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

**Abstract**

The increasing demand for horticultural produce and the strategic role of agriculture in regional development necessitate more integrated and spatially informed planning in agrarian regions like Indonesia. Despite favorable agroecological conditions, Deli Serdang Regency has not fully capitalized on its vegetable horticulture potential due to fragmented institutional support, inefficient marketing chains, and the absence of data-driven zoning. Addressing this gap, the present study evaluates the strategic value of red chili (*Capsicum annuum*) and bird’s eye chili (*Capsicum frutescens*) in enhancing local food security and economic growth.

This research employs a descriptive-quantitative design integrating multiple analytical tools: Location Quotient (LQ) to assess comparative advantage, Shift Share Analysis (SSA) for competitiveness, R/C ratio for farm feasibility, and marketing margin analysis to evaluate distribution efficiency. To guide strategic planning, the A’WOT method—combining Analytical Hierarchy Process (AHP) with SWOT analysis—was applied to identify priority development strategies.

The findings reveal that both chili commodities exhibit strong comparative (LQ > 1) and competitive advantages, and are economically feasible (R/C ratios ranging from 1.57 to 2.13). However, farmers receive only 48–56% of final market prices due to fragmented cooperatives, inadequate post-harvest infrastructure, and limited access to digital markets. The SWOT-AHP framework indicates that leveraging agroecological diversity and consistent yield potential can drive regional competitiveness if supported by targeted institutional reforms.

The study recommends strengthening farmer cooperatives, investing in cold storage and logistics, and aligning cultivation zones with agroecological suitability through spatial planning. These interventions offer a replicable model for integrating horticultural development into regional policy frameworks, thereby enhancing food security, rural livelihoods, and climate resilience.

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

1. **Indtroduction**

In recent years, regional development strategies have increasingly emphasized the integration of local agricultural strengths into spatial planning frameworks to foster inclusive and sustainable growth. Particularly in agrarian contexts like Indonesia, vegetable horticulture has emerged as a promising subsector due to its short production cycles, income-generating potential, and direct contribution to household nutrition and food security (Afandi, 2020; Mulyani, 2020). However, the performance of the horticultural sector remains suboptimal, often constrained by institutional fragmentation, weak integration in spatial planning, and a lack of coordinated value chain governance (Arifianto, 2023; Handayani et al., 2024).

Agriculture continues to serve as a foundation of Indonesia’s economy, contributing to rural employment and food security across the archipelago. Within this sector, chili commodities—especially red chili (Capsicum annuum) and bird’s eye chili (Capsicum frutescens)—have become critical, not only as dietary staples but also as high-value crops with strong market demand. Yet, regions like Deli Serdang Regency in North Sumatra, despite their agroecological diversity, have not fully capitalized on their horticultural potential. This is largely due to fragmented farmer organizations, inadequate access to post-harvest and cold storage facilities, and weak integration of spatial and institutional planning.

The urgency to enhance domestic vegetable production is further amplified by Indonesia’s persistent vegetable trade deficit and underperformance in achieving national self-sufficiency goals. The country continues to import substantial volumes of chili to stabilize prices during shortages, despite having suitable agroclimatic zones for year-round cultivation. This paradox points to a deeper structural issue: a lack of localized planning that aligns land use with agroecological suitability and market access.

The spatial dimension of horticultural development plays a critical role in optimizing land use, managing ecological risks, and aligning production with consumer demand. Evidence suggests that integrated regional development planning, when informed by land suitability evaluations and agroecological zoning, can substantially improve agricultural productivity and resilience (Hardjowigeno & Widiatmaka, 2007; Henny et al., 2020). In regions like Deli Serdang, which exhibit diverse agroecosystems and a strong horticultural tradition, these spatial advantages remain largely untapped due to weak institutional alignment and low technological uptake (Putra, 2021; Lubis, 2021).

National consumption of vegetables, including chili, remains below FAO-recommended nutritional thresholds, highlighting both a health concern and a market opportunity. At the same time, farmers in Deli Serdang are poorly integrated into profitable value chains, lacking bargaining power and institutional support to compete with imports or benefit from rising domestic demand.

To address these multidimensional challenges, scholars and policymakers have advocated for the adoption of strategic planning tools that combine spatial, economic, and institutional analyses. Approaches such as SWOT-AHP have proven effective in structuring policy decisions in complex, multi-stakeholder environments, allowing for a more systematic prioritization of development actions (Buzadjija et al., 2014; Sari et al., 2020). When complemented by participatory land-use assessments and climate-resilient planning, such frameworks can yield sustainable and locally grounded development outcomes (Putri et al., 2023; Hartono et al., 2020).

The role of farmer organizations, cooperatives, and digital market platforms also warrants attention. Studies show that access to digitalized marketing channels such as TaniHub and structured partnerships in closed-loop systems significantly enhance farmer profitability and bargaining power (Kusnadi, 2022; Siregar, 2022). Moreover, institutional strengthening—particularly in the form of cooperative development and inclusive financing—has demonstrated positive impacts on smallholder participation in competitive value chains (Hutabarat, 2021; Sari, 2021).

Furthermore, localized horticultural development must be aligned with broader sustainability goals, particularly in light of increasing climate variability and land use pressures. Climate-adaptive strategies embedded in spatial planning can mitigate risk and ensure continuity in vegetable production systems (Putri et al., 2022; Arsyad, 2006). This includes promoting diversified farming systems, strengthening extension services, and enhancing access to appropriate agricultural technology (Fauzi, 2020; Nasution, 2023).

Despite Deli Serdang’s agroecological diversity and long-standing agricultural base, the regency has yet to fully leverage its potential in vegetable horticulture. Previous studies have not sufficiently addressed the intersection of spatial zoning, value chain optimization, and institutional integration within this context. This represents a critical research gap in regional agricultural development planning. The present study responds to this gap by exploring the strategic potential of vegetable horticulture-based regional development in Deli Serdang using an integrative, multi-criteria framework. The research synthesizes agroecological assessments, institutional diagnostics, and value chain analyses to provide actionable recommendations for local planners and stakeholders. By drawing from national policy initiatives and grounded empirical data, the study aspires to offer a replicable model for other agrarian regions facing similar development constraints (Kementerian Pertanian, 2024; Djaenuddin, 2008).

Ultimately, integrating horticulture into regional spatial development is not merely a sectoral objective, but a broader pathway toward enhancing food security, reducing rural poverty, and building climate-resilient local economies. The lessons drawn from Deli Serdang can serve as strategic inputs for provincial and national agendas aimed at transforming Indonesia’s agricultural landscape through more participatory, data-driven, and ecologically sustainable approaches.

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

This study employs a **descriptive-quantitative approach** supported by spatial and institutional analysis to evaluate the strategic potential of vegetable horticulture-based development in Deli Serdang, Indonesia. The research design integrates a set of analytical tools—**Location Quotient (LQ)**, **Shift Share Analysis (SSA)**, **farm feasibility analysis (R/C ratio)**, **marketing margin assessment**, and **A’WOT (Analytical Hierarchy Process + SWOT)**—to systematically examine agroecological potential, economic viability, market dynamics, and strategic development pathways. This multi-criteria framework enables a holistic understanding of the region's horticultural sector while providing an evidence-based foundation for regional planning and policy formulation (Widiatmaka et al., 2015; Buzadjija et al., 2017).

**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 Location Quotient (LQ) and Shift Share Analysis (SSA) identified **red chili (Capsicum annuum)** and **bird’s eye chili (Capsicum frutescens)** as the dominant horticultural commodities in Deli Serdang. Red chili recorded LQ values ranging from **1.32 to 1.76** across selected subdistricts, signaling a strong **comparative advantage**. Simultaneously, bird’s eye chili showed consistently **positive differential effects** in SSA, confirming a **competitive growth pattern** over a five-year period.

These results reinforce earlier findings by **Handayani et al. (2024)**, which emphasized the suitability of chili commodities for tropical agroecosystems due to their adaptability and high demand elasticity. The geographic clustering of these crops in both **lowland (e.g., Beringin)** and **upland (e.g., Sibolangit)** zones presents an opportunity for **year-round production cycles**, thereby reducing seasonal vulnerability and increasing supply stability. This spatial advantage, however, has not yet been fully integrated into local agricultural zoning plans.

**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.

To formulate strategic recommendations, the study applied the A’WOT method, which integrates:

* SWOT Analysis to identify internal (Strengths, Weaknesses) and external (Opportunities, Threats) factors, developed from expert interviews and field insights.
* Analytical Hierarchy Process (AHP) to prioritize these factors through pairwise comparisons, applying a consistency ratio (CR) threshold of <0.1 for validity.

The output—SWOT-based strategy matrices (SO, ST, WO, WT)—formed the basis for spatially and institutionally grounded policy recommendations.

**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**

Comparative insights from other regions underscore the potential of **vegetable horticulture as a rural development engine** when supported by data-driven planning and institutional collaboration. In **West Java**, for example, multi-stakeholder agricultural zoning led to increased production efficiency and farmer incomes (Henny et al., 2020). Similarly, studies in **rural Kenya** and **Vietnam** have demonstrated that market-oriented horticulture can significantly reduce rural poverty when embedded in **inclusive value chains** and **resilient institutions** (Fauzi, 2020; Kusnadi, 2022).

Deli Serdang can learn from these models by adopting a **participatory planning approach**, incorporating local knowledge, climate considerations, and real-time market intelligence to build a horticulture system that is both profitable and sustainable

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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