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Policy and institutional reforms for sustainable horticulture: A case of STHDC, Nuwakot, Nepal

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Abstract

Horticulture development is one of the prominent gateways that reduce economic disparity and international trade imbalances; uncertain nutrition and food sovereignty; climatic risks; and unprecedented other problems in the agriculture sector of Nepal. This study aims to identify the gap at the Subtropical Horticulture Development Centre (STHDC), Nuwakot. The analysis reveals the following lead gaps: policy, organizational, managerial, budgetary, communication, productivity, efficiency, profitability, promotion and marketing, product line, distribution, change, and competitive gaps. The results are robust under benefit-cost ratio, SWOT and fishbone techniques. The study is significant against the backdrop of the semi-efficient results of STHDC, increasing fruit imports, and declining agriculture share in GDP.

Keywords: Gap analysis, SWOT, Fishbone, Benefit-to-cost ratio, Productivity

1.0 Introduction

The gap analysis is a scientific approach to analyzing the discrepancy between expected (targeted) gain and actual (current) gain (Gomm, 2009) and, is performed by comparing the current performance with the potential performance (Latinopoulos et al., 2018). It is appreciable when the gap is minimal. Zero gaps will be obtained when the desired state equals the actual gain. The whole process of this analysis can be summarized into three main questions: Where are we now? Where did we want to go? And, how are we going to close this discrepancy? Under the gap analysis method, the current situation is fixed, and then the goal is set, and the differences between these two are estimated. Finally, an action plan completes the entire process of the analysis (Ansoff, 1968). The first step in conducting a gap analysis is to revisit the organization's objectives. If expected results exceed aspirations, objectives can be revised upwards, and if aspirations significantly exceed achievable performance, objectives may need to be revised downwards. Despite rational adjustments to objectives, key gaps remain: product line (expanding or enhancing offerings), distribution (widening reach and exposure), change (attracting new users and increasing consumption), and competition (maintaining market position). Addressing these gaps requires new

strategies, along with continuous monitoring and evaluation to adapt to internal and external changes (Channon & Sammut-Bonnici, 2015).

Due to its abundant natural resources, including biodiversity, Nepal has great fruit and vegetable production potential. Excellent sunshine, fairly distributed rainfall patterns, huge water resources, and varied physiographic regions from Tarai to Hills to Mountains. Different climates exist in different parts of a hill or mountain at the same altitude. Most of the 1,210 mm of the annual rainfall falls from June to September. In the warm dry season, the temperature of hilly regions average 28 °C and that of lowlands 40 °C. In the cold winter months, the temperature of lowlands average 7 to 23 °C, while that of hilly regions average 12 °C and are below freezing at night (Karki et al., 2020). There are 6,000 rivers and rivulets flowing from the Himalayas range to the Tarai plains (Galy et al., 1999).

In this regard, the Subtropical Horticulture Development Centre (SHDC), Nuwakot has outlined the following goals: to produce quality plants of various evergreen fruits and distribute them to farmers; to conduct agricultural extension activities related to horticulture development in the Centre's area of influence; to collect and promote improved and local germplasm of subtropical fruits; and to provide technical assistance, supervision, and monitoring for the production of subtropical fruits in private nurseries; to produce high quality foundation and improved seeds of vegetables and distribute them to farmers; to conduct varietal selection and development of fruits and vegetables by collecting, conserving, and promoting various breeding materials; to develop and expand fruits of high potential such as banana, macadamia nut, avocado, litchi, pomegranate, etc.; to contribute to the improvement of people's nutrition by producing and selling improved varieties of vegetables seedlings (Subtropical Horticulture Development Centre [STHDC], 2022).

Governmental horticultural farms are always taken as resource centers for inputs supply, technology generation, verification and demonstration, and providing technical services to the entrepreneurs of horticultural crops (Shrestha et al., 2021). There are 45 governmental horticultural farms including research units scattered at different agroecological belts of the country which is now limited to 40 in number. Their importance and contribution in the past have been well recognized. Despite the goal of achieving a 1:1 budget revenue ratio, horticultural farms have historically been underfunded, with some being privatized, and facing land encroachment and repurposing by other organizations. As a result, these farms are often viewed as low-priority organizations (Acharya and Atreya, 2013). This report evaluates the performance and productivity of horticultural farms, specifically focusing on the Subtropical Horticulture Development Centre in Nuwakot, and offers suggestions for improvement in light of the issues and challenges faced by governmental horticultural farms.

Considering the country's farming potential, the Government of Nepal (GoN) has established several horticulture farms and agricultural research centers in various regions of Nepal. However, the production of vital horticultural inputs such as seeds and saplings, as well as the flow of technology and technical services, have fallen short of expectations. In contrast, the demand for high-value crops such as fruits and vegetables has increased in recent years due to a general rise in income levels, a greater awareness of food and nutrition, and the country's increasing urbanization and tourism. The majority of the rising demand has been fulfilled by imports, which has hurt the trade balance (Dahal, 2020). In addition, a substantial amount of cultivated land in hilly regions has been abandoned as people seek alternative employment and rely on remittances from abroad. Similarly, high climate vulnerability affects agriculture and diminishes farmers' means of subsistence.

Realizing the importance of horticulture, the government has been establishing many horticulture research centers like STHDC for the betterment of the domestic economy. This type of research center is pivotal for increasing agriculture's share in GDP, increasing employment, and reducing the trade deficit. This study aims to reveal the overall gap analysis of the STHDC, Nuwakot, for better performance.

To ensure the well-being of the state's economy, people, and environment; the government of Nepal has adopted different constitutional provisions, acts, policies, and strategies relevant to the country's and global agenda. Nepal has adopted the United Nations' sustainable development goals, periodic plans, and the 20-year Agriculture Development Strategy, 2015–35 (MoAL, 2023). Nepal's constitution ensures the right to food security and food sovereignty (MoJFA, 2019). The country is moving forward with agricultural yield promotion based on the principle of long-term environmental programs. Horticultural development is an important sector of agriculture that meets people's needs while mitigating climate risks, such as climate change issues, global warming issues, droughts, soil erosion, and so forth.

The backdrop of a huge trade deficit mainly with India is a common concern in Nepal. Nepal's horticulture sector has enormous potential for producing a wide variety of fruits at various altitudes, from Tarai to the Mountains. The economy will grow rapidly if this sector develops a minimum line that equalizes at least the domestic demand and supply of fruits. Furthermore, the food chain has another important scope in Nepal. Regarding these points, Horticulture's development is sine qua non for the development of the nation. Regarding these all, Gap analysis is exactly playing a monitoring tool for performance evaluation. Ultimately, STHDC's gap analysis contributes to the rethink and reboot of the action plan of the center ahead.

2.0 Methodology

2.1 The Study Area

The study area (STHDC) is situated in the municipality of Bidur in the Nuwakot district, about a three-hour drive from Kathmandu. Established in 2016 B.S., it is a pioneering governmental horticulture farm currently run by the Bagmati provincial government. The farm covers an area of 17 hectares and primarily cultivates tropical and subtropical fruit species. The climate of the Centre is sub-tropical. The average maximum temperature recorded here is 37 Degree Celsius and the average minimum temperature is 5 Degree Celsius. The center gets an average annual rainfall of 1685mm, mostly in the monsoon season. The soil depth is low in most areas of the station. The soils of the sandy loam type are made up of a mixture of small stones and sand left by the Trishuli River hundreds of years ago. Moreover, most of the land along the Trishuli River is sandy. The average soil pH ranges from 5 to 6.5 (STHDC, 2022).

2.2 Research Framework

This study focuses on the gap analysis of pioneering horticulture practices implemented by the Government of Nepal, specifically examining the STHDC in Nuwakot. A mixed-method research framework is employed, integrating both qualitative and quantitative approaches to comprehensively assess the gaps. The framework utilized analytical tools such as SWOT analysis, Fishbone analysis, and Benefit-Cost (B:C) analysis to identify and categorize gap systematically.

The analysis concentrated on four major focus areas:

1. Management practices and farm productivity.
2. Service delivery and stakeholder linkages.
3. Mechanization and technical aspects of farming operations.

4. Product distribution, marketing, and the benefit-to-cost ratio.

The research design is structured to explore these focus areas through both primary and secondary data sources, ensuring a holistic perspective on challenges and opportunities within the horticulture sector.

2.3 Data Collection

The study employed a combination of primary and secondary data collection methods to achieve its objectives.

- **Primary Data**
  Qualitative data are primarily collected through Key Informant Interviews (KIIs), conducted with stakeholders possessing firsthand knowledge of horticulture practices. Shrestha Nursery, a private facility located near the STHDC and the Agriculture Knowledge Centers (AKC) in the Nuwakot district, are chosen as the primary sites for data collection. These locations provided easy access to key stakeholders and relevant institutions, facilitating the acquisition of valuable insights into practices, challenges, and opportunities within the horticulture operations. To complement the KIIs, focus group discussions (FGDs) and field observations are conducted. These methods allowed for an in-depth evaluation of farm management practices, technical operations, mechanization levels, and staff expertise.
- **Secondary Data**

  Secondary data are obtained from horticulture databases and records maintained by the Ministry of Agriculture and Livestock Development. These sources provided supplemental quantitative and historical data, enhancing the analysis by offering broader insights into operational trends, progress reports, and marketing networks.

The collected data are further analyzed within the four conceptual areas identified in the research framework:

1. **Management Practices and Productivity**: Assessed through FGDs, field observations, and reviews of progress reports to identify gaps and potential for improvement.
2. **Service Delivery and Stakeholder Linkages**: Evaluated through KIIs with the private nursery owner and AKC officials to examine current service delivery mechanisms and stakeholder engagement.
3. **Mechanization and Technical Aspects**: Observed through field visits and FGDs, focusing on farm infrastructure (e.g., greenhouses, nursery houses) and technical expertise of staff.
4. **Product Distribution and B:C Ratio**: Analyzed through marketing network reviews, stakeholder linkages, and revenue versus cost assessments to determine economic efficiency.

2.4 Gap Analysis Tools

The applied tools used for gap analysis of STHDC are SWOT, Fishbone, and Benefit-Cost Ratio analysis. For this we use four prime steps, presented below:

Step 1: Objectives of the STHDC are identified. The term of references given by the ministry and approved annual programs are considered as the objectives of the STHDC. The set objectives are considered 100 percent of the target outcomes.

Step 2: Finding the current situation of STHDC. For this we conduct a comprehensive field observation, FGDs, KIIs with various stakeholders.

Step 3: Finding out a gap assessment between the target objectives and the current outcomes. A simple tabulation technique is applied to visualize the gaps and wherever possible the gaps are quantified and graded as a percentage of the set objectives.

Step 4: To visualize the gaps, SWOT and Fishbone, Benefit-Cost analysis is applied.

2.4.1 SWOT Analysis

Strengths, weaknesses, opportunities, and threats (SWOT) are used to assess an institution's overall effectiveness (Omani, 2011) and identify potential solutions to existing or emerging challenges, whether for an established business or a new venture (United States Department of Agriculture [USDA], 2008). This analysis can be represented mathematically as a function that evaluates an organization's internal and external factors to guide strategic decision-making. Letting S, W, O, and T to represent Strengths, Weaknesses, Opportunities, and Threats, respectively, the overall strategic position P of a business can be defined as:

$$P = f(S, W, O, T)$$

Strengths and Weaknesses (Internal Factors): Internal performance can be represented as:

$$I = S - W$$

Opportunities and Threats (External Factors): The impact of external factors can be expressed as:

$$E = O - T$$

where a higher O (more opportunities) and a lower T (fewer threats) indicate a more favorable external environment.

Overall Strategic Score: The total strategic potential of the business can be estimated as:

$$P = (S - W) + (O - T)$$

This equation suggests that businesses should aim to maximize strengths and opportunities while minimizing weaknesses and threats to achieve a competitive advantage.

Decision Optimization: If $P > 0$, the business has a favorable strategic position, whereas if $P < 0$, corrective measures are needed. The objective of strategic planning can be formulated as:

$$\text{Max } P = \max (S - W) + \max (O - T),$$

where businesses strive to enhance strengths, reduce weaknesses, capitalize on opportunities, and mitigate threats to ensure long-term success.

2.4.2 Fishbone Analysis

The fishbone analysis, also known as the Ishikawa Diagram, is a widely used tool for evaluating business processes and their efficiency. It was introduced by Kaoru Ishikawa, a Japanese expert in quality management and control. This diagram is named "fishbone" due to its distinctive structure, resembling the skeleton of a fish. Its primary purpose is to identify the causes and sub-causes of a particular issue, helping to uncover the underlying factors contributing to business challenges. For this reason, it is also referred to as a "Cause-Effect Analysis" (American Society for Quality, 2005). In the diagram, the central issue is positioned at the "head," while the main causes and their sub-causes are displayed as "bones." This structured approach enables a comprehensive analysis that ultimately reveals the root causes of the problem (Balanced Scorecard Institute, 2007).

Typically, fishbone diagrams classify the main causes of problems into six standard categories: people, equipment, materials, environment, management, and processes. Analyzing these six elements helps uncover the factors contributing to any business challenge, regardless of its

complexity or severity (Ishikawa, 1986). Initially, the analysis focused on the six core categories, and in subsequent stages, each category is further examined for additional causes. This method proved to be an effective way to gain a deeper understanding of the issue and to identify associated factors simultaneously. The fishbone analysis is particularly useful for delving into the root of a problem, offering valuable insights into potential solutions (American Society for Quality, 2005).

3.0 Results and Discussions

3.1 Current Status of STHDC

The promotion of saplings produced by STHDC in the market is identified as a significant gap. The gap analysis showed that nearly 30% of the produced saplings went undistributed, leading to lower revenue collection. The STHDC (2022) indicated that the revenue collected compared to production costs over the past nine years has ranged from 32 to 58%. This data is represented in Fig. 1.

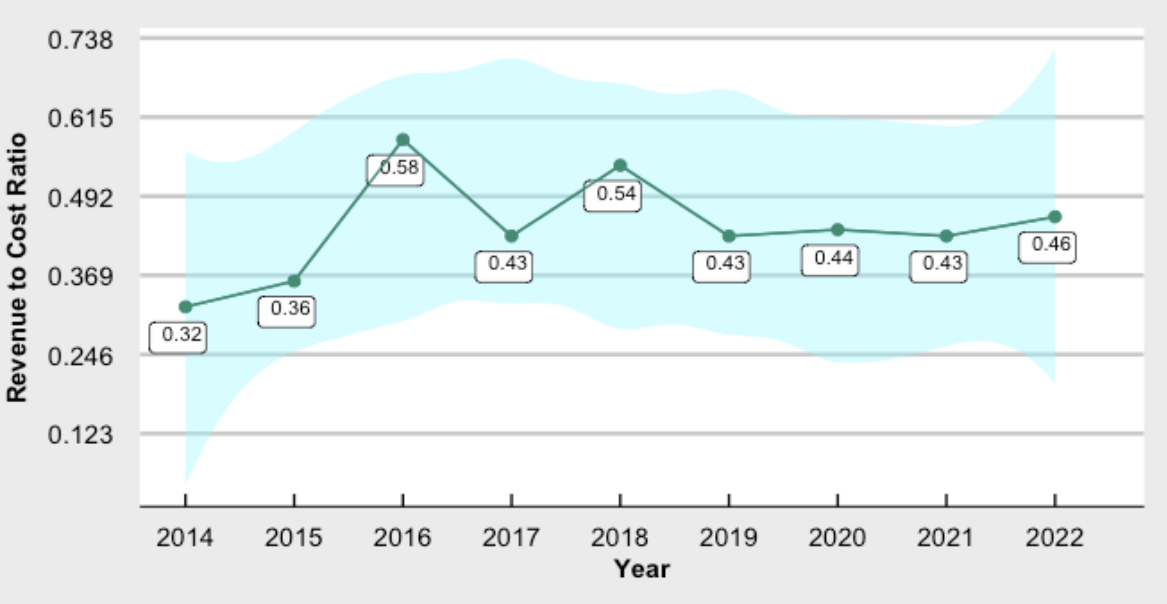

Figure 1: Trend of Revenue to Cost Ratio of STHDC**. Source:** The annual book of STHDC, 2022.

Figure 1 clearly shows that STHDC has been operating at a loss. Its revenue-to-cost ratio is significantly less than one, and it is also trending upward from 2014 to 2022. In 2016, this ratio is 0.58. This is the maximum value among all, and the minimum value is recorded at 0.32 in 2014. The STHDC is barely collecting half of what it costs. The situation is very frustrating and questionable.

3.2. Gap Analysis

As Channon and Sammut-Bonnici (2015) explain, STHDC should also think about the following four factors that contribute to the difference between the center's sales potential and how well it does: The identified gaps with potential bridges are depicted and described in Fig. 2.

- **Product line gap:** To fill this gap, it should be a top priority to bring in and make more new species or varieties of fruit saplings.

- **Distribution Gap:** This gap can be filled by expanding distribution coverage, intensity, and exposure. The marketing of produced saplings can be expanded through publicizing the products at various agro-fairs, distributing free samples in potential pockets, advertising in social media, national and regional print, and audio-visual media, and entering into contractual arrangements with the distributors. Coordination with local governments, Prime Minister Agriculture Modernization Projects (PMAMPs), and Agriculture Knowledge Centers can also be another strategy, as they have programs to distribute fruit saplings through subsidies.

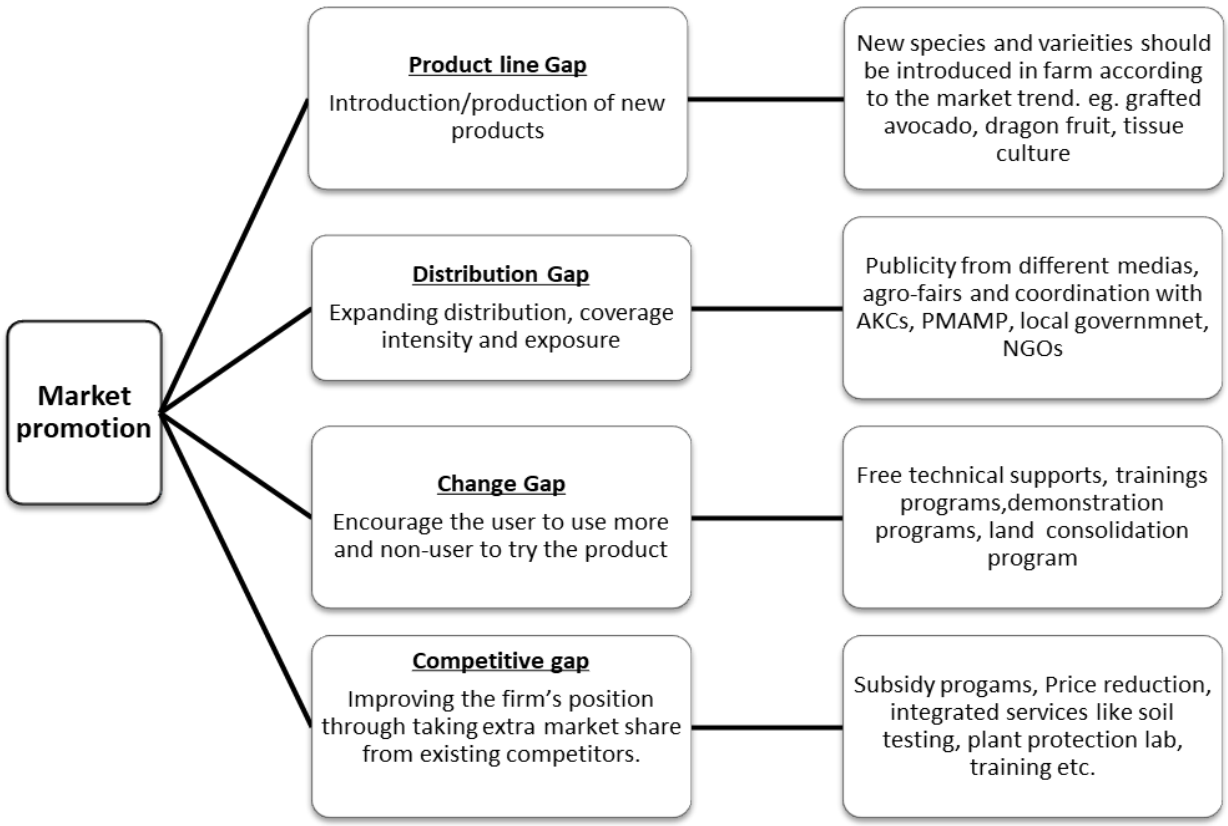

Figure 2: Bridging the marketing gaps

- **Change gap:** For this strategy, the firm endeavors to encourage nonusers to try the product and encourage existing users to consume more. Free technical support with the saplings can be another strategy to attract non-users. Similarly, training programs, field-level problem-based practical training, and motivational visits to the successful production pockets can encourage the existing users to plant more fruit saplings. Another strategy for attracting large corporate houses to establish new fruit orchard blocks could be policy reforms for land consolidation.
- **Competitive gap:** This gap can be closed by strengthening the Centre's position by acquiring additional market share from existing competitors. The Center may run a subsidy program for fruit orchard establishments, thereby attracting end users. The establishment of supportive facilities like soil, plant protection laboratories, and training facilities within STHDC's periphery could also improve STHDC's market share, thereby luring end users to get extra services from the same place.

3.3 SWOT Analysis of STHDC

Table 1: SWOT analysis

Strengths	Weakness
• Sufficient land (11.5 hector land) area with appropriate soil quality and climatic conditions. • Well-acquainted staff on nursery management. • Running development of mother plants of lime, lemon, mango, litchi, macadamia nut, pomegranate, pineapple, and avocado. • A sophisticated hi-tech greenhouse, nine top /side vent polyhouse with sprinkler irrigation systems, five shade houses, one net house, and two polytunnels are under operation. • All farm blocks are well connected with year-round irrigation facilities. • Well, mechanization.	• Lack of technical know-how on advanced plant propagation methods like grafting, and tissue culture. • Lack of sufficient hi-tech structures for plant propagation. • Still, some saplings are grown in open field conditions due to insufficient enclosed structures. • Lack of introduction of new varieties: The farm still relies on the varieties introduced before the 1990s. Nowadays farmers/ entrepreneurs look for new varieties with high productivity. • Lack of farm master plan: Not having any written concrete master plan. • Insufficient budget allocation. • Lacking facilities for on-farm training and well-equipped training hall, and dormitories.
Opportunities	**Threats**
• Favorable national policies for horticulture promotion like ADS, ABPP, NAP, etc. • Ever growing market of quality fruit saplings • PMAMP/AKC/NGOs/INGOs/Local government programs on fruit area expansion • Consumers are being more aware of the benefits of fruit consumption • Increasing postharvest facilities like cold storage, and processing companies. • Infrastructure development like road linkage, electrification • The attraction of farmers towards perennial fruit crops instead of annual cereal and vegetable crops to utilize barren lands.	• Unfair competition from the private sector and Commission System: Some private sectors are distributing fruit saplings at lower costs with quality compromise. • Open border: Import of saplings through open border • Climate change: Erratic rainfall, hailstone, drought, and rise in temperature are some of the threats to production and distribution. • Threats of new insect and pests: With climate change and plant quarantine regulation issues, new insect and pests are threatening the horticulture sector. • Policies issues: Some provincial governments are neglecting the importance of farm centers, Province 1 has merged the farm centers with AKCs. Lack of coordination among governmental farms, AKCs, PMAMPs, and local government • Frequent transfer of technical manpower • Reward and punishment system • Environmental issues: Plastic waste management and use of hazardous pesticides

	• Encroachment in land holdings: Farmland holdings are encroached by several sectors for off-farm purposes. • Wild animal issues: The farm is experiencing significant damage by wild animals like monkeys, squirrels, etc. • Linkage with research and education: Not any formal linkage policy with the research and education system • Poly-house maintenance: Cleaning and maintenance of large playhouses are challenging at the local level as dust buildup causes them to become opaque.

3.4 Fishbone Analysis of STHDC

From the discussion with FGDs, and KIIs, and reviewing the terms of reference of the STHDC, we found underperformance and low productivity of the STHDC to be a major problem. The weaknesses and threats sorted from the SWOT analysis are grouped into five categories, i.e., 1. products, 2. marketing, 3. mechanization, 4. environment/policies, and 5. personnel.

The main problem's causes are schematically depicted as a fishbone diagram, as shown in Figure 3. The fishbone diagram gives insights into the causes of the main problem and can be used to identify the bridges to close those gaps.

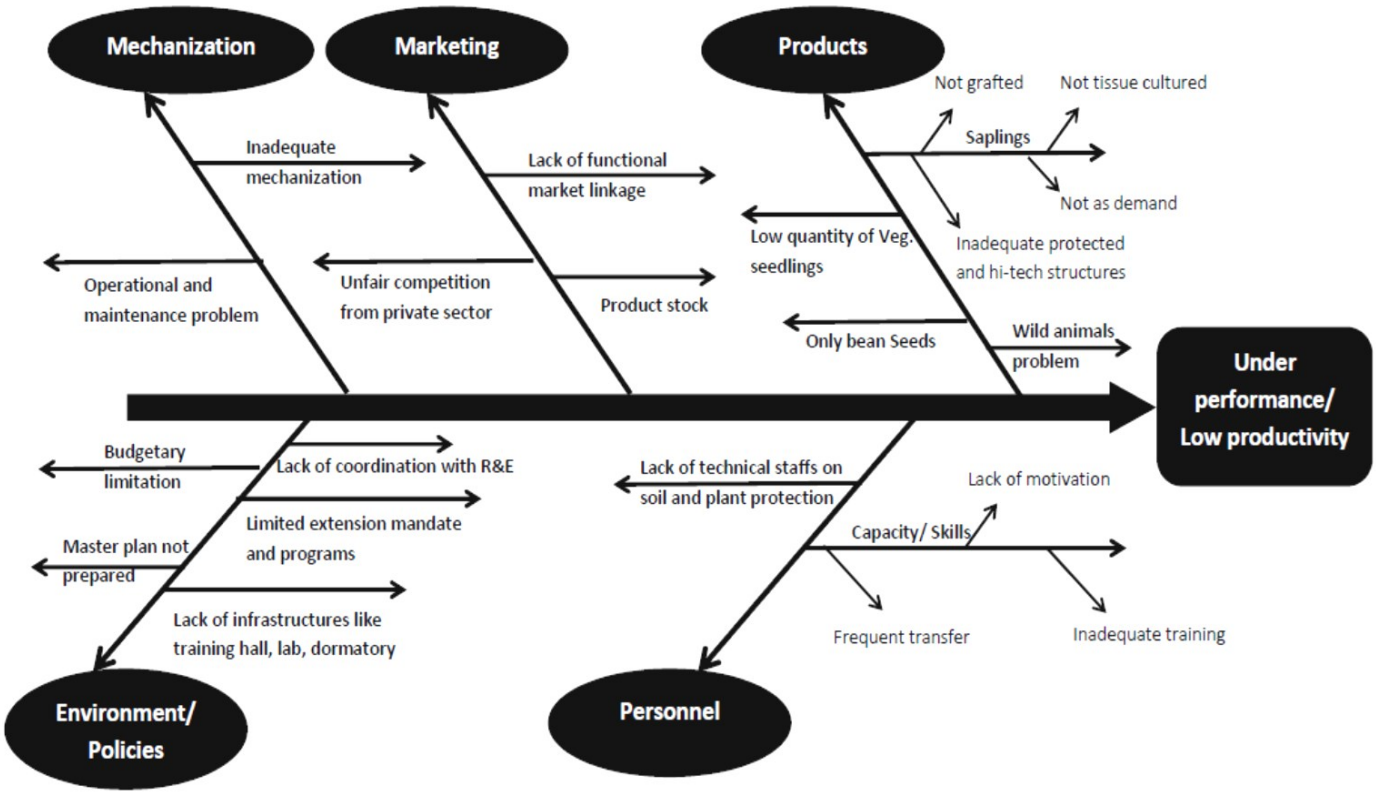

Figure 3: **Schematic diagram of fish bone analysis of STHDC**

From the SWOT analysis, Fishbone analysis, and reviewing some articles including the annual book published, we summarized the essence of GAP analysis in the following tabular form.

Table 2: Identification of various gaps

Main indicators	**Current status**	**Targeted status**	**Identified gaps**
Quality fruit sapling production	70000 saplings/year	100000 saplings/year	• Lack of technical knowhow of farm staff • Inadequate physical facilities like a greenhouse, shade-/house, net-house, hi-tech structures, and so forth • Inadequate mother plants and rootstocks of highly demanded varieties
Saplings sale and distribution	46000 saplings/year	90000 saplings/ year	• Not any functional linkage with consumers • Not any defined marketing channel • Lack of commission system for middlemen/agent • Disruption of the former distribution system after federalization • Produced saplings unmatched by consumer demand.
Farm mechanization	About 40% of farm works are mechanized	75% farm work mechanizatio n	• Lack of technological skills to successfully work with any new devices or machinery • Lack of introduction of specialized machines for horticultural farm operation
B: C ratio	0.45	1 or higher	• High operational cost due to inadequate mechanization • Lack of timely review of farm product prices, especially fruit saplings • Marketing problem of saplings
Extension & research works	Almost zero (few training and farmers problem-based field visits)	National-wide/Provinc ial resource hub and adaptive research center for main sub-tropical fruits	• Policy issues • Manpower

Germplasm collection and conservation	7 Mangos, 3 Litchis, 4 Guavas, 4 Bananas, 3 Pineapples, 2 Bel, 3 Lime, 1 Pomegranate, 4 Avocado, 1 Macadamia nut, 1 Hill Lemon, 2 Aonla, 1 Ber variety available	Farmer's preferred new varieties are not introduced since 1990	
Strengthening private nurseries	Not any programs for nursery	Supportive program for private nurseries	Lack of supportive annual program Nursery act/legislation
Vegetable seeds/seedlings	500 kg foundation seed production in 2079/80 of French bean. Yearly 150 thousand vegetable seedlings production	Production and distribution of main vegetable seeds of OP varieties and seedlings according to the command area.	
Varietal Selection	Not any programs	Adaptive trials in coordination with NARC	Lack of Policy and coordination with NARC Lack of manpower to conduct trials
Fruit development programs	Not any program	Supportive programs for subtropical fruit area expansion	Lack of budget and programs for fruit development. The command area is restricted to Rasuwa, Nuwakot, and Dhadhing districts.

4.0 Discussions

The findings of this study provide a comprehensive gap analysis of the Subtropical Horticulture Development Centre in Nuwakot, highlighting key challenges and areas for improvement. The study utilized SWOT, Fishbone, and Benefit-Cost (B:C) analysis to assess performance gaps in management, productivity, service delivery, mechanization, and marketing.

The results indicate that STHDC has been operating below its production potential, despite having 11.5 hectares of land with favorable soil and climate conditions. The production of fruit saplings remains lower than the targeted capacity, primarily due to inadequate infrastructure such as high-tech greenhouses, shade houses, and advanced plant propagation facilities. Additionally, the lack

of technical knowledge in advanced propagation techniques, such as tissue culture and grafting, has limited the center's ability to expand its production capacity (Shrestha et al. 2021). These gaps align with previous findings in horticultural research, which emphasize the importance of infrastructure and technical expertise in boosting productivity (Singh, 2010).

Budget constraints have also emerged as a significant challenge. Although STHDC receives budget allocations annually, capital expenditures often remain underutilized due to administrative delays and unstructured financial planning. The revenue-to-cost ratio has consistently remained below 1, indicating that the center is unable to generate sufficient revenue to cover its operational costs (STHDC, 2022). This financial strain has affected the implementation of key programs and expansion plans. Similar studies on government horticultural farms have found that financial sustainability remains a persistent challenge, necessitating better financial management and revenue generation strategies (Acharya & Atreya, 2013). Another critical issue is the weak linkage between STHDC and its stakeholders, including the Prime Minister Agriculture Modernization Project, Agriculture Knowledge Centers, and local governments. The lack of structured coordination has limited the effectiveness of service delivery, training programs, and extension services for farmers. Strengthening these networks is essential to maximize the impact of STHDC's initiatives and ensure that farmers receive timely technical support and quality saplings. Previous research on Nepal's horticulture sector has also emphasized the need for better institutional coordination to enhance agricultural development (Dahal, 2020).

Mechanization and technological adoption at STHDC are also below the desired level. Currently, only 40 percent of farm operations are mechanized, whereas the target is 75 percent. The absence of specialized machinery and the limited technical expertise to operate modern equipment have contributed to inefficiencies in farm operations. Mechanization is crucial for reducing labor costs and improving productivity, yet government horticulture farms often face difficulties in acquiring and maintaining modern farming equipment. Addressing this gap through targeted investments in mechanization and training programs for farm staff would significantly improve operational efficiency.

Marketing and distribution gaps are also identified as major barriers to STHDC's effectiveness. The study found that only 46,000 saplings are sold per year against a target of 90,000. The lack of structured market linkages, undefined distribution channels, and competition from private nurseries have contributed to these challenges. Unlike private nurseries, STHDC does not have a commission-based sales model, which makes its sapling distribution process less competitive. A well-defined marketing strategy, including the use of digital platforms, social media, and contractual agreements with distributors, could help improve sales performance and reduce wastage (Omani, 2011).

Policy gaps further hinder STHDC's efficiency. The absence of a long-term strategic master plan for farm operations, inconsistent nursery licensing policies, and frequent transfers of technical staff have created an unstable working environment. Policymakers need to formulate clear and consistent regulations to support the development of government horticulture farms. Additionally, ensuring stability in human resources by minimizing frequent staff transfers could improve institutional efficiency and execution of long-term planning (Timsina et al., 2018).

External threats such as climate change, pest infestations, and land encroachments pose additional risks to STHDC's operations. Erratic rainfall patterns, rising temperatures, and new pest outbreaks threaten sapling production and distribution (Karki et al., 2020). Land encroachments by local authorities and developmental projects further reduce the available space for horticultural activities. These threats necessitate the adoption of climate-smart farming techniques, improved

pest management strategies, and stricter land-use policies to safeguard the center's long-term sustainability.

5.0 Conclusion and Recommendations

5.1 Conclusion

This study conducted a comprehensive gap analysis of the Subtropical Horticulture Development Centre in Nuwakot, highlighting key deficiencies in productivity, financial sustainability, service delivery, mechanization, marketing, and policy implementation. The findings reveal that despite having favorable climatic and soil conditions, the center has been unable to meet its production targets due to infrastructure limitations, technical skill gaps, and budget constraints. The revenue-to-cost ratio has consistently remained below one, indicating financial inefficiencies.

Service delivery and stakeholder engagement are found to be weak, with insufficient coordination between STHDC and relevant institutions such as the Prime Minister Agriculture Modernization Project and Agriculture Knowledge Centers. The mechanization level remains significantly low, affecting farm efficiency. Additionally, marketing and product distribution gaps are identified as major challenges, with an inadequate marketing strategy limiting the Center's ability to reach its sales targets. Policy and regulatory issues, including the lack of a long-term operational master plan and frequent staff transfers, further hinder STHDC's effectiveness.

Despite these challenges, the center holds immense potential for improving horticultural production, strengthening market linkages, and enhancing financial sustainability. Addressing these gaps through targeted investments, policy reforms, and stronger institutional linkages will enable STHDC to fulfill its mandate more effectively.

5.2 Recommendations

To enhance the efficiency and sustainability of the STHDC, key improvements are needed. Infrastructure investment is crucial for expanding high-tech greenhouses, shade houses, and propagation facilities, along with technical training in advanced plant propagation methods. Financial restructuring should focus on optimizing budget utilization and exploring revenue-generating activities like paid training and consultancy services as it is given in Appendix A. Strengthening stakeholder collaboration with Agriculture Knowledge Centers the Prime Minister Agriculture Modernization Project, and private nurseries will improve service delivery and market access.

Mechanization and technology adoption must be prioritized to reduce labor dependency and improve efficiency through specialized machinery and automation. Enhancing marketing and distribution strategies by establishing structured channels, commission-based sales models, and promotional campaigns will increase sapling sales and minimize wastage. Policy reforms are necessary to develop a long-term master plan, improve regulatory frameworks, and ensure institutional stability by minimizing frequent staff transfers. Finally, climate resilience measures such as poly-house cultivation, integrated pest management, and soil conservation should be integrated to mitigate climate risks.

APPENDIX A:

The Subtropical Horticulture Development Centre in Nuwakot plays a pivotal role in advancing horticultural practices in Nepal's subtropical regions. Its activities encompass a broad spectrum aimed at enhancing productivity, sustainability, and farmer support. Below is an overview of the center's key activities:

Table A1: Major Activities in STHDC

Activity Category	Specific Activities
Research and Development	- Conducting trials and research on subtropical fruit and vegetable varieties to identify high-yield and disease-resistant strains. - Developing and testing innovative cultivation techniques suitable for subtropical climates.
Production and Distribution	- Producing high-quality planting materials, including seeds and saplings, to ensure the availability of superior horticultural inputs. - Distributing these materials to local farmers and stakeholders to promote improved crop varieties
Training and Extension Services	- Organizing training programs and workshops to educate farmers on best horticultural practices, pest management, and post-harvest handling. - Providing on-site demonstrations and field visits to showcase successful cultivation techniques and technologies.
Technical Support and Consultancy	- Offering technical assistance to farmers facing challenges in crop management, soil health, and irrigation practices. - Advising on the establishment and management of orchards and nurseries to enhance productivity.
Collaboration and Networking	- Partnering with national and international research institutions to stay abreast of advancements in horticulture. - Coordinating with government bodies, NGOs, and private sector entities to implement community-based horticultural projects.
Resource Center Management	- Maintaining a repository of horticultural knowledge, including publications, research findings, and multimedia resources, accessible to farmers and researchers. - Establishing model orchards and demonstration plots to serve as learning sites for innovative horticultural practices.
Quality Control and Certification	- Implementing quality assurance protocols for planting materials to ensure disease-free and true-to-type characteristics. - Facilitating certification processes for organic and GAP (Good Agricultural Practices) standards to help farmers access premium markets.
Market Linkage Support	- Assisting farmers in identifying and connecting with potential markets for their produce, both locally and nationally. - Providing information on market trends, pricing, and consumer preferences to aid in decision-making.

Sustainable Practices Promotion	- Encouraging the adoption of sustainable farming practices, including integrated pest management, organic farming, and water conservation techniques. - Conducting awareness campaigns on environmental conservation and the benefits of biodiversity in horticulture.

Source: *STHDC*

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