

Full Length Research Paper

S.W.O.T. diagnosis of the production system of dried mango slices produced in the North of the Côte d'Ivoire

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The study aimed to characterize the production system of dried mango slices in Côte d'Ivoire. The objective was to assess the production environment of dried mango slices sold on the national and international markets. To do this, a non-participant observation and a semi-directive interview were carried out using an observation grid (description of the different production operations) and an interview guide (13 people interviewed). The aim was to identify the strengths, weaknesses, opportunities and threats of the dried mango slices production system through a SWOT analysis. The diagnosis revealed several strengths, notably the proximity of the production unit to its customers and the very good reputation of the production unit. In addition, the analysis of the external environment showed opportunities (non-competitive local market, packaging and sale of by-products, availability and accessibility of fresh mangoes, etc.). On the other hand, problems of management, capacity building on production and good manufacturing practices have been identified. In addition, the lack of standards to ensure the quality of the finished product and the lack of bank financing were identified as threats to the existence of this activity. The proposed efficient corrective actions will make it possible to further guarantee the hygienic and marketable quality of dried mango slices produced in Côte d'Ivoire.

Key words: SWOT diagnosis, dried mango slices, production system, market, Côte d'Ivoire.

INTRODUCTION

Mango (*Mangifera indica* L.) is a tropical fruit, characterized by seasonal production. It ranks fifth in the world in fruit production after citrus, grapes, bananas and apples (Paull and Duarte, 2011; FAO, 2020). This leadership would be linked to its productivity, to the technical support of producers (mineral fertilization, phytosanitary warning system with control of diseases

and pests) (Vannière et al., 2004; CICT, 2021) and to its preponderance in the food habits in the form of desert fruit or derived products (Malik and Singh, 2006; Labaky, 2021). Nutritionally, regular consumption of mangoes is an excellent source of vitamin C (ascorbic acid), dietary fiber, phenolic compounds, minerals (calcium, potassium, phosphorus, and iron), and bioactive compounds

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(provitamin A carotenoids) (Guiamba, 2016; Maldonado-Celis et al., 2019). Thus, the literature reports that mango consumption may be associated with better nutrient intakes and diet quality (O'Neil et al., 2013; Tharanathan et al., 2006; Maldonado-Celis et al., 2019).

In Côte d'Ivoire, several varieties of mango are commercially produced and its preferred area is the northern part of the country. With 20,000 ha, mango production is estimated at 150,000 tons and the Kent variety mango represents more than 95% of national export production and is the most dominant (FIRCA, 2021). This production is carried out by small producers (about 7,000) and its trade contributes 4% to the national GDP and 10% to the agricultural GDP (FIRCA, 2021). However, according to Pugnet (2018), huge post-harvest losses are observed given the production differential between exports (33,000 tons) and production (150,000 tons). Non-exported mangoes therefore remain a major concern for producers because the local market can only absorb 14,000 tons. The lack of adequate management during storage and the highly perishable nature of mangoes, irreversibly lead to the problem of post-harvest losses (Mitrannavar, 2014; Sab et al., 2017). To this end, the work of Theodosy et al. (2011) and Sab et al. (2017) indicated that 34-40% of post-harvest losses of fruits were observed in developing countries due to lack of knowledge on post-harvest technologies, lack of storage facilities, and lack of guidance for post-harvest techniques.

To combat post-harvest losses of mango, the processing of fresh mangoes appears to be a viable alternative that can not only ensure its post-harvest conservation but also constitute an additional source of income for producers (CBI, 2019). In Côte d'Ivoire, mango processing, mainly into dried slices, is still a recent activity (2% of national production) (Konan, 2020) and cooperative societies are the main actors. This production of dried mangoes, whose unit price (100 g) is 1,000 CFA francs, does not yet benefit from labels to ensure its marketable and hygienic quality (CBI, 2021). Thus, this lack of quality certification could be a limiting factor for the sustainable development of these cooperative processing companies. Hence the importance of setting up a SWOT diagnosis in order to identify the internal and external factors that can influence the marketable quality of the slices produced (hygienic, sensory and nutritional). Indeed, this diagnosis, once implemented, would allow to make an inventory of a given situation (company, project) in order to be able to draw the lessons which are necessary and to take the efficient decisions for a sustainable development (Figaro, 2022). Thus, in the current context of strong competition, the use of this tool (SWOT) in the dairy industry has promoted the search for factors of formation, preservation and improvement of its competitiveness by allowing it to have a head start on its rivals (Mehadi and Kezzar,

2021). Thus, the objective of this article was to characterize the dried mango slices production system through a SWOT diagnosis in the largest cooperative society in northern Côte d'Ivoire.

MATERIALS AND METHODS

Methods and tools for data collection

Documentary research

The documentary research consisted in consulting documents related to the theme of post-harvest conservation, the requirements related to the production of dried mango slices, the implementation of good manufacturing practices (GMP) and the techniques of packaging of finished products (palletization; packaging, etc.). Thus, the mastery of these notions allowed for a better understanding of the phenomena observed in the field. Other primary data such as the statutes of the cooperative society, production activity reports, fair trade standards, and the list of members of the cooperative were studied. This included consideration of key elements of the production chain and applicable regulatory or trade requirements that have been appropriately monitored.

Non-participatory observation

The non-participatory approach (Hiroko et al., 2019) made it possible to characterize the value chain and particularly the dried mango slices production chain, without the intervention of the investigator. Thus, the observable elements of each production activity were recorded in a previously established observation grid. These raw data, essentially qualitative, were organized according to the UNIDO approach (ONUDI/UEMOA, 2007) on the restructuring and upgrading of agri-food enterprises.

Semi-structured interview

A semi-structured interview was conducted using an interview guide to obtain additional data. The flow of interviewees (Figure 1) following the organizational chart of the cooperative was 13 interlocutors targeted to better understand the observed phenomena. These interviewees were selected on the basis of their leadership and seniority. The objective of the interview was to know the investment capacity and the daily management of the processing unit. Thus, the themes addressed by the interview guide were: the level of investment, the assets of the processing unit, access to loans, remuneration of members, monitoring of the sales and export force, organization of training, positioning and production capacity of the processing unit.

The different stages of the interview were as follows: the preparation and setting up of the material (notepad and dictaphone), the quick presentation of the different themes to be addressed, the start of the interview, the conclusions to be drawn and the transcription of the interview in order to better perceive the main lines.

Data treatment

The SWOT matrix (Table 1) was used to analyze and process the data. Thus, the general data collection of the processing units was

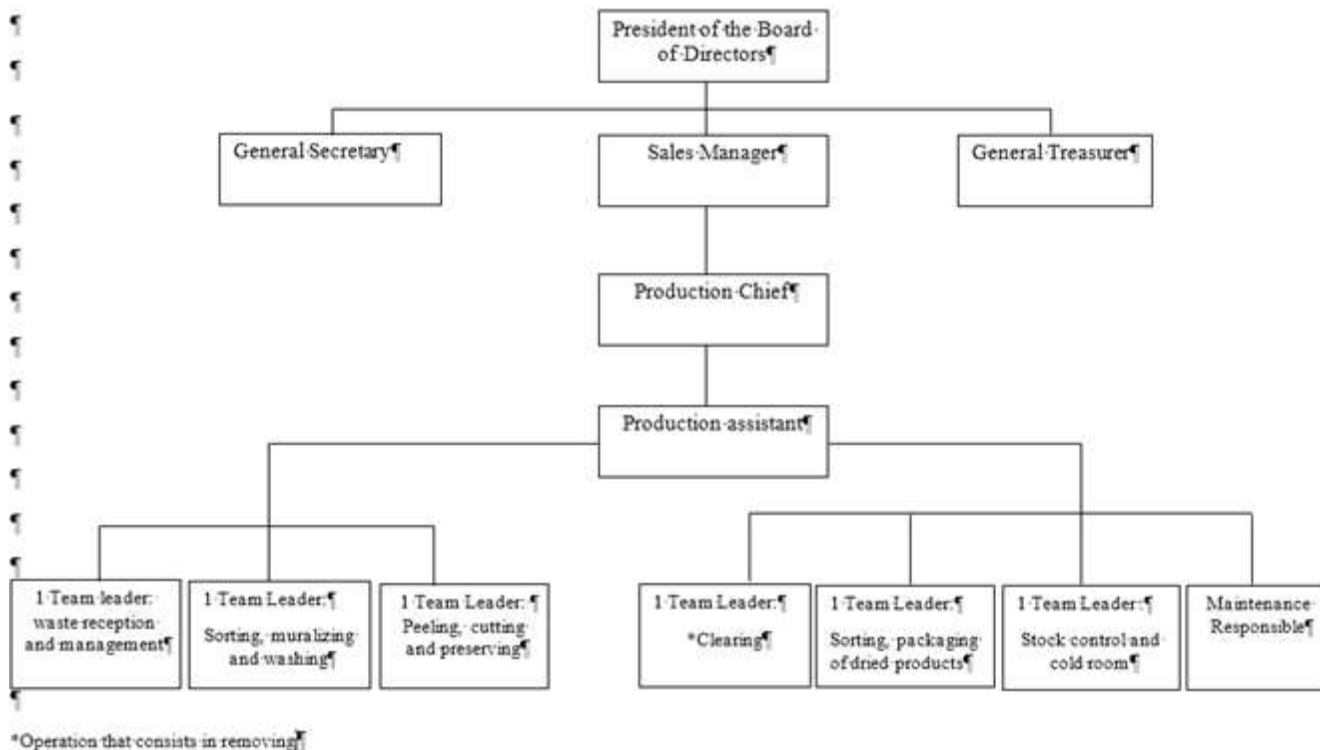


Figure 1. Flow chart of interviewees.
Source: Authors

Table 1. SWOT matrix.

Internal	Strengths	Weaknesses
External	Opportunities	Threats

Source: Authors

established by crossing internal and external data. The internal data taken into account were the strengths and weaknesses. As for the external data, they concerned the threats and opportunities related to the mango sector. The strengths and weaknesses concerned the internal resources available to the processing units, whether human, financial, intangible (patent) or material (production capacity). The opportunities and threats concerned the external elements (threats and opportunities) of the processing units that can contribute to their success or, conversely, harm them.

RESULTS

Value chain of the mango sector in Côte d'Ivoire

The general diagram of the value chain of the mango sector in Côte d'Ivoire is presented in Figure 2. Five major segments of activity have been identified: production; supply and marketing; processing; packaging and manufacturing followed by distribution and export

and sale to final consumers. In almost all segments of the mango value chain, an increasing horizontal and vertical concentration of operations is observed. The first segment is characterized by mango cultivation, orchard maintenance and phytosanitary treatments, and mango harvesting and draining. This segment is driven by farmers and cooperatives. A second segment, with trackers, transporters and processing units as key actors, includes mango supply, crating and trade. The operations of mango reception, brushing, polishing and sorting constituted the third segment, with the processing units and export packaging units as key actors. These units ensure local consumption, processing and perform the calibration of fresh mangoes for export in the fourth segment. The fifth segment concerns the export and consumption of dessert and dried mangoes, which are handled by forwarding agents, distributors and consumers.

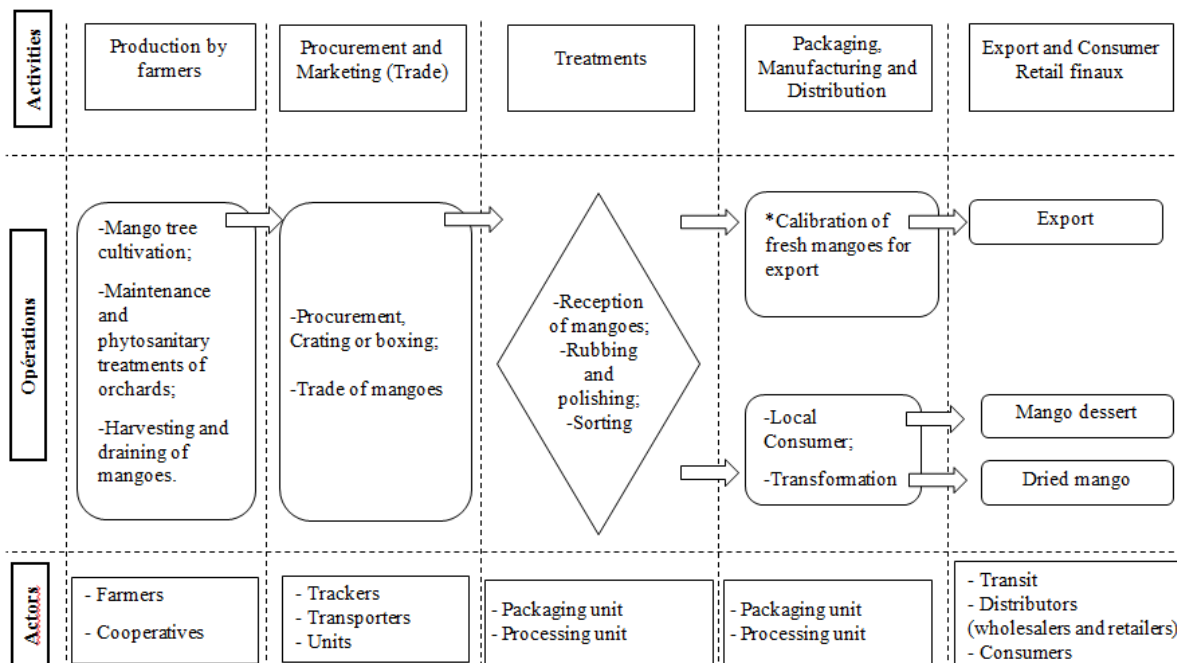


Figure 2. General diagram of the value chain of the mango sector in Côte d'Ivoire. *Calibration: this is done according to the size of the mangoes for export.

Source: Authors

Production diagram for dried mango slices in Côte d'Ivoire

Figure 3 shows the production diagram for dried mango slices, as well as the flows (materials, packaging and people) in the production unit. Actions such as receiving the raw material, obtaining fresh slices during cutting, drying the slices, packaging and storing the dried mango slices are the key steps in the manufacturing process. At the beginning, a sorting of the mangoes according to their degree of maturity is carried out as of their reception. The ripe mangoes (86 days after flowering) are washed with water while the unripe ones are stored in the ripening room, mostly covered under tarpaulins at room temperature to accelerate their ripening (7 to 9 days). After the washing of the ripe mangoes by a team of 2 women, the peeling as well as the trimming which consists in pitting the mangoes is carried out by 11 people in order to obtain the fresh slices. On average, a mass of 5 kg of fresh slices is soaked in a solution of meta-bisulfite (E 223) of concentration 0.04 Kg/L during 60 s to improve the conservation and perfect the yellowish aspect of the mango slices. After soaking, the slices are put on a rack for drying (65°C). However, the personal protective equipment (PPE) used for these operations (trimming and soaking) are inadequate and often absent.

A mass of 1200 kg of fresh flakes is stored in the oven

at 65°C for 24 h to obtain 240 kg of dried flakes for bagging. The drying is carried out by two (02) operators. In case of power failure, the drying process is stopped, causing a risk of delay in the delivery of the finished product. Once dried, the mango slices (240 kg) are stored in the packaging room for cooling. However, the cooling time is unknown to the operators. The cooled slices are detached from the racks and then calibrated manually with a stainless chisel according to the specifications (buyer's requirements), that is to say those of 6 - 9 cm and 2 - 3 cm in length respectively for the large and small mango slices. These calibrated slices are bagged in a polyethylene plastic package and stored in a cardboard box as secondary packaging followed by storage at room temperature. However, the cartons used do not display any information (name of the product, production and expiration date, nutritional value of the product) on the finished product they contain.

SWOT analysis of dried mango slice production in Côte d'Ivoire

The data presenting the strengths, weaknesses, opportunities and threats related to the dried mango slice production unit in the north of Côte d'Ivoire are recorded in Table 2. These data from the non-participant observation illustrate perfectly the internal organization in

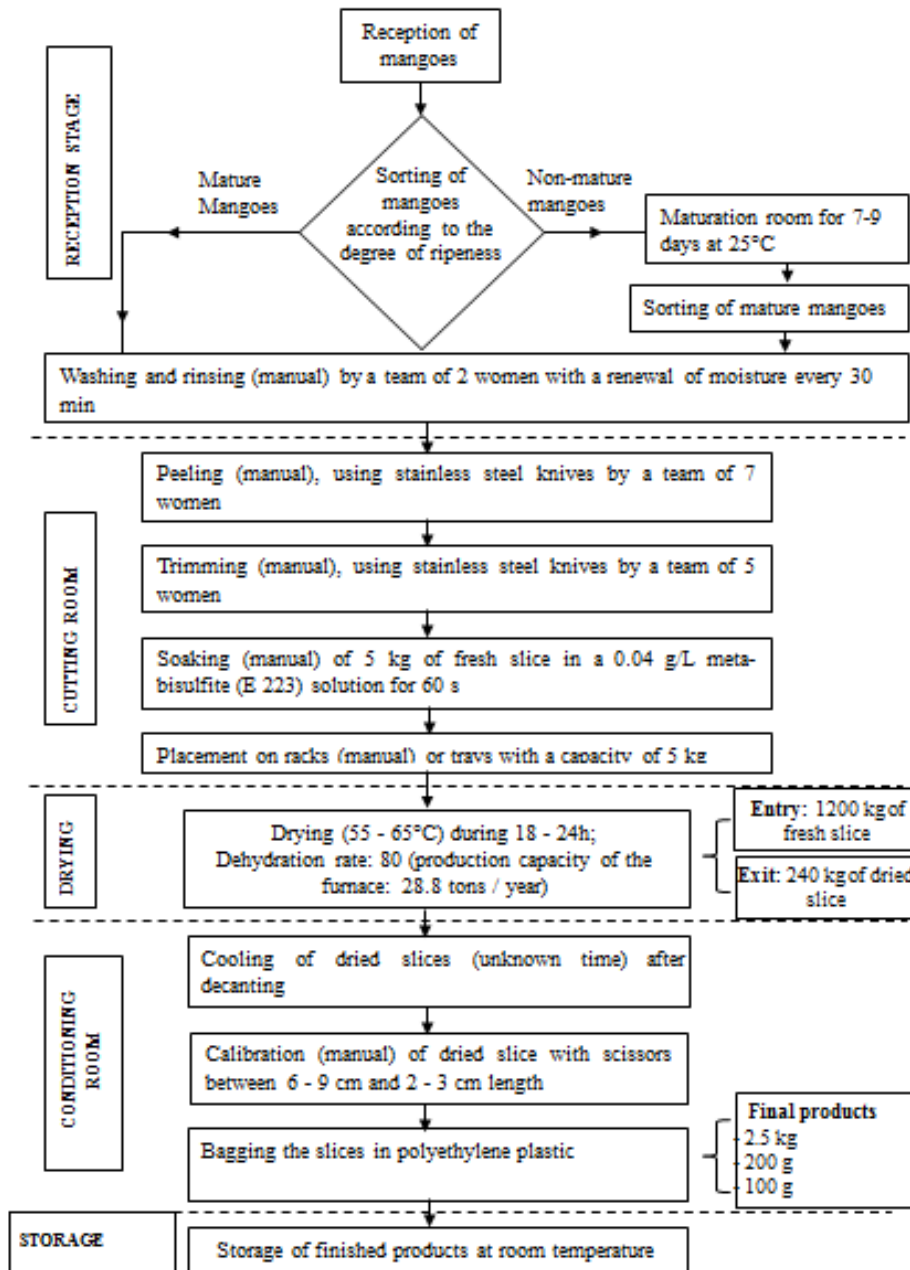


Figure 3. Production flowchart for dried mango slices.
Source: Authors

place and the opportunities it offers, but also point to the difficulties associated with the mango sector. Thus, four (4) assets were listed. These are the appreciation of the product by the consumers, the good commercial policy, the notoriety towards their partners and the loyalty of the producers. The availability and accessibility of fresh mangoes, the non-competitive nature of the local and sub-regional market and the sale of by-products constitute an opportunity for the sustainable development

of the mango sector in Côte d'Ivoire.

The absence of a capacity building plan and the lack of mastery of the principles of food technology by the staff were observed as weak points. Similarly, the low investment capital indicated by the management teams, the absence of metrology and preventive maintenance of equipment such as the oven and scales were noted. In addition, the absence of a quality control laboratory, which guarantees the conformity of products in terms of

Table 2. SWOT matrix describing the internal factors (strengths and weaknesses) and external factors (opportunities and threats) of the dried mango slice production unit in Northern Côte d'Ivoire.

Factor	Positive	Negative
	Strengths	Weaknesses
Internal factors	1. Product appreciated by consumers ; 2. Effective marketing policy; 3. Notoriety recognized by partners; 4. Loyalty of mango producers (availability of mangoes).	1. Lack of a staff capacity building plan ; 2. Low capital investment (no generator); 3. Lack of a quality control laboratory (no company standard*); 4. Strong presence of orality 4.1. No cleaning and disinfection plan 4.2. Lack of operating procedures 5. Lack of preventive maintenance ; 6. Lack of equipment metrology; 7. Unsuitable materials for production premises (use of wooden ceilings, no tiling of walls and floors, etc.); 8. No mastery of the principles of food technology 8.1. Non-compliance with the principle of forward motion; 8.2. Failure to control the cooling time of dried mango slices.
	External factors	1. Local and sub-regional market, not competitive; 2. Availability and accessibility of fresh mangoes 3. Production and marketing of mango products.

*Standard designed and adopted by a company on the basis of experience to guarantee the quality of the final products, in the absence of a national or international standard.

Source: Authors

hygiene and food safety, was reported. The observation also showed a strong presence of orality in the execution of daily tasks and the absence of cleaning and disinfection plan as well as operating procedures. The use of unsuitable materials for the production premises (use of wooden ceiling, no tiling of the wall and floor, etc.), the absence of quality label (risk of sanctions arising from European regulations) and the low accessibility to bank loans were also recorded.

Recommendations are then needed for added value in the processing of dried mango slice produced in Côte d'Ivoire. These are:

- (i) Establish a cleaning and disinfection plan for premises and equipment;
- (ii) Establish a capacity building plan for staff;
- (iii) Develop and implement a code of conduct in the company's environment;
- (iv) Establish a HACCP plan for better control of critical points;
- (v) To use specialized operators in the development of the premises to be used for the processing of mango;
- (vi) Establish a stock management plan (raw materials and finished products) based on FIFO;
- (vii) Establish a plan for preventive maintenance and

metrology of equipment;

Similarly, recommendations for the attention of the State can also be issued. These are:

- (i) Establish a national standard for the production of dried mango slice;
- (ii) Establish a policy to facilitate access to bank loans for farmers and cooperatives in the mango sector

DISCUSSION

The objective of this study was to evaluate the production system of dried mango slice produced in the north of Côte d'Ivoire to assess its impact on the hygienic and marketable quality. The study revealed that the production system is fraught with weaknesses. The problem of staff competence through the lack of capacity building and the lack of mastery of the principles of food technology illustrate this situation perfectly. Indeed, the observation showed that the staff did not apply the principle of forward movement, which consists of avoiding interactions between dirty and clean workers. The non-application of this principle would increase the risk of cross-contamination of the finished product. According to Vignola (2002), product, personnel, materials, packaging,

etc. should not be run in the opposite direction of the sequential pattern of product manufacturing steps.

This risk of cross-contamination could also be associated with the lack of control of the cooling time of the dried slice. Indeed, once taken out of the oven, the dried slice is stored for an undefined period of time in a packaging room where the choice of construction materials is poor (wooden ceiling and cement floor). According to the des Manipulateurs D'aliments de l'Ontario (2018), the faster the food is cooled (six hours of time), the less time it will remain in the danger zone and the less chance there is for bacterial growth.

The high presence of orality could be one of the causes of many malfunctions in the execution of daily tasks in the processing unit. Thus, the operating procedures as well as the cleaning and disinfection plan could not be established.

This lack of procedures would prevent a constant result for a given operation and the absence of a cleaning plan would contribute to the proliferation of germs likely to contaminate the dried mango slice. The Institut National de Recherche et de Sécurité (2003) agrees, noting that the integration of a cleaning and disinfection plan at the design stage ensures the feasibility of cleaning and disinfection to meet food hygiene requirements.

Good management of production costs is essential for any enterprise (Marshall and Nair, 2009). However, like all other processing units, the cooperative society does not have sufficient capital to meet the investments required for their sustainable development. This failure is a limiting factor for implementing an expansion policy or upgrading human and material resources as reported by Marshall and Nair (2009). It is because of this weak capital that the observation noted the absence of a quality control and equipment metrology laboratory within the units. Kore et al. (2000) even point out that metrology is required because of technological change and the need for precision. This is especially true in the food industry where measurements also contribute to ensuring food safety. This is why the State would gain by accompanying its processing units which are confronted with financial support defaults and difficult conditions of accessibility to bank loans. For many financial structures in Côte d'Ivoire, the processing activity managed by cooperatives is considered opaque given the difficulties in obtaining administrative and financial documents ensuring the sustainability of their activities (Gbede et al., 2017). Thus, the units will not be able to ensure their objective in terms of sustainable development due to lack of funding. According to the Conférence des Nations Unies sur le Commerce et le Développement (2014), international bodies are increasingly aware of the considerable role that financial structures can play in favor of sustainable development.

Other threats identified, such as the lack of a quality label, could contribute to the risk of sanctions arising from

European regulations. Indeed the non-compliance with the specifications of this regulation may constitute a real danger for processing units whose main activity is the export of dried slice. According to Biogascogne (2016), the specifications are a technical document defining the characteristics that the operator must present the modalities of control as well as the modalities of communication on the control. Failure to comply with the requirements from the specifications immediately leads to a non-conformity whose severity varies depending on the requirement.

In addition, it is clear that the partners are well known and that producers have confidence in the program. Beyond the threats and weaknesses identified, certain opportunities such as the local and sub-regional market, which is not competitive, the availability and accessibility of fresh mangoes as well as the production and marketing of mango by-products have been identified. It is only necessary to train the staff to boost the production of dried mango slice in Côte d'Ivoire. This reinforcement is necessary for the good functioning of the processing units, as well as for any organization that wants to be professional. The FAO (2010) even encourages capacity building because it facilitates the implementation of new activities (preventive maintenance and management of critical points in agri-food practice) and to improve the skills of leaders and managers of producer associations in agri-business management.

Conclusion

The implementation of the SWOT matrix has enabled a better understanding of the general functioning of the processing unit of dried mango slices produced in the north of Côte d'Ivoire. Thus, the strengths and weaknesses (internal factors), and opportunities and threats (external factors) were established. The suggested recommendations will allow to correct the detected insufficiencies and to boost more the quality of the dried mango slices. This SWOT analysis will enable the processing units to become aware of the complexity of their own organizations and the impact of their activities.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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