The pineapple value chain in Suriname

Diagnostics, investment models and plan of action for innovation and development

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List of Acronyms

3ADI+ – Accelerator for Agriculture and Agro-industry Development and Innovation project
ADEKUS – Aanton De Kom University of Suriname
ASFA – Association for Surinamese Manufacturing Companies
BPS – Bio Pineapple Suriname
CARICOM – Caribbean Community
CARDI – Caribbean Agricultural Research and Development Institute
CELOS – Centre for Agricultural Research in Suriname
EPA – Economic Partnership Agreement
FAO – Food and Agriculture Organization of the United Nations
FSA – Suriname Farmer's Federation
GAP – Good Agricultural Practices
HIT – Ministry of Trade, Industry and Tourism
IDB – Inter-American Development Bank
IGSR – Institute for Graduate Studies and Research
IICA – Inter-American Institute for Cooperation on Agriculture
IQF – Individual quick freeze
ISO – International Organization for Standardization
ITC – International Trade Centre
KKF – Chamber of Commerce
LVV – Ministry of Agriculture, Animal Husbandry and Fisheries
RO – Ministry of Regional Development
SAMAP – Suriname Agriculture Market Access Project
SMEs – Small and Medium-sized Enterprises
SBF – Suriname Business Forum
SCF – Suriname Candied Fruits
SDGs – Sustainable Development Goals
SPS – Sanitary and Phytosanitary
SSB – Suriname Standards Bureau
SWOT – Strengths, Weaknesses, Opportunities, Threats
UNIDO – United Nations Industrial Development Organization
VC – Value chain
VEAPS – Association of Exporters of Agricultural Products Suriname
VSB – Suriname Business Association
WTO – World Trade Organization

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Executive Summary

Context

The **Accelerator for Agriculture and Agroindustry Development and Innovation** (3ADI+) is a programme for promoting partnerships to achieve the sustainable development goals (SDGs), spearheaded by the Food and Agriculture Organization of the United Nations (FAO) and the United Nations Industrial Development Organization (UNIDO). The objective of this programme is that people in developing countries improve their livelihoods via sustainable agriculture and agroindustry, thereby contributing to the achievement of the SDGs. The programme began at the beginning of 2018 in three pilot countries - Bangladesh, Suriname and Tanzania. In Suriname, the International Trade Centre (ITC) is a key partner.

The pineapple value chain is a priority sector for the Government of Suriname to drive the diversification of the economy, which has been largely dependent on the extractive industry, forward. The recent decreasing global demand for aluminium and sharp declines in the market prices for oil and gold have put pressure on the Government to rethink its economic model. To this purpose, agriculture and agribusiness have been identified as key areas for development, with pineapple being one of the commodities of focus.

Over the past year, in collaboration with the Ministry of Agriculture, Animal Husbandry and Fisheries (LVV), the Ministry of Trade, Industry, and Tourism (HIT), and the Ministry of Regional Development (RO) of the Government of Suriname, 3ADI+ has engaged with representatives of local institutions, service providers, and actors at all stages of the value chain to analyse the strengths and weaknesses of the pineapple sector. On the basis of the diagnostic findings, a 2030 vision for an upgraded value chain was proposed, which has gathered widespread buy-in. Further, business models for upgraded farming and processing operations, as well as an action and investment plan, were developed for the Surinamese pineapple value chain.

Value chain diagnostic findings

In recent years, a growing consumer demand for sustainable pineapple products has been evidenced on the international market. The conventional market for fresh pineapple products is dominated by vertically integrated stakeholders, who produce at low costs and are highly competitive due to economies of scale. This market is characterized by overproduction, which is mainly driven by the largest pineapple producer Costa Rica. As a consequence, there has been a steady price decline and high price volatility. In addition, conventional pineapple production has caused serious environmental problems in the past due to, amongst others, the intensive application of agro-chemicals and the depletion of water resources. In this context, there has been an increasing demand for more sustainable pineapple products. Niche markets such as fair trade and organic offer promising market opportunities.

The pineapple value chain is a priority sector for the Government of Suriname to drive the diversification of Suriname's economy forward. Suriname's economy is largely dependent on its extractive industry: gold, oil and aluminium. The recent decreasing global demand for aluminium and sharp declines in global market prices for oil and gold have put pressure on the Government to rethink its economic model. In this context, the Government of Suriname adopted the *Policy Development Plan 2017-2021* with an overall objective to enhance the country's social and economic resilience through sector diversification. To this purpose, agriculture and agribusiness have been identified as they key development areas, with pineapple listed amongst one of the prioritized commodities.

The pineapple sector in Suriname presents substantial growth and market potential. Suriname has a great potential for expanding its pineapple sector and for developing it into a promising source of income and employment. Suriname has suitable agro-ecological conditions for pineapple cultivation and a large diversity of local, unexplored pineapple varieties cultivated primarily by the indigenous populations. Although the area of pineapple production in Suriname remains small, the genetic diversity is extraordinary. Further, the country possesses sufficient physical space for the expansion of production in areas that are not covered by primary forests.

At the moment fresh and processed pineapple products are sold exclusively on the domestic market. The largest share of the pineapples in Suriname is sold fresh, either by street or market vendors. However, given the fact that the Surinamese market for pineapples is limited in terms of its size, the identification of international market opportunities is a precondition in order to facilitate the development of the sector. On the one hand, the international market for fresh conventional pineapples is very competitive and given the lack of economies of scale, low productivity and high production costs, it is unlikely that conventional Surinamese fresh pineapples will become competitive globally within the next few years. On the other hand, because pineapples in Suriname are, to the largest part, cultivated in traditional production systems without the application of chemical inputs, the Surinamese pineapple sector provides excellent opportunities for fulfilling the unmet demand for sustainable pineapple products on international niche markets.

Nonetheless, pineapple production in Suriname is in a rudimentary state and faces several obstacles. Most producers cultivate pineapples in a traditional way and practice shifting cultivation. Some practice mono-cropping, some inter-crop pineapples with cassava, and some cultivate pineapples in an agroforestry system. They are scattered in different regions along the Savannah Belt, although the most market-oriented ones are concentrated in the Carolina region, particularly in the indigenous villages of Redi Doti, Pierre Kondre, and Powakka. They monocrop pineapples on a farm of two-three hectares on average, and some also practice crop rotation. Even amongst these producers, little farm management and good agronomic practices are applied, and knowledge on and experience in commercial pineapple production are limited. Although there seems to be an established body of traditional knowledge in the various communities, there is little scientific research into pineapples and extension service with a focus on pineapple production. Productivity and efficiency at the farm level have remained very low, especially when compared with lead players in the industry. In addition, pineapple production in Suriname is seasonal. This seasonality drives prices down during the harvest season, while during the off-season pineapples are mostly imported from neighbouring Guyana. Some farmers have only started to see pineapple farming as a business, and some are interested in forming cooperatives to have more bargaining power.

Equally, the processing sector is at an incipient stage of development and in order to create value addition, substantial upgrading is required. There are small family businesses that make and sell drinks from pineapples, such as juices, smoothies, and wines, as well as pineapple cakes; however, the quantity of pineapples used is negligible and large-scale industrial processing have not been explored. Recently, a candied pineapple processing company has emerged as the pioneer. They have developed outgrower contracts with a number of farmers from different villages in the Carolina region. While their operation is much larger in comparison with the artisanal shops in the country, it remains very small-scale for international standards. Furthermore, due the seasonality of pineapple production in Suriname, year-round processing is at present not possible without imports. Overall, the processing segment of the Surinamese pineapple value chain is still characterized by low levels of technological development and innovation. Large investment is essential to foster a breakthrough.

The infrastructure required for facilitating the development of the pineapple value chain is underdeveloped. While the main highways connecting the pineapple region and the capital, including the airport and harbour, are in fair condition, pineapple fields are often located along unpaved, tertiary roads, which deteriorate during the rainy season. Furthermore, high airfreight costs and complicated maritime connections hinder the competitiveness of Surinamese pineapples, if exported. There are no cooling facilities to maintain good quality and prolong the pineapple's shelf-life. No storage facilities or collection centres exist. Commercial nurseries are non-existent and little data is available on the local pineapple cultivars, in terms of their organoleptic properties (e.g. acidity and brix value) and physical characteristics (e.g. texture and susceptibility to damage during transport and handling).

The development of the pineapple sector is also hampered by a lack of cooperation between different value chain stakeholders. Different ministries, knowledge institutes and NGOs are engaged in improving different aspects of the pineapple value chain. However, information on knowledge created, analysis carried out, activities undertaken, and initiatives planed are, in general, not widely disseminated and coherently communicated. This represents a missed opportunity for creating important synergies and building up a common knowledge and database. Besides, value chain stakeholders are not interacting with each other in an organized and structured manner, for example through multi-stakeholder platforms, and no common development goal or strategy has been defined to guide the sector.

Large investment in the pineapple sector is needed, yet if not carefully and strategically planned, monitored and evaluated, they can have adverse effects on the environment and on social structures. As has been observed in large pineapple producing countries, negative environmental impacts such as groundwater and aquifer contamination, soil erosion, deforestation and biodiversity loss result from, amongst others, the intense use of agrochemicals and the cultivation of pineapples in monocultures. In addition to considering environmental risks, an upscaling of the pineapple production and processing in Suriname also needs to ensure the inclusion of the local communities and disadvantaged groups, especially female farmers in benefiting from these developments.

Recommendations

In order to facilitate the inclusive and sustainable development of the pineapple value chain in Suriname, an integrated development strategy to simultaneously tackle binding constraints is needed, which may include the following main activities:

1. **Establish a multi-stakeholder platform to strengthen value chain cooperation and address key enabling environment challenges**. The platform, which will comprise of representatives of value chain actors, from producers, processors to distributors, as well as relevant stakeholders and public entities, including the Ministries, university and research institutes, international organizations and NGOs, will give a common voice to the pineapple sector. It will facilitate public-private dialogue on policy and general issues affecting the value chain, as well as foster information exchange and trust between value chain actors that leads to more effective coordination.

2. **Establish a Pineapple Innovation Hub to consolidate sector-wide knowledge and efficiently link value chain actors to support services**. The hub will provide services such as technical expertise, trainings and market intelligence, in collaboration with international experts, public extension and existing research institutes in the country. As such, it is destined as a one-stop shop to generate and

centralize knowledge about pineapple production and trade in Suriname, as well as a research and training centre for agri-entrepreneurs and lead farmers.

3. **Assist the set-up of private service businesses that support functions along the value chain**. While some key support services are provided by the Pineapple Innovation Hub at the start, it is expected that private operators will gradually take over a number of services, such as the provision of organic fertilizer and pesticide, artificial flowering induction, irrigation and other equipment. Business plans to proof the economic viability of such services will be supported.

4. **Develop different upgrading options for pineapple producers, validate and adjust the improved production models on demonstration plots at the Pineapple Innovation Hub, and support farmers in adapting them**. Productivity and quality, as well as the protection of natural resources, should be enhanced with the application of best agronomic practices. For farmers that supply to processing factories, permanent production systems should gradually replace shifting cultivation, accompanied by irrigation and flower induction to achieve year-round yields. During the validation period of the demonstration plots, farmers will be sensitized to best practices in pineapple production and farm management, including record keeping and administration of costs. After the validation period and after the improved models have been adjusted and adapted to the Surinamese conditions, the positive experiences will be spread and scaled up.

5. **Develop plans and criteria for sustainable expansion of production areas.** Soil analysis of designated areas need to be conducted to determine their suitability for pineapple production. Equally, the expansion of pineapple farmland must be carefully monitored to curb deforestation rates and other adverse impacts on the environment. It must be in accordance with the National Development Plan while considering social factors, such as village customary land rights and approval of local communities. Producers will progressively be encouraged and supported in the establishment of permanent production systems, while the practice of slash and burn should be limited.

6. **Support the aggregation of small holders and strengthen vertical and horizontal linkages through different mechanisms, such as the set-up of farmer associations and contract farming**. The organization of smallholders to facilitate better access to inputs, services, and markets is crucial to the implementation of improved business models in both production and processing, as well as entrance to certified and high-value markets. Technical assistance will be provided for farmers who wish to set up cooperative or other types of associations, and trainings on cooperative and farmer organization management, covering issues such as contract negotiation and collective marketing, will be delivered through the Hub.

7. **Promote private sector investment in the establishment and improvement of processing facilities, including those owned and co-owned by groups of farmers, and support agri-entrepreneurs to access funding.** An increase in production and productivity must be strategically accompanied by an improvement in processing capacity. Given the incipient stage of the processing segment**,** low and medium investment options, such as dried pineapple and fresh cut pineapple, should be first and foremost explored. Finance could be the primary constraint to processors at the starting phase, as next to purchasing produce in bulk from farmers they must make substantial investments in equipment and workforce. Therefore, processors, especially small entrepreneurs, will be assisted in developing sound proposals to be submitted to different funding sources, including development banks, development projects with matching grants, and commercial banks.

8. **Effectively commercialize Surinamese pineapples and pineapple products in new and existing markets**. Surinamese pineapple value chain actors will be supported to gain access to local, regional and global markets. Detailed analysis of high potential markets will be carried out, lists of potential buyers will be compiled and concrete requirements will be obtained, in view of getting a clear understanding of market demands. Communication between the multi-stakeholder platform and global buyers/distributors will be explored to spark interests in Surinamese pineapple varieties.

9. **Build capacities of public extension officers and enhance the public sector capacity for food safety and quality control.** Training courses specifically targeted at extension officers will be organized through the Hub, together with the different Ministries to facilitate capacity building of public extension officers in organic and conventional pineapple farming techniques in particular, and good agricultural production practices and agribusiness development in general. It is also paramount that public investment be prioritized for the agricultural extension reform, so that extension officers have adequate information and technical capacity to support value chain actors. In addition, the project will assist food control agencies to strengthen food safety regulations in compliance with internationally recognized standards and enforce quality control at the national level.

10. **Facilitate investment in infrastructure for export competitiveness.** In addition to the improvement of "soft" skills and capacities, the pineapple sector can only achieve success if "hard" infrastructures are in place to support the flow of products along different nodes in the value chain. Public planning and investment must prioritize infrastructural needs to lift Suriname's key disadvantages in terms of roads, ports, and electricity, which will not only benefit the pineapple sector but also beyond.

Introduction

The pineapple has strong historic ties to Suriname. Originating from tropical South America, at least some varieties, notably the Smooth Cayenne, are assumed to have been developed, going back at least 8,000 years, from small-fruit ancestral plants by Amerindians in the Guiana Highlands, which include parts of Suriname (Clement et al, 2010)[1]. The richness of cultivated varieties in Suriname even includes some that are grown specifically for extracting fibre (e.g., for the manufacture of hammocks, fishing nets or clothing). In the 17th century, Dutch traders operating from Suriname were most likely also among the first to introduce the then highly prized pineapple to European consumers.

With the first pineapple plantations emerging in Hawaii at the end of the 19th century, Suriname started experiments with commercial pineapple production in its coastal plains and savannah soils in the 1930s. While the latter were found to be too nutrient-deficient, production at scale started in the coastal area. However, shipping of fresh pineapples to the Netherlands was generally not successful. From 1941 to the 1950s, an industry to process pineapple into juice and canned fruit emerged, but this ended in the 1950s for unknown reasons, probably due to a lack of competitiveness.

Pineapple production in Suriname then largely fell back to low-input low-output production on small family farms, largely by the Amerindian population in the Savannah belt. This quasi-organic production approach has positive aspects, such as low incidence of diseases and pests, as well as negative aspects, including the nutrient deficiency of the soil. Pineapples were mainly sold fresh in the local market. No processing took place beyond artisanal applications (e.g., fresh juice, wine). Varietal and fertilization experimentation continued to take place throughout the 1950s to 1970s, but this declined after independence and knowledge on modern pineapple production and handling practices available to farmers from public extension is practically absent today. From time to time, a new study emerged that looked into the potential for industrial pineapple production for export, but these did not lead to implementation. With relative stability in its forest cover, Suriname maintained its richness in pineapple varieties throughout this period.

Renewed interest in establishing a modern pineapple value chain emerged in recent years (since the mid-2010s) through collaborative efforts by the private and public sectors. On the private sector side, this includes the emergence of small mono-cropping pineapple farms and the emergence of a formal processor, who introduced a supply program with pineapple producers from the Amerindian communities in the savannah belt. On the public sector side, the development of a pineapple value chain targeting export markets has been prioritized by several ministries, most notably the Ministry of Trade, Industry and Tourism (HIT) and the Ministry of Agriculture, Animal Husbandry and Fisheries (LVV). This led to the initiation of several donor-funded projects that either specifically focus on pineapple or include pineapple as one of their target crops.

It is in this collaborative and entrepreneurial environment that this report was developed under the Accelerator for Agriculture and Agro-Industry Development and Innovation (3ADI+) program. 3ADI+ is an open partnership platform for sustainable agri-food value chain development, led by FAO and UNIDO. Suriname was included in its pilot-testing, which was further supported by ITC. What 3ADI+ brings to the table is an in-depth analysis, including extensive fieldwork by a team comprising of international experts from the three organizations and a national coordinator, using best practices of the pineapple value chain and the translation of this understanding into an integrated action and investment plan to realize the vision jointly developed with the stakeholders. Apart from supporting the technical and integrating aspects, 3ADI+ plays an

[1] The name “ananas” is derived from the Amerindian name of “nana”.

important facilitating role. The latter refers to the strengthening of a range of linkages: between various ministries, between private sector actors, between the public and private sectors, between different projects, between Surinamese and overseas firms and organizations, and between those who need access to finance and those who can provide it. Throughout these technical, integrating and facilitating roles, the program promotes a process that contributes to the country's SDGs achievements.

Methodology

This report is based on the 3ADI+ value chain development model, which takes a systems approach that combines the FAO (2014)'s Sustainable Food Value Chain framework with the UNIDO (2011)'s approach to Industrial Value Chain Development. It consists of two main components: a diagnostic study (sections 1 and 2) and a development plan (sections 3 and 4).

Diagnostic study

The diagnostic study is organized around three main components. The first component is the end-market analysis (retail and final consumer), as the identification of viable market opportunities and the specifics of their nature are the starting point of the approach. Data on the end-markets (both domestic and export), were obtained through key informant interviews (including with overseas importers), a consumer survey (150 consumers across four districts, interception in markets and shops), a survey of wholesalers and retailers (around 30 in Nickerie and Paramaribo, convenience sampling), observation (markets in Suriname and Europe), existing reports and publications, and ITC's Trade Map data.

The second component is a functional analysis which includes a mapping of the value chain followed by the analysis of four layers: (1) the core value chain (producer to consumer, products supplied, sizes, technologies, financing, management, profitability, level of formality, etc.); (2) support services provision (physical inputs, finance, knowledge, labour, and other services); (3) the societal environment (policies and regulations, infrastructures, organizations, socio-cultural elements); and (4) the natural environment (water, soils, biodiversity, climate, etc.). This analysis looks at the current structure, how and why this structure is changing (dynamics) and what drives the behaviour of the actors (incentives and capacities). Data for this analysis was obtained through key informant interviews (for all types of stakeholders), statistical data, observation (farm, factory, and market visits), extensive desk review of publications and reports, stakeholder workshops (inception, validation) and studies performed by technical experts (e.g., studies comparing the Suriname situation to global or regional practices and benchmarks).

The third component looks at the systemic elements (systems analysis) and is broken down into four sections: governance, margins, sustainability dimensions, and SWOT analysis. *First,* governance refers to the analysis of the relationships between the core actors in the value chain and how these, in combination with intrinsic characteristics, explain the behaviour and intentions of the actors. This includes, for example, how farmers sell to their buyers in terms of standards, price setting, payment terms, and so on and how this is influenced by factors such as market power, government regulation and end-consumer demand. *Second,* a basic margin analysis breaks down the value-added generated (gross margins) in the chain by type of core actor (functional – from producer to retailer). *Third,* the performance of the value chain is assessed along the three dimensions of sustainability. In terms of economic sustainability, we look at overall competitiveness, employment, tax generation, profitability, consumer benefits and economic externalities. In terms of social sustainability, we look at dimensions such as gender, youth, employment conditions, nutrition, and so on. In terms of environmental sustainability, we look at carbon emissions, water, soils, biodiversity, food loss and waste, and

so on. The goal is to identify, quantify and explain the main sustainability hotspots (most critical issues). Fourth, the main findings are summarized using an analysis of the main strengths, weaknesses, opportunities and threats (SWOT). The data for the systems analysis comes from the same sources as indicated for the functional analysis, and as before, looking at the current situation and wherever feasible, at the trends and their drivers.

Development Plan

The process toward a development plan starts from the creation of an inspiring vision and an associated set of SMART[2] goals, for example in terms of exported volumes or jobs created. This vision and its associated goals have to be based on both realistic assumptions and private and public sector interests and buy-in. They are derived from a 3ADI+ facilitated consultative process (through stakeholder validation workshops and individual meetings with key actors) that builds on the SWOT analysis.

Next, a core strategy is developed that lays out in broad terms what needs to happen to realize the concrete shared goals. Working back from specific end-market targets, this implies an integrated set of specific upgrading activities at the core actor level (farms, processors, etc.), at the support provider level (input suppliers, banks, etc.), and/or at the enabling environment level (e.g. policies, regulations, natural resource management). Upgrading here refers to new or more sophisticated technologies, products, markets, standards, management systems, organizations, policies, services, loan products, regulations, infrastructures, and so on. These upgrading options are either derived from global best practices adapted to the situation at hand, or represent unique solutions prepared by experts in the particular upgrading area. The validity of these solutions typically needs to be assessed during the early stages of the action plan implementation. At the level of the individual agribusiness, the economic viability of the upgraded business model is assessed using a basic financial analysis.

At the aggregate level, the set of upgrades represents the value chain development plan. The realization of the latter is then translated into the overall investment plan that is needed to realize the vision, combining different investments from the private sector, the public sector and development partners. The investment plan will also have to indicate the anticipated financing mechanisms, often a blend of equity investments, loans and grants, and the associated financial tools to reduce risk (e.g., loan guarantees) or incentivize early-adopters (e.g., soft loans). Further, part of the investment plan, typically supported through a grant, is the funding for a 3ADI+ partnership program. This program will provide facilitation services to guide stakeholders through the process and to ensure an effective and adaptive implementation of the action plan. Adaptive here refers to a continuous process of monitoring (behaviour), evaluating (impact), learning (why) and redesigning (if it does not work) or upscaling (if it does work). Part of the program will also be to provide technical assistance to various value chain actors to translate their upgrading plans into a pipeline of bankable and SDG-compliant investment projects and, in complement, to assist financial institutions to develop and offer financial products for these SDG-compliant upgrading options. Technical assistance will also be provided to the public sector in terms of upgrading that removes bottlenecks from the enabling environment or introduces new elements that are conducive to sustainable investments.

If it does not already exist, a commodity platform needs to be created that allows for all the value chain stakeholders, both public and private, to engage in an inclusive discussion on common challenges and their most promising solutions, and as such allows for the continuous upgrading that is needed to adapt to change. This platform, linked to a range of technical assistance and other service providers, will gradually replace the 3ADI+ partnership program and ensure institutional sustainability.

[2] Specific, Measurable, Attainable, Relevant, and Timely.

1. End-market and functional analysis

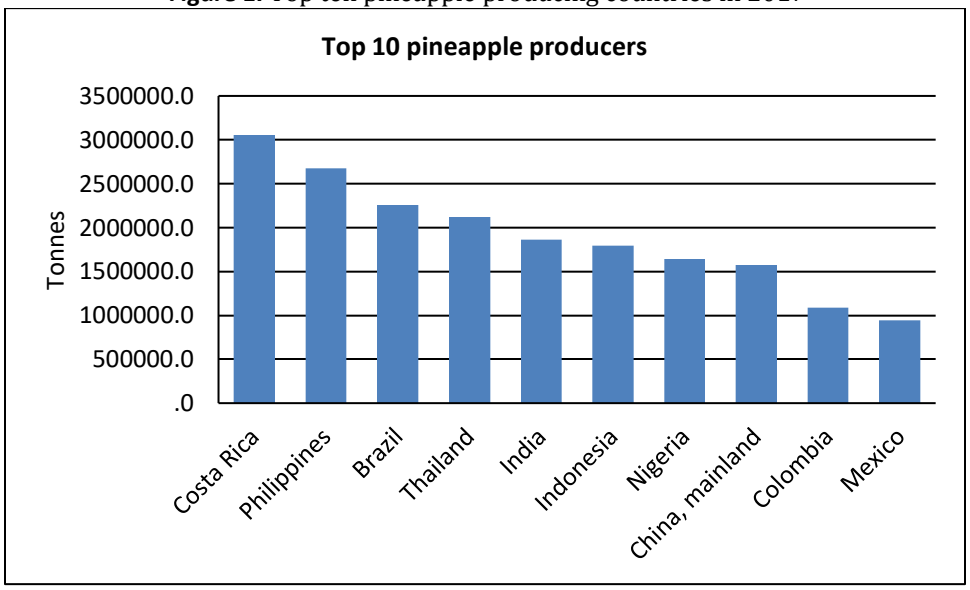
1.1 End-market analysis

At the moment, Surinamese pineapple products are sold exclusively on the domestic market, mostly as fresh fruits. The international market, particularly for conventional pineapples and pineapple products, is highly competitive and dominated by a few big players. Nonetheless, important market opportunities exist and the Surinamese pineapple sector has the potential to position itself as key supplier in high quality niche markets. This section will provide insights into both the domestic and the international pineapple markets. Consequently, market opportunities for the Surinamese pineapple value chain will be evaluated.

1.1.1 International market

Over the past years, conventional pineapple production has expanded from 16 million tonnes in 2002 to 26 million tonnes in 2016, which represents an increase of 63 % (FAOSTAT, 2018). This strong increase, which in recent years has led to an oversupply of fresh pineapples, which is driven by a few countries such as Costa Rica and the Philippines (see Figure 1), where new and highly productive varieties like the MD2 pineapple are cultivated. This, in turn, has been accompanied by a decrease in prices in the destination markets and it is expected that this trend will continue in the near future. In addition, the market is characterised by strong market power of vertically integrated international players such as Dole, Del Monte, Chiquita, and others, who produce at low costs, are highly competitive due to economies of scale, and strongly influence international price developments.

Figure 1: Top ten pineapple producing countries in 2017



Source: FAOSTAT, 2018

World imports of fresh or dried pineapples have experienced an increase of almost 250% over the last 15 years, from 980,000 tonnes in 2001 to 3,368,200 tonnes in 2017. The demands for fresh or dried pineapples are concentrated in the United States, the European Union, Japan, China and India, together making up the top 10 destinations and accounting for approximately 70 % of the global import demand.

Figure 2: Top importers of fresh and dried pineapples in 2017

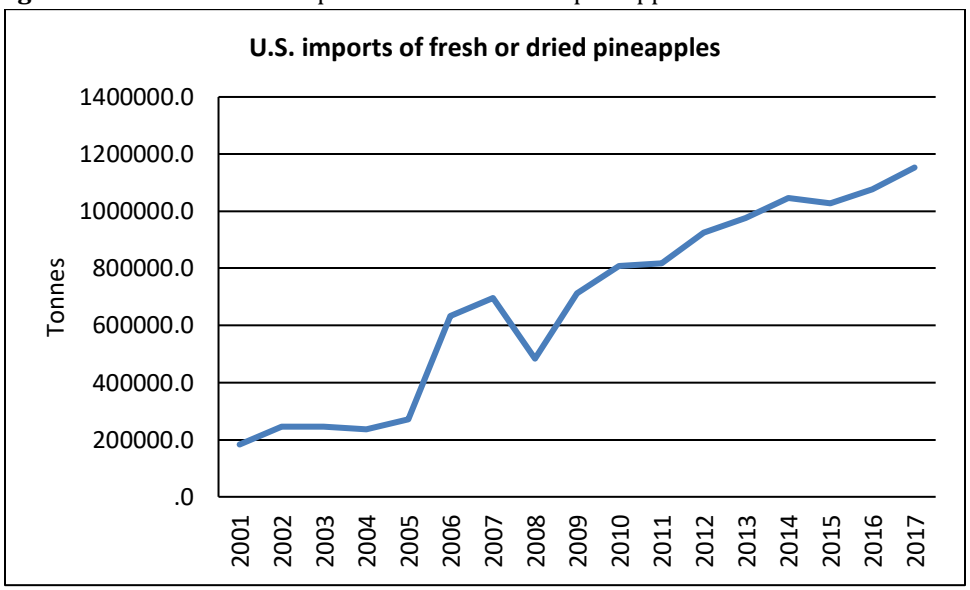
Importers	Imported value in 2017 [USD]	Imported quantity in 2017 [tonnes]	Share in value in world's imports [%]
U.S.	4,224,768	2,593,049	30.7
Netherlands	1,021,235	600,633	7.4
France	842,857	387,398	6.1
Germany	733,189	336,956	5.3
United Kingdom	689,997	391,013	5.0
Spain	508,155	322,056	3.7
Canada	498,013	291,35	3.6
China	425,918	264,148	3.1
Japan	376,968	227,427	2.7
India	344,507	386,898	2.5

Source: ITC, 2019

U.S. Market

In the United States, imports of fresh and dried pineapples show strong growth rates over the last 15 years. While imported quantities in 2001 amounted to less than 200,000 tonnes, in 2017 the U.S. imported close to 1.2 million tonnes of fresh or dried pineapples, an increase of 530 % (see Figure 3).

Figure 3: Increase in U.S. imports of fresh or dried pineapples between 2001 and 2017



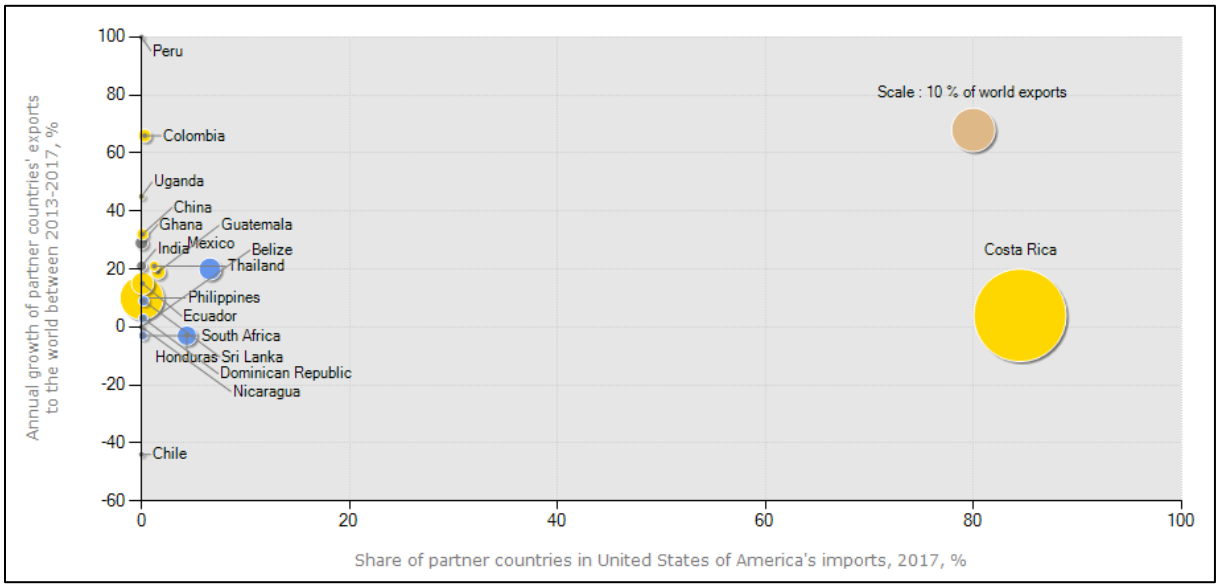
Source: ITC, 2019

The U.S. market is dominated by Latin American pineapples, complemented by domestic production. While Costa Rica is the largest supplier of pineapples to the U.S., alone making up 84 % of the supplies (see Figure 4), other important players on the U.S. pineapple market such as Mexico, Honduras, and Guatemala account together for 13 % of the total imports.

Consumer preferences in the U.S. indicate growing importance of fresh pineapples as opposed to canned pineapples. In addition, consumers are increasingly health-conscious and the wellbeing industry is becoming

an important market outlet for pineapple products and by-products, which are increasingly used in cosmetics, creams and dietary supplements.

Figure 4: Suppliers of fresh or dried pineapples to the U.S.

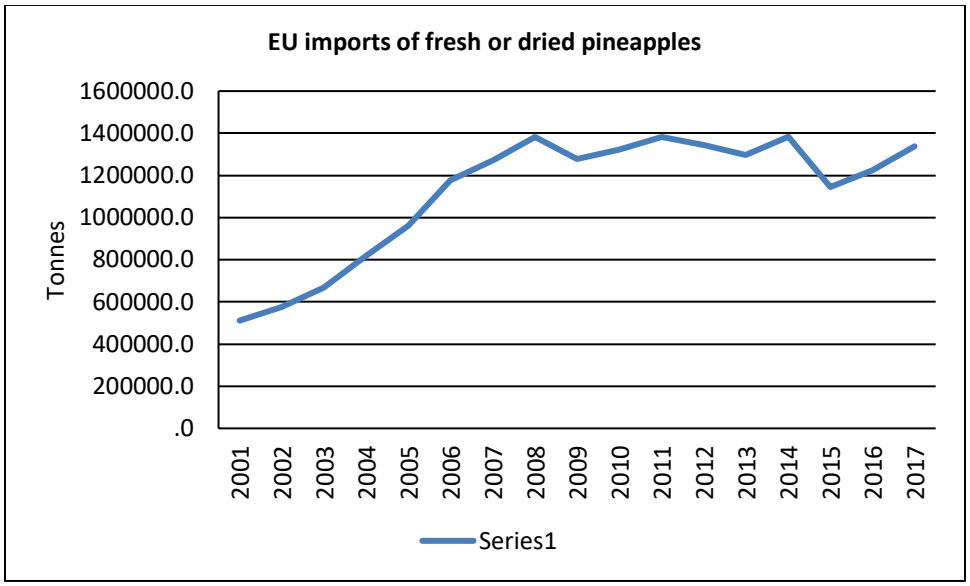


Source: ITC, 2019

EU Market

The EU is the largest market for fresh pineapples, accounting for approximately 40 % of the world's total consumption. Fresh pineapples in Europe come mainly from Latin America (around 80 %) and Africa (10–15 %). EU imports of fresh or dried pineapples have experienced strong growth rates between 2001 and 2008 (from around 500,000 tonnes to roughly 1,400,000 tonnes), but have since then stagnated and fluctuated around an average of 1,300,000 tonnes per year over the past decade (Figure 5).

Figure 5: EU imports of fresh or dried pineapples between 2001 and 2017



Source: ITC, 2019

While the overall trend in imports shows stagnation in recent years, EU imports of dried tropical fruits, including dried pineapples, have increased and it is expected that this trend will continue, in particular in the segment of natural dried tropical fruit. This expected increase is driven by the increasing demand for healthy food, particularly for healthy snacks, such as dried fruit and nuts mixtures, and dried fruit bars. Furthermore, demand for organic products has recently experienced strong growth rates in Europe. European consumers are getting more interested in organic and sustainable food, including pineapples, and are willing to pay more for certified pineapples or special varieties, as can be seen in Figure 6. Statements made by organic trade experts indicate a demand in the European market for pineapples of about five containers per week or 4,000 tonnes annually.

Figure 6: Indicative consumer prices for pineapples in Europe

Segment	Unit Price
Normal varieties	€1.50–2.50 per piece
Special or larger varieties	€2–7 per piece
Organic pineapple	Up to 50% higher retail price
Fair trade pineapple	Up to 50% higher retail price
Fresh cut pineapple	€7–10 per kg
Canned pineapple	€0.50–4 per kg

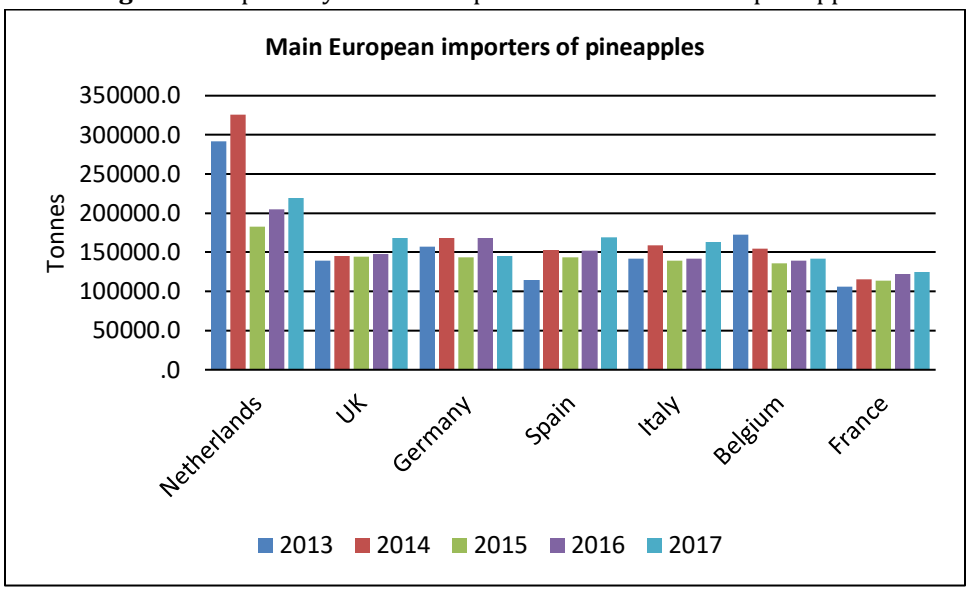
Source: CBI, 2018

The Netherlands is the largest importer of fresh or dried pineapples in the EU (see Figure 7), accounting for 16 % of total EU import volume in 2017. The UK, Germany, Spain, Italy, Belgium and France each constitutes 10-13 % of the EU imports of fresh or dried pineapples. These seven countries together account for approximately 75 % of all EU imports of fresh or dried pineapples.

The Netherlands is the largest importer of fresh pineapples, primarily because of its large seaports and its position as the main arrival port for large banana carriers. The main suppliers of pineapples to the Netherlands are Peru, Costa Rica, Chile, South Africa, Brazil, Israel, Mexico and Kenya. The Dutch market has developed

rapidly over the recent years, with supermarkets being the main outlet. The Dutch market is an important target market particularly for Surinamese pineapples and pineapple products due to the historic and cultural ties between the two countries. A twofold strategy can be considered when exporting to the Netherlands: 1) directly by focusing on geographical indication, country branding and emerging buyer and consumer trends in the Dutch market, and 2) by using the Netherlands as a port of entry to the U.K. and German market with a particular focus on organic, natural and sustainable products. Retailers in the U.K. and German market that are particularly interested in organic pineapple products include Sainsbury, Tesco, Waitrose, Aldi, and Pro-Natura. High-potential segments in those markets, furthermore, include the fresh cut, bakery ingredient, and frozen fruit segments.

Figure 7: Imports by main EU importers of fresh or dried pineapples



Source: ITC, 2019

In terms of EU consumer preferences, the following trends have driven the demand for pineapples over the past years:

- The interest in organic fruits continues to grow in the main EU markets and in Scandinavian countries. . The EU is the largest market for organic pineapple, with most coming from Ghana and increasingly from Costa Rica. In the EU, organic fruits represented 2.5-3 % of total fruits sales, with Germany being the leader in market size. An increasing number of consumers are critical on the taste level that has diminished in most mass-produced fruits. In addition, consumers are worried about the impacts on health of pesticides and fertilizers used in conventional farming.
- Demand for pre-cut pineapples sold through vending machines has shown significant growth rates, especially amongst young people who are more and more conscious of healthy eating habits. Del Monte and the Wittern Group have developed a fresh fruit vending machine that offers bananas, fresh-cut pineapple chunks and grapes in the U.S. This initiative is expected to be introduced in the EU, aiming to replace traditional vending machines that tends to offer sweets in schools, sports centres, hospitals, offices s.
- Convenience is still preferred, and even if fresh fruits are promoted through discount coupons, many consumers choose for convenience. They find pineapples bulky, topped by sharp leaves, difficult to peel and to cut in bite-size pieces. Rather than buying whole pineapples, they prefer chilled fresh cut pineapple chunks. These are all premium-priced choices for consumers in the higher-income groups

who are prepared to pay for options that are healthy, attractive and convenient. With the discount promotion by supermarkets, fresh cut pineapples increasingly become affordable to consumers in the lower-income groups as well.

- In addition to consumers' preference for exotic and special quality fruit and vegetables, taste and experience are playing an increasingly important role and consumers are willing to pay premium prices for products that have consistently good taste. Therefore, branding and storytelling have become important tools to support the marketing of exceptional taste experiences.
- Consumers ask for more sustainability in fruits. Due to poor practices and scandals in the food industry, a growing number of consumers demand access to information on how their fruits are grown and transported; transparency in the supply chain is therefore becoming more and more important. The large scale pineapple industry in Costa Rica has been criticized by influential NGOs such as Oxfam Germany (2016) and Consumers International (2010) for poor labour conditions, low payment to workers and smallholders, and above all for negative impacts on the environment.

CARICOM Market

The CARICOM market is a relatively small market, with imports of pineapples amounting to just over 1,500 tonnes in 2017 (see Figure 8). Nevertheless, the tourism sector in the area represents a unique market opportunity, particularly for fresh pineapples, but also for fresh cut or frozen pineapples, which can be transported by boat due to the proximity of Suriname to other Caribbean countries. Further market research is needed in order to determine specific buyer requirements and consumer demand, especially in hotels and restaurants, in the main importing countries in the region, such as Barbados, Antigua and Barbuda, Saint Lucia and Bahamas. In addition, nearby Dutch-speaking tourist destinations such as Curacao or Aruba offer excellent market opportunities and the possibilities of establishing linkages with buyers needs to be evaluated. In 2018 Curacao imported 210 tonnes of pineapples, equivalent to USD 133,000, while Aruba imported 784 tonnes, or USD 793,000, in the same year (ITC, 2019).

Figure 8: Pineapple imports in the CARICOM region in 2017

Importers	Imported quantity 2017 [tonnes]	Importers	Imported value 2017 [1,000 USD]
Barbados	571	Barbados	588
Antigua and Barbuda	226	Antigua and Barbuda	389
Saint Lucia	187	Saint Lucia	217
Bahamas	155	Bahamas	184
Suriname	124	Trinidad and Tobago	155
Trinidad and Tobago	95	Suriname	78
Dominica	87	Saint Kitts and Nevis	65
Haiti	70	Dominica	39
Saint Kitts and Nevis	30	Saint Vincent and the Grenadines	19
Saint Vincent and the Grenadines	14	Haiti	14
Jamaica	1	Jamaica	3
Total CARICOM	1,560	Total CARICOM	1,751

Source: ITC, 2019

1.1.2 Domestic market

Pineapples are native to South America and there is a long tradition of consuming pineapples in Suriname Fresh pineapples in Suriname are mostly sold by street or market vendors in Paramaribo, Wanica, Nickerie and other districts. Currently, only few large supermarket chains such as Choice or Tulip offer fresh pineapples in small quantities, but the importance of supermarkets as retail outlet might increase over the coming years.

Outside the main production seasons in Suriname, imported pineapples are occasionally offered by street and market vendors. It is estimated that in 2017, 124 tons of fresh pineapples were formally imported from neighbouring Guyana, which represents approximately 5 % of the aggregate domestic demand for fresh pineapples. The import of pineapples from Guyana represents an important opportunity for import substitution that could be taken advantage of if year-round production systems are established.

Other than fresh pineapples, imported processed products such as canned pineapples or pineapple juices are consumed in small amount in Suriname. There are currently no organic certified pineapple products on the market, however, in Suriname pineapples are also increasingly associated with a healthy lifestyle and consumer demand for fresh or natural pineapple products, such as smoothies, has shown increasing tendencies over the last years.

1.1.3 Market Requirements

For exports to the EU, the following control steps are executed according to EU legislation regulations:

- EU import checks. Pineapples, being plant products that are imported from developing countries, must pass through designated Border Inspection Posts (BIPs) where they are subjected to a series of checks. If passed they are allowed access to circulate freely to other member states.
- Phytosanitary Certificate: Compulsory plant health checks are carried out on all plants and plant products coming from non-EU countries in which pineapples are included. The certificate that was issued in the home country is double-checked to ensure the consignment is free from harmful organisms.
- Legal requirements are to guarantee consumer safety by preventing substances that are dangerous to health from entering the EU. If pineapples do not meet these requirements they are not allowed into the EU market and the supplying country runs the risk to get a penalty (up to € 70,000) if consumers make an official complaint.

For the export of organic products to the EU, further regulations are in place. Specific control bodies and control authorities are required to carry out controls and issue certificates, ensuring that organic regulations and control measures in the supplying countries are equivalent in effectiveness to EU organic regulations.

Just as in the EU, also in the U.S., fruits must be free of any signs of damage or disease in order to enter the country. Samples of imported fruits are taken and laboratory tests are conducted. Only if the fruits receive a passing grade will the customs clearance process be initiated. In case of fresh produce exported to the U.S. as organic, products need to comply with U.S. National Organic Standards.

In the CARICOM region there are currently no harmonized standards and regulations in place; every country has its own requirements. According to the Ministry of Trade and Industry, there are, however, plans to develop a harmonized system in the region to facilitate intra-CARICOM trade flows.

1.1.4 End-market opportunities

The traditional Suriname varieties offer opportunities, especially in the organic segment and niche market. Promising opportunities lie in the country's close social linkages with the Netherlands and existing committed business relationship.

Figure 9: Overview of end-market opportunities for Surinamese pineapple products

Region	Market	Product	Segment	Sales channel
Europe	Netherlands UK Germany	Fresh pineapple: organic; atypical varieties Processed pineapple: dried, fresh cut, frozen	Organic, fair and sustainable	Wholesalers Ingredient suppliers
North America	U.S.	Fresh pineapple: organic; atypical varieties Processed pineapple: dried, fresh cut, frozen	Organic, fair and sustainable	Wholesalers Ingredient suppliers
Caribbean countries	Domestic Tourist destinations	Fresh, fresh-cut	Conventional, organic	Wholesaler Ingredient suppliers Hotel and restaurant industry

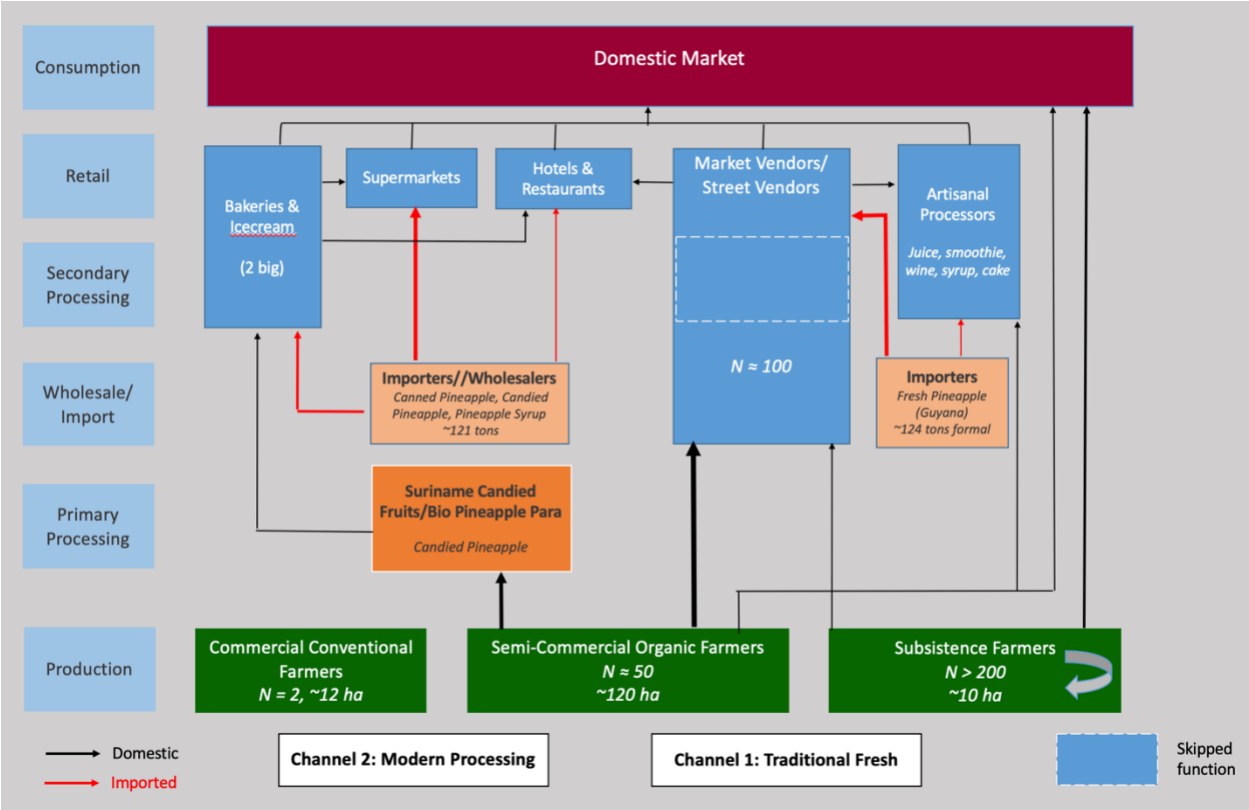
Source: Authors' own elaboration

1.2 Value chain map

Current situation of the pineapple value chain

The current situation of the pineapple value chain in Suriname is visualized in Figure 10. While this section aims to provide a general overview, other sections that follow will analyse the various functions in greater detail.

Figure 10: Map of Suriname's pineapple value chain



Source: Authors' own elaboration

At the production level, three types of producers can be categorized: commercial conventional farmers, semi-commercial organic farmers, and subsistence farmers. There are currently two conventional farmers, using fertilizer and pesticides, each with around 6 ha on average. These farmers have just started planting and therefore have not harvested and sold to any channel yet.

The second category, semi-commercial organic farmers, produce the majority of pineapples that are available in the local market. There are estimated over 50 semi-commercial organic farmers, located mainly in the Para region-, the main pineapple producing region of Suriname. They practice slash and burn, and organic agriculture with no use of chemical fertilizer and pesticides or herbicides. The average plot size ranges from 1 to 4 ha, contributing to a total production area of roughly 120 ha. Most farmers in Redi Doti, Pierre Kondre, Powakka and Matta have entered into agreements with a modern processor- Suriname Candied Fruits (SCF) or its branch Bio Pineapple Suriname (BPS)- to receive training on organic farming practices and commit to selling to the company. 18 farmers have so far been awarded with the EU Organic Certification through SCF, amongst whom 13 have been selling approximately 25% of their harvest to this

company. However, most of their harvest, around 75% or more, are sold to market or street vendors who come to the farm to transport the pineapples to the market or street corner and sell there. This is now the biggest channel for Surinamese pineapple. In addition, some farmers also go to the market or set up stalls on the road to sell directly to individual consumers. The last category, subsistence farmers are estimated over 200, scattered in different parts of the country, especially in the district of Sipaliwini, Marowijne and Para. They produce pineapples on very small plots and a large percentage of their produce is kept for their own consumption. When there is surplus, some sell to small market vendors in the local province or some set up booths on the road to sell directly to individual consumers.

At the primary processing level: There is currently one modern processor that buys from semi-commercial organic farmers to make candied pineapple. The factory has only recently been established and all candied pineapple is still in storage waiting to be exported. Only a marginal quantity (2%) is currently sold to Hollandia, the second biggest bakery in the country as an ingredient to the Christmas bread.

At the Wholesale/import level: There are two types of importers. Importers of processed pineapple products, such as canned pineapples, candied pineapples, and pineapple syrup, and importers of fresh pineapples. Wholesalers import processed canned pineapples, most of which are made in Thailand, to sell either to Hollandia bakery to be used for their fruit cakes, or to supermarkets. There is also a small import of candied pineapple from the Netherlands by Fernandes, the biggest bakery and beverage company in Suriname, to make Pina Colada ice-cream. Pineapple syrup is sold to hotels and restaurants. The estimated number for 2017 of processed pineapple imports is 121 tonnes. Meanwhile, most imported fresh pineapples come from neighbouring Guyana, with official import figures reaching 124 tonnes for 2017. These pineapples are sold through market/street vendors to reach individual consumers and households, or a small percentage goes to artisanal processors (juice, smoothie, wine, or cake shops).

At the retail level: Market and street vendors dominate. Based on our survey, we estimate that around 100 vendors operate in the pineapple season in urban areas. Apart from selling directly to end consumers, they also supply to hotels and restaurants as well as artisanal processors. Sometimes, small artisanal processors also come to Para to source directly from farmers or get the pineapples from the local market.

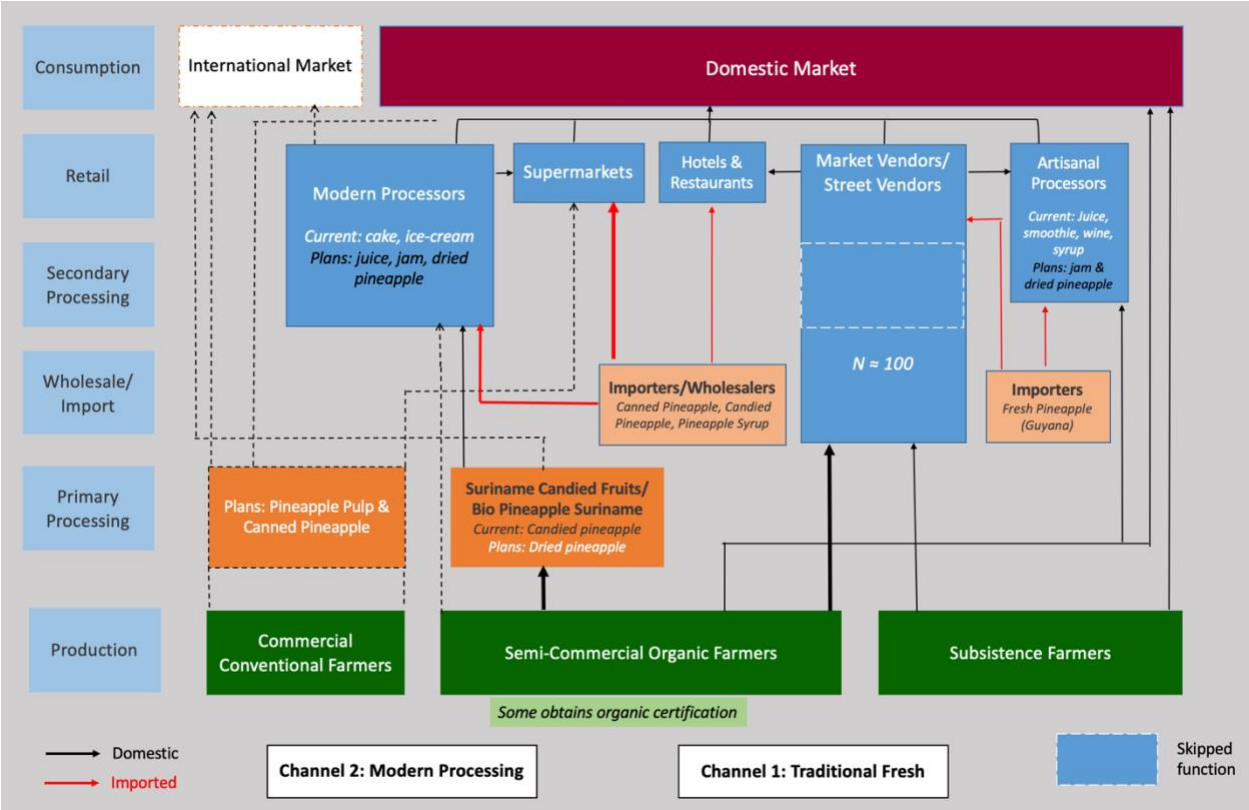
Overall, almost all pineapples in Suriname are produced for the domestic market and are sold fresh through the traditional channel dominated by market and street vendors. The estimated aggregate domestic demand for pineapples is 2,500 tonnes[3] per year according to the 3ADI+ consumer survey. The export channel is too negligible to depict. However, a second channel that entails modern processing and targets the international market has started to emerge.

Plans of value chain actors

Figure 11 shows the pineapple value chain map that takes into account the future plans of different individual value chain actors based on our interviews.

[3] This number is triangulated with the production data based on fieldwork survey. With 120 ha under semi-commercial pineapple production and an average of 9,000 fruits or 18,000 kilos harvested per ha, the total quantity of pineapples harvested by semi-commercial farmers in 2017 is estimated 2,160 tonnes. Together with 124 tonnes of formal imports, informal imports (estimated to be higher than formal imports) and harvests from subsistence farmers, the number arrives to around 2,500 tonnes.

Figure 11: Plans of value chain actors



Source: Authors' own elaboration

The conventional farmers plan to expand their production area and supply fresh pineapples to both the local market as well as the international market. They also plan to go into processing pulps and canned pineapples that will be sold to modern processors or exported. There will be one or two more modern processors of small scale that plan to process juice, jam and dried pineapples for the local market, and perhaps for export. As for semi-commercial organic farmers, more will obtain organic certification in the coming years and sell more to Suriname Candied Fruits/Bio Pineapple Para. This company also plans to make dried pineapples. Both candied and dried pineapples are to be exported.

Therefore, it is likely that the modern processing channel will gradually gain more importance. If the conventional farmers supply more pineapples to the local market at competitive prices, there is also opportunity for import substitution in the traditional channel.

1.3 Core value chain: Detailed description of each VC function

1.3.1 Primary production and harvest

The pineapple (*Ananas comosus*) is a perennial plant belonging to the family of bromeliads. It is native to tropical South America and as a xerophytic plant, it is adapted to grow in dry habitats. Pineapple cultivation in Suriname has a long tradition and is being practiced by different ethnic groups on an estimated total

area of 120 ha. Pineapple farmers in Suriname can be categorized into three groups according to their production systems:

- Commercial conventional farmers with an average planting density of around 30,000 plants per ha;
- Semi-commercial organic farmers with an average planting density between 5,000 and 15,000 plants per ha;
- Subsistence farmers with an average planting density of less than 1000 plants per ha.

Commercial conventional farmers

The first category has only recently emerged and comprises two conventional farmers who started planting pineapples in 2017. Both are entrepreneurs with access to large areas of land and well-established contacts to international pineapple experts, amongst others, in Costa Rica and Hawaii, which provide them expertise and guidance. The main rationales of the two entrepreneurs for starting to cultivate pineapples are, on the one hand, the opportunity of substituting imports of fresh pineapples and, on the other hand, the opportunity of responding to the unsatisfied demand for fresh pineapples during the off-season by means of establishing production systems which allow year-round supply. To this purpose, both farmers introduced staggered planting systems, one farmer intends to use artificial flower induction techniques, which he currently applies on trial fields, while the other farmer intends to achieve year-round production by applying specific fertilizing techniques. The two conventional farmers do not practice shifting cultivation but established permanent land use systems. While both of them cultivate mainly the Stuger pineapple variety at the moment, both of them are interested in importing pineapple varieties, such as the MD2 variety from Costa Rica or the Montserrat variety from Guyana.

Both farmers use agrochemicals, mainly fertilizers, which are applied in quantities of 200 grams per plant directly to the soil twice a year. According to the assessment of the 3ADI+ international pineapple expert who visited the conventional in August 2018, the plants show severe nutritional deficiencies (mainly N, but possibly also Mg, Ca, K, and P) despite the application of fertilizers. At the same time, the expert did not observe any signs of pests or diseases which could be partly attributed to the low pH of the white sandy soils. The farmers are well organized, have a precise overview on planting dates and planting densities and are aware of the importance of the planting material, which they select carefully. The fields on the conventional farms are organized in blocks (see Figure 12) and the planting density varies between 50x50 and 50x60 cm.
The farmers show strong entrepreneurial mindset, but lack expertise in more technical areas. They are, for example, not aware of the poor nutritional status of their plantations and, furthermore, do not seem to have technical knowledge on the specific properties of the sandy soils, for instance the low water retention capacity.

Figure 12: A conventional pineapple plot

Picture taken by Hanh Nguyen, July 2018

One of the farmers applies herbicides, while the other farmer controls weeds manually. Both farmers would like to introduce plastic mulch in the near future to better oppress weeds. In case they observe any signs of pests or diseases, the farmers take pictures and send them to their contacts, who then provide advice on the best control mechanisms. To further increase yields, one farmer also considers installing drip irrigation. Moreover, both farmers have plans to start processing pineapples (e.g. pineapple pulp). To this purpose one of the entrepreneurs already installed a water filter system (see Figure 13).

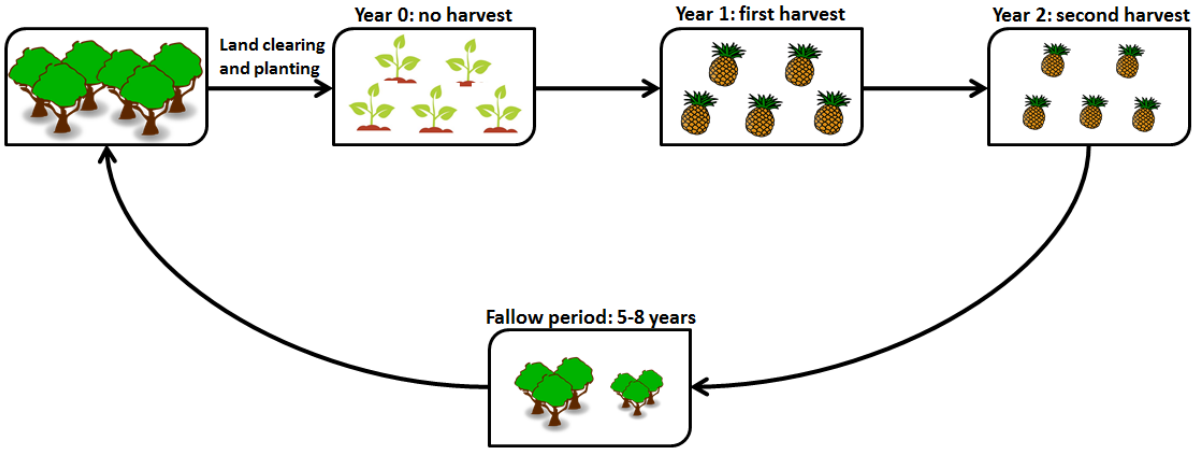
Figure 13: Water filtration system on conventional farm

Picture taken by Anja Lienert, July 2018

Semi-commercial organic farmers

This group of farmers, which comprises approximately 50 farmers, is mainly concentrated in the Para district, notably in the village Redi Doti, Pierre Kondre, and Powakka. Most are indigenous farmers with a long tradition in planting pineapples for home consumption and selling on local markets. They have only started producing on a more commercial scale approximately 2 years ago, when the processing company Suriname Candied Fruits established its branch Bio Pineapple Para (later Bio Pineapple Suriname) in the Para district and started purchasing pineapples from a growing number of farmers. The farmers belonging to this group are organic farmers by tradition; they have never used any type of agrochemicals, and shifting cultivation is a common practice. The farmers use the same plot of land for three years, before they leave the land fallow for 5 to 8 years (see Figure 14).

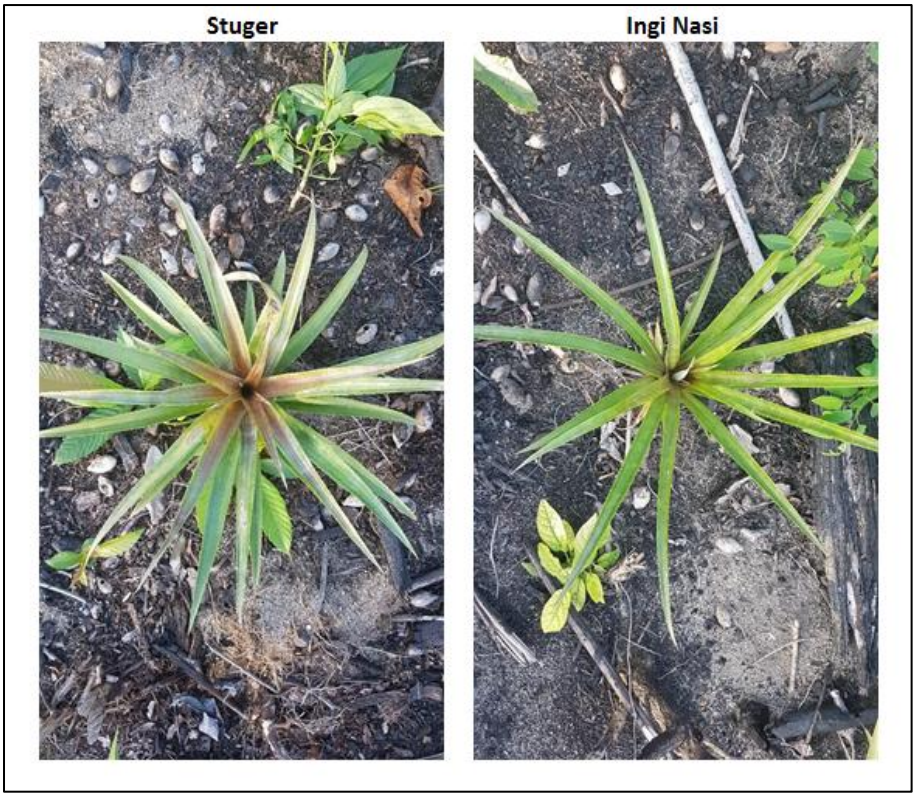
Figure 14: Shifting cultivation system practiced by Surinamese organic pineapple farmers



Source: Authors' own elaboration

The pineapple variety cultivated in largest quantities is the Stuger pineapple, and to a smaller degree the Ingi Nasi (see Figure 15). Some farmers explained that they prefer to plant Stuger due to its bigger size compared to other varieties and because it is more suitable for transport than Ingi Nasi, which gets damaged more easily.

Figure 15: Stuger and Ingi Nasi pineapple plants on a farm in Para District



Picture taken by Anja Lienert, February 2019

In July and August, the farmers start clearing the forest to establish a plot, often with hired labourers. Thereupon, the trees and plant remain are left on the fields for approximately 2 months to dry in the sun before they are burned. Further land preparation prior to planting, such as removing remaining tree trunks, ploughing or seed bed preparation, is not carried out and planting is done manually, mainly by family members. Planting is not staggered and takes place in the small rainy season, in November and December. The farmers plant the fields without preselecting the planting material by size or type; slips and suckers of different sizes are planted in the same field. The farmers buy the planting material only once, when they start cultivating pineapples, and then produce their own planting material. The fields are generally not organized in plots and rows (see Figure 16 and 17) and the average planting density is 12,500 plants/ha. The only agronomic practice that is undertaken by the farmers after planting is weeding, which is done manually every three to six months.

Figure 16: Organic pineapple field in Redi Doti village, Para district

Picture taken by Hanh Nguyen, April 2018

Figure 17: Organic pineapple field in Powakka village, Para District

Picture taken by Anja Lienert, February 2019

Most of the farmers do not keep records and therefore, they do not have good information on the planting dates and planting densities. Moreover, they do not apply any systematic methods to quantify their production, which is why the farmers know only roughly what the average fruit size is, how many fruits per hectare they produce and what percentage of the annual planting they harvest per hectare.

Artificial flower induction is not practiced, and producers depend on the natural induction of flowering. Consequently, there is no homogenous ripening of the fruits. The first fruits can be harvested after 18 months, while the ratoon crop is harvested after another 12 months. There is one main harvest season from May to August and one small harvest season from November to early January. During the harvest season the farmers harvest every third or fourth day between 1,000 and 1,500 pineapples per day. The fruits are separated from the plant with a knife, are collected on the side of the fields and are then transported by car to the houses of the farmers, where they are picked up by the buyers the same day. In case the farmers sell to the processing factory Bio Pineapple Suriname, they take the responsibility of transporting the pineapples to the factory with their own vehicles.

Similar to the conventional farms, the plants on the semi-commercial organic farms also show signs of severe nutritional deficiencies but no evidence of pest or diseases (see Figure 18).

Figure 18: Organic pineapple field showing signs of nitrogen deficiencies in Para district

Picture taken by Jhonny Vásquez Jiménez, August 2018

The farmers have limited knowledge with regards to modern pineapple production techniques and organic farming in general. Most of the farmers are not aware of the fact that year-round production is possible, they have not heard about artificial flower induction and many farmers are convinced that organic farming is an equivalent for no-input agriculture. They are not aware of organic fertilizers and are not familiar with agricultural practices such as composting or mulching.

Subsistence farmers

Estimated at least 200 subsistence farmers cultivate pineapples for home consumption and also for selling near their houses. These farmers are spread across the different regions of the country such as Marowijne and Apoera; they produce pineapples in agroforestry systems (see Figure 19) and generate some income by selling small amounts on markets or street stalls. This group of farmers is very diverse in terms of agricultural production practices: some farmers practice shifting cultivation, others have permanent land use systems, some use agrochemicals, others do not use any type of inputs. The average planting density is less than 1000 plants/ha, with large differences between individual farms and also the varieties cultivated differ largely from one farmer to another.

Figure 19: Pineapples cultivated in agroforestry system in the Marowijne district

Picture taken by Anja Lienert, July 2018

Within this category, the farmers in Matta village (in Para) traditionally intercrop pineapples with cassava in shifting cultivation. They plant cassava in October and pineapples in December; the pineapple planting density varies between 300 and 500 plants/ha. Due to a recent agreement with Bio Pineapple Suriname, the farmers, however, plan to stop intercropping and start the same system as the semi-commercial organic farmers.

Pineapple varieties

The pineapple varieties in Suriname are very diverse. More than 14 local varieties are known; however, there is little information available on the different pineapple varieties and research in this area is lacking. Most of the local pineapple varieties are a mix of native species and alien varieties, but the origins are difficult to trace back, since there is no system in place for determining and categorizing different species. The only information available is a report on pineapple varieties in Matta, which has been prepared by the research institute CELOS in 2008 within the scope of the Guyagrofor project. In this report, different varieties are described briefly with regards to external properties and taste. Detailed information on organoleptic properties, such as brix level, acidity level or flesh texture, is, however, not available.

In this context, the 3ADI+ international pineapple expert carried out a basic analysis of organoleptic properties of three different pineapple varieties – Stuger, Ingi Nasi and Bofroe - during the field visit in August 2018. Since the sample size was obtained at the end of the harvest season, the results presented below are only indicative and not representative. More research in this field is needed and the generation of detailed technical knowledge on organoleptic properties of different pineapple varieties is of high importance in order to determine which pineapple varieties are suitable for different processing options, for the local market or export.

- Stuger: This variety is the predominant cultivar on the conventional and semi-commercial organic farms. It is a large plant with spiny leaves that produces a large quantity of slips, which serve as main planting material for the farmers in Suriname. The fruit is conical (see Figure 20) and its average

weight is estimated to amount to 2 kg. When it is at its ideal point of ripeness the flesh has an intense yellow colour. The sweetest fruit found in this visit had a Brix level of 14 º[4]. However, most of the fruits analysed had Brix levels between 9 and 12 º. This suggests that high quality fruits can be obtained, but that the nutritional status of the plants needs to be improved in order to reach higher Brix levels. The conical shape of this variety makes it less suitable for industrial processing with standard machinery and equipment.

Figure 20: Plant and fruit of the Stuger variety

Picture taken by Jhonny Vásquez Jiménez, August 2018

- Ingi Nasi: According to the international pineapple expert, the name Ingi Nasi is used by different farming communities for different cultivars (Ingi Nasi simply means indigenous pineapple in Sranan Tongo), thus it can be concluded that a standardized nomenclature for the local pineapple varieties does not exist. The pineapple analyzed by the expert was harvested in Matta and had very different properties than the cultivar with the same name in Redi Doti. The Ingi Nasi plant in Matta has spiny leaves and produces abundant amounts of slips, which can result in reduced fruit growth, because the plant invests its energy in the vegetative plant parts rather than in the reproductive plant part. The Brix level of the fruit analysed was 17 ºBrix and a very pleasant smell was noted. The fruit has a unique, round shape, and the flesh is firm, making it compatible with industrial processing machines. However, the flesh is white (see Figure 21) and contains many seeds, which are considered disadvantageous marketing characteristics.

[4] A minimum of 12ºBrix (12% total soluble solids) was established in the Codex Alimentarius by FAO/WHO to guarantee consumer acceptance (FAO & WHO, 1993).

Figure 21: Plant and fruit of the Ingi Nasi variety

Picture taken by Jhonny Vásquez Jiménez, August 2018

- Bofroe: The cultivar that is called Bofroe in Redi Doti does not have spiny leaves, which is a desirable characteristic since it reduces the risk of injuries when the farmers or laborers work in the fields. The cultivar called Bofroe in Matta does have spiny leaves, which again suggests that there is no standardized nomenclature. The fruit is round, although less than the Ingi Nasi from Matta (see Figure 22). The brix level of the analysed fruit was low (9 º), the smell is not outstanding and the colour of the flesh is pale yellow.

Figure 22: Fruit of the Bofroe variety

Picture taken by Jhonny Vásquez Jiménez, August 2018

Competitiveness of alien varieties vs. local varieties

During the field work carried out in July and August 2018, several stakeholders expressed their interest in introducing the MD2 variety from Costa Rica to Suriname. Upon request, the international pineapple expert evaluated the agro-ecological conditions in Suriname in terms of its suitability for growing the MD2 variety and concluded that, because the ideal temperature conditions (minimum temperature of 20° C and day-night temperature difference of 10 °C), which are necessary for maximum rates of photosynthesis and, consequently, plant growth, cannot be found in Suriname, production levels similar to those in other pineapple producing countries would be difficult to achieve. In addition, the low water retention capacity of the white sandy soils and the lack of irrigation systems, which could balance out water stress during the dry season, represent another competitive disadvantage. The analysis of the expert strongly suggests that, given the specific agro-ecological conditions in Suriname, it would be extremely difficult to compete on the international market with varieties such as the MD2 and that the most promising value chain development strategy includes a strong focus on unique local varieties which represent Unique Selling Propositions.

1.3.2 Processing and by-products

Many products and by-products can be made from pineapples, such as dried pineapple, canned pineapple, candied pineapple, pineapple jam and juice. Apart from food products, pineapple fibre is also increasingly being used in the fashion industry. Currently in Suriname however, large-scale industrial processing has not been explored. Most pineapples are sold fresh to individual consumers. There are scattered small shops that make and sell drinks from pineapples, such as juices, smoothies, and wines, as well as pineapple cakes. These artisanal processors source pineapples in small quantities directly from farmers, or occasionally from middlepersons. They are small family businesses that own simple processing equipment (e.g. blender) that also make their living from other fruit products. The volume of pineapples used in this channel is negligible and likely to remain so, unless there is a substantial increase in local demand for fresh juices and cakes in the future. Competition has been strong from many Chinese shops that have been mushrooming in Suriname over the past decade and that offer imported cakes and juices with longer shelf-lives.

There is only one industrial processor of pineapples, Suriname Candied Fruits, currently the most important player in pineapple processing in Suriname. They source directly farmers in different villages in the Carolina region in order to make candied pineapple, an ingredient often used in the bakery industry. While their operation is much larger in comparison with the artisanal shops in the country, it remains very small-scale for international standards. It is also worth noting that candied pineapple makes up a small part of SCF's business, which involves the processing of non-timber forest products as well such as acai and the candying of other tropical fruits such as papaya and ginger, and especially citron peel (succade).

Candied pineapple is obtained by cooking pineapple chunks with sugar and water, and sometimes syrup, then letting them drain and dry. It is not usually consumed as an end product, but subject to further processing with other ingredients to make cakes, marmalades, ice-creams and other sweets. Pineapple candying used to take place in SCF's main factory in Saramacca. It was small-scale and on a trial basis, as most was dedicated to succade. However, since the establishment of its branch – Bio Pineapple Para (later Bio Pineapple Suriname) – that is dedicated to only the processing of pineapples in 2017, the processing line was moved to another location in Redi Doti at the beginning of 2018, closer to the production area. As the factory is still in the process of being set up, most of the work is done manually. Table 1 describes the main steps of candying pineapple at Bio Pineapple Suriname and suggests machinery that could be used at each step.

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Figure 23: Steps of candying pineapple at Bio Pineapple Suriname

Step	Description	Optional machinery
1. Receipt, weighting, and sorting	Pineapples are delivered to the factories by farmers, who are paid a fixed price of USD 0.6 per kg. Most pineapples are Stuger, and ideally are mature but not fully ripe, as the texture is harder and more suitable for processing than that of ripe pineapples. It is also important that the sorted pineapples are of uniform maturity, as that will allow uniform drying times for the candied pineapple chunks at the later steps.	
2. Peeling, washing and cutting into cubes	Different from normal practice, pineapples at BPS are not washed to remove surface contaminants, such as insects or dirt, after being sorted. They are immediately peeled and only washed after. In this step, the crown, eyes and outer skin of the pineapple are removed by knives. They are then washed and cut into small cubes.	Wash tanks, peelers, corers, dicers, or a combined machine
3. Cooking pineapple cubes in pots	The pineapple cubes are cooked in a small boiling pot which hold 50 litres with white sugar and water. For 1 kg of pineapples, 1 kg of sugar and 1 litre of water are added. Despite sourcing organic pineapples, the sugar that BPS uses is currently not organic. The mixture is cooked over low heat for approximately an hour until they are soft. The mixture is then placed in a large bowl to cool down and covered. After one day, the mixture is transferred to a big tank which holds 500 litres and is stored there.	Electric steam boilers
4. Draining and drying (still in pilot phase)	The cooked/crystallized pineapple cubes are drained slowly in cloths, afterwards they are dehydrated in an electric drying cabinet. Here the fruit cubes are exposed to temperatures ranging from 50˚C and 60˚C for 12 hours. Open-air drying has been tried; however the process is considered inefficient since it is heavily dependent on the weather and the products can be exposed to various contamination risks. Furthermore, in the candying process, natural acid is removed, and sugar is added, resulting in an environment where mould can grow more easily if the fruit is not dried properly.	Electric drying cabinets, tunnel driers

5. Packaging (pilot phase)	Once the candied pineapple cubes are dried, they are packed in airtight plastic pots of 100 gram each (see Figure 24). They are stored in a cool dry place away from direct sunlight. The shelf life of BPS's candied pineapple is 18 months.	
6. Waste disposal	All wastes are currently discarded.	

Source: Author's own interpretation

Figure 24: SCF's candied pineapple product

Picture taken by Hanh Nguyen, April 2018

Recently BPS has carried out small experiments with dried pineapples, which essentially follow the same process, without cooking and draining. The estimate conversion rate from fresh pineapples to candied pineapples is 28%, while for dried pineapple the rate is 7%. It is worth noting that only a small amount of candied pineapple currently goes through step 4 and 5 to obtain the final product (figure 13). An estimated 98% of the processed pineapples are still in storage tanks, while a marginal amount is sold to the second biggest bakery in Suriname- Hollandia- as an ingredient for their Christmas bread. While no precise number is disclosed, according to the CEO, the factory currently processes around 300 pineapples per day (approx. 600 kg fresh) during the harvest season and is closed outside the season. It employs 9 female and 1 male workers from the village on needs-based contracts, working for 4-6 hours per day for a minimum wage of 8 SRD net per hour. Pineapples that are delivered need to be processed immediately due to the lack of cooling facilities. Unlike the main factory of Suriname Candied Fruits in Saramacca, which is dedicated to the candying of other tropical fruits, BPS factory has not obtained the FSSC 22000 (Food Safety System Certification). As FSSC 22000 is considered a necessity for European importers and big bakeries in Suriname, such as Fernandes, BPS will not be able to supply to these actors until it is certified.

According to the CEO of BPS, since the activities of the factory in Redi Doti have only been in place for half a year, more time is needed to gain expertise and test the equipment, the processing flow and their business plan. In fact, many plans are in the pipeline. BPS plans to build a fully equipped factory and expand its processing capacity by procuring more machinery. For step 2 of the process described above, BPS currently owns a peeler and a dicer whose operational capacity is 250 fresh pineapples per hour. For step 4, an electric drying cabinet has been procured from China that can accommodate up to 500 kg of candied pineapples per 12- to 15-hour session. All these machines have yet been put into use, partly due to insufficient electricity, partly because BPS is awaiting further guidance from foreign experts that the mother company- SCF- occasionally brings in to support its operations.

Figure 25: Example of a manual peeler and corer machine

Source: Heatsealco

Figure 26: Example of an electric drying cabinet

In order to ensure electricity supply, the company also plans to procure a generator as back-up to state-provided electricity. Once stable electricity is secured, they intend to set up cooling facilities to prolong the shelf-lives of the fruits and install air-conditioning for workers. As the processing scale expands, electric steam boilers will replace small boiling pots in step 3, and stand-up pouches made of aluminium or polypropylene that is moisture-proof and airtight will replace the current plastic cups. Most of the equipment and packaging will be sourced from China, as according to the company owner, the Chinese suppliers offer competitive prices and quick delivery services of spare parts. Quotations from suppliers have already been received for additional industrial machines, yet how the machinery is going to be financed, apart from the owner's resources, is unclear.

Overall, a significant expansion in the scale of operations through mechanization is expected. The procurement target in 2018, which stands at 90,000 kg of fresh pineapples, is set to increase more than threefold to reach 300,000 kg in 2019. While candied pineapple is still the focus of the processing line, organic dried pineapple has emerged as another promising product, in response to high demand in the Western European market. The company leadership has taken active steps in connecting with buyers and bringing in foreign expertise to expand their product range to include dried pineapple. There is also consideration of making use of pineapple peels and cores, which are currently discarded, to produce syrup and export to Aruba, Curacao and French Guyana. The rest could be collected to make compost for the farms nearby.

If these plans are realized in the near future, they can provide a significant push to Suriname's emergent pineapple processing industry. Despite being the pioneer in this area, BPS, as part of SCF, benefits considerably from SCF's experience in the business of candied fruits and its relative success with the citron peel. SCF also possesses a good network both nationally and internationally. There are nonetheless substantial challenges facing the company, from broader societal obstacles (Suriname ranks 165 out of 190 countries on the World Bank's Ease of Doing Business Index – read more in Section 1.6. on the Enabling Environment) to financial constraints that affect its procurement model. On the one hand, SCF claims that the quantity of pineapples at the production level is not sufficient to meet export demands (not enough candied pineapple to fill even one cargo). On the other hand, the current processing capacity of the factory is not high enough to buy all the available pineapples, and cash flow problems have contributed to delaying the plan to fully operationalize the factory. Thus, a strategic balance must be found between the planned expansion in production and the increase in processing capacity. If farmers are encouraged to expand their production areas and periods, as well as improve their productivity, they should be more assured of good opportunities to sell all their produce at competitive prices. The recent cassava incidence, whereby many

farmers were persuaded to invest in growing cassava instead of other crops in the hope of supplying to a later defunct factory, have taken a heavy toll on their livelihoods. Sentiments of distrust still linger in communities that grow both cassava and pineapples, such as Matta.

1.3.3 Wholesale and retail distribution

The majority of consumers in Suriname purchase local fruits and vegetables, including pineapples, at wet markets or street stands. Meanwhile, big supermarkets tend to sell imported fruits and vegetables. There are many independent Chinese shops around every corner selling a wide range of food products. They are however mostly processed, and fresh pineapples are seldom found there. Apart from selling to SCF (which concerns a small number of semi-commercial farmers), farmers can either: (1) Sell to a middleperson (who is either a market/street vendor that sells to end consumers, or a market/street vendor who also sells on to other channels- hotels, restaurants, schools, petrol stations, and fellow vendors); (2) Sell to an artisanal processor; or (3) Sell directly at local markets, shops, or on the street.

While some farmers take up all options, the biggest volume of pineapples is sold to market and street vendors. In both domestic and imported fresh pineapple channels, market and street vendors dominate. They sell pineapples on market or street stands and pay a small levy to the local authorities for the space. Most provide transport from the field and procure from one trusted farmer. Some big market vendors, who buy from more than two farmers, also take on aggregation and wholesaling. There are estimated nearly a hundred market and street vendors of different scales in Paramaribo and Niew Nickerie, the two biggest cities in Suriname, twenty of whom also function as wholesalers that distribute to smaller vendors, hotels, restaurants and institutional buyers, apart from selling at their own stands. In order to attract more hotels and restaurants, many offer free cutting and peeling service. In addition to pineapples or when pineapples are out of season, many of them sell other fruits and vegetables.

Most of the pineapples sold in Paramaribo are transported by car from Para. Middlepersons often give farmers a few days' notice, so that they can plan their harvest and have the pineapples ready at their house for pick-up. In Niew Nickerie, imported pineapples from Guyana are prevalent due to its proximity to the border (though the trip by boat can take up to 7 hours), and to the fact that no other pineapple regions in Suriname are in the vicinity. There is reportedly pineapple production in in the Sipaliwini district, yet on a very subsistence level. Pineapples are transported by boat or ferry from the indigenous village of Oreala in Guyana, across the Corantijn River, to Suriname. According to the LVV regional office, over the past 5 years the official pineapple imports from Guyana have more than doubled from 33 tons in 2012 to 77 tons in 2017. It is suspected that even higher quantities of pineapples have been transported from Guyana to Suriname informally, although there has not been an attempt at estimating the figures.

Figure 27: Pineapples sold on the street and in the market

Pictures taken by Hanh Nguyen, June 2018

Occasionally imported Guyanese pineapples are found in Paramaribo, 350 kilometres from Apoera, a Surinamese village across the Corantijn River on the other side of Oreala. There are opinions that pineapples from Guyana are sturdier and thus easier to transport, and can keep for longer - up to two weeks compared to one week in the case of the current Surinamese varieties. However, comparison is difficult in this respect since the pineapples in Suriname are chiefly organic and Guyanese pineapples might not be. One key advantage that Guyana's pineapple sector could have over Suriname's is the year-round production, which results in a stable supply with little price fluctuation. Surprisingly however, only a small volume of pineapples from Guyana makes it to Paramaribo in the off-season, primarily to cater for tourists in up-market hotels. Our consumer survey reveals that most households in Greater Paramaribo do not consume pineapples out of the season. This suggests long distance transport might be an issue that renders the trade of Guyanese pineapples much less attractive in this area compared in Niew Nickerie, but this needs to be investigated further.

Even in the season, not many bars and restaurants offer freshly squeezed juices and blended drinks. Most use imported pulps and syrup rather than local fresh pineapples. Imported canned pineapples and pineapple juice are readily available in big supermarkets like Choi's and Tulip and in wholesale market such as Combe Markt. The two biggest bakeries in Suriname, Fernandes and Hollandia, both make use of imported pineapple products to ensure consistent quality and stable prices. While Hollandia, a local family business, uses canned pineapples from Thailand for their fruit cakes and a small amount of candied pineapple from SCF/BPS for their Christmas bread, Fernandes imports candied pineapple from the Netherlands for their Pina Colada ice-cream. As part of the biggest corporation in the country whose business spans from bottling and bakery to ice-cream, with exports to the Caribbean region, Fernandes abides by prominent international standards. Hence, Fernandes can only source from FSSC 22000-certified suppliers and thus is prevented from sourcing candied pineapple locally.

1.4 Value chain governance and margin analysis

Value chain governance refers to the coordination of value chain stages and the relationships between value chain actors, making it possible to bring a commodity from primary production to end use (UNIDO, 2011). Two kinds of linkages between value chain actors can be identified, which together form the governance structure of the chain (FAO, 2014). There can be vertical linkages between actors at different stages of the chain: how farmers, aggregators, processors, wholesalers, and retailers are strategically linked. There can also be horizontal linkages: between actors at a particular stage of the chain, such as farmers' cooperative or trade association. Governance is, moreover, about the establishment and enforcement of rules and parameters concerning what, how, when, and how much is to be produced. It influences the degree of information exchange, the provision of inputs and finance, the concentration of market power, and hence the distribution of economic benefits.

Suriname's pineapple value chains can be divided into two market channels, with different governance structures. In the "traditional fresh" channel, there are no formal contracts between actors and most transactions are spot-market. Commercial relationships in this channel are based on long-term transactions and trust, with each middleperson having only one or a few farmers from whom they buy pineapples year after year. There are no quality control or standards- except for the fact that middlepersons prefer riper pineapples than the ones used for processing. The risk passed to farmers, thus, is higher as riper pineapples in the fields are more likely to be damaged by insects and could be damaged more easily post-harvest. Farmers usually grade pineapples according to size (small, medium, big), which merit different prices that are also reflected in the selling prices to end consumers. Price-setting mechanism is nonetheless imprecise, based on individual negotiations, and highly influenced by seasonality. For the same pineapple, a farmer can get more than double the price at the beginning of the season compared to in high season. Farmers report to receive as low as 2SRD/kg in the peak of the season (May-July for the big harvest, December-January for the small harvest), and up to 6 SRD/kg at the beginning of harvest (April-early May for the big harvest, late November for the small harvest). While most interviewed vendors are satisfied with their suppliers, some farmers express grievances at seeing their pineapples being sold on the street at much higher prices than what they received. Farmers have little bargaining power, especially in the peak season where there is a surplus of pineapples that need to be harvested quickly. Market and street vendors, in turn, claim to shoulder different market risks and face steeper competition. While market and street vendors observe the prices of others who sell in the same market or neighbourhood in order to stay competitive, there is no explicit collaboration. It is still to be seen how the prices will change once the few conventional farmers that plant on much bigger scales start harvesting and selling to the local market.

Figure 28 and 29 show the average prices farmers and vendors get according to pineapple size and the time of the season.

Figure 28: Average prices at the farm gate

Pineapple size/Season time	Begin	Mid/High	End
Small (0.5 - 1 kg)	SRD 7.1	SRD 5.1	SRD 5.7
Medium (1.0 - 1.75 kg)	SRD 12.4	SRD 9.1	SRD 10
Big (1.75 - 2.5 kg)	SRD 16.9	SRD 12.5	SRD 13.4
Average	SRD 12.1	SRD 8.9	SRD 9.7

Source: Authors' compilation

Figure 29: Average sales prices on the market

Pineapple size/Season time	Begin	Mid/High	End
Small (0.5 - 1 kg)	SRD 11.5	SRD 7.8	SRD 11.5
Medium (1.0 - 1.75 kg)	SRD 18.5	SRD 12.5	SRD 16.7
Big (1.75 - 2.5 kg)	SRD 28.3	SRD 20	SRD 23.3
Average	SRD 19.4	SRD 13.4	SRD 17.2

Source: Authors' compilation

Margin analysis was conducted for the dominant channel "traditional fresh". At present, margin analysis for the "modern processed" channel is not possible as most processed pineapples at SCF/BPS are not yet sold. There are only main types of value chain actors participating in the traditional fresh channel, as presented in Figure 30 and 31. Both types, the semi-commercial organic farmers and the market/street vendors, are characterized by their relatively low operating costs. This entails that, despite moderate average annual incomes and low productivity rates in primary production, average profit margins of both groups of value chain actors are above 50 %.

Figure 30: Pineapple value chain margin analysis

Actor type	**Average income per year (SRD)**	**Average margin**	**Key performance descriptors**
Semi-commercial organic farmers	187,500	64%	Homogeneous group of small-scale farmers practicing low-input agriculture.
			Low operating costs (approximately 36 % of revenue), with main cost factor being labour costs.
			Profitable enterprises
Street and market vendors	210,438	51%	Homogenous group of vendors that, in most cases, buy pineapples directly from farmers during the two harvest seasons.
			Main cost factor is the purchase of the pineapples (approximately 90% of total costs).
			Profitable entrepreneurs with relatively low operating costs (approximately 50% of revenue).

Source: Authors' own elaboration

Figure 31: Average annual costs, revenues and profit margins of selected VC actors

Enterprise type	**Revenue** [SRD]	**Costs** [SRD]	**Gross Profit** [SRD]	**Profit Margin** [%]
Farmers	187,500	68,240	119,260	64
Street and market vendors	210,438	102,222	108,216	51

Source: Authors' own elaboration

In the "modern processed" channel, SCF is an important player in the chain that could inspire other entrepreneurs. With their contract mechanism that offers a guaranteed price and purchase quantity to pineapple producers, SCF has introduced a new level of coordination to the value chain.

Since 2016, SCF (and now its pineapple branch BPS) has provided training on organic production to around 50 farmers in the Para district, with whom they developed an outgrower system. The company has individual written contracts with these farmers, committing to buying at a fixed price, which is negotiated at the end of each year. SCF is responsible for supporting their outgrowers to obtain certifications, including financing certification costs, handling documentation processes and providing free training for the first few years. The price SCF has paid to participating farmers in the past two years is USD 0.6 per kg of fresh pineapples, which is high for the international average for conventional pineapples, but in line with the organic price trends. Still, interviewed farmers express their dissatisfaction with the price offered by SCF and would like it to reach USD 0.8 per kg. At the beginning of the pineapple season, some farmers are able to receive up to USD 0.8 per kg when selling to middlepersons, yet many are affected by the price fluctuations in the domestic market and appreciate the guarantee aspect of selling to the company. SCF, in turn, argues that their price is already higher than the international average of USD 0.35 per kilos and that farmers in Guyana normally receive half of their price. It is still to be seen how prices will evolve once SCF start exporting on a bigger scale. As some farmers have planted but not yet harvested, some have not been certified and due to the delayed pineapple processing factory, up till now SCF has only sourced from 13 farmers, who obtained the EU Organic Production certification in August of this year.

Overall, the introduction of organic certifications to Suriname's pineapple value chain has strengthened the vertical linkage between a number of growers and SCF and provided a push to drive the chain towards higher value-adding activities. SCF also assumes the fundamental task of 'localizing' international standards, which involves adapting standards criteria to local conditions and translating jargon-heavy codes to farmer-friendly training modules. Thus, it also opens up another channel and brings them closer to high-quality markets. Besides, the need to organize smallholders into groups in order to provide training and reach the minimum volume needed for certification has been conducive to furthering horizontal linkages at the farm level. A higher level of business-related interactions and knowledge exchange is witnessed amongst producers supplying to SCF than elsewhere. In response to new opportunities, a cooperative was established in Redi Doti- Pierre Kondre in 2017 and another one in Matta is in the process of legal registration.

As both vertical and horizontal connections between value chain actors become stronger, market power struggles can follow. Notable was the recent conflict between SCF and the Agro-Cooperative Redi Doti-Pierre Kondre, who entered a collaboration in 2017 under the facilitation of the Ministry of HIT. The cooperative consists of eleven members, five of whom supply to SCF. The cooperative and SCF set out to be equal shareholders of the processing factory Bio Pineapple Para; however so far there has only been investment from SCF, apart from an IDB grant for farmers in the coop to pay part of the certification costs and expand production area. Due to disagreement between the company manager and the cooperative board, this partnership never

materialized and the processing factory was renamed Bio Pineapple Suriname, 100% owned by SCF. It is also worth noting that although there was information exchange, it seems that the cooperative did not have much ownership of and decision-making power in the factory's business-related aspects. Furthermore, SCF contracts were signed with individual farmers, hindering any formal collective power. So far, the cooperatives have not played any significant role in the negotiation of prices, conditions of production, or terms of delivery and payment. In fact, as the only player in the value chain that possesses the knowledge of the certification process, ownership of technical know-how related to pineapple processing, and especially contact with international buyers, SCF has exclusive power in setting the price and determine the barriers to the certified channel, and ultimately who gains access and who is left out.

1.5 Extended value chain

1.5.1 Physical Inputs

At present, the large majority of pineapple farmers in Suriname does not use any inputs, such as fertilizers, pesticides, and improved plant materials. The farm mechanization level is very low, and labour is the most important input used at the moment. To upgrade the value chain, however, physical inputs play a key role, since they are necessary to improve productivity and quality both at the farm and at the processing level.

Plant material

At present, farmers produce their own plant material or, if needed, buy it from other farmers in their community. There are no farmers specialized in producing planting material as main business. Recently Grassalco, a state-owned mining company, has bought an old company in the Commewijne district to fill this market gap. The new company, called in InVitroPlants Grassalco, is a plant propagation laboratory that operates in collaboration with international plant propagation laboratories such as the French company Vitropic. The objective of InVitroPlants is to contribute to the economic diversification of Suriname by improving the competitiveness of the agricultural sector with improved plant materials, as well as becoming a regional and international supplier of plant material. InVitroPlants started producing banana, sweet potato, cassava and pineapple plant material three months ago, which have not yet been on sale. At the moment, InVitroPlant is experimenting with foreign varieties (MD2 and Queen Victoria) provided by their French partner.

Irrigation

Even though Surinamese pineapple farmers are currently not practicing irrigation, it might be necessary to move from seasonal to year-round production. Even though irrigation is practiced in other agricultural sectors, mainly in rice production, there is currently not enough local expertise on sprinkler or drip irrigation systems that would be needed for pineapple production. In addition, there are no Surinamese companies selling irrigation systems and all the equipment needs to be imported.

Fertilizers and pesticides

Except for the two conventional pineapple producers, most pineapple farmers in Suriname do not use fertilizers and pesticides. There is no domestic production of fertilizers and pesticides. Companies like Caribbean Chemicals and HJ Agro import these inputs to then resell it to farmers. Next to conventional fertilizers and pesticides, organic pesticides, fertilizers and other agrochemicals are also imported, such as cytoplex, which is used to enhance and control the ripening process of different crops like peppers, tomatoes, and eggplants. In order to manage the flowering process of pineapples, only ethylene is currently accepted by organic certifications.

Machinery and equipment

The large majority of pineapple farmers only use hand tools (like machetes, hoes, wheelbarrows or knives) and basic power tools (such as chainsaws and brush cutters) on their fields. Tractors or other more sophisticated agricultural machinery is only used by the two conventional farmers that produce on a larger scale. Equipment and machinery are imported and sold in specialized shops. While the renting of machinery and equipment is a common practice in the rice sector, in the pineapple producing regions there are no companies that rent out equipment, mainly because up to now there has been no demand from farmers.

For the processing sector, all the machinery and equipment are currently imported. SCF/BPS reports satisfaction with their imports from China via Alibaba, where prices are approximately 25 % lower than equipment from Europe or the United States.

Packaging

Even though packaging material is available on the local market, the prices are very high and weaken the export competitiveness of Surinamese pineapple products. For this reason, SCF/BPS decided to import packaging material directly from China via Alibaba at a price that is 25 % lower than on the local market. The challenge, however, is the large quantity that is required per minimum order.

1.5.2 Finance

In Suriname, commercial banks provide loans to entrepreneurs, including to small-scale farmers, at high interest rates that vary around 20 %. The loans need to be secured by collaterals, usually in the form of land, which represents an unsurmountable hurdle for many farmers that cultivate on community land and do not have land titles. The Ministry of LVV is aware of the difficulties many farmers face in accessing finance from traditional service providers; hence, the Ministry is working with the National Development Bank (NOB) to develop special financial services that allow farmers to obtain loans from NOB, using harvested products as collateral instead of land. Moreover, other commercial banks such as Godo Bank or Trustbank Amanah also offer financial services for micro entrepreneurs. The micro loans offered, however, are only up to SRD 10,000 (roughly USD 1300) which is not sufficient for farmers to cover operating costs or to make important investments. In this context, most of the pineapple farmers depend on their own savings or informal borrowings from relatives to finance operating costs or to make investments.

A few years ago, a group of farmers (11 farmers) from the Redi Doti area received an IDB grant of USD 22,000, to expand their production area. This grant was negotiated by SCF, on condition that USD 4,000 was used to obtain the organic certification. The same company also provided training for free to pineapple farmers in the Carolina region, to help farmers improve their production practices and, in turn, improve the supply of raw material needed by SCF. Thus, in the absence of traditional financial products that can be used by the pineapple farmers, alternative mechanisms emerged to fill this gap in support services provision. Overall, there are no financial services that are adapted to the pineapple production cycle, which is an important concern since farmers obtain their first income only more than a year after planting (18 months).

Access to finance is currently not only difficult for farmers but also for entrepreneurs in the processing industry. The difficulty of accessing finance and the absence of favourable interest rates represents a serious bottleneck for the sector as a whole.

1.5.3 Knowledge

Pineapple is a native crop in Suriname and traditional knowledge on pineapple cultivation has been passed on for generations. Although the area of pineapple production in Suriname remains small, the genetic diversity is extraordinary. Around 15 pineapple varieties have been recorded in the Matta village alone by

CELOS. Apart from the Stuger variety that is grown in many locations, different villages might cultivate indigenous breeds which they refer to as "Ingi Nasi" (meaning "indigenous pineapple" in the lingua franca Sranan Tongo), yet whose characteristics can widely vary. The initial analysis carried out by the Costa Rican agronomist, for example, shows that the Ingi Nasi in the Redi Doti village possesses very different Brix level and features from the Ingi Nasi in the Matta village. Thus, there seems to be a rich and long-established body of knowledge on pineapples within the various communities that need to be preserved. However, besides in-vitro collection of Ananas comosus at a small lab in the Aanton de Kom University of Suriname and a brief catalogue of pineapple varieties, accompanied by a soil analysis by CELOS in the Matta village, very limited research has been carried out and information disseminated in an inclusive and coherent manner.

Furthermore, the majority of Surinamese pineapple producers are not aware of, nor systematically trained on, best agronomic practices in the sector. It is still commonly believed that organic agriculture means depending on nature and using no inputs. Coupled with insufficient knowledge on business administration, such as record keeping and accounting, productivity and efficiency at the farm level has remained very low, especially when compared with lead players in the industry. It is therefore important to make the best use of traditional wisdom and ensure its preservation, while gradually supporting pineapple smallholders in the adoption of improved farming practices and modern technologies.

Although pineapple farming has a long tradition, knowledge on industrial pineapple processing is nascent. There is a critical need to bring in international knowledge and partner with research institutes in other countries. While Bio Pineapple Suriname can make use of their own network through the mother company, Suriname Candied Fruits, and thus may independently bring in sufficient knowledge to facilitate the operation of their factory, new and smaller players will require significant support in the technicalities of pineapple processing, including the feasibility assessment for different options (e.g. dried, candied, juiced, fresh cut, frozen,) and the matching investments.

1.5.4 Labour

Current pineapple farming practices in Suriname make little use of machinery and rely mainly on labour. Family members staying nearby in the rural areas tend to contribute to the general management and maintenance of the farm. Except for some parts of the Carolina region, where pineapple is increasingly bring grown as a commercial crop, for many others it does not constitute a full-time job and they still engage in other work and household duties. In the deep interior, since many men have left their villages to find work in the extractive industries and in the city, women increasingly provide on-farm labour (Pan American Health Organization, 2012). For arduous tasks such as forest clearing and during busy harvest periods, and sometimes weeding, farmers often hire male labourers in the same village on an informal basis and pay them a fixed daily wage of SRD 150 (approximately US$20). Most farmers report no shortage of labour as the level of work involved under the current production practices is minimal. Apart from forest clearing at the beginning of the production period (due to shifting cultivation), weeding only takes place occasionally. Staggered planting and irrigation are not carried out, and there is little soil fertility maintenance and pest and disease management. Thus, there is no on-farm work that requires a large amount of labour until harvest. Nevertheless, labour might pose a challenge in the future, when pineapple production expands or intensifies, especially due to the increasing migration of men and youth to the city and to other non-agricultural sectors.

Downstream along the value chain, the majority of actors are self-employed and the use of family labour is prevalent. Market and street vendors, as well as artisanal pineapple processors, are small businesses that

rarely require extra labour outside the family. Depending on the scale of the business, wholesaler vendors might employ one to two workers on an informal basis. Meanwhile, since the BPS factory went into operation in Redi Doti, a number of young people, especially women in the surrounding villages, have found work. At the time being, as the factory is still being set up and the processing capacity limited, most of the work is manual and the women are employed only part-time on minimum wage. However, as the factory is being expanded and mechanized, coupled with the prospect of other processing plants established, there is a potential to attract and provide employment to youth and women beyond the farm level.

1.6 Enabling Environment: Societal Elements

Value chain actors and support service providers operate in a broader enabling environment, comprising of societal and natural elements that can influence their performance through various pathways. Together they influence access to market, finance, information and resources of value chain actors, their relationships (governance) and their capacities and incentives to upgrade. In fact, many systemic causes of value chain constraints, and thus the greatest opportunities for improving value chain performance, may lie in the broader environment rather than the chain itself.

For analytical purposes, societal elements are divided into four categories: (1) formal institutional elements such as national policies, regulations and laws; (2) informal sociocultural elements such as norms, unwritten codes of conduct, cultural preferences and habits; (3) physical infrastructural elements such as energy, roads, ports, water, and telecommunication networks; and (4) organizational elements, such as inter-professional associations and research facilities.

1.6.1 Policies, Regulations and Laws

1.6.1.1 Overall policy framework

National plan for the agricultural sector

Suriname's economy is largely dependent on the extractive and services sectors, with agriculture, forestry and fisheries accounting for only 8-10% of national GDP (World Bank, n.d.). Heavy reliance on the mining of three commodities- oil, gold and previously bauxite- which contributed to 85% of exports and provided nearly 30% of government revenues in 2015 has rendered the country particularly vulnerable to mineral price volatility (CIA, n.d.). In fact, the sharp decrease in world's commodity prices in recent years, coupled with the closure of a major American mining company in Suriname, has plunged the economy in recession.

In this context, the Government of Suriname has declared a strategic shift in its approach towards agriculture in the five-year National Master Plan for Agricultural Development (2016), prepared in consultation with the Government of Israel and adopted by the Ministry of LVV. The Master Plan places high hopes for a new era for Suriname's agriculture, in the face of the decline of the mining industry. Agriculture is thus seen as a promising sector for economic diversification, foreign exchange generation, employment creation, and food security improvement.

Suriname has an abundance of unused land suitable for agricultural purposes. While agriculture has always been of socio-economic significance, especially for the rural areas, effective public investments and policy support have been lacking apart from those directed at the rice and banana sectors. In 2014, the value of imported agricultural products, which stands at USD 243 million, almost doubles that of exports. Although agricultural exports from Suriname have seen an increase in value since 2007, most are attributed to rice and bananas. Other fruits and vegetables are now also seen as potential areas for export promotion and

import substitution.

By 2025, the Government aims to increase the share of agriculture of the national GDP, as well as almost double the labour force to sustain 22,000 jobs in the sector. In order to reach such goals, the intention is to move beyond subsistence agriculture to "commercial, export-oriented and knowledge-driven modern agriculture" that benefits both small family farms and large industrial farms. Furthermore, it is expected that the modernization of agriculture will provide a reliable supply of raw materials that can support the development of Suriname's agro-industry to an intermediate level. In the Master Plan, $40 million per year of government investment is pledged to be distributed to various support mechanisms, including extension and research, credit, insurance, infrastructure, land lease and public-private partnership.

This ambitious plan, however, will be faced with formidable obstacles given the current business environment in Suriname. According to the World Bank's "Ease of Doing Business" index (2019), Suriname ranks 165 out of 190 countries worldwide, down 7 places since 2017. Its rank is also significantly lower than the regional average for Latin America and the Caribbean, as well as comparator economies in the CARICOM (low income countries like Guyana ranks 134, upper middle-income countries like Dominican Republic ranks 102, and Jamaica ranks 75). In the region, Suriname only ranks higher than Haiti (181) and Venezuela (188). While faring well in "Trading across border" (rank 87), Suriname underperforms particularly in the areas of "Starting a Business" (rank 182), "Enforcing contracts" (rank 187), and "Registering property" (rank 160). While Suriname has implemented several regulatory reforms to shorten its procedures of starting a business, it is still one of the main bottlenecks to an open business climate. For instance, despite introducing an online system for obtaining trade licenses, the process still takes up to 2 months. Furthermore, when registering their business, married women are required to submit documentation regarding their husbands' ownership of any businesses. This creates an additional burden for women's participation in agri-entrepreneurship.

Similarly, competitiveness in Suriname remained lower than the regional average, according to the Global Competitiveness Index of the World Economic Forum (WEF) in 2014-2015, the last years Suriname was included in the ranking. Inefficient government bureaucracy, corruption, and limited access to financing are named the three formidable obstacles to the development of Suriname's economy. The bulky size of the public sector and its personnel contribute to slowing down investments and innovations in the country. It is recognized in the National Development Plan 2017-2021 that government bodies assume overlapping duties and are overstaffed with low-skilled and ineffective workers. Furthermore, the Government has taken on too many roles and encroached on the space that should be left to the private sector and civil society. Fundamental reforms and restructuring, including significantly downsizing the bureaucratic machine, are proposed.

Government support for the pineapple subsector

Pineapple producing regions are amongst the regions of focus in the Government's strategy for agricultural promotion. The Ministry of LVV expresses the intention to maintain and advance organic farming, and the Government realizes Suriname's advantages in organic agriculture thanks to traditional farming practices and remote and expansive land areas with low levels of industrialization. The challenge would be how to do it properly in order to bring about economic and social values, apart from safeguarding the environment.

So far however, the pineapple subsector has not received much attention and explicit support from the Government compared to other traditional agricultural crops, such as rice and banana. This is understandable as rice and bananas are the most important agricultural exports, while no fresh pineapples

and almost no pineapple products have yet been exported from Suriname. There are no specific policy measures for the pineapple subsector in terms of subsidies, investment promotion, research or training. The capacity of agricultural extension services in the pineapple growing regions are very weak. Extension staff possesses limited technical knowledge in organic agriculture in general, and in the production and post-harvest handling of pineapples in particular. Thus, farmers do not receive state-funded trainings, manuals and other forms of guidance on these issues. Besides, no funding is allocated to the travel of extension officers to the farms, considerably hindering their incentives to support growers.

In order to address this gap, the Ministry of LVV is in planning a small project on pineapples, passion fruits and soursop supported with an IDB loan. Two main objectives of the project are (1) to understand the characteristics of some of the most planted local pineapple cultivars, and (2) to pilot two imported varieties – MD2 from Costa Rica and Montserrat from Guyana – on trial plots. A nursery and a gene bank for pineapples are also envisioned. For the past few years, the project has remained in the planning phase and except for this, no other activities in support of the pineapple sector have been carried out under LVV. The Ministry of Trade, Industry and Tourism (HIT), rather, has been active on this front, frequently engaging in promoting the pineapple sector. HIT was key in facilitating the establishment of the Agro-Cooperative Pineapple Para and contract agreements between Para farmers and Suriname Candied Fruits. It is also leading several projects to promote entrepreneurship in farming and agribusiness. In both Para and Marowijne, a number of pineapple growers are assisted by HIT officers in advancing their business management and administration skills. Inter-ministerial collaboration between the two ministries, thus, is crucial in this respect to improve and ensure coordinated and well-rounded support.

1.6.1.2 Trade Agreements

Suriname joined the General Agreement on Tariffs and Trade (GATT) in 1978 and is an original member of the World Trade Organization (WTO) and the Caribbean Community (CARICOM) in 1995. As a member of the CARICOM, Suriname is committed to coordinating regionally in trade-related policies and grants duty-free access to all goods originating from member countries, as well as applies the Common External Tariff for products outside the region with certain exceptions. It also has special trade agreements with the Dominican Republic and Cuba and benefits from the EU-funded Caribbean Regional Program as part of the block. For exports to the US, the most favoured nation principle applies and import tariffs range between 0.71 and 1.56%, while in the case of Canada, no imports tariffs are in place at the moment.

The European Union is the largest market for Suriname's fruits and vegetables, mostly exported to and through the Netherlands. Hence, there are opportunities to export fresh pineapples and processed pineapples products to Europe, targeting especially niche markets. As a member of the Forum of the Caribbean Group of African, Caribbean and Pacific States, Suriname benefits from the Economic Partnership Agreement (EPA), which was signed in 2008 between the EU and the CARIFORUM following the ACP-EU Cotonou Agreement. Under this comprehensive free trade agreement, Suriname can export to the EU market without duty and quota restrictions. However, 10 years after signing the agreement, Suriname still has not ratified the EPA, nor has the country taken proactive steps towards adopting and reforming regulations in different areas, such as competition policy or intellectual property for effective implementation of the treaty. In case of no actions from Suriname, the EU can introduce import duties for Surinamese products, which will have a direct negative influence on competitiveness of Suriname's pineapples on the European market.

1.6.1.3 Quality and Standards

Suriname is a member of influential international standards bodies such as the Codex Alimentarius Committee and the International Plant Protection Convention. The Suriname Standards Bureau (SSB), established in 2007, is in charge of developing, adopting and promoting the use of standards and technical regulations. SSB makes use of international standards such as ISO, Codex and GLOBAL GAP and adapts to Suriname context, but also develops national standards upon the requests of stakeholders. At a later stage, the GAP standard shall be transformed into a technical regulation, with which all farmers, including pineapple producers, need to comply. On a regional level, the CARICOM Regional Organisation for Standards and Quality has developed a standard for fresh pineapples and juices. This standard is applicable to Suriname on a voluntary basis, since only technical regulations are mandatory.

At present however, there is no quality control mechanism for fresh pineapples, nor are there regulations on organically grown produce in Suriname. For processed pineapple products, all processing factories are subject to inspection by the Bureau of Public Health (BOG) and all products must conform to SSB's general labelling requirements for the pre-packaged food. International standards are not mandatory, although the FSSC 22000 certification based on existing ISO standards is the prerequisite for companies that aim to export.

While Suriname has signed the WTO/SPS that set criteria in the area of food safety, it is currently not possible to export fresh pineapples from Suriname, due to the lack of the pest risk analysis, an essential part of the Sanitary and Phytosanitary Measures (SPS) requirements. At the time of the interview there had yet been active involvement in the preparation of a pest list from the LVV Plant Quarantine and Quality Control Department, such as research into pest and diseases related to the pineapple plant, or collaboration with other organizations that could support in this task. It is unclear when the process of establishing a list of pests and diseases for pineapple will begin, who will initiate it, and how long this process will take. This is a critical bottleneck in the sustainable development of the pineapple value chain, directly affecting farmers and companies who intend to export fresh pineapples.

1.6.2 Physical Infrastructures

1.6.2.1 In-country transport

The roads connecting the main pineapple growing district Para to the capital Paramaribo are newly built and in fair condition, making it easy to transport pineapples outside the region by pickup trucks or mini-buses. In fact, it takes only over an hour from Para to Paramaribo and the harbour, costing roughly 100 SRD (~ USD 13.5) for fuel, and 45 minutes to reach the international airport Zanderij. There is ongoing construction of a new road from Para to the airport, which is expected to reduce the travel time to less than half an hour when finished. Thus, Para has a competitive location regarding the export of fresh pineapples, as well as the supply of pineapples to the capital. The distance from Marowijne, the other pineapple producing region, to Paramaribo is twice of that from Para. Marowijne is nonetheless reasonably connected both by land and water as the infrastructure has been built by the bauxite industry. It is also located close to the border with French Guyana, a promising market. However, while pineapple farms in Para are also accessible by car, the rural roads that lead to the farms are bumpier. The conditions are exacerbated in the rainy season, when many puddles are formed on those roads. This might negatively affect the quality of the pineapples when transporting from the farm and increase post-harvest loss. If there are plans to expand the production of pineapples in these regions, it is necessary to invest in rural roads and maintain the roads from the regions to the city and airport.

1.6.2.2 Export Infrastructure

Currently there are no formal exports of fresh or processed pineapple products in Suriname. However, unknown quantities of fresh pineapples are traded informally to the neighbouring French Guyana. At the moment, fresh fruits and vegetables are exported by members of the Association of Exporters of Fruits and Vegetables (VEAPS), mainly to the Netherlands and the Caribbean region. The export of fresh fruits and vegetables is either by air freight or sea freight.

Air freight

The exporters of fruits and vegetables export their goods by airfreight with the airlines KLM, SLM and TUI, who have direct connection flights from Suriname to the Netherlands. On average, there are 12 flights per week, with a freight transport capacity of around 6 tonnes per flight. At the moment, the price for airfreight equals approximately USD 2.00/kg, which represents a critical constraint for the Surinamese pineapple sector to become competitive on the international market. As a comparison, For example the airfreight cost to transport produce from the Dominican Republic to the Netherlands is USD 0.80/kg, more than 50 % less.

Sea freight

Container vessels from Rotterdam head for Suriname on a regular basis; the transport in this direction takes approximately 3 weeks. Container vessels heading from Suriname to Rotterdam, on the other hand, have to make a detour, passing by the Caribbean first before returning to Europe. For this reason, the transport by sea freight from Suriname to the Netherlands takes approximately 8 weeks, which represents an important bottleneck when it comes to the export of fresh pineapples due to the limited shelf-life of the product. An exception from the long transport times are the shipments of the "Food Agriculture Industries (FAI)", adhering to the international company "The Fruit Farm Group". FAI produces bananas in Suriname that are exported by sea freight with the company's own boat on a direct route from Suriname to Europe. Further investigations are necessary in order to determine whether fresh pineapple products could be included as a cargo on the Fruit Farm Group's ships.

1.6.2.3 Energy

There is one sole provider of electricity in Suriname- the state-owned company N.V. Energie Bedrijven Suriname (EBS). All the residential areas in the coastal region and the savannah belt are well-covered for the cost of SRD 0.15 per KWH for the first 150kWh, with more tariff added the higher the consumption. There is almost no use of electricity on the field, as most farmers do not fertilize nor irrigate, while conventional farmers who do use machineries run by fuel. EBS has a power station in Powakka, at the heart of Para and less than 10km from Redi Doti. Electricity is a crucial bottleneck in the processing of pineapples, however. Bio Pineapple Para cites the inadequate provision of electricity as a hindrance to the factory's productivity. At the moment, the factory is not receiving enough electricity for the smooth and continuous operations of electrical equipment, thus having to rely mainly on manual labour. The stable supply of electricity is essential to the establishment of cooling facilities as the production and processing of pineapples expand.

1.6.2.4 Water and Irrigation

Water is provided by the state-owned company Suriname Waterleiding Maatschappij (SWM) through a piped water supply system to residents in urban and semi-urban areas near the coast. An estimated 90% of the population in the Greater Paramaribo area has access to clean water. Although there is a special department, De Dienst Watervoorziening (DWV) under the Ministry of Natural Resources, which supplies water to the rural areas and the interior, including Para and Marowijne, its coverage is spotty, and residents often must rely on shallow wells or collect and save rainwater for their livelihoods. There are plenty of water sources such as rivers and creeks, which could be accessed easily yet could be high in turbidity and

contaminated with mercury due to gold mining activities. Most farmers do not employ any irrigation methods and the cultivation of pineapples are dependent on rainfall. Especially during the dry seasons, access to water is significantly reduced for the interior population, who can only rely on groundwater. Occasionally, tap water can also be delivered by trucks by the DWV to areas that are not connected by pipelines. For instance, tap water is delivered by trucks to Bio Pineapple Suriname factory in Redi Doti for pineapple processing exclusively.

1.6.2.5 Telecommunications

Similar to the provision of water and electricity, the populated coastal area has better access to telecommunications than the interior. Currently there are two companies that provide telecommunications service in Suriname. Telesur is a state-owned company that provides fixed line telephone services and ADSL internet, as well as mobile phone services with internet data plan. Digicel is a private mobile phone network provider with coverage throughout the Caribbean. Internet is widely available in Greater Paramaribo, as well as in the villages of the savanna belt. All the value chain actors interviewed have a smart phone and access to the internet, which plays an important role in facilitating their communications on payment and delivery. The only challenge is the connectivity in some pineapple fields that are located further from the village.

1.6.3 Socio-cultural norms

1.6.3.1 Land Titles

Secure access to land is crucial to creating incentives to invest labour and other resources in the farm. The ownership and management of land in Suriname is governed under both the national legal system and the traditional customary system. Land rights have always been a contentious issue between the Surinamese state and the indigenous and tribal population. The Amerindian village authorities have been fighting for years to obtain collective land rights and access to the surrounding natural resources (ACT, 2010). However, Suriname is still the sole country in the Americas where the collective rights to land of indigenous and tribal peoples are not legally recognized. According to the constitution, all land and natural resources belong to the state, and only those with titles granted by the government can claim legal ownership (Kambel, 2007).

Most pineapple farmers, who belong to indigenous and tribal groups- Amerindians (early settlers before colonialist) and Maroons (descendants of runaway slaves), do not have titles to the land they inhabit and use. According to Struiken and Healy (2003), only around 17% of the rural population in Para holds rent or lease title. This number falls to 10% in Marowijne, and an alarming 0.03% in Brokopondo/Silipawini. Land registration procedures remain lengthy and complicated, while social and political connections can play a large part in this process. It can take five years or more and involve various trips to the capital and visits to the authorities, including the District Commissioner and the Office of Title Registry in the Ministry of Natural Resources. This lengthy and uncertain process proves particularly challenging to smallholders, who not only need to dedicate time to working on the fields but might also take up other side jobs to supplement their incomes. The lack of property rights, in turn, hinders their incentives to invest in the land for agricultural production, as well as their access to credit by offering land as a collateral.

In indigenous communities, land is considered a communal goods, and access to land is based on social norms. A village member who wishes to use the land needs approval from the village authority, thus highlighting the important role of the village “captains” (kabiten) and their assistants (basia) in this value chain. Interviews with pineapple farmers reveal that so far, there has not been major difficulty in requesting the use and expansion of land for pineapple production. However, they do not have any formal

rights to these lands and related resources, and so their ownership of the land could be contested or revoked. Although various international organizations have called for the introduction of legal instruments to respect the customary rights of indigenous people, the nature of these rights remains undefined. The diversity of Surinamese ethnic population and the presence of valuable natural resources and minerals in these areas have further contributed to the complications surrounding the collective land rights of indigenous and tribal peoples.

1.6.3.2 Gender Norms

As the Surinamese society is so ethnically diverse, the norms between tribes and villages can be vastly different. And yet overall, men are traditionally responsible for clearing the forest and burning down a plot for shifting agriculture, and women carry the main responsibility of cultivating the crops. This system has been witnessed in subsistence pineapple farms, although it is being challenged due to an increase in the migration of young men in the interior to the cities and mining areas, leaving women to clear the land themselves or hire labourers to do it. In the Carolina region of the Para districts, where the indigenous villages Redi Doti, Pierre Kondre, and Powakka are located, pineapple production is dominated by men. It is assumed that once farming for cash crops such as pineapples gets more commercial and lucrative, men tend to take over from women. While most men farm together with their wives, they are often identified as "the farmer" because of social expectations of men as breadwinners. Women are delegated a supportive role, and although it is traditionally accepted for women to keep their own income when they work, intra-household decision-making power tends to lie with men. Legislations were changed in the 1980s and since then women have been able to open their own bank account and get a loan. If a couple is married and one of them gets a loan, both have to sign. Nonetheless in the rural areas, most people are not often married by law. In Maroon societies, men occupy the highest positions in the village despite its matrilineal structure. There has been an increase in the number of female captains, though they are still few and far between. The captains represent the tribal leader, who can only be male. Women are also less mobile than men and seldom travel outside the village. In other value chain functions, especially in the city, there seem to be no clear gender distribution of roles. Both men and women can occupy different functions along the chain, coming to pick up pineapples from the farms and transporting them to the city to sell in the market or on the street. Sometimes, both husband and wife support each other in this business.

1.6.4 Organization and Cooperation

There is yet a central authority claiming to represent the pineapple sector. However, there have been individual involvements from various organizations, which could be a basis for stakeholder coordination in the pineapple value chain.

The Centre for Agricultural Research in Suriname (CELOS) is part of the Aanton De Kom University of Suriname (ADEKUS) that focuses on agriculture in the interior region (while LVV Agricultural Research Sub-Directorate focuses on the coastal area). As mixed production systems are prevalent in the interior, CELOS focuses its research on integrated production systems rather than mono-cropping. This focus has influenced other agriculture-related research of the Faculty of Technology at ADEKUS, particularly its newly established MSc Program on Sustainable Management of Natural Resources. A large part of CELOS recent work has been dedicated to the creation of a mixed production systems in which staple crops such as cassava are central. In some parts of the interior cassava is intercropped with pineapples, thus CELOS has worked with the indigenous communities in the village of Matta, where most local pineapple varieties can be found, to understand more about their different cultivars. This small research, conducted 10 years ago under a Dutch funded agro-forestry project, resulted in a small manual of simple descriptions of existing pineapple varieties. While a soil analysis in Matta is known to also have been carried out in the

same period, the results are not widely shared. In fact, an important bottleneck is the poor dissemination of findings and the weak collaboration between research institutes such as CELOS and the research and extension departments in the Ministry of LVV. Together with the Faculty of Technology, CELOS also possesses a plant tissue culture lab which purportedly carry out propagation of pineapple plants and in-vitro conservation of pineapple germplasm. Yet, there is little information exchange between this lab and the IDB Pineapple project team in LVV, whose aim is to establish a nursery and gene bank for pineapples in the future.

Next to CELOS, the Inter-American Institute for Cooperation on Agriculture (IICA) has influenced agricultural research and innovation in Suriname. Through the introduction of modern techniques, IICA has supported the move from shifting cultivation to more permanent, sustainable forms of agriculture for communities in the interior. From 2001 to 2004, IICA carried out training in pineapple planting (double row planting) with higher density for some farmers in Redi Doti and Pierre Kondre. IICA also has experience with flower induction techniques in other Caribbean countries, which address the seasonality of pineapples and increase productivity, and is willing to support the introduction of these techniques in Suriname. According to the IICA Representative, with double row planting, fertilizing and the application of flower induction techniques, the yield in Suriname, which is at the very low end of the spectrum, could increase threefold.

As a small country, Suriname might not be able to invest substantially in different research into particular crops. Hence, there has also been increased collaboration with research organizations from abroad through internationally funded projects, especially organizations from the Netherlands (Wageningen University), Belgium (Flemish Association for Development Cooperation and Technical Assistance) and Brazil (EMBRAPA- the Brazilian Agricultural Research Corporation). A key challenge is to go beyond piecemeal development and ensure the centralization of knowledge.

On the market development side, many organizations with different mandates are involved, such as the Chamber of Commerce (KKF), the Suriname Business Association (VSB), the Association for Surinamese Manufacturing Companies (ASFA), and the Suriname Business Forum (SBF). The Chamber of Commerce is a private body under public law that maintains the trade register for every private enterprise, with the exception of certain small-scale agriculture-related businesses. In recent years, KKF has moved beyond its role as simply a trade registration office and gradually become an active service provider. KKF has organized quite a variety of activities to foster collaboration in the business community, provide trade information, and advance entrepreneurship. For instance, every Tuesday, members are invited to a business evening when contemporary issues affecting business are discussed, accompanied by presentations from guest speakers. Apart from this weekly event, KKF also organizes occasional field trips abroad, sets up large agricultural fairs to display and promote Surinamese products, and provides training courses. KKF is currently partnering with HIT Extension Service in strengthening agri-business skills for farmers, such as bookkeeping.

In comparison, VSB – the representative of the business community in negotiation with the government, and ASFA – the umbrella organization for all processors, do not seem very active. Interviews with processing companies and bakeries indicate that despite the mandatory annual membership, there is little engagement with these organizations, apart from a few trainings on international exports and assistance with ISO standards provided by ASFA. While KKF, VSB and ASFA are supposed to represent private sector interests, the Suriname Business Forum identifies itself as a multi-stakeholder platform to facilitate dialogue between the public and private sector, as well as civil society. Over the past 2 years, it has focused on improving the capacity of Surinamese companies and products to target foreign markets through the

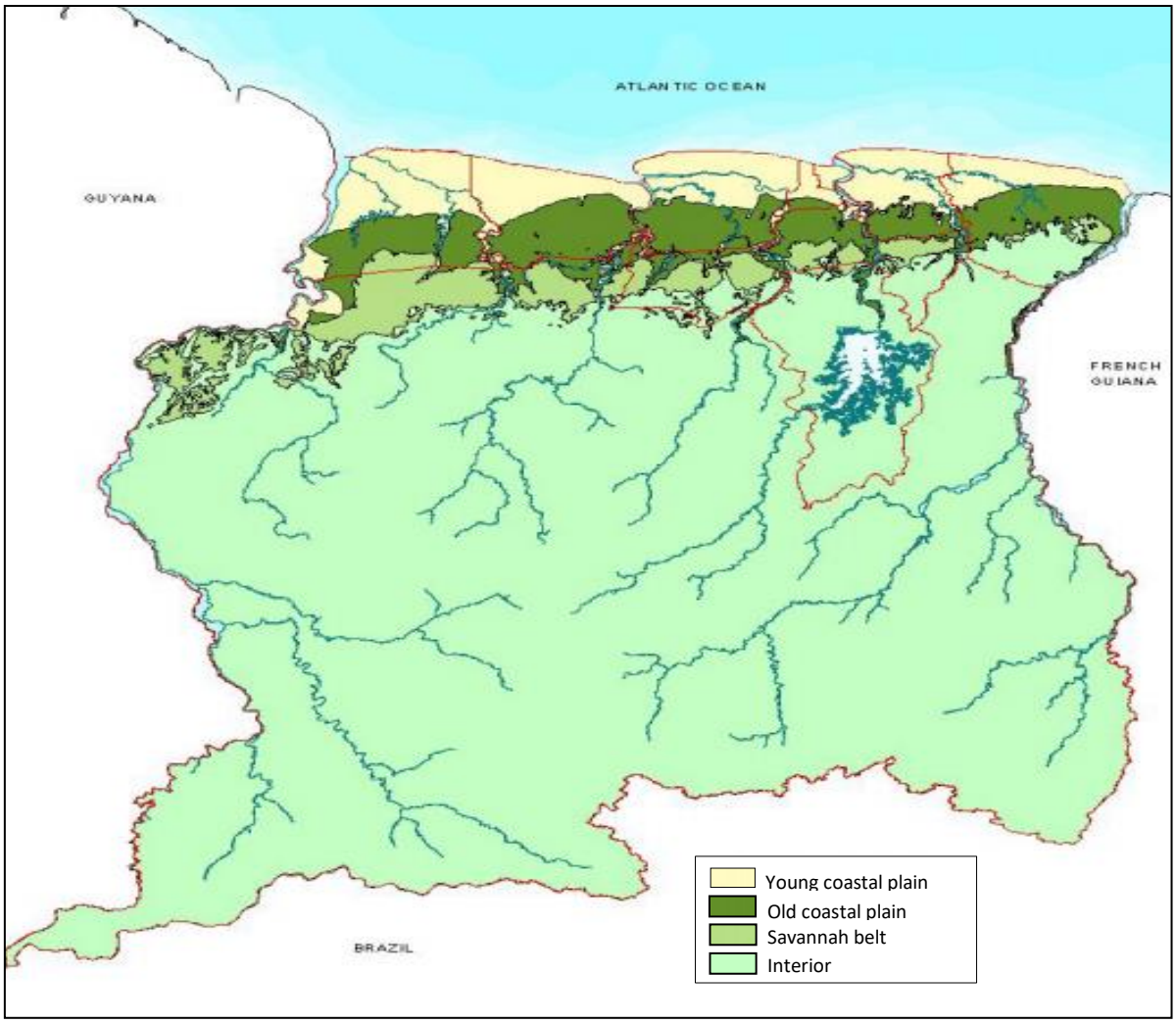
Export Readiness Project, in which SBF helps prominent Surinamese farms and processing firms with potential buyers.

With the vast array of activities and agencies with the overall aim of strengthening competitiveness and conducting 'business reform', Suriname has shown its willingness to make strides towards an open business climate. An overarching issue will be reviving the relatively weak coordination and collaboration between research, extension and market development.

1.7 Enabling environment: Natural elements

The Republic of Suriname is situated on the northern coast of South America between 54° and 58° western longitude and 2° and 6° northern latitude. It can be divided into the following three ecological regions: the coastal plain, the savannah belt and the tropical rain forest. The coastal plain, which can be subdivided into the young and the old coastal plains, is a lowland area with clay and loam soils, interspersed by sandy ridges. This is the most populated area of the country and also the region where most agricultural activities take place. The tropical rainforest region covers approximately 90% of the country's surface area. Soils in this region are diverse but of low fertility and agricultural activities are mostly of subsistence nature (ICCA, 1991) (Geijskes & Wagenaar Hummelinck, 1975). Forests in the interior are composed of wet tropical lowland forests and submontane forests (Whiting, 2016). The savannah belt that separates the coastal plain from the interior tropical forests is the main pineapple producing region. It covers approximately 10,000 km^2 and stretches from east to west. The belt is 5-10 km wide in the east and 60-70 km wide in the west, with elevations ranging from 10 m in the north to 50 m in the south. Soils in the savannah belt are mainly sandy soils and sandy loam soils (NIMOS, 2018) and vegetation is composed of a mix of open grassland, xerophyte forest, deciduous forest and rainforest (Whiting, 2016).

Figure 32: Map of Suriname showing the main ecological zones



Source: UNDP (2016)

1.7.1 Climate

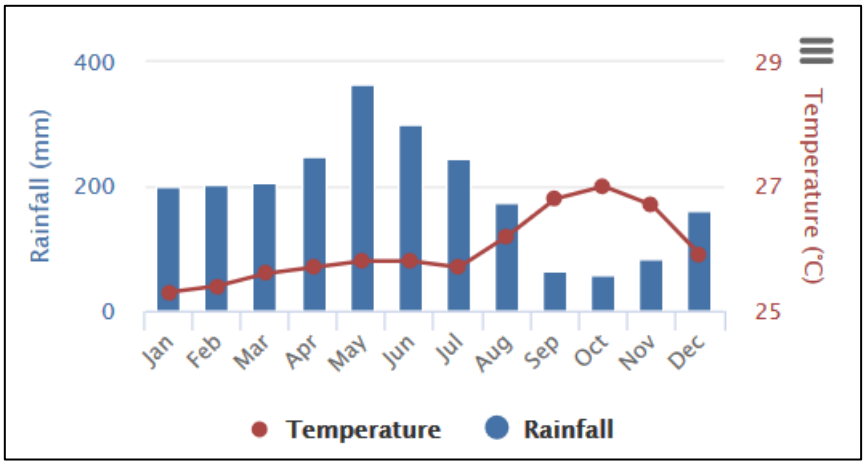
According to the Köppen climate classification, Suriname has tropical rainforest climate (Af) in the northern and monsoon climate (Am) in the southern regions. Climate in Suriname is influenced by the Inter-Tropical Convergence Zone (ITC-Zone) that passes over the country twice per year, resulting in the following four seasons (Ouboter, 1993):

- Short dry season from early February to late April
- Long rainy season from late April to mid-August
- Long dry season from mid- August to early December
- Short rainy season from early December to early February

The mean annual air temperature in the northern region ranges from 25-27.5° and in the southern regions from 23-25°C (McSweeney, et al., 2012), with the warmest month being October and the coolest month being January (see Figure 33). The mean of the maximum temperature is 30.5° and the mean daily minimum

temperature is 22.8° (Ouboter, 1993). The average daily temperature fluctuation in the northern regions is approximately 5°C and in the southern regions 10-12°C (NIMOS, 2014).
The mean annual rainfall varies from 1,450 mm to 3,000 mm, with the long-term mean annual rainfall in the northern regions amounting to 2,000 mm to 2,400 mm (Geijskes & Wagenaar Hummelinck, 1975), (Ouboter, 1993). The mean monthly rainfall during the long rainy season varies between 250-400 mm and between 150-200 mm in the short rainy season (McSweeney, et al., 2012). During the dry seasons the mean monthly rainfall is higher than 60 mm in most parts of the country, except for a small region along the coast in the North-West and in the South-West of the country (Ouboter, 1993).

Figure 33: Average monthly temperature and rainfall for Suriname from 1991-2015



Source: World Bank, 2018

Inter-annual variations of the climate conditions in Suriname can be observed due to the influence of the El Niño Southern Oscillation (ENSO). The warm phase of the ENSO, referred to as El Niño, brings warmer and drier climate conditions, whereas the cool phase, called La Niña, entails wetter and cooler climate conditions (McSweeney, et al., 2012).

Optimal climate conditions for pineapple cultivation

The pineapple is a xerophyte, which is a plant species that is well adapted to survive under dry climate conditions. The optimum annual precipitation for commercial production lies between 1,000 and 1,500 mm; however, pineapples can be cultivated in areas receiving yearly precipitation levels that range from as low as 600 mm per year to as high as 2,500 mm per year (Robin, et al., 2011). In view of these numbers, it can be concluded that precipitation in Suriname, and particularly in the northern part where most pineapple cultivation takes place, does not represent a limiting factor and that there is sufficient rainfall for commercial pineapple cultivation. However, because of the low water retention capacity of the sandy soils, water still is a limiting growth factor during the dry seasons.

For optimal plant development, temperature should be as equal as possible throughout the year. The optimal temperature is around 30°C during day and 20°C during night; plant growth rates decrease rapidly at temperatures below or above this range. A temperature difference of 10°C between day and night is of high importance in the case of pineapple, because it is a plant species that uses the Crassulacean Acid Metabolism (CAM) pathway for carbon fixation. Plants using this metabolism are well adapted to arid conditions, as CO_2 uptake occurs during night and not during day, which considerably reduces water loss through transpiration. If temperature during the night is above 20°C and the temperature differential between the day and night

does not reach 10°C, then the amount of CO_2 fixed during the night is not optimal and, therefore, the production of photo-assimilates is decreased. This, in turn, leads to a lengthened production cycle since it takes more time to reach the amount of reserves that are needed before the plant enters the reproductive growth phase, the flowering phase.

With an average diurnal temperature difference of 5°C in the northern part of the country and a mean daily minimum temperature of around 23° C, it can be concluded that growth conditions are not optimal and that it is difficult for Suriname to reach the levels of productivity that can be observed in other pineapple producing countries.

1.7.2. Soils

Pineapples grow on almost any soil that is well-drained, well-aerated and non-compacted. The most suitable soils are sandy loams with a high content of organic matter and a soil pH ranging from 4.5-6.5 (Robin, et al., 2011). Pure sand or clay soils need organic enrichment to improve growth conditions (Morton, 1987). Pineapples are highly sensitive to water logging, which is why they need to be cultivated on ridges in rainy climates or on heavy soils. At the same time, soils with very low water retention capacity can translate into adverse effects on plant morphology and growth during dry seasons, particularly due to the reduced number and length of roots that result from water stress. Therefore, even though the pineapple is a drought tolerant plant species, under certain soil and climate conditions irrigation is needed to maximise yields.

In Suriname, pineapples are mostly grown in the savannah belt on white sandy soils (see Figure 34). The soils in the savannah belt can be divided into bleached and unbleached soils. The bleached soils consist of more than 99 % of silica (SiO_2) and are considered barren soils. The unbleached soils, which consist of sandy loam or sandy clay loam, have good physical but poor chemical properties (NIMOS, 2018).

Overall, the soils in the savannah belt are described as infertile (ICCA, 1991) (SPS, 2008), even though a distinction between the areas with unbleached and bleached soils must be drawn, with the latter being less suitable for agricultural purposes. Improving the fertility of the bleached soils through fertilization is difficult, due to the low nutrient retention capacity of these soils, which leads to rapid nutrient leaching during the rain.

Figure 34: Pineapples grown on white sandy soils in the Surinamese savannah belt

Picture taken by Jhonny Vásquez Jiménez, August 2018

These soils are well-drained but of low water retention capacities. The soil pH is acidic and lies in the range of 4.7 to 5.4 according to samples taken and analysed by the 3ADI+ agronomist. The soil is not completely covered by vegetation in the pineapple fields, it is laid bare to wind and water erosion. This leads to soil compaction which has negative consequences for root penetration and development. The low water retention capacity of the sandy soils represents a constraining factor for pineapple production in Suriname, which leads to poor plant development during the dry season and, in the end, to reduced yields. It has, furthermore, implications on the varieties that can be cultivated in Suriname. Non-native pineapple varieties, which are not adapted to the sandy soils and climate conditions in Suriname, might only yield satisfactorily under irrigation. Furthermore, the low water retention capacity of the white sandy soils in Suriname affects planting dates, given the fact that, under the absence of irrigation, planting during the dry season is difficult and to establish year-round production the introduction of irrigation schemes might be necessary.

In order to further assess the suitability of the soils on which pineapples are currently being cultivated in Suriname, it is necessary to carry out more detailed soil analyses. The missing data and information and the fact that carrying out soil analyses prior to planting is an uncommon procedure in Suriname, add to the difficulty of clearly determining which soils are more or less suitable for pineapple cultivation and also which agronomic measures are necessary in order to improve soil texture and fertility.

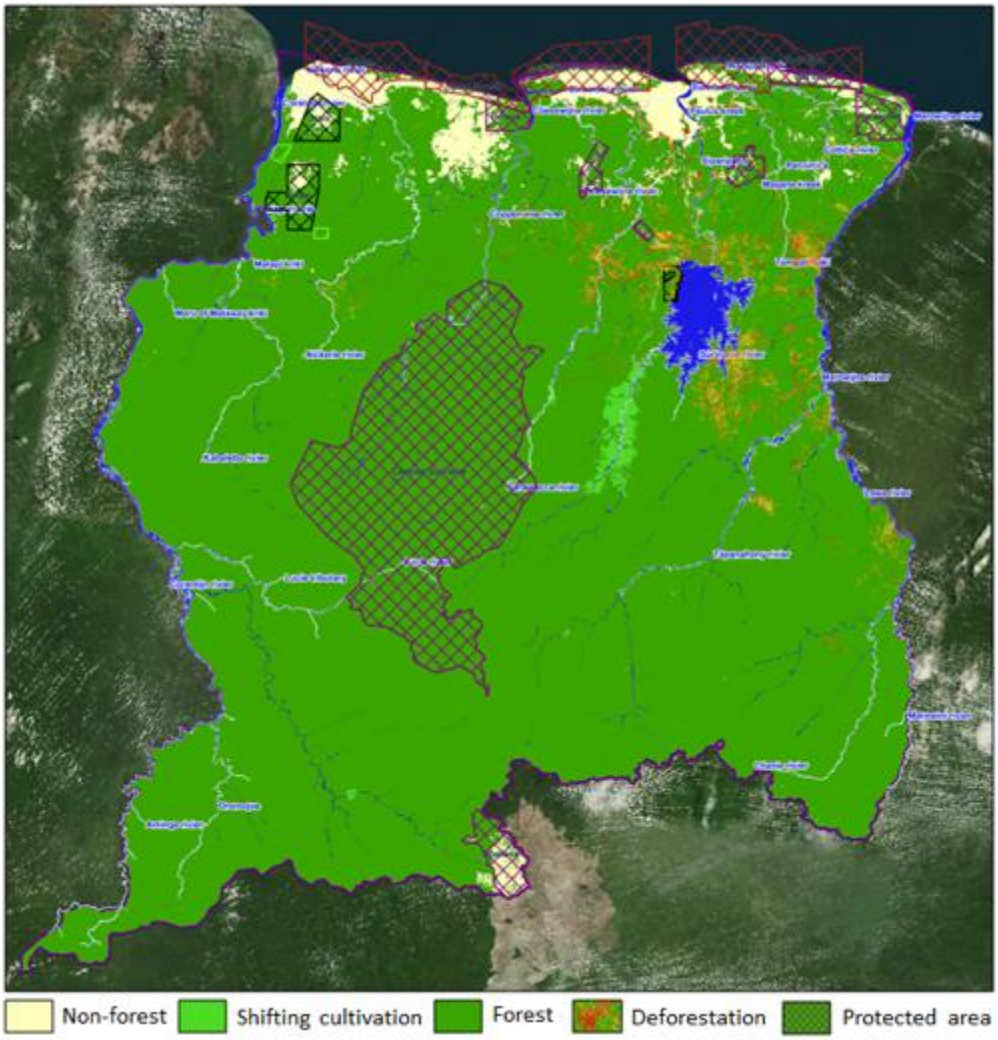
1.7.3. Forests

Suriname is one of 11 countries worldwide that are categorized as High Forest Cover/Low rate Deforestation (HFLD) countries[5] and is one of the most forested countries in the world (Shahbol, et al., 2018) (UNIQUE, et al., 2017). Approximately 93% of the country's land surface is covered by forests, which form part of the Guiana Shield Eco-region. This eco-region covers an area of approximately 270 million ha and is the largest complex of uninterrupted, intact primary forests in the world (UNDP, 2011). To maintain its HFLD status, protect its forest resources, and introduce and strengthen sustainable forest management practices, Suriname adopted the REDD+ program, a UN program for Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD+, n.d.).
Of the total forest area in Suriname, which amounts to 15.2 million ha (UNIQUE, et al., 2017), 70 % is excluded from forestry activities (10.36 million ha). This includes formally protected areas (1.35 million ha) (see Figure 3) and all forest areas located below 4° N (5.91 million ha). The remaining 30% (4.4 million ha) has been classified as production forest (FAO, 2010). However, because these areas have not been formally designated and because of the lack of an integrated national land use plan, the establishment of sustainably forestry practices in the areas categorized as production forest has been challenging. In terms of ownership, 99.7% of the forest is state owned and only 0.3% is private forest. (UNIQUE, et al., 2017).
There are 3 broad forest zones, which correspond to the three main ecological zones:

- Hydrophytic forest: 1.3 million ha in the north, which consists of swamp forest, mangrove forest and swamp forest.
- Xerophytic savannah forest: 150,000 ha in the savannah belt.
- Mesophytic forest: 13.4 million ha, which consists of predominantly humid high dry land forest (SBB, 2014).

Figure 35: Land use and cover map Suriname

[5] HFLD countries are countries with more than 50% forest cover and a deforestation rate below the global average of 0.22 % per year (Shahbol, et al., 2018)



Source: GONINI, 2018

According to an analysis carried out by UNIQUE forestry and land use GmbH and Stichting Bosbeheer en Bostoezicht (SBB), the deforestation rate in Suriname between 2000 and 2015 was 0.04 %, corresponding to an average of 5,676 ha/year. While this rate lies well below the global average of 0.22% per year, a strong increase in the deforestation rate can be observed between 2000 and 2015. Compared to the period 2000 - 2009 the annual deforestation rate was more than three times higher in the period 2009 - 2015 and increased from 0.02 to 0.07 (UNIQUE, et al., 2017).

The main causes for deforestation over the course of the last years has been legal and illegal mining, infrastructure and road constructions, urban development and agriculture, with gold mining being the largest driver (ibid), (FAO, 2010). Forestry activities itself are not a driving factor for deforestation, because logging is practiced in a selective way, ensuring that the forest cover remains (FAO, 2010). As current harvest levels remain far below the allowable cut, the risk of forest degradation or deforestation caused by timber production is minimal.

With regards to agriculture, in the period 2000-2015 it has been responsible for 2.6 % of total deforestation in Suriname. As majority of suitable land for agriculture is located in the coastal plain, a substantial part of the forests has been deforested and transformed into agricultural land. The interior, on the other hand, is

considered unsuitable for commercial agriculture activities due to the infertile soils of the Guiana Shield in this area. In addition, due to the remoteness and the lack of infrastructure in the interior, there is little incentive of converting the forests into agricultural land (UNIQUE, et al., 2017). The expansion of pineapple production areas in the interior might challenge these notions.

Deforestation caused by agricultural activities in the can be mainly attributed to shifting cultivation. The forest area subject to shifting cultivation has increased by 19,441 ha between 2000 and 2015, and agriculture nowadays is the second biggest contributor to forest related GHG emissions in Suriname (ibid). However, particularly during the last years, a decrease in the expansion of shifting cultivation areas can be observed. This can be explained by the stagnating population in the interior and the geographical shift of agricultural activities to areas close to Paramaribo, where shifting cultivation is no longer common practice (ibid).

1.7.4. Water

Water is an abundant resource in Suriname; according to the International Water Poverty Index, Suriname is among the top 10 water rich nations in the world (SWRIS, 2018). 95% of the country's drinking water is obtained from groundwater resources, while surface water is used for agricultural and industrial activities. In the interior, most households use surface water or rain water for their water supply (FAO, 2015).
Suriname can be divided into two hydrologically distinct regions: the Precambian Shield of crystalline rock in the interior and the coastal plain basin, which comprises the young coastal plain, the old coastal plain and the savannah belt. The groundwater resources in the coastal basin are renewable and are recharged directly through rainfall (SWRIS, 2018).

The seven largest rivers from east to west that drain into the Atlantic Ocean are: the Corantijn, Nickerie, Coppename, Saramacca, Suriname, Commewijne and Marowijne rivers. The largest artificial open freshwater resource is the Brokopondo Reservoir, officially named Prof. Dr. Ir. Van Blommenstein reservoir, which is located in the Suriname River 194 km upstream. The Brokopondo reservoir was built to supply energy to Paramaribo and to provide electricity for the aluminium refinery in Paranam, which has been out of operation since 2015 (ibid).

Figure 36: Map of Suriname showing the seven main river basins from east to west

Source: Mol, et al., 2012

In Suriname, approximately 70 % of water is used for agricultural (irrigation, livestock and aquaculture), 22 % for industrial and 8 % for municipal purposes. The most applied irrigation technique is surface irrigation, which is mainly used for rice cultivation in the district Nickerie, located in the North-West of Suriname. To a smaller degree sprinkler irrigation is also used. Rice accounts for 89% of the irrigated area, sugarcane for 5% and banana plantations for 3.5% (FAO, 2015).

Irrigation is currently not used for pineapple production in Suriname and is traditionally not applied by the small-scale farmers that cultivate pineapples. However, it is necessary to research possibilities to introduce irrigation (particularly climate-smart technologies such as drip irrigation) and to determine whether irrigation would be feasible from an economic point of view, what types of irrigation would be most suitable for the different soil types, and to what degree irrigation could contribute to increasing yields.

1.7.5. Biodiversity

Being home to at least 192 mammal species, 715 bird species, 318 fish species and more than 5100 plant species, Suriname is a country that boasts substantial biodiversity. It has intact wetlands and mangrove forests, large areas of untouched rainforests, diverse swamp and savannah ecosystems and high genetic diversity. While the ecosystems and habitats in the northern part of the country have been well researched, a large part of the interior rainforest region remains unknown (ATM, 2009).

In many countries, pineapple cultivation has been associated with substantial environmental damages, caused by large-scale, high-input and monoculture production systems. The intense use of agrochemicals and the poor application of good agricultural practices have led to, amongst others, contamination of groundwater, soil erosion, and deforestation (UNDP, 2015).

In Suriname, the majority of farmers cultivates pineapples either in agroforestry systems or organically, which are considered production practices that contribute towards preserving biodiversity. Therefore, it can be concluded that pineapple production in Suriname so far has not represented a risk for biodiversity. This might, however, change when pineapple production areas are extended or when a shift is made towards more input-intensive production systems.

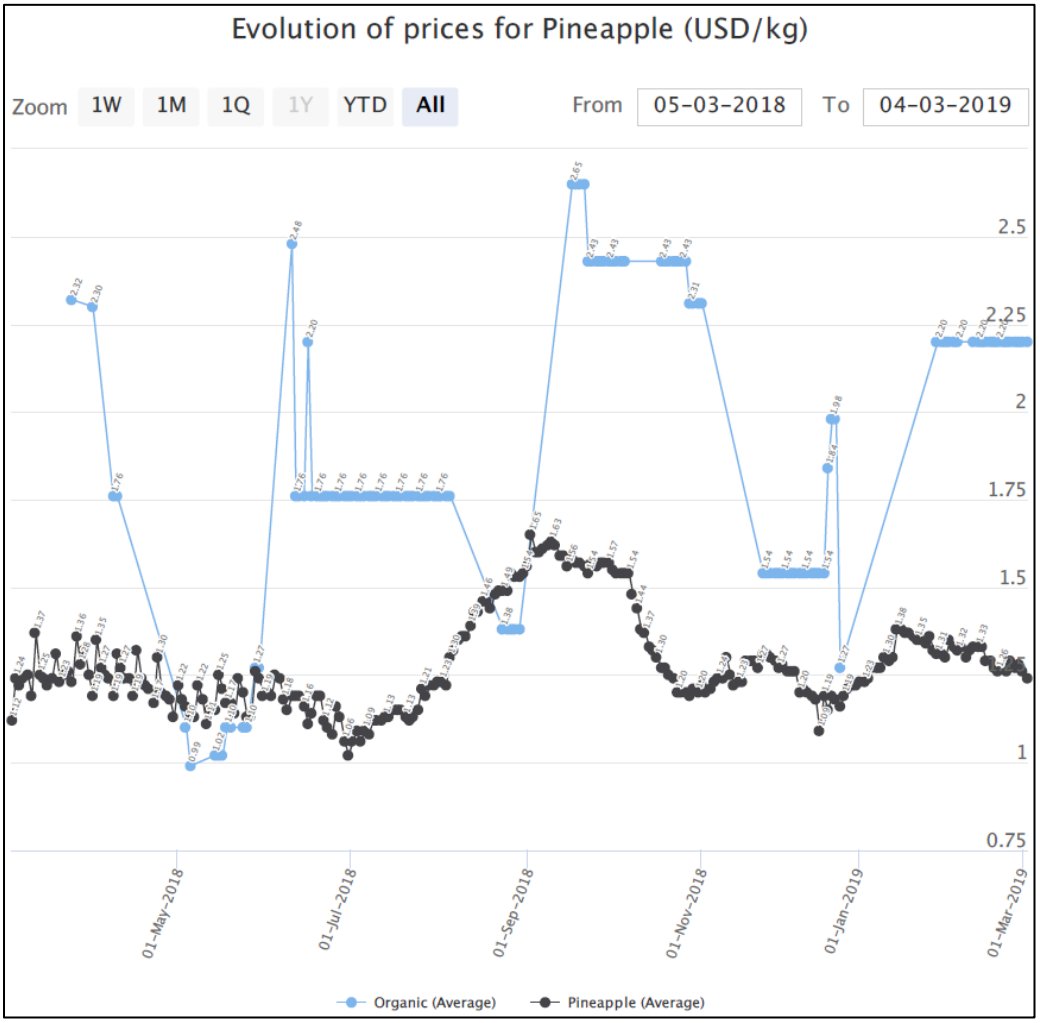
2. Strategic analysis

2.1 Sustainability performance

2.1.1 Economic sustainability

The international pineapple market is characterized by overproduction, which has entailed strong price decreases over the past years. In addition, the market is shaped by a few vertically integrated international players such as Dole, Del Monte, or Chiquita that produce at low costs, are highly competitive due to economies of scale, and, therefore, are able to exert substantial market power. In this context, small and less efficient producers, face increasing challenges to compete successfully in the market. Margins are particularly tightened for small-scale farmers that produce the most dominant varieties such as the MD2, since its production requires more fertilizer and chemicals for pest and disease control. Furthermore, farmers in the pineapple value chain are exposed to considerable market price fluctuations. This holds true both for the market price for conventional pineapples as well as for organic certified pineapples, as can be seen in Figure 37.

Figure 37: Market price evolution for pineapples between March 2018 and March 2019



Source: ITC, 2019

In case of the Surinamese pineapple sector, neither fresh pineapples nor pineapple products are currently exported. Hence, Surinamese pineapple farmers are not strongly exposed to international market price fluctuations at present. And even though domestic farm gate prices fluctuate over the year, depending on seasonal supply and demand dynamics, Surinamese pineapple farmers are overall profitable. Most of them produce in a traditional way, without applying inputs and with only labour being the main cost factor.
In this context, economic sustainability in the primary production segment of the value chain is mainly threatened by the following aspects:

- Mono-cropping farm systems: For small-scale farmers, heavy reliance on one crop can threaten the economic sustainability, since their income might significantly be affected in case of pest or disease outbreaks, natural disasters or unforeseen price developments.
- High market concentration in the processing segment of the value chain: The pineapple processing industry has only recently begun in Suriname with one sole enterprise. While this processor is an important driving factor in the modernization of the Surinamese pineapple value chain, the monopoly in this channel can be particularly risky for the few farmers that rely on this market outlet. The processor not only can exert substantial market price power, but also can also strongly influence the farmers' revenues through its business decisions on, amongst others, raw material needs both in terms of quantity or quality.

In the downstream segments of the value chain, economic sustainability is primarily restrained by constraints in the enabling environment. In particular aspects such as the missing pest and disease list, which is necessary for exporting fresh pineapples, or insufficient transport capacities and cold storage necessary to export fresh or processed pineapples, represent serious challenges that need to be addressed if the Surinamese pineapple value chain is to successfully position itself on the international market for high-value niche products. In addition, in order to be able to compete internationally, productivity and efficiency along the entire value chain will need to improve, so that Surinamese pineapple products can become price competitive (even in the niche market).

2.1.2 Social sustainability

As pointed out in the previous sections, there are only two big conventional pineapple farmers in the country. Even the so-called semi-commercial organic farmers have small plots of land and apply basic practices. Most pineapples are grown by these smallholders with the help of casual labourers in the interior, hence, any increase in returns from pineapple production can make a contribution to improving their livelihoods. Although pineapple is not a staple crop, it can be considered a high-value cash crop that could play an indirect role in alleviating food and nutrition insecurity through income generation. National statistics consistently show that the hinterland suffers disproportionately from higher rates of poverty and unemployment compared to the coastal areas. Infrastructures and services are also missing or in poorer condition. If the pineapple industry takes off, there is the potential for increased investments in infrastructures and services, contributing to raising the standards of living for the interior populations (the indigenous and Maroon). It will also encourage more young people to stay in the rural areas and preserve the community fabric. A pineapple processing factory has already shown its potential in providing employment to youth, and higher-value adding activities could make the sector more attractive. Diverse options of agro-processing, both on a small and medium scale (e.g. operating small drying facilities), can also encourage the hiring of female labour and improve the livelihoods of rural women, given that labour rights and conditions are respected.

In the future, there might be issues with labour availability because if improved pineapple production practices are adopted, more labour will be required for various aspects, such as soil nutrition enrichment, staggered planting, and irrigation. Labour capacity in the household might be surpassed and additional help will be

needed. Labour costs in Suriname are relatively high even in the rural areas, therefore savings and investments in farming will be needed to afford the extra labour. In addition, there are other land- and gender-related issues that can pose risks to the social sustainability of the sector, as it is developed and commercialized. As have been analysed in the Section 1.6, the majority of pineapple farmers do not possess formal land titles. Pineapple areas in the interior are considered communal land, to which the village authority has customary rights. Up to now the pineapple growing areas are limited and there has been no difficulty in acquiring the rights to use and expand land for agricultural purposes. Nonetheless, a significant increase in land demands when the sector grows (especially if shifting cultivation is still practiced) could lead to more intense competition and complications, given the diversity of Suriname's populations and their different customs.

Furthermore, as pineapple becomes an important and high-value cash crop, women might be further excluded from pineapple cultivation and women's control over farm incomes weakened, impeding the social inclusivity of the value chain. Due to gender norms considering men as the breadwinner, coupled with men's better access to productive resources, they tend to take over from women when farming moves beyond subsistence and gets commercialized. It might also explain why in the Carolina region, where pineapple is increasingly cultivated as a cash crop and production is better organized than other villages, pineapple farmers are predominantly men. Meanwhile in Matta, where the move from subsistence to semi-commercial production is not yet as established, there are more female farmers. Nonetheless, the fact that men are identified as the "farmer" does not necessarily imply that women's workload is reduced. Women's contribution can be less visible and often dismissed as simply providing help. If the advancement of organic production involves more labour, increased work burden might be created for women with low compensation, in addition to other traditional household tasks such as childcare and housekeeping.

2.1.3 Environmental sustainability

Negative environmental impacts of the pineapple value chain in many producing countries stem from heavy agrochemical use and intensive farming systems, causing, amongst others, deforestation, erosion, loss of biodiversity and water contamination. Further negative impacts on the environment can be traced back to the processing industry, inter alia, due to the accumulation of waste, water wastage and the extensive use of non-renewable energies.

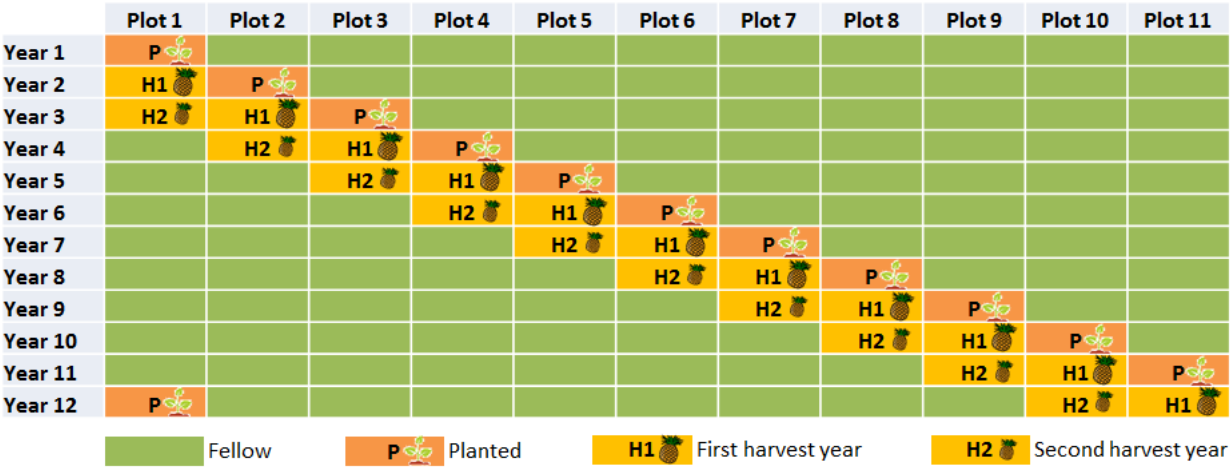
In Suriname, due to the predominating organic production practices and the small-scale nature of most farms and enterprises, the negative impact of the pineapple value chain can, at present, be considered as minimal. The processing industry is at a very incipient stage of development and semi-commercial and commercial pineapple production has only recently emerged. Furthermore, even though most farmers practice shifting cultivation, which can be an environmental concern, until now the cultivated area is still relatively small, does not encroach on areas of primary forests, and the fallow periods are sufficient for the secondary forest to recover.

With the envisioned upgrading of the pineapple value chain, however, a number of risks exist that jeopardize the environmental sustainability of the sector and that need to be carefully addressed and monitored. These include:

- Negative impacts if production areas are expanded and shifting cultivation is still practiced: in case the cultivated areas increase, deforestation rates will rise, which would have negative impacts on biodiversity. If shifting cultivation continues to be the main production practice and if fallow periods are shortened, increased soil erosion can be expected. In addition, if the cultivated area is expanded and farmers continue practicing shifting cultivation instead of establishing permanent land use systems, a significant area of forest will need to be cut down on a regular basis, which, in turn, has

negative impacts on biodiversity. The reason is that currently, most semi-commercial organic farmers have three plots of land under production at the same time, with two of them yielding pineapples. Because a fallow period of eight years follows after one plot of land has been harvested for two years in a row, the farmers need eleven plots of land to continuously be able to harvest from two plots, as it is outlined in Figure 38. If the production area is, for example, expanded to six plots of land under production with four of them yielding pineapples, and if farmers still practice shifting cultivation, this would imply that 22 plots of forest would need to be cut down on a regular basis and more biodiversity would be endangered.

Figure 38: Current shifting cultivation system practiced by semi-commercial organic farmers



Source: The authors

- Negative impacts due to the use of agrochemicals: An increase in planting densities might have an impact on the occurrence of pests and diseases, which, at the moment, do not represent a major threat. If farmers are not made aware and trained on organic pest and disease control mechanisms, the risk exists that farmers will revert to the use of chemicals, potentially without following Good Agricultural Practices (GAP). The same applies to a situation in which permanent land use systems are introduced, yet there is insufficient training and capacity building on organic fertilization techniques.
- Negative impacts due to the introduction of foreign pineapple varieties: the popularity of pineapple varieties like the MD2 or Smooth Cayenne might be to the detriment of local varieties if farmers decided to primarily cultivate foreign varieties. Knowledge on local varieties might be lost and the valuable genetic diversity in pineapple varieties in Suriname might decrease.
- Negative impacts due to increased pineapple processing: if the current pineapple processing factory is expanded and other ones emerge, the risk exists that this might be at the cost of the environment due to, amongst others, increased non-renewable energy use, waste creation and water contamination. Thus, it is critical that environmental safeguards and sustainable energy-efficient processing technologies be promoted.

2.2 SWOT analysis

A SWOT analysis in Figure 39 summarizes the strengths and weaknesses of the pineapple value chain in Suriname, as well as outlines the opportunities and threats facing the sector.

Strengths

Overall, Surinamese pineapples could be presented as unique ecological products, behind which lies a compelling marketing story: Pineapples originate from the region and until now have been produced organically and in synergy with nature by the indigenous populations. There are also many unexplored varieties that can add to the uniqueness of the Suriname brand and fetch high premiums on the export market. Further, Suriname can distance itself from other big players in the pineapple industry such as Costa Rica, where large mono-cropping plantations have caused irreversible damage to the environment. Pineapples in Suriname have mostly been cultivated in an organic manner or in an agroforestry system, which contributes to the low environmental impact of the sector. Building on current practices, Suriname has the basis to ensure that proper environmental safeguards will accompany the improvements in production and productivity. Additionally, the development of the sector benefits from emerging vertical coordination between value chain actors, the willingness of farmers to improve their practices, increased interest in investing in pineapple processing, as well as expressed commitment from the Government to promoting the agricultural sector in general and pineapple in particular as an important crop.

Weaknesses

Notwithstanding these strengths, many weaknesses of the Surinamese pineapple value chain are still observed. Most significant of all is the basic and nascent development at every stage of the chain, especially in terms of expertise and experience in best practices and modern technology. Seasonal production with inconsistent quality also creates challenges for industrial processing, which has only recently begun. Serious export of fresh and processed pineapple products has not taken place due to insufficient capacity, weak export infrastructures and lack of necessary requirements (such as the pest risk analysis for pineapple). The traditional fresh channel currently dominates, and most value chain actors still operate independently without systematic collaboration. Moreover, they virtually lack access to support services, from extension, research, input provision, and cold chain infrastructures to finance and business development services. The savanna soil on which most pineapples in Suriname are grown is not fertile and will require further analysis in order to determine the necessary nutritional improvements. Overall, the climate, soils, technology gap and limited scale make Suriname unsuitable for competition on the MD II pineapple variety – the dominating pineapple variety in the international market. Nevertheless, this weakness provides an additional justification for Suriname to focus on exploring its strength on its own pineapple varieties.

Figure 39: SWOT Analysis of the Pineapple Value Chain in Suriname

STRENGTHS	WEAKNESSES
▪ Unique and agro-ecological products. Many unexplored varieties that can fetch premiums in the niche market ▪ Traditional knowledge on pineapple production amongst indigenous populations that has been passed on for generations ▪ Rather suitable ecological conditions for native pineapple varieties (sufficient rainfall, land availability, fresh water sources – only around 10% of land considered suitable for agriculture is being utilized)	▪ Rudimentary stage of pineapple farming, with little adoption of modern technology, equipment, nor inputs. ▪ Land-intensive traditional methods ▪ Limited expertise and experiences in best agronomic practices. Widespread belief that organic means depending on nature. No staggered planting and record keeping. ▪ Incipient stage of pineapple processing, slow expansion in capacity.

▪ Low incidence of phytosanitary issues (pest and diseases) ▪ Committed value chain actors (farmers and processors) with emerging vertical coordination (outgrower system) ▪ Increased interest from the public sector and alignment with the National Development Plan (e.g. diversification of the economy and of the agricultural sector to promote high-value crops, development of the hinterland)	▪ Mostly ad hoc sale through middlemen to a small domestic market, inundation of produce certain periods (seasonality) ▪ Lack of access to finance ▪ Almost no effective established support services, e.g. nurseries, (organic) fertilizer providers, artificial flowering induction ▪ Missing or weak infrastructures (no irrigation, cold chain, collection centre) ▪ Missing institutions (national quality standards, pest risk analysis) ▪ Limited research into pineapple varieties and weak extension services ▪ No systematic consolidation and dissemination of knowledge, weak coordination between value chain stakeholders (working in silos) ▪ No experience of exporting fresh pineapples, extremely limited experience of exporting processed products (samples from one company) ▪ Infertile savanna soil with low water and nutrition retention capacity ▪ Climate, soils, technology and scale gap not suitable for competition on the MD II variety – the dominating pineapple variety on the international market
OPPORTUNITIES	**THREATS**
▪ Considerable niche market opportunities for high-end fresh pineapples and value-added pineapple products (fresh-cut, frozen, dried) grown in a sustainable manner (agro-ecological, socially inclusive). ▪ Potential for processing to export as well as import substitution of fresh pineapples from Guyana if the production season is expanded through changing farming practices and adoption of modern technology ▪ Potential to intercrop with other nitrogen-fixating crops in mixed farming systems ▪ Potential to link with tourism promotion strategies (Suriname as an exotic, nature tourism destination) ▪ Key entrepreneur in processing – potential for contract farming ▪ Existing projects that could support – at LVV, HIT, CELOS, experience from IICA, CARDI, plus	▪ Climate-related risks, such as higher rainfall variability and average temperature ▪ Likely increased incidence of pests and diseases due to more intensive production ▪ If expanded vastly and still shifting cultivation, likely negative environmental impacts on forests, biodiversity, soils, and groundwater ▪ Economic recession, lack of access to finance at all VC levels, while improvements require considerable investments both in finance and in labour ▪ Labor shortage - Permanent organic systems with improved practices will require significantly more labor ▪ Commercialization of pineapple farming – Risk of reducing women's role ▪ Heavy reliance on one key actor (risk of dropping out and conflict) ▪ Emergence of new actors supplying to niche pineapple markets

international expertise from SAMAP, 3ADI+, COLEACP ▪ Many activities and agencies with the overall aim of strengthening Suriname's competitiveness and moving towards an open business climate (e.g. KKF, Suriname Business Forum)	▪ Loss of preferential access to the EU market

Opportunities

There are considerable end market opportunities that have been discussed in section 1.1., especially in the US and the EU. While the markets for conventional pineapples are saturated, there is a growing demand for organic fresh pineapples and value-added pineapple products (e.g. fresh cut, dried, frozen) that are environmentally friendly and socially inclusive. Suriname, as a new and "exotic" destination, could attract the high-end segment whose consumers are interested not only in a product per se but also its origin and the possibility of agro-tourism. Although the volume of Suriname's pineapple sector is still negligible, high quality and uniqueness should be the objectives towards which the whole sector must work diligently and collaborate effectively. A key entrepreneur is already present in the processing segment and has already implemented an outgrower system. Thus, there is potential to scale up contract farming to facilitate farmers' access to markets and support services, while ensuring a reliable raw material supply of consistent quality. If the production season is prolonged through improvements in practices (e.g. staggered planting) and application of modern techniques (e.g. artificial flowering induction), the processing capacity can increase accordingly in order to respond to foreign market demands. Moreover, import substitution opportunities also exist in the domestic market to displace imported pineapples from Guyana in the off-seasons. All of these developments can be supported through the coordination of existing activities related to the pineapple value chain, including the IDB project under LVV, the agri-entrepreneurship project targeting pineapple producers under HIT, the CELOS project in Matta village, in collaboration with relevant research institutes and market development agencies (e.g. CELOS, IICA, CARDI, KKF, Suriname Business Forum), and through the facilitation of international organizations such as FAO, UNIDO, ITC and others.

Threats

The pineapple value chain in Suriname is faced with a number of threats, which could intensify in the future should no preventive measures be taken. As the case with other agricultural value chains, pineapple production in Suriname increasingly faces climate-related risks, such as an increase in rainfall variability and average temperature. It is thus critical to investigate into the possibility of adopting climate-smart technologies and setting up irrigation, which would certainly be required in more advanced stages that involve permanent farming systems and year-round production. Further, if pineapple production vastly expands and intensifies, negative impacts on forests, soils, groundwater and biodiversity might ensue if shifting cultivation is still practiced. Incidences of pest and diseases, currently not observed due to the low production density, might also occur. Besides, improvements in farming practices and in processing capacity will require a significant level of investment, both in terms of finance and labour. Yet, the country is undergoing an economic recession and there is virtually limited access to finance at all value chain functions. The migration of rural youth to the urban areas and other sectors could also contribute to labour shortage. The commercialization of pineapple farming might add burden to women's workload while reducing women's control over farm revenues. Besides, as of current, the modern processing segment of the value chain heavily relies on one key actor. In case this actor drops out, does not succeed or gets entangled in conflicts with others, the development of the sector might be at risk and its move towards value addition and modernization could be stalled. Last but not least, there are continuous

changes in the global market, and competing countries might quickly fill the niche market gap that Suriname's pineapple sector aspires to target. This could further be exacerbated by the loss of preferential access to the EU market if the EPA is not signed, rendering Surinamese products less competitive.

3. Business Models and Upgrading Opportunities

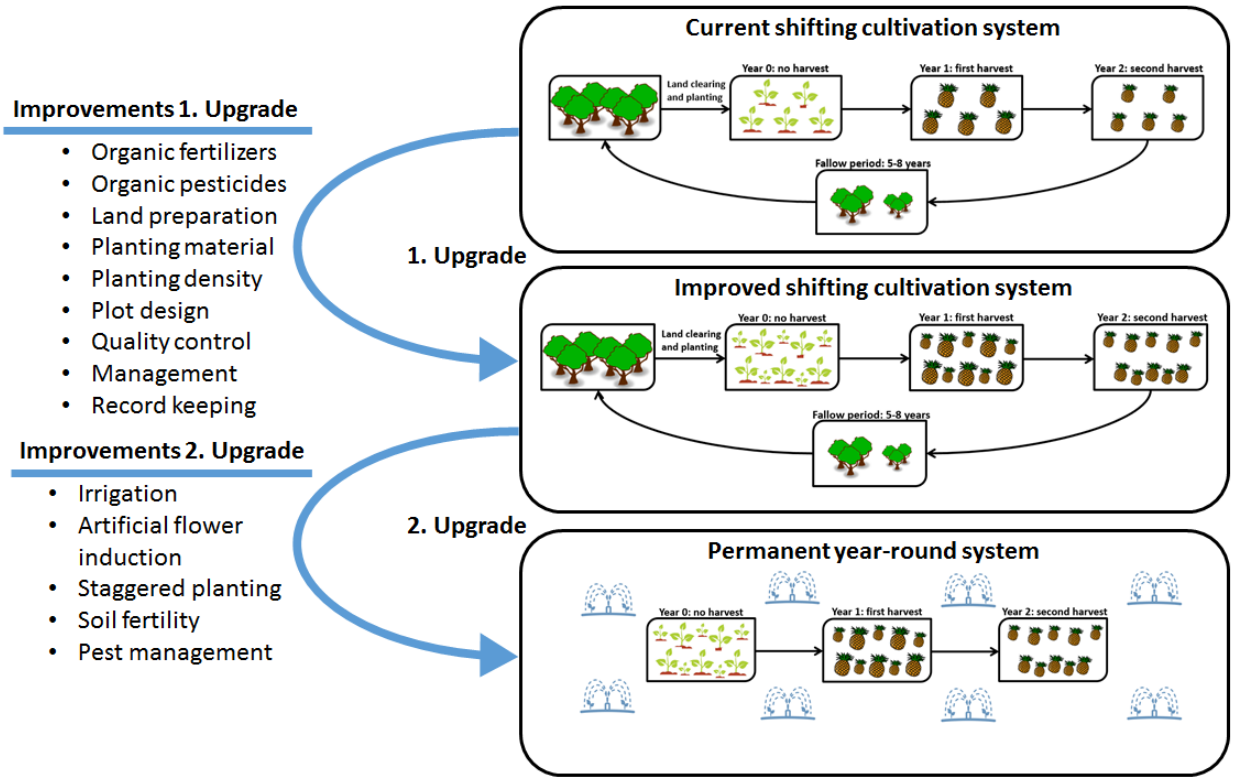
Based on the value chain diagnostics and the strategic analysis, a number of upgrading opportunities for both the primary production segment and the processing segment of the value chain were developed within the course of the 3ADI+ inception phase in Suriname. The purpose of this chapter is to present these different upgrading opportunities and explain how the implementation of improved business models will contribute to the development of the Surinamese pineapple value chain, both on economic, social and environmental terms.

3.1 Business models for primary production

Business models were developed for primary production, specifically, for organic production. The focus on organic farming is justified as it is the method practiced by the majority of pineapple producers in the country, and because it is aligned with key end market opportunities for Suriname in terms of accessing high value niche markets. One business model is constructed for the current situation, based on which two improved models were developed. The first improved model describes an upgraded system where improved production practices are applied, and the second improved model describes an upgraded farming system with year-round permanent production (see Figure 40).

The business model for the current organic production system was developed based on data collected by the 3ADI+ team in 2018. The two upgraded business models were developed based on working assumptions, as well as suggestions and inputs of the 3ADI+ contracted international agronomist. The business models provide a good overview on the current and potential cost, profit and investment structures. However, the two upgraded business models still need to be validated and adjusted in practice.

Figure 40: Current and improved business models for pineapple production



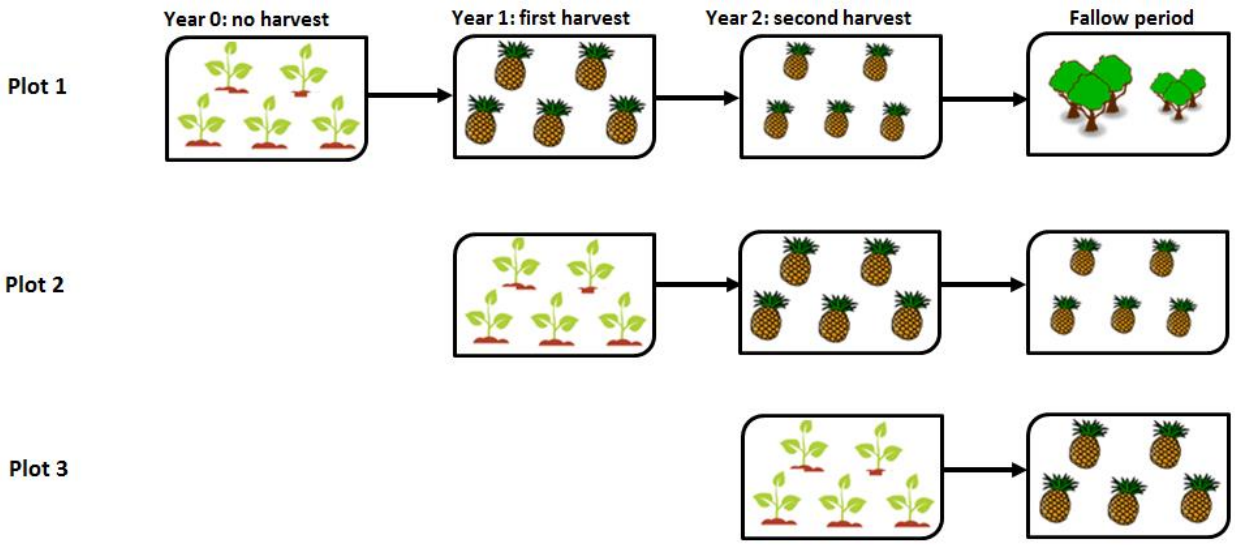
Source: Authors' own elaboration

3.1.1 Current production system

The first business model describes the current production system of semi-commercial organic pineapple farmers in Suriname. It provides insights into the practices and financial investments of a typical organic pineapple farmer that starts planting pineapples. As described more in detail in Chapter 1.4.1, most of the organic farmers practice shifting cultivation, meaning that they use the same plot of land for 3 years, before leaving it fallow for a period of 5-8 years. In the first year the forest is cleared, the land is prepared and the seedlings are planted. During this year, which is referred to as year 0 (Y0), the farmer does not harvest any pineapples. In the next year, year 1 (Y1), the farmer can harvest this plot for the first time. In year 2 (Y2), the farmer harvests on the same plot of land for the second time (but smaller quantities due to declining yields in Y2), before the fallow period starts.

It is important to note that the current business model was developed under the assumption that most farmers do not only cultivate one plot of land, as shown in Figure 41. The farmer starts clearing a new plot of land in Y1, which implies that in Y1 he has one plot of land from which he can harvest and one plot of land which is planted with pineapples, but from which he cannot harvest yet. In the next year, Y2, he can harvest from two plots of land while clearing and preparing another, and so on. It is assumed that from Y2 onwards this farmer will always have three plots under production and that he will always have two plots from which he can harvest.

Figure 41: Example of the shifting cultivation process on one farm under current production practices



Source: Authors' own elaboration

The next important characteristic of the current production practice is that, unlike in other pineapple producing countries, pineapple production in Suriname is seasonal. Special fertilization techniques and artificial flower induction are not practiced, resulting in two harvest seasons: the long harvest season from May till August and the small one from November to December. In addition, planting densities are low at the moment, on average around 12,500 plants/ha compared to around 80,000 plants/ha in conventional, high input production systems in leading suppliers like Costa Rica. And, finally, the level of input and technology use is low most organic farmers do not use any type of organic fertilizer or practice soil fertility improvement measures.

Assumptions

Figure 42 summarizes the main characteristics of the current organic production system. It provides an overview on prices[6], materials, labour and other expenses, and summarizes the principal farming characteristics of an average semi-commercial pineapple farm in Suriname at the moment. In addition, the table lists the main investments in terms of machinery for the same farm category.

Figure 42: Assumptions - current production system

Assumption category	Unit cost	Unit
Prices		
Average price (farm gate)	10	SRD/fruit
Cost of manual labour	150	SRD/person, day
Cost of management labour	300	SRD/person, day
Cost of land clearing	6,000	SRD/ha
Cost of land preparation	4,000	SRD/ha

[6] Cost of land is not included, since the land semi-commercial organic farmers use for pineapple cultivation is community land for which the farmers don´t need to pay.

Materials		
Diesel	7	SRD/litre
Plants purchased per cycle (pc)	1	SRD/seedling
Labour		
Planting rate per person per day	500	Plants
Harvesting rate per person per day	400	Pineapples
Weeding for 3 ha	20	Days/year
Sales & marketing	5	Days/year
Management (incl. records, quality check)	50	Days/year
Other costs		
Maintenance & Insurance	60	SRD/year
Farming		
Cultivated area	3	Ha
Planting density	12,500	Plants/ha
Harvest Y1	10,000	Fruits/ha
Harvest Y2	8,750	Fruits/ha
Production years	2	Years
Average fruit size Y1	2.0	Kg/fruit
Average fruit size Y2	1.8	Kg/fruit
Investments		
Machinery	30,000	SRD
Hand tools	1,000	SRD
Power tools	6,000	SRD
Wheelbarrow	1,500	SRD

Source: Authors' own elaboration

Cost and profit structure

Figure 43 shows the cost and profit structure under current production practices. The revenue has been calculated based on an average price of SRD 10 or USD 1.3 per fruit for 18,750 harvested fruits per year from the two productive plots after Y2. The operating costs can be broken down into the costs for land clearing and preparation and the costs for material, which are mainly plant material and diesel costs, as well as costs for labour, which is mainly used for planting, weeding, harvesting, sales and marketing, and management. In Y0, when the farmer does not harvest any pineapples, there are no profits. In Y1, when the farmer harvests from one plot of land, he gains a profit of approximately USD 5,500 and from Y2 onwards, when the farmer starts harvesting from 2 ha, the profit amounts to roughly USD 16,000.

Figure 43: Cost and profit structure - current production system

Year	**0**	**1**	**2**	**3**
Revenue (SRD)				
Harvest (pineapples)	0	10,000	18,750	18,750
Sold (kg)	0	20,000	35,750	35,750
Revenue (SRD)	**0**	**100,000**	**187,500**	**187,500**
Operating costs (SRD)				
Land clearing and preparation				
Land clearing	6,000	6,000	6,000	6,000

Land preparation	4,000	4,000	4,000	4,000
Total land clearing and preparation	**10,000**	**10,000**	**10,000**	**10,000**
Materials				
Diesel	65	130	195	195
Plants	12,500	12,500	12,500	12,500
Total materials	**12,565**	**12,630**	**12,695**	**12,695**
Labour				
Planting	3,750	3,750	3,750	3,750
Harvesting	0	3,750	7,031	7,031
Weeding	3,000	6,000	9,000	9,000
Sales & marketing	1,500	3,000	4,500	4,500
Management (incl. record keeping)	15,000	15,000	15,000	15,000
Total labour	**23,250**	**31,500**	**39,281**	**39,281**
Other expenses				
Maintenance & Insurance	60	60	60	60
Total other expenses	**60**	**60**	**60**	**60**
Safety margin (10%)	4,588	5,419	6,204	6,204
Total operating costs	**50,463**	**59,609**	**68,240**	**68,240**
Trading profit (SRD)	**-50,463**	**40,391**	**119,260**	**119,260**
Trading profit (USD)	**-6,728**	**5,385**	**15,901**	**15,901**

Source: Authors' own elaboration

Investment Analysis

Figure 44 shows the investment costs incurred by the farmer over a period of 8 years, mainly to purchase a pick-up truck, hand tools, power tools, and a wheelbarrow. Furthermore, it shows the operating costs, the sales revenue, as well as the net cash flow. The investment analysis reveals that the breakeven point of the investment is reached in Y2, that the internal rate of return is 87 %, and that the net present value is almost USD 10,000, which implies that the investment results in a net profit. It can be concluded that, overall, this business model shows that farmers currently make a profit from organic pineapple production. Yet, the profit is relatively small.

Figure 44: Investment analysis - current production system

Year	0	1	2	3	4	5	6	7	8
Investment costs (SRD)	38,500	0	1,000	6,000	32,500	30,000	7,000	0	2,500
Operating costs (SRD)	50,463	59,609	68,240	68,240	68,240	68,240	68,240	68,240	68,240
Sales revenue (SRD)	0	100,000	187,500	187,500	187,500	187,500	187,500	187,500	187,500
Net cash flow (SRD)	**88,963**	**40,391**	**118,260**	**113,260**	**86,760**	**89,260**	**112,260**	**119,260**	**116,760**
NPV (SRD)	**74,367**								
NPV (USD)	**9,971**								
IRR	**87%**								

Source: Authors' own elaboration

3.1.2 Improved production practices

The first upgraded business model shows a scenario in which farmers still practice shifting cultivation and production is still seasonal, but production practices are improved.

Assumptions

The upgraded model is the combination of the following individual upgrades:

- **Improved land preparation practices:** After clearing the land and making sure that all remaining plants are removed, farmers work in organic material (mulch or animal manure, for example), to improve the soil structure, increase the water retention capacity of the soil and improve the nutrient supply. Furthermore, the farmers plough in order to loosen the soil, so that the plant roots do not have growth problems. The farmers buy the organic material from service providers and either rent the necessary machinery or use their own machinery (either a ploughing machine or a shovel) to prepare the land prior to planting and to work in the organic material. Depending on the availability of family labour, the farmers hire labourers to carry out the work.
- **Improved plant material selection**: Farmers select plant material according to type and size/weight and make sure that plots of land are planted with homogeneous plant material. In addition, the time span from harvesting or separating the planting material from the mother plant until it is planted is no longer than 3 days.
- **Increased planting density**: The planting density is increased to 25,000 plants per ha.
- **Improved plot design**: Farmers plant in rows and blocks. The design of planting beds is not necessary due to the sandy soils, where no waterlogging occurs. The different plots planted are labelled with signboards. These boards include information on planting date, planting density, and type of plant material.

- **Application of organic fertilizers and pesticides**: The farmers carry out soil analysis in order to define the nutritional needs. The farmers apply organic fertilizers, which they need to buy from support services providers. The fertilizers and pesticides are sprayed manually considering best practices. The farmers keep records on spraying dates and quantities.
- **Integrated pest control**: The farmers apply organic pesticides (if needed), which they buy from support services providers. The pesticides are sprayed manually considering best practices. The farmers keep records on spraying dates and quantities. In addition, innovative, organic pest management practices are applied.
- **Improved weeding practices**: Weeding is carried out manually on a regular basis. Farmers hire labourers to carry out this work.
- **Fruit quality control**: Farmers carry out quality sampling to determine brix and acidity levels, and, thereby, determine the optimal harvest date. Farmers use their own equipment to carry out the organoleptic tests.

The changes in the assumptions made are summarized in the following Figure 45.

Figure 45: Assumptions - improved production practices

Assumption category	Unit cost	Unit
Prices		
Average price per fruit (farm gate)	8	SRD/fruit
Cost of manual labour	150	SRD/person, day
Cost of management labour	300	SRD/person, day
Cost of land clearing	6,000	SRD/ha
Cost of land preparation	7,000	SRD/ha
Materials		
Organic manure	1,875	SRD/tonne
Organic foliar fertilizer	130	SRD/litre
Organic pesticide	100	SRD/kg
Diesel	7	SRD/litre
Plants purchased per cycle (pc)	1	SRD/seedling
Labour		
Planting rate per person per day	500	Plants
Harvesting rate per person per day	400	Pineapples
Weeding for 3 ha	10	Days/year
Applying fertilizer to 3 ha	10	Days/year
Applying pesticides to 3 ha	5	Days/year
Sales & marketing	5	Days/year
Management (incl. records, quality check)	100	Days/year
Other costs		
Maintenance & Insurance	60	SRD/year
Professional fees (incl. association fees or fees for technical assistance)	1,200	SRD/year
Farming		
Cultivated area	3	Ha
Planting density	25,000	Plants/ha
Harvest Y1	22,500	Fruits/ha

Harvest Y2	20,000	Fruits/ha
Production years	2	Years
Average fruit size Y1	2.0	Kg/fruit
Average fruit size Y2	1.8	Kg/fruit
Investments		
Machinery	30,000	SRD
Hand tools	2,300	SRD
Power tools	6,000	SRD
Wheelbarrow	1,500	SRD

Source: Authors' own elaboration

Cost and profit structure

The new cost and profit structure of the first upgraded business model is shown in Table 5. While the revenue increases, mainly due to the larger quantities sold because of the larger planting density, the price itself decreases, because larger quantities of pineapples will be sold during only certain periods of the year. The costs for land clearing and preparation increase, because prior to planting best practices will be applied in terms of land preparation. The material costs increase as farmers start applying organic fertilizers and pesticides. The labour costs also increase since more labour is needed for land preparation, planting, harvesting, fertilization, pest control, and overall farm management. In general, despite increased operating costs, Figure 46 shows that the overall profit increases: from Y2 onwards it is approximately USD 10,000 higher than in the current business model.

Figure 46: Cost and profit structure - improved production practices

Year	**0**	**1**	**2**	**3**
Revenue (SRD)				
Harvest (pineapples)	0	22,500	42,500	42,500
Sold (kg)	0	45,000	81,000	81,000
Revenue	**0**	**180,000**	**340,000**	**340,000**
Operating costs (SRD)				
Land clearing and preparation				
Land clearing	6,000	6,000	6,000	6,000
Land preparation	7,000	7,000	7,000	7,000
Total land clearing and preparation	**13,000**	**13,000**	**13,000**	**13,000**
Materials				
Organic manure	3,750	7,500	11,250	11,250
Organic foliar fertilizer	650	1,300	1,950	1,950
Organic pesticide	500	1,000	1,500	1,500
Diesel	130	260	390	390
Plants	25,000	25,000	25,000	25,000
Total materials	**30,030**	**35,060**	**40,090**	**40,090**
Labour				
Planting	7,500	7,500	7,500	7,500
Harvesting	0	8,438	15,938	15,938
Applying fertilizer	1,500	3,000	4,500	4,500
Applying pesticides	750	1,500	2,250	2,250
Weeding	1,500	3,000	4,500	4,500

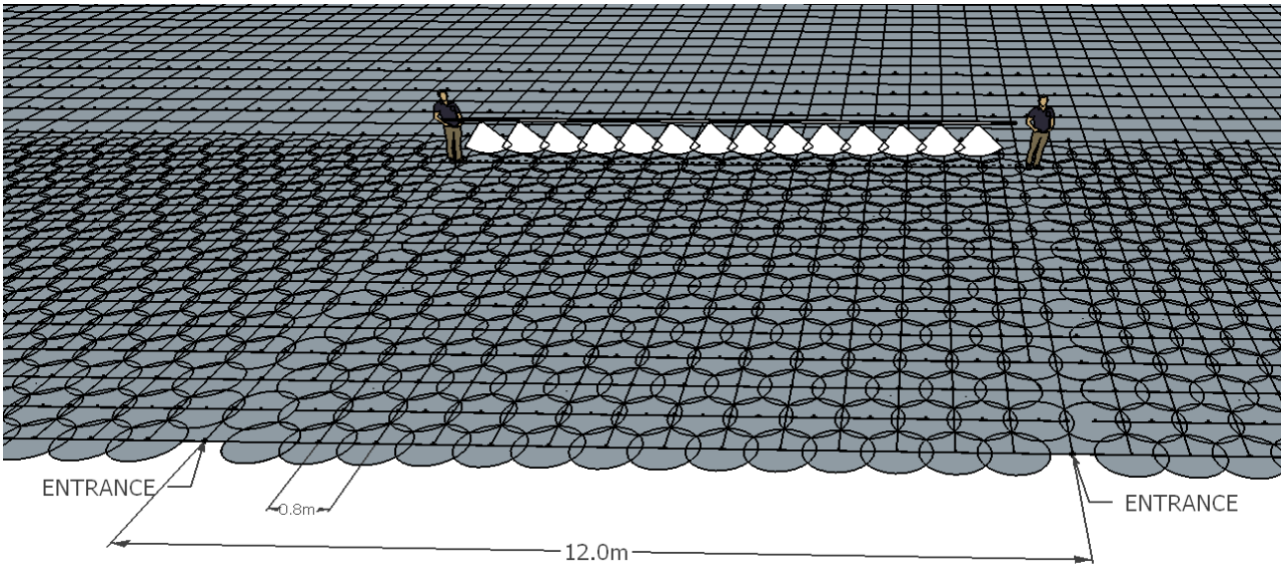
Sales & marketing	1,500	3,000	4,500	4,500
Management (incl. record keeping)	30,000	30,000	30,000	30,000
Total labour	**42,750**	**56,438**	**69,188**	**69,188**
Other expenses				
Maintenance & Insurance	60	60	60	60
Professional fees (incl. association fees or fees for technical assistance)	1,200	1,200	1,200	1,200
Total other expenses	**1,260**	**1,260**	**1,260**	**1,260**
Safety margin (10%)	8,704	10,576	12,354	12,354
Total operating costs	**95,744**	**116,333**	**135,891**	**135,891**
Trading profit (SRD)	**-95,744**	**63,667**	**204,109**	**204,109**
Trading profit (USD)	**-12,766**	**8,489**	**27,215**	**27,215**

Source: Authors' own elaboration

Investment Analysis

The investment costs in the improved model increase slightly, because farmers will need to buy a fertilization application device. This device could be for example a manual wet bar (see Figure 47), that can be operated by two people and which consists of a pipe on two wheels, with small holes in it, and which can be used to apply leaf fertilizers.

Figure 47: Example of a manual wet bar



Source: Vásquez Jiménez, 2018

Figure 48 reveals that the breakeven point of the investment is reached in Y2, that the internal rate of return is 97 %, and that the net present value is positive and amounts to 20,632 USD. The first upgraded business model shows that farmers, by improving their current production practices, can enhance their profits and that the investment in establishing the improved production system is profitable.

Figure 48: Investment analysis - improved production practices

Year	0	1	2	3	4	5	6	7	8
Investment costs (SRD)	39,800	0	2,300	6,000	3,800	30,000	8,300	0	3,800
Operating costs (SRD)	95,744	116,333	135,891	135,891	135,891	135,891	135,891	135,891	135,891
Sales revenue (SRD)	0	180,000	340,000	340,000	340,000	340,000	340,000	340,000	340,000
Net cash flow (SRD)	**-135,544**	**63,667**	**201,809**	**198,109**	**200,309**	**174,109**	**195,809**	**204,109**	**200,309**
NPV (SRD)	**154,739**								
NPV (USD)	**20,632**								
IRR	**97%**								

Source: Authors' own elaboration

3.1.1 Permanent and year-round production

The second upgraded business model depicts a scenario in which the farmers have improved their production practices as described in section 3.1.2. In addition, in this scenario, the farmers no longer practice shifting cultivation; instead, they establish permanent production systems which allow year-round harvest.

Assumptions

The second upgraded business model describes a scenario in which the forest needs to be cleared only at the beginning instead of every 3 years. This implies that the costs for land clearing will make up less of the total production costs compared to the shifting cultivation scenario. Fewer labourers are needed and famers will be able to save time and resources. At the same time, the farmers need to dedicate more time and resources to improving and maintaining soil fertility. In addition, the probability that pests and diseases will occur increases due to the establishment of permanent plots, which implies that more resources will be needed for pest management. The farmers will plant new seedlings every 3 years. In addition, farmers carry out staggered planting, apply artificial flower induction techniques and use irrigation. Farmers will need to spend more time on planning and recording, they need to buy the chemicals necessary for artificial flower induction (that is allowed in organic farming) and dedicate time and labourers to applying the chemicals. Moreover, farmers need to invest in setting up an irrigation system, they need to operate it and ensure maintenance. Because of irrigation, yields will be highest in this scenario. Furthermore, prices will be higher because the supply is more evenly spread over the entire year compared to the first improved business model. This is the business model with highest technological level.

The changes in the assumptions are summarized in Figure 49.

Figure 49: Assumptions - permanent and year-round production

Assumption category	Unit cost	Unit
Prices		
Average price per fruit (farm gate)	12	SRD/fruit
Cost of manual labour	150	SRD/person, day
Cost of management labour	300	SRD/person, day
Cost of land clearing	6,000	SRD/ha

Cost of land preparation	7,000	SRD/ha
Materials		
Artificial flower induction agent	100	SRD/litre
Organic manure	1,875	SRD/tonne
Organic foliar fertilizer	130	SRD/litre
Organic pesticide	100	SRD/kg
Diesel	7	SRD/litre
Plants purchased per cycle (pc)	1	SRD/seedling
Labor		
Applying artificial flower induction agent	6	Days/year
Planting rate per person per day	500	Plants
Harvesting rate per person per day	400	Pineapples
Weeding for 3 ha	10	Days/year
Applying fertilizer to 3 ha	20	Days/year
Applying pesticides to 3 ha	10	Days/year
Sales & marketing	5	Days/year
Management (incl. records, quality check, irrigation)	200	Days/year
Other costs		
Maintenance & Insurance	870	SRD/year
Professional fees (incl. ag innov hub)	1,200	SRD/year
Other expenses (incl. lab testing)	500	SRD/year
Farming		
Cultivated area	3	Ha
Planting density	25,000	Plants/ha
Harvest Y1	23,750	Fruits/ha
Harvest Y2	21,250	Fruits/ha
Production years	2	Years
Average fruit size Y1	2.0	Kg/fruit
Average fruit size Y2	1.8	Kg/fruit
Investments		
Machinery	53,500	SRD
Irrigation system	27,000	SRD
Hand tools	2,300	SRD
Power tools	6,000	SRD
Wheelbarrow	1,500	SRD

Source: Author's own elaboration

Cost and profit structure

The new cost and profit structure of the first upgraded business model is shown in Figure 50. There is a strong revenue increase, mainly due to an increase in the price and, on the other hand, due to the irrigation system which entails higher yields. The land clearing costs between Y0 and Y2 are the same as in the previous model. But once the plots are established they decrease, because forest clearing is not necessary anymore. Material costs increase, mainly due to the artificial flower induction agent and larger amounts of fertilizers and pesticides that are needed. Likewise, also the labour costs increase. The year round, staggered planting requires thorough record keeping and overall farm management is becoming more time-intensive. In addition, more

labour is required to apply the artificial flower induction agent, and the increased amounts of fertilizers, that are necessary to maintain the soil fertility.
Even though the total operating costs can increase considerably, the profit is approximately USD 20,000 higher than in the previous model, once the plots of land are established.

Figure 50: Cost and profit structure - permanent and year-round production

Year	**0**	**1**	**2**	**3**
Revenue (SRD)				
Harvest (pineapples)	0	23,750	45,000	45,000
Sold (kg)	0	47,500	85,750	85,750
Revenue	**0**	**285,000**	**540,000**	**540,000**
Operating costs (SRD)				
Land clearing and preparation				
Land clearing	6,000	6,000	6,000	0
Land preparation	7,000	7,000	7,000	4,000
Total land clearing and preparation	**13,000**	**13,000**	**13,000**	**4,000**
Materials				
Artificial flower induction agent	0	200	300	300
Organic manure	7,500	15,000	22,500	22,500
Organic foliar fertilizer	1,300	2,600	3,900	3,900
Organic pesticide	1,000	2,000	3,000	3,000
Diesel	650	1,300	1,950	1,950
Plants	25,000	25,000	25,000	25,000
Total materials	**35,450**	**46,000**	**56,550**	**56,550**
Labour				
Artificial flower induction	0	900	1,800	1,800
Planting	7,500	7,500	7,500	7,500
Harvesting	0	8,906	16,875	16,875
Applying fertilizer	3,000	6,000	9,000	9,000
Applying pesticides	1,500	3,000	4,500	4,500
Weeding	1,500	3,000	4,500	4,500
Sales & marketing	1,500	1,500	1,500	1,500
Management (incl. records, quality check, irrigation)	60,000	60,000	60,000	60,000
Total labour	**75,000**	**90,806**	**105,675**	**105,675**
Other expenses				
Maintenance & Insurance	870	870	870	870
Professional (incl. association fees or fees for technical assistance)	1,200	1,200	1,200	1,200
Total other expenses	**2,070**	**2,070**	**2,070**	**2,070**
Safety margin (10%)	12,552	15,188	17,730	16,830
Total operating costs	**138,072**	**167,064**	**195,025**	**185,125**

Trading profit (SRD)	**-138,072**	**117,936**	**344,976**	**354,876**
Trading profit (USD)	**-18,410**	**15,725**	**45,997**	**47,317**

Source: Authors' own elaboration

Investment Analysis

As can be seen in Figure 51, the investment needs are highest in this model, because an irrigation system needs to be set up and special equipment needs to be purchased or rented in order to apply the artificial flower induction agent. Also in this business model the breakeven point of the investment is reached in Y2, and the internal rate of return is 100 %. The net present value is positive and amounts to USD 36,840, making the second improved business model a profitable upgrading opportunity.

Figure 51: Investment analysis - permanent and year-round production

Year	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Investment costs (SRD)	90,300	0	2,300	6,000	3,800	80,500	8,300	0	3,800
Operating costs (SRD)	138,072	167,064	195,025	185,125	185,125	185,125	185,125	185,125	185,125
Sales revenue (SRD)	0	285,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000
Net cash flow (SRD)	**-228,372**	**117,936**	**342,676**	**348,876**	**351,076**	**274,376**	**346,576**	**354,876**	**351,076**
NPV (SRD)	**276,298**								
NPV (USD)	**36,840**								
IRR	**100%**								

Source: Authors' own elaboration

3.1.1 Comparison between different business models

Figure 52 provides a summary of revenues, operating costs and profits of the three business models presented in this chapter. It can be seen how from one model to the next the revenues increase, and how the cost structure changes. Overall, it becomes clear that by investing in improved technologies, by applying best production practices and by introducing innovations, organic pineapple farmers can increase their profits significantly, while still producing in an environmentally sustainable manner.

Figure 52: Comparison of revenues, operating costs and profits between different business models

Year	**0**		**1**		**2**		**3**	
Revenues	**SRD**	**USD**	**SRD**	**USD**	**SRD**	**USD**	**SRD**	**USD**
Current production system	0	0	100,000	13,333	187,500	25,000	187,500	25,000
Improved production system	0	0	180,000	24,000	340,000	45,333	340,000	45,333
Permanent and year-round production	0	0	285,000	38,000	540,000	72,000	540,000	72,000
Operating costs	**SRD**	**USD**	**SRD**	**USD**	**SRD**	**USD**	**SRD**	**USD**

Current production system	50,463	6,728	59,609	7,948	68,240	9,099	68,240	9,099
Improved production system	95,744	12,766	116,333	15,511	135,891	18,119	135,891	18,119
Permanent and year-round production	138,072	18,410	167,064	22,275	195,025	26,003	185,125	24,683
Profit (SRD)	**SRD**	**USD**	**SRD**	**USD**	**SRD**	**USD**	**SRD**	**USD**
Current production system	-50,463	-6,728	40,391	5,385	119,260	15,901	119,260	15,901
Improved production system	-95,744	-12,766	63,667	8,489	204,109	27,215	204,109	27,215
Permanent and year-round production	-138,072	-18,410	117,936	15,725	344,976	45,997	354,876	47,317

Source: Authors' own elaboration

3.1 Business models for processing

For the processing segment of the Surinamese pineapple value chain, which is currently still at a very incipient stage, different small and medium processing opportunities were established (see Figure 53).

Figure 53: Main small and medium-scale pineapple processing options

Type of process	Fresh Cut	Dried Fruit	Frozen Fruit
Small Scale 1- 5 MT/day	✓	✓	
Medium Scale 5 – 15 MT/day	✓	✓	✓
Cost of Investment	*	**	***
Level of sophistication	*	*	***
Maintenance	*	**	****

Source: The authors

The first two processing options are low investment options that are feasible already on a small-scale. They can, however, be upgraded easily and rapidly, and can be converted into medium or large-scale operations if needed. The third processing option, frozen pineapples, is, on the other hand, only feasible from a medium-scale onwards. Figure 54 provides a more detailed overview on market demand, investment needs, minimum infrastructure and basic equipment needed for the three different processing options. In the following the different options will be described more in detail and cost structures are presented.

Figure 54: Overview on market trends, investment needs, minimum infrastructure and basic equipment for four different pineapple processing options

Market Trends/Investments	Fresh Cut	Dried	Frozen Fruit
Domestic market potential	Medium	Low	Low
International market potential	High	High	Rising trend
Investment costs	Small plant: ~ USD 300,000	Small plant: ~ USD 500,000	Medium size plant: ~ USD 2,500,000
Logistics costs	High (air freight)	Low (sea freight)	Low (sea freight)
Main competitors	Costa Rica, Mexico	Costa Rica	Costa Rica
Know-how	Food Technologist Lab. Technician	Food Technologist Quality Technician	Food Technologist Industrial Engineer Lab. Technician
Infrastructure	Temp. controlled process room Storage cold room 2-4C	Temp. controlled process room Storage cold room 5-8 C	Temp. controlled process room Storage cold room -23 C or lower
Basic equipment	Photometer Balance Refractometer Trimmer Slicer Equip. microbial. analysis Conveyor belts Metal detector Thermo sealing equipment Vacuum pack equipment Cold room 2-4C	Photometer Balance Refractometer Trimmer Slicer Industrial ovens Conveyor belts Metal detector Halogen moisture analysis Basic micro lab equipment Cold room 5-8 C	Photometer Balance Refractometer Trimmer Slicer IQF System Conveyor belts Metal detector Equip. microbial. analysis Heavy duty freezing and cooling system Cold room -23 C
Dependence on equipment	Medium	Medium	High
Maintenance cost	Low	Low	Medium
Preventive maintenance	Low	Medium	High

Source: The authors

3.1.1 Fresh cut pineapple

This is the minimum processing option for fresh fruit that consists of the following steps:

1. Harvest and selection: consists of selecting the fruit to be transported to the processing plant. Fruits should be free of external defects, such as insect damages, and should not be overripe or immature.
2. Transport to plant: fruits are carefully transported to the processing plants.
3. Washing: fruits are carefully damped into a tank with a chlorine solution for initial washing and disinfection.
4. Fruit disinfection: fruits are washed with clean water and a chlorine solution prior to entering the processing line.
5. Cutting 1: heads and bottoms of the fruits are cut, either manually or by machine
6. Cutting 2: fruits are placed into a machine for core and skin removal or are peeled and cut manually.
7. Finishing: residues and any remaining parts of peel are removed.
8. Slicing: fruits are cut into rings or chunks, either by hand or by machine.
9. Conditioning: antioxidants and calcium are applied to avoid browning.
10. Sampling: prior to packaging, samples are analysed in order to check the moisture content.
11. Packaging: pineapple pieces are put into packages and are thermo sealed. Packages are tagged with traceability codes.
12. Storage: Packages are stored at 2-5 C

Figure 55: Final presentation of fresh cut pineapple at a retail store

Source: Francisco Lopez Lee, 2018

An overview on the estimated variable monthly costs of a fresh cut processing plant with a daily capacity of 8 tonnes of fresh fruits/day is shown in the following table. It is estimated that the average costs amount to approximately SRD 105,600 or USD 14,080 per month. With a conversion rate of 45 %, and a monthly production of around 78 tonnes of fresh cut pineapples, the estimated variable unit cost corresponds to 1.35 SRD/kg or 0,18 USD/kg.

Figure 56: Overview on monthly variable cost for a fresh cut processing plant (8 tonnes fresh fruits/day)

No. Workers	Shifts	Position	SRD/hour	Hrs/day	Days/week	Weeks/month	Total income/person/month	Sum costs/month
1	1	Fruit entrance and selection	12.50	8	5	4.33	2,165	2,165
1	1	Washing and disinfection	12.50	8	5	4.33	2,165	2,165
10	1	Processing	12.50	8	5	4.33	2,165	21,650
3	1	Packing	12.50	8	5	4.33	2,165	6,495
1	1	Clerk	12.50	8	5	4.33	2,165	2,165
1	1	Supervisor	25.00	8	5	4.33	4,330	4,330
1	1	Warehouse manager	20.00	8	5	4.33	3,464	3,464
1	1	QC inspector	22.50	8	5	4.33	3,897	3,897
1	1	Maintenance	17.50	8	5	4.33	3,031	3,031
Sub Total (SRD)								**49,362**
		Social Security	29.5%					14,562
		Insurance labour risk	3.0%					1,481
		Holiday pay	8.3%					4,112
		Payroll Tax	10.0%					4,936
		Health Insurance						3,000
Total Salaries and Benefits/Obligations (SRD)								**77,453**
Energy								2,000
Cost of maintenance/kg								8,400
Other supplies (cleaning, knives, clothing, packaging, trays, etc.)								10,000
Safety margin (10%)								7,745
Total Direct Costs (SRD)								**105,598**
Total Direct Costs (USD)								**14,080**

Source: The authors

3.1.2 Dried pineapple

The process of producing dried pineapples consists of the following steps:

1. Harvest and selection: consists of selecting the fruit to be transported to the processing plant. Fruits should be free of external defects, such as insect damages, and should not be overripe or immature.
2. Transport to plant: fruits are carefully transported to the processing plants.
3. Washing: fruits are carefully damped into a tank with a chlorine solution for initial washing and disinfection.
4. Cutting 1: heads and bottoms of the fruits are cut, either manually or by machine
5. Cutting 2: fruits are placed into a machine for core and skin removal or are peeled and cut manually.
6. Finishing: residues and any remaining parts of peel are removed.
7. Slicing: fruits are cut into rings or chunks, either by hand or by machine. Sliced fruits are placed into trays.
8. Dehydration: Trays are placed into oven. The process takes about 15 hours until the internal humidity content in the final product reaches 12-15%.
9. Sampling: prior to packaging, samples are analysed in order to check the moisture content.
10. Packaging: pineapple pieces are put into packages. Packages are tagged with traceability codes.
11. Storage: Packages are stored at 5-8 C

Figure 57: Dehydrated pineapple slices

Source: Francisco Lopez Lee, 2018

An overview on the estimated variable monthly costs of a dried pineapple processing plant with a daily capacity of 12 MT/day is shown in the following table. It is estimated that the average costs amount to approximately 140,000 SRD or 18,400 USD per month. With a conversion rate of 6.5 %, and a monthly production of 16.9 tonnes of dried pineapples, the estimated variable unit cost corresponds to 8.18 SRD/kg or 1.1 USD/kg.

Figure 58: Overview on monthly variable cost for a dried pineapple processing plant (12 tonnes of fresh fruits/day)

No. Workers	Shifts	Position	SRD/hour	Hrs/day	Days/week	Weeks/month	Total income/person/month	Sum costs/month
1	1	Fruit entrance and selection	12.50	8	5	4.33	2,165	2,165
1	1	Washing and disinfection	12.50	8	5	4.33	2,165	2,165
16	1	Processing	12.50	8	5	4.33	2,165	34,640
3	1	Packing	12.50	8	5	4.33	2,165	6,495
2	1	Clerk	12.50	8	5	4.33	2,165	4,330
1	1	Supervisor	25.00	8	5	4.33	4,330	4,330
1	1	Warehouse manager	20.00	8	5	4.33	3,464	3,464
1	1	QC inspector	22.50	8	5	4.33	3,897	3,897
1	1	Maintenance	17.50	8	5	4.33	3,031	3,031
Sub Total								**64,517**
		Social Security	29.5%					19,033
		Insurance labour risk	3.0%					1,936
		Holiday pay	8.3%					5,374
		Payroll Tax	10.0%					6,452
		Health Insurance						4,050
Total Salaries and Benefits/Obligations								**101,361**
Energy								4,000
Cost of maintenance/kg								12,600
Other supplies (cleaning, knives, clothing, packaging, trays, etc.)								10,000
Safety margin (10%)								10,136
Total Direct Costs (SRD)								**138,097**
Total Direct Costs (USD)								**18,413**

Source: The authors

3.1.3 Frozen pineapple

This process is referred to Individual Quick Freezing (IQF), which is a widely used method for improving the shelf life of perishable products. During IQF freezing air passes through the fruits at a high speed, provoking instant freezing. This instant freezing, in turn, stops the formation of sharp water crystals in the cells, which means that there is no damage to the cell walls and the texture of the product is not damaged.
IQF consists of the following steps:

1. Harvest and selection: consists of selecting the fruit to be transported to the processing plant. Fruits should be free of external defects, such as insect damages, and should not be overripe or immature.
2. Transport to plant: fruits are carefully transported to the processing plants.
3. Washing: fruits are carefully damped into a tank with a chlorine solution for initial washing and disinfection.
4. Fruit disinfection: fruits are washed with clean water and a chlorine solution prior to entering the processing line.
5. Cutting 1: heads and bottoms of the fruits are cut, either manually or by machine
6. Cutting 2: fruits are placed into a machine for core and skin removal or are peeled and cut manually.
7. Finishing: residues and any remaining parts of peel are removed.
8. Slicing: fruits are cut into rings or chunks, either by hand or by machine.
9. Freezing: fruit pieces are put on a conveyor belt and are frozen in the IQF machine.
10. Visual selection: to sort out pieces that deviate too much in terms of colour.
12. Packaging: pineapple pieces are put into packages. Packages are tagged with traceability codes.
11. Critical control point: every package passes a critical control point (metal detector).
12. Storage: Packages are put in cartons, which are then palletized and moved to the storage area. Pallets are stored at -20-25C.

An overview on the estimated variable monthly costs of an IQF processing plant with a daily capacity of 36 tonnes of fresh fruits/day is shown in the following table. It is estimated that the average costs amount to approximately 205,000 SRD or 27,300 USD per month. With a conversion rate of 38 %, and a monthly production of 263.3 tonnes of frozen pineapples, the estimated variable unit cost corresponds to 0.78 SRD/kg or 0.1 USD/kg.

Figure 59: Overview on monthly variable cost for an IQF processing plant (32 tonnes of fresh fruits/day)

No. Workers	Shifts	Position	SRD/hour	Hrs/day	Days/ week	Weeks/month	Total income/person/month	Sum costs/month
3	1	Fruit entrance and selection	12.50	8	5	4.33	2,165	6,495
3	1	Washing and disinfection	12.50	8	5	4.33	2,165	6,495
16	1	Processing	12.50	8	5	4.33	2,165	34,640
2	1	Packing	12.50	8	5	4.33	2,165	4,330
3	1	Clerk	12.50	8	5	4.33	2,165	6,495
2	1	Supervisor	25.00	8	5	4.33	4,330	8,660
1	1	Forklift operator	20.00	8	5	4.33	3,464	6,928
3	1	QC inspector	22.50	8	5	4.33	3,897	11,691
2	1	Maintenance	17.50	8	5	4.33	3,031	6,062
Sub Total								**91,796**
		Social Security	29.5%					27,080
		Insurance labour risk	3.0%					2,754
		Holiday pay	8.3%					7,647
		Payroll Tax	4.2%					9,180
		Health Insurance						5,400
Total Salaries and Benefits/Obligations								**143,856**
Energy			0.1					3,000
Cost of maintenance/kg			0.04					33,600
Other supplies (cleaning, knives, clothing, packaging, trays, etc.)			0.2					10,000
Safety margin (10%)								14,386
Total Direct Costs (SRD)								**204,841**
Total Direct Costs (USD)								**27,312**

Source: The authors

4. Vision, strategy and action plan for the pineapple value chain

4.1. Vision and concrete goals

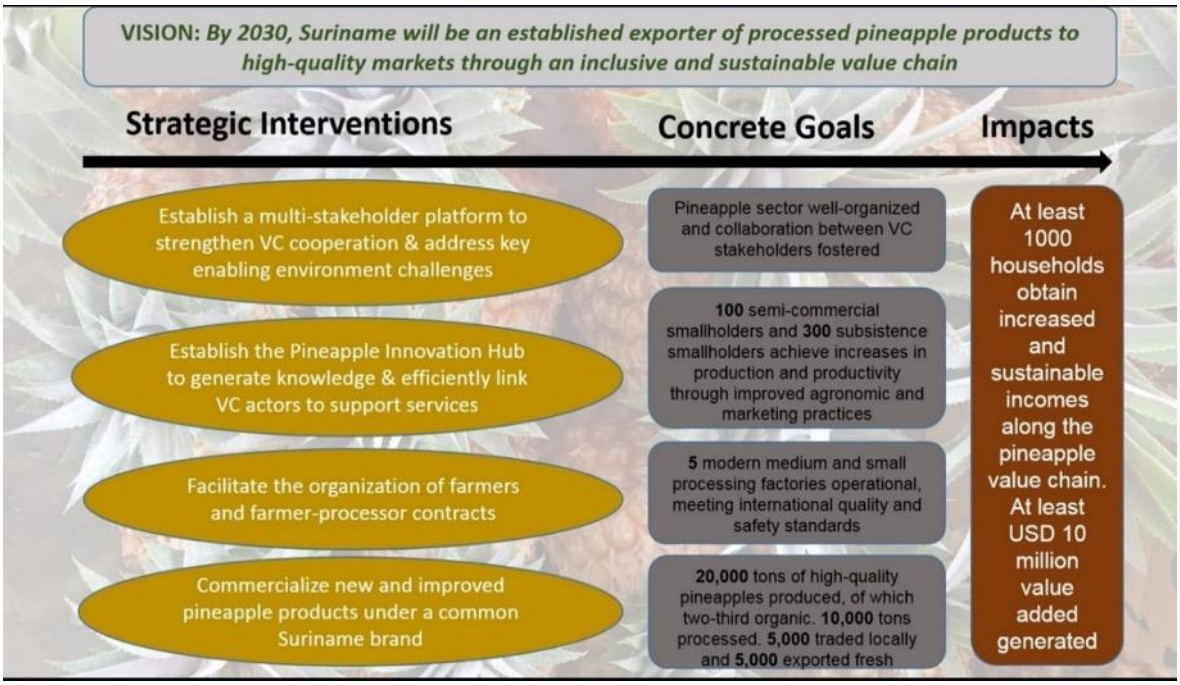
<u>Overall vision</u>: By 2030, Suriname will be an established exporter of processed pineapple products to high-quality markets through an inclusive and sustainable value chain.

Based on the analysis of the current situation, the vision was proposed and discussed amongst representative of value chain stakeholders at a 3ADI+ validation workshop in October of 2018. It is aligned with Suriname's national development plans and stays in touch with the observed entrepreneurial drive and political will. Thus, it has so far received buy-in across the private and public sector.
The concrete goals that need to be achieved in order to realize the vision are:

(1) The pineapple sector will be well-organized, and collaboration between value chain stakeholders will be fostered
(2) Around 100 semi-commercial smallholders and 300 subsistence smallholders will achieve increases in production and productivity through improved agronomic and marketing practices
(3) Around 5 modern medium and small processing factories will be operational, meeting international quality and safety standards
(4) Around 20,000 tons of high-quality pineapples will be produced, of which two-third is organic. 10,000 tons will be processed; 5,000 will be traded locally and 5,000 will be exported fresh.

The upgraded pineapple value chain will bring about benefits within and beyond. At least 1,000 households are expected to obtain increased and sustainable incomes along the chain, and at least USD10 million value added will be generated per year.

4.2. Strategic Interventions



The strategy to achieve these concrete goals and realize the overall vision by 2030 must be an integrated approach to simultaneously tackle all binding constraints. It should be a differentiation strategy that is based on four strategic interventions:

1. **Establish a multi-stakeholder platform to strengthen value chain cooperation and address key enabling environment challenges**.
   Identified key constraint: Little collaboration and sharing between value chain stakeholders, many working in silos without a common goal and approach.
   Proposal: The platform, which will comprise of representatives of value chain actors, from producers, processors to distributors, as well as relevant stakeholders and public entities, including the Ministries, university and research institutes, international organizations and NGOs, will give a common voice to the pineapple sector. It will provide a transparent mechanism to facilitate the identification of and discussions on critical constraints affecting the value chain as a whole, as well as foster information exchange and trust between value chain actors that leads to more effective coordination. Further, it provides a venue for public-private dialogue on key policy issues that impact the development and competitiveness of the sector.

2. **Establish a Pineapple Innovation Hub to consolidate value chain knowledge and efficiently link value chain actors to support services.**
   Identified key constraint: Prevalent lack of support services to provide value chain actors with technical knowledge, market information, and physical inputs to carry out their operations efficiently and effectively. Weak coordination between research, extension and market development.
   Proposal: The Pineapple Innovation Hub will be a public-private entity that provides services such as technical expertise, trainings and market intelligence, in collaboration with international experts, public extension and existing research institutes in the country. The hub is destined as a one-stop shop to consolidate information and knowledge about pineapple production and trade in Suriname, as well as a research and training centre for agri-entrepreneurs and cooperative leaders who will operate pineapple farms as businesses. It will address the lack of essential knowledge in pineapple production and processing and in the provision of support services in Suriname's pineapple sector. It will provide an overview and continued updates of the current situation and outlook, which will guide the decision making of not only value chain actors, but also policymakers. Equally, the hub can provide support and training for value chain actors to get more organized in their businesses, particularly in the areas of record keeping and finance, cooperative admin and management, and collective marketing. The hub will initially focus on providing or linking value chain actors with services that can improve production-related problems, and later on, as the pineapple sector takes off, expands to processing-related and export-related services.

3. **Facilitate the organization of farmers and farmer-processor contracts to strengthen value chain linkages and foster effective governance of the chain.**
   Identified key constraint: Fragmentation of value chain operation which hinders the provision of high-quality and stable supplies to the markets. The majority of smallholders work in isolation and thus have difficulty accessing markets, technologies, and other services.
   Proposal: 3ADI+ will support the aggregation of smallholders and strengthen value chain linkages through different mechanisms, such as the setting up of farmer associations and contract farming. Being organized in groups will help smallholders obtain better access to export markets, purchase inputs in bulk to bring costs down, and share machines and services such as storage and transport. Furthermore, upgraded horizontal linkages also facilitate the provision of information and knowledge through group trainings on best practices, modern technologies and quality standards. The organization of smallholders to facilitate better access to support services is crucial to the implementation of improved business models in production and processing, so as to boost the economic, social and environmental viability of the sector.

4. **Commercialize new and improved pineapple products under a common Suriname brand to target high-end and niche markets**
   ***Identified key constraint*:** Little experience in exporting fresh pineapples and pineapple products. Surinamese agricultural products still unknown in foreign markets, apart from the Netherlands.
   Proposal: 3ADI+ will assist in the development of differentiation marketing strategies that promote quality and uniqueness to establish Suriname's place in the niche market. Suriname has a compelling story to tell as one of the birthplaces of pineapples, with an exotic location and a strong tradition in pineapple farming amongst the indigenous populations. The project will conduct detailed analyses of potential markets and acquire concrete buyer contacts, facilitate communication between the multi-stakeholder platform and global distributors/ buyers, as well as support value chain actors to get a better understanding of market requirements and how to respond to them.

4.3. Proposed actions and timeline

This section outlines key concrete actions that need to be taken in order to address the aforementioned systemic constraints and upgrade the pineapple value chain in Suriname. All of these actions constitutes the holistic approach of a 3ADI+ development project. It is expected that substantial 3ADI+ support through development organizations such as FAO, UNIDO and ITC will be provided for a period of five year to take the initiative off the ground, after which point the value chain will continue on a sustainable development path, driven by the private sector and facilitated by the public sector and non-governmental stakeholders.

In 2019, development funds will be mobilized, and private and public sector interest will be raised to attract investment in the sector. This action plan will be validated with the government and relevant value chain stakeholders to assess its feasibility. It will also function as the basis to further exchanges with potential partners inside the country and internationally. Experts of relevant backgrounds, including economists, agronomists, anthropologists, environmentalists, gender and youth experts, are expected to be consulted in the preparation phase. A revised and more detailed action plan will be drawn up, accompanied by a monitoring and evaluation plan with concrete indicators.

During the implementation phase, a 3ADI+ facilitation team will be formed consisting of international and local experts from multiple disciplines. They will regularly engage with the multi-stakeholder platform for the consultation of main issues and concerns (Activity 4.1. elaborates on the structure of the platform), while the main activities will be carried out through the Pineapple Innovation Hub in coordination with actors along all nodes of the value chain, as well as different ministries and local partners (see Activity 5.1. for more details on the domains and operation of the Hub). At the beginning, the Hub will build up its service capacity especially on pineapple production, as production challenges in terms of insufficient output and quality are the critical bottlenecks that must be tackled first and foremost. The increase in production and productivity must, however, be strategically accompanied by an improvement in processing capacity. The hub, thus, will incrementally expand its technical domain and physical equipment to provide support to the processing segment. Needless to say, there will be a significant reliance on external experts initially, yet a local cadre of specialists will be gradually formed. In this sense, the hub, working under the guidance of the multi-stakeholder platform, will be a central driver to foster public and private cooperation in developing research capacities as well as market intelligence for the sector.

It must be emphasized that while different value chain actors, ministries or other partners might be more involved in certain areas and help advance certain outputs more than others, every activity is a collaborative effort. All of them cannot be carried out separately but will require close coordination, with

the overall goal of improving value chain linkages, promoting investment, and influencing policy for the sustainable and inclusive development of the pineapple sector.

Figure 60 provides an overview of the project facilitation activities that contribute to five key outputs, the timeline of the project, and the main partner institutions.

Figure 60: Timeline of the 3ADI+ Suriname five-year project

Output and activities	Year 1	Year 2	Year 3	Year 4	Year 5	Key partners
Output 1: Pineapple production quantity and quality increased in a sustainable manner, through the application of best practices and modern packages while preserving traditional knowledge						
1.1. Validate and adjust improved production models at the Pineapple Innovation Hub						LVV, RO, SAMAP
1.2. Identify and support farmers in implementing improved production models, learning from best practices in farm management, and establishing administrative systems						LVV, RO, CELOS, Federation of Suriname Farmers (FSA)
1.3. Assist farmers in entering high-value markets through sustainability certifications						LVV, HIT
1.4. Catalogue pineapple varieties and develop a nursery as part of the Pineapple Innovation Hub						LVV, CELOS, ADEKUS, IICA
1.5. Develop plans and criteria for sustainable expansion of production areas						LVV, RO, CELOS
1.6. Support farmers in diversifying their incomes by developing farm diversification strategies						LVV, CELOS
Output 2: Small-scale and medium-scale pineapple processing plants established, with enhanced capacities and upgraded technologies, which contribute to value addition through new and improved pineapple products						
2.1. Promote private sector investment in the establishment and enhancement of processing facilities						HIT, Chamber of Commerce(KKF)
2.2. Support the installation of private small-scale processing plants, owned or co-owned by groups of farmers						HIT, LVV, SAMAP, FSA
2.3. Support processing facilities to access funding						HIT, SAMAP
2.4. Assist processing companies in improving their business models through training in the application of protocols, standards and good processing practices, adoption of						HIT, COLEACP

innovative technologies, and business management.						
Output 3: New and improved pineapple products effectively commercialized in new and existing markets. Producers and processors gain access to local, regional and global markets						
3.1. Promote the consumption of pineapples and pineapple products as part of a healthy diet in the domestic market						Min of Health, Min of Education
3.2. Build linkages between Surinamese value chain actors with the regional and global markets						HIT, KKF, Association of Suriname Exporters (VEAPS),Suriname Business Forum
3.3. Foster the development of an export consortium and train national promoters						HIT, VEAPS
3.4. Establish a common brand and trademark for Surinamese pineapple products that focuses on market differentiation						HIT, KKF, VEAPS, Suriname Business Forum
Output 4: Linkages between value chain actors are strengthened, and collaboration amongst stakeholders is reinforced for a coherent development of the pineapple sector						
4.1. Facilitate the initiation and operation of a multi-stakeholder platform that represents the common interest of pineapple VC stakeholders						IGSR, LVV, HIT, RO, CELOS, KKF, VEAPS, FSA
4.2. Strengthen horizontal and vertical linkages between value chain actors						HIT, LVV
Output 5: Capacity of support services improved to foster efficient value chain operation, and the enabling environment is conducive to the development of the pineapple sector and beyond						
5.1. Support the creation, consolidation and sharing of knowledge and information in the pineapple sector through the establishment of the Pineapple Innovation Hub						LVV, HIT, RO, CELOS, IICA, IGSR, ADEKUS
5.2. Assist the setting up of private service businesses that support functions along the value chain						HIT
5.3. Improve access to financial services for value chain actors, especially for smallholders and small and medium enterprises (SMEs)						LVV, HIT, commercial banks
5.4. Build capacities of public extension officers, and enhance the public sector capacity for food safety and quality control						LVV, HIT, RO, SAMAP, Bureau of Standards
5.5. Facilitate investment in infrastructure for export competitiveness						Development banks

How each activity is to be implemented will be elaborated as follows.

<u>Output 1</u>: Pineapple production quantity and quality increased in a sustainable manner through the application of best practices and modern technologies while preserving traditional knowledge

Activity 1.1. *Validate and adjust improved production models at the Pineapple Innovation Hub.*
Surinamese farmers possess great potential to improve the productivity and quality of their pineapples by adopting better agronomic and farm management practices. Although pineapples have been grown in Suriname and valuable knowledge in this aspect has been passed on for generations, there is still much to be done to realize its economic, social and environmental viability, and to propel Suriname as a competitive pineapple supplier in the niche market. The previous chapters have outlined different scenarios on how improved production systems could look like, depending on the level of time and financial investments. These scenarios still need to be verified in practice, in order to determine the model best suited for different groups of Surinamese farmers. Demonstration plots, hence, need to be set up at the Pineapple Innovation Hub for this purpose. In order to best simulate, they need to be located in the current pineapple producing region for similar agro-ecological conditions. They would be operated and monitored closely both in terms of agronomic practices and in terms of financial costs.
Initially, the project needs to seek agronomic experts that can bring international best practices, especially in organic pineapple production, to the country. Contacts have been established with several Costa Rican pineapple specialists during the pilot phase, and these experts will be contracted with the Hub. They will provide technical expertise to the validation of the suggested business models, especially in methods that are currently not practiced, such as the application of organic fertilizer and pest and disease management and the introduction of modern technologies (e.g. climate-smart technologies) in order to determine what works best in Suriname in terms of productivity, quality and environmental impacts. For the sustainability of the project, the international experts will train a team of local agronomists at the Pineapple Innovation Hub and work closely with LVV and RO extension officers to institutionalize the knowledge. Partnerships are expected with national institutes focusing on agricultural production.
In terms of business development, the productivity and profitability of the plots must be monitored by consultants with background in business management and accounting. They will work closely with the international pineapple specialists and with public extension from HIT. These consultants can either become long-term professionals employed at the Hub or can supply their own business development services to interested farmers later on.

Activity 1.2. *Identify and support farmers in implementing improved production models, learning from best practices in farm management, and establishing administrative systems*

During the validation period of the demonstration plots, farmers will already be sensitized to best practices in pineapple production and farm management, including record keeping and administration of costs. Farmers who would like to apply the improved practices on their farms will receive support and guidance from the Hub, who can also share the knowledge with others in their communities. After the validation period and after the improved models have been adjusted and adapted to the Surinamese conditions, the positive experiences will be spread and scaled up. Training will be provided to support interested farmers in implementing these models, using FAO farmer field school approach whereby a group of farmers monitor and compare two plots over a season. While one plot is cultivated with the traditional methods, the other one follows “best practices” from the validated improved production models. The farmers will observe and discuss differences in the plots in terms of field conditions, plant development, phytosanitary condition, yields and quality, and see for themselves the required level of labour and financial investment. In addition to farmer field school, “farmer business schools” will be critical to promote the practice of record keeping and the establishment of administrative systems, even if simple, amongst farmers. Interested farmers will receive training on financial literacy and other business management aspects, so that they can make more informed business decisions. At the beginning, the master trainer will be international experts. Yet overtime, this responsibility could be passed on to local staff of the Hub, lead

farmers or extension service workers. Some of the first trainees will be farmers in the main pineapple producing areas of the Carolina district. Gradually, more pineapple farmers may wish to implement the improved models. The project will also work with the Government to identify subsistence farmers in more remote regions.

Activity 1.3. *Assist farmers in entering high-value markets through sustainability certifications*
In order to expand the markets for their produce and increase the returns from pineapple farming, certification options should also be explored next to improved productivity and quality. Some standards schemes, like Global GAP, set the prerequisite to enter certain markets, while others such as Organic and Fairtrade will likely reward smallholders with premiums and bring about improvements in efficiency and working conditions, if well implemented. Together with partner organizations (e.g. COLEACP), 3ADI+ will build producers' awareness of certified market channels and of the costs and benefits of certifications. For farmers that are interested in joining certification programs, the project will work with farmer associations and processing companies to build their capacity and knowledge on specific requirements. This will entail translating jargon-heavy codes to farmer-friendly learning modules, adapting international standards to Surinamese conditions, as well as developing and disseminating booklets on production practices, post-harvest handling, occupational health, safety, and labour rights.
It is important that end market opportunities are in sight, so as to create incentives for adoption and to ensure that certifications do not only create more burden to producers. Shifts in production practices must happen gradually. In fact, farmers who take on the improved production models will already move more closely towards sustainability standards. Support farmers in record keeping and administration as mentioned above is also an essential step to obtaining certifications. It should be insisted that sustainable production trainings will be offered across different areas so that more marginalized smallholders can be reached. Finally, the multi-stakeholder platform can facilitate the integration of sustainability principles into the national regulatory framework to raise the environmental and social standards for the sector and beyond.

Activity 1.4. *Catalogue pineapple varieties and develop a nursery as part of the Pineapple Innovation Hub*
Despite a wide range of pineapple cultivars currently grown in Suriname, there is little knowledge about their organoleptic properties. During the course of the analysis phase, 3ADI+ has made the first attempt at fruit analysis through the one-week visit of the Costa Rican pineapple expert to farmers in Redi Doti, Pierre Kondre, and Matta. However, due to the time constraint the number of obtained samples was only sufficient to make indicative, not conclusive, comments. It is, thus, critical under the implementation phase to facilitate a better understanding of the different pineapple varieties. In collaboration with international research centres on pineapples and tropical fruits and local research institutes, 3ADI+ will conduct research to determine the characteristics of Surinamese pineapples, assess their suitability for different types of processing, and especially compare them with some of the most widely cultivated varieties in the global market. Furthermore, 3ADI+ will collaborate with CELOS and the Ministry of LVV in the development of a nursery as part of the Pineapple Innovation Hub to preserve pineapple germ plasm and ensure a consistent supply of high-quality plant material. At a later stage, the private sector (e.g. Grassalco) might be further involved and the establishment of commercial nurseries is expected.

Activity 1.5. *Develop plans and criteria for sustainable expansion of production areas.*
Tacking stock of previous research and together with institutes such as CELOS and ICCA, soil analysis of designated areas will be conducted to determine their suitability for pineapple production. While Suriname has a high level of land availability, many areas cannot be converted into cropland without negative environmental consequences. Thus, in addition to economic viability, land conversion needs to take into account its impacts on native ecosystems and biodiversity, and freshwater resources. The expansion of pineapple farmland must not, for example, encroach on primary forests. Furthermore, it must be in accordance with the National Development Plan while considering social factors, such as village customary land rights and approval of local communities. In order to minimize the areas of secondary forests affected by pineapple farming activities, 3ADI+ will progressively encourage and accompany

producers in the establishment of permanent production systems, while the practice of slash and burn should be limited.

Activity 1.6. *Support farmers in diversifying their incomes by developing farm diversification strategies*
Building on the expertise of CELOS in integrated cropping systems, 3ADI+ will conduct research into associated crops that are compatible with pineapples, both in terms of the markets for their products and the technical know-how on production and processing. During the validation period on the demonstration plots, business models for pineapple production in an agro-forestry system as well as in other mixed farming systems need to be considered. Diversification strategies will be proposed for producers, so as to lessen the risks of over-reliance on one cash crop and also to alleviate the environmental impacts of mono-cropping. Integration of livestock rearing with cropping will also be looked into in order to maximize the use of resources (e.g. chicken manure can be used as fertilizer) and based on lessons from countries of similar climate conditions.

Output 2: Small-scale and medium-scale pineapple processing plants established, with enhanced capacities and upgraded technologies, which contribute to value addition through new and improved pineapple products

Activity 2.1. *Promote private sector investment in the establishment and improvement of processing facilities*
The increase in production and productivity must be strategically accompanied by an improvement in processing capacity. This necessitates the mobilization of private sector interest in setting up pineapple processing facilities, in addition to an investment boost to upgrade the existing one. To this end, the project will first and foremost work with the current pioneer processor to augment their capacity and secure a modern channel to absorb the existing raw material output. Steadily as the fresh pineapple volume increases and the production season lengthens, the project will attract private investments in the establishment of additional small- and medium-sized processing factories. 3ADI+ will work with the Government, business promotion agencies and business associations (e.g. the Chamber of Commerce, Suriname Business Forum, the Association for Surinamese Manufacturing Companies) to provide entrepreneurs with information on pineapple processing. Partially funded study visits to processing plants in key supplier countries like Brazil and Costa Rica can also be organized. Interested entrepreneurs and investors, together with representatives of the multi-stakeholder platform, will have the chance to observe the operation of well-established factories and get to know about the specificities and management models for different types of pineapple processing. Apart from fresh-cut and dried pineapple, which are the most viable starting options thanks to the high market demands and relatively low entry level, other processing options such as individual quick freezing may gradually emerge as investments go up. Further, the management model used for pineapple processing can be applied to the processing other fruits to create a mixed package (e.g. dried pineapple and papaya).

Activity 2.2. *Support the installation of private small-scale processing plants, owned or co-owned by groups of farmers*
Once improved business models at the production level have been adjusted and validated, they will generate adequate knowledge to inform the concretization of business models at the processing level and recommended investments for different processing options. Apart from gaining better returns at the farm level, producers can directly engage in value addition through functional upgrading. Groups of primary producers may wish to learn about processing technicalities from the models proposed by the project and start taking on simple processing options, such as co-owning small pineapple drying facilities. The project will support farmer groups in such endeavours by bringing in experts to accompany the initial setting up of the facilities, together with assistance from 3ADI+ core team (UNIDO, FAO, and ITC) in business development. Utilizing lessons learned from other successful initiatives both worldwide and in Suriname (e.g. cassava processing factory operated a woman cooperative), 3ADI+ will assist farmer groups in setting up business plans, implementing management models, and procuring equipment and workforce and other logistics arrangements such as storage and transport. In order to be commercially successful beyond the

course of the project, farmer groups will need to employ individuals that are skilled in product development, marketing and sales. The multi-stakeholder platform can function as a matchmaker for entrepreneurs and groups of farmers interested in agro-processing.

Activity 2.3. *Support processing facilities to access funding*

Finance could be the primary constraint to processors at the starting phase, as next to purchasing produce in bulk from farmers they must make substantial investments in equipment and workforce. Therefore, 3ADI+ will assist processors, especially small entrepreneurs, in developing sound proposals to be submitted to different funding sources, including development banks, development projects with matching grants, and commercial banks. The ongoing SAMAP project, for example, provides matching grants to farmer cooperatives. Through the Hub, the project will also aim to link agri-entrepreneurs with business incubators.

Activity 2.4. *Assist processing companies in improving their business models through training in the application of protocols, standards and good processing practices, adoption of innovative technologies, and business management*.
While initial efforts need to be directed at ensuring a consistent and quality supply of raw material to processing plants, expertise in pineapple processing, which is critically lacking in Suriname, must equally be built up. Next to a team of agronomists, the Pineapple Innovation Hub will contract international processing experts to bring best practices and innovative technologies to the country, who will then work with the private sector and research organizations to adapt them to the Surinamese conditions and assist in the formation of a local cadre of future processing experts. Although bigger companies may already have their own business development models and have a network to support their operation, small enterprises will particularly be likely to require 3ADI+ technical assistance in these respects to strengthen their competitiveness and sustainability. Based on requests, the hub will provide according support to newly established factories the latest knowledge, technologies, and technical regulations. Together with implementing partners such as COLEACP, the project can also provide training courses to quality managers in regulating their raw material supply and processing plant, so as to address sanitary and phytosanitary (SPS) issues, comply with international quality standards, and obtain essential certifications (e.g. ISO 20000, GlobalGAP).

<u>Output 3</u>: New and improved pineapple products effectively commercialized in new and existing markets. Producers and processors gain access to local, regional and global markets.

Activity 3.1. *Promote the consumption of fresh pineapples and pineapple products as part of a healthy diet in the domestic market.*
As with other fruits, consumption of fresh pineapples rather than sweetened dessert, and of freshly squeezed pineapple juice rather than sweetened sugar beverages can contribute to improving nutrition and health. 3ADI+ will work with the public sector to launch effective consumer awareness campaigns on healthy eating through fruit consumption in general and pineapples in particular. Additionally, the project will communicate with public and private institutional buyers such as schools, hospitals, the army, or mining companies to stimulate their interests in providing healthier food, which include fresh cut pineapples and other freshly made pineapple products and link them with pineapple traders and farmer organizations.

Activity 3.2. *Build linkages between Surinamese value chain actors and the regional and global markets.*
As Suriname has a small domestic market that does not tend to reward organic over conventional products, Surinamese pineapple value chain actors need to increasingly target the export market. Due to technology and productivity gaps, exacerbated by logistical challenges, it will take time for Suriname's pineapple sector to reach an economy of scale. Consequently, there is at present little opportunity to compete with other major supplying countries in terms of quantity. Instead, it would be wise to follow a differentiation strategy

and focus on improving quality and promoting uniqueness to establish Suriname's place in the niche market. In this respect, 3ADI+ will actively facilitate international market access for pineapple producers, processors and wholesalers. The project will conduct detailed analysis of high potential markets to get a better understanding of market demands, construct lists of potential buyers and obtain concrete requirements. It will facilitate communication between the pineapple multi-stakeholder platform and global distributors/ buyers to spark market interest in Surinamese varieties. Other activities can include the arrangement of buyers' visit to pineapple farms and factories, and shipment of fresh and processed product samples to buyers, as necessary.

Activity 3.3. *Foster the development of an export consortium and train national promoters.*
In order to effectively decrease export risks and costs, particularly to address problems associated with small volumes and respond to larger orders, Surinamese pineapple value chain actors may find it advantageous to partner with the processors and exporters of other fruits and related agricultural products. Building on UNIDO's experience in SME cluster and network development in Latin America and Asia, 3ADI+ will work with the Suriname Association of Exporters of Agricultural Products (VEAPS), the Chamber of Commerce and the Ministry of HIT to foster the creation of a voluntary alliance of firms, known as an export consortium. The project will promote awareness in the benefits of consortia amongst potential firms, such as reduction in administrative and promotional costs, reduction in risks of exporting to new markets, and provision of information on prices and market trends for members. It will help identify and train national promoters of export consortia in the private and public sectors, provide meeting venues and develop networking schemes for SMEs to exchange on their export plans, and encourage public sector support.

Activity 3.4. *Establish a common brand for Suriname's pineapple sector that focuses on quality and differentiation*
Suriname has a compelling story to tell as one of the birthplaces of pineapples, with an exotic location (the Amazon) and a strong tradition in pineapple farming amongst the indigenous populations. In order to realize these advantages, value chain actors need to work collectively to establish a common brand for Surinamese pineapples in the niche market. 3ADI+ will assist the multi-stakeholder platform in devising marketing strategies to emphasize the unique attributes of Surinamese pineapples and the social and environmental sustainability of the sectors. Geographical Indication options can equally be explored, building on FAO's expertise in a multitude of countries across continents. Trade fair participation will be a good opportunity to extend the presence of Suriname pineapple and pineapple products to the global market. The project will support pineapple value chain actors in preparing for and partaking in international agricultural fairs and forums, and following up with potential buyers.

<u>Output 4</u>: Linkages between value chain actors are strengthened, and collaboration amongst stakeholders is reinforced for a coherent development of the pineapple sector
Activity 4.1. *Facilitate the initiation and operation of a multi-stakeholder platform that represents the common interest of pineapple VC stakeholders*.

To improve value chain collaboration and policy alignment for the pineapple sector, 3ADI+ will initiate the establishment of a multi-stakeholder platform that brings together representatives from both the private sector (representatives of farmers, processors, distributors and exporters) and focal points from key public entities (e.g. Ministry of Agriculture, Ministry of Trade, Ministry of Regional Development, local councils) that govern common issues affecting the whole value chain. Furthermore, representatives of relevant university departments, research institutes, NGOs and international organizations will be invited to provide the technical insights.

The platform is a neutral space where value chain stakeholders collaborate to tackle technical and policy constraints and agree on key priorities. Members of the platform should meet monthly or quarterly, depending on the needs at certain periods, at an apolitical work space (such as the university). At the

beginning, 3ADI+ will provide support in the establishment, operation and facilitation of the platform, including organizing and mobilizing stakeholders. The facilitator of the platform will be elected by members for a period of one year and initially will be in frequent touch with 3ADI+. Private sector participation, especially smallholder inclusion and representation of the interior population, will be encouraged.

Activity 4.2. *Strengthen horizontal and vertical linkages between value chain actors*

To improve value chain governance and build relationships between actors, as well as to enhance access to markets and services, smallholders need to be organized. While there are varying degrees of coordination, at present the pineapple value chain in Suriname is fragmented and mostly operated based on arm's length transaction, apart from BPS's outgrower scheme that involves a small number of farmers. Hence, 3ADI+ will contribute to strengthening horizontal linkages by facilitating the set-up of cooperatives and other types of farmer's organizations. As well, vertical linkages could be enhanced through mechanisms such as contract farming.

Contract farming is a widely used mechanism to link individual smallholders to processors for the export of high-value agricultural products[7]. In many cases, processors can provide producers with physical inputs on credit, and other advisory support ranging from trainings to enrolment in certification programs. This arrangement can help producers develop capacity, manage risks and stabilize incomes, since they are assured of an outlet to sell their produce. Farmers can better plan ahead and under certain circumstances use their contracts as soft collaterals to access finance. Meanwhile, it could give processors a certain degree of control over their raw material supply. However, as contract farming is a new concept for pineapple smallholders in Suriname, 3ADI+ will assist in the initial development and negotiation of contract. Follow-up trainings on contract farming related matters will be offered to minimize side-selling and help foster a positive contractual relationship. Through the multi-stakeholder platform, policy changes may be leveraged towards an institutional and legal environment conducive to the enforcement of contracts.

Moreover, 3ADI+ will raise awareness about the benefits of smallholder aggregation in the pineapple producing regions and amongst village chiefs. The project will provide technical assistance for farmers who wish to set up cooperatives, or farmers who wish to join other types of associations, either for marketing or transport purposes (e.g. collection centres). Besides trainings for individual farmers on agronomic practices and financial management at the farm level, the Pineapple Innovation Hub will offer trainings on cooperative and farmer organization management, covering issues such as contract negotiation and collective marketing, to eligible board and management members, with an emphasis on women and youth. Experts from FAO, UNIDO and ITC will assist farmer organizations in setting their goal and specific operational and financial objectives, in preparing business plans, and developing business models.

Output 5: Capacity of support services improved to foster efficient value chain operation, and the enabling environment is conducive to the development of the pineapple sector and beyond

Activity 5.1. *Support the creation, consolidation and sharing of knowledge and information in the pineapple sector through the establishment of the Pineapple Innovation Hub*

The key constraint of Suriname's pineapple value chain and equally one of the biggest opportunities for improvement lies at the support services level. There is a prevalent lack of support services to provide value chain actors with technical knowledge, market information, and physical inputs to carry out their operations efficiently and effectively. Many of the facilitation activities of 3ADI+, hence, will be conducted via the Pineapple Innovation Hub. The hub will be a central driver to foster public and private cooperation in developing research capacities as well as market intelligence for the sector.

[7] For more information and case studies on contract farming, please consult http://www.fao.org/in-action/contract-farming/en/

Domains of the Hub

In terms of knowledge management, the Hub could conduct research and consolidate all the key aggregate data related to pineapple production and trade into a central database that is accessible to all stakeholders. During the value chain analysis phase, a lot of key data was found to be missing. For example, there is no central database for the number and location of farmers, as well as their growing areas. All are based on estimates and yet there should be a centralized mechanism to arrive at a more precise number. As well, the number of pineapple production and consumption in Suriname and trade statistics need to be more systematically collected. These are important not only for direct value actors, but also for policymakers when formulating their support for the sector. All of the collected data will form the Hub's database and will be regularly updated. The hub can also provide market information on prices at different stages of the value chain, so that actors can be more informed when making business decisions.

In terms of research and development, the hub will own demonstration plots and together with partner institutes and 3ADI+ experts, try out different agronomic and management practices to validate the different production models suggested in Chapter 3. Furthermore, the hub will provide important agronomic research on soil and on the characteristics of various pineapple varieties, in order to determine the most suitable combination for different processing and commercialization options. A nursery will form part of the Hub to ensure the proliferation of high-quality planting material. For the implementation of these activities, the hub will develop partnerships with regional and international research organizations to access a pool of international experts/agronomists and tap into information sharing and exchange programs. Training courses on good agronomic practices, business management and cooperative development could be offered at the hub.

In terms of physical inputs, the Hub will assume the role of provider for the initial years while private services are being set up along the value chain. Since the improved production models will involve the application of external inputs (for organic farmers, application of organic fertilizers and pesticides), the Hub will need to explore import options or link with importers, as there seem to be no providers of organic inputs at present in the country. As production and processing capacities increase, the Hub could expand its expertise in processing and invest in owning processing equipment. For instance, the hub could own a demonstration processing assembly line for interested entrepreneurs to test their products for a fee.

Working mechanism of the Hub

It is envisioned that the Hub will be a public-private entity managed by members of the multi-stakeholder platform. During the project phase it will need to rely heavily on international expertise. Gradually, the Hub will build local expertise through training professionals and partnering with the university and research institutes. It will fund its operation through:

- Selling pineapples on the demonstration plots;
- Selling high-quality planting material in its nursery to producers and ensuring quality standards for pineapple processors, through the provision of advisory support from planting to harvesting and post-harvest handling;
- Selling physical inputs and equipment, including renting out equipment;
- Offering various services for a fee (e.g. provision of market information, business management and agronomic trainings); and
- Providing linkages between value chain actors and other partner providers (outsourcing) for a commission.

While at the starting phase of several years the Hub can provide support to value chain actors at no cost, later the Hub must charge fees for its services and cooperatives can pay fees on behalf of its members (as part of an association fee). The Hub also provides linkages and can outsource several services to partner providers. The hub, consequently, could expand to the provision of research and services for other associated crops, becoming an agricultural innovation centre

Activity 5.2. *Assist the setting up of private service businesses that support functions along the value chain*

While some key support services are provided by the Pineapple Innovation Hub at the start, it is expected that private operators will gradually take over a number of services, such as the provision of organic fertilizer and pesticide, artificial flowering induction, irrigation and other equipment. 3ADI+ can support the development of business plans to proof the economic viability of such services. 3ADI+ is also able to facilitate linkages between private support providers and farmers, for instance, by working with service providers to offer a discount for the first year, or setting up a demonstration day to introduce the products and establish connections between the service provider and potential users. The project can share the cost of the event with the service provider and offer a remuneration to the owner of the farm where the event is organized.

Activity 5.3. *Improve access to financial services for value chain actors, especially for smallholders and small and medium enterprises (SMEs)*
The present interest rates from commercial banks are prohibitive for pineapple value chain actors, at 20% - 22% per year. Moreover, collaterals are in every case required while most farmers do not possess formal land titles. Hence, together with the Ministry of LVV and Ministry of HIT, 3ADI+ will support negotiations with financial institutions to alleviate the restriction of conventional loan requirements and adapt their offers to the needs of pineapple smallholders and SMEs. For instance, repayment terms could be made to mirror the pineapple production cycle (e.g. first loan paid back after 18 months instead of 12 months), and medium-term loans could be provided in addition to short-term ones. "Soft" collaterals such as purchase order or outgrower contract could be provided to signal creditworthiness, as substitute for traditional "hard" collaterals like land titles. Innovative financial products in the form of self-managed savings or credit associations should also be explored. In order to strengthen repayment capacity, 3ADI+ will provide trainings to smallholders and SMEs in finance and business management so that they can make effective decisions on credit, savings, and investment.

Activity 5.4. *Build capacities of public extension officers, and enhance the public sector capacity for food safety and quality control*

So as to institutionalize the knowledge in the national structures beyond the course of the project, as well as to enhance extension support for value chain actors, 3ADI+ will work with the different Ministries to facilitate capacity building of public extension officers in organic and conventional pineapple farming techniques in particular, and good agricultural production practices and agribusiness development in general. Training courses specifically targeted at extension officers will be organized through the Hub, and motivated officers could be chosen to work with the international pineapple experts on the monitoring of the demonstration plots. They will participate in some of the early farmer field schools and business schools, and competent officers can become facilitators for the other ones that follow. It is also paramount that public investment be prioritized for the agricultural extension reform. At present many extension officers lack transportation to visit the field and do not have adequate information and technical capacity to respond to requests from farmers. In addition, the project will assist food control agencies (e.g. Bureau of Standards) to strengthen food safety regulations in compliance with internationally recognized standards and enforce quality control at the national level. On top of that, 3ADI+ will work with the Ministry of LVV Plant Protection and Quarantine in the development of the pest risk analysis under the Sanitary and Phytosanitary Measures which is a prerequisite for the export of fresh pineapples.

Activity 5.5. *Facilitate investment in infrastructure for export competitiveness*
In addition to the improvement of "soft" skills and capacities, the pineapple sector can only achieve success if "hard" infrastructures are in place to support the flow of products along different nodes in the value chain. Particularly as concerns export markets, the costs, speed and reliability of product delivery is of paramount importance. Suriname is currently at a disadvantage in this aspect due to the indirect and complicated maritime connections to major high-end markets such as the EU and the US, as well as the considerable

limit in air cargo space, with only three airline carriers serving the country. Even export to the CARICOM suffers from high freight costs as percentage of product value. Given the environmental impacts of air freight, coupled with the sustainability movement in the niche market diverting away from air freight products, sea freight options should be explored more extensively. Within the country itself, the transportation of high-quality fresh pineapples depends on public investment in the maintenance of rural roads. Furthermore, a reliable supply of electricity is vital to the operation of processing plants and the development of cold chain. Through partnerships with development banks, 3ADI+ will support the government in planning and prioritizing infrastructural needs for the pineapple sector and facilitate investments to lift the key bottlenecks.

4.4. Estimated Investments

Figure 61 outlines the estimated investments from different funding streams that are needed in order to carry out the upgrading interventions. All are necessary and complementary, contributing to uplifting different segments of the value chain, the services that support the chain's operation, and the broader enabling environment, altogether constituting the holistic approach of a 3ADI+ development project. While large investment to upscale the pineapple sector is needed, activities need to be carefully planned and monitored, so as to avoid adverse effects on the environment, as observed in other pineapple producing countries, and to ensure the inclusion of disadvantaged groups, especially female farmers.

It is expected that substantial 3ADI+ support through development organizations such as FAO, UNIDO and ITC will be provided for a period of five years to take the initiative off the ground, after which point the value chain will continue on a sustainable development path, driven by the private sector and facilitated by the public sector and non-governmental stakeholders.

Figure 61: Estimated investments from different funding sources

Investments	Private Sector	Development Grants	Development bank loans	Totals
Pineapple Innovation Hub		1,350,000		1,350,000
Medium-scale processing plants (2)	800,000	200,000	200,000	1,200,000
Small-scale processing plants (3)	700,000	300,000	300,000	1,300,000
Semi-commercial smallholders (100 farmers, 300 ha)	2,000,000	1,000,000	1,000,000	4,000,000
Subsistence smallholders (300 farmers, < 20 ha)		300,000		300,000
Development of farmer organizations	50,000	150,000		200,000
Facilitation (analysis, design, coordination)		500,000		500,000
TOTAL (USD)	3,550,000	3,800,000	1,500,000	8,850,000

4.5. Risk analysis

The main risks associated with the implementation of the action plan as well as relevant risk mitigation measures are presented in Figure 62 below.

Figure 62: Risk analysis of the 3ADI+ action plan

Action plan outputs	Risk Description	Risk Type	Risk Level	Assumptions	Mitigation Measures
Output 1: Pineapple	- Attacks from pests, diseases or	Beneficiaries	Medium	- Primary production not	- Farmers are supported in the

production quantity and quality increased in a sustainable manner, through the application of best practices and modern packages while preserving traditional knowledge	natural disasters cause drops in primary production - Farmers are refusing to change their production methods and systems - Surinamese environmental conditions don't allow implementation of upgraded production models	Natural environment		threatened by pests, diseases or natural disasters - Farmers are eager to change their production practices - Favourable natural environment for implementation of improved production models	application of good production practices, which help control pests and diseases and mitigate potential negative impacts - Demonstration plots established to showcase upgraded production models and to train farmers - Field trials validate feasibility of upgraded production models
Output 2: Small-scale and medium-scale pineapple processing plants established, with enhanced capacities and upgraded technologies, which contribute to value addition through new and improved pineapple products	- Not enough entrepreneurs that are willing to start processing pineapples - Insufficient raw materials of adequate quality for processing - Difficult access to finance for initial investments	Beneficiaries	Medium	- Pineapple processing represents attractive business opportunity - Enhanced productivity and yields in primary production - Good access to finance for initial investments	- Awareness raising activities to promote new business models carried out and advantages of their implementation highlighted - Upgraded primary production systems ensure sufficient supply of raw materials - VC actors supported in accessing financial resources on time
Output 3: New and improved pineapple products effectively commercialized in new and existing markets. Producers and processors gain access to local, regional and global markets	- No market for new and improved products - Lack of market success due to insufficient price competitiveness and restricted markets - Restrictions in enabling environment impede access to regional and global markets	Enabling environment International environment	Small	- Price competitiveness of value chain actors - Sufficient market outlet for value added pineapple products - Favourable enabling environment	- Thorough evaluation of market potential of pineapple products prior to initiation of project activities - Systemic competitiveness or the potential for it when supporting value chain actors assessed on time - Actions to improve enabling environment, implemented
Output 4: Linkages between value chain actors are strengthened, and collaboration amongst stakeholders is reinforced for a coherent	- Value chain actors are not willing to participate in multi-stakeholder platform - Multi-stakeholder	Beneficiaries Governance	High	- Value chain actors are interested and eager to cooperate with each other - Efficient and effective governance	- Awareness raising for advantages of associativity and cooperation undertaken - Effective and efficient governance

development of the pineapple sector	platform loses momentum after initial phase - Value chain stakeholders are not willing to cooperate with other actors due to lack of trust			structure for multi-stakeholder platform in place	structure for multi-stakeholder platform developed and implemented - Multi-stakeholder platform facilitates creation of trust between VC actors
Output 5: Capacity of support services improved to foster efficient value chain operation, and the enabling environment is conducive to the development of the pineapple sector and beyond	- Lack of investment in infrastructure for export competitiveness - Lack of interest of private sector actors in starting private support businesses - Insufficient capacities to operate Pineapple Innovation Hub	Beneficiaries Enabling environment Project management	Medium	- Sufficient funds for improving infrastructure for export competitiveness - Private sector actors are eager to invest and implement new business models - Qualified human resources available for operating pineapple innovation hub	- Public sector supported in investing in infrastructure for export competitiveness - New business models for private support businesses supported and advantages of their implementation underlined - International experts train local staff of Pineapple Innovation Hub and accompany establishment of Hub.

5. Conclusions

Within the scope of the 3ADI+ pilot project in Suriname, a participatory value chain diagnostic was carried out to analyse the strengths and weaknesses of the Surinamese pineapple sector. On the basis of the diagnostic findings, a 2030 vision for an upgraded value chain was proposed. Furthermore, business models for upgraded farming and processing operations, as well as an action and investment plan were developed for the Surinamese pineapple value chain.

The results from the analysis show that growing consumer demands for sustainable pineapple products have been evidenced on the international market over recent years and that the pineapple sector in Suriname possesses substantial potential. Suriname has suitable agro-ecological conditions for pineapple cultivation and a large diversity of local, unexplored pineapple varieties cultivated primarily by the indigenous populations. In addition, because pineapples in Suriname are, to the largest part, cultivated in traditional production systems without the application of chemical inputs, the Surinamese pineapple sector provides excellent opportunities for fulfilling demands for sustainable pineapple products on international niche markets.

Nonetheless, pineapple production in Suriname is in a rudimentary state and faces several obstacles. Most producers cultivate pineapples in a traditional way and apply little farm management and good agronomic practices. Knowledge on and experience in commercial pineapple production are limited and overall productivity and efficiency at the farm level are very low. In addition, pineapple production in Suriname is seasonal, which drives prices down during the harvest season.

Equally, the processing sector is at an incipient stage of development and in order to create value addition, substantial upgrading is required. Large-scale industrial processing has not been explored and there is only one company that has recently started processing pineapples for export. Due to the seasonality of pineapple production in Suriname, year-round processing is at present not possible without imports and, furthermore, the levels of technological development and innovation in the processing segment of the value chain are in general very low.

The development of the pineapple sector is also hampered by a lack of cooperation between different value chain stakeholders. Information on knowledge created, analysis carried out, activities undertaken, and initiatives planed are, in general, not widely disseminated and coherently communicated. In addition, also the infrastructure required for facilitating the development of the pineapple value chain is underdeveloped. High airfreight costs and complicated maritime connections hinder the competitiveness of Surinamese pineapples on the international market. In addition, no storage facilities, collection centres and cooling facilities exist that are necessary to increase efficiency and to maintain good quality and prolong the pineapple's shelf-life.

In this context, large investment in the pineapple sector is needed, which needs to be carefully and strategically planned, monitored and evaluated, to avoid adverse effects on the environment and on social structures. In order to facilitate the inclusive and sustainable development of the pineapple value chain in Suriname, an integrated development strategy to simultaneously tackle binding constraints has been developed by the 3ADI+ team in collaboration with representatives of ministries and local institutions, service providers, and actors at all stages of the value chain. The recommended activities include:

- The establishment of a multi-stakeholder platform to strengthen value chain cooperation and address key enabling environment challenges.
- The establishment of a Pineapple Innovation Hub to consolidate sector-wide knowledge and efficiently link value chain actors to support services.
- The set-up of private service businesses that support functions along the value chain.
- The development of different upgrading options for pineapple producers, and their validation and adjustment on demonstration plots at the Pineapple Innovation Hub.
- The development of plans and criteria for sustainable expansion of production areas.
- The aggregation of small holders and strengthen vertical and horizontal linkages through different mechanisms, such as the set-up of farmer associations and contract farming.
- The promotion of private sector investment in the establishment and improvement of processing facilities, including those owned and co-owned by groups of farmers, and support agri-entrepreneurs to access funding.
- The effective commercialization of Surinamese pineapples and pineapple products in new and existing markets.
- The development of capacities of public extension officers and enhance the public sector capacity for food safety and quality control.
- The facilitation of investment in infrastructure for export competitiveness.

Each activity is a collaborative effort and all activities are complementary, contributing to uplifting different segments of the value chain, the services that support the chain's operation, and the broader enabling environment, altogether constituting the holistic approach of a 3ADI+ development project. After a period of project support, the value chain is expected to continue on a sustainable development path, driven by the private sector and facilitated by the public sector.

Annex 1: Business Model Calculations – Current Production System

Table 1: TRADING ACCOUNT (SRD)

Year	0	1	2	3	4	5	6	7	8
Harvest (pineapples)	0	10,000	18,750	18,750	18,750	18,750	18,750	18,750	18,750
Sold (kg)	0	20,000	35,750	35,750	35,750	35,750	35,750	35,750	35,750
Revenue (SRD)	0	100,000	187,500	187,500	187,500	187,500	187,500	187,500	187,500
Operating Cost									
Land clearing and preparation	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Materials									
Diesel	65	130	195	195	195	195	195	195	195
Plants	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500	12,500
Total materials	12,565	12,630	12,695	12,695	12,695	12,695	12,695	12,695	12,695
Labor									
Planting	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750
Harvesting	0	3,750	7,031	7,031	7,031	7,031	7,031	7,031	7,031
Weeding	3,000	6,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Sales & marketing	1,500	3,000	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Management (inc. record keeping)	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Total Labor	23,250	31,500	39,281	39,281	39,281	39,281	39,281	39,281	39,281
Other expenses									
Maintenance & Insurance	60	60	60	60	60	60	60	60	60
Total Other costs	60	60	60	60	60	60	60	60	60
Safety margin	4,588	5,419	6,204	6,204	6,204	6,204	6,204	6,204	6,204
Total Operat. Costs	50,463	59,609	68,240	68,240	68,240	68,240	68,240	68,240	68,240
Trading Profit	-50,463	40,391	119,260	119,260	119,260	119,260	119,260	119,260	119,260
Trading Profit (USD)	$ (6,728)	$ 5,385	$ 15,901	$ 15,901	$ 15,901	$ 15,901	$ 15,901	$ 15,901	$ 15,901

Table 2: INVESTMENT COST SCHEDULE (SRD)

Year	0	1	2	3	4	5	6	7	8
Pick-up truck (5 yrs)	30,000	0	0	0	30,000	30,000	0	0	0
Hand tools (2 yrs)	1,000	0	1,000	0	1,000	0	1,000	0	1,000
Power tools (3 yrs)	6,000	0	0	6,000	0	0	6,000	0	0
Wheelbarrow (4 yrs)	1,500	0	0	0	1,500	0	0	0	1,500
Total Invest. Costs (SRD)	***38,500***	***0***	***1,000***	***6,000***	***32,500***	***30,000***	***7,000***	***0***	***2,500***
Total Invest. Costs (USD)	***5,133***	***0***	***133***	***800***	***4,333***	***4,000***	***933***	***0***	***333***

Table 3: ANNUAL STATEMENT OF COSTS AND BENEFITS (SRD)

Year	0	1	2	3	4	5	6	7	8
Investment costs	38,500	0	1,000	6,000	32,500	30,000	7,000	0	2,500
Incremental WC (ignored)	0	0	0	0	0	0	0	0	0
Operating costs	50,463	59,609	68,240	68,240	68,240	68,240	68,240	68,240	68,240
Sales Revenue	0	100,000	187,500	187,500	187,500	187,500	187,500	187,500	187,500
Net Cash Flow	-88,963	40,391	118,260	113,260	86,760	89,260	112,260	119,260	116,760

NPV (SRD)	74,367
NPV (USD)	9,916
IRR	87%

Annex 2: Business Model Calculations – Improved Production Practices

Table 1: TRADING ACCOUNT (SRD)

Year	0	1	2	3	4	5	6	7	8
Harvest (pineapples)	0	22,500	42,500	42,500	42,500	42,500	42,500	42,500	42,500
Sold (kg)	0	45,000	81,000	81,000	81,000	81,000	81,000	81,000	81,000
Revenue (SRD)	0	180,000	340,000	340,000	340,000	340,000	340,000	340,000	340,000
Operating Cost									
Land clearing and preparation	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000	13,000
Materials									
Organic manure	3,750	7,500	11,250	11,250	11,250	11,250	11,250	11,250	11,250
Organic foliar fertilizer	650	1,300	1,950	1,950	1,950	1,950	1,950	1,950	1,950
Organic pesticide	500	1,000	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Diesel	130	260	390	390	390	390	390	390	390
Plants	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Total materials	30,030	35,060	40,090	40,090	40,090	40,090	40,090	40,090	40,090
Labor									
Planting	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Harvesting	0	8,438	15,938	15,938	15,938	15,938	15,938	15,938	15,938
Applying fertilizer	1,500	3,000	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Applying pesticides	750	1,500	2,250	2,250	2,250	2,250	2,250	2,250	2,250
Weeding	1,500	3,000	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Sales & marketing	1,500	3,000	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Management (inc. record keeping)	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000
Total Labor	42,750	56,438	69,188	69,188	69,188	69,188	69,188	69,188	69,188
Other expenses									
Maintenance & Insurance	60	60	60	60	60	60	60	60	60
Professional fees (inc. ag innov hub)	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Total Other costs	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260	1,260
Safety margin	8,704	10,576	12,354	12,354	12,354	12,354	12,354	12,354	12,354
Total Operat. Costs	95,744	116,333	135,891	135,891	135,891	135,891	135,891	135,891	135,891
Trading Profit	-95,744	63,667	204,109	204,109	204,109	204,109	204,109	204,109	204,109
Trading Profit (USD)	$ (12,766)	$ 8,489	$ 27,215	$ 27,215	$ 27,215	$ 27,215	$ 27,215	$ 27,215	$ 27,215

Table 2: INVESTMENT COST SCHEDULE (SRD)

Year	0	1	2	3	4	5	6	7	8
Pick-up truck (5 yrs)	30,000	0	0	0	0	30,000	0	0	0
Hand tools (2 yrs)	2,300	0	2,300	0	2,300	0	2,300	0	2,300
Power tools (3 yrs)	6,000	0	0	6,000	0	0	6,000	0	0
Wheelbarrow (4 yrs)	1,500	0	0	0	1,500	0	0	0	1,500
Total Invest. Costs (SRD)	***39,800***	***0***	***2,300***	***6,000***	***3,800***	***30,000***	***8,300***	***0***	***3,800***
Total Invest. Costs (USD)	***5,307***	***0***	***307***	***800***	***507***	***4,000***	***1,107***	***0***	***507***

Table 3: ANNUAL STATEMENT OF COSTS AND BENEFITS (SRD)

Year	0	1	2	3	4	5	6	7	8
Investment costs	39,800	0	2,300	6,000	3,800	30,000	8,300	0	3,800
Incremental WC (ignored)	0	0	0	0	0	0	0	0	0
Operating costs	95,744	116,333	135,891	135,891	135,891	135,891	135,891	135,891	135,891
Sales Revenue	0	180,000	340,000	340,000	340,000	340,000	340,000	340,000	340,000
Net Cash Flow	-135,544	63,667	201,809	198,109	200,309	174,109	195,809	204,109	200,309

NPV (SRD)	154,739
NPV (USD)	20,632
IRR	97%

Annex 3: Business Model Calculations – Permanent and Year-Round Production

Table 1: TRADING ACCOUNT (SRD)

Year	0	1	2	3	4	5	6	7	8
Harvest (pineapples)	0	23,750	45,000	45,000	45,000	45,000	45,000	45,000	45,000
Sold (kg)	0	47,500	85,750	85,750	85,750	85,750	85,750	85,750	85,750
Revenue (SRD)	0	285,000	540,000	540,000	540,000	540,000	540,000	540,000	540,000
Operating Cost									
Land clearing and preparation	13,000	13,000	13,000	4,000	4,000	4,000	4,000	4,000	4,000
Materials									
Artificial flower induction agent	0	100	200	200	200	200	200	200	200
Organic manure	7,500	15,000	22,500	22,500	22,500	22,500	22,500	22,500	22,500
Organic foliar fertilizer	1,300	2,600	3,900	3,900	3,900	3,900	3,900	3,900	3,900
Organic pesticide	1,000	2,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000
Diesel	650	1,300	1,950	1,950	1,950	1,950	1,950	1,950	1,950
Plants	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000	25,000
Total materials	35,450	46,000	56,550	56,550	56,550	56,550	56,550	56,550	56,550
Labor									
Artifical flower induction	0	900	1,800	1,800	1,800	1,800	1,800	1,800	1,800
Planting	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500
Harvesting	0	8,906	16,875	16,875	16,875	16,875	16,875	16,875	16,875
Applying fertilizer	3,000	6,000	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Applying pesticides	1,500	3,000	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Weeding	1,500	3,000	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Sales & marketing	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Management (inc. record keeping)	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000	60,000
Total Labor	75,000	90,806	105,675	105,675	105,675	105,675	105,675	105,675	105,675
Other expenses									
Maintenance & Insurance	870	870	870	870	870	870	870	870	870
Professional fees (inc. ag innov hub	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200	1,200
Total Other costs	2,070	2,070	2,070	2,070	2,070	2,070	2,070	2,070	2,070
Safety margin	12,552	15,188	17,730	16,830	16,830	16,830	16,830	16,830	16,830
Total Operat. Costs	138,072	167,064	195,025	185,125	185,125	185,125	185,125	185,125	185,125
Trading Profit	-138,072	117,936	344,976	354,876	354,876	354,876	354,876	354,876	354,876
Trading Profit (USD)	$ (18,410)	$ 15,725	$ 45,997	$ 47,317	$ 47,317	$ 47,317	$ 47,317	$ 47,317	$ 47,317

Table 2: INVESTMENT COST SCHEDULE (SRD)

Year	0	1	2	3	4	5	6	7	8
Pick-up truck (5 yrs)	30,000	0	0	0	0	30,000	0	0	0
Irrigation system (5 yrs)	27,000	0	0	0	0	27,000	0	0	0
Artificial flower induction equipment	23,500	0	0	0	0	23,500	0	0	0
Hand tools (2 yrs)	2,300	0	2,300	0	2,300	0	2,300	0	2,300
Power tools (3 yrs)	6,000	0	0	6,000	0	0	6,000	0	0
Wheelbarrow (4 yrs)	1,500	0	0	0	1,500	0	0	0	1,500
Total Invest. Costs (SRD)	***90,300***	***0***	***2,300***	***6,000***	***3,800***	***80,500***	***8,300***	***0***	***3,800***
Total Invest. Costs (USD)	***12,040***	***0***	***307***	***800***	***507***	***10,733***	***1,107***	***0***	***507***

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