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Production, Marketing and Future Prospects of Mandarin in Nepal

Anmol Regmi[1], Surya Mani Dhungana[2]

[1]PG Scholar, Department of Agricultural Economics and Agribusiness Management, Faculty of Agriculture, Agriculture and Forestry University, Rampur
[2]Assistant Professor, Department of Agricultural Economics and Agribusiness Management, Faculty of Agriculture, Agriculture and Forestry University, Rampur

**Corresponding Author: Anmol Regmi*
Email: anmolishani100@gmail.com

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Abstract

Citrus reticulata is a vital fruit crop in Nepal, where its demand is very high and has been produced as the main source of income in the hilly region. Nepal offers suitable topography, climate and soil for the profitable production of mandarins with great taste, precocity and high nutritive values. This study attempts to analyze the production trend, export and import, current scenario and prospects of mandarin in Nepal. The study employed a comprehensive review and synthesis of secondary data, including statistical records, publications from relevant organizations, and academic literature from 2001 to 2023, to analyze the production, marketing status, and prospects of mandarin in Nepal. The findings of the study shows that the production of mandarin is in increasing trend with an average annual growth rate of 7.04% from fiscal year 2019/20 to 2020/21 and cultivating area by 33.84 % from fiscal year 2019/20 to 2021/22. The study emphasizes the economic value of mandarins, especially in the mid-hill's region, as well as their health advantages because of their fiber and antioxidant content. The yield of mandarin has decreased because of several issues, such as high investment costs, lack of adoption of improved technology, poor orchard management, diseases and pests, unstable prices and profit margins along with inappropriate market channels. Therefore, to strengthen this subsector, it is advised to focus on developing mandarin productivity through conventional mechanization, better adoption of technology, price intervention, market recognition, HLB management, establishment of storage and processing centers, and diplomatic relations for easy international marketing.

Introduction

Nepal is home to a diverse variety of citrus fruits, including numerous species with significant commercial value that can help economic growth. Fruits constitute an important item of our life, and they play a significant role in the human diet through the supply of vitamins and minerals (Jayaprakash et al., 2023; Dhalaria et al., 2020). Mandarins (Citrus reticulata) are smaller and more oblate than conventional oranges, which are a mandarin pomelo cross-breed (Ali & Siddiqi, 2018). Citrus development in Nepal speaks to a critical rural division that contributes to the vocations of numerous, particularly in the mid-hills' locale. Mandarin occupies 65.3% and of the add up to citrus developing region and 67.2% of generation in Nepal separately (Pandey et al., 2017). The favourable climatic conditions and rich soil of this zone give a perfect environment for developing an assortment of citrus natural products, which are not as it were expended locally but moreover have the potential to be sent out, hence contributing to the country's economy (Radha & Mathew, 2007; Sanabam et al., 2018; Rajput et al., 2021).

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Mandarins, too known as mandarins or mandarines, are citrus natural products with various wellbeing benefits (Saini et al., 2022; Ma et al., 2020). They are wealthy in beta-carotene and beta-cryptoxanthin, cancer prevention agents that decreases cancer hazard. They are too a great source of dissolvable fibre, which makes a difference decrease LDL cholesterol and lower blood weight. Mandarins are too wealthy in flavonoids, which reinforce the safe framework (Mondal, 2023). They moreover boost intestine wellbeing by supporting assimilation and controlling bowel development recurrence (Salminen et al., 1996; Houghteling & Walker, 2015). Citrus natural products contain different bioactive compounds, counting vitamins, phenols, flavonoids, carotenoids, dietary filaments, minerals, and other supplements that moderate causes of open wellbeing concerns such as cancer, heart maladies, and weight (Goldenberg et al., 2018; Hazarika et al., 2019).

Citrus has been developed in 62 areas of Nepal out of them Dhankuta, Terathum, Sindhuli, Ramechhap, Dhading, Kavre, Gorkha, Lamjung, Tanahun, Kaski, Syangja, Myagdi, Palpa, Salyan, Dailekh, Baitadi, Dadeldhura are the major citrus developing areas (Adhikari et al., 2014; Prasad & Chandra, 2019; Sharma et al., 2021). Among citrus, mandarin orange is predominant which shares about 67 percent of the total citrus production in the country (Sharma et al., 2021). Unprocessed mandarin dominates the mandarin value chain, indicating a lack of processed products. The gross margin and high B/C ratio received by the mandarin growers showed that the mandarin farming is profitable (Shrestha, 2015; Gautam et al., 2020).

Despite the promising prospects, the citrus industry in Nepal is not without its challenges. Viral diseases such as Greening, Tristeza, and Xyloporosis pose a significant threat to the yield and quality of the crops (Panth & Dhakal, 2019; Iftikhar et al., 2021). In research by Parajuli et al. (2023) explain that the extent of decline and losses has not been correctly assessed in Nepal, nor attempts have been made to map the malady. Mismanagement, wide use and distribution of unhealthy citrus saplings, increasing drought/dryness, lack of balanced plant nutrition, and application of updated technology are some of the major factors contributing to the citrus decline problem in Nepal (Panth & Dhakal, 2019; Poudel et al., 2023). This appears gigantic scope to scale up the generation of mandarin in Nepal for elevating the job of Nepalese farmers and commercializing the farming industry of Nepal (Atreya et al., 2020; Thapa, 2020).

Methods

The study was carried out to know the production and marketing status of mandarin in local and global context for Nepal. The study is based on the review and synthesis. A thorough review of the literature along with its relevant database by exhaustive search of academic databases and relevant sources to identify studies and resources pertaining to the subject, covering the period from 2001 to 2023. The data for the study are collected through the secondary data collection from the different publications. These publications include Food and Agriculture Organization (FAO), Statistical Information on Nepalese Agriculture, publications of Ministry of Agriculture Development (MoAD), Various books and booklets and relevant statistical records.

Dozens of literatures with open access online peer-reviewed national and international research papers from different journals, reports, abstracts, blogs and websites were reviewed and thus the collected data were assembled in Microsoft Excel and graphs were drawn. A critical and SWOT analysis was carried out to evaluate prospect of mandarin based on the recent national and international trends of mandarin production and import-export performance. Linear trend line analysis was carried for estimating the average annual change in the mandarin production in the country.

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Mathematically expression for linear trend line:

$$Y = a + bt$$

Where "Y" is a production of the mandarin at time (t), "b" is an average annual growth (MT), "t" is a time factor in years, and "a" is an intercept.

Percentage change was estimated with the following expression:

$$\text{Percentage (\%) change} = (X2-X1)/x1 * 100$$

This model was chosen as being the simplest one and which would give a direction as to what should be expected in the future. The diagnostic tests used to check for the goodness of fit for the specified model included checking for auto correlation and heteroscedasticity of the residuals.

Besides the trend analysis, percentage changes computation was used to give the level of growth or reduction, concerning the totality of features like production quantity, area under cultivation, and market share proportion. The formula used for percentage change was:

$$\text{Percentage Change} = \frac{\mathbf{X2-X1}}{\mathbf{X1}} \times 100$$

This analysis therefore gave a quantified values of changes that had occurred over the period under study giving a qualitative and quantitative aspects of predominantly mandarin production system in Nepal. To identify the strength and weakness of mandarin farming in Nepal, analysis was carried out to determine the strengths, weaknesses, opportunities, and threats associated. The SWOT was used both at macro (national) and micro (local) levels showing the variety of external and internal factors affecting the mandarin sector. This analysis was based on the national and international trends as well as the scholarly opinion that was obtained from the literature review.

Results and Discussion

Global Trends of Mandarin Production

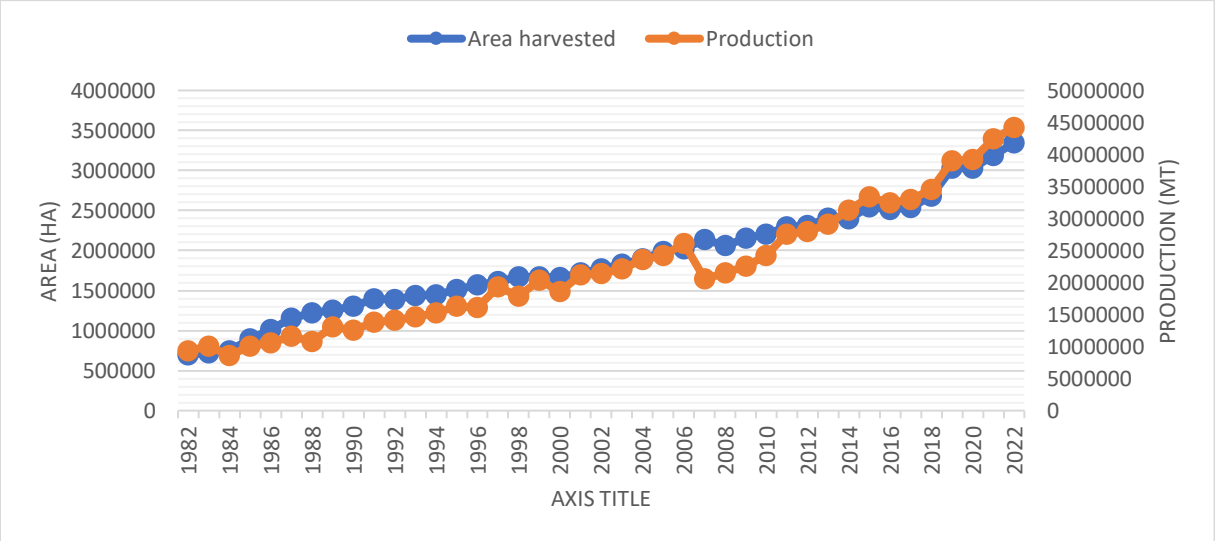

Figure 1. World Mandarin Production Trend (1992-2022)

Source: (Faostat, 2022)

The world mandarin production trend (Figure 1) shows that the area under cultivation and production has been increasing over the years. In 2007, there was a slight decline in mandarin

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production, followed by a slight increment in subsequent years. Although its exact history is unknown, Clementine Mandarin is thought to have started in China and was chosen in Algeria. Over the past five decades, "clementine" has emerged as the citrus variety with the quickest expansion rate in Spain and Morocco. Additionally, "Clementine" mandarin is produced in South Africa, Argentina, Uruguay, and Peru (Agustí et al., 2014). China is the largest producer of Satsuma mandarins as the main cultivars, followed by Turkey, Spain, Brazil and Japan. Spain is the world's largest producer of Clementines, whereas Japan mainly produces Satsumas (El-Otmani et al., 2011).

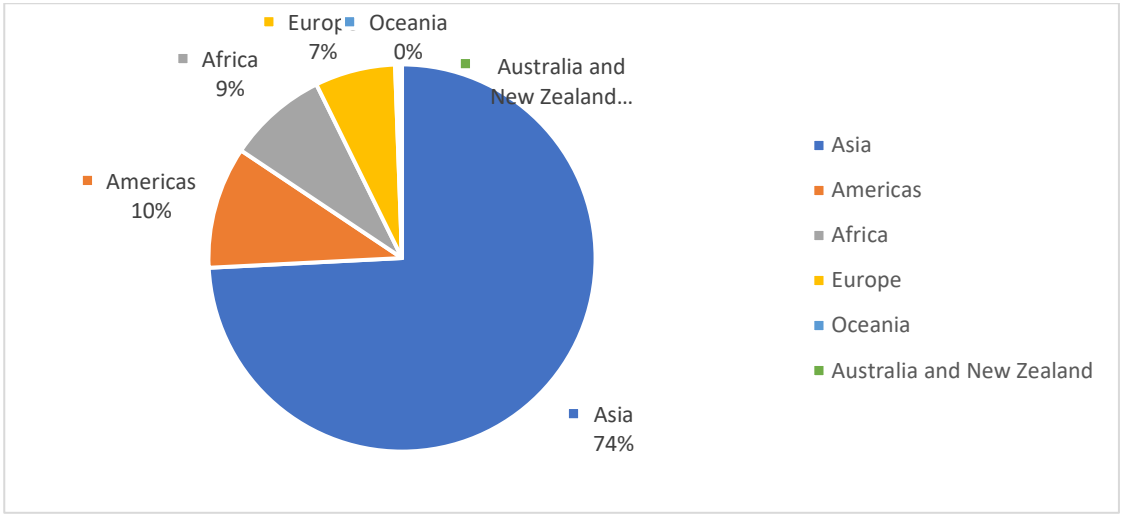

Figure 2. World Mandarin Production Share by Region in 2022

Source: (Faostat, 2022)

The average annual growth rate of Mandarin production in the world was estimated around 4.4%. The estimation of the percentage change in the mandarin production from base year 1982 to recent year 2022 was 374.77% increase. While similar estimation for the Mandarin cultivated area showed that there was increase by 377.63% from 1982 to 2022. Annual growth rate of Mandarin production in the world for an individual year is shown in Figure 3.

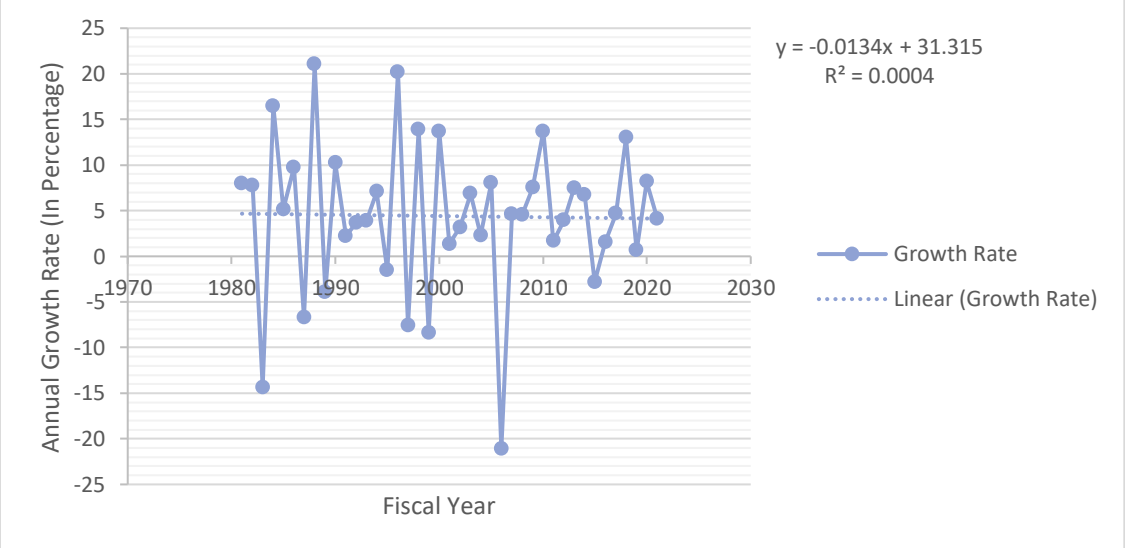

Figure 3. Annual Growth Rate of Mandarin Production in World

Source: (Faostat, 2022)

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Figure 4 shows the top 10 Mandarin producing countries in the world. China is top mandarin producing country followed by Turkey, Spain, Morocco and Brazil. Mandarin is being produced in commercial scale in China and in 2022, China alone contributed about 60% of total world production. But, with the increase in global demand, China has emerged as top producer of mandarin in the world and shares 50.59% of total world production in the year 2018 (Faostat, 2022). The top 10 mandarin producing countries in the world accounts for 83.92% of total world mandarin production (Faostat, 2022).

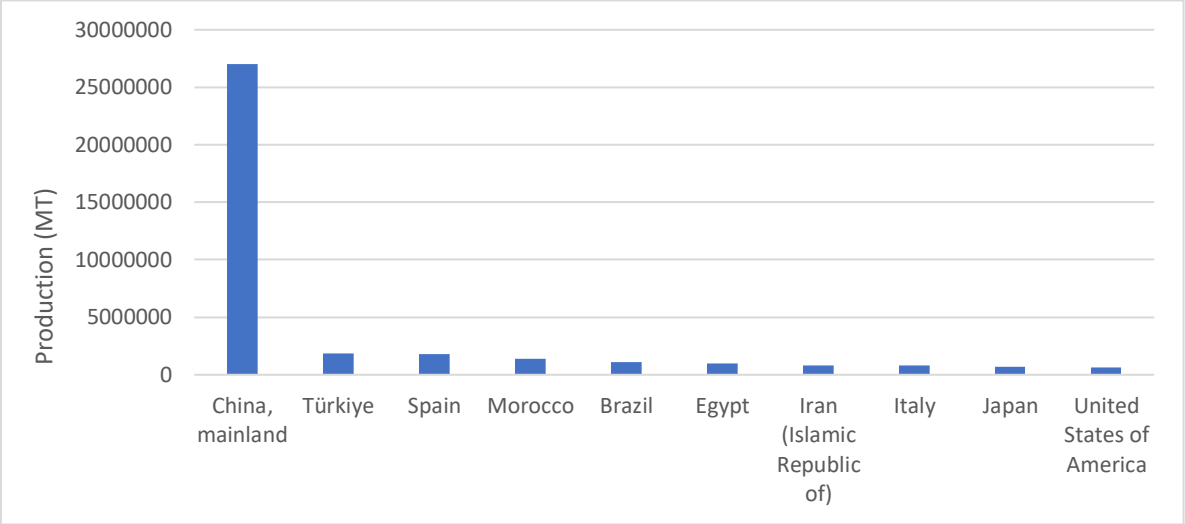

Figure 4. Top Mandarin Producing Countries in 2022

Source: (Faostat, 2022)

Status of Mandarin Production in Nepal

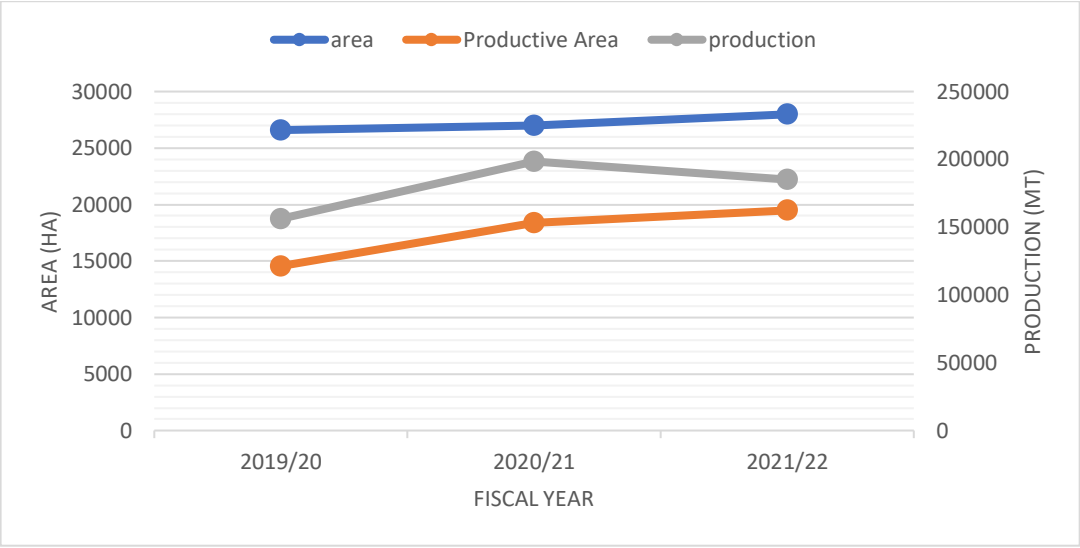

Figure 5. Mandarin Production Trend in Nepal

Source: (*Statistical Information On Nepalese Agriculture*, 2021/22)

Fruits contribute about 7% AGDP (Sribuathong & Trevanich, 2010). The total area under fruit cultivation in Nepal is 182,648 ha and has production of 1,416,750 mt with productivity of 10.94 mt/ha in FY 2021/22 (*Statistical Information On Nepalese Agriculture*, 2021). The majority of the growing area is occupied by mandarin oranges, which are followed in order of

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preference by sweet oranges and acid limes (Sharma & Upadhayaya, 2020) .Mandarin orange is major citrus crop grown in hills and mid-hills in different parts of Nepal. The Area occupied by mandarin is 2/3rd of the total area occupied by citrus and 1/3rd of total area occupied by fruits in Nepal (Shrestha, 2015). However, Production of citrus is in increasing trend but productivity has not been increased as expected (Pokhrel, 2011).

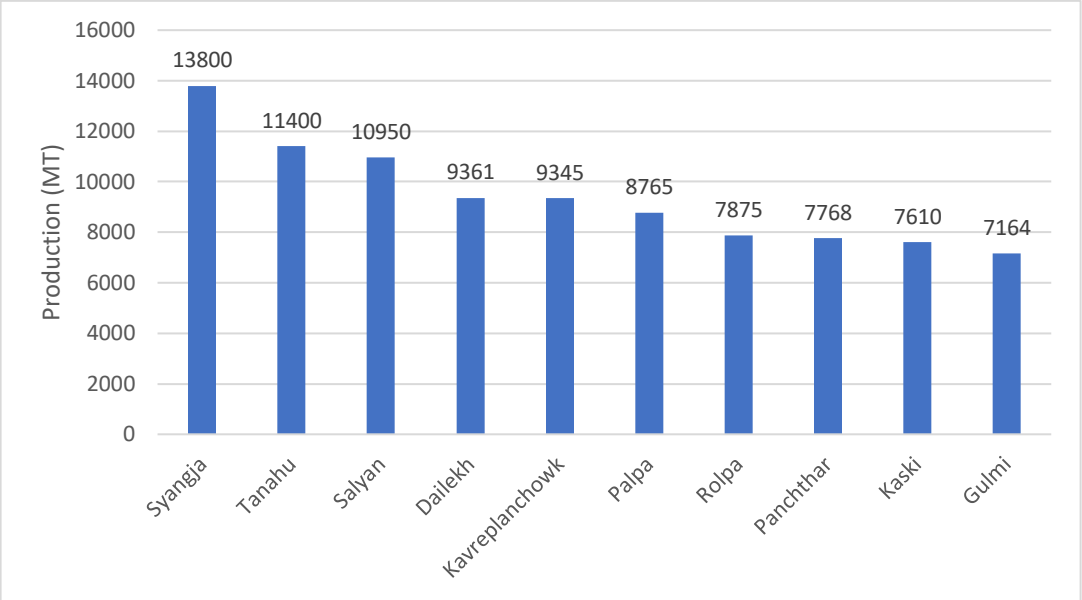

Figure 6. Top 10 Mandarin Producing Districts of Nepal

Source: (*Statistical Information On Nepalese Agriculture*, 2021/22)

The average annual growth rate of mandarin production in Nepal was estimated around 7.04% from fiscal year 2019/20 to 2020/21. The percentage change in mandarin production from the fiscal year 2019/20 to 2021/22 was estimated at 18.67%. Similarly, there was increase in mandarin cultivating area by 33.84 % from fiscal year 2019/20 to 2021/22. However, decline of mandarin production was noticed by 6.5%. Several biotic, abiotic, and management variables impacts mandarin production. The primary factor affecting orchard management that contributed to the production decline in the previous years was the poor adoption of management practices like extensive intercrop, rain-fed irrigation, an inappropriate dose of manure and fertilizer, the incidence of insect pests and diseases, as well as lack of control methods (Adhikari et al., 2021; Fatondji et al., 2024). Citrus greening or Huanglongbing and citrus die-back are major constraints in orchard management. Along with United State of America (U.S.A), HLB is presently contained and has affected citrus-producing regions of Africa, Brazil, the Middle East, the Indian subcontinent and Southeast Asia (Bové, 2006). Traditionally, HLB is managed by controlling the psyllid vector, removing affected trees aggressively to cut down on disease sources, and establishing nursery stock free of HLB (Alvarez et al., 2016). Citrus decline is not a single disease, but rather a clinical manifestation of several underlying causes (Poudel et al., 2022; Abbas et al., 2021). Incidence of diseases and pests, poor planting materials, poor soil status, and climatic variability may result in the citrus decline (Panth & Dhakal, 2019). Management techniques such as irrigation, pruning, manuring, application of Bordeaux and control of insects strongly correlate with the rejuvenation of the declining mandarin orchard (Poudel et al., 2022).

Figure 5 shows the production trend of Mandarin in Nepal. The Syangja district was the top-producing district in mandarin, producing 13,800 mt., followed by Tanahu and Salyan.

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Recognizing the high potential of mandarins in Nepal, Government of Nepal has established different zones (Syangja, Udaypur, Solukhumbu) and block (Kaski, Dailekh, Baglung, Gulmi, Arghakhanchi, Parbat, Tanahun, Gorkha) in order to promote mandarin farming at commercial scale. Mandarin is cultivated in most of Nepal's hills and mid-hills region (Figure 6).

Global Trends of Mandarin Export and Import

Due to the high juice contents as compared to the other citrus varieties, total world exports of mandarin have been increasing in recent years (Naseer et al., 2019). Because of their great taste, health benefits and nutrition values, Mandarin is gaining popularity in modern time. It is well established that the consumption of citrus fruits reduces the risks of lifestyle-related diseases, such as cancers, cardiovascular diseases, and diabetes. In these fruits, high amounts of bioactive compounds are accumulated in the peel and pulp (Ma et al., 2020). Primary and secondary metabolites are among the many phytochemicals that may be found in mandarin fruit. According to Lado et al. (2018), the macronutrients that make up its primary metabolites are mostly sugars, organic acids, lipids, and vitamins. Meanwhile, the compounds that make up its secondary metabolite classes phenolics, flavonoids, and limonoids determine its flavour and additional health advantages.

The global export of mandarin was 5.56 million Mt. worth USD 5.53 billion in the year 2022. Spain was the largest exporter of mandarin with the total quantity of 1245922.97 mt and export value of USD 1.59 billion followed by Turkey, China and South Africa. Russia was the biggest importer of mandarin with the import quantity of 864,554 mt. and export value of USD 581 million followed by United States of America, France and Germany.

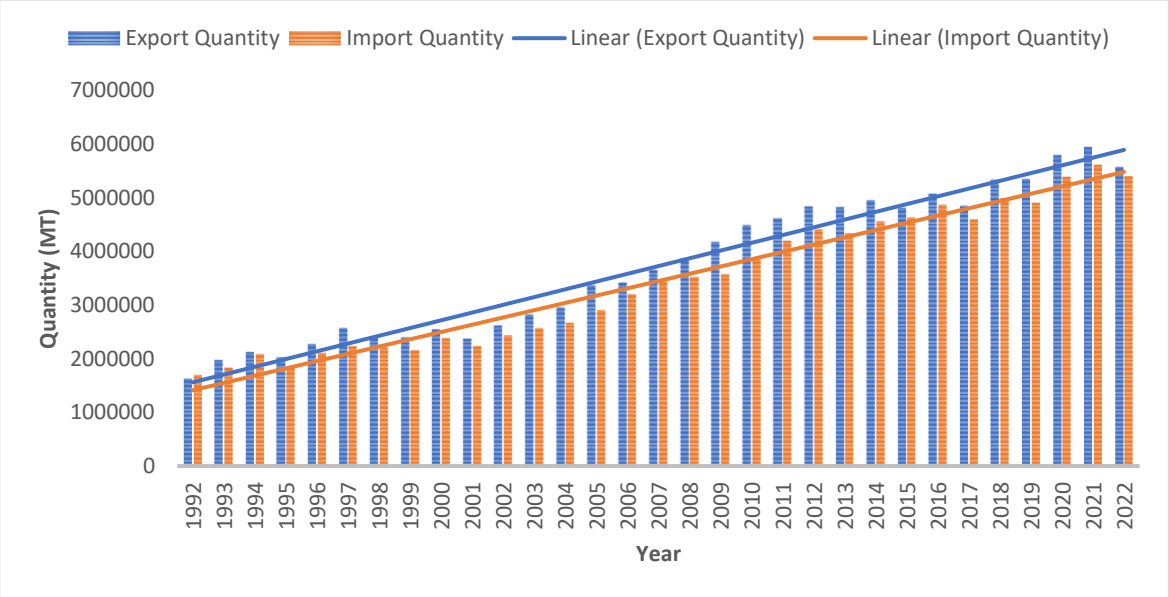

Figure 7. World trend of Export and Import of Mandarin

Source: (Faostat, 2022)

Export and Import of Mandarin in Nepal

Unlike other fruits, there is inconsistency in trade of mandarin in Nepal. There is an increment in mandarin production within country and a gradual decrease in import of this fruit. According to Faostat (2022), the import of mandarin is gradually decreasing. This may be due to an increase in awareness among consumers about the consumption of local products. Domestic production does not fulfil demand during the off-season due to lack of storage facilities. The

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demand for citrus goods among consumers has long been sustained by advertising and promotional efforts (Spreen et al., 2020). The time series data for the import value (USD) and import quantity (kg) of Mandarin both had a positive but insignificant trend at the 95% confidence level (Dahal et al., 2020).

There is a good chance that Nepal may export mandarin to its neighbours. We must achieve extremely high-quality standards if we want to sell mandarin to the world market. However, the quality of mandarin produced in Nepal suffers from several issues. They are too tiny and neither uniformly nor of the same variation in size. Consequently, more attention to quality improvement techniques needs to be paid to compete in the global market.

Table 1. Status of Import and Export of Mandarin in Nepal

Year	Import		Export	
	Quantity (mt)	Value (USD)	Quantity (mt)	Value (USD)
2017	1736.33	749000	2.11	5000
2018	429.6	176000	-	-
2019	16.25	8000	-	-
2020	41.61	35000	-	-
2021	58.9	40000	-	-
2022	6	4000	-	-

Source: (Faostat, 2022)

As demonstrated in the table 1, there is reducing trend in the import of mandarin in Nepal where the quantity has declined from 1736. From 33 Metric Tons to 6 Metric Ton and from $749, 000 to $4. This we expect to result in enhanced mobilization of resources towards the domestic production of similar goods and services rather than the importation of the same. On the export side, there is very less activity, only a small quantity was exported in calendar year 2017 and there were no exports in the subsequent years showing that Nepal has not explored the export market yet. A hike in the self-sufficiency ratio in mandarin production is revealed at the same time lifted up the export competence as a major weakness.

Opportunities include favourable climate, well established market image, and experienced farmers. The weaknesses include the fact that production capacities are low, large investments are required, and facilities are insufficient. Some of these are export prospects, governments' help, and increase the local market's scope. Nevertheless, weather risks, diseases, and competition with cheaper imports are the main risks that this sector takes. The highlighted analysis reveal that Nepal has a favourable industry structure capable for mandarin production growth, however identification of weaknesses and threats is the prime requisite for maximum utilization of its opportunities in local well as global markets.

The present study contributes to understand the production, import and export trends of mandarin in Nepal and has identified some important issues that need further discussion. It revealed an annual growth rate of 7 per cent, though the officials said the increase in number was observed every year. It is worth to understand, approximately 04% up in domestic production between the FY 2019/20 to 2020/21 is quite positive inclination in making improvements to the dependency of Nepal on China for mandarin production. However, the concurrent 6. Such a 5% decline is a cause for concern on the sustainability of this form of growth; Besides, this can be caused by many factors that are normally linked to one another;

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poor orchard management measures, diseases such as Huanglongbing (HLB), and poor access to modern agricultural inputs as have been noted in other citrus producing regions.

Table 2. SWOT Analysis of Mandarin

Internal Factors	External Factors
Strengths Ideal climatic conditions for mandarin production, with south-facing slopes at 1000-1800 meters above sea level providing ideal sunshine, temperature, and well-drained soil for superior fruit quality. Good image of mandarin in the market of that location due to good taste. Production based on organic farming methods, addressing the growing demand for healthy, chemical-free fruits. Abundant land suitable for mandarin cultivation, allowing for potential expansion and increased production. Mandarins from specific regions, such as Syangja, are known for their exceptional quality in the domestic market. Skilled farming community with a deep understanding of mandarin cultivation practices.	**Opportunities** Potential to export mandarins to neighbouring countries by improving quality standards, developing export-oriented marketing strategies, and investing in infrastructure improvements. Significant domestic market opportunity. Diverse climate allows to extend harvest seasons and expand the market reach. Enhance land utilization and conservation, creating employment opportunities in rural areas. The government and NGOs are prioritizing commercial mandarin cultivation, enhancing the citrus value chain, and conducting research on improved varieties Improved market access to established markets through the development of collection centres, improved transportation networks, and proper storage facilities to reduce post-harvest losses and improve overall production efficiency.
Weakness Many mandarin producers are small-scale, scattered farmers with limited landholdings and access to credit. Requires high investment in essential resources like quality inputs, irrigation systems, and proper storage facilities. Low use of external inputs like fertilizers, pest control measures, and improved varieties increases costs. Lack of proper transportation infrastructure, storage facilities, and processing plants leads to significant post-harvest losses. Deficiencies in technical know-how among some growers regarding improved cultivation practices and a lack of substantial government subsidies	**Threats** Extreme weather events like heavy rainfall, hailstorms, and prolonged droughts that can significantly damage crops and disrupt harvest cycles. Emerging Diseases and Pests like citrus greening disease, increased attacks from insects Influx of cheaper mandarins from neighboring countries like India and China Disruptions in the market due to pandemics or political instability can affect sales and distribution. Marketing challenges include logistical issues, lack of information on marketing strategies, and reliance on contractual orchard systems, potentially lowering farmers' profits.

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For instance, in their review of various constraints affecting citrus production, Alvarez et al. (2016) argue that HLB menace has affected yields of citrus crops particularly in Florida, USA and this has called for increased use of integrated Pest Management and vector control. Likewise, such decline in productivity could also be overcome by such appended models of interventions in future integrated approaches best suited to contexts such as Nepal. The current study points the need for better management practices better than in the rain-fed irrigation, in properly fertilizing plants and in the lack of efficient disease control measures which play their part in the coming of poor yields.

SWOT analysis also enhance the understanding of business opportunities and threats of Nepal mandarin sector which reveals a dual nature of opportunities and threat. Although the country's favourable climatic factors and the market segment's inclined towards organically produced mandarins presents some strong thrusts, these are severely outweighed by threats. Division of production with every worker operating with limited resources is consistent with Shrestha (2015) observation that such fragmentation will increase costs because of inefficiencies. This is compounded by the post-harvest loses as a result of poor infrastructure which the current study has outlined as a major constraint. To mitigate these challenges, there is need for Nepal to encourage investment on infrastructure, especially the construction of cold storage and processing technologies that would help to preserve mandarins for a longer time so that losses through perishability could be reduced, while improving on profitability.

In terms of market access, the study reveals a paradoxical situation: Although, there has been a rise in the production of Mandarins at domestic level, the export figure of Nepalese Mandarin is still very disappointing. This is even more so on quality related factors because the fruits that are exported do not come to par with the that of the international market in as much as quality size and uniformity not to mention taste. Analyzing the examples of comparative research in citrus trade, including Spreen et al. (2020), one can identify the leading producers of mandarins, including Spain and China owing to more efficient control of quality and highly developed marketing techniques. If Nepal has to succeed, it needs not only to upgrade the quality of its mandarins but also to devise a proper export plan that must include the analysis of markets, creation of brand image and awareness, and use of IT tools to target potential buyers. This would mean that the government and private sector would have to address the need to harmonise production practices and accreditation procedures that are in parity with the international standards.

Moreover, there is so much prospect for increasing the exportation of mandarins to the neighboring countries that has not fully been exploited. According to the study, realization of this potential would require significance investments in infrastructure and in enhancing quality of service. But this must be done judiciously because the global citrus market is very intensively competed and entering this market does not hinge solely on the expansion of production. According to Ma et al. (2020), the major challenges of citrus exports include health restrictions and consistent supply chain to meet phytosanitary requirement, which are big challenges for Nepal at present.

Conclusion

With the growth of cultivating fields from various parts of the country, the area occupied and total output of mandarin in the nation are trending upward. Nepal is seeing a slight but steady increase in mandarin production, primarily due to a lack of scientific study and discourse. The growing production and consumption of mandarin in Nepal appears to be a desirable and feasible choice. Mandarin, an excellent source of vitamin C and other important elements, is an important fruit enhancing an individual's health. The major problem in mandarin production

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is the high investment required to establish orchard, quality of seedling materials, poor marketing and increasing incidence of diseases and pests. Therefore, to help mandarin producers, cultivation and management techniques of mandarin needs to be improved, and a production planning committee must be established so that they get sufficient, effective, and efficient in providing extension services. Despite some production constraints, mandarin stands a greater chance of becoming a commercially viable fruit crop. To increase the output of mandarin and draw more farmers to this area, new and better technology, tools, and equipment should be used to mechanize the mandarin subsector.

ORCID

Anmol Regmi https://orcid.org/0009-0001-9230-0435

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