agroecological advantages and consistent yields to meet rising chili demand |
| ST | Strength-Threat | Improve post-harvest infrastructure to reduce losses using natural advantages |
| WO | Weakness-Opportunity | Strengthen farmer institutions to access government horticulture programs |
| WT | Weakness-Threat | Build climate-resilient cooperatives with financial and technical training |

* **SO (Strength-Opportunity)** strategies capitalize on strengths and external opportunities. For Deli Serdang, this means using its agroecological diversity and consistent yields to meet the growing chili demand. These efforts may include scaling production in optimal zones and linking to national supply chains.
* **ST (Strength-Threat)** strategies use internal strengths to mitigate external threats. Here, leveraging natural productivity advantages to reduce post-harvest loss through better infrastructure—such as cold storage and logistics—becomes essential.
* **WO (Weakness-Opportunity)** strategies focus on overcoming internal weaknesses by exploiting opportunities. For instance, the region can use existing government horticulture programs to build and formalize farmer institutions, making them more resilient and networked.
* **WT (Weakness-Threat)** strategies aim to minimize both weaknesses and threats simultaneously. In this context, establishing *climate-resilient cooperatives* with training in financial literacy and risk management will help farmers adapt to unpredictable weather while improving bargaining power and income stability.

This quadrant-based formulation helps prioritize spatially sensitive, institutionally grounded, and economically feasible strategies for sustainable vegetable horticulture development in Deli Serdang.

The integrated A’WOT analysis prioritized four key development strategies:

* SO Strategy: Strengthen farmer cooperatives and deploy digital market platforms to exploit rising chili demand.
* ST Strategy: Enhance post-harvest infrastructure to mitigate spoilage risks and counter supply chain vulnerabilities.
* WO Strategy: Improve training and extension on precision farming to overcome technological knowledge gaps.
* WT Strategy: Encourage zoning regulations that align agroecological potential with market access to minimize land-use conflict and over-exploitation.

The AHP pairwise comparison yielded a consistency ratio (CR) of 0.06, validating the robustness of stakeholder responses. The highest weighted factor was “market access infrastructure,” followed by “institutional farmer capacity,” indicating where policy and investment focus should be directed. This supports earlier findings by Yüksel & Dağdeviren (2007), who emphasized the effectiveness of hybrid decision frameworks in agricultural strategy formulation.

**3.6 Institutional and Policy Alignment**

Despite promising agroecological and economic conditions, institutional bottlenecks persist. Farmer organizations in Deli Serdang remain fragmented, with limited access to financial services and extension programs. Coordination gaps also exist between local agricultural offices and land planning authorities, hindering implementation of region-specific zoning policies.

This reflects broader institutional challenges documented by Rustiadi et al. (2011), who argue that regional development success in Indonesia hinges on integrated governance structures. Without synchronized planning, even scientifically sound development strategies risk being stalled by bureaucratic inertia.

**3.7 Comparative Insights and Broader Implications**

The findings from Deli Serdang resonate with outcomes from similar regional studies in Indonesia—such as those in Batang (Widiatmaka et al., 2015) and Enrekang (Yusuf, 2019)—where horticulture was positioned as a rural development engine. A common success factor across these contexts was the institutionalization of farmer-led cooperatives and support from local governments in integrating production with downstream processing.

1. **CONCLUSION AND RECOMMENDATIONS**

**4.1 Conclusion**

This study concludes that vegetable horticulture—particularly red chili and bird’s eye chili—holds strategic value for regional development in Deli Serdang by enhancing food security and economic resilience. Using spatial and economic analyses, these commodities were shown to be both agroecologically suitable and financially viable (R/C > 1). However, the presence of fragmented farmer institutions, limited access to finance, inefficient marketing chains, and vulnerability to climate variability constrain overall impact. Through the integration of SWOT-AHP and spatial planning, the research identifies critical leverage points for targeted intervention, particularly in institutional strengthening, land-use alignment, and value chain improvement. These findings affirm that a data-informed, spatially guided, and institutionally supported approach is essential to realizing the full potential of the horticulture sector in achieving sustainable local development.

To advance vegetable horticulture as a regional growth engine, this study recommends strengthening farmer cooperatives, investing in post-harvest infrastructure, and aligning cultivation zones with agroecological suitability through integrated spatial planning. Policies should prioritize access to credit and digital marketing tools while promoting climate-resilient farming practices. A coordinated governance model—linking agricultural agencies, planners, and farmer groups—is essential to synchronize interventions and scale impact. With these actions, Deli Serdang can transform its horticulture sector into a high-value, inclusive, and resilient driver of food security and economic progress.

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