



Developing Sustainable Agricultural Sector in Suriname

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PREFACE

The work of Conservation International (CI) is premised on the connection between natural ecosystems and human well-being. In a developing country context, economic and societal gains, to be sustained, must be linked to the conservation of natural systems and the key services they provide, or as we say in brief, “People Need Nature to Thrive”. While CI is convinced the connection is strong, we also recognize that there are many other drivers of human well-being which are external to the relationship with natural ecosystems. For example, political context, investment strategies and conditions in the global economy are key factors, among others, that may mask the connections between natural systems and development success.

CI-Suriname contracted the International Institute for Sustainability to prepare the report on developing sustainable agricultural sector.

This Report presents alternatives to reconcile development with protection of natural resources and will explore opportunities for sustainable development of agricultural sector in Suriname.

I. EXECUTIVE SUMMARY

Sustainable increase of agricultural productivity is paramount for sustainable development. It is also key for avoiding deforestation when simultaneously meeting an ever increasing demand for agricultural commodities. In this report we introduce sustainable agriculture within international context of priorities to reconcile development with protection of natural resources. We then introduce rice sector in Suriname and present both quantitative and qualitative analysis for future alternatives for developing a sustainable rice sector. Finally, we present opportunities for greening the agricultural sector by developing organic farming. We review organic farming worldwide, present European Union legislation for organic farming and analyze opportunities for Suriname to develop organic agricultural sector for both domestic and external markets.

Suriname is in an extraordinary position to benefit from incentives to conserve forest carbon and biodiversity. Most of Suriname forests, which have not been deforested to large extents over the last decades, present top levels of both carbon and biodiversity. Suriname therefore may benefit from REDD+ funds that are expected to reach up to US\$ 40 billion per year. These incentives are a strong reason to pursue a sustainable pathway for agricultural expansion. This is also a unique opportunity for Suriname to demonstrate that it is possible to reconcile protection of precious natural resources with development. Moreover, recent increase in environmental awareness from private actors, such as the Consumer Goods Forum, mostly fuelled by increased awareness in final consumers, have pledged to remove from their supply chains products related to deforestation. The Consumer Goods Forum is an association that brings together over 400 retailers and manufacturers from 70 countries, with combined sales of US\$3.1 trillion and nearly 10 million people employed. The ability to access these markets that represent a substantial fraction of global agricultural trade, by pursuing a sustainable agriculture production without deforestation, would bring an important competitive advantage to Suriname goods.

Because productivity levels have a large impact on the demand for land from the rice sector, if rice productivity stagnates at current levels (approximately 4.2 tonnes per hectare), high production targets would mean that rice production area in Suriname would need to increase by more than 20.000 hectares by 2022. On the other hand an accelerated productivity increase combined with modest increases in production targets would mean that 10.000 hectares could be liberated from rice production. If productivity increase keeps pace with production targets, fifteen thousand hectares could be available for other crops after meeting production targets from the rice sector. This area is three times as large as the area currently occupied by vegetables and fruit crops in Suriname. Economic returns from these crops are on average ten times higher than returns from rice production.

Conflicts over land can be avoided as long as rice productivity does not stagnate at current levels, suggesting that Suriname already has enough land cleared for agriculture to meet ambitious targets from the rice sector and increase the area dedicated to higher value crops without deforestation (chapter 3).

Rice production has indeed a long tradition in Suriname dating back to the time when the country was a Dutch colony. To this day, the rice sector is one of the most important economic activities in the country compared to other economic sectors as well as within other agricultural products. In spite of substantial government support, the rice sector has faced a steady decline over the last 30 years. Currently rice farmers in Suriname use traditional flooding systems to irrigate their fields. There are two sowing periods with varieties that have 120-125 growing days and currently the new varieties released by ADRON have a growing period of 100 days. This allows for two harvests per year but the second sowing occurs during months of low precipitation, thus the need for supplementary irrigation.

Although it is well known that rice grows under flooded conditions, rice is unique from other major food crops in its ability to grow under a wide range of conditions depending on water availability, soil types and climate. Changing the irrigation system to a more aerated option has its tradeoffs. These systems can increase weed infestation and thus it is important to provide alternative control methods to farmers other than herbicides. On the positive side these methods improve soil aeration, which in turn improves biological soil activity and stimulates a much stronger and deeper root system of rice plants, which in turn improves the rate of fertilizer intake.

Two alternative irrigation systems: System of Rice Intensification (SRI), Alternate wetting and drying (AWD), are presented as potential alternatives to be tested in Suriname. These systems have been tested especially in Asian countries with promising results both in yield increases and in better environmental conditions. As agriculture is an extremely complex system, often adopting new practices or cropping technologies means that the farmers will need to learn new skills to deal with a different set of challenges that the new proposed system could bring. Farming can never be approached as a “one solution fits all” but rather as a flexible system that should offer a variety of alternatives to the farmers where they can choose the ones that suit them best. Aside from adopting a different irrigation system there are also cultural practices that can help improve the performance of the crop and optimize the use of water (sustainable crop intensification practices). These practices are in line with Rice Integrated Crop Management (RICM) systems and can also improve water efficiency. Improved varieties land leveling, seeding methods, improved soil organic matter content and mulching are presented.

In chapter 3 we also evaluated the potential effects that the adoption of three alternative agricultural practices could have for rice production in Suriname. These practices are components of integrated and resource management (ICM) package for rice production. They include: i) improved nutrient management, ii) planting of young seedlings, and iii) application of intermittent irrigation. Based on our cost-benefit analysis, it is shown that adopting the three ICM practices has a lower production cost (5% less) and generates twice as much net revenue as the conventional practice. Thus implementing sound sustainable farming practices may also generate higher economic returns to farmers while improving their environmental performance.

Organic farming offers an opportunity to contribute to greening of and simultaneously adding value to Surinamese agricultural sector (chapter 4). Organic farming may provide a wide range of economic, environmental and social benefits. Over the past two decades, global markets for certified organic products have grown rapidly, and sales are expected to continue to grow over the next years. While sales are concentrated in North America and Europe, production is global, with developing countries increasing their share of production and exports. By developing a framework to stimulate organic farming and by working with smallholder farmers, Suriname may benefit from an increased value of its national agriculture, create both alternative and higher incomes (also by investing in high cash products, such as açaí), offer an alternative path for rural people, create new job opportunities, achieve food security both in terms of provision and healthier products, among many other benefits. Recent initiatives, such as safe farming towards sustainable agriculture showed that there is a national interest in, and a market for more sustainable agricultural products. These projects and existing infrastructure (such as Centre for Agricultural Research - CELOS) may provide a starting point for the development of a national organic farming framework, for both raw and processed products (which can further contribute to increasing the value of the agricultural sector). Furthermore, the global market for organic products is likely to continue to expand, with global trade moving towards higher-quality products, demanding higher social and environmental standards.

In chapter 4 we also synthesize and analyze the EU legislation on organic farming and its implementations and we discuss legal requirements for imports to EU. We provide recommendation on compliance of Suriname organic farming with EU requirements. We conclude that, in order to enable penetration into the EU organic market, Suriname needs to develop high technical and legal expertise. These could potentially be acquired through cooperation with Certification Bodies recognized under the EU's equivalence scheme. To this end, liaison should be sought with regional, as well as European organizations, which could provide the necessary technical and policy-relevant know-how. Cooperation should be sought with countries recognized under the EU's equivalent country scheme. Although a range of opportunities to develop organic farming market in Suriname exists, there are some constraints to overcome, including: management skills for integrated land management are needed and capacity must be developed. Importantly, due to the lack of inputs to be used in organic farming, such as biopesticides and biological soil amendments, it is very difficult to grow organic, even if the desire exists. This limitation may however potentially become an opportunity for the country because it can promote the creation of such local industries, stimulate the economy and thus create job opportunities.

Although the development of an organic farming market in Suriname is challenging, time consuming and may incur some set-up costs, there is a potential to develop and establish a more sustainable, higher income agricultural sector.

II. INTRODUCTION

The development of a sustainable agricultural sector has been recognized globally by both developed and developing countries as of prime importance to achieve long term environmental, social and economic benefits. Although complex and often requiring active participation of a range of stakeholders, sustainable development can be found in governmental agendas worldwide. Indeed, within the last decades numerous scientific evidence and real-world environmental disasters demonstrated that if economic and societal gains are to be sustained they must be linked to the conservation of natural systems and the services they provide. In particular, sustainable increase of agricultural productivity has been proposed as key to meet future demands and protect natural environments (Foresight, 2011).

Although developing sustainable agricultural sector may be challenging there are various alternatives to arrive at the goal. In Figure 1 we present a selection of means with which development of sustainable agricultural sector can be promoted and stimulated, which will be examined throughout this Report.

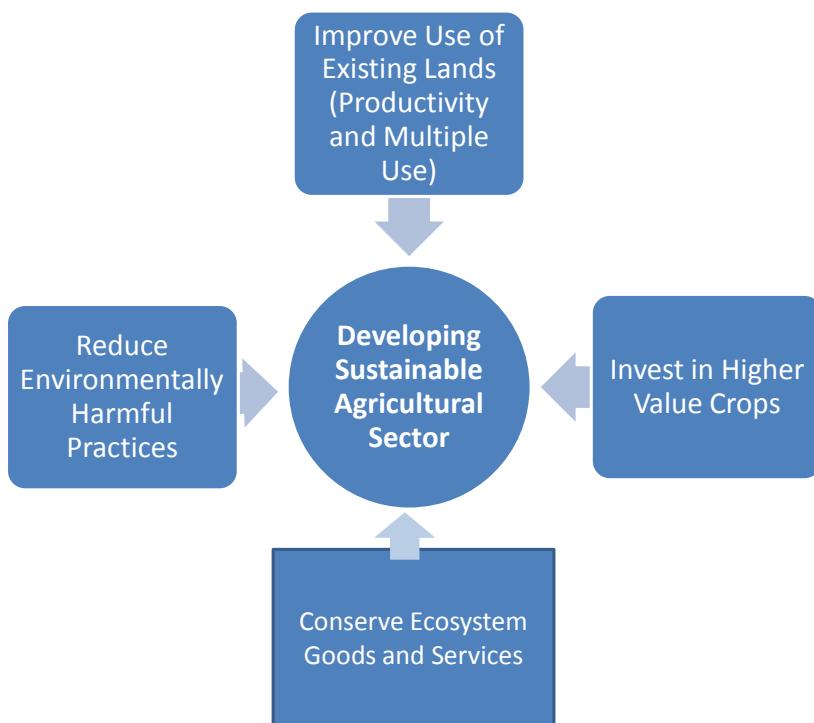


FIGURE 1. DEVELOPING SUSTAINABLE AGRICULTURAL SECTOR

The remainder of this chapter presents a brief overview of the importance of natural environments and their services for human wellbeing in general and agriculture in particular, with special attention to water-related services and payments for ecosystem services. In Chapter 3 we focus on the rice sector of Suriname (being the most important agricultural sector in the country) and present constraints and opportunities for developing a more sustainable rice sector, including a cost-benefit analysis of different alternatives and an

analysis of future land availability for rice and other higher value crops under different productivity scenarios. In the fourth chapter we analyze opportunities to invest in sustainable agriculture systems such as organic farming for both domestic market and for exports (in compliance with European Union legislation). We then formulate policy recommendations and a framework for development of sustainable agricultural sector in Suriname. We show that although challenging, investing in development of sustainable agricultural sector in Suriname results in long-term benefits for the environment, people and the economy.

1. AGRICULTURE AND THE ENVIRONMENT: TRENDS, CHALLENGES AND OPPORTUNITIES

According to FAO, world food production will have to increase 70% by 2050, in order to feed 9 billion people. This increase in demand is mainly driven by an increase in global population, by changes in consumption patterns and an increase of the demand of agricultural products for non-traditional industries (i.e. energy and biofuels, industrial, pharmaceutical/health) (Boehlje and Broring, 2011). The challenge to meet this increase in demand is further exacerbated by climate change and shrinking or deteriorating land and water resources (Smith et al., 2010). As a consequence, we need to produce more food with less inputs than currently used (land, water, energy, fertilizer and pesticides). However, agriculture is reaching, and in some geographies it has already reached, the maximum utilization capacity of productive inputs, especially those coming from natural resources.

The Green Revolution helped agriculture overcome physical and biotic constraints, such as insects, diseases and weeds, with unprecedented increases in production (Jozsef and Hantos, 2011). The combined effects of factors such as improved (high yielding) cultivars, soil cultivation techniques, chemical fertilization, pest control via synthetic pesticides and irrigation, helped world food production to double in the past 50 years. However the green revolution came at a cost: soil, water and air contamination; soil and water degradation; side effects on non-targeted species; loss of biodiversity and agrobiodiversity; deterioration of human health especially for small farmers, among other effects.

Investments in the agricultural sector can be a very powerful tool to reduce poverty and improve social conditions. The World Bank shows that economic growth originating in agriculture is twice as effective in reducing poverty as economic growth outside of agriculture (World Bank, 2010). Agriculture is also one of the economic sectors with the highest rates of job creation. Agriculture has many opportunities to offer both for poverty alleviation, improvement of livelihoods in rural areas, and climate adaptation and mitigation. Smallholder farmers produce a significant amount of the world's food of global agricultural production (50%; UN, 2011) and as much as 90% in Africa. These small farms support livelihoods of up to two billion people, or a nearly one-third of humanity. Women farmers are especially important as they produce 60-80% of the food in most developing countries and are the main producers of the world's staple crops—rice, wheat and maize—that provide 90% of the food consumed by the rural poor. Studies have shown that increases in income controlled

by women are more likely to be spent on food and children's needs, thus amplifying benefits (USAID, 2010).

The conversion of natural systems to agriculture leads to the loss of important benefits nature provides to human society. Some of these impacts occur at local levels, such as those related to water flow and quality (discussed briefly in the next section). Other impacts such as deforestation have both global and local impacts. Deforestation is the major driver of biodiversity loss globally, and the second major source of greenhouse gas emissions that are fuelling global climate change. For these reasons the international community has been searching for solutions to address these global impacts of local land-use change. The Rio Conventions on Climate Change and Biodiversity are the main intergovernmental *fora* for these discussions. Although progress has been slow over the last 20 years, expectations are growing that some binding agreements will be reached in the coming years.

One of the most promising tools to provide incentives to avoid deforestation is the Reducing Emissions from Deforestation and Forest Degradation (REDD+) mechanism being discussed within the UN Climate Change Convention (Strassburg et al., 2009). Under this mechanism, the international community would provide financial incentives for countries that reduce deforestation or degradation or conserve and restore their natural environments. These incentives would be based on the biomass carbon content of each ecosystem. There are currently discussions within the UN Biodiversity Convention on how to link incentives for biodiversity conservation into REDD+, as there would be substantial co-benefits between these services (Strassburg et al., 2012).

Suriname is in an extraordinary position to benefit from incentives to conserve forest carbon and biodiversity. As shown in figure 2.1 taken from a global assessment of carbon and biodiversity congruence, most of Suriname forests present top levels of both carbon and biodiversity (dark green areas). So-called "early-action" REDD+ finance is already being paid mostly through bilateral agreements, and REDD+ funds are expected to reach up to US\$ 40 billion per year (Strassburg, 2009). These incentives are a strong reason to pursue a sustainable pathway for agricultural expansion through the routes discussed in the previous section. In addition to economic incentives, there are crucial environmental arguments to protect natural environments in Suriname, such as mangroves. Indeed, according to expert opinion there is a risk of encroachment into the mangroves, which are vital for providing environmental services. They are also paramount for protection against extreme weather events (Costanza et al., 2008), which are predicted to escalate in the future. For example, Costanza et al. (2008) showed using regression model that coastal wetlands reduce the damaging effects of hurricanes and serve as valuable, self-maintaining 'horizontal levees' for storm protection. Restoration and preservation of coastal wetlands is an extremely cost-effective strategy for society (Costanza et al., 2008).

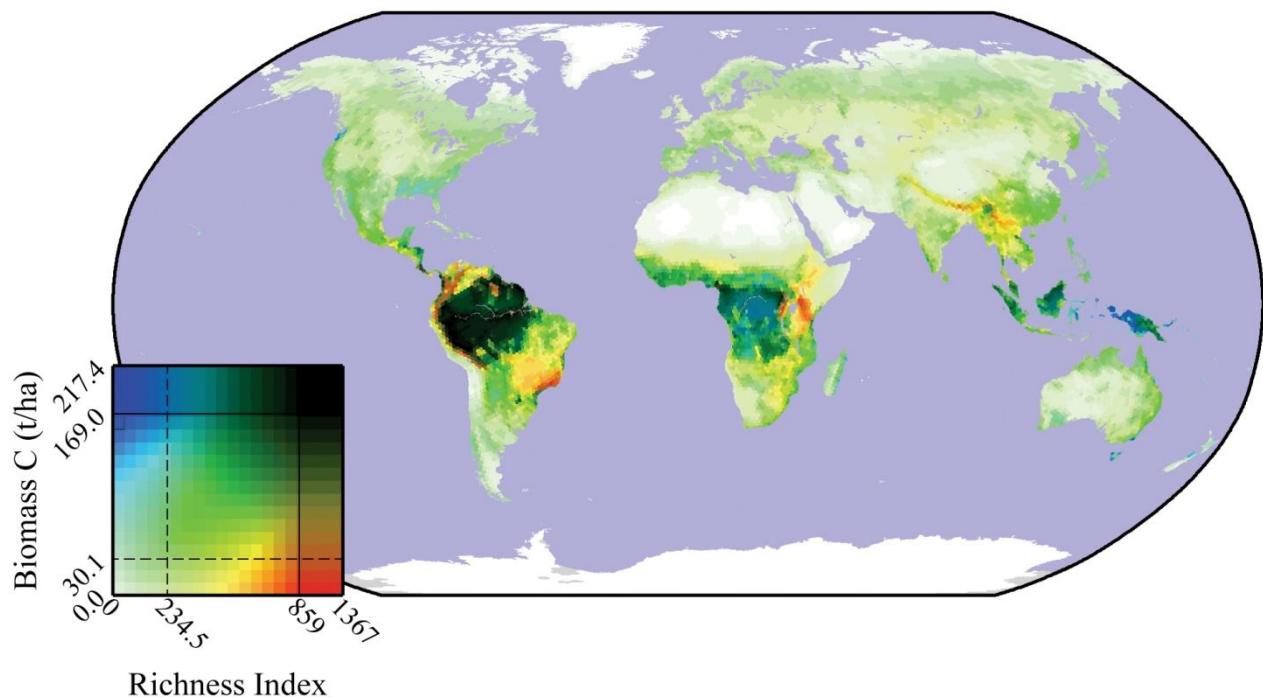


FIGURE 2.1 SOURCE: STRASSBURG ET AL., 2010

Another recent development in this context is the increase in environmental awareness from private actors, mostly fuelled by increased awareness in final consumers. One example is the Consumer Goods Forum, an association that brings together over 400 retailers and manufacturers from 70 countries, with combined sales of US\$3.1 trillion and nearly 10 million people employed (CGF, 2012). These companies, that represent a substantial fraction of global agricultural trade, have recently pledged to remove from their supply chains products related to deforestation before the end of this decade. The ability to access these markets by pursuing a sustainable agriculture production without deforestation would bring an important competitive advantage to Suriname goods.



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2. ECOSYSTEM SERVICES AND SUSTAINABLE AGRICULTURE

Ecosystem Services can be defined as "the benefits people obtain from ecosystems" (MEA, 2005). Ecosystem services have now become the central tool to express humanity's need for the rest of living nature. They have been classified in a number of different ways. The most commonly cited one is from the Millennium Ecosystem Assessment (MEA), reproduced in Figure 2.2. The box on the left represents the four categories of ecosystem services from the MEA. The box on the right illustrates the constituents of human well-being. The arrows between them illustrate how ecosystem services affect human well-being.

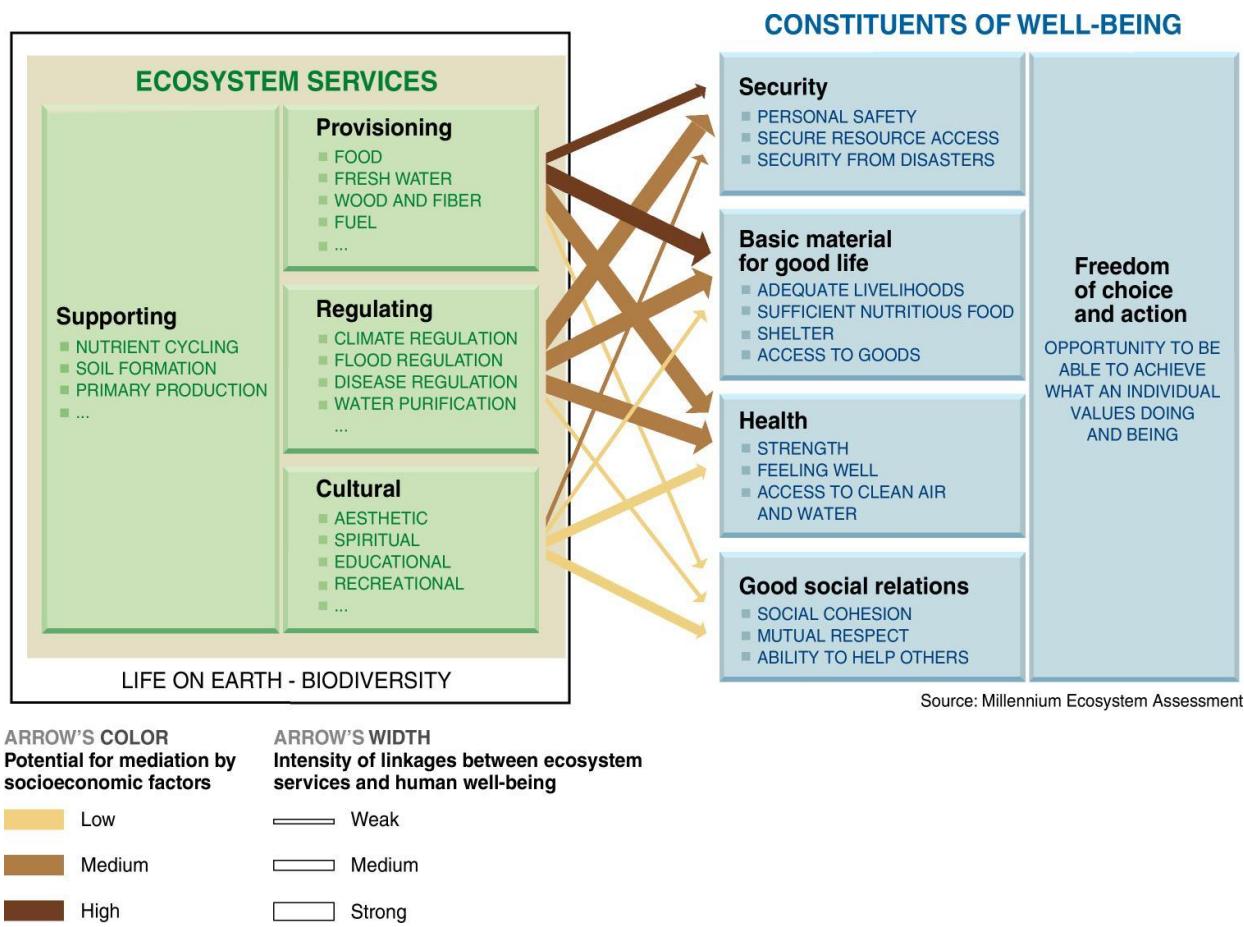


FIGURE 2.2 SOURCE: MEA, 2005

The ecosystem services concept provides a useful way to establish relations between agriculture and nature. Agriculture is related to nature mainly through six major direct ecosystem services: water supply, soil fertility and nutrient cycle, pollination, genetic resources, climate, pest and disease control. However, not all direct and indirect ecosystem services will be relevant for a specific area or region. Their relevance depends on the types of crops being grown and the dependency of the households on indirect services. Given Suriname's position as one of the world's most important countries in terms of water supply and the weight of the water-dependant rice sector in Suriname's agriculture, this section will examine in greater detail the water-related ecosystem services.

Freshwater provides a myriad of benefits including water for drinking, irrigation in agriculture, habitat for fish for consumption, birds and other wildlife, and the dilution of pollutants. However, only a small portion of earth's water wealth consists of liquid water that is good enough to drink or grow crops. Of the total volume of water on the planet, only 2.5% is fresh but two-thirds of that is locked in glaciers and ice caps. Human demands for water has been increasing over the last decades as a result of population growth, changes in diets, higher levels of consumption and, on account of future predictions, demand for freshwater will further increase. In a recent report (Kaufman, 2012) hydrologists warn that water tables are dropping across Asia while in Nebraska, the Ogallala aquifer under parts of the midwestern United States is declining at an alarming rate. The implications are severe: the destruction of aquatic ecosystems, the extinction of innumerable species and the risk of regional and international conflicts. The value of freshwater and numerous threats to them strongly suggest a need for a major international effort to prevent further degradation.

Water is a key resource for agriculture as this sector alone accounts for the use of around 70% of all fresh water resources in the world. Water demand from rice can be as high as two to four times that of other crops. For countries whose agroclimate conditions are close to the tolerance limits of the crops being farmed, there will be an increased demand of inputs. Currently, Suriname is perceived to have a surplus of fresh water. However, empirical observations indicate that the need to supplement water during dry periods has been increasing (personal interview water board). Furthermore, increased water demand could also come from other economic sectors and especially human consumption.

The practice of flooding rice fields produces other side effects that have overall negative impacts on rice production and on human health and soil fertility. Some of these effects include:

- Increased use of pesticides (especially fungicides and bactericides);
- Increased soil compaction: soils that are oversaturated with water are more susceptible to be compacted during mechanization processes. This in turn reduces the air content of the soil which in turn reduces the capacity of the plant to produce a healthy root system;
- Increased use of herbicides: the flooding irrigation system in rice fields is combined with a random seeding of plants that makes it impossible to control weeds through mechanical means;
- Increased use of fertilizers: nitrogen is a very permeable element in any soil. Thus it tends to wash off with excess water. In a flooding system, farmers need to increase both the intensity and frequency of application, so nitrogen is readily available for plant growth.

An interesting tool related to ecosystem services are the "payments for ecosystem services" (PES) schemes, which put value on natural resources in order to incentivize the protection of resources. PES projects aim to provide financial incentives to land owners or managers for implementing conservation actions that they would not have adopted without those incentives. For example, the world's largest and longest (began in the 1950s) running PES program is the United States Conservation Reserve Program, which pays about \$1.8 billion a year under contracts with farmers and landowners of environmentally-sensitive land (with high risk of erosion). Originally, the program called for three-year contracts in which the government would pay for land improvements that increased soil, water, forestry, or wildlife quality if the farmer would agree not to harvest or graze contracted land. One of the most important benefits provided by CRP was the improvement of water quality due to the reduction of erosion and runoff reaching water bodies (runoff materials from agricultural lands included chemical fertilizers, nitrogen, phosphorus, and sediments). Filter strips and buffer strips along the edge of agriculture fields intercepted the runoff materials and keep them from leaving the field.

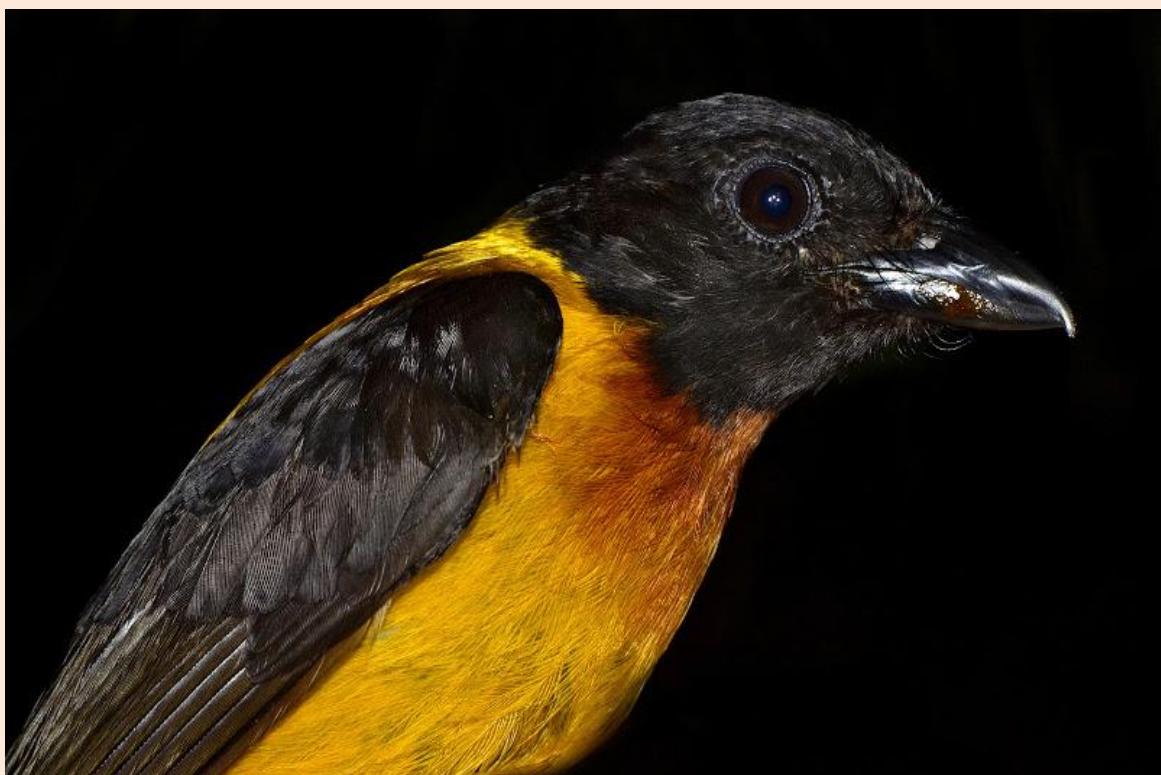
PES schemes can be an interesting option to incentivize an adequate use of water resources in Suriname. Box 1 presents an example of payments for water services in practice, while table 2.1 summarizes some water-related PES schemes currently being implemented around the world.

Box 1. PES for water - Honduras - Jesus de Otoro

The Payment for Environmental Services scheme in the town of Jesus de Otoro compensates upstream landholders for conserving forests and for adopting better environmental practices. The creation of the local NGO Council for Administration of Water and Sewage Disposal (JAPOE) was a response to serious problems of water access and quality that Jesus de Otoro faced at the beginning of the 1990s. There were many conflicts between downstream residents concerned about pollution of drinking water supplies and upstream coffee producers. The downstream community resorted in 1996 to destruction with machetes of coffee seedbeds of upstream producers, arguing that this activity of upstream producers was the main source of water pollution. In 2001, the Program for Sustainable Agriculture in Hillsides of Central America (PASOLAC), financed by Swiss international cooperation, proposed to the JAPOE the establishment of a payment scheme for environmental services in the watershed, and provided a seed fund of US\$4,000. The scheme is meant to reduce water pollution, mainly by promoting the adoption of more environmentally friendly agricultural practices upstream (no burning before, during or after planting; use of vegetation fences; irrigation ditches and terraces; establishment of agroforestry systems; production of organic fertilizers; recycling of coffee pulp and management of wastes from coffee processing; implementation of organic agriculture or agroforestry systems).

Willingness to pay within PES schemes is driven by the fact that the costs associated with adverse consequences of some activity are much higher than incurring smaller costs to prevent these activities. Indeed, a survey among water users downstream (100 users) showed that the average income per household is \$275 per month and 57% of them drink water directly from the tap. Forty-three per cent of the water users downstream are aware of the PES programme and 72% agreed that the payment (US\$0.06 per household) is fair. Almost 80 per cent of households believe that the quality of water has improved in the past two years, however the survey did not examine whether it was due to PES or not.

	WATER-RELATED ECOLOGICAL SERVICE PROVIDED	SUPPLIER	BUYER	INSTRUMENTS	INTENDED IMPACTS ON FORESTS	PAYMENT
Self -organized private deals	<i>Costa Rica: FONAFIFO and hydroelectric utilities payments for watershed services</i>					
	Regularity of water flow for hydroelectricity generation	Private upstream owners of forest land	Private hydroelectric utilities, Government of Costa Rica and local NGO	Payments made by utility company via local NGO to landowners, payments supplemented by government funds	Increased forest cover on private land, expansion of forest through protection and regeneration	Landowner who protect their forests receive US\$ 45/ha/year, those who sustainably manage their forests receive US\$70/ha/year, and those who reforest their land receive US\$ 116/ha/year
	<i>France: Perrier Vittel's payments for water quality</i>					
Trading schemes	Quality drinking water	Upstream dairy farmers and forest landholders	A bottler of natural mineral water	Payments by bottler to upstream landowners for improved agricultural practices and reforestation of sensitive filtration zones	Reforestation but little impact because program focuses on agriculture	Vittel pays each farm about US\$ 230/ha/year for seven years. The company spent an average of US\$ 155,000 per farm or a total of US\$ 3.8 mln
	<i>United States: Nutrient trading</i>					
	Improved water quality	Point source polluters discharging below allowable level, non-point source polluters reducing their pollution	Polluting sources with discharge above allowable level	Trading of marketable nutrient reduction credits among industrial and agricultural polluting sources	Limited impact on forests, mainly the establishment of trees in riparian areas	Incentive payments of US\$5 to US\$ 10 per acre
<i>Australia: irrigators financing of upstream reforestation</i>						
	Reduction of water salinity	State Forests of New South Wales (NSW)	An association of irrigation farmers	Water transpiration credits earned by State Forests for reforestation and sold to irrigators	Large-scale reforestation including planting of desalination plants, trees, and other deep rooted perennial vegetation	Irrigators pay \$40/ha/year for 10 years to the State Forests of NSW, a government agency that uses revenues to reforest on private and public lands, keeping the forest management rights.



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III. SUSTAINABILITY IN THE RICE SECTOR

The focus of this chapter is to understand production patterns and current production costs and benefits (both public and private), and compare them to the production costs of alternative technologies and identify potential improvements, specifically related to improved water usage for rice production. We will also attempt to identify key constraints for adopting alternative production techniques and offer ideas for overcoming these constraints.

Suriname's economy is highly dependent upon the extraction of non-renewable natural resources- mainly gold, oil and bauxite. Mining, agriculture and fisheries accounted for 17.3% of GDP in 2008. Employment is dominated by the public sector, which accounts for 40% of the workforce followed by the tertiary sector. Overall the country has a positive balance of payments with an export value larger than imports. GDP growth has been steady at an average annual rate of 4% since 2001, with a minor setback during 2007-09, and a low percentage of foreign debt.

TABLE 3.1. CONTRIBUTION OF ECONOMIC SECTORS TO GDP, SURINAME - 2011

Industries of origin	GDP (In 1000 SRD)
Manufacturing	1,532,061
Mining and quarrying	939,205
Wholesale and retail	776,163
Agriculture, animal husbandry and forestry	375,211
Construction	336,177
Electricity, gas and water	309,193

Source: ABS 2010 In Rao Consultants, 2011

Mineral resources, which have been the basis of Suriname's economy, are considered non-renewable and thus will be exhausted in the long-run. As mineral resources continue to be exploited, the government should actively seek to invest in other, more sustainable sectors, especially those sectors where the country has accumulated specific knowledge and traditions. This is the case of rice which is the most important agricultural product and the most successful agricultural export in Suriname. The vast majority of the land devoted to agriculture is used for rice (88%), followed by banana, oranges, vegetables and coconuts.

Agriculture has the potential to contribute more to employment creation than mining, while also providing export opportunities and additionally food security (World Bank, 2010). Thus, it is not surprising that the government of Suriname has provided continuous support for this sector and, in the past decade, has tried to stimulate its growth.

1. OVERVIEW OF WORLD RICE MARKET

Rice is one of the three most important grains consumed throughout the world (the other two are wheat and maize). Historically, global demand has expanded at the same rate as population growth. For many developing countries, rice self-sufficiency is a strategy for achieving food security and thus trade is considered a residual option. In spite of trade liberalization efforts, rice continues to be one of the most protected commodities in both developed and developing countries. It is not unusual to see some countries shift from being net exporters to net importers, depending on the outcome of their own production annual production. According to Calpe (2004), governments have several policies to protect the supply and the production of rice within their boundaries. These measures can include minimum price programs, government-owned stocks, export limitations, and a centralized government-owned trading agency. In high-income countries the sector has been isolated (OECD, 2012) through outright import prohibitions, state trading monopolies, minimum import quotas, high tariffs or variable duties. In the 1980s, the volume of traded rice represented only 4% of total global production. Traded volume grew by only 2% annually from 1961 to 1989, but increased to 6% in the 90's and reached 7% during 2000-03. This increase is due to the growing reliance on imports from countries in Africa and the Near East where imports represent 40% of domestic demand. For Central American and Caribbean countries, 50% of their consumption comes from imports.

World prices, in real terms, have had a distinct declining tendency of about 3% per year since 1960. However, rice prices were much more volatile than maize or wheat for the same period (since 1960) but this variability has been decreasing over time. The price decreasing trend has remained constant for the last 30 years, except for the period 2007-09, when the price of major grains suffered a severe increase. The United Nations Food and Agriculture Organization (FAO) reports that the possible causes for this rise include: levels of world cereal stocks; crop failures in major exporting countries; rapidly growing demand for agricultural commodities to make biofuels; and rising oil prices. As prices increased, other factors exacerbated the increase in prices: government export restrictions, a weakening US dollar and speculation as well as index funds for wider commodity portfolio investment. This unexpected increase could corroborate the perception that the international rice market is highly distorted, segmented, thin, and volatile.

In spite of this high variability in the market, world demand is not very responsive to changes in price and income. Rice is a highly valued commodity for the very poor and they will resort to adaptation strategies to be able to cover the increased cost of their typical diet. Annual average per capita consumption is around 57.3kg, which is expected to remain stable at 68kg for developing countries and 13kg for developed countries (FAO, 2009).

The four leading exporting countries include Thailand, India, Vietnam and the United States. There is no geographical concentration of rice imports to specific countries. Broken down by regions, Asia dominates imports followed by Africa. Rice is a highly fragmented market as there are no leading producers or processing companies but rather small and medium size

producers dominate the market. Four varieties can be distinguished: Indica, leading the market with 75% of exports, Japonica and Aromatic, which have over a 10% market share each, and finally Glutinous which represents 1% of total exports.

2. INDUSTRY OVERVIEW AND RECENT TRENDS OF RICE PRODUCTION IN SURINAME

Rice production has a long tradition in Suriname dating back to the time when the country was a Dutch colony. To this day, the rice sector is one of the most important economic activities in the country compared to other economic sectors as well as within other agricultural products. In terms of cultivated area, contribution to GDP (3% in 2002), foreign exchange earnings (approximately USD\$14 million in 2002) and direct employment (8,000 jobs in 2002) rice is the most important crop in Suriname (Poerschke, 2005).

Suriname presents agroecological conditions that are favorable for rice production, especially in the north. In this region, the average monthly temperature is around of 25-26°C during January and February and 27-28°C from August to October. There are no major differences between average monthly maximum and minimum temperatures which imply that there are no risks of frost. There are two rainy seasons, the first occurring from April to August with a median rainfall of 1005mm, and the second from November to January with median rainfall of 375mm (Rees et al., 1994).

Production has been traditionally concentrated in the Nickerie district accounting for more than 75% of productive land dedicated to rice, followed by Saramacca with around 10% and Coronie with approximately 7%. This distribution has experienced minor annual variations over the past 10 years. With regards to land ownership, over 80% is under hereditary long-term lease or land lease, less than 10% is rented, and less than 5% is owned as allodial property. 12,000ha are farms of 1-12ha and 18,000ha are farms of over 250ha (Rees et al., 1994).

GOVERNMENT SUPPORT

The rice sector has traditionally been an important economic activity for Suriname and this is reflected in the amount of support it receives from various government agencies. The major provider of services for the sector is the Ministry of Agriculture, through extension and education, research (through ADRON), water management/irrigation, standardization and quality control (which was performed in the past for wet paddy, but has been suspended as of this report). The Ministry of Finance collects taxes on rice exports and re-directs the majority of this revenue to the rice research institute (ADRON). It also provides a fuel subsidy established at 125 liters of fuel per hectare. In 2006 this subsidy amounted to USD\$1,703,240 and benefited 1,270 farmers. The Ministry of Transport, Communication and Tourism (TCT) is in charge of managing the country ports, which for the case of rice, the most important are the ports in Paramaribo and Nickerie. The Ministry of Public Works (OW) is in charge of

maintaining all main waterways, roads, bridges, sluices, etc. The Ministry of Regional Development coordinates and supervises different departments in the districts thus its function is mainly administrative. One of its responsibilities is the management of tertiary infrastructure (minor roads and trenches) and it is also responsible for providing administrative assistance to the recently established “water boards modern style”. The Ministry of Trade and Industry (HI) is mainly in charge of issuing trading licenses for establishing processing units, import of inputs (agrochemicals and machinery), and export of rice. It is also responsible for negotiating trade agreements mainly with the EU, CARICOM and relations with the World Trade Organization (WTO). Finally, the private sector, through the banking system, provides support through finance for farm investments and to cover the production costs during the growing season (Graanoogst and Grijpstra, 2007).

RECENT TRENDS

In spite of this substantial government support, the rice sector has faced a steady decline over the last 30 years. Rice production in Suriname reached its peak during the mid 80s and since then the sector has had small recovery periods but with a clear downward trend. If we compare the 2007 situation it only represents 69.5% and 64.8% of the production volume and harvested area reached in 1980 and, more dramatically, only 59.3% and 56.3% of the 1985 levels. This constitutes an average decline of a little over 2% per year both in terms of production volume and harvested area for the period between 1980 and 2007 (Figure 3.1).

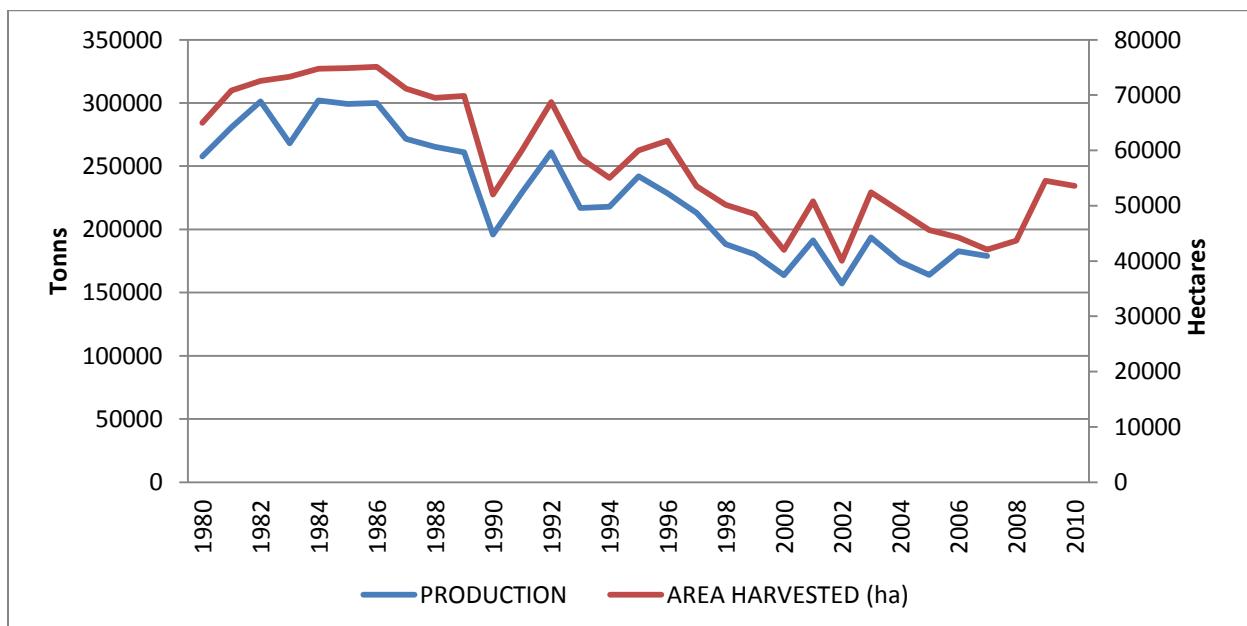


FIGURE 3.1: ANNUAL AREA HARVESTED AND TOTAL PRODUCTION VOLUME (1980-2010) Source: FAO statistics

This situation is even more dramatic if we consider export volumes. In this case export volume in 2007 only represents 16.7% of the level reached in 1980 but when compared with 1985, which records the highest exported volume of the period under analysis, 2007 represents only 12.3% of the volume exported in 1985. This accounts for a dramatic average decline of a little over 12% per year on exported volume for this commodity (Figure 3.2).

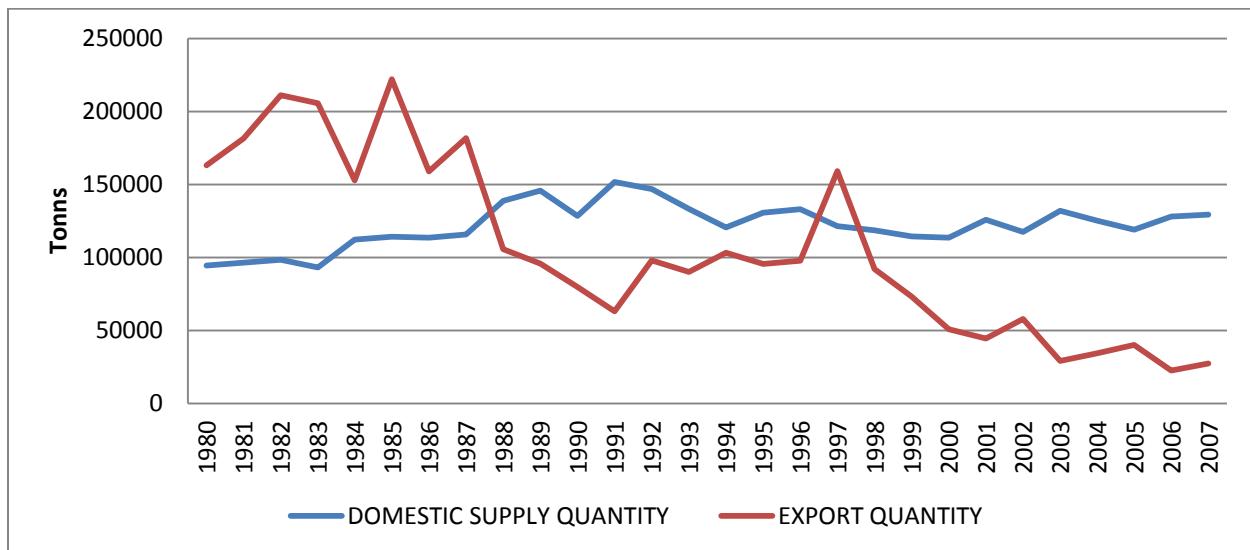


FIGURE 3.2: DOMESTIC CONSUMPTION VERSUS EXPORTS, VOLUME (1980-2007) Source: FAO statistics

With respect to local consumption, it has grown at an average annual rate of 0.8%, although this growth is not constant for every year and there are periods where domestic demand shows a noticeable decline or increase, with respect to a previous year, that one would not expect to see with staple products such as rice (Figure 3.2).

Annual yield has remained somewhat constant at 3.8 tons per hectare with a modest increase during 2006 and 2007. Here the sector also shows a decreasing, although less dramatic, trend (Figure 3.3). This average yield is far from reaching the potential yield of 6-7tons/ha of the varieties currently produced in Suriname.

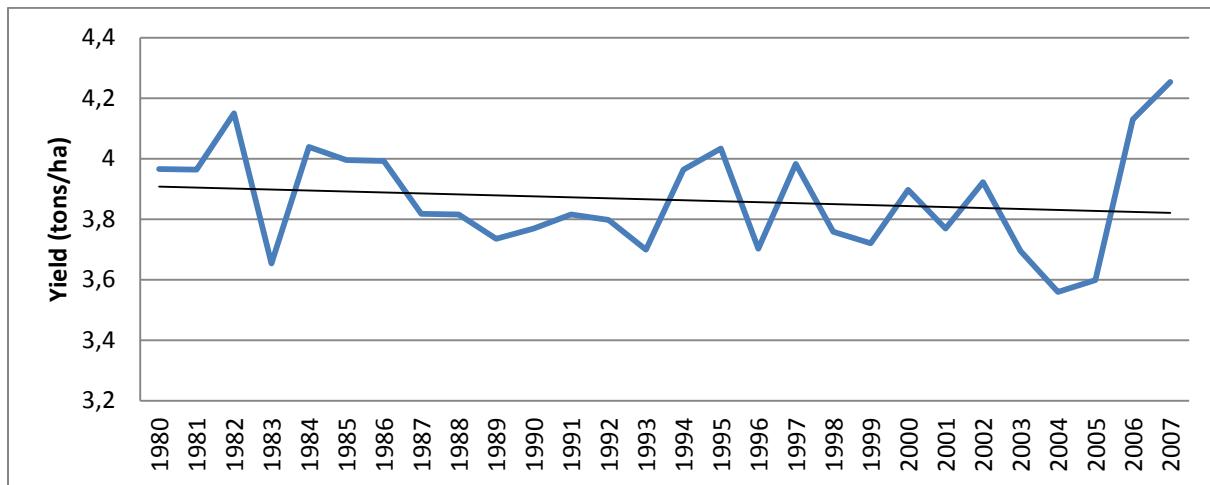


FIGURE 3.3: AVERAGE ANNUAL YIELD, 1980-2007. FAO statistics

KEY FACTORS

Although this report is mainly focused on farming practices and more specifically related to water management and rice production, the following section provides a brief overview of key issues that have contributed to the declining trends described above. It is important to take a holistic approach when designing a supporting program for the rice sector as most of these factors are interrelated and tend to have either positive or negative influences over other conditions that may seem unrelated. Thus we encourage the government of Suriname to take all these factors into account when designing action plans to stimulate the rice sector.

Exports: Suriname has traditionally exported its rice to two markets: 1) Europe, mainly through the Netherlands; and 2) the Caribbean countries, mainly through Martinique and Guadalupe, during the 90s. More recently, Suriname has explored other markets in Latin America (Poershke, 2005). While Europe has been increasingly more open and transparent in trading around the world, this has had a negative impact on Suriname through the reduction of its preferential access to this market and an increased competition from other exporting countries within the EU market. In 2004 Europe lowered its import tariffs on husked and milled rice. Prior to this year, Suriname was part of the EBA (everything-but-arms program) of the EU, which gave preferential treatment to less developed countries (LDCs) through a small duty-free access of rice to this market (Calpe, 2004). The EU has also been increasing the quality standards for most of the agricultural products that enter its market, including rice. Thus Suriname has been facing higher competition from other exporting countries and higher quality demands from the European market. This pressure for higher quality standards is not exclusive to the EU but a global trend as well. In 2003, CARICOM countries implemented a regional rice standard for both local and export markets in the region. Suriname ratified these standards but only applies them to exports and formal legalization is still pending (Graanoogst and Grijpstra, 2007). When Suriname had preferential access to the EU, this agreement did

not include quality specifications. This has had negative consequences for the country since Suriname does not have a price differential or an organized processing that can reward farmers for improved quality. Today millers mix different varieties and qualities during their processing and farmers have no stimulus, through higher prices, to increase the quality of their produce or sow specific varieties demanded by the market.

Processing: This increased quality pressure is coupled with sub-optimal conditions of the polishing sections of most processing companies in Suriname. According to Elmont (2010) the rice sector, and more particularly, the milling subsector suffer from several factors that have contributed to the deterioration of the sector, including: underutilized milling capacity, leading to higher processing cost that leads to uncompetitive products in the international market; no value added to rice and rice by-products; waste of rice production barely utilized; and, lack of structured product development research.

Infrastructure: Traditionally the Nickerie port was used for rice exports. However, due to its deteriorating conditions most exports now take place from the Paramaribo port, which translates into increased transport costs. The irrigation system (both with respect to maintenance and building of new infrastructure), and the administration of this key service to the farmers also represents a limiting factor that contributes to the sector's current challenges (Mertens, 2008). This point will be further elaborated in the coming sections.

Access to credit: Suriname has weathered at least two economic crises in its recent past (in 1995 and 2005 the country experienced hyperinflation). The regional banking system finances farm investments and seasonal credits to cover production costs for one growing season. A survey carried out by SPMU in 2007 reveals that financial sources are: banks, relatives (generally living overseas), own farm money, millers (mainly through supply of fertilizers and pesticides in exchange for buying the harvest), and NGOs. Harvest insurance and farm machinery insurance do not exist. High interest rates (currently between 12 to 13%) have increased farmer defaults and have reduced the level of investment on farm equipment for the past 15 years. This recession resulted in all main machinery suppliers closing their shops, including repair shops and spare part supply. Most of the machinery found on farms today could be considered obsolete and past its usable life span (Graanoogst and Grijpstra, 2007). Since then, the government has provided short term interventions in the form of reduction of debt, new flexible credits, and diesel subsidies which have helped farmers with short term cash flows but have not addressed the true causes of the sector's decline (Poerschke, 2005).

Research and extension: Current activities of ADRON include seed breeding and production, research on crop management and post harvest practices, extension services to seed farmers, and an information center for paddy producers. One of the key limitations that farmers have is access to certified seed. Breeding programs have helped increase production from 4.1 to 4.7 tons/ha of wet paddy. ADRON is helping small farmers produce certified seed. However, in 2007 only 400ha were planted for seed production and the expectation is to have 1000ha planted for seed as ADRON estimates that this extension would cover current demand. To this end, ADRON has supported the establishment of a Seed Growers Association. The biggest limitation for the expansion of the program is lack of processing

facilities and certification of seed. A Seed Act was ratified by the government in 2005. However international procedures require clear policies on Breeder's Intellectual Rights (i.e. to be able to brand a seed line as a commercial variety) before it can be enacted (Graanoogst and Grijpstra, 2007). The Ministry of Agriculture is responsible for providing technical assistance and technology transfer to the farmers, i.e. an extension program. This type of assistance has been weakening over the last 30 years.



ADRON EXPERIMENTAL FIELD. PHOTO: BERNARDO STRASSBURG



ADRON EXPERIMENTAL FIELD. PHOTO: BERNARDO STRASSBURG

Farmers' organizations: During the 70s the Ministry of Agriculture was actively promoting farmers' cooperatives. However several factors have contributed to the decline and limited cooperation, including: fraud from members of the board of directors; absence of clear organizational objectives; economic decline in the sector leading to a climate of uncertainty about the future; centralized government structure; lack of education among board members and participants; and government cutting investment in organizational development (Zalmijn, 2006). In 1992, coordinating and steering institutions for the commodity chain (the State Rice Commission and SUREXCO) were dismantled out of pressure that came from the exporters association or millers association (Graanoogst and Grijpstra, 2007). In 2001 an effort was undertaken to establish the SPBA (Surinaamse Padie Boeren Associatie) but found obstacles to its successful operation. The government of Suriname wanted to organize farmers, millers/exporters, input suppliers, service providers, bankers, rice research into one structure: The Rice Board. However, it is highly unadvisable to incorporate members with high heterogeneity into one single group. In other words, groups that are highly successful in their operation are those that include members that share common characteristics with regards to economic and social status, economic activity, education, etc. Currently there is only one farmers' association SPBA with 800 active members but only 400 are up-to-date with paying the required fees.

CURRENT RICE PRODUCTION SYSTEM IN SURINAME

Currently rice farmers in Suriname use traditional flooding systems to irrigate their fields. Until the 60s there was only one growing season per year and at that time water boards played an important role in maintaining waterways. In fact this maintenance was mandatory and included in land-lease agreements. Farmers gradually started to skip this responsibility with the introduction of a double cropping system. Currently there are two sowing periods of 6 weeks each with varieties that had 120-125 growing days and currently the new varieties released by ADRON have a growing period of 100 days. This allows for two harvests per year but the second sowing occurs during months of low precipitation, thus the need for supplementary irrigation.

Having the two growing seasons so close together results in poor soil tillage between crops. It is likely that this has resulted in an increase of red rice infestation. In the 80s, the practice was to dry the fields after sowing to encourage prompt germination but, as of 2007, farmers were leaving their fields flooded as a means to help them control red rice. Red rice infestation could be so severe as to account for 30% of the harvested volume which was reported on at least one occasion causing a shipment to be banned from export. The use of flooding to control red rice could have its negative consequences such as poor stand establishment as a result of reduced growth, uprooting and drifting. Another weed control method that the farmers are currently using is mainly chemical. However, this type of control can derive in the buildup of weed tolerance to these pesticides which, according to Suriname experts, is starting to happen. Water management practices for weed control have also resulted in increased problems with snails (Rees et al., 1994). Flooding rice fields as means for weed control prevents farmers from using mechanical means for weed control. Mechanical controls usually resort to mechanical eradication of weed seedlings. The basis of such control is to reduce the amount of weed plants that mature and produce seeds and thus help spread their population.

The use of fertilizer has increased over time. Sowing one single crop period after period tends to deplete soil nutrients. The soils in Suriname tend to have a good level of phosphates. Recent soil tests show that phosphate content has decreased over time. With respect to nitrogen, farmers are using high doses up to 400kg/ha in 2 or 3 applications per growing cycle. ADRON recommends application rates between 180-260kg/ha (Rees et al., 1994)

The use of flooded fields has both beneficial and negative effects. It is very effective for weed-control, as previously discussed. A constant water layer could also have stabilizing effects against weather changes, especially in places that have a high fluctuation of temperature between day and night. The water layer creates a microclimate in the rice field that helps reduce the effects of temperature shocks. Flooding systems could have a beneficial effect to counteract negative effects of high temperatures as the humidity creates a much cooler microclimate around the rice plants. Rice has good adaptation strategies for coping with high daytime temperatures but recent studies reveal that high nighttime temperatures can have a much greater detrimental effect. High temperatures also have a negative effect on grain quality (Wassmann, 2010).

The negative effects of this system include changes of the soil's physical and chemical properties. These changes are complex but mainly related to changes in the soil's pH from alkaline to acid, which in turn increases the toxicity of soil components. Rice flooded systems are also more susceptible to soil salinization, which is the accumulation of soluble salts in the soil. Both of these effects can result in irreversible degradation of agricultural land. Flooded rice also emits greenhouse houses (carbon dioxide and methane). It has been estimated that rice fields contribute to around 10 percent of worldwide methane emissions (Wassmann , 2010).

Assuming proper water availability, flooded systems can be sustainable even with more than one crop per year. Some benefits include effects on soil acidity; improved organic content of the soil; improved availability of nutrients, especially phosphorus, iron and zinc; and nitrogen fixation. Promoting more aerobic conditions can reduce these benefits, except under "safe alternate wetting and drying" (AWD) that is described further below in this document. This technique alternates dry and wet periods and can be more rigorous if the dry periods are allowed to dry below the soil saturation level. Other problems could arise when changing the irrigation system as agriculture is an interrelated process and thus water strategies can have an impact on soil quality (both chemical and physical characteristics), biotic stress (control of weeds, pests and diseases), and mechanization practices, etc. Empirical evidence also shows that with regards to pests and diseases, aerobic conditions can have a higher incidence of soil-borne pests such as nematodes, root aphids and fungi. Also, research studies indicate that under aerobic conditions rice cannot be grown continuously without considering other strategies to improve soil conditions (rotation of crops, application of organic matter, etc.). Otherwise, yields tend to decline over time (Bouman et al., 2007). The following sections provide a description of alternative cropping methods for rice. However, these practices need to be tested first to understand the benefits and risks that they may bring.

3. SUSTAINABLE AGRICULTURAL PRACTICES AND STRATEGIES

The twenty first century is and will be increasingly facing challenges regarding food production and we will not be able to rely solely on the use of chemicals to overcome them. Furthermore, relying solely on external inputs (fertilizers, chemicals, machinery, etc.) can sometimes bring unintended social effects if farmers acquire debts greater than their repayment capacity. This can lead to an erosion of their family and productive assets which could impoverish them instead of improving their livelihoods.

Experts estimate that food production will have to increase by 70% from current rates by the year 2050. World rice production would have to increase by 50% in the year 2025 (Sita Devi and Ponarasi, 2009). This increase will have to occur while facing more uncertain weather patterns and with less use of inputs. Average per capita food consumption is expected to rise while other production factors are stagnant or even decreasing. Water resources are becoming scarce or polluted; in some continents, farm land cannot be expanded any further, and even

worse in some cases it is being degraded and becoming unfertile; the use of fertilizers for increased production is reaching its limit where further applications do not increase yields any further and can even have a negative effect on the soil and the environment; pesticides have proven to be harmful to human health if abused (Wassmann, 2010). All of this will be compounded by the increasing weather variability that is predicted to occur with climate change. Production levels for key crops in Sub-Saharan Africa are expected to decline by 22% for maize and 17% for sorghum and millet. Optimal location for crops and crop productivity levels will be modified; irrigation requirements could increase; soil erosion and salinity will increase; and there will be an increased likelihood of extreme events as well as pests and disease incidence (Iglesias, 2011). Agricultural production will suffer not only from temperature increases and an increase/reduction of precipitation patterns but also from other events such as floods, droughts, frosts, hail and wind (Gornall et al., 2010 cited in Valenzuela and Anderson, 2011). For rice, for example, Peng et al., (2004) found that rising temperatures had a severe effect on yields causing losses of 10% to 20% of harvests in some areas.

It is important that countries realize how these changes will impact their economies and begin to take action towards either mitigating or adapting to these changes. The following sections discuss alternative production methods with special emphasis on water management. Although Suriname perceives itself as a water-rich country, this is not the case for all its districts. If the country intends to promote other economic alternatives, it needs to understand how these new industries will rely on water usage and what this use will mean for sectors that are currently heavily dependent on this resource, such as rice. It is also important that the government understands how much it will cost to supply this resource versus the social and economic benefits that these sectors can bring before considering their promotion.

WATER MANAGEMENT

Water is a resource that is becoming increasingly scarce due to: 1) decreasing availability (e.g., falling groundwater tables, silting of reservoirs); 2) decreasing quality (e.g., chemical pollution, salinization); 3) poor infrastructure maintenance and planning of irrigation systems; and 4) increasing competition of demands from various economic sectors.

Water is a key resource for agriculture as this sector alone accounts for the use of around 70% of all fresh water resource use in the world. Out of this consumption, rice production under flooding systems receives between 34% and 43% of total world irrigation water (Bouman et al., 2007). Water demand from rice can be as high as two to four times that of other crops. Currently, Suriname uses a little over 92% of its fresh water for agriculture. Although total available fresh water has remained stable at 88km³, per capita availability has declined due to population growth (FAOSTAT).

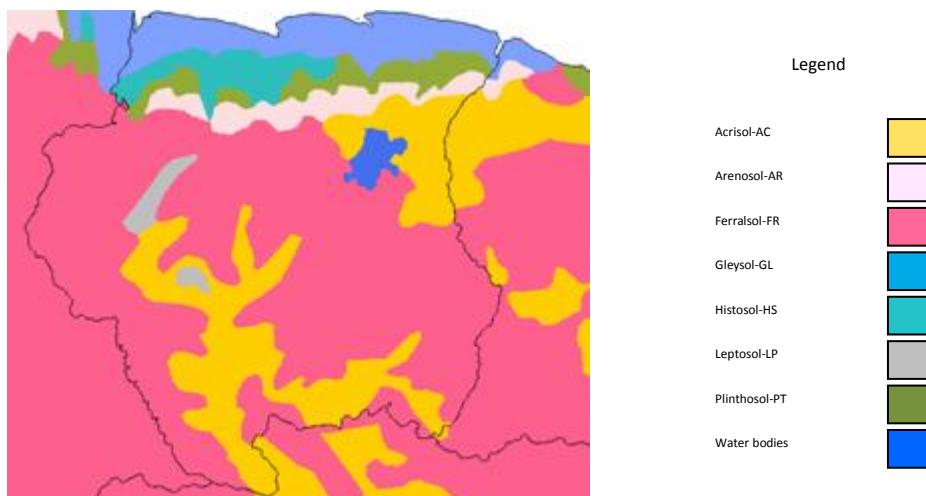
Water scarcity can have several effects on rice production depending on its severity and the physiological period in which it occurred. Thus if it occurs during the vegetative period, flowering could be delayed up to 3 or 4 weeks. Scarcity during or before tillering can reduce the number of tillers per plant. If drought occurs around flowering this can produce spikelet

sterility which will translate in less grains per panicle. Finally if it occurs after flowering it could result in less weight per grain and lower quality (Bouman et al., 2007).

Irrigation could also have several impacts on physical and chemical characteristics of soils. In particular, water quality can be a very important factor for agricultural land located near ocean shores. The rise in sea level is estimated to be around 0.25m over the next 30 years. This will have negative effects on land and water resources as it will: 1) reduce drainage capacity of existing sluice gates; 2) increase intrusion of salt wedge into rivers; 3) increase risk of overtopping flood alleviation infrastructure; and 4) increase salinization of soils (Mertens, 2008). If ocean water increases its influence on rivers, this will reduce their water quality. Soil salinization is a severely degrading factor that could lead to the permanent loss of the soil's productive capacity. Suriname does not have much farm land and thus losing it could have severe social and economic consequences as affected communities cannot be relocated to other areas.

As shown in Graphic 3.1., most of southern Suriname is dominated by Ferralsol soils. These soils are characterized as having a thin layer of organic matter, and are very rich in iron and aluminum. These soils are characteristic of tropical areas with heavy rain. Due to this climatic condition, nutrients tend to leach to lower layers and eventually to river systems. Thus these soils have very low fertility and tend to degrade easily.

GRAPHIC 3.1. SOIL DISTRIBUTION MAP FOR SURINAME



Source: FAO/IIASA/ISRIC/ISS-CAS/JRC, 2012.

Flooded fields and the increased use of nitrogen fertilizers increase the release of greenhouse gases such as methane and nitrous oxide. Furthermore the increase in temperature due to climate change will increase the water demand from the fields to mitigate or reduce the negative effects that temperature stress has on crop yields and quality. Flooding rice fields produces other side effects that have overall negative impacts on rice production and on human health and soil fertility. Some of these effects include:

- Increased use of pesticides (especially fungicides and bactericides)
- Increased soil compaction: soils that are oversaturated with water are more susceptible to be compacted during mechanization processes. This in turn reduces the air content of the soil which in turn reduces the capacity of the plant to produce a healthy root system.
- Increased use of herbicides: the flooding irrigation system in rice fields is combined with a random seeding of plants that makes it impossible to control weeds through mechanical means.
- Increased use of fertilizers: nitrogen is a very permeable element in any soil. Thus it tends to wash off with excess water. In a flooding system, farmers need to increase both the intensity and frequency of application so that this nutrient is readily available for plant growth. The runoff of fertilizers into water streams can cause eutrophication and have negative impacts on fresh water or marine species.

At present Suriname is perceived to have a surplus of fresh water. However, empirical observations seem to indicate that the need to supplement water for rice production during dry periods has been increasing in the Nickerie district (personal interview with Nickerie's water board representatives). Furthermore increased water demand could also come from other economic sectors and especially human consumption. Currently only ground water is used for human consumption in Nickerie. However, if ground water is being exploited at unsustainable rates then at some point the local government will have to look for other water sources. This could increase the demand on water sources that are currently only being used for agriculture in this district.

In a study done to assess the potential to increase irrigated land for rice production, Mertens (2008) claims that around 15,000 ha could be rehabilitated provided that:

- there is a deeper understanding of the water availability from the different water sources (rivers and swamps in the districts of Coronie, Nickerie and Saramaca);
- there is investment done to rehabilitate and build new irrigation infrastructure; and
- the water analysis includes considerations for water quality, especially given the risks of soil salinization.

This effort will require a total investment of over €27 million for rehabilitation and new infrastructure. If this is carried out, it will bring recurring costs for running and operating the system. Thus any economic opportunity needs careful consideration regarding the investments it will require, how it will be operationalized and which resources will be necessary for the investment to be successful.

Thus it is important that Suriname understands the water availability of its water sheds either for improving rice performance or for promoting other economic sectors that will also use water in their productive systems. The following section discusses alternative cropping systems especially designed for water-saving purposes. These systems need to be tested

within Suriname with strong participation of rice farmers before they can be implemented at a national level.

ALTERNATIVE PRODUCTION TECHNOLOGIES

Although it is well known that rice grows under flooded conditions, rice is unique from other major food crops in its ability to grow under a wide range of conditions depending on water availability, soil types and climate. Changing the irrigation system to a more aerated option has its tradeoffs. However, these systems can increase weed infestation and thus it is important to provide alternative control methods to farmers other than herbicides. On the positive side these methods improve soil aeration, which in turn improves biological soil activity and stimulates a much stronger and deeper root system of rice plants, which in turn improves the rate of fertilizer intake (Wassmann, 2010).

The following alternative growing systems are presented as potential alternatives to be tested in Suriname. As agriculture is an extremely complex system, often adopting new practices or cropping technologies means that the farmers will need to learn new skills to deal with a different set of challenges that the new proposed system could bring. Farming can never be approached as a “one solution fits all” but rather as a flexible system that should offer a variety of alternatives to the farmers where they can choose the ones that suit them best. It is important to understand that the proposed strategies require that farmers are trained in water management and how to measure moist content in the soil. Rice is very susceptible to water shortages and yields could decline if water content drops below saturation level. Also, the implementation of these systems requires guaranteed water access throughout the entire growing cycle (Wassmann, 2010).

System of Rice Intensification (SRI): It was developed by Fr. Henri de Laulanie, S.J. and it is based on the principle of providing the plant with the best growing conditions possible. The system improves the development of tillers and a larger and more robust root system and also more grains per panicle. The key of the system lies in using 15 day old seedlings instead of direct seeding and transplanting them one by one, at 25 centimeters from each other, rather than in bunches. This gives the plant enough access to space, nutrients and sunlight to develop all its genetic potential. The SRI system does not require having a damped field but rather keep the soil moist during the growth period. This allows oxygen into the soil which is also necessary for a good plant development. Weed control is done by hand using a rotating hoe and it's done two or three times after transplant. The system also recommends incorporating organic matter into the soil. This method uses two-thirds more labor per hectare especially during the first and second year of adoption. After that the farmer gains more experience and the increase in labor drops to one-third or a quarter more than the flooding system. Experience with this farming system has shown positive increments in yields.

The SRI system is based on 6 core principles: seedlings are transplanted at a much younger age and only one seedling is used in each planting spot; plants are spaced wider apart; intermittent irrigation is provided to alternate between dry and wet soil conditions; mechanical weeding is used; and there is an increased application of organic matter.

There are various success stories and testimonies that attest to the benefits of this system. However, independent researchers have not been able to replicate these successes when comparing SRI with local best-management practices and they have even found yields around 11% lower.

Alternate wetting and drying (AWD): This system consists, as its name suggests, in alternating wet and dry periods in which irrigation is provided after the disappearance of ponded water. Periods between irrigation can fluctuate between 1 to over 10 days, depending on the local conditions. Some authors have found that in rare occasions this system has higher yields than the flooding system. However this is the exception and this method at its best produces similar yields as those of the conventional method. Some of the benefits of this method are: improved root system, higher water efficiency, and better control of some diseases such as gold snail. However there can be an increased risk of rat attack during dry soil periods. On average this system can save between 16-24% in water costs and 20-25% in production costs. The following is a description of how the system should be implemented to avoid water scarcity during sensitive periods, specially flowering:

“In Safe AWD, the following rules should be observed. AWD irrigation can be used from a few days after transplanting (or a 10-cm-tall crop after direct seeding) till first heading. In the period of first heading to 1 week after flowering, keep the field flooded with 5-cm depth. After that, during grain filling and ripening, apply AWD again. When many weeds are present in the early stages of crop growth, the implementation of AWD can be postponed for 2–3 weeks until weeds have been suppressed by the ponded water.” (Bouman, B.A.M. et al. 2007)

The downside of this method is that farmers need to be trained in water management to avoid creating water stress for the plant. Another limitation of the system is that water management would require being independent for each plot, i.e. water must be readily available for the farmer to irrigate whenever necessary and this practice should not affect adjacent fields that might not need irrigation.

SUSTAINABLE AGRICULTURE PRACTICES AND STRATEGIES

Aside from adopting a different cropping system there are also cultural practices that can help improve the performance of the crop and optimize the use of water (sustainable crop intensification practices). Agriculture needs to be viewed as an interrelated system where a single cultural practice can have effects on several other issues. For example, the irrigation system has implications for things such as soil quality and fertilization efficiency; pest and disease management; mechanization choices; weed management etc. The practices outlined below are in line with Rice Integrated Crop Management (RICM) systems and are not by any means the only practices that can be implemented to improve water efficiency. Integrated crop management generally refers to a set of agricultural best practices that consider all the life-cycle of a crop.

Improved varieties: The use of cultivars and genetic material adapted for specific environmental or biotic conditions has proven to be quite successful. For water management

purposes, the varieties could be selected for traits such as drought tolerance, reduced nutrient needs or even morphologic characteristics such as reduced cropping cycle, early flowering and improved yields. Current limitations in Suriname include the low capacity to produce certified seed and lack of legislation regarding proper legislation to protect intellectual property rights as discussed previously.

Land levelling: This practice greatly improves irrigation efficiency and weed control. Levelling ensures a more homogeneous distribution of water throughout the field and thus less water is required to ensure that soil is properly flooded.

Seeding methods: There are basically three seeding methods for rice: transplanting, direct seeding on dry soils, and direct seeding on flooded or saturated soils. Each of this has its benefits and challenges and thus farmers need to select which method they prefer based on the effects that this choice will have on other agricultural practices. For example, direct transplant can reduce the amount of seed used (which is important especially for certified varieties that could be expensive); give the farmer a better control of plant distribution throughout the field which in turn makes it easier to use mechanical means of control for weeds. The challenges of this practice are that it requires more water than the other two options; and it increases the use of labor.

Improve soil organic matter content: This practice will improve physical characteristics of the soil that increase its ability to retain water. There are several ways in which this can be accomplished including applying animal manure; compost; humus; etc.

Mulching: Use of mulch for keeping soil moisture could be an alternative that is being practiced in China. This could also have a positive effect for weed control. Empirical data of this method estimate that some of the advantages may include: earlier crop establishment, mainly due to the fact that the soil cover increases soil temperature making it possible to seed earlier in temperate climates; higher yields; less weed growth; and less water use. The mulch type that was used in these trials was plastic. However there are several other means for mulching including the rice straw (Bouman, 2007).

AGRICULTURAL EXTENSION PROGRAMS

Recommendations on farming best practices need to be passed on to farmers through an effective extension program. In the past technical recommendations were very simplistic (focused on a single production factor) and usually emphasized the use of agrochemicals. Technology transfer through this means usually had disappointing effects because it did not consider the effects of the recommendations on other cropping factors and it didn't promote farmers understanding the reasoning behind the recommendations. Researchers and developers realized the importance of farmers' participation in the adoption of new technology. The following section describes the Ricecheck system that was implemented in Australia as an example of a successful participatory extension exercise. The system started its implementation in 1987 when national yield average was around 6 t/ha and it helped reach an average yield of 9.65 t/ha by 2000, which was the world's highest yield for that year. This

extension program is based on three key pillars: specific technology; ricecheck system; and, discussion groups. The following is a brief discussion of each of these pillars:

Specific technology: Research carried out during the 1980s in Australia showed that no single factor had a consistent influence over rice yields, but rather that higher yields were a result of combining and performing key factors. Eight key factors or ‘key checks’ were identified and recommended (see Table X for a description of key checks). Over time these factors have been modified to include quality and environmental issues as well. These recommendations are communicated to the farmers through extension officials and are adjusted every season using information and feedback sent by farmers.

Ricecheck system: The key checks were transformed into objective goals that farmers can use to evaluate their performance. Any subjective or ambiguous language (such as early or late, high or low, etc.) was avoided. Checks are also divided into input recommendations, which are the technical recommendations and materials to be used, and output recommendations, which are the expected results of following input recommendations. For example, a specific seed rate would be the recommended input to achieve a desired plant density, which would be the recommended output. The farmers provide feedback on these checks to improve existing knowledge and technology so they are active participants on the development of technology. Rice farmers are encouraged to follow the recommended best practices, and also monitor and report on the observed outcomes. This information is then sent to a common database for further analysis and record keeping.

Discussion groups: Farmers are encouraged to participate in discussion groups, facilitated by extension officials, to share their experiences, be exposed to new technology recommendations, and provide a collaborative learning space for feedback on the applicability of the recommended technology. The meetings are scheduled according to the rice-growing cycle: pre-season, post-establishment, panicle initiation, pre-harvest, post-harvest.

TABLE 3.2: DESCRIPTION OF KEY RICECHECK RECOMMENDATIONS

Key check	Description
Field layout	Develop a good field layout with a landformed, even grade between banks and well constructed banks of a minimum height of 40cm (measured at the lowest point).
Sowing time	Sowing on time during ideal sowing window for each variety.
Crop establishment	<ul style="list-style-type: none"> • Undertake major field layout improvements (landforming and bank construction) prior to winter. • Start ground preparation (vegetation control and/or cultivations) early enough to ensure sowing on time. • Provide a level service with enough roughness or cloddiness to suit the sowing method. • Sow 125-150kg seed/ha when aerial sowing and 135-170kg seed/ha when drill sowing. Achieve 200-300 plants/m² established through the permanent water to ensure uniform crop establishment over 100% of the area.
Crop protection	<ul style="list-style-type: none"> • Prepare the field to minimize weak and snail numbers at sowing. • Apply only registered or approved pesticides to control weeds and insect pests to prevent economic yield loss. • Monitor herbicide resistance and implement recommended strategies.
Crop nutrition – Pre-flood nitrogen	Pre-flood nitrogen – apply sufficient nitrogen to achieve the target range nitrogen uptake at panicle initiation (PI) so that PI topdressing requirement does not exceed 60kg/ha.
Crop nutrition – Panicle initiation nitrogen	PI nitrogen – Topdress nitrogen based on fresh weight and NIR analysis using the Rice NIR Tissue Test and/or ‘MaNage rice’.
Panicle initiation date	Achieve PI before 10 th January for each variety.
Water management	<ul style="list-style-type: none"> • Apply shallow water (3-5 cm on the high side of each bay) during establishment and tillering. • Achieve 10-15cm on the high side of each bay at the panicle initiation. • Achieve a minimum water depth of 20-25cm during early pollen microspore stage. • Drain at the right time to ensure grains mature properly and prevent the crop haying off.

Source: Singh, R.P., Brennan, J.P., Lacy, J., Steel, F. (2005)

4. COST-BENEFIT ANALYSIS OF CURRENT VERSUS OTHER CROPPING SYSTEMS

Changing irrigation practices in rice will not only affect water-use levels but it will influence other factors such as: amount and quality of seed used; labor requirements; use of herbicides; and use of other agrochemicals such as fertilizers and biocides. These effects will ultimately have an expression on yield and quality. Thus, before these practices can be widely disseminated, they require a careful evaluation to understand if the benefits or gains from these effects actually outweigh the costs that they intrinsically entail. Promoting any of the previously described practices will demand an investment of resources both from the private producers and from the government. More importantly, prior to their implementation, careful consideration and planning must be undertaken. One must also understand how much information is relevant in making such decisions as there rarely exists a single perfect solution regarding how resources should be invested; therefore, it is imperative to accept some level of tradeoff and uncertainty. The following section provides a brief review of decision making tools and how they can be useful for evaluating new production technologies. The section also includes an economic evaluation of cropping practices for the case of Suriname, where possible. As we were unable to find this information for Suriname, we caution the reader in that the information used was extrapolated from tests performed in other countries. According to ADRON representatives, these farming alternatives have not been tested in the country. We will elaborate on this point in greater detail in the following section.

In economics, the primary decision making driver is the idea of *efficiency*. This concept is based in the notion that resources (financial, human, natural) are scarce and they have the potential to generate both positive and negative effects on society. For this reason, investments need to be carefully evaluated. Efficiency can be analyzed at the private level (single individual or firm) or at the social level (regional or national). In welfare economics, efficiency is defined as the comparison of all gains and losses that an investment can generate as viewed from all individuals within a society. Thus, the primary objective of a cost-benefit analysis is to evaluate the efficiency of decisions (investments, policies, programs, etc.). The process has three core steps:

- i) Identify positive and negative social consequences
- ii) Assign a monetary value to as many as possible consequences
- iii) Apply the appropriate decision criteria to weigh benefits and costs

As simple as it may seem, there could be various ways for evaluating efficiency, although this description would be beyond the scope of this document. However, it is worth noting that efficiency expresses only one, of many goals, that a decision maker may desire. Other criteria that should be kept in mind when evaluating a decision are (Fuguit and Wilcox, 1999):

- Distributional equity: who are the groups that will benefit from an investment and who are the social groups that undertake any burdens derived from a decision?
- Sustainability: How will future generations be impacted by present decisions? This criterion is especially relevant when the decisions that are being considered are related to irreversible changes to natural capital.
- Human Rights: This criterion incorporates a moral principle to the evaluation process, which weighs any investment against human rights. If the negative effects can have an impact on fundamental human rights, then the investment or decision should not be carried out.
- Nature's Rights: Same as human rights, this concept introduces an ethical consideration on the impacts that an investment decision may have over nature. Cost-benefit analysis excludes both intrinsic and instrumental values of nature from the analysis. However, it can shed light on negative impacts and evaluate the most cost-effective option for mitigating those impacts.

The following analysis evaluates the private efficiency of adopting some of the proposed farming alternatives. In other words, we will attempt to evaluate the economic impact that adopting these methods could have for Surinamese farmers. However, we need to express caution on the interpretation of this information as the data that is used as proxy of potential effects, comes from experiments performed in Indonesia and extrapolate these results into the cost structure of a Surinamese farm. The authors of this report could not find this type of information in Suriname, therefore this could be a potential option for predicting these effects. The greatest limitation is that the analysis has an underlying assumption that conditions in Indonesia are comparable to those in Suriname. Another important point of this analysis is that it is limited to the private effects that these farming techniques could have. Decision makers need to be aware that the implementation of these practices would need proper government support from infrastructure, research, extension programs, and other policies needed to aid the effectiveness of these measures. Government support will also translate into a cost to the Surinamese society that needs to be evaluated against the benefit that such practices might bring. Some of those social benefits could be new job creation, increased livelihoods of rice farmers, and improved trade valances by substituting imports, among others.

Please refer to the article by Wardana et al., 2002 for a detailed explanation of the experiment that we are using as reference for this analysis. The research performed in Indonesia tested three components of integrated crop and resource management (ICM) for rice. These included:

1. Improved nutrient management: "...fertilizer management consists of organic matter application-compost, farmyard manure, or rice straw is incorporated during land preparation (2-4 t/ha) and nitrogen application is based on leaf color chart (LCC) monitoring. A second and third N fertilizer application (each 70 kg urea ha⁻¹) are made only when the LCC reading is below no.4."

2. Planting of young single seedlings: "...your single seedlings of only 10-15 days are planted at one seedling per hill at a spacing of at least 20x20cm."
3. Application of intermittent irrigation: under this practice, "...rice fields are alternately flooded and drained depending on the prevailing rainfall and soil water status." This intermittent water provision is practiced throughout the vegetative period, after which the fields are kept flooded and then it is dried again 25 days before harvest.

Of the groups of farmers adopting these practices, some adopted only one, others two and around one third adopted all three practices. In all three cases yields were significantly higher than conventional farming. It is worth noticing that the IMC practices that were evaluated under this study closely resemble the principles of SRI previously described. The authors of this report derived a production function in which the variables with the highest impacts on yields were the use of split fertilizer application and the irrigation method, this last one having the highest effect of all variables tested. The report does not provide details on what other variables they considered for the production function but, given the reports of results from SRI and agro-ecological principals, it is possible to expect that transplanting only one seedling per spot could also have an important impact on yields.

TABLE 3.3. OUTPUTS AND INPUTS USED BY CONVENTIONAL AND ICM FARMERS. ICM COMPONENTS APPLIED SHOWN IN BOLDFACE: F=FLOODED, I= INTERMITTENT IRRIGATION, 20-3=SEEDLING AGE AND NUMBER OF SEEDLINGS PER HILL, OM= ORGANIC MATTER, N= NITROGEN FERTILIZER APPLICATION BASED ON THE LEAF COLOR CHART. INDONESIA

outputs/inputs	conventional		ICM	
	(F/20-3)	(F/20-3/N/OM)	(F/16-1/N/OM)	(I/16-1/N/OM)
Yield (kg/ha)	5401	5813	6068	6889
Organic matter (kg/ha)	0	1880	2253	2923
age of seedlings (d)	24	22	14	15
Nitrogen, urea (kg/ha)	330	220	249	224
Phosphate, SP36 (kg/ha)	62	29	37	42
Potassium, KCl (kg/ha)	19	2	0	44
Biocide (L/ha)	0.6	1	0.7	1.1
Weeding	0	1	1	1
Fertilizer split	0	1	1	1
Irrigation method	0	0	0	1

Source: Wardana, I.P. et al. 2002

On the economic side, the production factors that reduced costs for farmers implementing ICM practices were N fertilizer, seed, and phosphate. The factors that increased costs were organic matter, biocides, and additional labor for incorporating organic matter, weeding and applying split fertilizer. The increase on labor ranged between 10 to 15 labor days per hectare. Table 3.4. shows the items that were used as a reference for modifying the production costs for Suriname. Although there were other effects captured for Indonesia especially related to organic matter application and irrigation, these could not be included because they were not considered for the production costs in Suriname and thus we did not have a reference point for comparison.

TABLE 3.4. PARTIAL BUDGET ANALYSIS OF ICM FARMERS COMPARED TO CONVENTIONAL RICE CULTIVATION AS USED TO MODIFY PRODUCTION COSTS IN SURINAME. (for category definition please refer to table 3.3.)

		(F/20-3)	(F/20-3/N/OM)	(F/16-1/N/OM)	(I/16-1/N/OM)
ICM practices/output/input	AMOUNT	AMOUNT	AMOUNT	AMOUNT	AMOUNT
Added return					
	increased yield (kg/ha)		411.7	667.3	1487.7
reduced cost					
	Seed savings (kg/ha)		6.4	27.2	25.5
	urea (kg/ha)		109.8	80.9	105.6
Added costs (labor)					
	planting	16.1	14	19.7	16.1
	weeding	18	25.7	25.7	25.1
	fertilizer application	7.3	11.5	11	11.2

Source: Wardana, I.P. et al. 2002

The information on the cost structure for rice production in Suriname comes from Rees et al., 1994. This was the only detailed information that we were able to find on the subject. Thus, given how outdated the information is, the analysis will only focus on relative figures and it will not present dollar values. We perform this analysis as an exercise that could shed light on the possible general trends of implementing the cropping practices previously outlined. We also perform this analysis only for the cost structure of small farms (between 1 to 12ha) as bigger farms are highly mechanized compared to those where the experiment was carried out in Indonesia.

METHODOLOGICAL APPROACH

The following section provides a description of how calculations were performed and special considerations taken into account. The production cost for Suriname was originally calculated assuming that even in the smallest farms there was at least some level of mechanization (25%). Based on this information we developed production costs that assumed 0% of mechanization as this is the case for Indonesia and this helped us extrapolate the results from Indonesia to the case of Suriname.

The levels of input and labor use were available from the original analysis on production costs for Suriname. Thus we used these values as reference or “conventional” practice and then proceeded to modify these values using the observed percentage changes in Indonesia. For example, if a change in labor was observed in Indonesia, we calculated the percentage change of this modification with respect to the “conventional” method in Indonesia and then applied this percentage change to the “conventional” practice in Suriname as a proxy of the changes that could be observed if these practices were adopted in Suriname. Once we obtained these values that modified the level of input or labor used, we proceed to calculate the dollar value of these changes using the same costs provided by Rees et al., 1994. This exercise then gave us both the changes in input usage as well as the impact in dollar terms that these changes could have for the production of rice in Suriname.

Changes in yield were calculated using the average yield in Suriname as the basis and modifying it by the percentage amount observed in Indonesia from implementing the three ICM management practices as described above.

Changes in amount of seed used (kg/ha) was estimated using the Suriname base of 150kg/ha and then reducing the amount it was observed in Indonesia. Here we could not use a proportional change because the amount of seed used in Indonesia was not given.

Changes in amount of urea applied (kg/ha) were calculated using the average amount used in Suriname as the basis and modifying it by the percentage amount observed in Indonesia from implementing the three ICM management practices as described above.

Changes in labor used for planting, weeding, fertilizer application, and spraying, were also calculated using the amounts observed in Suriname as base and modifying them by the percentage amount change observed in Indonesia from implementing the three ICM management practices as described above. Unfortunately labor costs for organic matter application (amount and labor used) are practices that are not common in Suriname and the reference data does not provide information on this. Thus we refrained from introducing these costs into Suriname’s production costs.

Irrigation costs are also very important especially when considering water-saving practices. Unfortunately the data for Suriname only considers equipment cost (tractor and pumping costs). Irrigation costs for Indonesia were only captured on the amount of labor required. However it is important to consider that irrigation costs should also include the cost of water itself. On a report by Mertens (2008) the cost of providing this service was estimated at €8/ha

per year only for energy consumption at the pumping stations and at €80/ha per year for the government costs on operations, management and investment in the irrigation system for Suriname. The report in Indonesia only considers irrigation labor but it does not consider how much water was saved with intermittent irrigation method and it does not put a value for this service. In most developing countries, the cost of water provision is mainly incurred by the government and it is not charged to the users. However the fact that the governments are not charging this cost to farmers does not mean that is a free service. The government is investing resources for its provision, which must be taken into account when understanding the social impacts of agricultural activities.

RESULTS

The following section describes the results obtained from this exercise. It is worth remembering the reader that the analysis has some limitations as previously described. Nonetheless, it is useful in providing some perspective of what could be expected if similar practices were tested in Suriname. Table 3.5 presents in detail the cost structure of the four options that are being compared.

TABLE 3.5. PRODUCTION COSTS FOR SURINAME CONSIDERING CONVENTIONAL PRACTICES AND THE VARIATIONS THAT RESULT FROM IMPLEMENTED ICM PRACTICES

INPUT	ACTIVITY	Conventional I	(F/20- 3/N/OM)	(F/16- 1/N/OM)	(I/16- 1/N/OM)
Labor					
	seeding (\$/ha/day)	6	5.217391	7.341615	6
	weed control (\$/ha/day)	3	4.283333	4.283333	4.183333
	pest control (\$/ha/day)	3	3	3	3
	fertilization (\$/ha/day)	3	4.726027	4.520548	4.60274
	red rice control (\$/ha/day)	4.5	4.5	4.5	4.5
Inputs					
	seed sowing (kg)	31.5	30.156	25.788	26.145
	herbicides (liters)	34.32	34.32	34.32	34.32
	pest control (liters)	29.3	29.3	29.3	29.3
	urea (ton)	98.502	65.7277	74.35409	66.98136
	water pumping	81.6	81.6	81.6	81.6
other practices not modified					
	land preparation	101.57	101.57	101.57	101.57
	snail control	15.18	15.18	15.18	15.18
	ditch maintenance	1.5	1.5	1.5	1.5
	Transport	2.22	2.22	2.22	2.22
	Harvesting	86.87	86.87	86.87	86.87
	Infrastructure	3	3	3	3
	land lease	0.24	0.24	0.24	0.24
	Insurance	0.3	0.3	0.3	0.3
	Depreciation	0.8	0.8	0.8	0.8
	labor (other)	36	36	36	36
other costs from activities broken down					
	weed control	2.33	2.33	2.33	2.33
	pest control	2.33	2.33	2.33	2.33
	urea application	2.33	2.33	2.33	2.33
	ditch maintenance	1.5	1.5	1.5	1.5
	Seeding	1.14	1.14	1.14	1.14
	water pumping	97.92	97.92	97.92	97.92
financial costs			0	0	0
	interest rate (6%)	34.38	34.38	34.38	34.38
	farmer margin (10%)	60.75	60.75	60.75	60.75
	TOTAL COST	745.082	713.1905	719.3676	710.9924

Source: Wardana, I.P. et al. 2002 and authors

According to this analysis, the cheapest production option would be the one that adopts all three ICM practices. This is because this is the option that uses less urea which is the most expensive input that was modified. It is worth mentioning that the costs of organic matter application could be important as well as the cost of water and thus a more thorough analysis would need to incorporate these.

TABLE 3.6. ECONOMIC INDICATORS OF ICM PRACTICES COMPARED WITH CONVENTIONAL PRACTICES.

Return/cost/economic indicator	Conventional	(F/20-3/N/OM)	(F/16-1/N/OM)	(I/16-1/N/OM)
Total costs (\$/ha)	100	95.71973	96.54878	95.42472
AVERAGE PRODUCTION (t/ha)	100	107.6282	112.3496	127.5505
Price of paddy (\$/t)	253	253	253	253
Total revenue (\$/ha)	100	107.6282	112.3496	127.5505
Net return	100	135.5725	149.4274	202.9361
Breakeven yield (t/ha)	2.94498814	2.818935	2.84335	2.810247

Source: authors

According to these results, adopting the three ICM practices has a lower production cost (5% less) and generates twice as much net revenue as the conventional practice. Thus implementing sound sustainable farming practices may also generate higher economic returns to farmers while improving their environmental performance.

5. OPPORTUNITIES FOR MULTIPLE USES

There are numerous examples of rice fields being able to produce animal protein of species that are adapted to the type of agro-ecology that the rice fields provide. This could include species such as ducks, frogs, snails, and fish. The entire infrastructure used for rice crops could be useful for raising these species including the rice fields themselves but also associated ponds and canals (Bouman et al., 2007).

Asia, as the center of rice's origin, has a long history of associating rice crops with fish and other species. This system could be divided into "capture" or "culture" systems depending on whether the fish enter the fields from adjacent water bodies or if the farmers themselves seed the fish from fingerlings. Rice fields could also be used for producing fingerlings that are used in other aquaculture systems. Other species that could be grown in rice fields and that are used for human consumption, animal feed or medicinal purposes are: crustaceans, mollusks, amphibians, insects, reptiles, and aquatic plants. It is important to keep in mind that for these systems to be successful they require management strategies that reduce the use of pesticides, take into account the preservation of fish breeding grounds, and ban illegal fishing practices (chemical poisoning, overfishing, illegal fishing and stealing). These systems also need a

regional effort due to the effects that practices on adjacent fields can have on the secondary species that are being grown (Halwart, 2002)

The secondary species grown in the rice fields could provide several benefits of which the most important would be to provide a source of protein and income for the farmers, and the potential to act as pest controls. It is important to understand the biology of the secondary species and the resources that will be required for their successful establishment. Usually carnivorous species will require a source of protein, which in many cases include other fish species. Even if the fish species are herbivorous it is important to understand how they will be fed and evaluate the long-term sustainability and costs of the system before its implementation.

6. ANALYSIS OF FUTURE LAND AVAILABILITY

In this section we analyze the land availability in a variety of scenarios over the next 10 years. The area (in hectares) necessary to meet rice production targets is dependent upon the production target (in tonnes of rice) and productivity (in tonnes of rice per hectare). For each of these two parameters, three scenarios are analyzed: (i) stagnation, where values remain constant until 2022; (ii) modest increase, where there is an increase of 1% per annum until 2022; and (iii) high increase, where there is an increase of 3% per annum until 2022. Table 3.7 summarizes the three scenarios for both parameters.

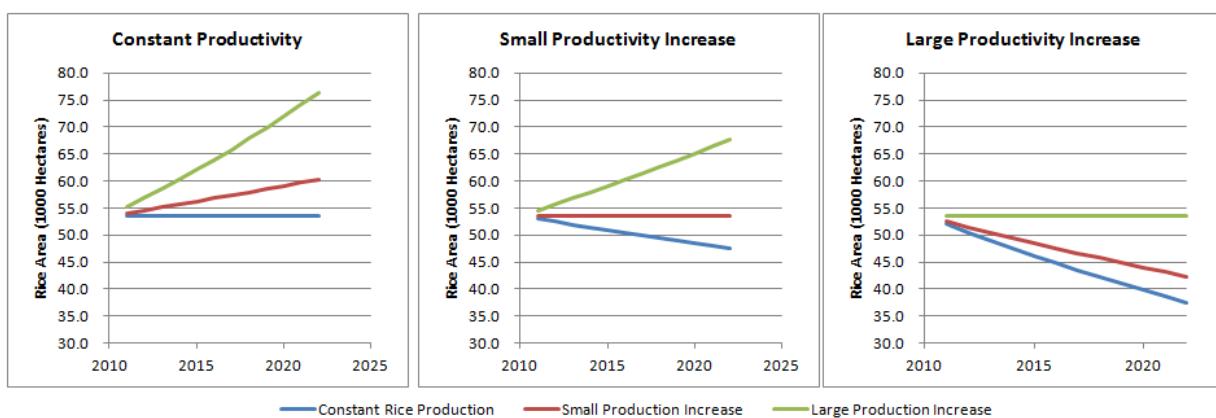
TABLE 3.7 FUTURE RICE PRODUCTIVITY SCENARIOS

	Rice Production Scenarios												
	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Production(1000 t)	Constant	227	227	227	227	227	227	227	227	227	227	227	227
	Modest Increase	229	231	234	236	238	241	243	245	248	250	253	255
	High Increase	233	240	248	255	263	271	279	287	296	305	314	323
Productivity (t/ha)	Constant	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23
	Modest Increase	4.28	4.32	4.36	4.40	4.45	4.49	4.54	4.58	4.63	4.68	4.72	4.77
	High Increase	4.36	4.49	4.63	4.76	4.91	5.05	5.21	5.36	5.52	5.69	5.86	6.04

In the scenario of modest increase, rice production would reach 255 thousand tonnes in 2022, the highest value since 1992. An accelerated increase of 3% per year would increase rice production by almost 40% in 10 years, reaching 323 thousand tonnes in 2022. This would surpass the record production of 1984 of 302 thousand tonnes. In relation to productivity the scenario with a high increase would bring productivity to approximately 6 tonnes per hectare, a level close to the estimated potential yield of Suriname farms using technologies and cultivars available today (GAEZ, 2012).

The interplay between production target and productivity changes will determine the area necessary. Graph below summarizes the area required to meet the production targets under different productivity levels.

Area Needed for Rice Production under Different Production and Productivity Levels



As can be observed, productivity levels have a large impact in the demand for land from the rice sector. If productivity levels stagnate at current levels (approximately 4.2 tonnes per hectare), high production targets would mean that rice production area would need to increase by more than 20.000 hectares. On the other hand an accelerated productivity increase combined with modest increases in production targets would mean that 10.000 hectares could be liberated from rice production.

According to Mertens (2008), up to fifteen thousand hectares could be reincorporated to the rice sector. Adding to this area the fifty three thousand already under production, results in a total area already cleared for the rice sector equal to sixty eight thousand hectares. If combine this area with the analysis above, it is possible to estimate the area already cleared for rice production that could be liberated to other uses (in particular higher value crops such as vegetables and fruits) after meeting rice production targets. Table 3.8 synthesizes the results.

TABLE 3.8 AREA AVAILABLE FOR INCREASE IN VEGETABLES AND FRUITS

Area Available for Increase in Vegetables and Fruits in 2022 (hectares)			
	Rice Productivity		
	Constant	Modest Increase	High Increase
Constant Production	15,000	20,497	29,432
Modest Production Increase	8,744	15,000	25,189
High Production Increase	-6,194	1,853	15,000

If productivity increase keeps pace with production targets, fifteen thousand hectares could be available for other crops after meeting production targets from the rice sector. This area is three times as large as the area currently occupied by vegetables and fruit crops in Suriname. Economic returns from these crops are on average ten times higher than returns from rice production (FAOSTAT, 2012). When productivity increases are higher than production targets, even more land would be made available. It is important to note that further analyses should investigate which fraction of these areas would be biophysically and economically suitable for alternative production systems.

The scenario where rice production targets are high but productivity stagnates present a serious threat to natural ecosystems. In this scenario, even if all fifteen thousand hectares potentially available to be reintegrated to rice production are used, there would be an additional demand for more than six thousand hectares. This scenario further reinforces the need to invest in productivity increase, for example through technologies discussed above, in order to avoid conflict between agricultural productions and environmental conservation. The performed analyses show that this conflict can be avoided as long as rice productivity does not stagnate at current levels, suggesting that Suriname already have enough land cleared for agriculture to meet ambitious targets from the rice sector and increase the area dedicated to higher value crops without deforestation.

7. CONCLUSIONS AND RECOMMENDATIONS

The following section provides a summary of the main conclusions and recommendations that, from the view of the authors, can have the greatest potential to contribute to the rice sector in Suriname.

CONCLUSIONS

Countries whose economies heavily depend on exhaustible resources such as mineral extraction, should actively seek to invest in other more sustainable sectors, especially those sectors where the country has accumulated knowledge and tradition. This is the case of rice which is the most important agricultural product and the most successful agricultural export in Suriname.

The rice sector in Suriname has received substantial government support. However, in spite of this effort, the rice sector has faced a steady deterioration over the last 30 years.

It is important that Suriname understands the water availability of its watersheds either for improving rice performance or for promoting other economic sectors that will also use water in their productive systems.

This chapter provided an overview of alternative cropping systems especially designed for water-saving purposes. Promoting any of the practices described in this chapter will demand an investment of resources both from the private producers and from the government. More importantly, prior to their implementation, careful consideration and planning must be undertaken.

RECOMMENDATIONS

If the government of Suriname intends to promote other economic alternatives, it needs to understand how these new industries will rely on water usage and what this use will mean for sectors that are currently heavily dependent on this resource, such as rice.

It is important to take a holistic approach when designing a supporting program for the rice sector as most factors are interrelated and tend to influence and deteriorate other conditions that may seem unrelated. Thus we encourage the government of Suriname to take factors, (such as use of natural resources, technological improvements, policies, access to credit, infrastructure development and maintenance) into consideration when thinking about ways to stimulate the rice sector.

There are several technological alternatives for producing rice and improve the performance of the sector. However, they require a careful evaluation to understand if the benefits or gains from these effects actually outweigh the costs that they intrinsically entail, before these practices can be widely disseminated.

The provision of key resources for the rice sector requires government investment. This is the case of water and the irrigation system in Suriname which has administrative, operation and maintenance costs.

The provision of water for the rice sector requires government investment. The irrigation system in Suriname requires resources for its administration, operation and maintenance. It is important to design management systems and even set a fee on the provision of this service to increase the efficiency of the system and improve its performance.

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IV. ORGANIC FARMING AS AN OPPORTUNITY FOR SUSTAINABLE AGRICULTURE IN SURINAME

This chapter presents the legislation on organic farming in the European Union (EU) and potential requirements for Suriname organic products to be exported to European markets. The chapter is divided into five subsections. The chapter: i) introduces organic farming in a global context, ii) synthesizes and analyzes the EU legislation on organic farming and its implementation, iii) discusses legal requirements for imports to EU, iv) proposes opportunities for organic farming in Suriname, and finally, v) proposes a framework for organic production in Suriname in compliance with EU legislation, along with challenges and recommendations. This study relies on the literature review and synthesis of EU legislation, consultations with EU policy experts, consultations with organic-farming experts both in Europe and South America, two fieldtrips in Suriname including consultations with a range of stakeholders and experts opinion.

1. ORGANIC FARMING WORLDWIDE

The fundamental groundwork for agricultural management based on organic inputs tracks back as far as the early decades of the 20th century. In the 1920s and 1930s, pioneering scientific research on soil organic matter and soil-crop relations emerged in the United States and France (Aubert, 1996), while in Germany and Switzerland alternative farming systems were developed due to concerns over soil fertility caused by predominant farming systems. In Germany, this consequently led to the world's first organic certification label, Bioland. The social and practical foundation for modern organic farming was established in the 1940s in industrial countries. Organic farming emerged as an alternative to the increasing intensification of agriculture, particularly to the use of synthetic nitrogen fertilizers. Work on earthworms by Charles Darwin was paramount for organic farming pioneers' understanding of organic matter dynamics in soils. By the late 1940s, the first organic farming organizations were established (e.g. Soil Association in the UK, Rodale's publishing house in the United States). Many social scientists perceive organic farming as a new social movement which developed most intensively over the 1970s and 1980s, as part of the environmental movement emerging in the Western world (Michelsen, 2001; Guthman, 2004).

The term 'organic farming', along with the concept of systemic approach referring to designing and managing the farm as an organic system that integrates soil, crops, animals, and society, was first used in 1940 by Lord Northbourne in his book *Look to the Land* (Scofield, 1986). Currently, definitions of organic farming are similar worldwide and focus on ecological principles as the basis for crop production and animal husbandry. In that, organic farming broadly refers to agricultural production that relies primarily on renewable resources, maintains the fertility of the soil, maximizes recirculation of plant nutrients and organic matter, does not use organisms or substances foreign to nature (e.g. Genetically Modified Organisms (GMOs), chemical fertilizers or pesticides) and maintains diversity in the

production system as well as the agricultural landscape. Definitions of organic farming increasingly include social and ethical issues, for instance fair labour practices, family farm viability, and animal ethics.

The global organic agricultural land area has steadily increased. Currently, there are 37 million hectares of organically managed land worldwide (Fibl and IFOAM, 2012; Figure 1). Oceania, Europe and Latin America have the largest areas of organically-managed agricultural land, which accounts to 12.1, 10 and 8.4 million hectares, respectively. Between 2009 and 2012, there was a rapid growth in organic land area in Europe, where overall organically-farmed areas increased by 0.8 million hectares (9 percent), with France (0.17 million hectares), Poland (0.15 million hectares), and Spain (0.13 million hectares) being the countries with the largest increases.

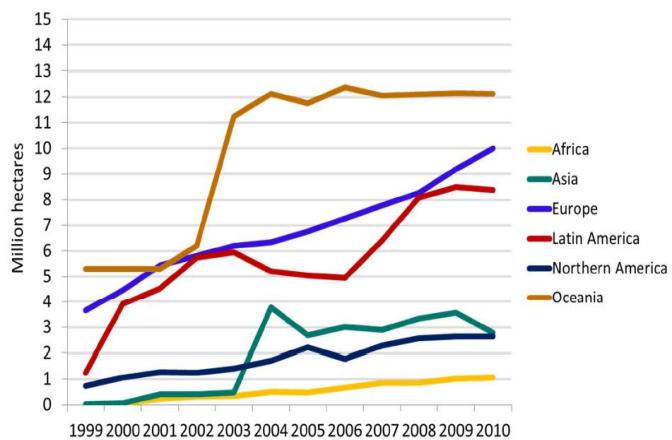


FIGURE 1. DEVELOPMENT OF THE ORGANIC AGRICULTURAL LAND 1999-2010 IN DIFFERENT REGIONS. SOURCE: (FIBL AND IFOAM, 2012).

Organic farming is a dynamic sector in Europe. In most countries, the organic area is increasing and the market continues to grow. Within the EU, the highest shares of organically-managed land are in the British territory of Falkland Islands (35.9 percent) while in Europe, in Liechtenstein (27.3 percent) and in Austria (19.7 percent). Sweden, Estonia, Switzerland and Czech Republic also have more than 10 percent organic agricultural land with 14.1, 12.5, 11.4 and 10.5 percent, respectively. Along with increasing organic-land area, sales of organic products in the food and textile markets have been increasing. This positive development is also due to several policy support measures, such as funding under rural development programs, legal protection, action plans as well as support for research and advice (IFOAM, 2010). Nevertheless, there are still substantial differences among EU Member States regarding the importance and relative contribution of organic farming to overall agricultural systems. While the above-mentioned six countries present relatively high

shares of organically managed land, other countries have less than ten percent of agricultural land devoted to organic farming (Figure 2). The country with the largest organic agricultural land area is Spain with 1.5 million hectares, followed by Italy with 1.1 million hectares (also the country with the highest number of producers, more than 44 000 producers) and Germany with 0.99 million hectares.

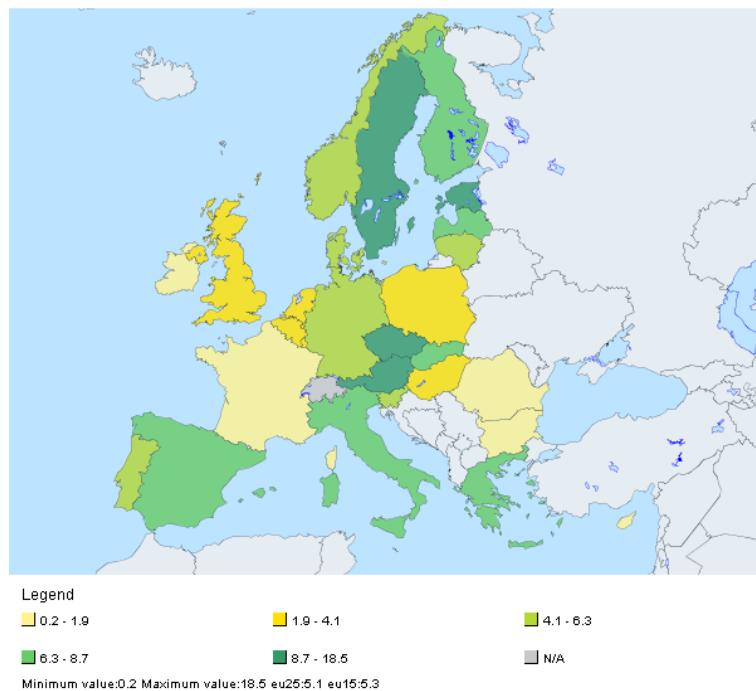


FIGURE 2. AREA UNDER ORGANIC FARMING IN 2009 (%). SOURCE: EUROSTAT.

In 2010, the world-wide market for organic produce (food and drinks) had a total value of US\$ 59 billion dollars (EUR 44.5 billion at the average exchange rate of 2010). The largest consumers of organic products were USA and EU, accounting for 96% of total sales. Conversely, more than three quarters of the producers were located in Africa, Asia, and Latin America. In Europe, sales of organic products were approximately EUR 19.6 billion in 2010, with Germany remaining the largest organic retail market, supplied both by domestic production and by imports (turnover of 6 EUR billion; Figure 3). This is followed by France with EUR 3.4 billion and UK with EUR 2 billion, while the highest annual per capita consumption was reported for Switzerland (153 Euros) and Denmark (142). The countries with the highest market share for organic food in 2010 were Denmark (7.2 percent), Austria (6 percent) and Switzerland (5.7 percent). Annex I is a summary by the Research Institute of Organic Agriculture (Fibl) and International Federation of Organic Agriculture Movements (IFOAM) (Fibl and IFOAM 2012) of Organic Agriculture World Report, containing global

statistics on organic farming. Annex II is the summary specifically focused on Europe. Annex III shows the statistics for organic farming with division into global regions.

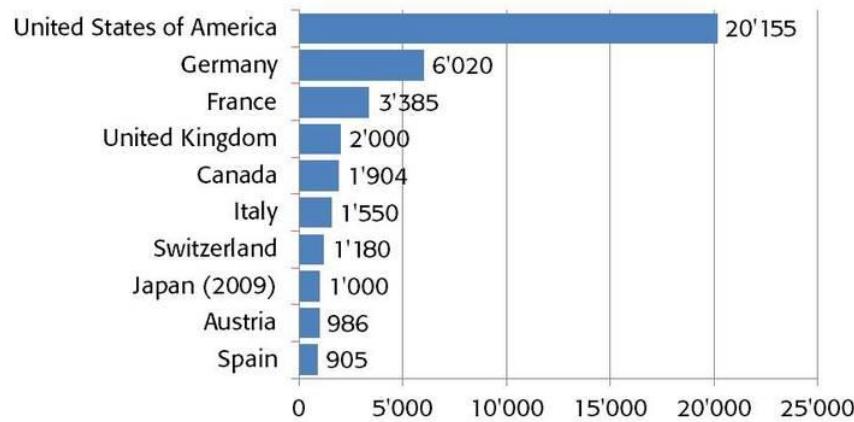
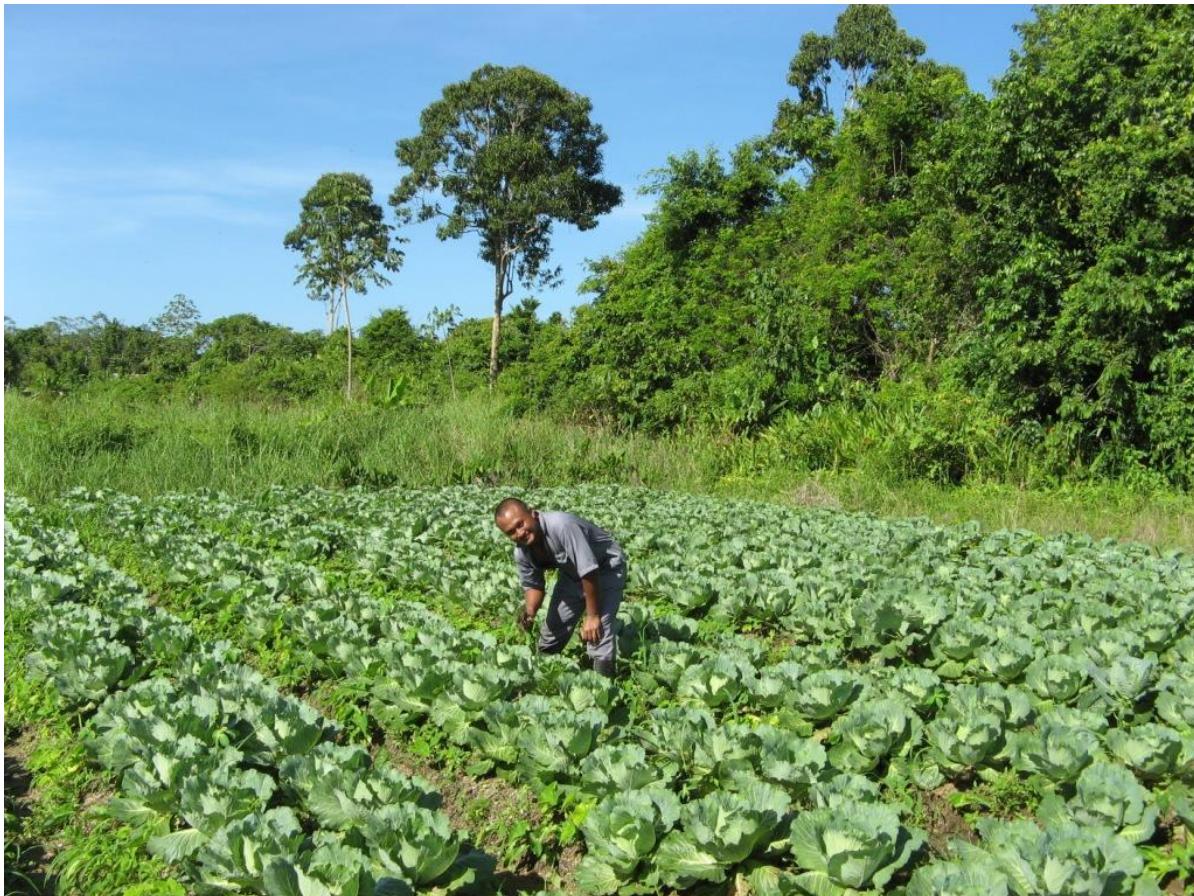


FIGURE 3. THE TEN COUNTRIES WITH THE LARGEST ORGANIC MARKETS IN 2010 IN BILLION EUROS (IFOAM, 2012).

With respect to developing countries, organic farming may provide a wide range of economic, environmental and social benefits. Over the past two decades, global markets for certified organic products have grown rapidly, and sales are expected to continue to grow over the next years. While sales are indeed concentrated in North America and Europe, production is global, with developing countries increasing their share of production and exports. Recent studies in Africa, Asia and Latin America suggest that due to expanding markets and price premiums, organic farmers generally earn higher incomes than their conventional counterparts (UNCTAG, 2008). Organic production is particularly applicable to smallholder farmers, who comprise the majority of the world's poor. It may contribute to reducing dependency on external resources and facilitate higher and more stable yields and incomes, enhancing food security and providing more resilience. Furthermore, organic agriculture in developing countries is underpinned by farmer's rich heritage of traditional knowledge and traditional agricultural varieties, which should be preserved. Organic farming may also strengthen communities and give youth an incentive to continue farming, thus reduce migration.

Concomitant with the world trends, Suriname has plans to expand sustainably managed agricultural land and become the “food basket of the Caribbean”. A number of projects focused on sustainable and organic farming are being funded and implemented, for example, by the Suriname Business Development Center (SBC) or the United Nations Development Program Suriname (UNDP-Suriname). The SBC has funded and conducted a number of studies related to the agricultural sector, including, for example, a study of possibilities to add value to and improve utilization of rice bran in Suriname and an analysis of the agricultural sector and the transition process towards organic farming by supporting organic waste management for composting. Through UNDP's initiative of 'GEF Small Grants Programme' (SGP) funded by the Global Environment Facility (GEF), financial and technical support to

NGOs in Suriname have been channeled for activities that conserve and restore the environment while enhancing people's well-being and livelihoods in the areas of biodiversity, climate change, land degradation and pollution. These projects include various activities related to sustainable land management such as agroforestry, non-timber forest products (NTFP), for instance, açai or handcrafts using seeds and weeds. UNDP-Suriname, in collaboration with GEF and the Ministry of Planning, Land and Forest Management (RGB), has also recently launched a three-year initiative of the Coastal Protected Area Management Project in Nickerie to promote the sustainable development and biodiversity of the Coastal Protected Area through effective management and sustainable income generation. Suriname is also taking part in UNDP discussion of UN-Reducing Emissions from Deforestation and Forest Degradation (REDD+) program which is framed within the context of the Surinamese Government's Readiness Preparation Proposal for the Forest Carbon Partnership Facility (FCPF).



SUSTAINABLE-AGRICULTURE FARM IN SURINAME.
PHOTO COURTESY OF MAUREEN SILOS

2. POLICY FRAMEWORK FOR ORGANIC FARMING IN THE EUROPEAN UNION

Compared to the Common Agricultural Policy (CAP), which was established in Europe at the end of World War II, legislation on organic farming is relatively new within the EU policies. Legislation for EU organic farming was derived from the first EU regulation on organic farming (EEC) No 2092/91 (EC, 1991) of the European Council of 24 June 1991 (EU-Eco-regulation). This 1991 Regulation 'on organic production of agricultural products and indications referring thereto on agricultural products and foodstuffs' was then replaced in 2007 by Council Regulation (EC) No 834/2007 of 28 June 2007 'on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91' (EC, 2007, Annex IV)¹. It entered into force on 1 January 2009. The legislation on organic farming was generated as a result of a number of initiatives to foster organic farming. Within the same framework, in 2004 the Commission adopted an 'Action Plan for Organic Food and Farming' (COM, 2004). It covered the general guidelines on organic farming, recognizing and stressing that organic farming is a valuable tool for promoting the production of high-quality products with simultaneous advantages for the environment, rural development and animal welfare. The Regulation delivered a legal framework for organic products, it defined the general principles applicable to organic production (for instance, specific production methods, the use of natural resources and stringent restrictions on synthetic chemical inputs), the rules on production and processing of organic food and organic animal feed, labeling, controls and trade with third countries. Specifically, the Regulation legislated agricultural products (including aquaculture products), either processed or unprocessed and intended for human consumption, animal feed, vegetative propagating material and seed used for crops, yeasts used as food or feed, seaweed and wild plants.

¹Throughout the document the (EC) No 834/2007 will be referred as 'The Regulation'

According to the Regulation:

'Organic production is an overall system of farm management and food production that combines best environmental practices, a high level of biodiversity, the preservation of natural resources, the application of high animal welfare standards and a production method in line with the preference of certain consumers for products produced using natural substances and processes. The organic production method thus plays a dual societal role, where it on the one hand provides for a specific market responding to a consumer demand for organic products, and on the other hand delivers public goods contributing to the protection of the environment and animal welfare, as well as to rural development.'(EC, 2007)

The Regulation also underlines specific objectives of organic farming which focus on sustainable agriculture and production quality. It aims to establish a sustainable management system for agriculture that respects nature's systems and cycles and sustains and enhances the health of soil, water, plants and animals and the balance between them contributing to a high level of biological diversity. It aims to ensure responsible use of energy and natural resources, and respects high animal welfare. The principles used to achieve these objectives are detailed in the Regulation. As reported by the general rules for organic production, genetically modified organisms (GMOs) are prohibited in all their forms as well as is treatment by ionizing radiation. Organic plant production management system is based on soil fertility management, choice of species and varieties, multiannual crop rotation, recycling organic materials and cultivation techniques that maintain and enhance soil life and natural soil fertility, soil stability and soil biodiversity preventing and combating soil compaction and soil erosion. In addition, farmers operating both organic and non-organic agricultural production must ensure that animals and land for these two activities are separated. According to more specific rules for production of organic plant, the production must preserve wildlife and the natural fertility of the land, prevent damage based on natural methods (although farmers can use a limited number of plant protection products authorized by the Commission). Organic farming should rely on renewable resources and minimize use of non-renewable resources and off farm inputs, and be based on recycling. Moreover, seed and plant propagation material must be produced using organic methods while cleaning products must have authorization of the Commission. The Regulation also allows a limited number of products (and with conditions for application) in organic farming, including for plant care, animal feed and the cleaning of buildings used for livestock and plant production. Further, the Regulation sets out the rules for farms that are transitioning into organic farming (regarding compliance with a conversion period).

To describe an organic product, its ingredients, or raw materials, terms such as 'eco' and 'bio' may be used for labeling, advertising or commercial documents. The control body that certifies the product must be clearly visible on the organic product. The logo labeling of the European Union is mandatory to use on organic products from 1 July 2010, as is an indication of the origin of raw materials used in the product process (although is not obligatory for imported products).

Contrary to mainstream farming, the EU organic farming policy has an intrinsic feature of being heavily influenced by a social movement including not only the producers of organic food but also consumers and environmentalists (Moschitz, 2009; Tovey, 1997). Therefore, organic farming communities hold a potential power to influence organic farming policies, the extent of which depends on the resources, such as size and the structure of organic farming networks. In the countries within EU where the organic farming community is unified and not affected by internal conflicts, the organic farming organization may constitute a significant influence power on policy-making (for example in Switzerland and Denmark).

Organic farming is considered one of the ways to achieve sustainable agriculture. By favoring soil protection, animal well-being, biodiversity, plant nutrients and water protection resulting from reduced use of pesticides, organic agriculture plays an important role in achieving the CAP objectives of improving the sustainability of agriculture and the environment.

IMPLEMENTATION OF ORGANIC FARMING LEGISLATION IN EUROPE

The rules for implementation of the Regulation are detailed in Commission Regulation (EC) No 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control'. This document along with the rules for implementation of organic farming can be found in Annex V of this document. Briefly, the rules for implementation refer to production, processing, packaging, transport and storage of plant, mushroom, seed data base, livestock and feed as well as rules for disease prevention, veterinary treatment, labeling and control requirements. With respect to plant production, the nutritional needs of plants should be met through, for instance, production that uses tillage and cultivation practices that maintain or increase soil organic matter, enhance soil stability and soil biodiversity, and prevent soil compaction and soil erosion. Fertility and biological activity of the soil shall be maintained and increased by multiannual crop rotation including legumes and other green manure crops, and by the application of livestock manure or organic material, both preferably composted, from organic production (EC 824/2008). Where the nutritional needs of plants cannot be met by the Regulation, only fertilizers and soil conditioners referred to in Annex I to the Regulation may be used in organic production and only to the extent necessary. Similar rules apply for pest, disease and weed management. Operators must keep documentary evidence of the need to use the product. The total amount

of livestock manure, as defined in Council Directive 91/676/EEC (8) concerning the protection of waters against pollution caused by nitrates from agricultural sources, applied on the holding may not exceed 170 kg of nitrogen per year/hectare of agricultural area used. This limit shall only apply to the use of farmyard manure, dried farmyard manure and dehydrated poultry manure, composted animal excrements, including poultry manure, composted farmyard manure and liquid animal excrements.

In order to regulate and facilitate the sale of quality products from the growing organic-farming market, third-party certification is obligatory within EU organic farming system, and is awarded at the government level. This means that the term 'organic' may only be used for certified products. Organic standards are derived from the above-discussed organic production guidelines. The International Federation of Organic Agriculture Movements (IFOAM) is a leading organic farming organization with members in 108 countries and it offers 'Organic Guarantee System' enabling organic certifiers to become IFOAM Accredited. Other similar organizations include Organic Crop Improvement Association, Soil Association (UK) and Ecocert. To qualify for EU organic farming at least 95% of products' ingredients must be organically produced. Supervision of certification bodies is handled at the national level of each Member State.

The International Federation of Organic Agricultural Movements has recently released a report (IFOAM, 2012) that evaluated EU regulation on organic farming after 3 years of its implementation in 2009 (Annex VI). The report concludes that since the EU legal framework was established, organic farming has developed quite quickly in the EU. The legislation provided a solid basis for a balanced development of organic production in the EU. It was concluded that farmers and food producers were sufficiently assured that a stable legal framework was underpinning their intentions to switch over to organic farming and food production, and provided adequate basic conditions for fair competition. The report also drew attention to the importance of credibility. The credibility of organic farming, dependent on the quality of certification along with transparency, are crucial to the consumers of organic products. The organic consumers are generally highly knowledgeable regarding organic farming and its standards. They are keen to know where the products come from, which operations were involved, how it is composed and processed and what quality systems are installed. Recent issues with fraud (e.g. Sunnyland and Agrital in Italy, Roberts Geflügel in Germany) endanger the credibility of the entire organic farming system. Although fraud is a common problem for the whole food sector, for organic it is also a highly sensitive aspect because consumers pay between 20% and 100% more in comparison to conventional food. The fast growth of organic sector puts pressure on the maintenance of organic credibility and therefore the legal requirement for certification plays an important role in strengthening consumer trust.

A Recent Report of the Institute of Farm Economics (IFE, 2011) on Use and efficiency of public support measures addressing organic farming' provided a comprehensive study pertinent to formulation of organic farming support mechanisms (Annex VII and Annex VIII). Annex IX of this report is 'Commission Regulation (EC) No 1235/2008 of 8 December 2008

laying down detailed rules for implementation of Council Regulation (EC) No 834/2007 as regards the arrangements for imports of organic products from third countries'. Annex X is 'List of Control Bodies and Control Authorities in Charge of Controls in the Organic Sector', Annex XI is 'List of Code Numbers of Control Bodies and Authorities from Equivalent Third Countries', while Annex XII is 'List of Code Numbers of Control Bodies and Authorities Working under the System of Import Authorizations Issued by Member States'. Guidelines on imports of organic products into the European Union are in Annex XIII.

COMMON AGRICULTURAL POLICY AND SUBSIDIES TO ORGANIC FARMING IN EUROPEAN UNION

Over the past two decades, the EU supported organic farming through agri-environmental legislation and monetary measures. In 1992, the EU published Regulation EEC No 2078/92 which provided direct payment for organic farmers. More recently, under the 2003 CAP reform environmental and land management standards became a prerequisite for single farm payments (Pillar I) and rural development schemes (Pillar II) (Padel and Lampkin, 2012). For example, in the UK environmental stewardship schemes are supported by Natural England (<http://www.naturalengland.gov.uk/ourwork/farming/funding/es/default.aspx>).

In return for adopting measures to promote environmental protection, farmers receive payments which compensate them for potential loss of productivity. An organic farming stewardship scheme is one of three entry levels for the stewardship scheme. The EU is currently negotiating further CAP reforms that will extend the environmental prerequisites for receiving EU monetary support. These reforms are likely to benefit organic farmers who are expected to automatically qualify for the scheme (Padel and Lampkin, 2012).

Historically, the EU CAP ensured European farmers received high payment for their produce. While subsidies secured the livelihood of EU farmers, the CAP disadvantaged non-EU farmers and importers and created barriers to trade (Borrell and Hubbard, 2000). The post-2013 CAP reform is at present under negotiations (http://ec.europa.eu/agriculture/cap-post-2013/index_en.htm). The reform is expected to remove EU quotas on dairy and sugar, and have some effects on rice and cotton production. However, a recent study by Matthews (2011) maintains that the reform will not take significant steps towards the removal of trade barriers. The study concludes that each developing country should assess the impacts of the reform on its export strategy.

3. EU REGULATIONS FOR IMPORTS OF ORGANIC PRODUCTS

To date, several means of importing organic products to EU markets exist. These are import authorisation schemes; imports from countries recognised for equivalency of organic production; imports through control bodies or control authorities recognised for equivalency; and imports through compliance schemes, verified by control bodies or control authorities. These alternatives and their implementation in practice are summarised in Table 1, and discussed in more detail below.

Import regime	Managed by	In operation September 2012
<i>Import authorisation</i>	Member States	Yes – to be phased out by 2014
<i>Equivalent countries</i>	The European Commission	Yes – eleven countries recognized
<i>Equivalent control bodies/authorities</i>	The European Commission	Yes - over thirty control bodies recognized as of July 2012
<i>Compliant control bodies/authorities</i>	The European Commission	No – implementation delayed until October 2014

TABLE 1: EU IMPORT REGIMES FOR ORGANIC PRODUCTS.

SOURCE: ADAPTED FROM EUROPEAN COURT OF AUDITORS (2012: P. 15)

Under the ‘old’ EU Regulation on organic production (EC, 1991), two import systems existed. Imports through recognized third countries, and under import authorization schemes. The latter was established as a transitional means of importing organic products from third countries under Regulation (EEC) No 2083/92 (European Court of Auditors, 2012: 16). Through this regime, each EU importer must apply to the competent public authority in his country of origin for an import authorization, for each exporter he trades with. The competent authority then assesses the supply chain before granting its approval. This method allows for control over the integrity of the whole supply chain. However, the regime is time-consuming and creates administrative burden. Further, it creates potential discrepancies in the organic standards and import authorizations among EU Member States, and therefore can adversely affect the functioning of the single European market (IFOAM, 2012: 34). Regulation No 1267/2011 stipulates that from 1 July 2014 it will not be possible to import organic products through the import authorization scheme. Further, any import authorizations granted from 1 July 2012 must expire after 12 months at the latest (European Court of Auditors, 2012: p. 16). Since 2006, the EU has sought to withdraw the import authorization regime, and introduce new measures to regulate the import of organic products. The amendment of Article 11 of

Regulation (EEC) No 2092/1991 in December 2006, and Regulation No 834/2007 introduced two guiding principles for the import of organic products. Article 32 of the Regulation introduced the principle of the import of *compliant* products. The principle of compliance necessitates that the importer applies *identical* practices to those set out in Title II, III and IV of the Regulation, and thus fully complies with EU organic standards. Alternatively, Article 33 of the Regulation introduced the principle of *equivalence*, through which ‘the product has been produced in accordance with production rules *equivalent* to those referred to in Titles III and IV’ [Article 33(1a), emphasis added]. The principle of equivalence ensures that the EU’s organic standards, and the objectives and principles outlined in the Regulation are met, while encouraging the ‘development of standards and controls adapted to local conditions’ (European Commission, 2012: 10-11). The international *Codex Alimentarius* guidelines on organic food provide an important point of reference for ensuring equivalence, and facilitating international harmonization of standards for organic products. Equivalence agreements are also encouraged by the World Trade Organization. Thus, *Equivalence* allows for more flexibility in meeting EU organic standards than *compliance*. These import possibilities are discussed in some detail below.

Under the principle of *equivalency*, two import possibilities exist – equivalent countries and equivalent control bodies. There are currently eleven countries which enjoy an equivalency status for organic farming. These are Argentina, Australia, Canada, Costa Rica, India, Israel, Japan, New Zealand, Switzerland, Tunisia, and the U.S.A (European Commission Regulation No 1235/2008: Annex III; IFOAM, 2012: p. 7). Seventeen additional requests are pending. The process of achieving an equivalent country status requires an official application by national authorities to the Commission, and includes a detailed assessment of the applicant country’s organic standards and control systems. In a recent report, the Commission conceded that this process requires significant resources. While minor differences in organic standards may be accepted, divergent standards may result in restrictions on imports (European Commission, 2012: Article 5.1.1). According to the Commission’s report, national equivalency offers the most stable and reliable approach to organic imports, and encourages developing countries to put in place rules and control systems to promote and safeguard organic farming practices (the detailed specifications of these requirements are listed in Regulation No 1235/2008). However, reaching this type of equivalency is time-consuming and requires a high level of technical expertise (European Commission, 2012: Article 5.1.1). In order to be able to apply for an equivalent country status, countries need to establish national organic control bodies, as well as technical expertise in organic farming practices. A system to ensure organic farming practices must therefore be in place, and applied at all levels of governance – from the local through the regional, national and international – before applying for an equivalent country status.

Achieving equivalence under control bodies (CBs) or control authorities may provide an alternative, practical and reliable approach for imports of organic produce. A control authority is a *public body* in the EU Member States or third countries, whereas a control body is a *private, third party* organization which the Commission has approved for the certification of organic products [Regulation No 834/2007, Article 2 (o-p)]. Whereas control authorities

operate mostly within the domain of Member States and recognized equivalent countries, control bodies are global in their outreach, and operate across Asia, Europe, the U.S, Central and South America, the Middle East and Australia. For example, the CB Bio Latina Certificadora (<http://www.biolatina.com>), which is based in Lima, Peru certifies organic products from ten South and Central American countries (European Commission Regulation 1267/2011: Annex IV). In December 2011, the EU published a list of thirty international CBs with an equivalency status under Regulation 1267/2011 (Annex IV). These CBs operate under the equivalence scheme as of July 1st 2012. There are, however, some concerns regarding the reliability, transparency and fairness of this system. The new import system shifts responsibility for ensuring organic standards are met away from Member States and other competent authorities, towards the Commission, and private CBs. The reliability of these institutions will have to be evaluated over time. Further, the transparency of equivalence standards needs to be ensured through their publication, and fairness must be established for the purpose of ensuring the equal implementation of equivalence standards in equivalent countries and CBs (IFOAM, 2012: pp. 32-33). The Commissions considers that equivalent CBs offer adequate supervision of safe organic practice (European Commission, 2012: Article 5.1.2). However, it is too early to evaluate the operation of this element of the EU's organic import regulations.

Under the equivalence scheme, products from third countries can be placed on the EU market, provided that

- (a) The product has been produced in accordance with production rules equivalent to those referred to in Titles III and IV'' of the Regulation (Title III and IV are, Production Rules and Labelling, respectively);
- (b) The operators have been subject to control measures of equivalent effectiveness to those referred to in Title V (Controls) and such control measures have been permanently and effectively applied;
- (c) The operators at all stages of production, preparation and distribution in the third country have submitted their activities to a relevant control authority or control body;
- (d) The product is covered by a certificate of inspection issued by the competent authorities, control authorities or control bodies of the third country or by other recognized control authority or control body, which confirms that the product satisfies the required conditions (EC, 2007: Article 33).

Each consignment is checked against the certificate of inspection by Customs at the EU point of entry. The certificate provides an important means of tracing an organic product from the producer through to the EU importer, and further down the supply chain (European Commission, 2012: Article 5.3).

The final option for gaining access to the EU markets is through the compliance regime. Under this scheme, third countries are required to strictly adhere to EU legislation on organic farming, as discussed above. The principle of equivalence is thus replaced by identical rules. This system poses further challenges to importers, as demands are usually greater than under the equivalency schemes. The system will not be implemented before 31 October 2014. Based on past experience, the Commission concluded that

[I]t is doubtful that the compliance regime will provide for better access to the EU market and will bring additional benefit to the EU's trading partners compared to what is already provided by the equivalence regime (European Commission, 2012: Article 5.2).

The compliance regime is expected to create a greater workload for both importing countries and the Commission, while not providing additional benefits to consumers.

In summary, the EU system for import of organic products is undergoing a major overhaul, which is placing greater responsibility for the implementation of organic standards in the hands of the European Commission, private CBs and Authorization Bodies. The repercussions of this change are yet unknown. Nonetheless, this can be an opportune moment for Suriname to increase its knowledge of organic farming and policies to support these practices through cooperation with both regional and European CBs and countries recognized under the equivalency scheme, such as Costa Rica and Argentina.

4. OPPORTUNITIES FOR DEVELOPING ORGANIC FARMING SECTOR IN SURINAME

A country wishing to develop its organic farming sector needs to perform an in-depth integrated assessment of its general agriculture policies, programs and plans, in order to understand how they affect the competitiveness and the conditions of the organic sector. Legislation is important, however other bodies such as, international, foreign or domestic development agencies and their programs can also greatly influence agriculture development. In fact, in countries where fully operating organic farming legislation is not in place, NGOs and private sector may be in charge of organic farming and its exports. In many developed countries (including EU countries), where sophisticated legal organic farming framework is in place, the early development of organic farming has been initiated by either NGOs or by private companies, and sometimes both. Further, in some countries, such as New Zealand where the organic market reported in 2009 to amount to around EUR 220 million, there is no organic market regulation and the market surveillance is regulated in the Fair Trading Act (for exports, which were estimated at EUR 110 million in 2009, there is a voluntary, government-managed certification scheme accepted in the EU, USA and Japan) (IFOAM, 2011).

If Suriname intends to rely upon a mandatory organic regulation, it is of critical importance that such a regulation is “farmer-friendly” and “trade-friendly”. For example, in some countries with mandatory regulation on organic farming, there are special rules and exemptions for small farmers. In the US, farmers selling organic products for less than US\$ 5,000 annually are exempt from certification, i.e. they can make the organic claim, have to follow the standards but do not have to be certified (and incur extensive costs).

A badly drafted organic farming regulation is likely do more harm than good. To adopt an organic regulation from another country or region, for example from the EU, may not directly guarantee the success of organic farming. A viable organic sector will not necessarily emerge due to the policy environment, but good policies will provide a good foundation for the organic sector to grow. Importantly, if the aim is to support the export sector there is no need for mandatory regulation. It is sufficient to create a governmentally-supervised system for export and marketing of organic products. The key to gaining access to external organic markets lies in establishing close relations with competent and qualified existing certification organizations, and efforts to strengthen these relations should have priority.

It should be highlighted that in developing a market of organic farming, compulsory legislation, especially when inadequately formulated, may hinder rather than stimulate the development of organic production. Mandatory organic legislation may indeed facilitate organic farming practices, however it certainly is not a prerequisite for the development of an organic sector. In early stages of development of the organic market what really is of prime consideration is promotion and support rather than a series of compulsory requirements. In that, participatory guarantee systems (PGS) may support and encourage organic market to grow (IFOAM, 2011). PGS are locally-focused quality assurance systems which certify producers based on active stakeholder participation. They are built on social networks and knowledge exchange, and provide a credible guarantee for consumers seeking organic products. Thus, they provide an alternative to third-party certification, and are especially adapted to local markets.

In Suriname, organic farming is currently driven by NGOs actions towards more sustainable agricultural practices. Although organic agriculture as such (i.e. certified products) does yet not exist, significant steps towards organic farming have been made over the last years. For instance, The Caribbean Institute, funded by the UNDP-GEF Small Grants Program, the Alcoa Foundation and the Inter-American Development Bank (IDB), has been leading a number of successful projects and initiatives towards organic farming, making significant progress in engaging with communities throughout Suriname. These projects demonstrated a desire for food that is grown in a more environmentally-friendly manner, that uses less pesticides, and is based on integrated land management from both supply (farmers) and demand (buyers) within internal market. Introduction of this, so called 'safe food' products is a milestone towards creation of organic farming market (Box 1).

Box 1. Safe food market in Suriname

In recent years, there has been an increasing interest of the Surinamese farmers to product healthier and more environmentally-friendly food. This has been driven by increasing concern over the overuse of pesticides and risks associated both with excessive use (direct risk for farmers) and consumption of agricultural products contaminated with chemicals. The Caribbean Institute (<http://www.caribbean-institute.org/>) has been leading a successful initiative to assist farmers in their transformation towards a more environmentally friendly, so called 'safe food'. Upon entering the domestic market these products were received with enthusiasm and, importantly, were not necessarily more expensive. This initiative showed not only that a market for a more environmentally-friendly food exists in Suriname, but also indicated that current supply cannot meet increasingly growing demand. One of the recurrent obstacles to faster expansion of 'safe food' farming was the scarcity of organic compost necessary to provide nutrients in organically-managed farms. Current initiative of the Caribbean Institute related to compost production and management, may greatly facilitate a move towards larger scale 'safe food' production and, ultimately, towards certified organic farming.



SAFE FOOD MARKET IN SURINAME. PHOTO COURTESY OF MAUREEN SILOS



TRAINING SO CALLED "PLANT DOCTORS" IN SURINAME. RECOGNISING CAUSES OF PROBLEMS WITH AGRICULTURAL PRODUCTS IS PARAMOUNT FOR AVOIDING EXCESSIVE USE OF AGRO-CHEMICAL AND A KEY STEP TOWARDS ORGANIC FARMING. PHOTO COURTESY OF MAUREEN SILOS.

Regarding international trade, out of the different options for importing organic produce to the EU (see Section 3 of this chapter), Suriname could collaborate with regional or international CBs in the first instance. Cooperation with an approved CB, such as Bio Latina, could create the necessary expertise for Suriname to at a later date apply for an equivalent country status. Further, Suriname can collaborate with countries which have achieved equivalent country status, such as Costa Rica and Argentina, in order to gain a better understanding and knowledge of the requirements of EU schemes for the trade of organic products. Once expertise and safe organic farming practices are acquired and well rooted, Suriname can take steps to seek an equivalent country status. These efforts will require a longer-term vision for the promotion of safe and organic farming practices.

Possible markets and trade structure for organic products from Suriname are presented in Figure 4. The product (either organic or non-certified 'safe food') enters the domestic market via direct sale from the producer, or is delivered to customers upon processing by manufacturer. Producers may also export the product, processed or not, as organic, providing

they comply with international production and certification regulations. In case of exports to the EU, the product must comply with the requirements outlined in the EU Regulation on organic farming. The product must be certified by an EU-recognized body (as discussed above). The importing agent may introduce the product directly to the market in the importing country, and/or re-export to other countries, and/or sell to the manufacturer for food processing.

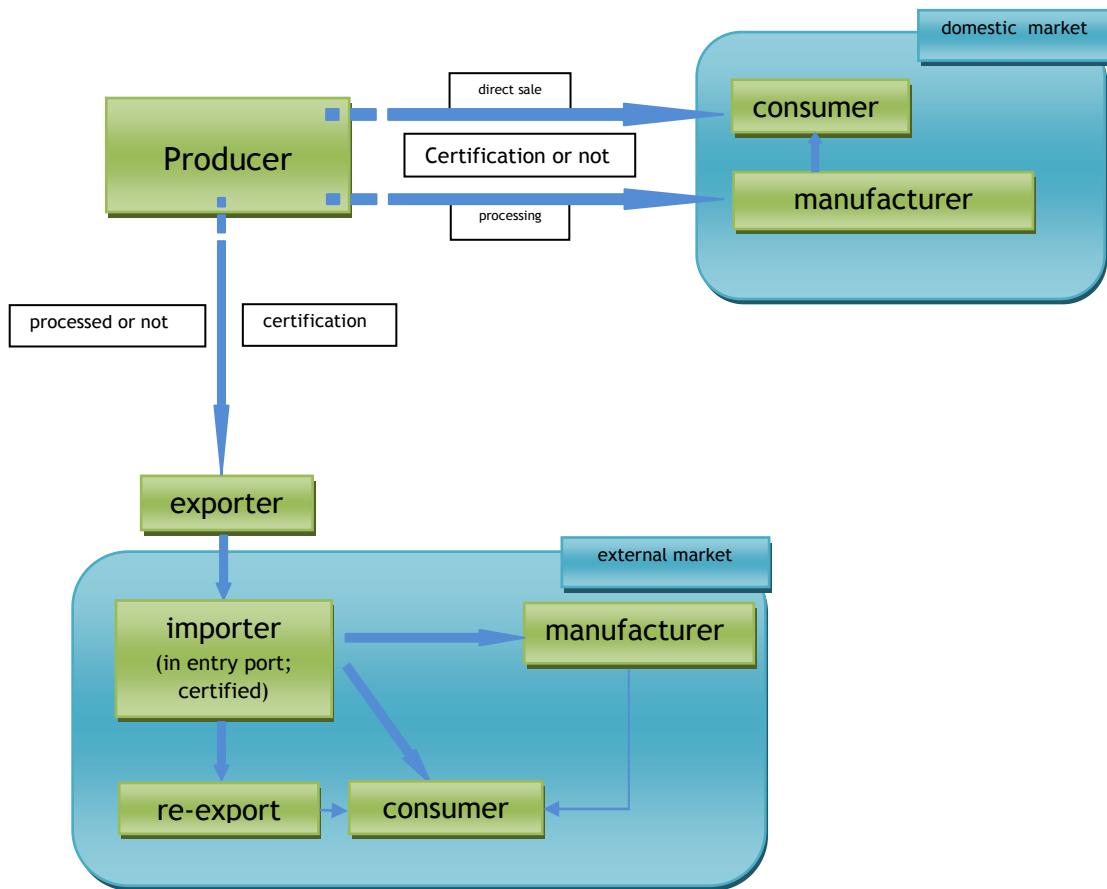
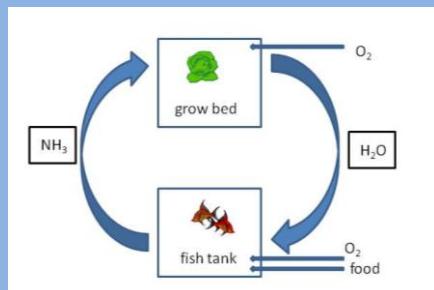


FIGURE 4. MARKETS AND TRADE STRUCTURE FOR ORGANIC PRODUCTS.

One of the opportunities for development of sustainable agriculture in Suriname is aquaponics. Aquaponics is a food production method combining aquaculture (production of fish) with hydroponics (cultivation of crops rooted in water) in a closed-loop system. At the heart of the process is the nitrogen cycle, which symbiotically provides fertility to the plants and simultaneously de-contaminates water for the fish from excess of ammonia (Box 2). The nitrogen cycle occurs as ammonia-rich water flows from fish tanks to plants through biological filters containing bacteria, and back again to the fish tank. Aquaponics provides with a range of benefits including environmental (reduces agricultural runoff, and reducing the water usage required by regular agriculture), food security, and community development benefits (creates activity, provides employment and job skills training opportunities).

Box 2. Aquaponics



In the aquaculture part of the system, farmed fish produce ammonia-rich waste. Ammonia is carried with effluent to the hydroponic part of the system, where the by-products from the aquaculture are filtered by the plants, and clean water is re-circulated back into the fish tanks. Ammonia is aerobically converted by bacteria (*Nitrosomonas* and *Nitrobacter* into nitrates and nitrites, respectively). This practice reduces water toxicity for the fish, and allows the resulting nitrate compounds to be taken up by plants for nourishment.

Another promising solution towards a more sustainable agriculture in Suriname is the adoption of agroforestry (silvopastoral systems) (Box 3). Agroforestry has been shown to prevent and reverse soil degradation, increase biodiversity and the provision of environmental services (German et al., 2006). In addition to mutual biophysical benefits of both systems, such as soil protection and yield increase, incorporating trees into croplands or pasturelands, may result in a range of socio-economic benefits. For example, it enables to maintain agricultural productivity and supplementary farm outputs, enhance the supply of diverse market products, and it provides farmers with alternative products for fodder, fuel, construction materials and food (Gutteridge and Shelton, 1993). Thus, as compared with traditional agriculture, agroforestry may improve rural livelihoods by providing higher incomes and more financial resilience.

Box 3. Agroforestry in Suriname

Agroforestry is an age-old agricultural practice where at least one woody tree species is cultivated on the same land-management unit as plant or animal species. This integrated approach may provide a more diverse, productive, profitable and healthy land-use system.

Suriname already has a record of successful agroforestry projects. For example, 'Women Futunakaba and Sustainable Agriculture (Agroforestry)' project coordinated by UNDP-Suriname Small Grant Programme engaged women from the village Futunakaba. The project contributed to development of a sustainable agricultural system that conserves biodiversity and provides alternative income, combating poverty. Agroforestry was applied as an alternative method to the traditional shifting cultivation (slash-and-burn) and included alley cropping, multiple cropping and multi-storage farming. The project contributed to improvement of the efficiency of the farming system, increased food production, increased the income and the well-being of the families, and improved the position of women and communication.

Another example of the agroforestry-related activity is capacity building in the Pusugrunu area. The local community (Matawai Maroon tribe) was supported with the planning grant for the development of agroforestry activities in their area. This project addressed one of the bottlenecks to the introduction of more sustainable agricultural systems. In that, it aimed to support development of a project proposal contributed to capacity building towards framing, writing and contextualizing grant proposal. Importantly, it was the community itself that determined the scope and focus of the future projects pertinent to the community. Because agroforestry has been a tradition for the Maroon women for centuries, the proposal would target them to develop economic activities within agricultural sector.

5. RECOMMENDATIONS FOR DEVELOPMENT OF ORGANIC SECTOR IN SURINAME

By keeping its native forests, supporting 'zero deforestation' policy and developing a 'greener' agricultural sector, and promoting sustainable development, Suriname has a unique opportunity to set an example both in the region and at the international level. Organic farming offers an opportunity to contribute to greening of and simultaneously adding value to Surinamese agricultural sector. By developing a framework to stimulate organic farming and by working with smallholder farmers (most of the farmers have between 5-10 ha of agricultural land), Suriname may benefit from an increased value of its national agriculture, create both alternative and higher incomes (also by investing in high cash products, such as açai), offer an alternative path for rural people, create new job opportunities, achieve food security both in terms of provision and healthier products, among many other benefits. Recent initiatives, such as 'safe farming' towards sustainable agriculture showed that there is a national interest in, and a market for more sustainable agricultural products. These projects and existing infrastructure (such as Centre for Agricultural Research - CELOS) may provide a starting point for the development of a national organic farming framework, for both raw and processed products (which can further contribute to increasing the value of the agricultural sector). Furthermore, the global market for organic products is likely to continue to expand,

with global trade moving towards higher-quality products, demanding higher social and environmental standards.

Although a range of opportunities exists, there are some constraints to overcome, including: management skills for integrated land management are needed; capacity must be developed (even though funds to support organic farming exists, there may be problems with realizing projects on the ground or putting proposals together); there is a lack of infrastructure, electricity, health care, running water, and education (also making them priorities to resolve). Importantly, due to the lack of inputs to be used in organic farming it is very difficult to grow organic, even if the desire exists. With respect to exports, EU competition and subsidies and the CAP reform may affect Suriname's future export strategy. This matter will need to be clarified once the reform has been concluded, in consultation with economists and agricultural trade experts. Although the development of an organic farming market in Suriname is challenging, time consuming and may incur some set-up costs, it is an opportunity to develop and establish a more sustainable, higher income agricultural sector.

RECOMMENDATIONS:

Some general recommendations are outlined below. These recommendations draw on the Report 'Best Practices for Organic Policy. What developing country Governments can do to promote the organic agriculture sector' from the United Nations Conference on Trade and Development United Nations Environment Programme in 2008 in New York and Geneva (UNEP-UNCTAD, 2008). Since the organic farming sector may be guided by NGOs and other parties rather than exclusively government, the recommendations below are also applicable to those parties.

LEGISLATION

1. All stakeholders should be involved in the development of policy for organic farming and in development of plans and programs related to organic farming;
2. Both general and organic-agriculture policies should support each other to promote effective policy coherence;
3. Upon participatory consultations and assessment of needs, and based on analysis of the state of the sector, an action plan for the organic sector should be developed. It should state measurable targets for the organic sector to help agencies and stakeholders focus their efforts;
4. Before establishing regulations, government should clarify the objectives (export focused, internal market focused, both etc.). Governments, in close consultation with

the sector, should develop the regulations and ensure that the regulation is enabling rather than controlling in nature;

5. A leading role on organic farming should be assigned to one government ministry or agency, accompanied by other positions established in other relevant ministries and agencies;
6. Governments should recognize the diverse interests represented in the organic sector (such as seeking new profits or food security) and ensure that all of them are considered properly, as well as direct special attention to disadvantaged groups;
7. A permanent body could be established for the consultations between the Government and the private sector;
8. Mandatory regulations should only be considered when the need is clearly established and other simpler options have been eliminated. In the early stage of development, a mandatory organic regulation is not likely to be a priority;
9. Legislation for domestic markets should be based on local conditions, and not adjusted to the conditions in export markets.

EXPORTS

10. In order to enable penetration into the EU organic market, Suriname needs to develop high technical and legal expertise. These could potentially be acquired through cooperation with Certification Bodies recognized under the EU's equivalence scheme. To this end, liaison should be sought with regional, as well as European organizations, which could provide the necessary technical and policy-relevant know-how;
11. Cooperation should be sought with countries recognized under the EU's equivalent country scheme. For example, cooperation with Argentina and Costa Rica could enhance Suriname's knowledge of organic farming and export practices.
12. Follow the post-2013 CAP reform and assess its implications for Surinam's agricultural export strategy;
13. The importance of transparency and credibility to the EU organic trade schemes should be taken into consideration. Trust and transparency have extraordinary relevance for organic consumers who have expectations towards organic farming products and are usually highly knowledgeable with respect to organic food.

STANDARDS AND CERTIFICATION

14. National or regional standards for organic production should be developed, through close cooperation between the Government and private sector to provide the highest adaptations of the standard to the local conditions while complying with international standards. Whether through mandatory regulation, voluntary public programs or by the private sector helps to build energy and join activities in the sector
15. Governments should facilitate the access to certification services, either by stimulating foreign certification bodies to open local offices, or by supporting the establishment of local service providers;
16. Participatory guarantee systems (PGS) should be developed to promote and encourage organic market to grow;

17. Producers, especially smallholders, should be supported to comply with standards, certification procedures and regulations. Special considerations should be taken for certification of smallholders;
18. In some countries, especially where the private sector is weak, the government could consider establishing a governmental certification service;
19. Compulsory requirements for mandatory third-party certification should be avoided, as they will not enable other alternatives to emerge. Other conformity assessment procedures, such as participatory guarantee systems, should be explored;
20. The recommendations from the International Task Force on Harmonization and Equivalence in Organic Agriculture (ITF) for regulatory solutions, especially those relating to import access should be considered;
21. Consolidate and strengthen the control mechanisms to guarantee the quality of organic products;
22. Structure and strengthen the forums that guarantee social participation in the creation and control of regulations and public policies directed at the organic sector.



CERTIFICATION. PHOTO COURTESY OF MAUREEN SILOS

EDUCATION

23. Governments should actively contribute to raising society's awareness of organic agriculture on all levels: schools, universities, opening new courses and general capacity building;
24. Organic agriculture should be integrated into the curriculum of primary and secondary schools. Specialized institutions involved in training for organic agriculture should be supported;
25. Higher education in organic agriculture should be developed;
26. Investment in scholarships for integrated land management should be procured;
27. Studies in integrated land management (for organic farming) should be incentivized;
28. Special research programs should be established for organic research, and the sector should be involved in setting of the priorities for the sector. Research and development (R&D) in organic agriculture should be participatory, build on and integrate traditional knowledge (where relevant), and be based on the needs of the producers;
29. Support for grant applications should be provided (capacity building for applying for grants, support to develop ideas, encourage creativity);
30. Awareness of safe agriculture should be spread and linked into income generation in addition to non-material benefits (health).



TRAINING OF ''PLANT DOCTORS''. PHOTO COURTESY OF MAUREEN SILOS

MARKETING

31. Public procurement of organic products should be encouraged, including featuring organic food in important public events;
32. Consumer education and awareness should be actively promoted;
33. Domestic market development strategies should include measures for both the supply and demand side;
34. The organization of farmers with regards to marketing, joint distribution and storage should be supported;
35. Support should be provided to the farmers to sell their products on markets, with packaging, labeling and processing;
36. Market information systems should be established;
37. Export promotion activities should be supported, recognizing the special nature of organic markets. Organic exporters should be encouraged to join forces to promote and market their products;
38. Developing agreements with the clients in case of non-constant provision of organic farming products (possibilities for flexibility in delivery consistency should be addressed);
39. A common (national, regional or international) mark for organic products should be established and promoted;

EXTENSION AND SUPPORT

40. Data about organic production and markets need to be collected over the years, analyzed and made available to the sector and policymakers;
41. Training programs for farmer groups to set up internal control systems should be supported;
42. Organic farming extension services need to be established and the staff trained. Organic extension should be developed and implemented in a participatory manner and have the farm and the farmer as the centre of attention;
43. District level advisory centers in Suriname should be developed to introduce farmers to organic farming management techniques and to incentivize farmers to the transition towards organic farming;
44. Traditional knowledge about pest and weed control treatments should be surveyed and brought into the extension service, especially with respect to organic alternatives to chemical pesticides;
45. Successful examples of organic farmers in the region should be widely disseminated (follow the leader strategy);
46. Government (and/or other actors) should establish basic controls of biological inputs such as pest control agents and organic fertilizers and support and investment for other management instrument for organic farming (such as organic waste management);
47. Organic products should be excluded from any mandatory phytosanitary treatments that are not permitted for organic products. Alternatives for fumigation should be supported;
48. Direct support measures to producers need to be adapted to small farmers as well as to commercial operations;

49. Policies need to ensure that GMO seeds are not distributed or used in a way that can cause contamination of the seeds used within organic farming;
50. Governments and the private sector should participate or encourage to participate in relevant international forums such as the Codex Alimentarius, IFOAM and the ITF;
51. Economic instruments should be created to stimulate agro-ecological transition and the growth of organic production;
52. Availability of appropriate technologies and inputs for the agro-ecological transition and organic production should be increased or provided as in the case of inputs where many struggle to sustain organic agriculture without products;
53. Recycling of agriculture and food waste into organic farming systems should be promoted through, for example, composting;
54. Seed breeding and seed testing should be oriented to organic production (compulsory seed treatments should be forbidden for organic farmers and untreated seeds should be made available);
55. Soil protection should be promoted (for example by crop rotations) while soil fertilization loss should be prevented by a proper nutrient management.



COMPOST IS KEY FOR ORGANIC FARMING. MAKING COMPOST IN SURINAME – PHOTO COURTESY OF MAUREEN SILOS

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COMMISSION REGULATION (EC) No 1235/2008 of 8th December 2008 with detailed rules for implementation of Council Regulation (EC) No 834/2007 as regards the arrangements for imports of organic products from third countries

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008R1235:EN:NOT>

Including amendments:

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<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32009R0537:EN:NOT>

COMMISSION REGULATION (EU) No 471/2010 of 31st May 2010 amending Regulation (EC) No 1235/2008, as regards the list of third countries from which certain agricultural products obtained by organic production must originate to be marketed within the Union (Text with EEA relevance)

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32010R0471:EN:NOT>

COMMISSION IMPLEMENTING REGULATION (EU) No 590/2011 of 20th June 2011 amending Regulation (EC) No 1235/2008, laying down detailed rules for implementation of Council Regulation (EC) No 834/2007 as regards the arrangements for imports of organic products from third countries Text with EEA relevance

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011R0590:EN:NOT>

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<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011R1084:EN:NOT>

COMMISSION IMPLEMENTING REGULATION (EU) No 1267/2011 of 6th December 2011 amending Regulation (EC) No 1235/2008 laying down detailed rules for implementation of Council Regulation (EC) No 834/2007 as regards the arrangements for imports of organic products from third countries

<http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32011R1267:EN:NOT>

Commission Implementing Regulation (EU) No 126/2012 of 14 February 2012 amending Regulation (EC) No 889/2008 as regards documentary evidence and amending Regulation (EC) No 1235/2008 as regards the arrangements for imports of organic products from the United States of America Text with EEA relevance

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Quality Assurance International US-based but also has some useful information on certification and international trade, including Latin America <http://qai-inc.com/>

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List of importers of organic foods

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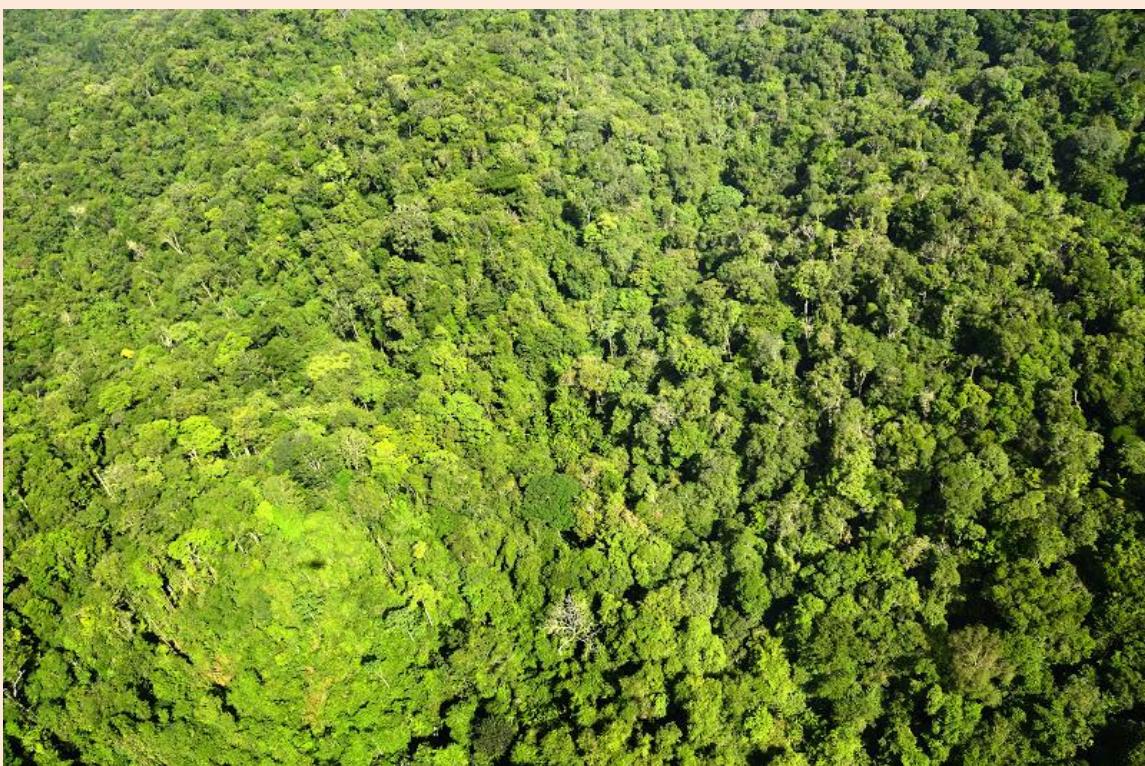
Further information on certification systems, structure, analysis <http://www.certcost.org/>

Recommendations for certification improvement can be found at

http://www.certcost.org/Upload/CERTCOST/Document/D24_designed_web.pdf

and

http://www.certcost.org/Upload/CERTCOST/Document/D23_designed_web.pdf



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V. CONCLUSIONS AND POLICY RECOMMENDATIONS

Sustainability is key to development goals. As scientific evidence shows there is a consensus between academia, private sector and governments of developed and developing countries worldwide that sustainable development is the most promising form of development. The consideration of economic, social and environmental aspects when defining policy goals and perspectives is key to providing long term benefits.

Recent international trends such as incentives to avoid carbon emissions from deforestation (REDD+) or the exclusion of deforestation-related goods from supply chains suggest Suriname is in extraordinary position to greatly benefit from becoming a leader in deforestation-free agriculture.

Countries whose economies heavily depend on exhaustible resources such as mineral extraction, should actively seek to invest in other, more sustainable sectors, especially those sectors where the country has accumulated knowledge and tradition. This is the case for rice, which is the most important agricultural product, and the most successful agricultural export in Suriname.

The provision of water for the rice sector requires government investment. The irrigation system in Suriname requires resources for its administration, operation and maintenance. It is important to design management systems and even set a fee on the provision of this service to increase the efficiency of the system and improve its performance.

Sustainable increase of rice productivity may meet future demands and spare land for other high income agricultural uses, and avoid deforestation path.

Direct income support through the agro-environmental/rural development programs, marketing and processing support, certification support, producer information initiatives (research, training and advice), consumer education and infrastructure support should be provided for successful development of sustainable agricultural sector.

Government, NGOs, private sector should work together to support sustainable rice intensification and on developing organic farming network. Regional cooperation in marketing, standards, conformity assessment and research and development should be promoted.

Organic farming is one of the viable alternatives for sustainable development and greening the agriculture sector in Suriname. Both domestic and external markets exist for organic farming products.

Organic farming may lead to income increase for a variety of stakeholders.

Policy support would boost organic sector in Suriname. Demand exists, however given the early stage of development, it would be desirable to introduce incentives to stimulate further development of the sector (rather than following obligatory rules). Technical support for commercial organic farming is needed in order to successfully apply large-scale organic farming practices.

Import tax exemptions for organic farming products (or safe food products) would stimulate the market. Without products that are needed in organic cultivation, such as biopesticides and biological soil amendments, it may be challenging to develop organic farming market in Suriname.

VI. RESEARCH TEAM

**Agnieszka Ewa Latawiec - International Institute for Sustainability**

Dr. Latawiec is a senior researcher at the International Institute for Sustainability. She holds a BSc in Environmental Engineering and a MSc in Environmental Protection. Having received her PhD in Environmental Sciences from the University of East Anglia UK she has been involved in research related to sustainable land management, innovative technologies to increase soil quality, regulation on organic farming and sustainable increase of agricultural productivity in both developed and developing countries. Particularly, she is interested in solutions to reconcile development with protection of natural resources.

**Ana Maria Rodriguez - Conservation International**

Ms. Rodriguez received her M.Sc. in Agriculture and Natural Resource Economics from the University of California, Davis, as well as a B.S. in Agricultural Engineering from the Universidad Central in Ecuador. Building off of a solid academic background in agriculture, she worked with avocado and potato farmers in Ecuador to improve the marketing chain and farming techniques for their produce in order to boost production quality and generate added value. Her breadth of knowledge spans organic to conventional agricultural production techniques, and genetics to economic analysis of the agricultural sector. She has relevant experience providing guidance on subjects such as financial sustainability, designing and addressing economic viability of entrepreneurial projects, and policy analysis for marine/coastal resources and the agricultural sector.

**Bernardo Strassburg - International Institute for Sustainability**

Dr Strassburg is the executive director of the International Institute for Sustainability in Rio de Janeiro. He holds a Bachelor's degree in Economics, a MSc in Environmental Planning and a received his PhD in Environmental Sciences from the University of East Anglia. He has been involved in research relating to land sustainability, focusing on REDD, biodiversity and ecosystems services, agriculture and integrated spatial planning. He is interested in finding solutions to conciliate human needs and environmental conservation.

**Elah Matt – University of East Anglia**

Dr. Elah Matt is a policy expert in European Union environmental, climate change and transport policies. She completed a PhD examining EU policies on reducing carbon dioxide emissions from cars at the University of East Anglia, Norwich, UK. She holds a MSc in Environmental Policy and Regulation from the London School of Economics and Political Sciences, and a BSc in Environmental Sciences from the University of East Anglia. She currently collaborates with a number of international partners on forthcoming projects and publications.