



International Journal of Agriculture Innovation, Technology and Globalisation

ISSN online: 2516-1970 - ISSN print: 2516-1962
<https://www.inderscience.com/ijaitg>

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DOI: [10.1504/IJAITG.2024.10067064](https://doi.org/10.1504/IJAITG.2024.10067064)

Article History:

Received:	16 January 2023
Last revised:	17 January 2023
Accepted:	09 March 2023
Published online:	11 October 2024

The mango value chain in Haiti: constraints and opportunities of a promising industry

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Abstract: Mango plays a vital role in Haiti, ranking as the second-largest export crop. However, despite a staggering number of mango varieties cultivated in the country, only the Francique variety is suitable for export, primarily to the USA. This paper, driven by desk research and using the value chain approach and an adjusted Porter's diamond model, offers a comprehensive review of the Haitian mango value chain, aiming to pinpoint constraints and opportunities for optimising gains, minimising losses, and bolstering competitiveness in this promising but highly vulnerable industry. Challenges include the scarcity of commercial orchards, tensions among stakeholders, limited coordination along the chain, and inadequate access to credit for producers. Furthermore, marketing remains dependent on traditional modes of transportation, such as donkeys and human-powered transportation, causing important rates of damage and rejection. Recommendations for upgrading the value chain are proposed, along with suggested actions for government agencies and other relevant organisations.

Keywords: mango industry; upgrading; Haiti; value chain; porter's diamond model.

Reference to this paper should be made as follows: Brunache, M. (2024) 'The mango value chain in Haiti: constraints and opportunities of a promising industry', *Int. J. Agriculture Innovation, Technology and Globalisation*, Vol. 4, No. 1, pp.37–62.

Biographical notes: Magdalee Brunache completed her Bachelor's in Agribusiness at National Chung Hsing University, during which this research was conducted. Afterwards, she pursued a Master's in Rural Development at Ghent University as an Erasmus Scholarship Recipient. In 2023, she started a PhD in Political Science at the University of Toronto. As an aspiring researcher, her interests encompass gender and development, intersectionality, social anthropology, sustainable food systems, conflict and multi-stakeholder processes, migration studies, qualitative social research, development studies, and narrative analysis.

1 Introduction

Mango stands out as one of the most globally consumed tropical fruits. Whether enjoyed fresh or processed into various forms such as nectar, canned slices, puree, and pickles,

mango holds a prominent place in the culinary world. Beyond its delectable flavour, mangoes offer numerous health benefits, serving as an excellent source of essential nutrients and vitamins. Scientific literature suggests that a diet enriched with mango may potentially reduce the risk of chronic diseases (Ribeiro and Schieber, 2010). Notably, Mangiferin, a key compound found in mango leaves, is recognised for its antioxidant properties and pro-hypoglycemic effects (Okwu and Ezenagu, 2008; Swaroop et al., 2018). Mango originated from the Indian subcontinent. It was later grown throughout Southeast Asia before reaching the Americas and the Caribbean Islands. Currently, mango production spans more than 90 countries, and the market for this tropical fruit is continually expanding (Hippolyte et al., 2013). In 2018, mango was the most cultivated tropical fruit with a production volume exceeding half of the total global major tropical fruit production (Altendorf, 2019; Sulistyawati, 2020). In 2021, India led the world in mango production, contributing over 40% of the total output, followed by other significant producers such as China, Indonesia, Pakistan, Mexico, and Brazil.

Developing countries play a major role as major mango producers globally, while mango production in developed countries, except for the US, is fairly limited. In many Global South countries, mango cultivation aligns with development policies, focusing on both exporting and enhancing food security. Extensive planting areas serve as a valuable resource, particularly for substantial international market sales in terms of exported volumes (MARNDP, 2012). In Haiti, mango holds significance as a widely consumed fruit, contributing significantly to the country's economy and playing a vital role in ensuring food security in rural areas (MARNDP, 2012). With an estimated 10 million mango trees, primarily intercropped with other tropical fruits like avocado and papaya, Haiti's agro-ecological conditions, especially in the southern and south-eastern departments (Vayssières, 2013), are well-suited for mango cultivation. In this country, the fruit is typically cultivated at elevations below 1,000 metres, with optimal yields achieved at altitudes around 400 meters above sea level (Castañeda et al., 2011). This adaptability makes mango a resilient and well-suited crop across various regions of Haiti, with the potential for increased suitability in some areas due to climate change-induced higher temperatures (Eitzinger et al., 2013). Furthermore, beyond its economic and dietary contributions, mango cultivation significantly aids in soil preservation throughout the Haitian countryside (Hippolyte et al., 2013).

Mango is one of Haiti's most important export crops, with 12,113 metric tons exported in 2021 (USITC, 2022) and the country is a prominent mango exporter in the Caribbean and Central America (Vayssières, 2013). Mango exports generate an estimated \$10 million in revenue for the Haitian economy each year (Hippolyte et al., 2013). Baptiste, Corne, Doudouche, Fil, Jean-Marie, Muscat, Blanc, and Francique are the most common commercial mango types in Haiti (Castañeda et al., 2011, MARNDP, 2012). Francique is the only variety suitable for export to the US because it can withstand hot water treatment to prevent fruit fly contamination (Castañeda et al., 2011). This variety, which is endemic to Haiti, commands premium prices in the US.

In the late twentieth century, Haiti was one of the biggest mango producers in the Americas meeting a significant part of the demand in the US (Vayssières, 2013). However, due to the embargo imposed on Haiti by the US after the 1991 coup d'état, mango exports came to a complete halt, providing an opportunity for competitor countries like Peru and Brazil to gain traction (Jayaram, 2018). This three-year embargo had lasting negative impacts on the Haitian mango industry (Jayaram, 2018). Moreover, the fast-growing demand for mangoes in the US, the limited capability of Haitian mango

production, and the high rejection rates along the supply chain prevent mango exports from reaching their full potential in bringing home foreign currency and improving farmers' income in Haiti.

After the 2010 earthquake and the influx of foreign aid, mango exports were positioned as a crucial instrument for restructuring Haiti's economy (Jayaram, 2018). Consequently, substantial initiatives, supported internationally, emerged in various regions of the country (Jayaram, 2018). Numerous projects aimed at enhancing specific facets of the supply chain have been implemented (Edmondson, 2016; TechnoServe, 2014), resulting in mixed outcomes (USITC, 2022).

The main question remains how to develop a paradigm that benefits all parties in the mango supply chain while also boosting Haiti's global competitiveness in this industry. To achieve the aim of lowering losses and increasing the competitiveness of the Haitian mango sector, it is critical to develop a thorough understanding of the value chain. The purpose of this research is to examine mango production and marketing in Haiti, identify constraints and opportunities, highlight major players in the value chain, and provide recommendations to improve the sector's prospects.

1.1 The value chain approach

A value chain approach is a whole-market point of view with an emphasis on sustainability and poverty reduction. It takes account of the competitiveness and power dynamics involved in all parts of the chain. It also considers the competitiveness and power dynamics at play throughout the chain, from consumers to producers (Walters, 2002). This approach is increasingly promoted in agroindustry in many developing countries as improving smallholders' and marginalised groups' access to markets and leading them toward innovation and commercialisation have become major strategies in recent rural development projects (Fischer et al., 2020; Webber and Labaste, 2009).

Gereffi and Korzeniewicz (1994) specified four dimensions of Global Commodity Chains (a previous paradigm on value chains): input-output structure, territory covered, governance structures, and institutional framework. The emphasis on the importance of quality management by later scholars highlighted the concept of governance. Governance embraces the concepts of chain membership, leadership, power asymmetry, and rule enforcement (Marketlinks, n.d.a; Coulibaly et al., 2010). Three types of governance have been identified: legislative governance (setting input standards, purchasing prices, and mandatory delivery conditions), judicial governance (monitoring the farmers' activity and distribution techniques), and executive governance (sending different forms of assistance) (Khoi and Van-Dung, 2014).

Value chain methods have been applied to study different commodities including dairy (Khoi and Van-Dung, 2014; Minh Huy, 2009), cashew (Bassett et al., 2018), mango (Arlinloye et al., 2017; Roy and Rahman, 2022). Methods used have included quantitative approach-cost and benefit analysis, value chain mapping, and statistical analysis.

1.2 Upgrading value chains

Scholars have stressed that value chain approaches can favour technological adoption and increase participants' bargaining power and income level by helping to develop responses that are based on a market system perspective and a better understanding of relationship

dynamics within the value chain (Bolwig et al., 2013; Seville et al., 2011). To McCormick and Schmitz (2001), value chain approaches can help increase the income and bargaining power of less powerful actors in the chain by providing a better understanding of the mechanisms of market access, acquisition of production skills, and profit redistribution. Therefore, it facilitates the identification of leverage points for action and assistance. However, for producers in developing countries to be able to meet domestic and global demand and increase their competitiveness, upgrading is essential.

Upgrading refers to any adjustment or innovation toward improving productivity and raising products to international standards and food safety measures (Bolwig et al., 2013). There are different forms of upgrading, such as intra-chain or functional upgrading, product upgrading, process upgrading, and inter-chain upgrading; each comes with its own set of advantages and disadvantages (Mitchell et al., 2009; Ponte and Gibbon, 2005). Upgrading may facilitate processes and increase the competitiveness of less powerful groups, thus raising their incomes. For instance, improved infrastructure reduces the risk of post-harvest losses so that farmers can deliver higher quality products and obtain a better price from wholesalers or exporters. In Haiti, an NGO-led initiative raised farmers' earning price for mangoes by 32% on average by providing training and agricultural extension services to farmers (Edmondson, 2016). However, a hostile institutional context, unfavourable market structure and orientation, harmful regulations, exclusive value chain structure, lack of agricultural extensions, and poor infrastructure can cause development models to fail to reach their goals (Kilelu et al., 2017; Trienekens, 2011).

Mitchell et al. (2009) provide a set of seven distinct types of strategies to improve the rural poor's position in value chains which include

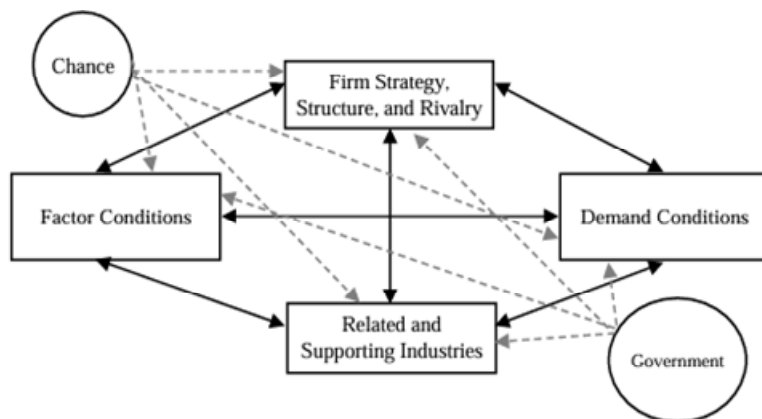
- 1 horizontal coordination through the creation of collective structures such as producers' groups
- 2 vertical coordination through longer-term contractual commitments as in contract farming
- 3 functional upgrading, for instance, when producers start to engage in processing activities
- 4 process upgrading through increasing value chain efficiency
- 5 product upgrading by raising the quality of the products
- 6 inter-chain upgrading, which may imply moving from traditional commodity production to high-quality exports
- 7 finally, upgrading of the enabling environment through enhancements to the infrastructure, services, institutional, legal, and policy frameworks.

Multi-stakeholder processes can improve horizontal and vertical coordination as well as create the conditions for an inclusive value chain, although they may have mixed effects on product and process upgrading (Kilelu et al., 2017). Roy and Rahman (2022), in their assessment of the mango value chain in Bangladesh, recommended partnerships between the government and private companies to improve the institutional dimensions of the chain and guarantee the sector's pro-poor and inclusive growth. Nonetheless, beyond an uncritical focus on incorporating farmers in global markets and streamlining the commodity chain, it is also important to consider social and cultural factors within

mango-producing areas, potentially disruptive consequences of upgrading projects, gender dynamics, and inequalities within global economic systems (Jayaram, 2018).

In short, making value chains more equitable through upgrading requires that the focus does not reside solely on market involvement. Rather, the terms of actors' participation in these chains more than their mere access to them should be carefully analysed. Indeed, power dynamics in the chain governance that marginalise or exclude certain actors may signify that upgrading, although improving the quality of the products, fails to bring any significant gains for the rural poor (Bassett et al., 2018).

Figure 1 Porter's diamond model (see online version for colours)



Source: Tsiligiris (2018, p.4)

1.3 Porter's diamond model

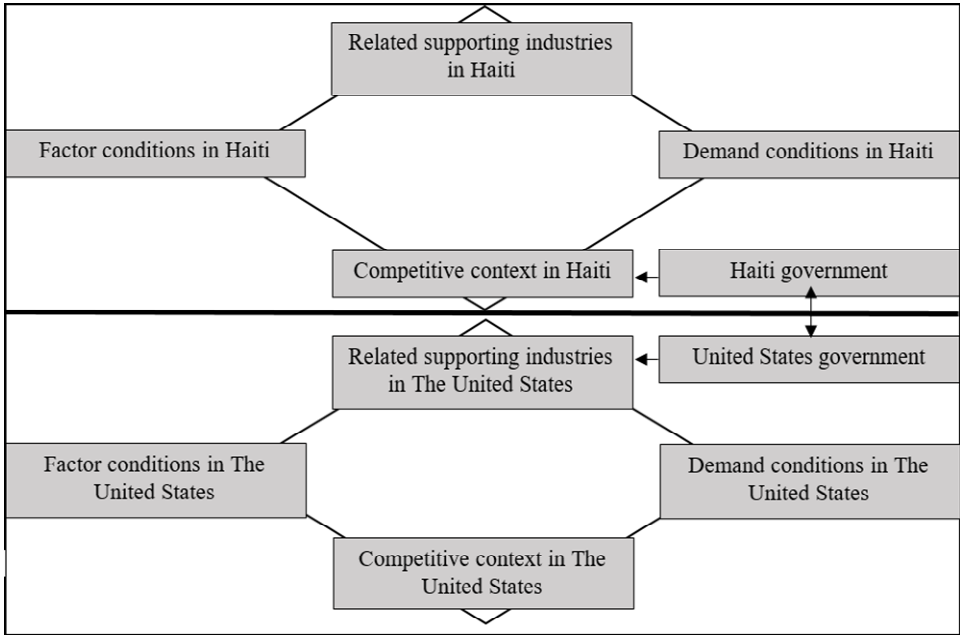
After the devastation caused by the 2010 earthquake in Haiti, there has been a push for the country to 'build back better', and mango has been identified as a key competitive advantage to boost the country's economy (Jayaram, 2018). A useful tool to reflect on the potentiality of the sector is Porter's diamond model. The latter highlights components that are decisive for a country's international competitiveness, centring domestic firms as the unit of analysis. It holds that the success of a firm in international markets depends on its ability to harness relevant elements in the home country's diamond (Porter, 1991). Four determinants unique to each country and two exogenous factors – chance and government – form the basis of Porter's model (Figure 1). These factors include factor conditions, encompassing natural resources, infrastructure, and the labour force within a country; demand conditions, which involve the characteristics of the domestic market and consumer sophistication; related and supporting industries, assessing the global competitiveness of suppliers and related sectors; and firm strategy, structure, and rivalry, focusing on the circumstances guiding the establishment, management, and organisation of businesses, along with internal competition among existing firms in the country (Porter, 1990; Rugman and D'Cruz, 1993). This model has since been applied in several studies (e.g., Cho and Hong, 1998; Porter, 1991).

Chance and government are the two external influences. The government has a significant impact on a country's competitive advantage, employing measures such as

tariffs and subsidies to impact both foreign and domestic enterprises, which may be more or less effective in assuring both short-term and long-term competitive advantages (Rugman and Verbeke, 1987). External shocks such as wars or crises are included in the model's concept of chance.

The diamond of competitive advantage is shaped by the interactions between these four factors and the two external influences; the character and quality of these interactions determine a nation's ability to compete internationally (Porter, 1990; Rugman and D'Cruz, 1993). In turn, the country's diamond influences the competitive landscape for local businesses, either facilitating or hindering the development of favourable competitive conditions (Rugman and D'Cruz, 1993).

Figure 2 Adapted double diamond model



Source: The author

While acknowledging the utility of Porter's model in devising strategies to enhance a nation's foreign competitiveness, Rugman and D'Cruz (1993) assert that the single-diamond model has important flaws. A key critique is its inadequate representation of the international competitiveness of small, open-trade nations, particularly those heavily reliant on exports to neighbouring powerful countries. Cartwright (1991) proposes a 'double diamond' approach for such cases (Figure 2). Therefore, it is recommended, for example, that the diamond model for Caribbean countries be compared to that of the US (Rugman and D'Cruz, 1993). This is pertinent in the context of Haiti, given that most mango production is currently destined for the US. Furthermore, a high proportion of the investments in the Haitian mango industry originates from the US. Lastly, under the CBERA preference scheme, Haitian mangoes are duty-free in the US (USITC, 2022).

1.4 SWOT analysis and TOWS matrix

A SWOT analysis is used to assess an organisation's internal strengths and weaknesses, as well as external opportunities and threats. Internally, it entails examining an entity's resources, capabilities, distinguishing characteristics, and strategic edge. Resources include tangible factors such as technology, infrastructure, and human capital, and intangible ones such as reputation. The goal of this internal analysis is to identify the resources that can be harnessed strategically to enhance the competitiveness of the studied entity (Sammuto-Bonnici and Galea, 2015).

Externally, the analysis aims to identify significant trends and their potential future impacts by examining elements within the broader environment. These trends can be either positive or negative, as the SWOT analysis considers both threats and opportunities. The external environment comprises the competitor, industry, and general environment (Sammuto-Bonnici and Galea, 2015). Therefore, it is crucial to initially evaluate the strengths and weaknesses of competitors, followed by an assessment of patterns and power dynamics within the industry and the position of the studied entity in this larger context. Lastly, the general environment encompasses all relevant aspects, including political, economic, socio-cultural, technological, legal, environmental, and more (Sammuto-Bonnici and Galea, 2015). Opportunities may arise from developments such as increased consumer demand, new commercial opportunities, upcoming favourable legislation, technological advancements, and so on, while threats could stem from natural disasters, political changes, heightened competitive advantage of a competitor, and so forth.

The TOWS matrix, derived from the SWOT analysis, suggests strategic approaches to seize opportunities or mitigate threats by leveraging existing strengths and mitigating weaknesses (Sammuto-Bonnici and Galea, 2015). It categorises strategies into four types. The WO strategy emphasises capitalising on external opportunities while addressing internal weaknesses. The SO strategy seeks to optimise both strengths and opportunities, positioning the organisation favourably in the competitive landscape. The ST strategy employs internal strengths to tackle external threats. In contrast, the WT strategy becomes crucial for entities facing a critical situation, necessitating the minimisation of both weaknesses and threats (Sammuto-Bonnici and Galea, 2015).

2 Methodology

Secondary data was gathered from publicly available sources such as the Ministry of Agriculture, Natural Resources and Rural Development (MARNDP), the Food and Agriculture Organization, published and unpublished sources, as well as district agricultural and natural resource offices¹. The value chain approach was utilised in the study as a descriptive-analytical technique. This method was used to map out the complete value chain of the fruit, highlighting the numerous people involved, their interactions, and their respective duties along the way. In addition, additional desk research was undertaken to obtain insights into the industry, identify major limits and opportunities, and develop suggestions to address the identified challenges. Lastly, an adjusted version of Porter's diamond model was included for a more in-depth understanding of the industry and to devise more effective strategies.

3 Results

3.1 *The Haitian mango industry*

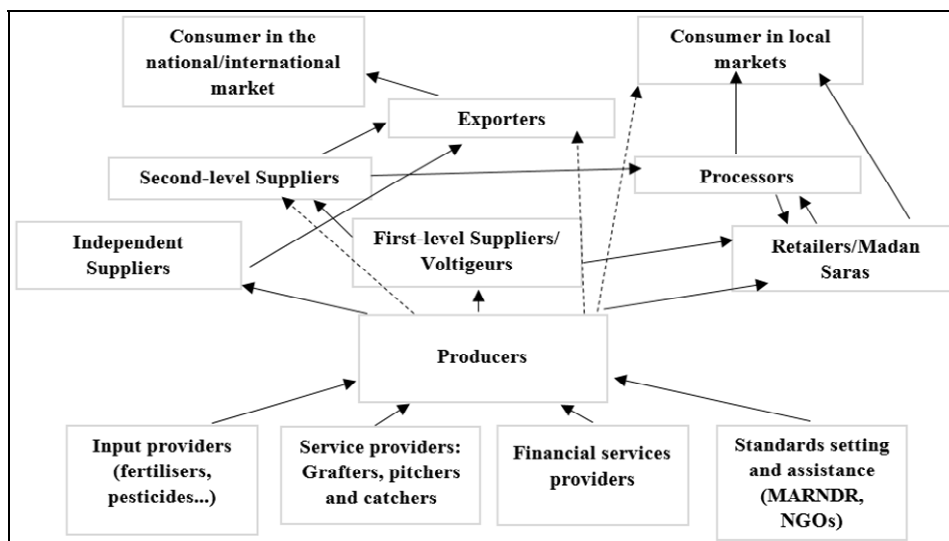
Hippolyte et al. (2013) identified ten main actors in the Haitian mango value chain, including producers, first-level suppliers, independent suppliers, second-level suppliers, local retailers, Madan Saras, exporters, rural retailers, and consumers, as well as Port-au-Prince retailers and consumers. In Southern Haiti, Castañeda et al. (2011) outlined actors such as agricultural input providers, mango farmers, middlemen, smallholders' associations, Madan Saras (female traders), exporters, and service providers. In that region, according to (Castañeda et al., 2011), there are three different distribution channels for mangoes. The first, which is the most detrimental for smallholder farmers, consists of non-associated producers dealing with middlemen who serve as linkages for selling the selected fruits to exporters in the capital city, Port-au-Prince. Alternatively, in the second circuit, exporters purchase the mangoes directly from the producers. Lastly, a more recent and innovative circuit, characterised by minimal rates of rejection along the chain, involves the private company JMB SA, which purchases from mango producer associations in diverse regions in the country, primarily for exports to the US. Mangoes rejected for export are sold to the Organization for the Rehabilitation of the Environment (ORE) to be processed in their drying facility in Camp-Perrin (Castañeda et al., 2011). The first two circuits are common in most other mango-producing regions. Additionally, Hippolyte et al. (2013) highlight that in addition to the export channel, a local distribution circuit is also significant within the country. Figure 3 illustrates the Haitian mango value chain and the most important stakeholders involved.

Agricultural input suppliers are largely concentrated in Port-au-Prince and Haiti's southern areas (Castañeda et al., 2011). Pesticides, fertilisers, seeds, tools, and grafted plants are among the agricultural inputs sold. Some also provide grants and loans to farmers. They are non-specialised, which means they do not focus on mango specifically. They also do not manufacture. Pesticides are brought into the country from the Dominican Republic, Venezuela, and China (Castañeda et al., 2011). The government frequently subsidises fertiliser imports (Castañeda et al., 2011).

Grafters, pitchers, and catchers are examples of labour service providers (Castañeda et al., 2011). Financial service providers in Haiti are categorised into three main groups: commercial banks, credit unions (cooperatives), and non-cooperative microfinance institutions (MFIs) (Castañeda et al., 2011). In Southern Haiti, prominent financial services providers include Caisse Populaire – CAPOSAC and FONKOZE. The first one is located in Camp-Perrin (Les Cayes) and provides four credit options: consumption, commercial, construction, and agriculture (Castañeda et al., 2011). Non-financial service providers are organisations and cooperatives such as the ORE and Agronomes and Vétérinaires Sans Frontières (AVSF) along with the Ministère de l'Agriculture des Ressources Naturelles et du Développement Rural (MARNDR). The latter is the Ministry of Agriculture, which provides guidelines for controlling fruit flies and supervises post-harvest treatment and quarantine facilities (Castañeda et al., 2011). This institution also provides modest subsidies, training, and other sorts of assistance to farmers. Therefore, the MARNDR is partly responsible for the legislative, judicial, and executive governance in the mango value chain. However, given the MARNDR's limitations, other

powerful parties such as NGOs and exporters are formidable contenders for chain governance.

Figure 3 Structure of the Haitian mango industry



Source: The author

Producers are the basis of the mango value chain. According to MARNDR (2012), there are 500,000 mango producers in the country. 150,000 of them grow the Francique variety. Large producers possess over 30 mango trees, middle producers have 20 to 30 mango trees, and small producers own less than 20 mango trees. Castañeda et al. (2011) identified three different types of producers in the mango chain in southern Haiti. The first type owns mango plantations with surfaces ranging from 2 to 10 ha. These producers are more informed regarding good agricultural practices and have adopted technologies such as planting distance, pruning, and other growing methods. They often also engage in exports and have higher incomes. The second type is small-scale producers with less than two ha who use very little technology access to pesticides and fertilisers. The last group has even less than two ha and close to no agricultural inputs.

Hippolyte et al. (2013) noted that there are significant producers known as 'grand do not who own more than 100 trees. However, typically, as per USITC (2022), households in Haiti maintain three to six semi-cultivated mango trees. These trees develop organically, with no intentional planting and minimal use of inputs such as insecticides and fertilisers. Active tree management techniques, such as pruning, are also sparingly applied. Despite these practices, only a minority of Haitian mangoes are certified as organic. Due to the precarious nature of their livelihoods, mango growers tend to be risk-averse, opting for a low-input, low-output approach that still allows them to generate limited additional income, often directed towards their children's education (USITC, 2022).

During the first harvest season, growers sell their mangoes in units of lots to first-level suppliers, independent suppliers, and sometimes Madan Saras. In September, long before harvest season, first-level suppliers, commonly known as *voltigeurs* may

pre-purchase mango trees from growers. Growers are under constant financial pressure and liquidity constraints, particularly before the mango harvest season, either to afford their children's education or to put food on the table (Lerebours, 2010). They also lack adequate transportation to reach markets or distribute to exporters on their own. Therefore, they are bullied by first-level suppliers into accepting low prices, often half of what they would get by selling on markets or to exporters. At harvest time, all mangoes on a tree are picked, at various levels of maturity, but smallholders are only paid for mangoes in suitable conditions, meaning undamaged and not overripe (USITC, 2022). The relations between farmers and *voltigeurs* are described as strained and highly asymmetrical (Castañeda et al., 2011) as the latter often serve as the bridge between the farmers and exporters. Farmers often benefit less from the mango industry, with exporters earning the highest revenue (USITC, 2022).

Smallholder farmers are particularly vulnerable due to their lack of understanding of how quality issues affect prices and their diminished bargaining power (TechnoServe, 2014). This vulnerability stems mostly from limited access to alternative financial choices, insufficient marketing outlets, poor trading connections, and a lack of transparency within the domestic value chain (TechnoServe, 2014). As a result, they tend to receive a minimal share of a mango's value (USITC, 2022). Cooperatives and farmers associations, when they exist, provide some relief to farmers, by buying mango harvests directly from them at higher prices (Castañeda et al., 2011). Farmers are recommended not to sell outside the association to which they are affiliated.

First-level suppliers are among the main stakeholders in the export distribution channel. They are in direct contact with farmers and carry out a thorough selection of mangoes for export after harvest (Hippolyte et al., 2013). Later, they transport the selected mangoes from the farms to collection centres where they are picked up by second-level suppliers. First-level suppliers participate in the harvesting process, accompanying and providing directives to the farmers as well as to the catcher and pitcher. They discard low-quality mangoes into the domestic market (Hippolyte et al., 2013).

Voltigeurs offer modest cash advances to farmers throughout the year and may approach farmers at any time, mandating the harvest of mango trees, even if the fruits are not fully mature. The rejected mangoes, categorised as second-class, find their way into the domestic market, where regulatory standards are not strictly enforced. The mango selection process by *voltigeurs* contributes to an approximate loss of 50% of the potential harvest. This is partly attributed to the absence of a robust processing industry in the country (Castañeda et al., 2011).

Independent suppliers' roles are somehow similar to those of first-level suppliers. However, they constitute a link between producers and exporters instead of second-level suppliers (Hippolyte et al., 2013). They have a more nomadic lifestyle. They receive cash from exporters, which they spend by moving from farm to farm to rent mango trees from growers. According to Hippolyte et al. (2013), a ferocious rivalry often exists between second-level suppliers, Madan Saras, and independent suppliers.

Mango marketing is the area of expertise for second-level suppliers, which are typically farmers' groups, cooperatives, and their closely associated partners. Their activity involves purchasing mangoes from first-level suppliers for export (Hippolyte et al., 2013). Gatherers, *voltigeurs*, first-level suppliers, and producers are among the groups for whom they provide training. They concentrate on teaching picking, pruning, storing, and packing processes. These second-level suppliers, who prioritise

professionalism and quality as mandated by the MARNDR, are essential to supplying factories and exporters with high-quality products (Hippolyte et al., 2013; MARNDR, 2012). Relationship tensions develop between first-level suppliers and second-level suppliers since the latter frequently reject inferior goods to avoid possible rejection by factories and exporters. To overcome this difficulty, some second-level suppliers setup their own teams for harvesting (Hippolyte et al., 2013). Despite major financial difficulties, second-level suppliers also frequently attempt to reach farmers directly to provide farmers with better prices and training.

Exporters usually purchase from second-level suppliers, though some exporters prefer to deal directly with producers (Hippolyte et al., 2013). There are ten major mango exporters in Haiti, mostly located in the outskirts of Port-au-Prince (Tabarre, Cité Soleil, Croix des Bouquets) and only one in the region in Artibonite (Pont Sondé), all grouped in the National Association of Mango Exporters (ANEM) (Castañeda et al., 2011). The latter distributes and collects USDA fees for inspection. Exporters take responsibility for various aspects of the mango export process, including transportation, storage, packaging, grading, and the final step of placing the mangoes into crates for export, as outlined by MARNDR (2012).

The demand for processed mango products is growing; nevertheless, despite huge mango losses and high rejection rates, mango processing is severely inadequate across the country (Hippolyte et al., 2013). Mango processing is a recent focus in Haiti, with individuals, businesses, and non-governmental organisations (NGOs) launching initiatives to add value to mangoes and prevent waste. Mangoes are mostly dried or transformed into jellies, jams, candied fruits, cr  mas, and liqueur (Carvil et al., 2010). Delicious Fruit, Famosa, ORE, and the ‘Sisters of the Incarnation’ are examples of companies and organisations involved in mango processing (Hippolyte et al., 2013).

A processing plant in Mirebalais, funded by the US Agency for International Development (USAID), has a drying capacity of 6,000 lbs of dried fruit per quarter (Hippolyte et al., 2013). Furthermore, JMB recently opened an Individually Quick Frozen (IQF) facility, which makes it possible to turn rejected mangoes into frozen pulp, cubes, and halves (Jean et al., 2011).

Madan Saras serve a crucial role in Haiti’s local mango distribution network, acting as retailers specialising in the sale of mangoes that fall short of international market standards (Hippolyte et al., 2013). They source these mangoes directly from producers or from first-level suppliers and subsequently resell them to small retailers. The latter, in turn, target consumers in towns, villages, and the capital city (Hippolyte et al., 2013). Madan Saras have simply been described by Hippolyte et al (2013, p. 26) as a group ‘who have cash’ and ‘possess considerable bargaining power’. Nonetheless, their challenges with neglected transportation infrastructure, limited access to formal credit and assistance, poor security, and the gender-specific violence they encounter have been emphasised elsewhere in the literature (Hosseini, 2015).

Operating without storage facilities, street retailers opt for small quantities and prioritise quick sales, resulting in relatively low selling prices (MARND, 2012). While some supermarkets in Haiti do offer mangoes, these may be less accessible to lower-income individuals (MARND, 2012). Middle and high-income consumers tend to purchase mangoes from supermarkets, enticed by the generally superior quality compared to mangoes sold on the streets (Hippolyte et al., 2013).

3.2 *Porter's analysis*

3.2.1 *Factor conditions*

The factors required in the production process are referred to as factor conditions in Porter's (1990) diamond model. These encompass infrastructure, knowledge resources, and human resources. They can also be characterised as resource, capital, technology, and labour.

3.2.1.1 *Number of trees and orchards*

Mango production in Haiti totals 400,000 metric tons for a total estimated population of 4.5 million trees and the yield average of an adult mango tree is around 100 kg/plant/year (Carvil et al., 2010). In 2020, Haiti's mango production amounted to 238,000 metric tons (USITC, 2022). Mango is produced in numerous parts of the country. However, the production of Francique mangoes happens mainly in Artibonite (Gros-Morne), the West (Léogâne, the Plaine de Cul de Sac, Arcahaie and Cabaret), the Central Plateau, Northeast and Belladère (Central Department) and to a lesser extent in the South and the Southeast (Hippolyte et al., 2013; Castañeda et al., 2011; MARNDR, 2012). There is a lack of commercial orchards throughout the country (Hippolyte et al., 2013). Usually, mango trees are typically intercropped with other fruit and food crops. Mango trees can rarely be found in mono-specific orchards in Haiti. According to Carvil et al. (2010), there are only around twenty mango orchards in production in the country. Moreover, most of the trees are less than ten years old (Hippolyte et al., 2013). Land insecurity may explain why enterprise owners are reluctant to invest in implementing mango orchards (MARND, 2012; Castañeda et al., 2011). Nonetheless, in recent times, several commercial orchards, including a 200-hectare orchard in Artibonite and others near the capital city, have emerged, primarily targeting export markets and selling minimally to local urban markets (USITC, 2022).

3.2.1.2 *Suitable microclimates*

The mango season in Haiti is from mid-March to the end of August, with a major harvest between April and July. During this period, most regions are in full-swing harvest and the fruit is found in markets across the country (Hippolyte et al., 2013). Table 1 shows the harvest season of the key production areas of the Francique mango variety, which thanks to the diversity of the ecosystems throughout the country, can nearly be cultivated the whole year (Damais and Bellande, 2004).

3.2.1.3 *Techniques and infrastructure for harvest and post-harvest*

According to Hippolyte et al. (2013), the most common methods of mango harvesting include hand-picking and the use of picking poles. In the earlier, a pitcher climbs on top of the tree and drops the fruit to a catcher waiting under the tree. In other areas, the lack of cutting blades on the picking pole favours latex burn. This issue could be solved by immediately washing the fruit. However, the closest water sources may be more than 15 minutes away. Handpicking, in turn, often leads to bruising, reducing the quality and attractiveness of the fruit. Mangoes destined for home consumption and local markets are generally picked either by specialised techniques such as using a fruit picker or more

traditionally by shaking the fruit-bearing branches to make the fruit fall (Doreus, 2012). In contrast, those fruits that are intended for export and city markets, which require the involvement of intermediaries are harvested by a specialised team using a sacked pole to protect the fruit (Doreus, 2012).

Figure 4 Harvest seasons in Haiti's key production locations for the Francique variety

Production area	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Leogane												
Plaine du Cul-de-Sac												
Arcahaie and Cabaret												
Artibonite												
Central Plateau												
Gros-Morne and Port-de-Paix												
South and Southeast												

Source: Adapted from Damais and Bellande (2004)

Mangoes are transported to packhouses by donkeys and pickup trucks after harvesting for cleaning and packaging before shipping (USITC, 2022). Straw bags made of weaving are used to carry mangos from fields to gathering places or packing sheds (Hippolyte et al., 2013). Poor road quality contributes to fruit damage during transportation, with an estimated 50% of the crop becoming non-exportable as a result (USITC, 2022). Mangoes are sorted, hot water treated and packaged for shipping in the packhouse. It has been reported that there are approximately ten packhouses certified annually by the USDA's Animal and Plant Health Inspection Service. These few packhouses have insufficient capacity to handle export volumes during peak harvest periods (USITC, 2022). For the local market, human-powered transportation is common with mangos transported on people's heads in sacks or baskets to rural markets, and trucks are used to deliver to markets in the capital city (Hippolyte et al., 2013). Refrigeration is seldom employed during transportation, and the lack of reliable energy poses challenges for packhouses, causing disruptions in the cold chain. All this, in turn, adversely affects mango freshness and quality, resulting in fruit rejection (USITC, 2022). Rejected mangoes are often lost due to a scarcity of processing facilities in the country. Losses and rejections are significant across the value chain, reaching above 60% (Daynac, 1986; Medlicott, 2001). According to ORE (2002), mango losses owing to immaturity and inappropriate handling during field harvest might exceed 30%.

Transportation is a significant constraint in the Haitian mango industry, and it worsens during harvest season when the number of available transport vehicles is insufficient to carry all of the picked mangoes (MARNDP, 2012). Trucks are the most common means of transportation used to reach factories and exporters. Mango losses are substantial due to a scarcity of vehicles and the negligence of public transporters,

significantly lowering growers' income. Bad road conditions, sunburn, delays, and distance cause further damage. Mangoes are not always transported in crates due to budget constraints. Damages caused by unsafe transportation may result in rejections of more than 30% in mountainous areas (Hippolyte et al., 2013). The lack of appropriate roads creates an enormous challenge for smallholders, preventing mangoes from being transported to more profitable local metropolitan or international markets (USITC, 2022).

3.2.1.4 Investment in the sector and producers' capital

Barriers to entry such as facilities and funds for investment characterise the extremely promising processing industry. Small-scale producers have little access to credit and thus, struggle to produce high-quality fruits and can hardly engage in value-adding activity (Castañeda et al., 2011). About 60% of their income is allocated to feeding their families or investing in their farm production. Therefore, they obtain low returns from the production process (Castañeda et al., 2011). Lack of access to credit is keeping them from upgrading and moving vertically in the value chain (Castañeda et al., 2011). Farmers are mostly excluded from formal financial institutions, so they either rely on moneylenders and pay high-interest rates, or succumb to the financial pressures of middlemen, which puts them at a significant disadvantage (Castañeda et al., 2011).

NGOs provide resources by investing in the processing industry or developing local projects to improve production and support smallholders. In 2010, TechnoServe launched Haiti Hope, a five-year, \$9.5 million credit program in Haiti. This initiative, resulting from a public-private partnership involving the Coca-Cola Company, the Multilateral Investment Fund (MIF) of the Inter-American Development Bank Group (IDB), and the U.S. Agency for International Development (USAID), aimed at fostering sustainable development. The program, implemented by TechnoServe, included the introduction of a loan program in 2011 (Castañeda et al., 2011). Another noteworthy initiative, the Mouvement Moun Mango (3M) program, focused on producing Fair Trade Certified™ mangoes to allow smallholders to obtain a premium price. Additionally, JMB S. A., in collaboration with CHF International and USAID, established post-harvest and storage centres in Cameau and Saut d'Eau. This partnership also involved training farmers on post-harvest practices to reduce losses and enhance farmers' income (Castañeda et al., 2011).

3.2.1.5 Quality of the human capital

Mangoes are grown by an estimated 500,000 people in the country, with 150,000 cultivating the Francique type. During the mango harvest season, an estimated 500,000 jobs are created in the sector. The lack of skills and knowledge is a commonly acknowledged limitation in the centre, ranging from poor knowledge of crop management techniques by producers, and rudimentary skills and harvest and post-harvest good practices demonstrated by both producers and other actors in the field such as pickers, transporters and suppliers which result in important rates of rejection. It is also worth noting that rising demand for the Francique mango could lead to greater pressure to rely on child labour (Jayaram, 2018) in a context where enforcing mandatory schooling remains illusory.

3.2.2 Demand conditions

3.2.2.1 At the international level

Import rates of mango have increased in recent years due to the increasing diversification of ethnicity in developed countries along with the increased availability of the fruit at more affordable prices (Evans, 2008; Jedele et al., 2003; Norvilus and Jean-Baptiste, 2008). The mango importing countries are in order of importance: The USA, Holland, the UK, the UAE, and Germany. From 2007 to 2011, the proportion of mango consumers in the USA rose from 67 to 78% (Hippolyte et al., 2013). As one of the biggest importers, the US purchases mangoes mainly from Latin and Central American countries such as Mexico, Brazil, and Peru. Haiti, once the second-largest exporter of mangoes to the US, fell to the sixth position in the 1980s due to a rapid increase in demand and limited improvements in Haitian mango production (Raphael, 2009). Today, only 20% of mangoes produced in Haiti can meet international market requirements (Hippolyte et al., 2013). It is estimated that Haitian mangoes constitute 2.2% of all US mango imports (USITC, 2022).

Although fresh mangoes are the most imported in the US, there is undoubtedly, a market for mango byproducts (USITC, 2022). Main purchases include preserved mangoes, and frozen, mashed, or dried mangoes (MARNDR, 2012). Foreign consumers are increasingly demanding high-quality products. This implies that certification requirements have become barriers to entry for growers and exporters to these markets. The USDA regularly updates and publishes the grades and standards for mangoes, which represents a first step towards a more severe control of mangoes entering the US market. This codification/standardisation process risk requires the actors involved in the Haitian mango value chain to incorporate quality control and processes following international standards. It is worth noting that USDA control incurs a relatively high cost to mango exporters in Haiti (MARNDR, 2012).

3.2.2.2 At the domestic level

The domestic market for mangoes in Haiti has developed and become more diverse since approximately the end of the last century. MARNDR (2012) reports a 60% increase in the domestic consumption of mangoes since the 1970s. Nonetheless, the supply is still falling short of meeting the national demand. Notably, as a result of rapid urban population expansion, new consumer habits have emerged, including an increase in the consumption of juices and portions of cut fruit (MARNDR, 2012).

3.2.3 Related supporting industries

3.2.3.1 Innovation and research

The level of innovation and research activities in the sector will influence its long-term viability. The Haitian mango sector confronts significant constraints, which new research could help to alleviate. In 2007, exports of Haitian mangoes to the US were temporarily prohibited due to contamination by fruit flies (Vayssières, 2013). The latter constitutes a serious threat to mango production and must be eradicated without deterring consumers' confidence in the fruit's quality. Therefore, biological control has been held to represent a more sustainable way to tackle this issue. Sharma et al. (2009) highlighted that, among

various strategies, the use of microbial antagonists appears to be one of the most promising methods for controlling post-harvest diseases in fruits and vegetables. Focusing specifically on the Haitian mango sector Mertilus et al. (2017) report that low-cost artisanal traps can be effectively used for mass fruit fly catching in Haiti. Apart from the threat represented by fruit flies, inadequate cold chains are another important cause of losses in the mango sector. Cost-effective and innovative solutions are also needed in this area. Such research is necessary and should be encouraged by the government.

3.2.3.2 Other institutions involved in the sector

In Haiti, institutions from both the governmental and commercial sectors play a role in the mango industry, engaging in various aspects such as production, commercialisation, quality control, and institutional and organisational strengthening (MARNDNR, 2012). Projects are primarily focused on marketing, quality improvement, and production. The collaboration between NGOs and producer associations aims to increase the volume of exports and enhance producers' income (MARNDNR, 2012). International actors such as the MIF or the USAID invest importantly in the sector. Additionally, as a partner of the Mouvement Moun Mango, the Whole Trade Guarantee of US-based grocer Whole Foods Market acquired certified organic and Fair Trade mangoes from Haiti to support the Haitian economy (Castañeda et al., 2011).

3.2.4 Competitive context

Haiti exports between 10,000 and 15,000 metric tons of fresh mangoes to five countries: the US, the Dominican Republic, the Turks and Caicos Islands, the Bahamas, and Canada (Hippolyte et al., 2013; Norvilus and Jean-Baptiste, 2008; Raphael, 2009). The US buys over 75% of Haiti's total mango exports (Hippolyte et al., 2013). However, although Haiti is still ranking fairly well in global markets, it faces harsh competition from other countries in the region (MARNDNR, 2012). Being less common than the plethora of red mangoes available in supermarkets, the Francique mango has its niche in US markets, mainly on the East Coast, allowing it to yield higher prices. However, its production cannot yet reach demand, this variety remains unknown in the inner parts of the US and the high prices may be a deterrent for some consumers (USITC, 2022).

3.2.5 Government and chance

As part of the business-enabling environment, the Haitian government, through the Ministry of Agriculture (MARNDNR) facilitates producers' efforts to meet quality standards by collaborating with NGOs to implement grafting, training, and best tree maintenance practices (Carvil et al., 2010). After the US banned imports of mango from Haiti due to serious infestation by fruit flies in 2007, the MARNDNR, in conjunction with USDA and ANEM, established a program that accentuated the release of parasitoid wasps to control the flies. Nonetheless, there is a lack of governmental investment in the processing industry.

Table 1 SWOT analysis

<i>Strengths</i>	<i>Weaknesses</i>
• Low or no use of chemicals (largely meet requirements for organic certification) • Suitable climate (diversity of microclimates, alternating rainfall regime, almost year-round harvesting...) • Higher temperatures may benefit mango production • A wide range of varieties of mangoes that are yet to be valued in processing and export • Resilience to climate change • Increased investments in the processing industry • New value chain management techniques are being introduced (e.g. KBST1) • The provision of training to producers by NGOs • Important investments made in the sector in recent years	• Lack of inputs • Lack of access to credit for the actors • Lack of technical knowledge on orchard production (pruning, GAP...) • Lack of fertilizers, herbicides, and pesticides to control the weeds and pests • Limited understanding of advanced harvesting procedures and the usage of rudimentary harvesting methods for mango fruits • Lack of appropriate knowledge of post-harvest management and processing equipment • Lack of market structure • High transportation cost • Inadequate storage facilities, a poor market structure, and poor road conditions • Production areas not yet covered by the fruit fly program • Aging of the plantations • Very weakly structured associations and cooperatives struggle to carry out their projects in the long term. • Rising operating costs of factories • No reference system
<i>Opportunities</i>	<i>Threats</i>
• Growing interest in mango production and export • Growing international demand for healthy, exotic, natural, and quality products • The leadership of supporting institutions • Proximity to the USA and Canada • The variety (Francique) appreciated in the US is endemic to Haiti • Under the CBERA preference scheme, Haitian mangoes are duty-free in the US	• Fruit fly infestation in mango areas • Deforestation and charcoal production • Political turmoil that affects the state's public works projects • Rising quality standards in international markets • Competition from other countries for international markets • Rising gang violence

Source: The author

The US Government has a lot of influence over the Haitian mango industry. The USAID funds projects for the improvement of the sector. As the main importer of Haitian mangoes, the US has immense power and can completely disrupt the sector by stopping imports as was done by the USDA in 2007 or during the US embargo on Haiti in 1991

(Jayaram, 2018). This vulnerability highlights the necessity for Haiti to formalise and improve its trading relationships with other countries, notably within Latin America and the Caribbean (MARNDP, 2012).

Table 2 TOWS matrix

<i>S/O strategies</i>	<i>W/O strategies</i>
• Inter-chain upgrading: Engage in the production of high-quality, certified products for niche segments in international markets • Market diversification (the reliance on a low-volume, unique variety of mango for exports to the United States is a key limiting factor for Haiti that can be addressed by investing in improving existing varieties to meet international standards and enhancing processing capabilities to move beyond the export of low value-added fresh mangoes)	• Support the involvement of producers in processing activities through the provision of credit and training • A partnership between the MARNDP and other organisations to define a joint plan to streamline post-harvest management • Provide training to make producers aware of consumer demands at the national and international level • Upgrading the enabling environment through building roads and other relevant infrastructures
<i>S/T strategies</i>	<i>W/T strategies</i>
• More investment is needed to avoid losses and boost marketing of the Francique variety, which is the only one that can withstand the hot water treatment required to combat fruit fly. • Through training, introduce producers to techniques used to control fruit flies in other mango-producing regions in the world	• Horizontal upgrading: bring farmers together into producers' groups where they can pool knowledge and resources • Broaden the reach of the fruit fly program

Source: The author

The sector has faced several external shocks over the decades ranging from the 1991 embargo, and the 2010 earthquake to the recent rise in gang violence in the country. Following President Moïse's assassination in 2021, there was a marked increase in gang-related confrontations and territory disputes, resulting in the displacement of nearly 19,000 people in the capital (USITC, 2022). The USITC (2022) further reports that due to these security concerns, mango exports from the northern regions have significantly declined as Haitian packing facilities are virtually unreachable given the gang-controlled checkpoints setup around the capital city. The increase in gang violence in Haiti, particularly in Gonaïves, has severely affected the once-thriving mango sector (Rivers, 2023). Gang-controlled routes have become inaccessible, with checkpoints staffed by young and armed gang members, resulting in the abandonment of thousands of mangoes in fields. Due to the security crisis, markets critical to the distribution network have closed. Kidnappings of people involved in the sector, such as the Madan Sara, have become prevalent, leaving victims with terrible experiences of physical and sexual abuse, economic repercussions, and long-term trauma (Rivers, 2023). While gender-based violence has always been a major concern for Madan Saras (Hosseini, 2015), the situation has deteriorated dramatically in recent years, with the Haitian government powerless to stop the spread of gang rule throughout the country.

4 Discussion and recommendations

The Porter's diamond as well as the SWOT analyses revealed several weaknesses and constraints in the mango value chain. The main challenges facing the Haitian mango industry at the production level include the lack of commercial mango orchards in the country and the low Francique mango tree density per farmer. This difficulty proves arduous to address given the high fragmentation of land tenure and elevated land prices that hinder farmers from expanding their farm size (Castañeda et al., 2011). Additionally, despite the highly suitable climates in the country, there is an insufficient level of technical support provided to growers for managing their plots according to local conditions. This challenge is linked to the absence of agricultural extensions and resources specific to the sector. Another production hurdle arises from the ineffective crop management techniques employed by farmers, the high incidence of pests and diseases compounded by inadequate pest management, and subpar harvest and handling procedures. At the harvesting level, rudimentary practices significantly impact mango quality and appearance, and poor post-harvest management skills and infrastructure are major issues, particularly affecting non-associated farmers. Furthermore, transportation is a primary concern along with the unavailability of markets for mango byproducts which could help cut down waste (Castañeda et al., 2011).

On the demand side, increased consumer sophistication presents both new potential and additional obstacles for the sector, with enhanced quality criteria and standards, sanitary norms and USDA supervision, and growing appeal for producers to obtain international certifications. Haiti is also struggling to meet demand both internally and globally, and current prospects for generating and commercialising mango byproducts have yet to be capitalised on. Intense competition from other mango-producing nations puts Haiti at a disadvantage due to its low production volume. Additionally, the country's reliance on a single variety, which is comparatively more expensive than offerings from other countries, further hampers its competitiveness. Thus, the need for research-driven solutions to foster market diversification and reduce losses through improved pest and disease control and post-harvest techniques to boost export volume is established.

Achieving this goal requires a greater commitment from the government, particularly the Ministry of Agriculture, to invest more resources in the sector. Despite ongoing efforts by MARNDR to assist producers, limitations such as insufficient resources hinder the expansion of critical programs, including the fruit fly initiative. Additionally, the lack of government investment is evident in the processing industry. Haiti's heavy dependence on the US for both investments and access to crucial import markets is a notable concern. Lastly, the multifaceted challenge of gang violence has significantly impacted the mango sector in recent years.

Despite these limitations, the SWOT and TOWS analysis (Tables 1 and 2) highlight the existence of resources and opportunities that can be harnessed for the benefit of the sector and put forward important areas to focus upgrading actions. Upgrading the Haitian Mango industry implies enhancing competitiveness at all links of the value chain. Such a process could help the industry to reach its full potential, benefiting the national economy in the process. Governance should thoroughly understand the economic interests, social structure as well as competition, and strategy in the chain to render their actions truly effective. This paper has provided insights into those factors. Some recommendations will be provided below to upgrade the industry.

Haiti is a small country, which constitutes a weakness compared to the extensive land areas of its competitors such as Brazil or Mexico. It is increasingly difficult for the country to meet internal and external demand. To increase its share of the markets, Haiti needs to increase its production and keep rejection rates low. The number of commercial mango orchards on the Haitian territory is insufficient. The Haitian government needs to improve the land registration system, ensuring secure property rights to prospective investors. Moreover, the Ministry of Agriculture must provide incentives to growers to increase the number of trees that they own and to specialise more in mango production. Examples of incentives can be government loans, subsidies of agricultural inputs, or an increased number of agricultural extensions to support mango growers.

Existing agricultural extensions can favour the transfer of technological knowledge to encourage the adoption of more efficient methods and practices. Post-harvest loss reduction strategies are a key point on which farmers need training. Numerous scholars have provided recommendations for good mango post-harvest management. The main strategies include harvesting mangoes after morning dew had evaporated, applying vapour heat treatment to the fruits to kill insect eggs, and reducing latex burn by using harvest aids with cutter blades. Early morning or late night transportation also help to reduce losses caused by sunburn. Moreover, according to Sharma et al. (2009), using microbial antagonists to reduce post-harvest diseases in fruits and vegetables produces beneficial outcomes. Lastly, the government should invest in the improvement of roads and post-harvest facilities.

Furthermore, the sector needs standardisation to assure product safety, quality, and a more reliable market structure. The asymmetry of information prevailing in the industry must be addressed. Discussion forums can allow better distribution of information and transform relationships between actors. The empowerment of actors and more precisely small-scale producers through training and credit access is the key to both vertical and horizontal integration. The lack of market structure is a key constraint for the mango industry. For example, farmers sell their products in lots, for which a specific weight or quantity of mango has not been specified (Castañeda et al., 2011). Apart from the USDA control, which is strictly enforced, there are no regulations or standards prevailing in the industry. Quality standards should be enforced in the whole chain to ensure safety and to reach a high-end product that can satisfy all consumers. The attitude of *voltigeurs* who harvest fruits before they are ripe should not be tolerated. The Ministry of Agriculture should provide guidelines on good cultivation practices, sanitary conditions of processing facilities, and price floors for raw materials to protect producers. Almost all the stakeholder groups have created associations to defend their interests. These associations could also design good practices, ethical norms, and training platforms to improve professionalism at their link in the chain. Traceability should be enhanced in the sector. New technology could bring us there. AgriLedger, a Haitian start-up, is working with SourceTrace and its local Haitian partner, Ecole Supérieure d'Infotronique d'Hati (ESIH), to develop a new blockchain/DLT solution that could increase traceability in the Haitian mango value chain (Leveille, 2021).

Each of the stakeholder groups can influence the competitiveness of the Haitian mango value chain or be affected by it. Thus, they must work to reach a clear and consensual strategic vision to move the industry forward in the long term. To facilitate the process, the MARDNR and other associations should hold regular forums where all the actors can be represented and useful information can be shared on new quality standards and the price and process of USDA inspection. Moreover, it is crucial to

empower smallholders who often bear the brunt of challenges. Addressing the issue of illiteracy is paramount, and efforts should focus on utilising visual materials in Haitian Creole to ensure effective communication and understanding.

NGOs, along with associations and cooperatives, can play a crucial role in initiating loan projects and working in tandem with MARNDR authorities to enhance technical and support services. They are also suitable to provide training to producers and suppliers in effective harvesting and post-harvesting techniques. Additionally, these organisations may conduct workshops for small-scale producers, focusing on affordable mango processing and offering financial literacy education. Moreover, they can assist growers in the organic certification application process. One significant way in which they may offer support, as observed in some cases, is by bringing growers together into producer groups and acting as intermediaries between growers and exporters.

Indeed, a possible scenario for empowering producers is the creation of local groups of small-scale farmers and entrepreneurs who are provided training and access to credit. This is an example of horizontal integration. As part of the Haiti Hope project mentioned earlier, the establishment of producer business groups (PBGs) by farmers was encouraged. The main goals were to create a direct line of communication between farmers and exporters and to enable the former to be trained in critical business skills, production metrics, and suitable harvesting methods (TechnoServe, 2014). Similar strategies may be considered with proper concern for gendered and local dynamics. Jayaram (2018) indicates that the expansion of monetised relationships in the production of Francique mango as an exportable commodity translated into greater economic power for adult men, particularly those in possession of more land and able to afford paid labour. Although, within the Haiti Hope project, there have been conscious efforts to ensure that access to training expanded to both men and women (TechnoServe, 2014), gender stereotypes might still constitute a hindrance for women to engage in wage work in the sector. Indeed, Jayaram (2018) suggests that, regardless of formal skills, women may be considered too weak to be involved in mango harvesting. This underscores the importance of implementing targeted programs to combat gender stereotypes and encourage the inclusion of women in all stages of mango production and processing.

Moreover, market diversification is one of the greatest opportunities for the Haitian mango industry to yield greater benefits to the country. Mango can be transformed into jams and cr  mas (a low-cost traditional Haitian beverage). If encouraged, even the poorest producers could engage in this activity. Barriers to entry for transforming mango into other products may be overcome by providing credits, workshops, and new marketing outlets to those who wish to engage in this promising business. This could be the chance for a vertical integration for growers and more importantly, female farmers who could see their revenues increase significantly. Existing companies should receive greater support from the government, which has not been much involved in the processing industry up until now.

Lastly, Haiti must also seek markets beyond North America. Europe may be a possibility following the ratification of the ACP. Haiti currently exports six varieties of mangoes to the Dominican Republic and one to the Cayman and Turkish islands (MARNDP, 2012) but this is done through unofficial channels. It is necessary to systematise these trade connections and promote them to domestic actors (MARNDP, 2012). Haiti's belonging to the Caribbean Community (CARICOM) is an opportunity that should not be ignored (MARNDP, 2012).

5 Conclusions

Numerous constraints are keeping the Haitian mango industry from reaching its full potential. Lack of inputs, the problem of access to credit for the actors, lack of technical knowledge on orchard production (pruning, GAP, ...), Limited understanding of advanced harvesting procedures and the usage of rudimentary harvesting methods for mango fruits, and lack of market structure are among the main weaknesses of the industry.

A thorough understanding of the mango value chain governance and the power dynamics involved are necessary to implement solutions that are sustainable and can alleviate poverty. As demand for exotic fruits both fresh and processed is growing in the international markets and evidence that high temperatures induced by climate change will likely benefit mango production in the country, a vast array of opportunities is opening up to the Haitian mango industry.

Governments, social organisations, and other stakeholders (producers, suppliers, exporters) should collaborate to design a national project to upgrade this promising industry. This will require identifying who in the chain are price makers and understanding the complex interactions throughout the value chain, such as the rivalry between second-level suppliers and Madan Saras, and the bullying of farmers by voltigeurs. Minimising rejection rates while increasing mango production, standardisation, social dialog, empowerment of actors and market diversification are recommendations laid out in this paper. Focusing on leverage points like post-harvest loss reduction is essential. More research is needed to investigate the specific roles and gender related issues faced by women, particularly Madan Saras, along the value chain. Investigations should also dive into the on-the-ground consequences of NGO programs in the major mango production regions within the country, as well as the recent disruptions caused by gang violence in the industry. Finally, it would be beneficial to broaden the scope of this research by doing a quantitative assessment of the mango industry's international competitiveness using the proposed updated Porter's diamond model.

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Note

- 1 This paper builds on research conducted as part of a bachelor's project at National Chung Hsing University.

Abbreviations

ANEM	National Association of Mango Exporters
AVSF	Agronomes and Vétérinaires Sans Frontières
CAPOSAC	Caisse Populaire
CBERA	Caribbean Basin Economic Recovery Act
CHF	Cooperative Housing Foundation
FAO	Food and Agriculture Organization
FONKOZE	Fondasyon Kole Zepòl
IDB	Inter-American Development Bank
MARNDR	Ministère de l'Agriculture des Ressources Naturelles et du Développement Rural
MIF	Multilateral Investment Fund
ORE	Organization for the Rehabilitation of the Environment
USAID	US Agency for International Development
USDA	US Department of Agriculture
USITC	US International Trade Commission
3M	Mouvman Moun Mango
