

Citrus Industry Value Chain Development in Nepal

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Abstract

This study aims to identify the problems and opportunities for the citrus value chain development in Nepal, along with the possible areas for improvement. Citrus industry in Nepal contributes to 1.41 per cent of agricultural gross domestic production (AGDP), occupies 22.37 per cent of the total fruit production and 3 percent of the fruit export by volume. Mandarin, sweet orange and lime are the major citrus fruit that are produced in commercial scale. Despite attracting high priorities in the government policies and programs, the performance of citrus industry has not geared up to tap the opportunity of commercialization and export to its potentials. This happens at a time when the demand for citrus produce has increased rapidly in Nepal and globally and consumers' awareness of the health and nutritional benefits of citrus fruit is increasing. Moreover, Nepal and China have agreed to facilitate citrus export to huge Chinese markets. This study identifies and prioritises critical problems as well as opportunities for growth and development of citrus from whole of chain perspective. Inferior planting material (saplings), weak orchard management practices (scale of operation and agronomic), weak collaboration among actors and stakeholders, poor market and post-harvest infrastructure were found to be the main problems of the citrus value chains in Nepal. The surplus supply of citrus associated with the short production window without any post-harvest processing and cold chain maintenance have rendered Nepali citrus to become less profitable. Promoting orchards, regulation of nurseries, implementation of bud wood certification, market orientation of growers, development of post-harvest facilities, increasing functional collaboration among the actors and increasing the capacity of both public and private stakeholders regarding trade compliance are identified as potential areas for improvement from citrus value chains development perspectives. Based on the findings from the review, this paper proposes recommendations for policy, extension and management for the whole of chain development of citrus industry in Nepal.

Keywords: citrus, cold chain, commercialization, postharvest, value chain

Introduction

Citrus species constitute major fruit of Nepal, the second most important fruit crop grown in Nepal in terms of area and production (MoALD, 2022). Among different citrus species grown in Nepal, mandarin (*Citrus reticulata* Blanco), sweet orange (*Citrus sinensis* Osbeck) and acid lime (*Citrus aurantifolia* Swingle) are major and cultivated on a commercial scales (Acharya, 2021; Gauchan, 2003). The area under citrus fruit cultivation is 50,235 hectares, out of which only 32,188 hectares are productive, with the production of 3,11,188 metric tonnes (MoALD, 2022). Being the major fruit crop in mid hill, citrus fruit contribute more than 5 billion rupees to the economy of Nepal (D. Aryal et al., 2022). Among citrus species mandarin is the major fruit crop in the mid hills and also famous for its early maturity, taste and freshness in Nepal (Gauchan, 2003). Majority of citrus farming in Nepal is in hilly areas; however, lemon fruit are also grown in the southern plain part of Koshi province, Madhesh, Bagmati, Lumbini and Sudurpaschim Province. Koshi Province is the leading place in terms of total (12,387 hectares) as well as the productive area (8,571 hectares) under cultivation, while Gandaki province is leading in the per unit productivity (10.72 mt/ha) of citrus fruit (MoALD, 2022). Over the past decade, the area under citrus fruit has increased considerably, showing a preference among producers for this crop (MoALD, 2022).

Despite research and development institutions in place, favoured by a sectoral policy like Agriculture Perspective Plan (1995-2015), National Agriculture Policy (2004), 20 years Agriculture Development Strategy (2015-2035) and developmental projects and programs from both public and donor agencies, the performance of the citrus industry is

not satisfactory. The citrus industry in Nepal is characterized by low returns, smallholder farmer-dominated, short and fragmented value chain with low-value addition delivering the product of mixed quality to local markets (D. Aryal et al., 2022). The industry is still struggling to tap the opportunity for citrus commercialization to its fullest extent for promoting export and substituting import.

It is imperative that the nature and extent of the challenges or problems faced by Nepalese citrus industry be fully comprehended from whole of chain approach so that suitable interventions can be identified and developed for implementation by both public and private sector stakeholders. This paper therefore discusses the constraints in Citrus industry value chains in Nepal and recommends possible solutions based on desk review of literature on national and international studies, journal papers, newspapers and reports of concerned government offices, particularly being focused on Mandarin.

Methodology

The paper is based on desk review of literature on national and international studies, journal papers, newspapers and reports of concerned government offices. The data on area, production, productivity and price margins portray approximate figures that appear in formal reports of customs and other government portals. In some cases, information is also using data generated by commodity and trade associations and informal sectors as well. Available details were assembled, synthesized, triangulated and presented to meet the objective of study.

Result and discussion

Area, production and yield of citrus fruit in the last ten years

Figure 1 presents the area, production and productivity of citrus crops (mandarin, sweet orange, lime and lemon) in the last 10 years. The compound annual growth rate (CGAR) calculated from the data presented on the figure 1 shows an annual growth of 2.95% on area, 2.94% on productive area, 2.60% on production and -0.33% on productivity in the last decade.

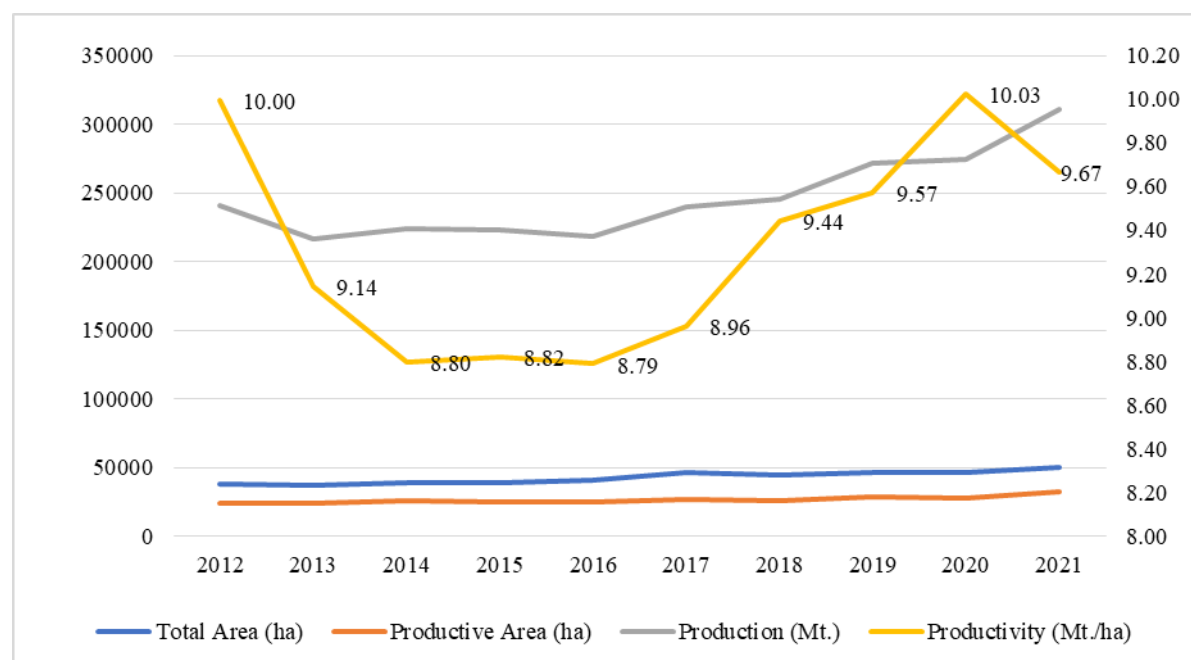


Figure 1. Area, productive area, production and productivity of citrus fruits in Nepal (MoALD, 2022)

The growth on area and production and yet negative growth of productivity illustrates limitations on the production process. Among different citrus species, Mandarin has the highest area and production followed by sweet orange, lime and lemon. The production distribution of different citrus species is presented in Figure 2.

In the next section, the problems identified by different researchers on the citrus industry in Nepal will be discussed.

Production scenario

Size of firms

Nepalese citrus producers are largely engaged in a subsistence production system, where orchards are established in less than 0.5 hectare with integration of cereals, vegetables, livestock and agro forestry (Acharya et al., 2011; Pokhrel, 2011; Sharma et al., 2021). Only a few

commercial farmers are growing tree fruit crops on a semi-commercial to commercial scale across Mid hill regions. The citrus orchards receive little attention for management and is not part of the dietary system but represent a minor source of cash income to manage household expenditures. Increase in fruit production generally occurs at the expense of cereal and livestock production, which requires more cash income from fruit to replace lost production. The small size of farms, therefore, makes production and marketing of fruit less economical.

Agronomic Practices

The problems regarding agronomic practices are similar among the different citrus species except the citrus decline and greening is less prominent in Acid lime (Gupta et al., 2017). The past research has pointed low quality of planting materials, poor irrigation, improper and insufficient fertilizer management, poor orchard management and inappropriate harvesting system as the major agronomic problems. The study reported by Poudel et al. (2022) states around 84% of Mandarin orchard in Myagdi district had seedling origin, whereas tree grown by vegetatively propagated materials were poor quality fruit. Use of seedling and poor quality vegetative propagated materials is one of the major reasons for high mortality of planted trees and low productivity. Since most of the citrus orchards are established in upland and marginal land, the problem of irrigation is also severe in most of the commercial pockets. A study conducted by Acharya et al. (2011) in Dailekh found around 50% of the farmers do not have irrigation facilities and around 30% of farmers have only seasonal irrigation. Irrigation problem has been ranked as the major constraint by farmers in different citrus production pockets (Acharya et al., 2011; Pokhrel, 2011). For fertilization, majority of the farmers are using compost manure as a major source. However, they are unknown about the requirement of the plant, time and technique of manure application. Further, majority of the farmers apply manure for the intercrop rather to the citrus tree crop (Acharya et al., 2011). These poor agronomic practices coupled with disease and pest incidence has resulted citrus decline, which is considered as one of the reasons for decreasing productivity despite of increase in area and production. Poudel et al. (2022) found more than two third mandarin growing farmers had experienced citrus decline problem in their orchards. It was also reported that disease and pest incidence, climatic extremities, poor fertility status of soil, low-quality planting materials and poor orchard management were positively influencing citrus decline where pest infestation would increase the chances of citrus decline by 52 percent as compared to insect non-infested conditions. In addition to these farmers have been following traditional harvesting systems which causes harm to fruit and tree. The harvesting process is further aggravated by the pre-harvest contract system where tree health is given no significant importance by traders. Often the fruit are harvested prior to physiological maturity to catch the higher market price and also harvested during in inappropriate time i.e. late or mid-day (Acharya et al., 2011).

Post harvest scenario

The production of Nepalese mandarin is highly seasonal (November to January) and emphasis is placed on trading the fruit quickly, before the post-harvest problems become apparent, rather than solving the problem before and at harvest. Post-harvest losses in citrus results from harvesting at an improper stage of maturity, improper methods of

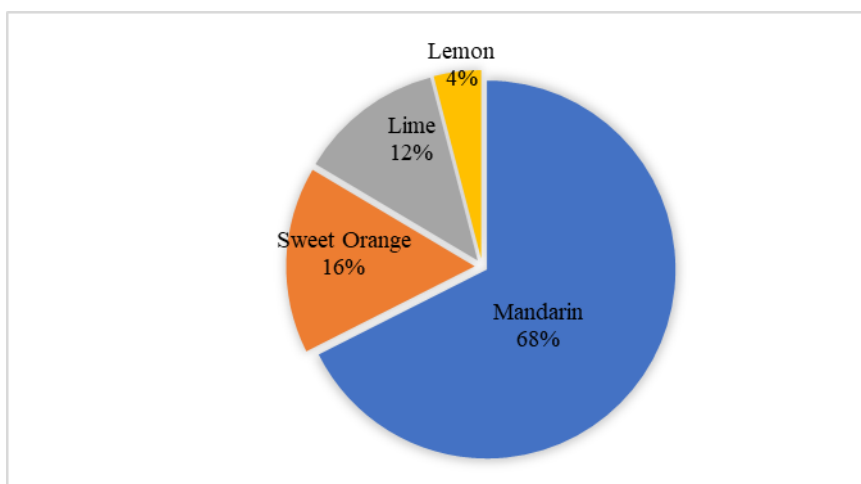


Figure 2. Production distribution of major citrus species in Nepal (MoALD, 2022)

harvesting, packaging, transportation and storage. Fruit is generally harvested by shaking trees or by hitting with a stick. The fruit consequently drop with the peduncle and leaves. The majority of loss occur during transportation to wholesale market and retail outlets (Adhikari & Aarati, 2021). Different studies have found 15%-46% post-harvest loss in citrus produced in Nepal. Bhattarai et al. (2013) reported 46% post-harvest loss in Mandarin produced in Dhankuta of which around 25% loss occurred during transportation. A total loss of 14%-18% was recorded in postharvest operations of Mandarin in Gandaki Province where lack of knowledge about post-harvest handling and high cost of technology adoption among farmers were found to be the major constraints of high post-harvest loss (Acharya et al., 2023).

Citrus trading systems

Majority of the farmers are following pre-harvest contracts for marketing of Mandarin (Acharya et al., 2023; Bastakoti, 2001; Gautam et al., 2020). The price for the fruit in the orchard is negotiated based on average number of fruit per tree. Farmers are attached to this system as they receive partial payment in advance and do not have to bear further production and market risk. From the review of different literatures in citrus value chain, the following trading systems could be documented to be prominently operated:

- i. *Producers- pre-harvest contractors- wholesalers-retailers- consumers*
- ii. *Producers-wholesalers- retailers- consumers*
- iii. *Producers- retailers- consumers*
- iv. *Producers- consumers.*

Generally, after harvesting, fruit are carried in bamboo baskets with a capacity of around 20-25 kg in local markets. Plastic crates (carrying approximately 20 kg) are used in transport of fruit to more distant markets. This process renders the fruit with physical damage while loading, carrying in and unloading. Acharya et al. (2011) reports the fruit are carried either in plastic crates or in bamboo baskets for local markets whereas for distant markets trucks or buses are used. There is no postharvest care practices (washing, waxing, sorting) of fruit and the trucks do not have any cooling system, rather fruit is exposed to the various environmental conditions (i.e. rain, dust, heat).

Each of the players in the supply chain is a small business owned and operated by a family. Some information on market pricing is kept by grower, in terms of raw data on prices and arrivals of fruit in selected markets only, but dissemination of this information is very poor. The first steps in the consolidation of retailing are seen in the emergence of a 'supermarket' format. Various supermarket retail chain with stores in cities like Bhat-bhateni, Big mart, Sales-berry, are the most well-developed example of this type. However, due to lack of consistency in supply window, quality and uncertainty on chemical residues, this chain does not generally buy domestically produced fruit.

Chain governance and relationship

Beside market governance, other forms of chain government have not developed in citrus industry in Nepal. Information sharing among the actors is very limited. The major source of market information for farmers is neighbours and telephone call for traders. Contractors were found to be the major players in the marketing of mandarin orange in Nepal. Farmers preference towards pre-harvest contract (forward sale) is common because it transform burden of marketing risk to the contractors as well as provides the money in time although it gives lowest share to the consumers rupee to the growers.

Profitability

The analysis of benefit cost ratio of mandarin production in different districts is seen to be profitable. Most of the profitability studies have shown benefit cost ratio to be between 2-4. Sharma et al. (2021) found benefit cost ratio of Mandarin in Syangja district to be 2.3. Similar studies by Karki (2018) in Kristi and Nirmalpokhari of Kaski found benefit cost ratio of 2.57 and 3.31 respectively. Similarly, the benefit cost ratio of Mandarin production in Gulmi and Parbat district were found to be 2.59 and 2.93 respectively (Gautam et al., 2020; Baral et al., 2021). The higher benefit cost ratio despite of the various problems in the upstream and downstream value chain, paves a path for improving the value chain performance and upgrading.

Export potential

Reduction of tariff or non-tariff barriers with a system designed to meet phytosanitary requirements, market intelligence on size and value of the prospective markets are the prime requirement for successful export market. Seasonal advantage, consistency and volume of supply and quality of fruit will be the key factors in maintaining presence in export markets. However, the ability of Nepalese value chain to deliver in such areas is limited. The market of the developed world demands a high level of quality control, e.g., quality assurance documentation, phytosanitary procedures, traceability and certification. The geography and transport infrastructure of Nepal shows potential export markets in India and China (Tibet), but this is yet to be developed. In contrary, large quantities of fruit from India and China are entering the Nepalese market with apparently little or no regulation while trade in the reverse direction is quite tightly regulated.

China is a major importer of citrus, with an increasing of import of 10.91% per annum and this is expected to increase by around 4.55 million tons by 2030 (Aryal et al., 2022). Similarly, the consumption pattern of citrus in India has also increased by around 77% in the last decade and the imports in Bangladesh have surged by around 160% between 2017 and 2020. In one hand India shares a significant portion of imports, whereas Bangladesh and Nepal are major importers for Indian citrus (FAO, 2023). These high demands of citrus in neighbouring countries shows high potentials for export of citrus fruit to China, India and Bangladesh. Figure 3 presents the consumers price of Mandarin in market of different countries in the year 2022. The status of the consumer's price shows that consumers price for Nepalese mandarin are higher than that of India and China (Tibet). Thus, Nepalese mandarin producers are required to increase competitiveness for export in India and China (Tibet).

To export to Bangladesh, exporters must submit a Certificate of Origin, a Weight Certificate and a Quarantine Certificate when crossing both the Indian and Bangladesh borders. A 35% custom duty and other taxes and fees, must also be paid (MoA, 2008). In total, a 58% increase in price due to such fees is expected. In contrast, fruits from Bhutan are subject to a custom duty of only 17.5%. Despite of the custom duty and other taxes, there is ample space for Nepalese Mandarin in Bangladesh market.

China and Nepal ratified an agreement in late 2019 that allows export of citrus from Nepal to Tibet on condition

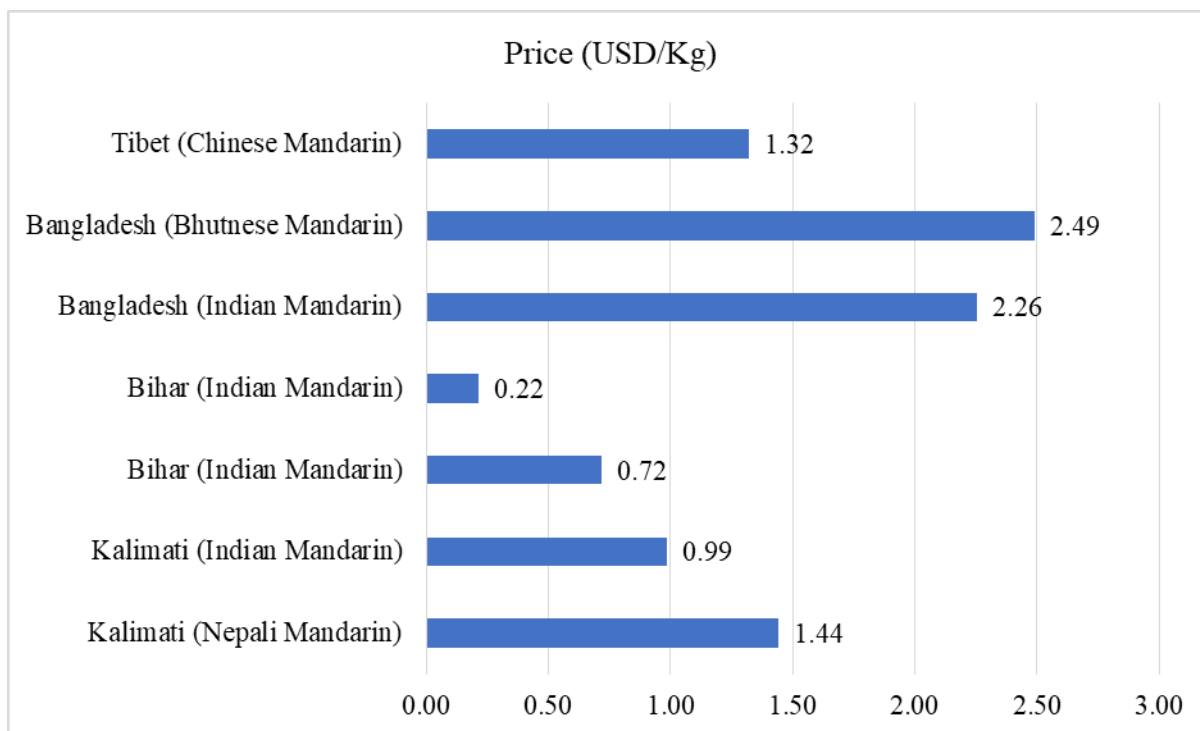


Figure 3. Consumer's price on Mandarin Orange in market centre of different countries

(Source: <https://kalimatimarket.gov.np/>, <https://chaldal.com/fresh-fruit>, <https://market.todaypricerates.com/Bihar-fruits-price>)

that phytosanitary measures are respected, especially in the context of the problem caused by fruit fly species and other diseases/pests. This agreement allows for the export of “pest-free product”, i.e., the product and not the production area must be free of designated pests, with the product to be from designated production areas and packhouses practicing control measures. The agreement is set to automatically extend in its current form unless the parties enter negotiations for alterations. The agreement, however, does not stipulate the disinfestation treatments to be used for elimination of the listed pests. Dipendra Aryal et al. (2022) suggests Nepalese stakeholders for further clarification on the disinfection treatment to be used for elimination of the listed pests. Reviewing the agreement of China-Mexico, Pakistan-China and Egypt-China (as these also includes the same fruit fly species as in Nepal-Tibet agreement) would also provide ideas for disinfection treatment to be used for elimination of the listed pests. As *Bactrocera dorsalis* also occur in China and are unable to establish in Tibet, the requirement for the product free status in Nepal-Tibet trade agreement could be discussed/questioned in future negotiations round.

Way Forward

The key to value chain promotion is identification of appropriate markets that offer a better ‘value proposition’, followed by focus on growing product to meet the needs of those target markets. With increased profit available, there is incentive for:

- consolidation of land parcels
- adoption of grower co-operative or contract growing arrangements
- Year-round grower control irrigation system
- adoption of new crop management and postharvest practices
- adoption new varieties (to extend the production window and to adjust to the market preference once studied)

The government and private sector should:

- provide market information, both domestic and export (prices and volume by month in key export markets)
- ensure timely support of export activities (e.g., phytosanitary inspections, market assessments)
- ensure that proven varieties are readily available for expansion of new area
- provide extension material and training to emergent value chains
- encourage extension self-sufficiency of established value chains
- study the market intelligence in potential markets of India, China and Bangladesh.

Marketing groups should make use of the altitude gradients available over relatively short distances in Nepal to arrange production of a given tree fruit crop over an extended window, augmented by cold storage. A national marketing activity should develop a ‘brand’ for Nepalese fruit in key export markets, as well in the developing Nepalese supermarkets.

Conclusion and Recommendations

The sustainability of Nepalese Citrus industry has been challenged by increasing imported products and rural hill land turned into barrel unproductive loss of rural labour. To commercialize tree fruit crop, appropriate markets with better value propositions should be identified and product should be grown to meet the needs of those markets. Profitability will incentivize throw land consolidation, co-operative or contract growing culture, farmer control irrigation facility and adoption of new varieties and practices. For improving the export potential, development of packhouses with management skills to support grower/marketing groups. Make sure pest management, documentation of production process, implementation of cold treatment procedures, development of appropriate transport options for fresh produces and study of willingness to pay and preference of customer should also be focused. Value chains should be developed to exploit market niches, with vertical integration to provide finance and advice to actors in the chain. The government bodies should lead to provide market information, support export activities, provide technical extension material and training and encourage external investment. Marketing groups should arrange production of a given crop over an extended window and develop a brand for Nepalese Citrus.

References

- Acharya, U., Ghimire, K., Timsina, K., & Subedi, G. (2011). Improving Citrus Production in Dailkeh District of Nepal. *Proceedings of the Horticulture for the future*, 18-21.
- Acharya, U. K. (2021). Research Activities and Achievement in Citrus FruitsFruit. Citrus Thematic Working Group Workshop, Kathmandu, Nepal.
- Acharya, Y., Upadhyaya, N., & Sapkota, S. (2023). Socioeconomic Assessment of Mandarin Postharvest Loss: A Case of Gandaki Province, Nepal. *Research on World Agricultural Economy*, 4(1), 1-9.
- Adhikari, B., & Aarati, G. (2021). Post-harvest practices of horticultural crops in Nepal: Issues and management. *Archives of Agriculture and Environmental Science*, 6(2), 227-233.
- Aryal, D., Subedi, P. P., Walsh, K. B., & Shivakoti, S. (2022). Potential for Citrus Exports from Nepal to Tibet. In J. Timilsine, T. N. Maraseni, D. Gauchan, J. Adhikari, & H. Ojha (Eds.), *Agriculture, Natural Resources and Food Security: Lessons from Nepal* (pp. 53-68). Springer. https://doi.org/doi.org/10.1007/978-3-031-09555-9_25
- Bastakoti, R. (2001). Production and marketing efficiency of mandarin orange in western mid-hills of Nepal. *Tribhuvan University, Nepal*.
- Bhattarai, R. R., Rijal, R. K., & Mishra, P. (2013). Post-harvest losses in mandarin orange: A case study of Dhankuta District, Nepal. *African Journal of Agricultural Research*, 8(9), 763-767.
- Gauchan, D. (2003). *Economics and sustainability of citrus farmers in Nepal: A case study of mid-hills* Proceedings of the third national horticultural research workshop,
- Gupta, K.N., V.K. Baranwal and Verma, R. (2017). Occurrence of Citrus Greening disease in Acid Lime [*Citrus aurantifolia* (Christm) Swingle] orchards in Pune (Maharashtra), *India.India.Int.J.Curr. Microbiol. App.Sci.* 6(9):3600-3603.[doi: https://doi.org/10.20546/ijcmas.2017.609.442](https://doi.org/10.20546/ijcmas.2017.609.442)
- Karki, A. (2018). Comparative Analysis of Production and Marketing of Mandarin Orange in Krishnachnechaur and Nirmalpokhari Villages of Kaski, Nepal. *Nepalese Horticulture*, 13(1), 52-58.
- MoALD. (2022). *Statistical INFORMATION ON NEPALESE AGRICULTURE 2020/21*. Government of Nepal, Ministry of Agriculture & Livestock Development, Kathmandu, Nepal
- Poudel, A., Sapkota, S., Pandey, N., Oli, D., & Regmi, R. (2022). Causes of citrus decline and its management practices adopted in Myagdi district, Nepal. *Heliyon*, 8(7), e09906. <https://doi.org/https://doi.org/10.1016/j.heliyon.2022.e09906>
- Sharma, A., Dhakal, A., Pandey, A., Adhikari, D., & Adhikari, A. (2021). Production and Marketing of Mandarin in Putalibazar Municipality of Syangja. *International Journal of Environment, Agriculture and Biotechnology*, 6(6), 296-301.
- Subedi, P., Walsh, K., Khatiwada B., Acharya, U. (2016). Prospects of developing commercial production of tree fruit in Nepal with focus on citrus production, pp 87-111. In Adhikari, A.P. and Dahal, G.P. (eds). *Sustainable Livelihood Systems in Nepal: Principles, practices and prospects*. IUCN and CFFN, Kathmandu, Nepal. ISBN: 978-9937-8467-2-1.