Analysis of the Dynamics and Sustainability of Supply Chains for the Vegetable Market in Bartella and Qaraqosh for the Production Season 2025

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Abstract

Despite Iraq's rich agricultural legacy, the sector faces persistent challenges, including water scarcity, outdated infrastructure, and fragmented supply chains. This study investigates the sustainability and dynamics of the vegetable markets in Bartella and Qaraqosh during the production season of March–April 2025. A cross-sectional survey was conducted using KoboToolbox to collect data from 180 stakeholders 60 farmers, 60 vendors, and 60 consumers via mobile tools with GPS capabilities. The primary objectives are to analyze the structure, gaps, and profitability of the vegetable supply chain; assess stakeholder relationships; determine cost accuracy and profit margins; compare regional differences; and recommend strategies to reduce import reliance. The study presents pricing models, evaluates seasonal supply gaps, identifies weak logistical links, and provides a breakdown of the costs borne by each market actor. Unlike previous national-level studies, this research adopts a local, field-based perspective with specific focus on post-conflict recovery conditions and detailed supply chain dynamics in Bartella and Qaraqosh. New insights into local stakeholder preferences, greenhouse farming trends, and the effects of inconsistent pricing and logistical deficiencies are included. Key recommendations include improved infrastructure, farmer training, and government policies that promote local vegetable self-sufficiency.

Keywords: Vegetable Markets, Local Sourcing, Supply Chain Gaps, Sustainability, Agricultural Supply Chains

1. Introduction

In the context of food security and rural livelihoods, local vegetable markets play an essential role in ensuring access to fresh produce, enhancing farmer income, and sustaining socio-economic development, particularly in post-conflict regions such as Bartella and Quaraqoush in northern Iraq. Following years of armed conflict, displacement, and the subsequent return of communities, the agricultural systems in these areas remain under reconstruction. The resilience and sustainability of vegetable markets have become central to rebuilding local economies, improving nutrition, and reducing dependency on imported food [1], [2].

The agricultural sector in Iraq is endowed with natural resources and a

long-standing cultural tradition of farming, yet it continues to face profound structural challenges. Among the most pressing are water scarcity, outdated infrastructure, limited investment in innovation, and weak institutional support [2], [3]. These constraints are magnified in localized markets, where smallholder farmers struggle to access urban markets due to poor logistics, fragmented supply chains, and a lack of post-harvest facilities. In Bartella and Quaraqoush, vegetable vendors and producers operate within an informal and often inefficient system marked by price instability, seasonal gluts and shortages, and heavy reliance on intermediaries [4].

The dynamics of local sourcing are also heavily shaped by a mismatch between production cycles and market demand, insufficient cold storage, and lack of organized cooperatives. Furthermore, cultural and social factors such as trust, community cohesion, and customary trade practices play a significant role in market behavior and influence the resilience of these systems in times of economic stress or climate shocks [4], [5]. Enhancing fairness and equity in market participation is crucial to support the long-term viability of local agriculture and ensure that small-scale producers retain a fair share of value creation [5].

Sustainable agri-food value chains require coordinated interventions across production, transportation, processing, and retailing phases. These include the integration of environmentally sustainable practices, adoption of modern agricultural technologies, improved infrastructure, and inclusive governance frameworks [6], [7]. In post-conflict areas like Bartella and Quaraqoush, these needs are particularly urgent given the compounded effects of war-related disruption, institutional fragility, and climate-related risks. A shift from traditional, fragmented supply chains to structured, cooperative, and innovation-driven systems can facilitate resilience and foster self-sufficiency [7], [8].

Compared to previous studies on agricultural recovery and market systems in Iraq, this research provides a more localized and updated perspective, focusing specifically on the micro-dynamics within Bartella and Quaraqoush. Earlier assessments often concentrated on national or regional trends, highlighting generalized constraints such as water shortages, policy gaps, and weak institutional capacity [2], [3], [8]. While these findings remain relevant, this study goes further by incorporating field-level insights from post-conflict zones where communities are actively transitioning from humanitarian aid dependence to self-reliance. Unlike earlier works that tended to emphasize production or input supply chains, this research explores the full value chain including vendor-consumer interactions, informal trade networks, and quality drivers within the context of fragile market infrastructure. Additionally, it incorporates a participatory approach through stakeholder engagement, providing a more nuanced understanding of local perceptions and adaptive strategies. By doing so, it not only confirms known systemic challenges but also uncovers emerging trends, such as the increasing interest in greenhouse farming and the evolving roles of women and youth in

local markets areas previously underexplored in the literature.

Government and donor-led recovery programs have identified agricultural revitalization as a strategic pillar for Iraq's economic reconstruction. However, most national policies still lack targeted interventions for localized markets and smallholder vegetable producers. Addressing this gap requires not only physical investment in farming and transport infrastructure but also policy reform that enables market access, value addition, and equitable growth [8], [9].

This study analyzes the current state of vegetable markets in Bartella and Quaraqoush, with a focus on the sustainability of local sourcing practices, identification of supply chain gaps, and strategic interventions necessary to support long-term development. The analysis draws on case studies, field data, and stakeholder perspectives to examine how social, economic, and environmental factors interact to shape market performance. The ultimate goal is to offer evidence-based recommendations for designing resilient, inclusive, and sustainable market systems in the context of post-conflict rural Iraq.

The primary objective of this study is to analyze the structure, efficiency, and resilience of the vegetable supply chain in the post-conflict areas of Bartella and Qaraqosh, with a focus on enhancing local production systems. It seeks to identify key actors, market relationships, and logistical flows that shape the availability and distribution of vegetables from farm to market. A central aim is to evaluate the sustainability of current sourcing practices and their alignment with production capacity, seasonal cycles, and consumer demand. The study also investigates the main barriers affecting the supply chain, such as inadequate infrastructure, limited access to inputs and storage, and market instability. In addition, it explores how social, economic, and environmental factors influence the performance of local markets and the participation of smallholder farmers. Ultimately, the research aims to provide actionable recommendations for improving supply chain efficiency, promoting self-sufficiency in vegetable production, and building a more inclusive and climate-resilient agri-food system in Bartella and Qaraqosh.

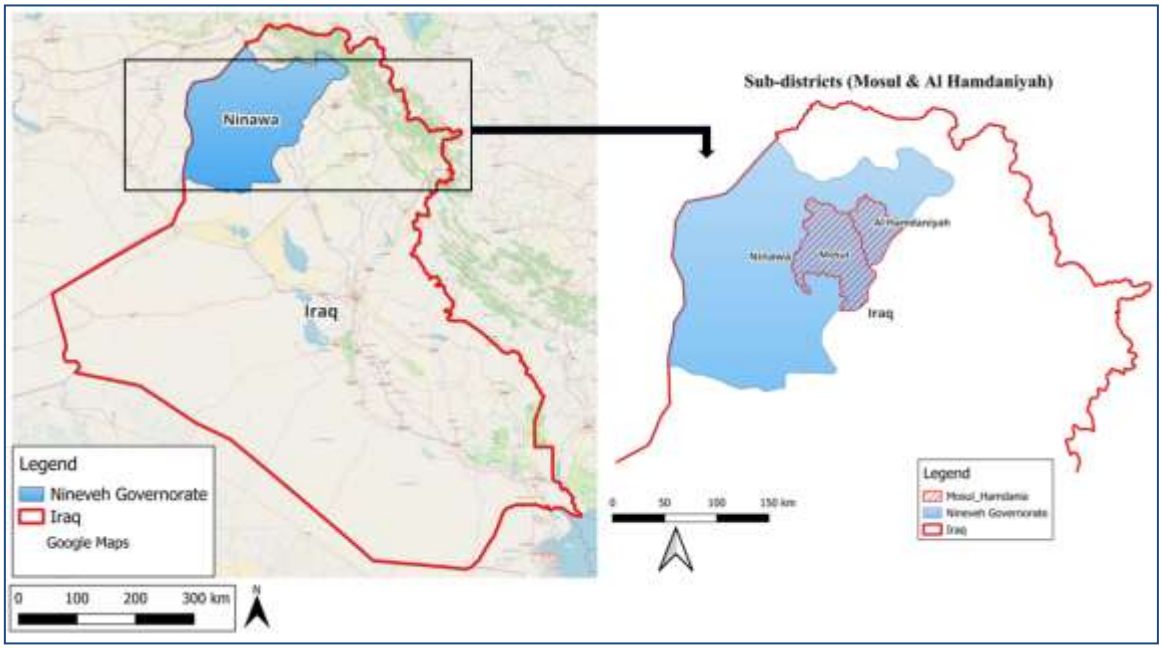

Figure 1. Map of the study area showing the Mosul and Al Hamdaniyah sub-districts within the Nineveh Governorate, Iraq.

2. Materials and Methods

2.1. Study Area and Period

This study was conducted in the vegetable markets of **Bartella** and **Quaraqoush**, situated in the **Al-Hamdaniyah District** of **Nineveh Governorate**, northern Iraq. These towns are significant agricultural centers and serve as key market nodes in Iraq's post-conflict reconstruction efforts. Given their centrality in vegetable trade and ongoing efforts toward rural revitalization, they were selected as representative study areas. The field survey was carried out over four weeks, from **March 10 to April 7, 2025**, coinciding with the peak of local vegetable production and market activity[10] .

2.2. Research Design and Data Collection

A cross-sectional survey design was adopted to collect primary data from three categories of market stakeholders: farmers, sellers, and consumers. A structured questionnaire was developed to assess a range of variables, including sourcing practices, pricing dynamics, storage challenges, supply chain gaps, and stakeholder perceptions of fairness and efficiency.

To ensure efficient and accurate data capture in a resource-limited environment, the questionnaire was digitized and deployed using KoboToolbox, a free and open-source platform designed for mobile-based field research. KoboToolbox offers various features suitable for field conditions, including: Offline data collection via mobile devices (e.g., tablets, smartphones); Real-time validation and error checking; GPS geo-tagging for spatial referencing of data points; and Enhanced data security and reduced

entry errors compared to paper-based methods [11].

Face-to-face interviews were conducted using the Kobo Collect Android application. Enumerators recorded responses directly into the app, which then uploaded the data to the KoboToolbox cloud server once internet access was available.

2.3. Sampling and Survey Procedure

The study targeted three stakeholder groups involved in the local vegetable market system:Farmers: Primary producers transporting their goods to the market;Sellers: Wholesalers, retailers, and market, vendors;Consumers: Buyers purchasing vegetables for household use. A purposive sampling method was employed to ensure the inclusion of individuals with direct engagement in the vegetable supply chain. A total of 180 respondents were selected, with 60 participants from each group. This approach aimed to capture diverse insights across the production, distribution, and consumption spectrum. Interviews were conducted on-site at markets, farms, and local commercial areas. Before participation, enumerators obtained verbal informed consent and assured respondents of data confidentiality. [12]

2.4. Ethics and Quality Assurance

All ethical protocols were adhered to in the design and implementation of this study. Participation was voluntary and anonymous. Respondents were informed that their data would be used strictly for academic and research purposes. The use of KoboToolbox's integrated validation tools, including skip logic, duplicate checking, and mandatory field settings, enhanced the accuracy and consistency of data collection [13].

2.5. Data Management and Analysis

After data collection, completed responses were automatically uploaded to the secure KoboToolbox server and exported into Microsoft Excel for preprocessing. The dataset was cleaned by checking for missing entries, inconsistent responses, and outliers. Once validated, the final dataset was imported into SPSS Version 25 [16] for statistical analysis.

2.6. The data analysis included:

Descriptive statistics, such as frequencies and percentages (e.g., types of vegetables sold, gender distribution), and means and standard deviations (e.g., average prices, transportation costs); Cross-tabulations to examine relationships between demographic or operational factors (e.g., market access vs. price fluctuation);
Simple correlation analysis to explore associations between sourcing practices and market perceptions; and Spatial mapping using GPS data to visualize producer-to-market linkages and consumer distribution [17], [19].

The approach aligns with recent best practices in post-conflict and development research, where mobile-based data collection and participatory diagnostics are increasingly being used to inform localized agricultural and economic recovery planning [15], [18], [20].

3. Results and Discussion

3.1. Small Retail Survey: Market Dynamics and Consumer Preferences

The data from Figure 2 highlights the dynamics of local vegetable markets in the Bartella and Quaraqoush regions. Both areas sell a similar range of products, including cucumber, peppers, eggplant, and other vegetables. Notably, strawberries are also mentioned as a local product in one instance in Quaraqoush, reflecting some diversity in the offerings. The focus on these specific vegetables indicates their prominence in local consumer preferences.

Several reasons drive the purchase of local vegetables. Key motivators include price, with many stores emphasizing affordability as a significant factor. Additionally, customer demand is consistently cited as an essential reason for sourcing local produce, as consumers show a preference for locally grown vegetables. Quality is another critical driver, with stores prioritizing the freshness and overall standard of local vegetables. In some cases, community support is also mentioned, demonstrating an intention to contribute to local economic sustainability. A few stores cite other reasons; such as purchases made upon specific requests or agreements.

The average purchase volumes of local vegetables vary across stores. Most stores operate within the range of 500–1000 IQD per kilogram, indicating moderate demand and a willingness to pay for locally grown produce. A smaller proportion of stores report average purchase volumes in the higher range of 750–1000 IQD per kilogram, which may reflect higher quality or customer-specific requirements. In contrast, some stores in Quaraqoush operate at lower price points of 250–750 IQD per kilogram, possibly reflecting cost-saving measures or smaller-scale operations.

While local vegetables are preferred for their quality and alignment with customer demand, limited reasons for favoring imported goods are provided. This suggests a strong market inclination toward local produce, with minimal competition from imported alternatives. Overall, Bartella and Quaraqoush demonstrate a robust reliance on local vegetable markets, with consistent preferences for affordability, quality, and customer satisfaction driving purchasing decisions. This analysis underlines the importance of targeted strategies to support local producers, enhance supply chain efficiency, and maintain product quality.

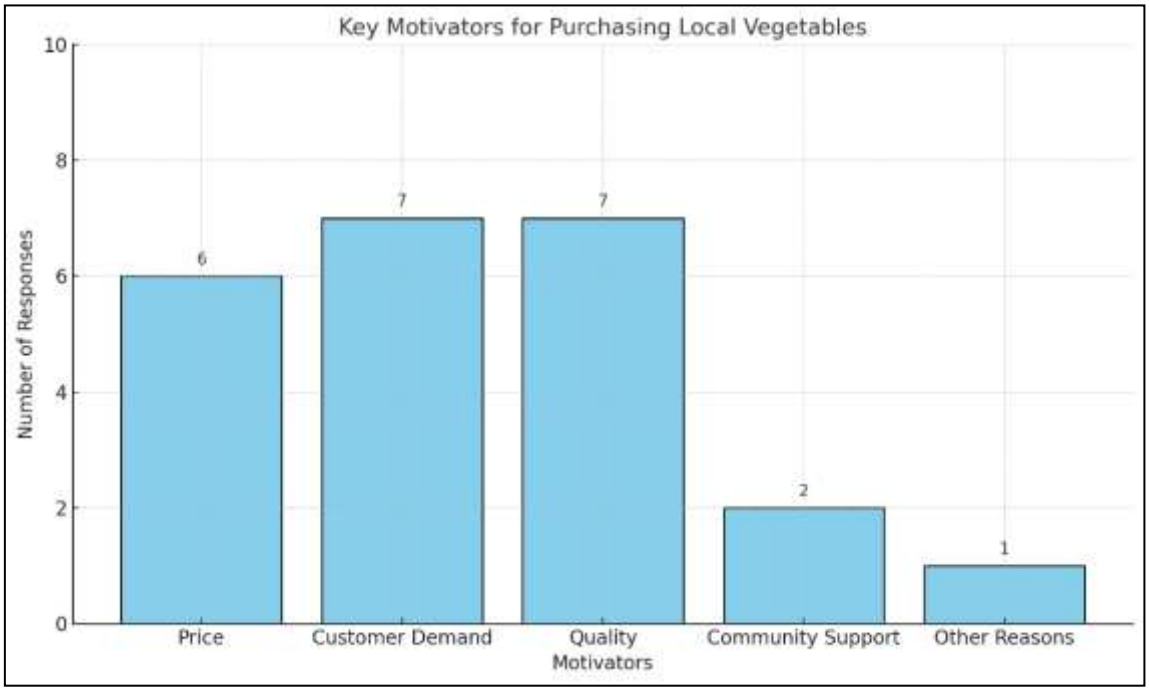

Figure 2. Key Motivators for Purchasing Local Vegetables.

The graph illustrates the key motivators for purchasing local vegetables as identified in the data. Customer Demand and Quality are the top reasons, each cited by seven responses. Price closely follows with six mentions, reflecting the importance of affordability. Community Support, mentioned twice, highlights the social aspect of supporting local farmers. Finally, "Other Reasons," including specific requests, is the least cited motivator, with one response. This visualization underscores the dominance of economic and quality-driven factors, along with customer preference, in influencing purchasing decisions for local vegetables.

3.1.1. Explanation and Analysis of the Data:

The data from Figure 3 highlights several reasons why local markets may prefer imported vegetables to local ones. Quality is the most commonly cited reason, with five responses emphasizing that imported vegetables are perceived as being of higher quality. Additionally, customer demand influences the decision to stock imported goods, as two responses indicate that retailers choose imported vegetables to meet specific consumer preferences. A few responses also cite undefined or general reasons for preferring imports. Respondents consistently express a desire for a wide variety of vegetables to be available in local markets. Many emphasize the need for "all vegetables" or "all vegetables and fruits," highlighting the importance of diversity in market offerings. Specific requests include staples like cucumbers and tomatoes, as well as unique products such as oranges. This reflects a broad demand

for both basic and specialty produce in the local market.

The weekly purchase quantities of vegetables vary greatly, ranging from 350–750 kg to 500–1500 kg per type of vegetable, depending on the store's size and customer needs. Some respondents specify that their purchases depend on market demand, suggesting that consumption patterns are influenced by seasonal availability and shifting consumer preferences. This variability highlights the need for flexibility in local vegetable production and distribution systems. Certain vegetables are identified as difficult to source locally during specific seasons. Broccoli is the most often mentioned as scarce, indicating a significant demand-supply gap. Red and white onions are also noted as challenging to find, along with beans, kidney beans, cowpea, and pomegranate. These shortages point to a need for better planning and resource allocation to address seasonal supply issues.

To address these findings, local markets and producers should focus on quality improvement efforts to compete with imported vegetables. Educating and supporting farmers in adopting better farming and post-harvest practices can improve the quality of local produce. Additionally, encouraging diverse crop planning can help meet consumer demands for both commonly consumed vegetables and those currently in short supply, such as broccoli and onions. Optimizing the supply chain is vital to ensuring the consistent availability of in-demand vegetables throughout the year. Finally, ongoing market intelligence efforts can monitor consumer preferences and guide local production strategies to better align with market needs.

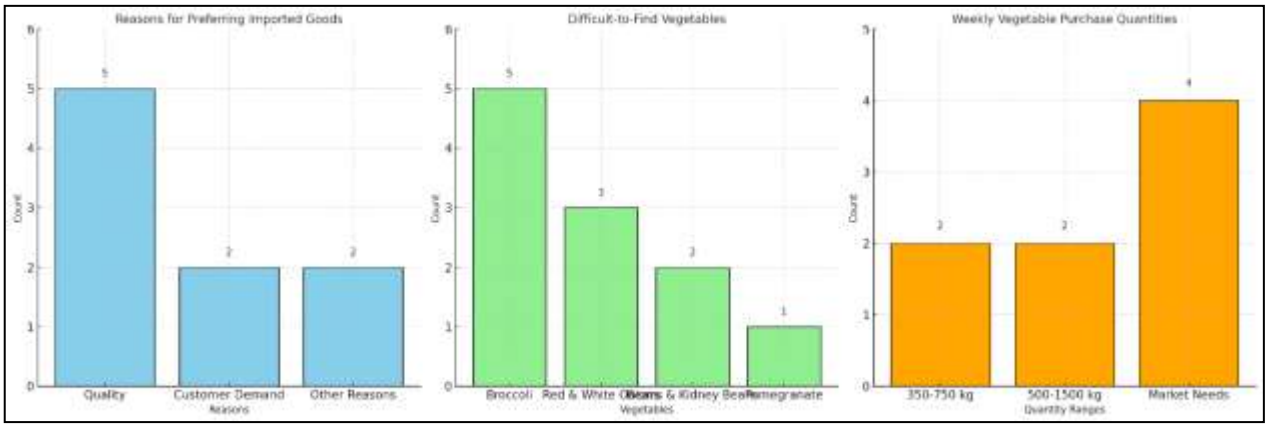

Figure 3. Visual representation of key findings from Reasons for Preferring Imported Goods, Difficult-to-Find Vegetables, and Weekly Vegetable Purchase Quantities

3.2. Restaurant Survey: Sourcing Practices and Quality Priorities

Figure 4 highlights the reveals of various factors contributing to improved vegetable quality. Post-Harvest Handling ranks highest, with a 95% importance score, reflecting its critical role in maintaining freshness and extending shelf life. High-Quality Seeds (90%) and Soil Health (85%)

also rank highly, emphasizing their foundational role in producing robust and nutritious crops. Other significant factors include Pest Management (85%) and Collaboration with restaurants and retailers (85%), which ensure consistent standards and market alignment.

Sustainable practices, such as crop rotation and organic methods, and Training for farmers score 75%, demonstrating their long-term value in maintaining quality. Lower-ranked factors like Technology (70%) and Packaging (60%) indicate areas where improvements could complement other high-priority strategies.

This analysis suggests that focusing on foundational practices (seeds, soil, and pest management) alongside effective post-harvest handling and collaboration can lead to significant improvements in vegetable quality. Investments in training, technology, and sustainable practices can further enhance the quality and market competitiveness of local produce.

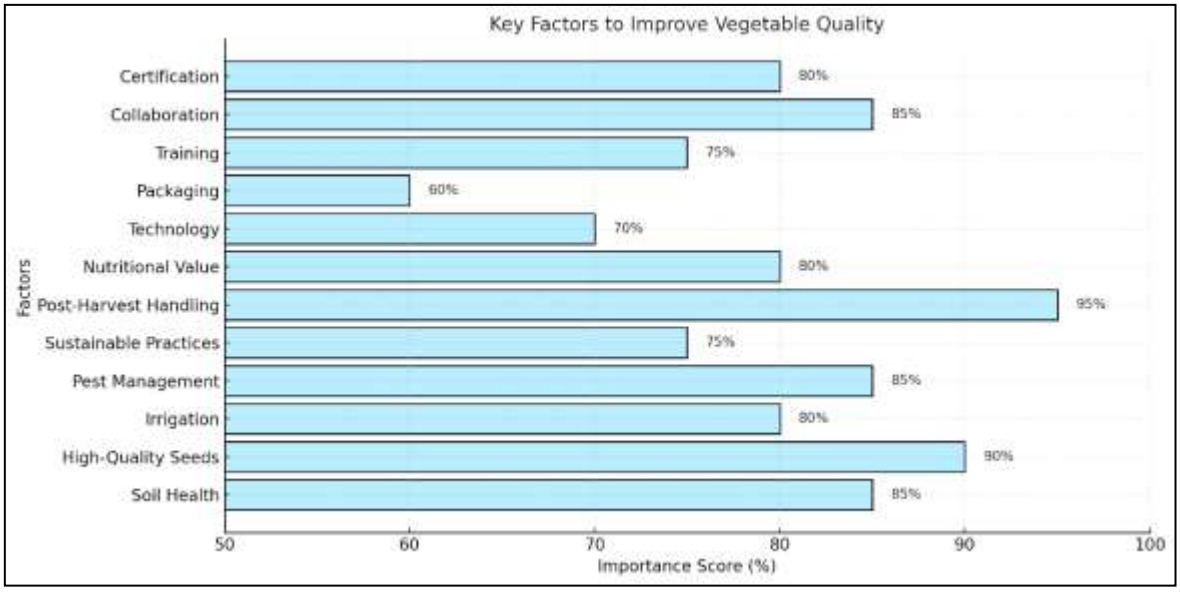

Figure 4. Key Factors to Improve Vegetable Quality

This analysis highlights the need to focus on quality, variety, and supply chain efficiency to enhance the local vegetable supply for the Quaraqosh/Bartella restaurant market.

The data highlights the vegetable sourcing practices of restaurants in the Quaraqosh and Bartella regions, revealing a reliance on both locally produced and imported vegetables. Many restaurants prefer locally produced vegetables due to their availability and cost-effectiveness, while others opt for imported produce to meet specific customer demands and ensure consistent quality. Quality, defined by resistance to climatic conditions and good taste, is a crucial factor influencing sourcing decisions. While some restaurants express satisfaction with the quality of imported products, there is a willingness among several to purchase higher-quality local produce, even at higher prices, provided it meets their standards.

Weekly vegetable purchases vary significantly among restaurants, ranging from 50 kg to 700 kg for specific items such as tomatoes and onions. Price ranges for local vegetables are generally between 500–1500 IQD per kilogram, with most restaurants operating within the 750–1000 IQD range. Staple vegetables like onion, tomato, cucumber, lettuce, and radish are consistently required, with some restaurants emphasizing the need for all vegetables commonly used in their meals. This underscores the importance of maintaining a steady and diverse supply of staple vegetables in local markets.

To meet these needs, local vegetable production should focus on improving the quality and variety of available produce. Enhanced farming practices to ensure resistance to climatic conditions, coupled with efficient storage and distribution systems, can address seasonal shortages. Additionally, fostering direct collaborations between farmers and restaurants can help stabilize demand and supply, ensuring consistent availability of high-quality local produce. Competitive pricing strategies and targeted market support can further strengthen the local vegetable supply chain and reduce reliance on imported goods.

Collaboration between restaurants and farmers can create a mutually beneficial relationship, ensuring restaurants have access to fresh, high-quality produce while providing farmers with consistent demand and fair pricing.

3.3. Strategies to Reduce Reliance on Imported Vegetables

The figure 5 shows the practices that have performed and effected to reduce reliance on imported vegetables. The graph shows a prioritized set of strategies aimed at reducing dependence on imported vegetables, emphasizing their importance in strengthening local agricultural systems. Leading the list is Government Policies (95%), which are vital in promoting self-sufficiency through regulatory measures such as subsidies for local farmers, tax incentives, and import restrictions. These policies help create a supportive environment for the growth of domestic vegetable production. Closely following is the strategy to Improve Local Quality (90%). By implementing better farming practices and post-harvest handling techniques, local producers can improve the quality of their vegetables, making them more competitive with imported products. Similarly, Increasing Variety (85%) is crucial; expanding the variety of vegetables grown locally ensures a year-round supply that aligns with consumer preferences and reduces the need to import off-season or specialty items. Also rated at 85% importance is Farmer Training. Educating farmers about modern agricultural techniques and sustainable practices can lead to better productivity and higher-quality yields, directly enhancing market competitiveness. Supporting these initiatives is the development of an Efficient Supply Chain (80%), which involves investments in storage, transportation, and distribution infrastructure to ensure that fresh local produce reaches consumers quickly and cost-effectively. Collaborative Partnerships (80%) are equally important, fostering direct connections

between farmers, retailers, and the food service industry. These networks help stabilize demand, reduce waste, and streamline distribution. Another key factor is Market Awareness (75%), where informing consumers about the economic, environmental, and health benefits of local produce can influence purchasing decisions in favor of domestic products. Lastly, Financial Support (70%) such as grants, low-interest loans, and other incentives can empower farmers to expand their operations and adopt innovations that boost productivity. Overall, the analysis highlights the need for a comprehensive approach. Combining policy measures, quality improvements, and supply chain enhancements can greatly reduce dependence on imported vegetables and strengthen the resilience and sustainability of local agriculture

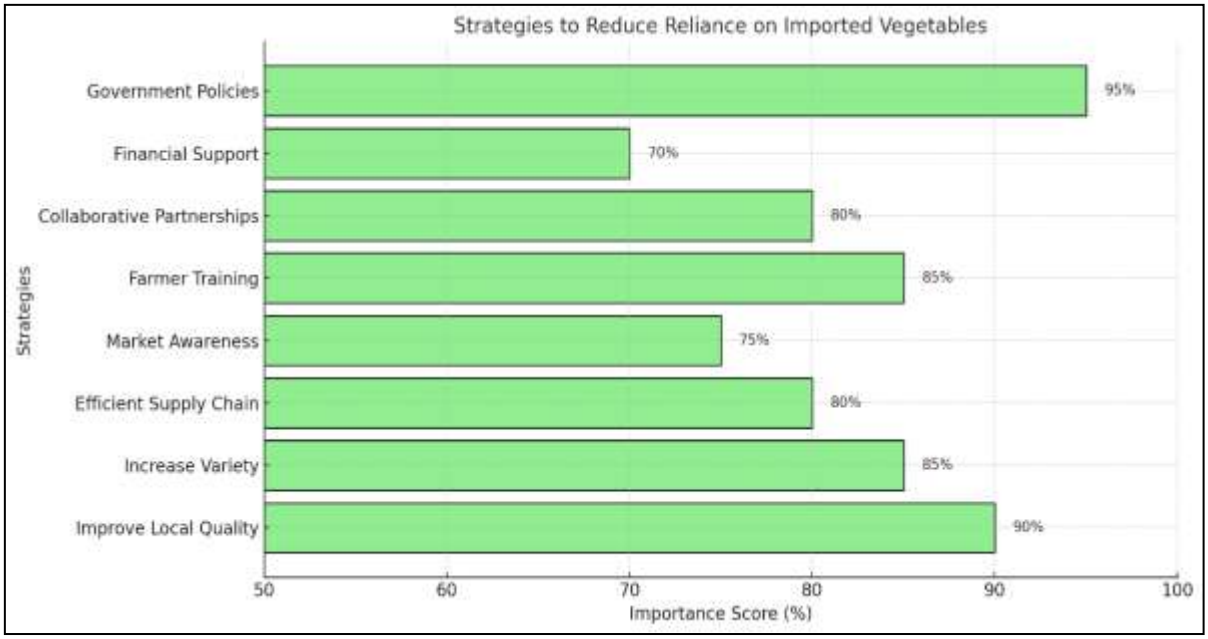

Figure 5. Strategies to Reduce Reliance on Imported Vegetables.

3.4. Greenhouse Cultivation: Income Maximization and Crop Diversification

The greenhouses give farmers a great way to increase income by creating controlled environments that boost productivity, lower risks, and improve crop quality as shown in the figure 6. They allow for year-round growth by extending seasons and enabling cultivation regardless of weather. This guarantees a steady supply even in off-seasons, allowing farmers to sell their produce at higher prices when supply is scarce.

The ideal conditions inside greenhouses, such as controlled temperature, humidity, and light, greatly enhance crop yields compared to traditional open-field farming. They also support vertical farming, helping farmers maximize the amount of produce per square meter. These environments also protect crops from pests, diseases, and harsh weather, resulting in healthier, higher-quality produce. Farmers can focus on high-

value crops like strawberries, cucumbers, and exotic vegetables, which fetch better prices locally and internationally.

Greenhouses also let farmers diversify their income by growing a broader range of crops, including herbs, flowers, and high-demand fruits that need controlled conditions. Growing multiple crops at once or in rotation creates additional income streams. The enclosed setting minimizes losses by reducing exposure to pests, diseases, and extreme weather, ensuring consistent production and cutting pesticide and operational costs.

The cost savings of greenhouses add to profitability. Systems like drip irrigation and targeted fertilization reduce water and nutrient waste, while the controlled environment cuts down on manual labor, saving time and money. Greenhouses also help farmers reach premium markets, including export channels, by meeting strict quality standards. Direct sales to restaurants, supermarkets, and upscale retailers boost earnings. Growing high-value crops is another benefit of greenhouse farming. Farmers can cultivate specialty crops like bell peppers, broccoli, and herbs that are highly sought after in niche markets. They can also try exotic crops not usually grown in their region, drawing in new customers and expanding market reach.

Though greenhouses require an initial investment, they offer lasting advantages such as stable income through consistent production and higher revenues. They are scalable, allowing farmers to grow further over time and diversify their crops. Improved marketing and branding opportunities are another perk, as greenhouse-grown produce can be promoted as fresh, locally grown, and high-quality, appealing to health-conscious buyers. Using eco-friendly methods, like solar-powered systems, can also attract environmentally conscious consumers.

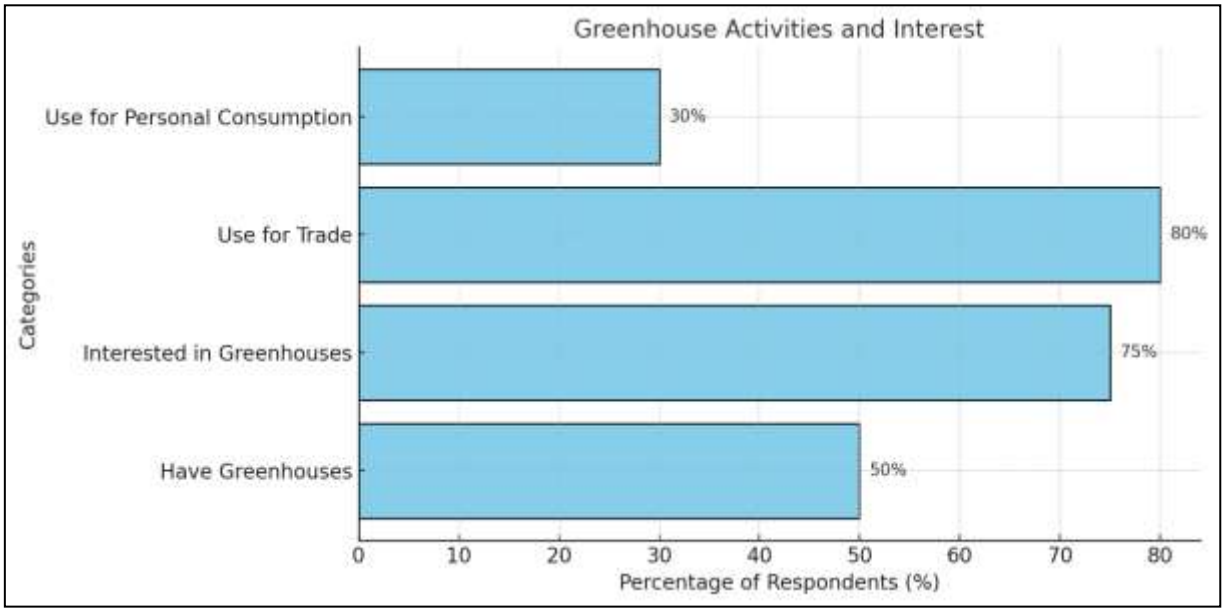

Figure 6. Greenhouse Activities and Interest

3.5. Crop Distribution and Agricultural Priorities

The figure 7 illustrate a clear visual of crop distribution within the local agricultural sector. Vegetables lead the landscape, making up 60% of total crop cultivation. This significant share highlights their high demand and profitability, driven by local market needs and the nutritional value of commonly grown vegetables like tomatoes, cucumbers, carrots, and bell peppers. Their relatively short growing cycles and consistent market turnover make them an attractive choice for farmers seeking steady income.

Cereals, which account for 20% of crop production, are mainly cultivated for their role as staple foods and livestock feed. Crops such as wheat, maize, and barley support both human diets and animal farming, maintaining food security and supporting mixed agricultural systems. While essential, cereals tend to have lower profit margins compared to vegetables.

Fruits, making up 10% of the distribution, occupy a smaller portion due to their longer maturation periods and specific climatic and soil needs. Apple orchards, citrus groves, and banana plantations, for example, require more intensive management and investment but can yield high-value products over time.

Another 10% is allocated to greenhouse crops, reflecting the rising trend of controlled-environment farming. Greenhouse farming allows for year-round production, protection from climate variability, and the cultivation of high-value crops. Although still niche, this category shows promise as a solution to agricultural challenges in areas facing land and water shortages.

Overall, this distribution demonstrates a strategic focus on vegetables, both for local consumption and trade. The prominence of vegetables underscores their vital role in supporting farmers' livelihoods and meeting consumer demand, while the growth of greenhouse activities offers new opportunities for innovation and increased productivity.

3.5.1. Greenhouse Activities and Interest

The bar chart analysis illuminates the current status and potential of greenhouse farming in the region. Notably, 50% of respondents already own or operate greenhouses, showing their established presence in local agriculture. These structures enable farmers to extend the growing season, shield crops from adverse weather, and boost productivity.

More importantly, 75% of farmers expressed interest in adopting greenhouse practices, indicating substantial untapped potential. This suggests that with the right incentives—such as financial support, access to materials, and technical training—a significant increase in greenhouse use could be achieved.

Regarding usage, 80% of greenhouse produce is sold for trade, emphasizing its role as a key activity and a major source of farmer income. Greenhouses make it possible to produce premium crops that command higher prices in local markets,

especially when out of season. Meanwhile, 30% of the produce is reserved for personal use, reflecting its importance for household food security but also confirming that income generation remains the main goal.

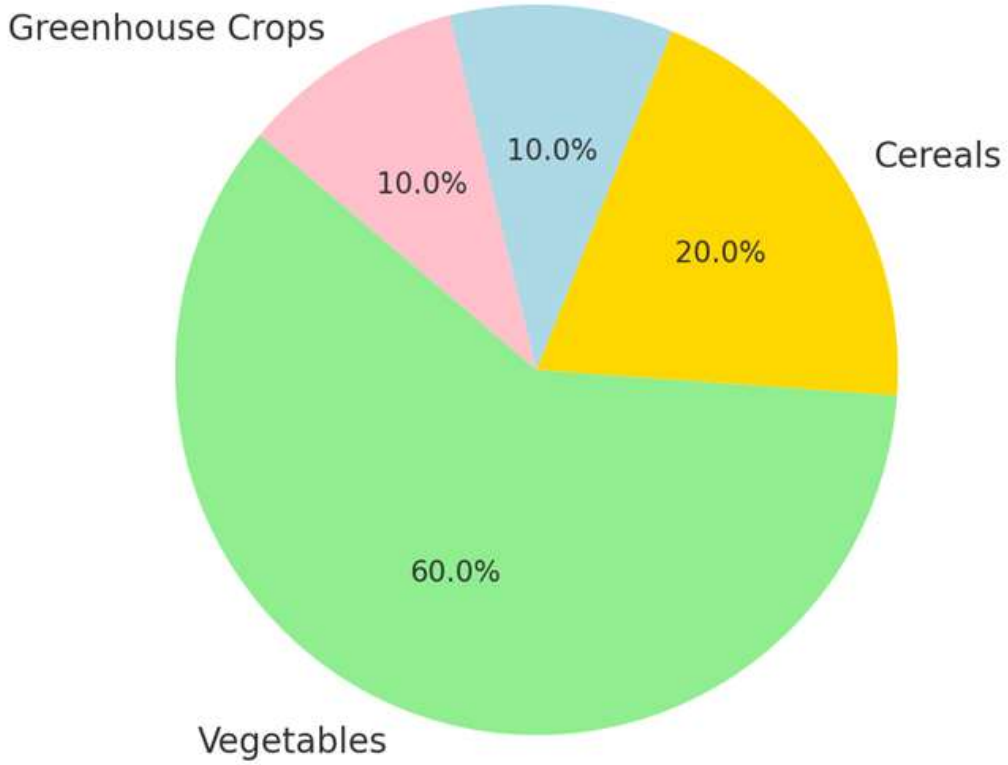

Figure 7. Greenhouse Activities

3.5.2. Greenhouse Farming and Vegetable Market Access: Analysis and Strategic Recommendations

As shown in the figure 8, the greenhouse farming has become a transformative tool in modern agriculture, especially in boosting farmer incomes and resilience. The analysis highlights how greenhouse cultivation greatly increases productivity, product quality, and market access while reducing environmental and financial risks. For example, a farmer using a 1-hectare greenhouse for year-round cucumber production can increase yields by 2–3 times compared to traditional open-field farming. By taking advantage of off-season demand and selling at premium prices ranging from 750 to 1,000 IQD per kilogram, such farmers can potentially double their income while protecting against pests and weather-related losses.

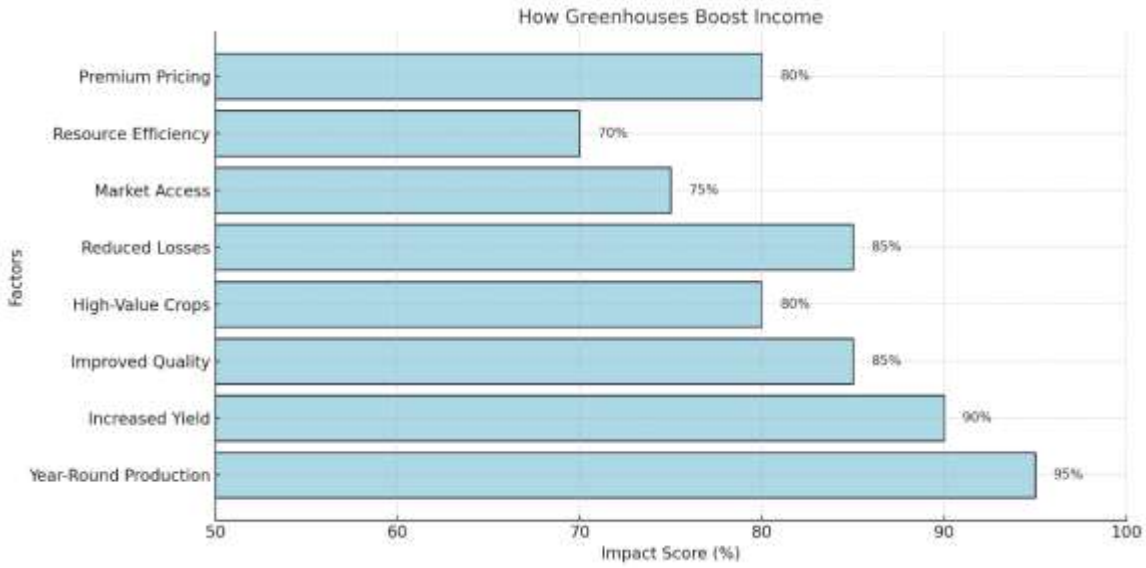

Figure 8. Greenhouses Boost Income

The accompanying graph points out eight key areas where greenhouse farming helps to increase income. Year-round production (95%) stands out as the biggest benefit, enabling farmers to supply during high-price, low-supply seasons. Increased yield (90%) is closely behind, showing how the controlled environment optimizes growth conditions for maximum output. Better crop quality (85%) and fewer losses (85%) reflect advantages from pest control and protection from climate extremes, resulting in more market-ready produce. Greenhouses also support the growth of high-value crops (80%), such as strawberries and specialty herbs, which offer better returns. Premium pricing (80%), market access (75%), and resource efficiency (70%) complete the list, illustrating how greenhouses not only boost profits but also promote environmental sustainability and direct trade.

However, to fully unlock the economic potential of vegetables especially those grown in greenhouses farmers need to overcome significant market access barriers. These include inadequate transportation systems, poor storage infrastructure, fragmented market connections, and limited buyer networks.

Based on the study's findings, the vegetable market in Bartella and Qaraqosh exhibits several notable strengths and weaknesses. On the strength side, there is a clear preference among consumers and vendors for locally produced vegetables, which supports local farmers and encourages short supply chains. The growing adoption of greenhouse farming also reflects a positive shift toward modern production methods that enable year-round availability and higher crop yields. Additionally, strong community ties, trust-based trade practices, and informal collaboration between farmers and vendors contribute to market resilience and flexibility. However, the market also faces critical weaknesses, including poor infrastructure for storage and transportation, leading to post-

harvest losses and supply inconsistencies. Price volatility and reliance on intermediaries create economic instability for both producers and consumers. The absence of organized cooperatives, limited access to financial support, and lack of formal market regulation further constrain the efficiency and equity of the supply chain. These challenges hinder the market's ability to meet demand sustainably and limit opportunities for long-term growth and competitiveness.

A comparison between Bartella and Qaraqosh reveals both similarities and subtle differences in their vegetable markets and pricing dynamics. In both towns, local produce dominates the market, with a shared preference for fresh, locally sourced vegetables over imports. However, Qaraqosh tends to exhibit slightly more price variability due to its larger market size and higher consumer demand, which attract a broader range of vendors and intermediaries. This creates occasional price inflation during peak demand periods. In contrast, Bartella's market is relatively smaller and more stable, with prices generally consistent and shaped by stronger vendor-farmer relationships and less market congestion. While both areas face challenges in infrastructure and post-harvest handling, Qaraqosh has a more active commercial environment, whereas Bartella benefits from tighter-knit community trade practices that help maintain pricing fairness and transparency.

4. Conclusion

The study identified major weaknesses in market coordination, infrastructure, and seasonal planning. Bartella outperformed Qaraqosh in price stability and supply chain efficiency. Greenhouse adoption offers a scalable solution for sustainable vegetable production. Cost structures were clarified, and realistic profit models were developed.

Author Contributions:
Conceptualization, S.A.; methodology, D.A, resources, S.A, analysis; writing—original draft preparation, S.A; D.A writing—review and editing, D.A.; visualization, and S.A.; supervision, D.A and S.A; funding acquisition, S.A.

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Conflicts of Interest: The authors declare no conflict of interest.

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