Direct RESEARCH JOURNALS

Direct Research Journal of Agriculture and Food Science
Vol.8 (4), pp. 116-129 April 2020
ISSN 2354-4147
DOI: https://doi.org/10.26765/DRJAFS40252693
Article Number: DRJAFS40252693

https://directresearchpublisher.org/drjafs/

Review Paper

The organic pepper (*Piper nigrum* L.) value chain in São Tomé e Príncipe under a value chain analysis for development methodology perspective

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Received 28 March 2020; Accepted 20 April, 2020

Pepper exports have recently increased in São Tomé e Príncipe, although their amount being far from matching those of cocoa and coffee. In the last decade, a policy of agricultural value chain promotion was implemented with the support of international cooperation (e.g., International Fund for Agricultural Development), aiming at the improvement of local agricultural development as well as the socio-economic conditions in rural areas. As a result of this movement, a dichotomy was introduced in these chains, certificated and non-certificated farmers; formal and informal trade; and domestic or international trade circuits. Aiming to provide more and updated data to decision-makers and conduct a broader analysis that includes not only production issues but also socioeconomic analysis, this review was carried out based on the methodology of value chain analysis for development, to describe the pepper sector in São Tomé e Príncipe. This analysis concluded that the pepper sector is divided into two sub-chains; non-certified pepper value chains and certified pepper value chains, the latter being by far the most important, due to the number of producers and the amount produced. Production systems are very similar, as well as the market linkage, although the non-certified value chain being informal. All sub-chains need capital and technology accessible to all farmers.

Keywords: Informal, organic farming, income, sustainability, small farming

INTRODUCTION

The pepper (*Piper nigrum* L.) has its origin in Asia/India (Ferrão, 1993; DESER, 2008; Lourinho *et al*., 2014) and is the most consumed and valued spice in the world (Lima *et al*., 2010; Nelson and Cannon-Eger, 2011; Damanhouri and Ahmad, 2014). Jointly, Brazil and some Asian countries, namely Vietnam, Indonesia, India, Malaysia, and China, are responsible for more than 80% of total world pepper production (Junior *et al*., 2017). The main flows of pepper trade occur between the regions of Asia and North America, but the European Union and Mercosur are other important net consumers (Homma, 1981; DESER, 2008; Lourino *et al*., 2014).

Pepper production has grown in both conventional and organic sectors, creating a new range of products in the market (FiBL and IFOM, 2013; FiBL, 2017a and 2017b). Organic species and herbs account more than 50% of total species traded globally (ReportBuyer, 2018), and the Asian producing countries are also the largest

producers of organic spices in the world. Although, the organic methods increase the yield and soil fertility and reduce the cost of inputs (Parvathi and Waibel, 2015), fair trade certifications have also been very important. When applied to smallholders, they protect them from price risks and promote the development of new business networks, such as niches of market for certified products, where the price reflects the real social, economic and environmental cost of their products (Hassler and Franz, 2012; Parvathi and Waibel, 2013).

Brief history of pepper cultivation in São Tomé e Príncipe

Pepper was introduced in São Tomé e Príncipe (STP), by the Portuguese in the XVIII century (Ferrão, 1993), and until 1975 (date of STP independence) was exported to Portugal (MAP, 1980). During the 80s and 90s, with the support of bilateral cooperation with Spain, commercial production was unsuccessfully tried by the local public agricultural services. The failure of commercial production is related with, on the one hand, by the strategy adopted (making a new crop the first activity of farmers), and on the other hand, the unfavourable international price conjuncture. Recently, from the mid-2000s on, pepper was relaunched as an organic chain and linked to the global market. Known as a high quality export product, like coffee and cocoa (AICEP, 2017a and 2017b), these singular and sustainable chains are growing in terms of production and in the number of farmers. Beyond its contribution to the export sector, pepper production has a great importance to the local economy, particularly in providing extra income for smallholders.

Although modest, the 15[1] tonnes demanded domestically (PAPAFPA and FIDA, 2011), and the 22 tonnes currently exported, representing around 2% of total national exports (INE-STP, 2017), the pepper crop could be a potential strategic crop for rural development policies. Locally the major constraints for pepper production are the lack or inadequate irrigation systems and water supply, and the low capabilities of farmers due to:

(i) The absence of the new crop technology knowledge by most farmers;
(ii) The exigence of higher management skills if compared to the other export crops such as coffee and cocoa.

The PAPAC[2], financed by IFAD (International Fund for Agricultural Development), has been supporting the development and consolidation of cooperatives, whose products can be exported. The processed pepper is one of those products which, until the creation of the cooperative CEPIBA[3] in 2007, was produced and traded informally, artisanal, and very little developed methods.

There are four cooperatives (one for coffee, one for pepper and two of cocoa), promoted in the ambit of a public-private partnership (PPP), among the following's partners: farmers, external buyer, local government, AFD (Development French Agency), and the just mentioned IFAD. Regarding to pepper value chain (VC) in STP, in this paper, we divided it into two sub-chains:

(i) Informal producers non-affiliated to the cooperative, "non-certified organic pepper value chain – VC1", these producers do not apply chemical synthesis fertilizers;
(ii) Informal producers now affiliated to the cooperative, the "certified organic pepper value chain – VC2", those subscribe internal and external certification processes.

This paper deals with the entire pepper VC in STP, describe both of sub-chains, VC1, and VC2 through Value Chain Analysis for Development (VCA4D) methodology and correspondent SWOT analysis. Applying this recent methodology, a set of data is provided to local and foreign decision-makers for their policies and intervention projects. STP has received attention from international organizations such as the European Union and the African Development Bank. Therefore, the diagnosis of leading value chains is the first step for agricultural policy and strategy design. The VCA4D methodology comprises two steps: the first step is the functional analysis; and the second step is the analysis of sustainability at social, economic, socioeconomic, and environmental levels (Table 1). Taking into account the lack of data, the VCA4D methodology was not fully applied, mainly in what concerns the environment. The questions on (Table 1) are guidelines for the following discussion. The objective of the paper is not to compare the two sub-chains, but rather to present data and explain the interactions/linkage between the two sub-chains.

[1] Domestic demand of 2011 based on national per capita consumption (90 g\inhab\year), and local total population 166,728 thousand inhabitants.

[2] PAPAC – Project to Support Small Family Commercial Agriculture in progress (2015-2021), is a continuation of PAPAFPA with a more commercial approach -. Its intervention cover, plantation development and strengthen cooperatives structures (education, infrastructure, support operational cost, etc.).

[3] CEPIBA – Export cooperative of pepper and vanilla, was born in 2007 with the support of donor (IFAD), aiming the exportation of these products, however the cooperative is only engaged in supporting pepper producers and export their product.

Table 1. Guidelines for economic, social, socioeconomic and environmental analysis.

Economic description	Social description	Environmental description	Socioeconomic description
What is the contribution of the VC to the economic growth?	Is the VC socially sustainable?	Is the VC environmentally sustainable?	Is the economic growth inclusive?
How profitable and sustainable are the VC activities for the entities involved?	Are working conditions throughout the VC socially acceptable and sustainable?		How is income distributed across actors of the VC?
What is the contribution of the VC to the GDP?	Are land and water rights socially acceptable and sustainable?		What is the impact of the governance systems on income distribution?
What is the contribution of the VC to the agricultural sector GDP?	Is the gender equality throughout the VC acknowledged, acceptable and enhanced?		How is employment distributed across the VC?
What is the contribution of the VC to the balance of trade?	Are food nutrition conditions acceptable and secure?		
Is the VC viable in the international economy?	Is the social capital enhanced and equality distributed throughout the VC?		
	To which standards are major social infrastructure and services acceptable and do the VC operations contribute to improving them?		

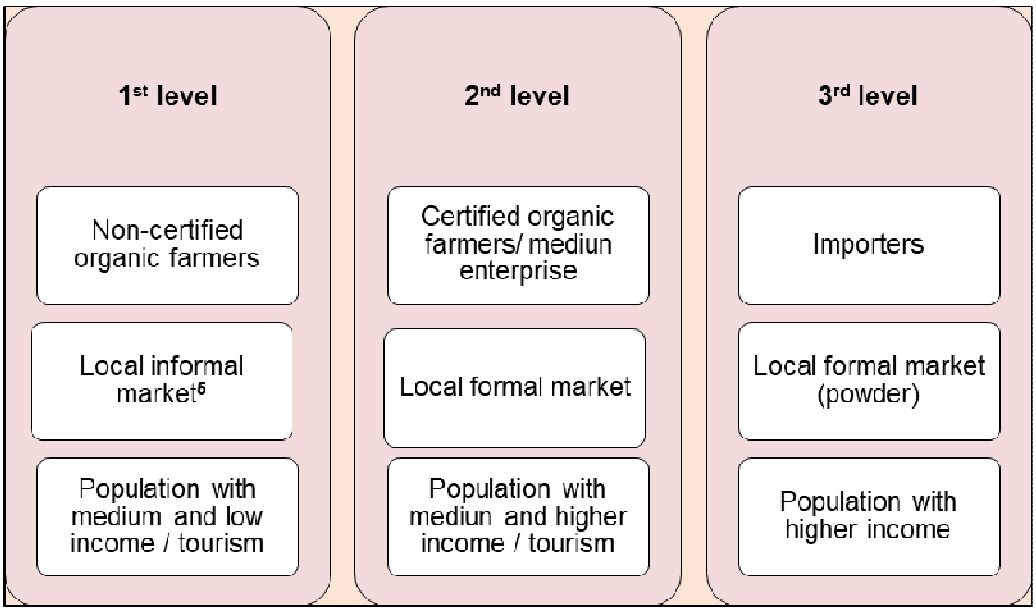

Figure 1. Internal flows of pepper and type of consumers in STP.

Note: This figure draws the internal pepper circuit constituted by informal side (first level) and the formal side (second and third level). [5] Local market – The local market, correspond to the two main markets of country (Mercado Municipal and Mercado de Coco-Coco) located in the capital, district markets, and micro sellers around the country. *Source*: Own elaboration.

DISCUSSION

Flows and macro indicators of local pepper VC

The local pepper supply chain (SC) is very fragmented because within the two sub-chains mentioned above, in VC1, producers act individually, generating several linkage and organizational patterns. Thus, the pepper SC is organized in three levels (Figure 1); based on the suppliers, trade circuits, and the type of consumers. In the first level, pepper is sold in the informal market, and it represents the largest internal circuit. The second and third levels are in the formal circuit because they have a physical sale point (normally a store), pay taxes, and

Table 2.Production and exported amount of pepper in VC1 and VC2.

		Years										
		2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
VC2	Total production(t)	-	1.8	3	4.4	5.3	2.7	4.9	9.7	7.9	13.1	14*
	Exports (t)	-	-	3	4.3	5.3	2.5	2.3	9.6	6.3	12	13.9
	Internal market (t)**	-	1.8	0	0.1	1.2	0.2	2.6	0.1	1.6	1.1	0.1
VC1	Total production(t)	-	-	-	2.9	3.8	4.4	-	-	-	-	-
	Imports(t)	4	14	9.5	12	7.8	-	-	-	-	-	-

Source: PAPAFPA and FIDA, 2011; CEPIBA; INE-STP, 2014b, 2015, 2016, 2017 e2018.
Note: * Provisional data; ** Estimation

comply with other legal precepts. Regarding to second level, the usual stores are the NGO Quá-Telá[4], the airport store, hotels, medium supermarkets, and circuits for tourists. The peppers sold on the second level by the certified farmers do not comply with export requirements. Finally, the third level refers to imported pepper, and is operated by only one importer. Table 3 shows the description of the packaging associated with the three levels of local pepper SC.

Local consumers' preference

The local consumers prefer white pepper than black due to its flavour and appearance. Normally, pepper is sold together with cumin, which is also quite appreciated by local consumers. According to a market study carried out by PAPAFPA and FIDA, (2011), only 3% of consumers bought pepper without cumin. Local consumers also prefer peppercorns than powder due to its flavour after milling, and so, powder pepper is almost inexistent in the local informal market. The circuit of black and powder pepper, normally addressed to tourist, can be found on the 2nd and 3rd level of local pepper SC (Figure 1). In relation to the frequency of consumption, 46% of local consumers use pepper every day and 80% 4-6 days per week, thus explaining the local highly spicy diet associated to the consumption of pepper and cumin (PAPAFPA and FIDA, 2011).

Despite the local higher consumption, consumers are very sensitive to price changes, as it happened in 2010, when a serious drought increased the price, reducing the consumption about 30-60% (PAPAFPA and FIDA, 2011).

Consumers´ preference between local certified and non-certified agricultural products is not documented. As described above, at the second level, tourists are willing to pay for certified products. However, it is important to promote the local consumption of certified products. In his study about consumers' willingness to pay for organic and fair-trade products, Garcia-Yi (2017) pointed out that consumers are concerned with products grown with synthetic fertilizers and calls the attention for the need of consciousness change.

Production and exports

There is little data about production and its flows on the VC1, and so the data in the table may not reflect the real state of this sub-chain. According to a study carried out by FIDA and PAPAFPA (2011), the imports take place when: (i) international price is favourable; and (ii) local production is lower than expected. If these conditions do not verify, the local small merchants buy pepper locally, exerting their coordinated power at upstream and downstream of VC. Since 2012 CEPIBA´s production and market share increase putting an end to imports (FIDA and PAPAFPA, 2011). Moreover, CEPIBA´s production allowed for around 59.2 tonnes of exports until 2017. CEPIBA´s internal market share is important because it promotes price stabilization and thus avoiding the illegal sale of pepper from VC2 to VC1. The role of CEPIBA in the market is most effective in first level in (Table 2 and Figure 1) not only because it is the larger share of the market but also because the second and third levels supply tourists and higher income consumers that require pepper specifications and can pay prices not affordable to the majority of local consumers.

Packaging in the local market by traders in VC1 and VC2

Packaging is important because, beyond its basic function of product container, it can be used for marketing actions (Kotler and Armstrong, 1987). The information to consumers is another main component of packaging. However, due to the low standards required by local consumers and the absence of a legal framework, packaging is little developed for pepper and not fully used. Nevertheless, changes in local agri-food systems

[4] NGO Quá-Telá – This NGO works with stakeholder's linkage in the agri-food sector, providing them conditions to develop their products and way to sell them.
[5] Local market – The local market, correspond to the two main markets of country (Mercado municipal and Mercado de Coco-Coco) located in the capital, district markets, and micro sellers around the country.

Table 3.Type of packing, quantities, and consumers prices of the pepper in local markets.

	Type of packing	Processing	Level on SC (see figure 2)	Amount (g)	Price (€)*
Traditional packing	Plastic	Corn	1st	15-20**	0.4
				<10**	0.2
				<10**	0.08
	Glass (tin of condensed milk)	Corn	1st	250	-
Convention al packing	Paper	Corn or powder	2nd	50	1.43
		Corn or powder	, 3rd	75	3.1
	Bottle	Corn or powder	2nd, 3rd	75	4.9

-* Actual rate of exchange 1€=24.5STN. STN (dobra) local currency. – ** Values based on market observation. \ Conventional packages are used by cooperative and medium enterprises.
Source: NGO Quá-Telá; File PAPAFPA.

have allowed for improvements in packaging (Table 3). These changes are related with the increase of tourism and the emergence of markets and supermarkets in the last years, offering new opportunities for the development and modernisation of the agri-food sector. In the case of pepper this evolution has occurred on 2nd and 3rd level of pepper SC (Table 3) due to the better performance of sale points and requirements of consumers. The price of conventional packaging is fixed without any accountability of processing cost, for example, 50 grams in paper packaging cost 1.43€, whether it is peppercorns or powder. The same inconsistency is verified for 75 grams on paper or bottle packing. Table 3 also shows that in the case of plastic packaging, consumer prices may vary a lot for the same amount: a pack of <10 grams can, for example, cost 0.2 or 0.08€. This inefficiency in price fixing leads to losses for both consumers and traders.

Functional analysis of VC1 and VC2

Functional analysis typically includes VC mapping, technical diagnosis, and governance structure (Bellù, 2012; EC, 2017). Next, based on VCA4D methodology, a functional diagnosis is provided for VC1 and VC2. First, on (Table 4), all main actors and their functions are described. Regarding VC1, it is normal that the number of partners is just one, considering that it is an informal sector and largely composed by smallholders without any interaction among them. In the case of VC2, there are partnerships in several areas which are important for its development. However, two crucial agents are missing: credit entities and an entity which should represent the interest of all cooperatives promoted by PAPAC vis-à-vis government, donors, and other key institutions. A credit entity is a core service because it could also benefit the informal sector (VC1), at least the medium enterprises that may offer guarantees for credit. The local bank provides credit but, due to the higher interest rate, it is inaccessible for new and small cooperatives as CEPIBA, let alone for poor smallholders. CIAT action is linked to both sub-chains, and the reinforcement of its technical capabilities and resources could mitigate producers' limitations and constraints in all country. CIAT is also a key driver for local agribusiness development because it can promote the technical and technological changes which are essential for productivity growth and maintenance of commercial agricultural plantations.

Mapping of value-chain-1 and value-chain-2

The production process and processing are similar for both sub-chains, as shown in (Figure 2). In VC2, the subsidized inputs refer to cuttings, disease and pest control products, and manure. According to CEPIBA, its production is divided into 80% of white pepper and 20% black one. For VC1, the percentage of white pepper is probably, the same or even higher because the local consumption of black pepper is quite small. The processing of other types (red and wild) of pepper is sporadic and statically insignificant due to its low quantities. All post-production activities in the VC2, including the exports, are carried out by CEBIPA while for VC1, each producer is responsible for the production and trade. Moreover, in VC1, women have a more important role.

Trade

In STP, like in other low-income countries, the market informality is spread, aggravated by the high level of market fragmentation, making the establishment of market rules more difficult. However, La Porta and Shleifer, (2011) underline that the solution is not to eradicate informality, but to find solutions to improve its performance. In this sense, the internal pepper trade

Table 4. Actors and their functions in the VC1 and VC2.

	Ambit	Actors	Function
VC2	Partners of public-private partnership	AFD IFAD Hom &Ter Government	Financial, technical and logistic support
	Technical and training support	CIAT AGRISUD CIAT	Technician assistance
	Certification	Agricert CIAT	Certification
	Input provider	Nursery Manure	Assistance
	Internal sale	Representative	Sale
VC1	Technical assistance	CIAT	Technical support

Note: CIAT - Tropical Agricultural Research Centre.

should be regulated, mostly the price, to guarantee fair competition. It is also important and urgent to try establishing a legal circulation of agricultural products between STP and neighbour countries such as Nigerian, Gabon, and Angola, as mentioned in the report of PAPAFPA and FIDA, (2011). Regarding to VC2, the pepper is sold only in the ambit of the current PPP where this cooperative was created. This marketing monopoly is a trade-off for 50% early payment to producers at harvest. As mentioned in the note of (Figure 2), the internal circuit of VC2 is supplied by pepper not qualified for exports.

Price

The current price agreement was signed in 2009 between CEPIBA and the business society Hom & Ter, which is the private entity of PPP, and has been revised every year. The main rules of this agreement are; (i) price revision according to the international pepper price and the local exchange rate, (ii) bags (of 25.2kg) for pepper export, (iii) harvest funding, (iv) premium of 0.2€/Kg to each association linked to the cooperative. The price paid by the external buyer is split in 70% for producers and 30% for the cooperative. CEPIBA management provides two systems for the producer's payment: delivered[5] and consigned[6]. The prices for the different types of pepper are shown in (Table 5) for 2017. The delivered system was introduced due to the farmers' need of cash to meet their daily expenses. As compensation consigned producers receive around 20% more than the delivered. Those preferring the delivered system are mostly smallholders whose main (or even unique) source of income is pepper production. The large variability of price shown in (Table 6) results from two key factors; the harvest season and the level of rainfall of the previous year. This price difference, despite being seasonal and illusory, has promoted the illegal transfer of pepper from VC2 to VC1.

Table 5.Price of export peppercorn in 2017 paid to the producer.

Type of pepper	Delivered		Consigned	
	STN\kg	€\kg	STN\kg	€\kg
White	50	2	60	2.4
Black	43	1.6	52	2.1
Red	170	6.9	208	8.5
Wild	120	4.9	147	6

Note: Red and wild pepper are not in production at moment.

Table 6. Price paid to producers on VC1.

	Pepper price (€/kg)	
	Minimum	Maximum
White	4.9	12.2

Source: PAPAFPA and FIDA, 2011.

Marketing

According to Kotler and Armstrong (1987), marketing is more than promotion and sale, insofar as if all VC activities since design until the distribution of the product are well accomplished; the sale becomes a very simple process. Obviously, this is what leads trading firms to aim at imposing their coordination power along the entire VC, to get the best product image at sale points.Thus, the attributes of marketing on VC2 are the organic production and the promotion through packaging. On VC1, although the use of packaging has been improved, the marketing is mainly related to the origin of products. Since STP is known internationally by the quality of their agricultural products, mentioning of country origin is also one of the

[5] Delivered – the payment is made at delivery.
[6] Consigned – the payment is made after pepper exportation, generally between December\January.

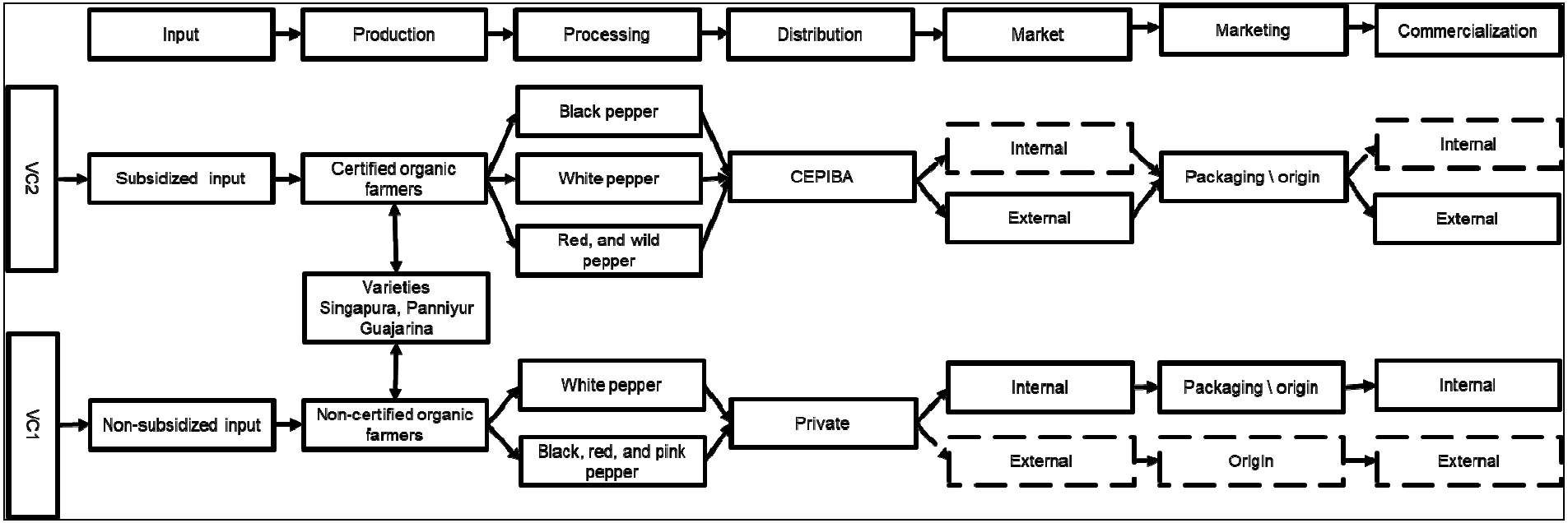

Figure 2. Mapping of value-chain-1 and value-chain-2
Note: Dashed lines represent on VC2 pepper not qualified for exportation, and on VC1 a sub-circuit totally informal.
Source: Own elaboration.

marketing strategies of VC2. As expected, in the informal market, the marketing is almost inexistent because the consumers' preference is limited to the cheapest price. In the future, the development and registration of a brand for local agricultural products must be studied in order to take advantage of the STP reputation of the quality of agricultural products.

Technical diagnosis

Agricultural production

The pepper plantations are in shadow regime, in other words, using other bigger trees to avoid full penetration of natural light aiming, among other advantages, the promotion of nutrients recycling, and water retention. This agroforestry system is dominant in both sub-chains, although some plantations conducted under the conventional unshaded mode. Considering the context of the high level of biodiversity and low socioeconomic development in STP, the agroforestry systems are important to provide environmental services, promote and ensuring the sustainability, biodiversity, and socioeconomic standards of life for their practitioners (Montagnini and Nair, 2004; Jose, 2009). This is beneficial for both VC1 and VC2. For VC1, shadow trees also provide fruits, coal, and wood, which are another source of income. For VC2, beyond this additional income source, the shadow regime is compatible with organic production methods.

Planting methods

(a) Intensive 2 plants/tutor (5000 plants/ha).
(b) Extensive 1 plant/tutor (2500 plants/ha).

The cultivated varieties: are singapura, panniyur, and guajarina. The first two are recommended because they have more berries by bunches than guajarina. All varieties are propagated through cuttings. In STP, the shadow trees used as living tutors can be *Spondias mombin* L. (local name, "guegui"), and *Newbouldia laevis* (local name "quimi"). *Newbouldia laevis* is the most used

because the farmers are aware that the *Spondias mombin* is sensitive to the main pepper disease, the fusarium. However, it is a leguminous tree used on agroforestry systems in tropical areas (UNCTAD, 2003), and therefore its adaptability should be tested in different communities.

Type of producers

Most farmers in VC2 were previously in VC1, and the remainder are new farmers, which explain the little differences among the two chains. Nevertheless, some distinctive factors regarding the size of cultivated area, technical skills, and capital availability can be detected and are shown in (Table 7). Micro-producers are dominant in the pepper sector, which is in accordance with the characteristics of local agricultural systems, but, unfortunately, these micro-producers are the ones with less technical and capital capabilities. Almost all farmers are involved in more than one culture, to diversify their source of agricultural income.

Services in the ambit of the VC1 and VC2

The services provided in the framework of VC2 are: input supplying, rural extension, certification process, consulting, and other technical services. The extension service is provided by Tropical Agricultural Research Centre [7](CIAT), which has little technological solutions for organic farming. Regarding VC1, the unique available service is the public extension services, which can be addressed in case of technical assistance (pest and disease control or training in pruning). These services are not spread to all farmers because they are centralized. In general, technical support reaches the entire set of producers only when there is a project financed by foreign institutions as it is the case of PNAPAF[8]. In the case of VC2, the support services are fundamental for its consolidation and development. For example, technical assistance has also been developed through partnerships with local and foreign institutions and neighbour producers' counties such as Madagascar and Cameroon. Regarding partnership with Madagascar, STP field technicians, processing technicians and elements of the cooperative´s social bodies received technical training. And, as result of this learning and exchange of experience, a "Good Practices Manual" was developed to provide technical support to the cooperative producers.

Access to aid regarding factors of production, covers the following areas: (i) subsidized inputs (cuttings, portable stairs and tutors), (ii) free inputs (sawdust, manure, phytopharmaceuticals, and on-site assistance), (iii) subsidized inputs granted only to new producers. The organic certification is attributed by Ecocert Company, allowing the access to the international market. There is no Ecocert office locally; therefore, a technical certification visit is made every year. Additional certifications, such as quality and phytosanitary certification, are provided by CIAT. Services related to credit, financing consulting, and specialized technical assistance to organic production are embryonic or even absent. These services depend on efforts and partnerships between public and private services and with all actors of local VC. In addition, it is urgent to build, at the national level, a platform for knowledge sharing and diffusion because knowledge and technical skills are not available to all producers around the country.

Equipment and infrastructures

Traditionally the STP agricultural system relies mostly upon subsistence farming. But this situation can be changed with the development of pepper and other value chains such as cocoa and coffee. However, the low technological level, as well as the incipient and inadequate support structures, is a serious barrier to this evolution. The promotion of agricultural value chains constitutes an opportunity for technological and structural changes of agri-food systems (Trienekens, 2011). Following this path, the development of VC's in STP can be a strong component for technology change as well as research and development. Despite the fact that in pepper VC there are quite numerous and different producers, the processing methods are similar. This diversity can be an advantage in trade, insofar as each individual producer can look for better price opportunities and clients. This is the reason for VC1 producers being often faced with the dilemma of joining the cooperative when VC2 prices are higher or not joining when prices are lower. Still regarding the equipment and infrastructure, and based on available data, producers on VC1 and VC2 were divided into two groups (see (Table 8), the group A covers the micro and small producers, and the group B, medium producers and medium enterprises, all of them, defined on the (Table 7).

As the growth in production is highly dependent on technical skills and technological capacities, the medium and long-term cooperative goals risk not being achieved. That is why, mechanisms of partnership must be created, as it is the case of the innovation platform mentioned by Adekunle and Fantunbi, (2012) to promote the engagement and participation of all stakeholders (e.g.,

[7] CIAT – is an autonomous public entity linked to the Ministry of Agriculture and Rural Development which offers extension services such as plant and seed production, technician support, training, soil analysis, etc.

[8] PNAPAF – National Family Farming Promotion and Support Program.

Table 7. Type of producers by cultivated area, skills and capital in the VC1 and VC2.

	Type of producers	Number (%)	Cultivated area (ha)	Main features
VC-2	Medium-producers	7	0.5-2	More technical skills and capital to invest.
	Small-producers	17	0.25-0.5	Agricultural income based on more than one culture; Moderate capital and technical skills.
	Micro-producers	76	≤0.25	Agricultural income based on more than one culture; Less capital and technical skills.
VC-1	Medium enterprises	10	10-100	Agricultural income based on more than one culture; capital and technical skills to produce.
	Micro-producers	90	≤0.25	Agricultural income based on more than one culture; Less capital and technical skills.

Source: Adapted from CEPIBA.

Table 8. Available technology and know-how for producers on VC1 and VC2.

Parameters	Group A	Group B
Irrigation	Water bucket, watering can and garden hose.	Sprinkler and drip irrigation systems.
Input	Lack or difficult access to the inputs.	Available inputs and resource to transport them. Skills to develop local input (e.g. biological insecticide).
Knowledge	Ignorance of good agricultural practices and pepper crop cultivation.	Better know-how and technical skills.

Source: Own elaboration.

policy makers, NGO, private-sector, farmers and their organizations) in finding the best solutions. When the purpose is the promotion of agricultural value chains, the process of technological change and the increase in productivity cannot rely only on the public sector and farmers (Reardon, 1998).

In a study about "Upgrading in agricultural value chain: the case of small producers in Honduras", Fromm (2007), concluded that the competitive pressure among smallholders in developing countries is increasing, specially within those who are linked to European and/or North American markets, as the case in VC2. The author also highlights that to be competitive and efficient; these smallholders must upgrade their processing and production levels.

Technological change normally flows, developed countries to developing ones. In this regard, Armstrong and Diepeveen, (2011) argue that information and communication technologies (ICT) is one of the key factors of this process. The authors also claim that ICT applies to both developed and developing countries, based on the example of Australia and India. However, in STP the use of ICT is not common, in contrast with what happens namely eastern African countries, like the archipelago of Seychelles, where ICT is largely applied to mobile services in the agricultural sector (Furuholt and Matotay, 2011; Asenso-Okyere and Mekonnen, 2012; Mtega and Msungu, 2013). Notwithstanding, the use of mobile services in rural areas requires technological support infrastructures such as electricity, which are usually not spread in these areas (Mtega and Msungu, 2013; Mattern and Ramierez, 2017).

Post-harvest

The bulk of all post-harvest operations are manually executed. Only in VC2, there is the use of some simple technologies like washing tanks and solar dryers. For VC1, where the process is fully artisanal, the post-harvest is usually carried by the producer's wife, except in the case of medium enterprises where it is performed by hired fixed workers. Almost all VC1 producers supply white pepper, but it is possible to find a few producers of black, pink, or red pepper, normally for tourist circuits, as described above. In VC2, black and white peppers are processed, with more than 80% of white pepper being exported. The processing of red and wild peppers was not frequent and is now interrupted. The processing centre is in the community of Rio Lima, district of Mé-Zóchi, the second most populous in the county. It does not have the capacity to process the current pepper

production; part of its structure is not isolated from local community and needs some improvement for staff accommodation. Improving processing centre conditions is one of the big challenges of CEPIBA, which has a rehabilitation project waiting for financing. The improvements should give special attention to rehabilitation and building more dryers; prevent theft of pepper on solar dryers; accountability of all activities; improve activities efficiency to avoid pepper losses, for example, during the washing. Processing is one of the most important post-production activities, central to the development of agribusiness by creating jobs, increasing value added, and promoting the agri-industry. This issue is transversal to all Sub-Saharan African countries, and one of the most important challenges in the coming years is to reinforce the entire food system, promote employment and economic growth (OECD/FAO, 2016), through the development of sustainable VC. For VC1, given its current technical conditions, there is not much room for increasing neither production nor income. The foreseeable options are: remaining an informal sector with the same economic margins, integration in VC2; or, in case of medium enterprises, improves their technical capacities to get more market share.

Governance of VC

In VC2, the governance structure is based on vertical coordination because the CEPIBA, through their members, must meet the specifications agreed in the ambit of PPP; ensure that norms of organic agriculture and other international standards are respected. As a cooperative, CEPIBA is the sole buyer of pepper produced by its members, thus acting as a very important player in the pepper market in STP. Vertical coordination is common in agri-food systems and will increase in the coming years because this system requires innovation and the fulfilment of global and private standards (Fromm, 2007), which is often promoted and monitored by so the called leading firms. Internally, CEPIBA should train and improve employee skills to avoid the ongoing management model, fully centralized and dependent on the executive director, which is not very efficient. CEPIBA autonomy structures concentrate in the executive director the fulfilment of management tasks. A horizontal management model seems more suitable for cooperatives because it reinforces the trust among members as well as the compliance with the basic principles of Cooperativism. Regarding the VC1, in spite its market informality and largely represented by subsistence farmers, the governance matters because, according to Schmitz (2005), it is determinant for market access as well as the pattern of profit distribution (Kaplinsky, 2000). Thus, the future of farmers in VC1 will follow one of these two directions: association with a foreign agricultural firm or joining the cooperative.

Because the opportunities in the local market are limited, the VC2 or private foreign firms are the only capable of providing them at least financial support. Even though the low production, as well as the small number of farmers involved in VC1, seems to indicate that their survival will be very difficult, when there is another consolidated circuit in expansion, as it is the case of VC2.

Value chain model

The model in which VC2 was developed is the already mentioned PPP. This model has been largely recommended in last years because it has been successful on VC analysis in developing countries (GTZ, 2007). This model has the advantage of involving the private sector, one of the best ways to promote economic growth and poverty reduction, as discussed by Humphrey and Navas-Alemán (2010), in his studies about Value chains, donor, interventions and poverty reduction. This is why; the approach is largely applied by international development agencies and donors promoting the VC analysis adoption for international and domestic markets (Fonseca et al., 2019). For VC1, the model is an individual production system, where each farmer finds its sale circuits and tries to keep customer loyalty as best as they can. In the future, probably, the increase of markets and supermarkets in STP will change the market situation, mostly in the informal sector, for farmers in VC1 that will remain out CEPIBA.

Economic and management description

In the ambit of the current PPP, the management of CEPIBA has changed, leading to more autonomy for its executive direction. Thus, the cooperative is administrated by the PAPAC and the CEPIBA, because it still does not have financial autonomy. Regarding CEPIBA´s activities, the entire activity is financed with revenue provided by PAPAC and CEPIBA (Table 9). The economic importance of the pepper sector depends on production growth and other improvements in efficiency, in the management of transport and other activities. By 2020, CEPIBA staff hope to reach 30 tonnes, the required amount to support all their activities. Nevertheless, even producing 30 tonnes, the support of donors and other stakeholders is necessary to support activities such as extension services, credit systems, training, and irrigation structure to improve the value chain. The financial autonomy of CEPIBA is important to fulfil the needs and challenges of their members and support the local economy. Agriculture may not be the economic key driver, but it provides basic livelihood standards for smallholders and their communities (Table 10). Based on the provisional data in (Table 10), pepper exports represent around 0.05% of national GDP, a

Table 9. Origin of funds, responsible agent and supported activities.

Agents	Funding	Covered activities
CEPIBA	Receipt of selling	(a) Pepper buying (b) Staff
PAPAC	IFAD	(a) Transport and equipment (b) Certifications (c) Exportations (d) Meeting and assembly (e) Training (f) Input (e.g. cuttings)

Source: CEPIBA

Table 10. Share of pepper on national economy.

Parameters	Data from 2017 (STN)	Ratio ($y/x_1.x_n$) (%)
GDP (x_1)[a]	$8.535*10^{12}$	0.05
Agricultural GDP (x_2)[a]	$4.35*10^{11}$	1.01
Agricultural exportation (x_3)	$2.04936*10^{11}$	2.14
Trade balance (x_4)	$2.58912*10^{12}$	0.17
Pepper exports (y)	4393200	-

Source: INESTP, 2017; BCSTP, 2017. *Note*: a – provisional data.

Table11. Increase of farmers annual income in VC2.

Year	2016	2017
Increase of annual income	50%	37%

Source: CEPIBA.

significative value for a cooperative that most of their members are smallholders, and the plantations have not yet reached full production. On the other hand, pepper revenue is seen like an extra income. Thus, its economic importance is also vital to meet household expenses. On the macro-economic side, pepper covers around 2% of STP agricultural exports, and, with the upward trend in production, it can become the second export product in the coming years. According to (Table 11), the farmers' income has been growing, which is obviously positive for their socioeconomic development. But one should take into account that this progressive increase of income may be more related to the annual revision of price agreed between the partners of the current PPP than to technological development. Regarding to VC1, the lack of data is not possible to provide a more detailed analysis. However, based on the average of VC1 production (Table 2), and its maximum and minimum price (Table 6), for the period between 2010-2012, the gross average revenue of pepper was estimated in 31,635€ per year, (medium price 8.55€ times the average production 3.7t). Despite some constraints, like the illegal flow of pepper from VC2 to VC1, which was estimated in 12% in 2016, pepper exports have been increasing its share on the national economy (Table 10).

Social description

For social description, the VCA4D provides six variables (working conditions, living conditions, social capital, food and nutrition security, gender equality, and land and water rights) to carry out the social analysis. Thus, on (Table 12), the available data was organized based on these six variables. The social analysis shows similar results for both VC1 and VC2 (Table 12), which is expectable based on all described evidence. The access to communities is a key factor for agribusiness development, requiring better and new roads. On VC2, given the bad roads conditions, the access to the communities is longer and detrimental to the maintenance of means of transports. Food and nutrition security should be promoted through the consumption of local products. Nutrition education should lead to good food practices such as vegetables consumption, varied diet, and promotion of livestock, especially in isolated communities. The cooperative has been supporting the women producers in most heavy tasks, which is an incentive for work conditions conversion. It is also an important social measure because, according to the cooperative staff, households head by women show a positive impact on revenue. Mostly, the public concession is the main type of land tenure for both certified and non-certified organic pepper producers, because most of them are former state dependents. There is not any legal framework for water use in irrigation, nevertheless, in the coming years; any large-scale irrigation project will need a previous study of adequate legislation.

Environmental description

The environmental analysis seeks to evaluate the effects of activities and products of a VC on public health and the environment. Neither VC1 nor VC2, the producers, apply chemical synthesis fertilizers, and in VC2, the production

Table 12. Social analysis of VC1 and VC2.

Chains	Work conditions	Living conditions	Social capital	Food and nutrition security	Gender equality	Land and water rights
VC2	Manufacture; Processors employees have individual protection equipment (glove, musk and boots).	Owner house; Isolated community (bad roads conditions).	Producers' type: former state producers; medium entrepreneur and hired workers.	Higher in urban zone than rural due to the access and eating habits.	Women producers (35%). Support of cooperative for heavy tasks (e.g. ground preparation).	Land tenure: public concession. There is not any law for water use.
VC1	Manufacture.	Owner house; Closer to the cities and public services.	Producers' type: former state producers; medium. Entrepreneur and hired workers.	Diet is based on consumption of products from farms and livestock.	Women producers (10%).	Land tenure: public concession. There is not any law for water use.

Source: CEPIBA; Almeida, 2012; CISCOS, 2016.
[1] Former state producers – After independence in 1975, private farms were nationalized, and the farmers become public servants. This system remained until 1980s when it began to distribute farms among these farmers.

Table 13. Swot analysis for entire pepper value chain in STP.

Strengths	**Weaknesses**
Woman emancipation	Trust
Quality of product	Centralized management of the cooperative
Obtaining plant material	Geographical and numeric distribution of farmers
	Low productivity
	Lack of public institutional and extension services
Opportunities	**Threats**
New interest in agricultural activities	International market uncertainty
New demand for local quality products	Lack of infrastructures
Production growth	Climate change
Growth of tourism	Missing of market regulation

is organic, aiming the protection of earth systems such as land and water. And as the pepper system is multi-culture, there is a favourable environment for biodiversity and its development. The price of pepper in VC2 for the international market is higher than the conventional one, expecting that this price reflects the real social, environmental, and economic cost of pepper for the local farmers and their communities.

Swot analysis

Based on the analysis in (Table 13) the need for a strategy to address at least the problems of climate change negative effects, the reinforcement of cooperatives and public structures is quite evident. Reforms in the national agri-food system and management of CEPIBA are also crucial for agribusiness development. Finally, the local market regulation and opportunities should not be disregarded.

CONCLUSION

In STP, the local agribusiness is quite undeveloped for pepper, as well as for coffee and cocoa. However, the development of VC is an opportunity to join all stakeholders (government, NGO, farmers, donors, private sector, etc.) and find solutions for key problems such as support infrastructures, research and development, credit, and technological changes. Despite similarities between sub-chains VC1 and VC2, the differences in trade conditions are clearly favourable to VC2 due to the access to the more profitable markets. In addition, the access of VC2 producers to these markets is only possible due to the established PPP financed by international organizations (e.g., IFAD). However, the local VC can be improved by building national platforms for share and disseminate knowledge, address

the public and donors' funding to maintain the support infrastructures and, more training and sustainable practices. For the market, we suggest the certification for pepper sellers, a partnership among informal producers who cannot participate in the cooperative, with public support try to develop formal trade circuits with neighbour countries and program to promote managerial skills among small traders.

ACKNOWLEDGMENTS

We thank the International Rice Research Institute for the scholarship provided and CEPIBA by the collaboration and data provided.

Authors' declaration

We declared that this study is an original research by our research team and we agree to publish it in the journal.

REFERENCES

Adekunle AA, Fatunbi AO (2012). Approaches for setting-up multi-stakeholder platforms for agricultural research and development. *World Applied Sciences Journal*, 16 (7):981-988.

AICEP (2017a). São Tomé e Príncipe, Alimentação e Bebidas – Breve apontamento. Mercados, informação setorial. *aicep Portugal Global*.

AICEP (2017b). São Tomé e Príncipe, Alimentação e Bebidas, Breve apontamento. Mercados, informação global. *aicep Portugal Global*.

Almeida JFC (2012). *Consumo e Segurança Alimentar em São Tomé e Príncipe: Estudo de caso no distrito de Água-Grande*. Lisboa, Portugal. Instituto Superior de Agronomia, Universidade Técnica de Lisboa. Master thesis.

Armstrong LJ, Diepeveen DA (2011). Effective ICTs in agricultural value chains to improve food security: an international perspective. *World Congress on Information and Communication Technologies*. Mumbai, India.

Asenso-Okyere K, Mekonnen DA (2012). The importance of ICTs in the provision of information for Improving agricultural productivity and rural incomes in Africa. UNDP, Working paper 2012-015: January. Regional Bureau for Africa.

Bellù LG (2012). FAO VCA-Toll: a software for value chain analysis. Manual for Version 3.1. EASYPol Series 074. FAO, Rome, Italy.

BCSTP (2017). Relatório sobre a economia santomense 2017. Banco Central de São Tomé e Príncipe.

CISCOS (2016). Avaliação do programa "saúde para todos" em São Tomé e Príncipe no período 2005-2015. Departamento da Universidade de Saúde Pública, Faculdade de Ciências Médicas – Universidade de Lisboa.

Damanhouri ZA, Ahmad A (2014). A Review on Therapeutic Potential of Piper nigrum L. (Black Pepper): The King of Spices. *Med Aromat Plants*, 3 (161). DOI: 10.4172/2167-0412.1000161.

Departamento de Estudos Sócio-Económicos - DESER- Secretaria de Agricultura Familiar/MDA – Convénio MDA 112/2006. A Cadeia Produtiva da Pimenta. 2008. Curitiba, Brasil.

(EC) European Commission (2017). Value Chain Analysis for Development (VCA4D). Providing Value Chain Analysis for improving operations. Why? What? How? *Directorate General International Cooperation and Development – EuropeAid*. Rue de la Loi 41 B-1049 Brussels.

Ferrão JEM (1993). *Especiarias: Cultura, tecnologia e comércio*. Ministério do Planeamento e da Administração do Território – Secretaria de Estado da Ciência e Tenologia – Instituto de Investigação Científica Tropical.

FiBL (2017a). Organic Agriculture Worldwide 2017: Current Statistcs. Helga Willer and Julia Lernoud, Frick, Switzerland.

FiBL (2017b). Media kit, The World of Organic Agriculture 2017. BIOFACH and VIVANESS press conference 2017. Helga Willer and Julia Lernoud.

FiBL, IFOAM (2013). The World of Organic Agriculture, Statistics and Emerging Trends. Frick and Bonn.

Fonseca CMB, Coelho JC, Soares FB, Correia AMNG (2019). Value chains analysis: Overview and context for development. *Direct Research Journal of Agricultural and Food Science*, 7 (12):356-361. DOI: https://doi.org/10.26765/DRJAFS13808532.

Fromm I (2007). Upgrading in agricultural value chains: the case of small producers in Honduras. GIGA Research Programme: Transformation in the Process of Globalization. Working paper nº 64.

Furuholt B, Matotay E (2011). The development contribution from mobile phone across the agricultural value chain in rural Africa. *The Electronic Journal of Information Systems in Developing Countries*, 48 (7):1-16.

Garcia-Yi J (2017). Willingness to pay for organic and fairtrade certified yellow chili peppers. *British Food Journal*, 117 (2):929-942 http://dx.doi.org/10.1108/BFJ-11-2013-0321.

GTZ (2007). ValueLinks Manual – the methodology of value chain promotion.

Hassler M, Franz M (2012). The bringing role of international intermediaries in food production networks: Indian organic pepper in Germany. *Tijdschrift voor Economiche en Sociale Geografie*, 104 (1):29-40.

Homma AKO (1981). Oferta e demanda de pimenta-do-reino a nível mundial; perspetivas para o Brasil. Miscelânia, nº 8. Belém, Pará. ENBRAPA-CPATU.

Humphrey J, Navas-Alemán L (2010). Value chains, donor, interventions and poverty reduction: a review of donor practice. Institute of Development Studies. Research report nº 63.

INE-STP (2014a). Contas Nacionais Preliminares: ano 2014. Provisório para 2014. *Departamento de Contas Nacionais, Instituto Nacional de Estatísticas*.

INE-STP (2014b). Estatística Do Comércio Externo, ano de 2013. *Núcleo de comércio externo, Instituto Nacional de Estatística*.

INE-STP (2015). Estatística Do Comércio Externo, ano de 2014. *Núcleo de comércio externo, Instituto Nacional de Estatística*.

INE-STP (2016). Estatística Do Comércio Externo, ano de 2015. *Núcleo de comércio externo, Instituto Nacional de Estatística*.

INESTP (2017). Estatística Do Comércio Externo, ano de 2016. *Núcleo de comércio externo, Instituto Nacional de Estatística*.

INE-STP (2018). Estatística Do Comércio Externo, ano de 2017. *Núcleo de comércio externo, Instituto Nacional de Estatística*.

Jose S (2009). Agroforest for ecosystem services and environmental benefits: an overview. *Agroforestry Systems*, 76 (1):1-10. DOI: https://doi.org/10.1007/s10457-009-9229-7.

Junior JFCC, Lima JM, Silva ALP, Nascimento MNCF (2017). Análise de mercado da pimenta do reino no período de 1990 a 2015. *Tecnologia e Ciência Agropecuária*, 11 (6):139-145.

Kaplinsky R (2000). Globalization and unequalisation: what can be learnt for global value chain analysis). *Journal of Development Studies*, 37 (2):117-146.

Kotler P, Armstrong G (1987). *Marketing: an introduction* – second edition. New Jersey, USA. Prentice – Hall International Editions.

La Porta R, Shleifer A (2011). The Unofficial Economy in Africa. *National Bareua of Economic Research*. Working Paper nº16821. 1050 Massachusetts Avenue, Cambridge, MA 02138.

Lima JSS, Oliveira RB, Rocha W, Oliveira PC, Quartezani WZ (2010). Análise de Atributos Químicos do Solo e da Produção da Cultura Pimenta-do-Reino (*Piper nigrum* L.). *IDESIA*, 28 (2):31-39.

Lourinho MP, Costa CAS, Souza LC, Souza LC, Neto CFO (2014). Conjuntura da Pimenta-do-Reino no Mercado Nacional e na Região Norte do Brasil. *Enciclopédia Biosfera, Centro científico conhecer*, 10 (18):1016-1031.

Mattern M, Ramierez R (2017). Diditizing value chain Finance for smallholder farmers. Focus Note nº106. Washington, D.C.:CGAP, April.

MAP (1980). I Seminário Nacional sobre a Reforma Agrária e o

Desenvolvimento Rural. Ministério da Agricultura e Pesca de STP.
Montagnini F, Nair PKR (2004). Carbon sequestration: An underexploited environmental benefit of agroforestry systems. In: Nair P.K.R., Rao M.R., Buck L.E. (eds) New Vistas in Agroforestry. *Advances in Agroforestry*, 1. Springer, Dordrecht.
Mtega WP, Msungu AC (2013). Using information and communication technologies for enhancing the accessibility of agricultural information for improved agricultural production in Tanzania. *The Journal of Information Systems in Developing Countries*, 56 (1):1-14.
Nelson SC, Cannon-Eger KT (2011) (revised). Farm and Forestry Production and Marketing Profile for Black Pepper (*Piper nigrum*). In: Elevitch, C.R. (ed.). Specialty Crops for Pacific Island Agroforestry. Permanent Agriculture Resources (PAR), Holualoa, Hawai'i. Available at: http://agroforestry.net/scps.
OECD/FAO (2016). Agriculture in Sub-Saharan Africa: Prospects and challenges for the next decade, in *OECD-FAO Agricultural Outlook 2016-2025*, OECD Publishing, Paris. DOI: http://dx.doi.org/10.1787/agr_outlook-2016-5-en.
PAPAFPA, FIDA (2011). Estude de la Filiere Poivre a Sao Tome e Principe – Situação Actualle et Perspectives. Rappor final. Axes Strategiques Pour le Développement D´une Filiere Poivre Biologique. Jean Zaslavsky.
Parvathi P, Waibel H (2013). Fair trade and organic agriculture in developing countries: A review. *Journal of International Food and Agribusiness Marketing*, 25 (4):311-323. DOI: 10.1080/08974438.2013.736043.
Parvathi P, Waibel H (2015). Is organic agriculture and fair-trade certification a way out of crisis? Evidence from black pepper farmers in India. German Association of Agricultural Economists, 55th Annual Conference, Giessen, Germany, September 23-25. DOI: 10.22004/ag.econ.209209.
ReportBuyer (2018). Global Organic Spices and Herbs Market Research Report – Forecast to 2023. CISION. https://www.prnewswire.com/news-releases/global-organic-spices-and-herbs-market-research-report---forecast-to-2023-300631324.html (31/05/2018).
Reardon T (1998). African agriculture: productivity and sustainability issues. Eicher, CK, Staatz, JM (eds). *International Agricultural Development, third edition*. Maryland, USA. The Johns Hopkins University Press. Pp.444-457.
Schmitz H (2005). Value Chain Analysis for Policy-Makers and Practitioners. International Labour Office. Geneva, Switzerland.
Trienekens JH (2011). Agricultural Value chains in developng countries : a framework for analysis. International Food and Agribusiness Management Review, 14 (2).
UNCTAD (2003). Organic Fruit and Vegetables from the Tropics, Market, certification and production information for producers and International trading companies. UNCTAD/DITC/COM/2003/2, New York.