

Exploring the Economic and Health Benefits of Dragon Fruit: Consumer Perceptions, Market Dynamics, and Strategic Development for Filipino Farmers

Adelfa C. Silor, Faith Stephanny C. Silor, Miguelito B. Emfimo

Mindanao State University-Iligan Institute of Technology, Philippines

DOI: <https://doi.org/10.51244/IJRSI.2024.1110035>

Received: 10 October 2024; Accepted: 12 October 2024; Published: 12 November 2024

ABSTRACT

This study examined the prominence of dragon fruit, focusing on its medicinal benefits, food and beverage applications, and essential products. By understanding the economic and health advantages associated with dragon fruit, the research provided insights into its value across various contexts, highlighting its potential to enrich production strategies. A total of 125 respondents participated in the study, which identified trends and patterns in consumer perceptions, offering insights into market dynamics and potential areas for development. A structured questionnaire using a 5-point Likert scale was employed to systematically collect data on subjective opinions, quantifying perceptions regarding the economic and health benefits of dragon fruit. Descriptive statistics, including mean scores and standard deviations, summarized the data, indicating strong and weak perceptions that informed recommendations for enhancing dragon fruit production. The findings revealed significant economic and health benefits for Filipino farmers, despite challenges such as low market availability and poor visibility. While the crop is recognized as commercially viable and easy to grow, uncertainty regarding production costs and a lack of comprehensive information hinder its growth. Additionally, differing perceptions about dragon fruit's uses in food, beverages, and personal care products highlighted a critical gap in knowledge that must be addressed. The study concluded with strategic recommendations for enhancing awareness through Information, Education, and Communication (IEC) initiatives, improving marketing strategies, diversifying product lines, and promoting gender inclusivity in dragon fruit farming to maximize its benefits for farmers in the Philippines.

Keywords: Essential, sustainable, IEC initiatives, viable

INTRODUCTION

Dragon fruit is one of the most nutrient-dense and flavorful exotic fruits globally. Its production is a profitable industry that holds great promise for increasing the incomes of Filipino farmers (Tepora, 2019). With its exotic appeal and substantial nutritional benefits, dragon fruit has become a leading fruit globally. Introduced to the Philippines in the early 1990s, dragon fruit has thrived in the country's climate, leading to significant growth in cultivation. This is evident in the vast areas of land now dedicated to dragon fruit farming, which contributes to high productivity and is a vital economic resource for farmers. The Philippines' ideal climate makes dragon fruit easily adaptable, allowing it to grow anywhere in the country, even in remote areas. Dragon fruit has become a key player in the local fruit industry due to its profitability and high demand, providing growers with a lucrative income (Pascua, L., Pascua, M., & Gabriel, M., 2015).

On the other hand, since dragon fruit can grow in even the most remote and least accessible areas, its cultivation expands farming opportunities in diverse regions, increasing its economic value. The versatility of dragon fruit can also be harnessed to create various value-added products, such as juices and jams, enhancing its market appeal and profitability. This crop has improved farmers' livelihoods and contributed to regional economic growth and sustainable agriculture. As a result, dragon fruit has become essential to local economic stimulation and agricultural development, serving as a leading example of economic and environmental sustainability.

Dragon fruit has emerged as a low-cost cash crop in Vietnam, significantly improving the livelihoods of many people in the country. Experts highlight its prominence in the poor Mekong Delta region, where it plays a key role in the country's sustainable development strategies, particularly in addressing challenges such as droughts and saline intrusion caused by climate change (Luu et al., 2021). The red dragon fruit, scientifically known as *Hylocereus polyrhizus*, is renowned for its high nutritional content and beneficial effects on human health worldwide. Despite its low plasma bioavailability (<1.0%), red dragon fruit is rich in health-promoting betalains, which offer various therapeutic benefits (Ngoc et al., 2024). Fermentation methods have been developed to maximize the betalain content, especially in local strains (Thoo, 2018). Recent research on fermented red dragon fruit has focused on enhancing the stability of betalains using hydrocolloids. Xanthan gum and carboxymethyl cellulose have been employed to improve viscosity and stability in fermented red dragon fruit, increasing its commercial potential and contributing to sustainable agricultural practices and local economic growth (Lim, 2022; Lim et al., 2023).

Despite these promising developments, significant research gaps remain. Gonzaga et al. (2017) cautioned that very few studies have examined local farming practices related to key components of agroecosystems, such as nutrient management. Given the growing interest in dragon fruit, particularly for its health benefits in managing type 2 diabetes, the need for comprehensive studies is timely. Further research opportunities include exploring dragon fruit's role in economic development through agritourism, value-added products like juices and jams, and seasonal work to diversify local agriculture. Additionally, research on marketing strategies and securing governmental support to address supply and demand issues could boost the fruit's market potential and improve farmer livelihoods.

This study aims to address these gaps by investigating the economic and health benefits of dragon fruit farming, alongside agronomic practices, market potential, and strategic development. It will also examine how dragon fruit can improve local livelihoods and contribute to sustainable agricultural growth through a comprehensive framework for its future development. In 2016, the administrator of Mariano Marcos State University emphasized that agricultural technicians and organizations supporting dragon fruit growers should gain practical experience in the sector to better understand its challenges and needs. He also advocated for expanding dragon fruit farming to address supply shortages and meet market demand.

The *Hylocereus* genus, which includes dragon fruit, may help prevent diseases related to oxidative and inflammatory processes. Due to its bioactive compounds, such as vitamins, potassium, betacyanin, p-coumaric acid, vanillic acid, and gallic acid, studies suggest that dragon fruit can benefit patients with diabetes, dyslipidemia, metabolic syndrome, cardiovascular diseases, and cancer. Additionally, dragon fruit can be used as an edible film, natural colorant, eco-friendly packaging material, ingredient for photoprotective products, and additive in food and nutraceuticals. Despite its potential as a source of bioactive chemicals, dragon fruit has limited bioavailability, which may be improved by developing efficient delivery systems (Nishikito et al., 2023). While dragon fruit farming is a promising venture, significant research gaps remain. Few studies have explored local farming practices and essential agroecosystem components, such as nutrient management. Given the growing interest in dragon fruit for managing type 2 diabetes and other health benefits, more comprehensive research is needed. Further studies should also investigate dragon fruit's role in economic development, particularly in agritourism, value-added products like juice and jam production, and seasonal job opportunities that diversify local agriculture. Addressing these gaps could strengthen the fruit's market potential and improve farmers' livelihoods. This study aims to bridge these gaps by examining the economic and health benefits of dragon fruit farming and evaluating its agronomic practices, market potential, and strategic development. It will also recommend a holistic framework for future development.

LITERATURE REVIEW

The Food and Agriculture Organization (FAO) of the United Nations plays a crucial role in addressing global food security challenges (Petrova & Revenko, 2021). FAO's primary goal is to ensure worldwide food security and access to adequate nutrition for all (Gonzalez & Francesco Mezzalama, 2003). Despite efforts, as of 2021, 2.3 billion people faced food insecurity (Dicken & Batterham, 2022). The World Food Summit in 1996 emphasized the need to increase food production and strengthen political commitment to achieve food security

(Fresco, 1997). Food security, as defined by the UN's Committee on World Food Security, encompasses physical, social, and economic access to sufficient, safe, and nutritious food for all people at all times (Khodjaveva Aziza Bahtiyarovna, 2020). FAO implements various projects to reduce malnutrition globally and collaborates with countries like Russia in economic, political, and research spheres (Petrova & Revenko, 2021). However, challenges such as climate change, international tensions, and rising prices continue to hinder progress towards global food security (Dicken & Batterham, 2022).

Dragon fruit (*Hylocereus* spp.) is gaining popularity due to its nutritional value, health benefits, and economic potential for farmers. It is rich in minerals, vitamins, and bioactive compounds, offering antioxidant, anti-inflammatory, and disease-preventive properties (Hossain et al., 2021; Franceschi Nishikito et al., 2023). The fruit can help manage conditions like diabetes, cardiovascular diseases, and cancer (Franceschi Nishikito et al., 2023). Dragon fruit cultivation is relatively easy, with low water requirements and resilience to abiotic stresses, making it suitable for various climates (Singh & Kumar, 2023). Farmers perceive several advantages, including easy cultivation, year-round harvesting, and reasonable market prices (Saediman et al., 2021). However, there is a need for improved knowledge and skills among farmers to enhance productivity and sustainability (Saediman et al., 2021). The fruit's potential extends beyond fresh consumption, with applications in functional foods, natural colorants, and packaging materials (Franceschi Nishikito et al., 2023).

Dragon fruit (*Hylocereus* genus) has gained attention for its numerous health benefits and therapeutic potential. Studies have shown that it possesses anti-inflammatory, antioxidant, anti-diabetic, anti-cancer, cardioprotective, hepatoprotective, and neuroprotective properties (Franceschi Nishikito et al., 2023; Joshi & Prabhakar, 2020; Luu et al., 2021; Chatterjee et al., 2024). These effects are attributed to various bioactive compounds present in the fruit, including betacyanin, vitamins, polyphenols, flavonoids, and dietary fibers (Franceschi Nishikito et al., 2023; Chatterjee et al., 2024). Dragon fruit extracts have demonstrated antimicrobial activity against bacteria, fungi, and viruses (Luu et al., 2021). Additionally, the fruit has shown potential in managing conditions such as diabetes, obesity, hyperlipidemia, and metabolic syndrome (Franceschi Nishikito et al., 2023; Luu et al., 2021). Its prebiotic properties and wound-healing capabilities have also been noted (Chatterjee et al., 2024). Due to its nutritional value and adaptability to various environmental conditions, dragon fruit cultivation has become economically important in countries like Vietnam (Luu et al., 2021).

Dragon fruit (*Hylocereus* spp.) has gained economic importance globally due to its nutritional value and adaptability to various environmental conditions (Hossain et al., 2021; Luu et al., 2021). It is rich in minerals, vitamins, dietary fiber, and antioxidants, offering numerous health benefits including improved digestion, diabetes management, and cardiovascular protection (Singh & Kumar, 2023; Hossain et al., 2021). The fruit's cultivation has expanded in countries like Vietnam and India, where it has become a cost-effective crop, particularly in challenging environments such as saline or drought-prone areas (Luu et al., 2021; Ali et al., 2024). Dragon fruit plants are easily propagated by stem cuttings and can thrive in various soil types, making them suitable for sustainable agriculture (Hossain et al., 2021; Ali et al., 2024). The increasing popularity of dragon fruit has led to growing research interest in its cultivation techniques, nutritional properties, and potential applications in food and pharmaceutical industries (Ali et al., 2024; Singh & Kumar, 2023).

Dragon fruit (*Hylocereus* spp.) has gained popularity due to its unique appearance, nutritional value, and potential health benefits (Hossain et al., 2021; Ali et al., 2024). The fruit is rich in essential vitamins, minerals, dietary fiber, and antioxidants, contributing to overall well-being (Rathi et al., 2023). Research has explored its cultivation techniques, including propagation, irrigation, and nutrient management (Ali et al., 2024). Dragon fruit has demonstrated various therapeutic properties, including anti-inflammatory, antimicrobial, antidiabetic, and anticancer effects (Joshi & Prabhakar, 2020; Rathi et al., 2023). The fruit's peel and seeds also contain valuable phytochemicals, expanding its potential applications (Joshi & Prabhakar, 2020). Traditional uses include its role as a natural coloring agent (Joshi & Prabhakar, 2020). As interest in functional foods grows, dragon fruit's nutritional and medicinal attributes make it a promising candidate for enhancing human health and reducing the risk of chronic diseases (Rathi et al., 2023).

Dragon fruit farming offers significant economic and health benefits. Studies have shown high social benefits and economic value for organic dragon fruit cultivation (Kustiawati Ningsih et al., 2020). The fruit is rich in

nutrients, including minerals, vitamins, and dietary fiber, and has potential health benefits such as strengthening the immune system and treating diabetes and heart diseases (F. Hossain et al., 2021). Dragon fruit extracts exhibit various biological activities, including antimicrobial properties and the potential for treating chronic diseases (Thi-Thuy-Hai Luu et al., 2021). The crop's adaptability to diverse environmental conditions makes it suitable for sustainable development in tropical regions like Vietnam, particularly in areas facing climate change challenges (Thi-Thuy-Hai Luu et al., 2021). Investment feasibility analysis has demonstrated a positive Net Present Value, favorable benefit-cost ratio, and sound Internal Rate of Return for dragon fruit farming, indicating its potential as a profitable agricultural venture (P. L. Kikon et al., 2021). Investment feasibility analyses of dragon fruit farming consistently demonstrate its potential as a profitable agricultural venture. Multiple studies across different regions have shown a positive Net. These findings consistently indicate that dragon fruit farming is financially viable and potentially lucrative across various geographical contexts.

METHODOLOGY

This study examined the prominence of dragon fruit by exploring its medicinal benefits, food and beverage applications, and essential products. It sought to understand the economic and health advantages associated with dragon fruit, contributing to insights into its value across various contexts. This understanding proved crucial for enriching production strategies.

Data Collection

Sample Size: With 125 respondents, the study identified trends and patterns in consumer perception, providing insights into market dynamics and potential areas for development.

Instrument: A structured questionnaire was employed to systematically collect data on subjective opinions using a 5-point Likert scale. This approach quantified perceptions regarding the economic and health benefits of dragon fruit, allowing for a clearer picture of consumer attitudes.

Scales: Likert scaling proved essential for quantifying qualitative data. The detailed breakdown from "Strongly Disagree" to "Strongly Agree" provided nuanced insights into the areas where participants felt most strongly about dragon fruit.

Analysis of Data

Descriptive Statistics: The computation of mean scores and standard deviations summarized the data, providing an overview of general trends. This analysis indicated where perceptions were strong or weak, informing recommendations for enhancing dragon fruit production. Such categorization by the mean score into descriptive levels helped reveal the consensus or lack thereof, indicating areas of convergence or divergence in consumer perception.

The methodology offered a clear pathway toward addressing the research title. It framed a context within which one could analyze consumer perception and market dynamics related to dragon fruit. This approach balanced quantitative analysis with detailed interpretation, assisting in developing actionable insights to enhance dragon fruit production for maximum benefit to Filipino farmers.

RESULTS AND DISCUSSIONS

Table 1. Responses on Dragon Fruit Prominence and Commerciality

Statements	Mean	Std. Deviation	Interpretation
Dragon Fruit is widely spread and well-known in the area.	3.69	0.88	Agree

It is easy to grow and cultivate	3.57	0.82	Agree
Dragon fruit is highly marketable and easily distributed	3.70	0.88	Agree
Dragon fruit is always available and is sold throughout the year.	2.97	0.98	Disagree
There are a lot of by-products made from the fruit.	3.15	0.94	Agree
I know a lot of dragon fruit products.	2.98	0.86	Neutral
I see a lot of dragon fruit products everywhere.	2.87	0.93	Disagree
Dragon Fruit business is costly.	3.50	0.82	Neutral
Dragon fruit production and processing is time and effort-consuming	3.56	0.78	Neutral
Dragon fruit business is complicated and error-prone.	3.20	0.77	Neutral
Total	3.32	0.87	Agree and Neutral

Legend:

Scale	Range	Descriptive
1	1.00-1.80	Strongly Disagree
2	1.81-2.60	Disagree
3	2.61-3.40	Neutral
4	3.41-4.20	Agree
5	4.21-5.00	Strongly Agree

Table 1: Prominence and Commerciality of Dragon Fruit

The results reveal a significant disparity in respondents' views on the availability and prominence of dragon fruit products, indicating a gap in its perceived ubiquity. According to Emfimo, et al. (2024), stated that integrating gender education into the system is the key to breaking free from biases, closing pay gaps, ending workplace segregation, and empowering women economically. It transforms education into a catalyst for societal equality. Additionally, the primary cause of this inequality stems from early childhood education. The home environment, including parental upbringing and family interactions, particularly in cultural beliefs and norms, significantly influence children's mindsets (Silor, FSC & Silor, ACS, 2023). The item that showed the highest level of disagreement was the statement that dragon fruit is always available year-round, with a mean score of 2.87. This suggests that while dragon fruit is well-known, it is not consistently found in the market. Despite this, there was a high level of consensus on several other aspects. Respondents generally agreed that dragon fruit is widely recognized, scoring 3.69, easy to grow with a score of 3.57, highly marketable with effective distribution channels at 3.70 and that various by-products can be made from it, scoring 3.15.

However, the neutral ratings for the statements regarding knowledge of dragon fruit products (mean score of 2.98) and the challenges of the business—such as it being costly, time-consuming, and error-prone (mean scores of 3.50, 3.56, and 3.20, respectively)—highlight divided opinions on these aspects. These findings imply that Filipino farmers lack sufficient information about the prominence and commercial potential of dragon fruit, which has hindered its widespread adoption and appreciation in Philippine agriculture.

From a global perspective, dragon fruit is considered a high-value crop, as evidenced by Vietnam’s large exports to China, proving its high demand and economic significance. With the potential for similar success in the Philippines, there is an urgent need for Information, Education, and Communication (IEC) programs to promote the dragon fruit industry. These programs should provide farmers with knowledge about cultivation techniques, market potential, and economic benefits, while also sharing best international practices. Ultimately, strengthening IEC programs will help Filipino farmers understand the value of dragon fruit, streamline cultivation processes, and create a competitive local market, closing the information gap and replicating global successes. This result could be enhanced through The Food and Agriculture Organization (FAO) of the United Nations which plays a crucial role in addressing global food security challenges (Petrova & Revenko, 2021).

Table 2. Responses on Dragon Fruit as Medicine

Statements	Mean	Std. Deviation	Interpretation
Dragon fruit is a good and well-known source for its medicinal benefits and purposes.	3.872	0.79287	Agree
I know that dragon fruit is a widely used ingredient for medicine and vitamins.	3.592	0.77351	Agree
I know a lot of dragon fruit vitamins, supplements, and/or medicines on the market.	3.224	0.85065	Neutral
Dragon fruit medicines and vitamins are quickly sold in the market.	3.136	0.84571	Neutral
I think that dragon fruit medicines, vitamins, and supplements are pricy.	3.52	0.74704	Neutral
The sales of these products are high.	3.576	0.7958	Agree
I believe that dragon fruit is a very effective fruit for overall well-being.	3.728	0.65224	Agree
I will probably buy/use dragon fruit vitamins, supplements, and/or medicinal products.	3.432	0.69949	Neutral
I would probably advertise or persuade others to buy/use dragon fruit medicinal products.	3.424	0.63834	Neutral
I believe more dragon fruit medicinal products should be released in the future for people to buy.	4.08	4.55185	Agree
Total	3.5584	1.070916	Agree and Neutral

Legend:

Scale	Range	Descriptive
1	1.00-1.80	Strongly Disagree
2	1.81-2.60	Disagree
3	2.61-3.40	Neutral
4	3.41-4.20	Agree
5	4.21-5.00	Strongly Agree

Table 2: Perception of the medicinal value of dragon fruit

The responses revealed mixed views regarding dragon fruit's medicinal and market potential, with some indicators receiving agreement and others being rated neutrally. Respondents agreed with statements such as dragon fruit being well-known for its medicinal benefits (mean score of 3.87), its use in medicines and vitamins (3.59), high sales in medicinal products (3.58), its effectiveness for general well-being (3.73), and the expectation that more dragon fruit medicinal products will be required soon (4.08). However, neutral ratings were given to statements about the availability of vitamins, supplements, and medicines derived from dragon fruit (3.22), ease of selling these products (3.14), perceived cost (3.52), likelihood of purchasing (3.43), and willingness to recommend (3.42). These findings suggest that while there is general acceptance of dragon fruit's medicinal value, there is also significant uncertainty regarding its availability, cost of production, and market potential. Dragon fruit is highly regarded for its nutritional and therapeutic benefits, including the ability to lower blood sugar levels in type 2 diabetes patients. It is also a rich source of essential nutrients such as iron, magnesium, vitamin B, phosphorus, protein, calcium, and fiber, along with polyunsaturated fatty acids (PUFA), omega-3, and omega-6, which contribute to cardiovascular health. Dragon fruit can thus be considered a low-calorie, nutrient-dense fruit with significant health benefits. Given these features, effective Information, Education, and Communication (IEC) programs should be implemented to increase awareness and adoption of dragon fruit farming, particularly targeting faculty and students in higher education institutions (HEIs). By educating farmers about the health benefits and market potential of dragon fruit, these programs can help boost adoption rates and lead to both economic and health benefits for farmers in the Philippines. This result is supported by Anne Saab (2024) stated that by working together, the WHO and FAO produce expert publications on nutrition and the prevention of chronic diseases that guide international policy (Margetts, 2003). To safeguard the objectives of food security, these organizations actively participate in World Trade Organization (WTO) decision-making procedures alongside others such as the World Food Programme and the Office of the High Commissioner for Human Rights (Anne Saab, 2024).

Table 3. Responses on Dragon Fruit Food and Beverages

Statements	Mean	Std. Deviation	Interpretation
There are a lot of dragon fruit products sold in the market.	3.1200	.89443	Neutral
These products are in high demand and easily distributed in the market.	3.1440	.76942	Neutral
I have seen, tried, or sold dragon fruit dishes like lumpiang Shanghai, noodles, soup, etc.	2.5440	.92024	Disagree
I have seen, tried, or sold other dragon fruit delicacies like candies, ice cream, bread, cakes, and pastries	2.9360	1.07571	Disagree
I have seen, tried, or sold dragon fruit beverages like wine, juice, and preserves like marmalade, yogurt, and jam.	3.2800	1.10424	Agree
I have seen, tried, or sold dragon fruit condiments as seasoning and flavoring.	2.6880	.90175	Disagree
These dragon fruit products are easy to make	3.0320	.75066	Neutral
Dragon fruit food product sales are high	3.3680	.73546	Neutral
Dragon fruit beverage sales are high.	3.2960	.74079	Neutral
Dragon fruit condiments sales are high.	3.2240	.77109	Neutral
Total	3.0632	0.866379	Neutral

Legend:

Scale	Range	Descriptive
1	1.00-1.80	Strongly Disagree
2	1.81-2.60	Disagree
3	2.61-3.40	Neutral
4	3.41-4.20	Agree
5	4.21-5.00	Strongly Agree

Table 3: Participants' perception of Dragon fruit foods and beverages

The data in Table 3 reveal a split opinion on the ten indicators related to dragon fruit products. Of these indicators, only one received an "Agree" rating, with a mean score of 3.28, where respondents affirmed that they have seen, consumed, or sold dragon fruit beverages like wine, juice, and preserves such as marmalade, yogurt, and jam. In contrast, three indicators were rated as "Disagree," with corresponding mean scores of 2.54, 2.94, and 2.69, suggesting that respondents are less familiar with dragon fruit dishes like lumpiang shanghai, noodles, or soup; delicacies such as candies, ice cream, bread, cakes, and pastries; and condiments made from dragon fruit used as seasonings and flavorings. Additionally, six other indicators were rated neutrally, with mean scores between 3.03 and 3.37. These included perceptions of the abundance of dragon fruit products in the market, its demand and distribution, ease of production, and sales of dragon fruit foodstuffs, beverages, and condiments. These neutral ratings indicate that while some potential is recognized, there remains uncertainty regarding the fruit's market presence, demand, and profitability.

Overall, the findings suggest an awareness and acceptance of dragon fruit beverages but limited knowledge of a broader range of dragon fruit food products and their market performance. This indicates latent opportunities for expanding the variety and prominence of dragon fruit-based foods and beverages. Filling these gaps through effective marketing and product development could unlock the full potential of dragon fruit in the beverage and food industries.

Table 4. Responses on Dragon Fruit Essentials

Statements	Mean	Std. Deviation	Interpretation
I've heard or known a lot of dragon fruit essential products (or just with dragon fruit content) sold in the market.	2.9680	.90639	Neutral
I have seen, used, or sold dragon fruit organic products such as facial cleansers, toners, oil/serum, masks, moisturizers, scrubs, etc.	2.6480	.91806	Disagree
I have seen, used, or sold dragon fruit hygienic products such as soap, shampoo, toothpaste, etc.	2.5280	.81889	Disagree
I have seen, used, or sold dragon fruit beauty products or makeup such as lipstick/tint/balm	2.5600	.86509	Disagree
I think that dragon fruit essential products are pricy.	3.4240	.74340	Neutral
The sales of these products are high	3.3520	.75409	Neutral
I believe that dragon fruit is a very effective fruit for hygiene.	3.0960	.64036	Neutral

I will most probably buy/use Dragon Fruit essential products.	3.1920	.60503	Neutral
I would probably advertise or persuade others to buy/use dragon fruit essential products.	3.2800	.62990	Neutral
I believe more dragon fruit essential products will be released for people to buy.	3.4560	.67804	Neutral
Total			Neutral

Legend:

Scale	Range	Descriptive
1	1.00-1.80	Strongly Disagree
2	1.81-2.60	Disagree
3	2.61-3.40	Neutral
4	3.41-4.20	Agree
5	4.21-500	Strongly Agree

Table 4: Respondents' perception about the role of dragon fruit in daily need products.

The data reveals that respondents expressed disagreement with three of the ten indicators related to dragon fruit products, with mean scores of 2.65, 2.53, and 2.56, respectively. Specifically, the respondents did not agree with statements regarding their experiences with dragon fruit in personal care products, such as: "I have seen, used, or sold Dragon Fruit Organic Products like Facial Cleansers, Toners, Oils/Serums, Masks, Moisturizers, and Scrubs," "I have seen, used, or sold Dragon Fruit Hygienic Products like soap, shampoo, and toothpaste," and "I have seen, used, or sold Dragon Fruit Beauty Products or Makeup like Lipstick/Tint/Balm." These results imply a low level of familiarity or exposure to dragon fruit products in these categories.

In contrast, the remaining seven indicators received a neutral rating, with mean scores ranging from 2.97 to 3.46. These included perceptions about the availability and market presence of essential dragon fruit products, such as "I have heard or know a lot about dragon fruit essential products sold in the market that contain dragon fruit," "I think that dragon fruit essential products are pricey," "I think the sales of these products are high," "I believe that dragon fruit is a very effective fruit for hygiene," "I will most probably buy/use dragon fruit essential products," "I would probably advertise or persuade others to buy/use dragon fruit essential products," and "I believe there should be more dragon fruit essential products released in the future for people to buy." The neutral responses indicate a lack of strong opinions or specific knowledge, highlighting the potential need for increased information and education on dragon fruit.

These findings underscore a significant knowledge gap among respondents regarding dragon fruit products and their benefits. This gap highlights the importance of educational initiatives aimed at increasing farmers' understanding of the uses and potential of dragon fruit in various product markets. As noted by the chancellor of Mariano Marcos State University in 2016, agricultural technicians and organizations providing support to dragon fruit producers must be aware of the challenges and needs within the sector. Given the current supply shortage relative to market demand for dragon fruit products, there is a compelling reason for collaborative efforts to bridge this gap. Additionally, integrating marketing strategies and establishing standardized regulations for the dragon fruit marketing system could strengthen the market for dragon fruit products. Government involvement in developing and implementing consistent marketing policies remains crucial to promoting growth in this subsector.

Table 5. Supporting Information

Statements	Mean	Std. Deviation	Interpretation
Dragon Fruit is a highly profitable business.	3.8000	.72956	Agree
Sales from the fruit itself are higher than the sales of its by-products.	3.6960	.77485	Neutral
Other non-edible by-products can be created out of this fruit.	3.4320	.68787	Neutral
I think the dragon fruit business has a great chance of expanding and will be highly demanded in the market in the next 5-10 years.	3.7920	.67556	Agree
The dragon fruit business is expected to alleviate in the next 5-10 years.	3.7600	.67680	Agree
Total	3.6960	0.708928	Agree

Legend:

Scale	Range	Descriptive
1	1.00-1.80	Strongly Disagree
2	1.81-2.60	Disagree
3	2.61-3.40	Neutral
4	3.41-4.20	Agree
5	4.21-5.00	Strongly Agree

Table 5: Stakeholder perceptions on dragon fruit production.

The profitability and potential of dragon fruit production are reflected in the respondents' varied opinions on its by-products. Only two indicators received neutral responses, indicating that respondents are relatively indifferent to the profitability of dragon fruit by-products and the possibility of developing non-edible products, with mean scores of 3.70 and 3.43, respectively. In contrast, three indicators showed agreement: "Dragon fruit is a highly profitable business" with a mean score of 3.80, "The dragon fruit business has a great chance to expand and is highly demanded in the market in the next 5–10 years" with a mean score of 3.79, and "The dragon fruit business is expected to grow in the next 5–10 years" with a mean score of 3.76. These findings reflect a positive outlook on the economic viability and growth potential of the dragon fruit industry. Overall, the production of dragon fruit is perceived as enterprising, with promising prospects for expansion and long-term sustainability. Data indicates that enhancing dragon fruit production will economically and environmentally benefit Filipino farmers. Increased production could lead to better value chain development, improved processing methods, and wider market opportunities. This growth would promote economic sustainability, especially when empowering people, regardless of gender, to engage in dragon fruit farming. Efforts should focus on involving more farmers, including women and girls, in dragon fruit cultivation. For the sustainability of dragon fruit farming, the Office of Agriculture in the Philippines must follow the policy of the FAO. FAO's purpose includes providing governments with direct development assistance and policy guidance, as well as expertise in agriculture, nutrition, fisheries, and forestry (Thompson, 2011). Achieving global food security and guaranteeing that everyone has access to sufficient nourishment is the organization's main goal (Gonzalez & Francesco Mezzalama, 2003).

Globally, dragon fruit is a significant agricultural product, particularly in countries like Vietnam, Malaysia, Thailand, Taiwan, Sri Lanka, China, and Israel. Reports indicate that there is high demand for Vietnamese dragon fruit, with 70% of the crop exported to China; conversely, 99% of the dragon fruit consumed in China is sourced from Vietnam, illustrating its high economic value, as reported by the Vietnamese Ministry of Industry and Trade (2020). This global demand presents an opportunity for Filipino farmers to enter the market. However, Ani and Casasola (2020) argue for developing more gender-responsive approaches in agriculture, as women often lack recognition and access to extension programs. Women are frequently underrepresented in agricultural databases, hindering their participation. Therefore, it is essential to ensure the active involvement of women and girls in dragon fruit farming, providing them with equal opportunities and benefits. Such inclusivity will enhance the attainment of sustainable agricultural development and gender equality. Improved dragon fruit production has the potential to provide economic advantages and health benefits for farmers in the Philippines. By closing gender gaps and empowering women through inclusive business practices, the sector can contribute to broader development goals and drive sustainable growth.

CONCLUSIONS

The potential for increased dragon fruit production in the Philippines presents farmers with significant economic and health benefits. While the crop is recognized as commercially viable, challenges such as low market availability and poor visibility hinder its growth. Dragon fruit is considered easy to grow and has high market potential, but there is considerable uncertainty regarding its production costs and difficulty. This uncertainty and a lack of comprehensive information affect the crop's visibility in the market. However, dragon fruit is valued for its medicinal properties and health benefits, suggesting that enhanced awareness and targeted education could facilitate greater utilization of its products. The study also reveals differing perceptions about the content of dragon fruit in food and beverages. While beverages are familiar to consumers, other product categories and condiments remain relatively unknown, indicating a potential area for diversification and increased product awareness. Very few respondents recognized the uses of dragon fruit in personal care products, highlighting a critical gap in knowledge that must be addressed to harness the fruit's potential and stimulate growth, thereby maximizing its economic and health benefits for farmers in the Philippines.

To fully capitalize on the potential benefits of dragon fruit for farmers, several strategic recommendations can be made for the Philippines. First, enhanced Information, Education, and Communication (IEC) initiatives should focus on educating farmers and consumers about the economic and health benefits of dragon fruit farming. Successful international practices should be shared to illustrate potential growth and profitability, thus increasing adoption rates and productivity among Filipino farmers. Raising awareness and visibility in the market is crucial; campaigns highlighting the availability and benefits of dragon fruit as a food and medicinal product can significantly enhance public awareness. Improved distribution channels and marketing strategies will further bolster market visibility. Additionally, diversifying the product line to include new foods, beverages, and condiments based on dragon fruit will require substantial long-term investments in research and development. Promoting the medicinal benefits of dragon fruit through health-related campaigns can also help alleviate market uncertainties. Gender inclusivity is an integral factor in achieving equitable development; applying a gender-responsive approach that empowers women and girls in dragon fruit farming will create an enabling environment with equal opportunities. This empowerment will strengthen women's roles in the agriculture sector and contribute to sustainable development. As of 2023, approximately 924 million people face acute food insecurity, an increase of 207 million since the pandemic (Suri, 2023). Factors contributing to this include broken food supply networks, high unemployment rates, income loss, and rising food prices (Suri, 2023). To address these challenges, the international community must align efforts with the 2030 Agenda and the UN Sustainable Development Goals to create a more resilient, sustainable, and equitable global food system (Suri, 2023; Fung & Lee, 2017). This requires a multifaceted approach that considers environmental sustainability, agricultural practices, and socio-economic well-being (Suri, 2023).

REFERENCES

1. Afrianto, E., Pangestu, M. A., & Isyaturriyadhah, I. (2021). Feasibility analysis of red dragon fruit (*Hylocereus polyrhizus*) farming in Rimbo Ilir District, Tebo Regency. Baselang.

2. Ali, A., Sharma, N., Vishwakarma, P. K., & Chavda, D. (2024). Exploring dragon fruit in India: From taxonomy to nutritional benefits and sustainable cultivation practices. *Applied Fruit Science*.
3. Café, A., & Arciaga, E. (2018). Dragon fruit production is an emerging industry. Available at: <https://saad.da.gov.ph/2018/09/dragon-fruit-production-an-emerging-industry>
4. Chatterjee, D., Mansuri, S., Poonia, N., Kesharwani, P., Lather, V., & Pandita, D. (2024). Therapeutic potential of various functional components present within dragon fruit: A review. *Hybrid Advances*.
5. Dicken, S.J., & Batterham, R.L. (2022). Ultra-processed food: a global problem requiring a global solution. *The lancet. Diabetes & endocrinology*.
6. Eldeen, I. S., Foong, S., Ismail, N., & Wong, K. C. (2020). Regulation of pro-inflammatory enzymes by the dragon fruits from *Hylocereus undatus* (Haworth) and squalene—Its major volatile constituents. *Pharmacognosy Magazine*, 16(64), 81–86. <https://api.semanticscholar.org/CorpusID:214807433>
7. Emfimo, M. B., Silor, F. S. C., & Silor, A. C. (2024). Best practices in promoting gender equality in Philippine education. In *The Southeast Asian Conference on Education 2024: Official conference proceedings*. Mindanao State University-Iligan Institute of Technology, Philippines.
8. Fresco, L.O. (1997). Keeping world food security on the agenda : implications for the United Nations and the CGIAR.
9. Fung, W.M., & Lee, S. (2017). Efforts to Increase Global Food Security: Implications for International Nutrition Education. *Journal of nutrition education and behavior*, 49 5, 365-366 .
10. Gonzaga, N., Gonzaga Jr., A., Taylaran, R., Pajinag, R., & Quirino, R. (2017). Productivity and fruit quality of red-fleshed dragon fruit, *Hylocereus polyrhizus* (Britton and Rose) under Jasaan series. *Journal of Multidisciplinary Studies*, 6(2), 27–46. <https://doi.org/10.7828/jmds.v6i2.1050>
11. González, F.J. (2009). Plato and Heidegger: A Question of Dialogue.
12. Hidayatullah, R. F. (2021). Analisis kelayakan pada usahatani buah naga di Desa Summersari Kecamatan Summersari Kabupaten Jember. *Jurnal Ilmiah Mahasiswa Pertanian*.
13. Hossain, F., Numan, S., & Akhtar, S. (2021). Cultivation, nutritional value, and health benefits of dragon fruit (*Hylocereus* spp.): A review. *Journal of Horticultural Science*, 8, 259–269.
14. Joshi, M., & Prabhakar, B. (2020). Phytoconstituents and pharmaco-therapeutic benefits of pitaya: A wonder fruit. *Journal of Food Biochemistry*, e13260.
15. Kikon, P. L., Kashyap, D., Choudhury, J. C., Devi, H. A., & Devi, R. R. (2021). Investment feasibility analysis of dragon fruit farming. *International Journal of Agricultural Sciences*.
16. Lim, T. W., Lim, C. J., Liow, C. A., Ong, S. T., Lim, L. H., Pui, L. P., Tan, C. P., & Ho, C. W. (2022). Studies on the storage stability of betacyanins from fermented red dragon fruit (*Hylocereus polyrhizus*) drink imparted by xanthan gum and carboxymethyl cellulose. *Food Chemistry*, 393, 133404. <https://doi.org/10.1016/j.foodchem.2022.133404>
17. Lim, T. W., Lim, R. L. H., Pui, L. P., Tan, C. P., & Ho, C. W. (2023). Synergistic enhancing effect of xanthan gum, carboxymethyl cellulose, and citric acid on the stability of betacyanins in fermented red dragon fruit (*Hylocereus polyrhizus*) drink during storage. *Heliyon*, 9(10), e21025. <https://doi.org/10.1016/j.heliyon.2023.e21025>
18. Luu, T., Le, T., Huynh, N., & Quintela-Alonso, P. (2021). Dragon fruit: A review of health benefits and nutrients and its sustainable development under climate changes in Vietnam. *Czech Journal of Food Sciences*, 39(2), 71–94. <https://doi.org/10.17221/139/2020-CJFS>
19. Margetts, B.M. (2003). FAO/WHO launch expert report on diet, nutrition and prevention of chronic diseases. *Public Health Nutrition*, 6, 323 - 325.
20. Ningsih, K., Sakdiyah, H., Felani, H., Dwiastuti, R., & Asmara, R. (2020). Economic valuation for organic farming of dragon fruit: Cost benefit analysis approach. *IOP Conference Series: Earth and Environmental Science*, 469.
21. Ngoc, T., Pham, T., Dang, M., Le, U., Nguyen, N., Ngo, T., Pham, K., Le, H., Truong, N. M., & Nguyen, Q. T. (2024). Influences of fermentation conditions on the chemical composition of red dragon fruit (*Hylocereus polyrhizus*) wine. *Beverages*. <https://api.semanticscholar.org/CorpusID:271196420>
22. Nishikito, D. F., Borges, A. C. A., Laurindo, L. F., Otoboni, A. M. M. B., Direito, R., Goulart, R. A., Nicolau, C. C. T., Fiorini, A., Sinatora, R. V., & Barbalho, S. M. (2023). Anti-inflammatory, antioxidant, and other health effects of dragon fruit and potential delivery systems for its bioactive compounds. *Pharmaceutics*, 15(1). <https://api.semanticscholar.org/CorpusID:255537733>

23. Pajinag, R., Quirino, R., Gonzaga, N., & Gonzaga Jr., A. (2017). Productivity and fruit quality of red-fleshed dragon fruit, *Hylocereus polyrhizus* (Britton and Rose) under Jasaan series. *Journal of Multidisciplinary Studies*, 6(2), 27–46. <http://dx.doi.org/10.7828/jmds.v6i2.1050>
24. Pascua, L., Miriam E. Pascua, M., & Gabriel, M. (2015). Dragon fruit production and marketing in the Philippines: Its status, constraints, and prospects. Available at: https://www.fftc.org.tw/htmlarea_file/activities/20150817121105/05-15P10.pdf
25. Petrova, A.M., & Revenko, L.S. (2021). The Role of FAO in Tackling the Global Food Security Issue. *Current Economic Trends*.
26. Rathi, K., Singh, S. L., Gigi, G. G., & Shekade, S. V. (2023). Nutrition and therapeutic potential of the dragon fruit: A qualitative approach. *Pharmacognosy Research*.
27. Saab, A. (2024). Anne Saab, Review of Matias E. Margulis, *Shadow Negotiators: How UN Organizations Shape the Rules of World Trade for Food Security*. *European Journal of International Law*.
28. Safira, A., Savitri, S. L., Putri, A. R. B., Hamonangan, J. M., Safinda, B., Solikhah, T. I., Khairullah, A. R., & Puspitarani, G. A. (2021). Review on the pharmacological and health aspects of *Hylocereus* or pitaya: An update. *Journal of Drug Delivery and Therapeutics*. <https://api.semanticscholar.org/CorpusID:244502686>
29. Saediman, H., Mboe, I. S., Budiyanto, B., Sarinah, S., & Hidrawati, H. (2021). Smallholder adoption of horticultural crops: The case of dragon fruit in Southeast Sulawesi. *IOP Conference Series: Earth and Environmental Science*, 819.
30. Silor, F. S. C., & Silor, A. C. (2023). Gender inequality in STEM education: Basis for gender sensitization program. In *The Barcelona Conference on Education 2023: Official conference proceedings*. Mindanao State University-Iligan Institute of Technology, Philippines.
31. Singh, S., & Kumar, S. (2023). A review on nutritional, medicinal and bio-active compounds of dragon fruit *Hylocereus polyrhizus* (F. A. C. Weber) Britton & Rose. *International Journal of Biochemistry Research & Review*.
32. Suri, S. (2023). Navigating the nexus: Challenges to global food security and the 2030 agenda. *Food Nutrition Chemistry*.
33. Tepora, T. (2019). Problems and opportunities of dragon fruit production in the Philippines. *FFTC Agricultural Platform. Food and Fertilizer Technology*.
34. Thoo, E. (2018). Fermentation of red dragon fruit (*Hylocereus polyrhizus*) for betalains concentration. <https://api.semanticscholar.org/CorpusID:198977757>
35. Tiyas, A. K., Putra, I. G., & Dewi, I. A. (2015). Analisis finansial usahatani buah naga super merah (*Hylocereus costaricensis*) (Studi kasus di kelompok tani Berkah Naga Desa Sambirejo Kecamatan Bangorejo Kabupaten Banyuwangi). *Journal of Agribusiness and Agritourism*, 4.
36. Thompson, B. (2011). *FAO's Approach to Nutrition-Sensitive Agricultural Development*.