

FINAL

Environmental and Social Analysis

Suriname

Sustainable Agricultural Productivity Program

SU-L1052

Prepared for:

Inter-American Development Bank
and
Suriname Ministry of Agriculture,
Animal Husbandry and Fisheries (LVV)

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List of Acronyms

ADRON: Anne van Dijk' Rice Research Organization

ATM: Ministry of Labour, Technology, and Environment

CAHFSA: Caribbean Agriculture Health and Food Safety Agency

CARICOM: Caribbean Community Market

CDEMA: Caribbean Disaster Emergency Management Agency

CELOS: Center for Agricultural Research

EA: Environmental Assessment (set of environmental evaluation requirements by the Bank)

ESA: Environmental and Social Assessment

ESMP: Environmental and Social Management Plan

FAO: Food and Agriculture Organization (United Nations)

GEF: Global Environment Facility

I&D: Irrigation and Drainage

IDB: Inter-American Development Bank

IICA: Inter-American Institute for Cooperation on Agriculture

ILO: International Labour Organization

IPM: Integrated Pest Management

IPPM: Integrated Production and Pest Management

IRRP: International Rice Research Institute

LVV: Ministerie Van Landouw, Veetelt en Visserij (Ministry of Agriculture, Animal Husbandry and Fisheries)

NCCR: National Coordination Center for Disaster Relief

NIMOS: Nationaal Instituut voor Milieu en Ontwikkeling in Suriname (National Institute for Environment and Development in Suriname)

NMR: National Council for the Environment

NSP: Naational Surinaam Peil (National Suriname Level) (approximate Mean Sea Level)

O&M: Operation and maintenance

OW: Ministry of Public Works, Transport and Communication

OWMCP: Overliggend Waterschap MCP (Overlying Water Board of the Multi-Purpose Corantijn Project)

PAHO: Pan-American Health Organization

PEU: Project Executing Unit

PPE: Personal protective equipment

RAMSAR: Convention on Wetlands of International Importance

RO: Ministry of Regional Development

SRP: Sustainable Rice Platform

STINASU: Stichting Natuurbehoud Suriname (Foundation for Nature Preservation in Suriname)

UNDP: United Nations Development Program

UNFCCC: United Nations Framework on Climate Change

WHO: World Health Organization

I. INTRODUCTION

1.1 Background

The Inter-American Development Bank (Bank) and the Suriname Ministry of Agriculture, Animal Husbandry and Fisheries (LVV) have prepared the Sustainable Agricultural Productivity Program, which is designed to increase agricultural productivity in Suriname through investments in infrastructure and management of irrigation and drainage (I&D) systems; the transfer of these system's operation and maintenance (O&M) responsibilities to farmers organized in water boards (see Section 3.3.8 for a description of water boards and their functions); and to improve the conditions for information-based policy-making by increasing the amount and quality of agricultural information on a national level. The total expected value of the proposed loan by the Bank for the Program is US\$298 million over six years.

The Program (hereinafter referred to as "Project") is expected to result in: an increase in rice productivity in I&D areas; water boards operating and contributing to O&M; and improved statistics and information systems. The Project consists of two components: Irrigation and Drainage and Agricultural Statistics and Information. The first component will focus its efforts in the Nickerie District to benefit rice production and other crops. The second component will involve agriculture in the entire country. The components are explained in further detail in Section 1.3.

1.2 Institutional Setting for Irrigation and Drainage

Three ministries share responsibility for maintenance and repair of irrigation and drainage systems in Suriname: Agriculture, Public Works, and Regional Development. Their individual responsibilities are explained below but the three ministries have formed an inter-ministerial working group to improve communication and coordination in their respective activities.

LVV, which is responsible for development of plans, policies and programs in the areas of agricultural research and extension, livestock, and fisheries, as well as irrigation, will implement the Project. LVV operates crop experiment farms throughout the country and also collaborates with and funds some of the activities of the Anne van Dijk' Rice Research Organization (ADRON). LVV has responsibilities for irrigation and drainage, but has no corresponding department at the headquarters level. The main mandate of this Ministry in water management relates to the implementation of services to ensure that adequate and timely water for irrigation is supplied for crop production and that excess water is drained out to ensure optimal conditions for crop growth, land preparation and timely cultural operations. Within its mandate the Ministry is responsible for the water calendar, determining water supply to the various crops, in line with cultural practices, and maintenance of secondary canals. LVV has also implemented some rehabilitation of I&D systems of water board polders and the tertiary road systems in Nickerie.¹²

The Ministry of Public Works, Transport and Communication (OW) is responsible for the maintenance of primary canals and pump stations as well as the planning, design and implementation of all major and technically more complex civil and hydraulic engineering works.³

¹ Inter-Ministerial irrigation and Drainage Coordination Working Group, Dec 2015

² LVV, meeting Nickerie, November 2017.

³ Inter-Ministerial Irrigation and Drainage Working Group, Dec. 2015.

The Ministry of Regional Development (RO) has a mandate relating to the regional governance, decentralization and development of the districts, ensuring the general welfare and the implementation and promotion of district development programs. As such it is responsible for the economic development in the district and makes available regional funds for the rehabilitation and operation of the secondary and tertiary I&D irrigation canal system. It is specifically responsible for the promotion and strengthening of local organizations and as such is responsible for the establishment, supervision and strengthening of the water boards, including approving the water board regulations.

The Overlying Water Board of the Multi-Purpose Corantijn Project (OWMCP) in Nickerie (created to manage the irrigation water resources in the Nickerie District when the Corantijn Canal Project was developed) is responsible for directly managing water boards and also carries out operation and maintenance of the main I&D infrastructure of the Nickerie system and comes under the RO Ministry.

In practice, the lines of responsibility are not so clearly drawn and the three entities at the local level collaborate and share resources as maintenance needs arise.

1.3 Project Description

A brief description of the Program and its objectives are provided here. Detailed information about the investments for Component 1 are provided in Section V.

1.3.1 Component 1, Irrigation and Drainage

The Irrigation and Drainage (I&D) Component will finance:

- rehabilitation/modernization of irrigation and drainage infrastructure, benefitting a large number of small and medium farmers through improvements in productivity and/or reduction in the risks of flooding;
- support for developing and strengthening water boards' capacity to take over the operation and maintenance of canals and sluices in the polders of each water board;
- capacity building of government bodies in charge of water resource administration for irrigation and drainage;
- design and implementation of incentive mechanisms, including cost sharing for land levelling costs and training in pesticide and fertilizer management, aimed at improving efficiency in farmers' water and agrochemical use and increasing their willingness to cover O&M costs;
- a water balance project using existing water level data to be carried out by the Bank's Hydro-BID Modelling Program;
- installation of a permanent water level monitoring system; a stakeholder engagement and communications plan;
- an ecological assessment of the Nanni Swamp; and
- a pesticide study consisting of a survey and water quality/sediment assessment (see Section VIII).

1.3.2 Component 2, Agricultural Statistics and Information

The Agricultural Statistics and Information Component will finance: (i) design of the Agricultural Information System; (ii) design and implementation of the agricultural census; (iii) design and collection of one or two years of agricultural surveys with probabilistic sampling; (iv) institutional strengthening; and (v) annual update of the estimates of the public support to the agriculture sector.

1.3.3 Related Bank Programs

To support the development of the Project, a Policy Based Programmatic Loan ⁴was approved in 2014 to support of a series of institutional and policy reforms in the agriculture sector, aimed at increasing long term agricultural growth in Suriname. The specific objectives of the Policy Based Loan related to this Project were:

- Modernization of Agricultural Statistics; and
- Modernization of Irrigation and Agricultural Drainage Services

A Strategic Socio-Environmental Assessment was prepared for the Policy Based Programmatic Loan, which concluded that there would be no significant adverse socio-environmental impacts and only minor risks that could be minimized by incorporating socio-environmental sustainability aspects into the policies under development.

A second related IDB Program was approved in 2016 and will begin operation in 2018 – the Agricultural Competitiveness Program, which will finance improvements in plant health, animal health, and food safety. It also has a small agricultural innovation component which includes a project to strengthen the rice sector to help reduce yield losses and production costs, as well as reduce the widespread misuse of pesticides.⁵ This project, to be carried out by Anne van Dijk’ Rice Research Organization (ADRON) and LVV, will develop Integrated Pest Management (IPM) strategies for managing weeds, fungal diseases, insect pests and pests that are problematic during storage. The IPM strategies will be tested in farmer’s fields and once they are validated, farmers will be trained in the implementation of IPM. An Environmental and Social Assessment was prepared for this Program and included an Environmental and Social Management Plan (ESMP). Given that the Program has only just begun execution, the ESMP has not yet been operationalized.

1.4 **Socio-Environmental Classification and Evaluation Requirements for the Program**

The Inter-American Development Bank has established policy directives⁶ requiring the evaluation of environmental and social impacts of projects and the development of environmental and social management plans that identify necessary measures to mitigate potential adverse impacts of proposed operations and the institutional mechanisms for carrying them out.

Following the requirements of the Bank’s Environment and Safeguard Compliance Policy (OP703) the project team screened and classified this Project using its Safeguard Policy Filter. The team found the Project to be classified in category “B” which relates to “operations that are likely to cause mostly local and short-term negative environmental and social impacts and for which effective mitigation measures are readily available”. More specifically it was determined that the following directives and policies⁷ applied to the Program: making Program documents available to the public; evaluating risks of natural disasters; assessing ways to promote climate change adaptation; ensuring compliance with country laws and regulations related to the environment, gender issues, and indigenous people’s rights; assessing risks related to weak institutional capacity for environmental management; conducting an environmental assessment; carrying out stakeholder consultation; ensuring provisions for supervision and compliance monitoring during Program execution; managing hazardous materials; ensuring

⁴ Modernization of Agricultural Public Services, SU-L1033.

⁵ Investment Loan for the Agricultural Competitiveness Program, SU-L1020.

⁶ IDB, 2006

⁷ IDB’s six safeguards policies can be found at <https://www.iadb.org/en/about-us/sector-policies,6194.html>

pollution prevention and abatement; and considering environmentally responsible procurement, where appropriate. Section X of this report presents an explanation of how the ESA and the Environmental and Social Management Plan for the Program will ensure compliance with the afore-mentioned policies.

Category B operations require the analysis of socio-environmental impacts and risks that focus on the specific issues identified in the safeguards filter report. This analysis includes the following elements:

- analysis of proposed project activities to identify potential environmental or socio-cultural impacts or risks, including the mitigation measures to manage them;
- analysis (using secondary sources) of the hydrological and ecological resources potentially impacted in the area of the project;
- assessment of gender or vulnerable populations that could be affected by the project;
- evaluation of disaster risk to and from the project;
- consideration of climate change implications of the project and of climate resilience opportunities for the project;
- analysis of local environmental and social laws and policies, how they apply to the Project;
- evaluation of institutional capacity for socio-environmental management, specific mechanisms for socio-environmental management of this project, and recommendations for improving socio-environmental management in LVV;
- development of actions necessary to avoid, reduce or mitigate the identified significant adverse impacts and risks; and
- preparation of an environmental and social management plan (ESMP), which includes identification of institutional responsibilities, budget, schedule, and mechanisms for monitoring implementation of the plan; and
- a stakeholder mapping and consultation plan, including the identification of indigenous groups in the direct and indirect area of influence of the program

1.5 Purpose and Content of the Environmental and Social Analysis Report

The purpose of this report is to present the findings of the socio-environmental analysis; describe the public consultation process; identify mitigation measures for significant adverse impacts; identify management strategies for reducing risks; and present an Environmental and Social Management Plan (ESMP) to be included in the operation's operating manual.

This report presents:

- a description of the proposed components and activities;
- a summary of the relevant institutional and legal framework for environmental and social management in Suriname, as well as a discussion of international standards for environmentally sustainable irrigated rice production;
- a description of the environmental socio-economic and agricultural setting in Suriname and specifically in Nickerie, which is the priority area identified for the Irrigation and Drainage Component;
- a discussion of potential social and environmental impacts and risks of anticipated investments and the measures to mitigate or reduce adverse impacts and risks;
- Assessments of disaster risks and climate change impacts and adaptation opportunities;
- an Environmental and Social Management Plan that includes management measures, execution mechanisms and responsibilities, provisions for monitoring the implementation of the plan, and a budget; and

- a description of the consultation processes with affected parties.

II. SURINAME'S AGRO-ECOLOGICAL SETTING

This section presents a brief overview of Suriname's climate, ecology, agricultural production and cultural characteristics and then focuses on the Nickerie region, which is the priority geographic area to be supported by the Program.

2.1 Location and Climate

Suriname is located on the northeast coast of South America. It is bordered by the Republic of Guyana on the west, Brazil on the south and French Guyana on the east. The country has a total land area of 166.000 km² and a 370 km long coastline along the Atlantic Ocean in the north.

With a tropical climate, the country has temperatures ranging from 21°C to 32°C. Rainfall averages about 320 cm per year, with a short rainy season from early December to the end of January, a short dry season from early February to the end of April, a long rainy season from early May to mid-August, and a long dry season from mid-August to the end of November.⁸ The El Nino and La Nina weather phenomena also influence Suriname's weather.

In the last several decades, coastal and river flooding due to increased precipitation has increased in scale and frequency and many tornadoes have occurred.⁹ Increased coastal and river flooding has already damaged agricultural production in some areas and there is saltwater intrusion into agricultural lands in the Nickerie and Coronie districts. On the other hand, dry periods have also started earlier than in the past, requiring irrigation to start earlier and earlier each year.

2.2 Ecosystems

As shown in Figure 1 there are five main ecological zones in Suriname:¹⁰

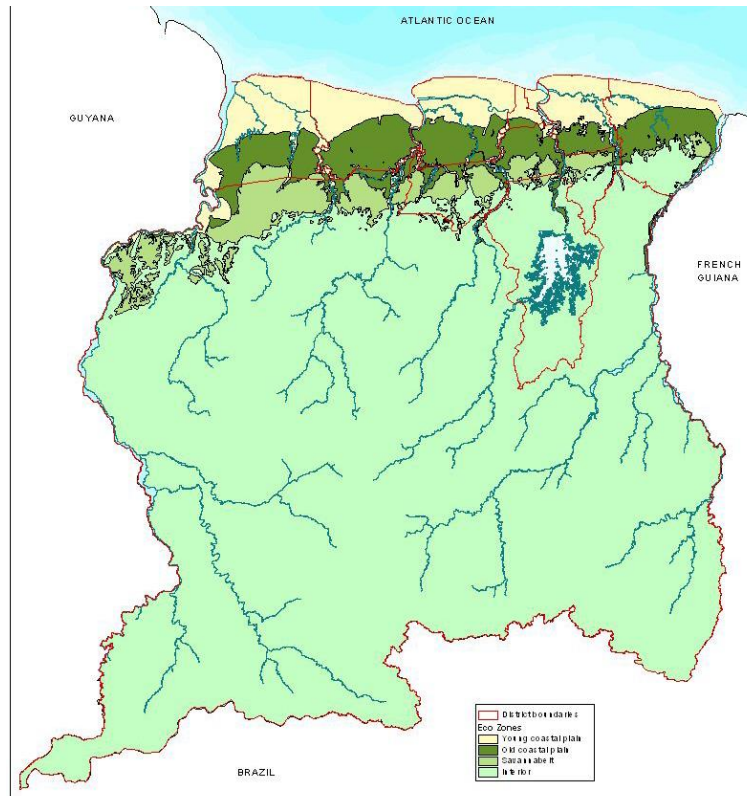
- Marine Zone, including all off and near shore environments;
- Young and Old Coastal Plains –
 - Young Coastal Plain including coastal beaches, estuaries, mudflats, mangrove communities, and swamp and coastal forest environments; and
 - Old Coastal Plain, including higher sandy ridges, inland swamps, wetlands and forests;
- Savannah Belt (50-60 km. wide), including a mix of open grasslands, xerophytic forest, deciduous forest and rainforest communities; and
- Interior Forests, including wet tropical lowland and sub-montane forests and some massifs as high as 1,255 m above sea level, which cover about 75% of the country's land surface.

⁸ WWF, <https://www.worldwildlife.org/ecoregions/nt0149>, accessed Dec 1 2017

⁹ Raghoobar, Hein, August 2013.

¹⁰ Ministry of Labour, Technology Development and Environment, et.al., 2006

Figure 1. Ecosystems in Suriname¹¹



Suriname's 8 major rivers and numerous fresh and saltwater wetlands provide important agricultural, social and environmental services for the country. The Corantijn River forms the border between Suriname and Guyana on the west. The Marowijne River forms Suriname's eastern border. Between them they drain over half of the country. Other major rivers include: the Nickerie in the west; the Coppename and Saramacca Rivers in the center of the country; the Suriname, which flows through the capital of Paramaribo; and the Commewijne and Cottica Rivers on the east. The Suriname River has a large dam and reservoir, which provides hydroelectric power for Paramaribo. The Nickerie,

Corantijn and other rivers in the west provide important irrigation and drainage services, particularly for rice production.

Wetlands in the old coastal zone cover an area of about 12,000 square kilometers, a third of which are permanently inundated, while the rest of the area is seasonally inundated. This region extends as a narrow, near-coastal strip, across all of northern Suriname, from the Corantijn River along the Suriname-Guyana border to the Marowijne River along the eastern border of Suriname. The freshwater swamps of the coastal plains, which form part of the Paramaribo Swamp Forest Ecoregion, are mainly characterized as having herbaceous vegetation, interrupted by elevated natural sand ridges and often man-made levees. High swamp forests exist in the higher elevations.¹² Two of the largest fresh-water wetlands include Nanni Swamp in the Nickerie District and Coronie Swamp in the Coronie District, both of which have been historically used for irrigation and water supply. The Coppename mounding wetland in the Saramacca District has been designated as a RAMSAR site.

2.3 Socio-Economic and Agricultural Characteristics of Suriname

Suriname is divided into ten political districts: Nickerie, Coronie, Saramacca, Wanica, Paramaribo, Commewijne, Marowijne, Para, Brokopondo, and Sipaliwini as indicated in the map in Figure 2. Of Suriname's population of over 500,000 people, about 95%, live in the coastal plains and another 5% in the interior (mostly Marron communities and native Amerindians).

¹¹ Ministry of Labour, Technology Development and Environment, 2006.

¹² WWF, 2017

Figure 2. Political Districts of Suriname ¹³



Suriname's total land area is around 15.6 million hectares. About 1.5 million hectares have agricultural potential, but less than 6% of these lands are actually being farmed. Based on the Fifth Agricultural Census 2008-09 there are 10,234 farm holdings in Suriname, of which the large majority are family farms (10,188). The remaining non-family farms, which include a few very large farm holdings, occupy about 39% of all agricultural land in Suriname.

Some 85% of the agricultural lands are located in the coastal plains.¹⁴ These areas, largely characterized as low-lying and swampy, were diked and drained by early colonists. Only about 16% of the population is dedicated to agricultural production, with the most important activities being rice production (80-85% of harvested cropland, concentrated mostly in the Nickerie region and two smaller rice production areas in the Coronie and Saramacca districts) and characterized by a combination of small, medium and large farms with considerable mechanization). Farm size in the rice sector varies greatly – at one end of the spectrum there are many small producers with only a few hectares, but the bulk of the rice production capacity (some two-thirds) is concentrated in a relatively small group of large farms of 75 ha and more (some 55 farms).¹⁵

Bananas are a second important crop (a single company); and fruits and vegetables are a third important crop – mostly grown on small family farms. The main citrus (oranges, pomelos, and others) production areas are in the districts of Commewijne, Saramacca and Wanica. Coconuts were once an important crop of the Coronie area, but are no longer cultivated due to soil salinization, however, small scale harvesting of existing coconut trees as well as honey production are important in the Coronie area.

¹³ Ministry Labour, Technology, Development and Environment, 2011

¹⁴ Roseboom, Johanne, 2012.

¹⁵ Inter Ministerial Irrigation and Drainage Coordination Working Group, 2015

On a national basis, women play an important role in working on the farms, both working on their own farms with other family members and to some extent as hired help. In the majority of the coastal plain districts (especially in rice production) the family farm is in most instances headed by a man and the majority of the work on the family farm is done by the man (64%). In the three interior districts- Marowijne, Brokopondo, and Sipaliwini, the situation is the opposite, with some 71% of women working on the farm. In these districts 64% of contracted labourers are also women. These districts are mainly populated by Maroons (descendants of escaped slaves) and indigenous populations, who practice small-scale agriculture mainly for their own consumption. The traditional role division in these groups is that the men are responsible for clearing the land and the women for growing the crops.¹⁶

III. INSTITUTIONAL AND SOCIO-ENVIRONMENTAL LEGAL FRAMEWORK

It should be noted that Suriname has no comprehensive and overarching law for environmental protection and management and the institutional framework for environmental management is not yet well defined. However, the Constitution of 1987 lists as one of its objectives *“The creation and promotion of conditions, necessary for the protection of nature and for conservation of the ecological balance”*.¹⁷ Also, there are various laws and policies related to social and environmental issues and various institutions involved in carrying them out. Suriname is a party to numerous international conventions related to the environment, which drive many of its environmental policy and project efforts.

3.1 Institutional Setting for Environmental Management

A National Council for the Environment (NMR) was established in 1997 as an advisory body to the government and consisted of 5 members appointed by the president and five members representing the trade and industry, unions, Amerindian and Maroon communities and consumer organizations. It is not clear if the Council is active today.

The National Institute for Environment and Development in Suriname (NIMOS) was created in 1998 to support the NMR in implementation and research and to create a national framework for environmental policies and management. NIMOS's current activities include review of environmental and social impact assessments of proposed projects, environmental monitoring and enforcement of environmental mitigation plans, and education and outreach. NIMOS, with 9 technical staff, including the director and a number of support staff, is also involved in grant-funded projects related to the environment, including climate change initiatives.

An Environment Section was created in the Ministry of Labour, Technological Development and Environment (ATM), which was converted to a Directorate in 2011. NIMOS received some budget funding under this Directorate. The 2012 ATM budget did not include any funding for the Directorate or NIMOS. In 2013 the Directorate was removed from the Ministry and a National Environmental Policy Office was created in the Office of the President of the Republic, which was to oversee NIMOS. The Policy Office, which did not become operational until late 2015, was responsible for formulating and coordinating environmental policy and environmental legislation and serving as the environmental focal point, representing the country in the various environmental conventions it is party to.¹⁸ In 2017 the National Environmental Policy Office was eliminated and the Coordination Environment was created,

¹⁶ Roseboom, September 2016.

¹⁷ Del Prado, 2013

¹⁸ Personal communication, Haydi Berrenstein, National Environmental Policy Coordinator, June 17, 2016.

still within the Office of the President. The Coordination consists of a Presidential Advisor and an Environmental Policy Officer. In late 2017 it was officially established that NIMOS would function under the direction of this office, which is reflected in a new draft environmental law (see below).

Additional environmental management activities and policies are carried out under various ministries. The Ministry of Spatial Planning, Land and Forestry Management is responsible for protected areas and forestry management. Within this Ministry the Nature Conservation Department is tasked with the overall management and enforcement of protected areas, of which there are currently 16.

The Ministry of Natural Resources manages water resources policy, drinking water supply (groundwater and small community drinking water systems not served by the state water company), energy resources, and mineral resources. It also controls extraction of sand, rock and gravel and reportedly issues permits for these types of mines.¹⁹ The Ministry of Public Works, Transport and Communication, Transport and Communication (OW) manages surface water and urban drainage, conducts hydrological and meteorological monitoring, and manages sewage treatment. In the environmental arena, the Ministry of Health²⁰ is responsible for regulating medical waste management. LVV is responsible for pesticide management, including approval of imports, distribution, storage and use.

3.2 Key International Environmental Accords and Corresponding National Policies and Programs

Suriname is party to many international conventions, which provide a framework for environmental management in Suriname, given the lack of a national environmental law. Only those conventions that are relevant to this Project are described here.

3.2.1 Kyoto Protocol to the United Nations Framework Convention on Climate Change. An inventory of CO₂ emissions has been done and a National Climate Change Strategy has been prepared. (See Section 7.1 for more discussion on this strategy and the Project's impacts and opportunities).

3.2.2 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. Ratified 2000. Two pesticides have been banned by Suriname to date (Dieldrin and Monocrotophos) and the country has notified its "No consent to import" for 26 other chemicals.²¹ This convention largely drives Suriname's procedures for evaluating and deciding on the import of pesticides into the country.

3.2.3 Convention on Biological Diversity. Ratified in 1996. A Strategy for Biodiversity was prepared in 2006 as well as a Biodiversity Action Plan. The most recent report for Suriname was submitted in 2015. Suriname has 16 protected, proposed for protection, and special multiple-use areas totaling over 2 million acres (see Section 3.3.3 for more detail on the Country's conservation strategy and Section 6.2 for analysis on how this Project impacts the strategy).²²

¹⁹ Personal communication, Mr. van der Kooye, LVV, November 2017.

²⁰ Sometimes referred to as Public Health.

²¹ Rotterdam Convention website, <http://www.pic.int/>, September 2013

²² Ministry of Labour, Technology and Environment, 2012.

- 3.2.4 Convention on Wetlands of International Importance especially as Waterfowl Habitat. (RAMSAR). Came into effect in 1985. Suriname has one site designated under RAMSAR – Coppename monding in the Saramacca region (12,000 ha.).²³

3.3 National Socio-Environmental Legislation, Policies and Practices

3.3.1 Environmental Management and Protection Policies and Legislation

The policy of the Government of Suriname on environmental management was specified in the Government's Policy Development Plan for 2017 to 2021²⁴: which established the following goal of having

“Adapted legislation and increased environmental awareness of the public, policy planners and decision-makers in the private and public sectors ensure the responsible use of nature and the resources it provides and promote planned environmental restoration.”

The Plan established the following desired outcomes

1. Environmental legislation and the related national environmental strategy and follow-up programs to influence and raise environmental awareness of the public, policy planners and decision-makers in the private and public sectors, with particular attention given to the issues of sea level rise, controlling and or preventing disasters and the nature reserves.
2. In acquiring their livelihoods and products for the market, citizens and businesses use the resources that nature provides responsibly, and the Government ensures this, where necessary with support from the international development partners.
3. Based on the Environmental Legislation, the related national environmental strategy, the Development Plan 2017-2021 and the district plan, citizens and businesses invest and work in accordance with their national and international obligations on the restoration of the environment damaged by their economic or other activities.
4. Suriname has integrated its sustainable development strategy into the regional and international environmental strategies and action programs and has developed the capacity to participate fully in the financing and monitoring programs.
5. Based on the Environmental Legislation and the National Environment Strategy, Suriname participates in regional and international programs for the management of the CO2 levels in the atmosphere and to minimize the damage to Suriname's infrastructure and economy.

Despite the existence of the Coordination Environment in the Office of the President and NIMOS, there is no over-arching law for environmental management in Suriname. A draft law to establish an environment management framework was proposed in 1998 and submitted to the Council of Ministers, which then submitted it to Parliament. The law was never passed. Another version of an environmental law was prepared by the Climate Change Expert Group of Suriname²⁵ and submitted to the Council of Ministers in 2013. This law was not passed either. NIMOS submitted yet another version of the law to the Council of Ministers in 2016 and is now working on a modification of it to update the institutional

²³ RAMSAR Convention website, http://www.ramsar.org/cda/en/ramsar-home/main/ramsar/1_4000_0

²⁴ Suriname Stichting Planbureau Suriname (National Planning Office), January 2017.

²⁵ Made up of representatives from NIMOS, the Meteorological Office, Conservation International, and University of Suriname, among others.

authorities under the law, with plans to resubmit it to the Cabinet soon. NIMOS reports that there appears to be momentum in Parliament to take up the law in early 2018.²⁶

If adopted this law would establish an Environmental Authority²⁷ which will have the authority to propose regulations to manage pollution, including waste management, hazardous materials management and the creation of pollution standards. The law would create a Supervisory Board made up of technical experts in a wide variety of disciplines as well as representatives of indigenous and maroon populations. Its function would be to supervise the activities of the Environmental Authority. The law would require the assessment of potential environmental impacts of certain types of proposed projects and allow the Environment Authority to issue environmental permits/licenses. An environmental fund would be created to pay for the activities of the Environment Authority (although the source of the funding is not made clear). The law also would establish a mechanism for creating a National Environmental Policy Plan which would drive environmental management programs. It would be updated every 5 years, with the Environment Authority providing periodic reports on progress. Additionally, the law would establish sanctions for violations.

Suriname has no regulatory standards for ambient water quality, ambient air quality, or management of hazardous substances or wastes.²⁸

3.3.2 Environmental Impact Assessment and Environmental Permitting

NIMOS has developed guidelines for classifying and studying environmental impacts of proposed projects (similar to those of the IDB) and procedures for their review and enforcement of mitigation measures, but they are currently not mandatory. Generic guidelines have been developed for the classification of proposed projects, and the type of environmental evaluations required, as well as specific guidelines for some sectors, including: power and transmission projects; social impact; forestry; and mining. However, NIMOS reports that numerous international companies voluntarily subject themselves to the guidelines and follow the procedures, including the preparation environmental management and monitoring plans. There are no written guidelines for evaluation of policy projects or programs, although NIMOS states that the generic guidelines may be used for these kinds of proposals.

There are no current laws requiring environmental permits for programs or projects.

3.3.3 Biodiversity and Protection of Natural Resources

Suriname's approach for conservation of biodiversity involves designating areas as protected in one of three ways: Nature Reserve (NR); Nature Park (NP); and Multiple Use Management Area (MUMA). The Nature Conservation Department of the Ministry of Spatial Planning, Land and Forestry Management has overall responsibility for management of protected areas.

Under the Nature Conservation Act of 1992 (*Natuurbeschermingswet 1954*, G.B. 1954 no. 26 z.l.g. bij S.B. 1992 no. 80 (Nature Conservation Act 1954, G.B. 1954 no. 26 as amended by S.B. 1992 no. 80) the President may designate land and water in the public domain for protection as a Nature Reserve. One of the criteria for an area to be designated as a nature reserve is that "the area in question due to its diverse natural and scenic beauty and/or by the presence of important flora, fauna and geological

²⁶ Personal Communication, Cedric Nelom, NIMOS, November 27, 2017.

²⁷ NIMOS would be absorbed into the new Environmental Authority

²⁸ There are some standards for airborne chemicals and particulates for indoor air quality in the workplace.

objects requires protection by the government”.²⁹ While hunting and fishing are generally not allowed in a Nature Reserve, there may be exceptions for indigenous and Marron populations.

A Nature Park may be established on the basis of Land Reform Decrees from 1982. Brownberg Nature Park is the only Nature Park currently in Suriname and is managed for tourism, research and education by the Stichting Natuurbehoud Suriname (STINASU)³⁰

Multiple-Use Management Areas (MUMAs), are also established on the basis of the Land Reform Decrees of 1982 and are managed under adopted management plans. MUMAs are “areas where integrated management by or on behalf of the Government is needed for a rational use of its natural resources”. Protection aims at keeping the ecosystem functionally intact and productive, to ensure the survival of vulnerable wildlife populations, while still allowing hunting and fishing as well as other activities.³¹

At present, Suriname has 16 legally established protected areas (11 NRS, 1 NP, and 4 MUMAs). Four areas have been proposed for protection, but it appears that this is not actively being pursued, with the possible exception of the Coronie freshwater swamp. A description of the currently protected areas and those proposed in the Project area is provided in Section 4.2.2

In addition to the legally established protected areas as described above, a Ministerial Order in 2005 provided guidelines for land issuance within the estuarine zone of rivers. It states that there should be a 500 m wide area on both sides of the river conserved for forest and a 200 m wide area on both sides of creeks for the same purpose.³² It is not known if this guideline is actually applied in practice.

3.3.4 Pesticide Management Legal Framework

Suriname does not have any pesticide manufacturers; all pesticides are imported. The levels of documented imported pesticides in 2013 included 73,144.77 kg of insecticides; 447,390.80 kg of fungicides and 277,234.00 kg of herbicides.³³

The Pesticide Act of 1972 (Bestrijdingsmiddelenwet G.B. 1972 no. 151, z.l.g. bij S.B. 2005 no. 18 (Pesticides Act G.B. 1972 no. 151 as amended by S.B. 2005 no. 18) requires that all pesticide manufacturers and importers obtain authorization from LVV to import and use pesticides. These authorizations are good for 5 years. Additionally, the Law of Import and Export of Goods (1999 and 2003) prohibits the import of all Rotterdam Annex III (extremely hazardous) chemicals and the possession, sale and use of 33 different pesticides. Six additional pesticides are prohibited to be imported by decree and LVV is prohibiting import of 5 more. Methyl bromide is also prohibited by Suriname under the Stockholm Convention. The State Order of Pesticides of 2005 classifies pesticides as to their toxicity, requires adequate labelling, specifies the use of protective clothing for pesticide applicators, provides basic requirements for storage facilities and authorizes LVV to regulate disposal of containers. There is a separate Ministerial Order on labelling as well. A new pesticide law was approved by Parliament in 2016 that will prohibit the sale of pesticides in grocery stores and other unlicensed facilities.

²⁹ Third National Report to the United Nations Convention on Biological Diversity, 2009.

³⁰ Foundation for Nature Preservation in Suriname

³¹ Third National Report to the United Nations Convention on Biological Diversity, 2009

³² Del Prado, 2013.

³³ Abdoel et.al., 2016.

Despite the existing laws and rules, LVV lacks an adequate system and the capacity to adequately monitor imports of pesticides. Current practice is to review MSDS submittals and labels (labels must be in Dutch) for adequacy, but Suriname does not yet have the capability to test pesticide content to confirm ingredients listed on the labels.³⁴ LVV also lacks sufficient regulations and staff (there is currently one staff person in charge of the Division and one assistant) to inspect and supervise pesticide distributors and oversee pesticide use, although there are various efforts to inform farmers about pesticide risks and methods for protection, and a program is being developed to train staff as inspectors for inspecting pesticide distributors and dealers.

3.3.5 Solid and Hazardous Waste and Wastewater Management

The Ministry of Public Works, Transport and Communication is responsible for planning and financing collection and disposal of solid wastes in the greater Paramaribo area. The Ministry of Regional Development is responsible for solid waste management in the Districts outside of Paramaribo.³⁵ According to the 2006 National Profile prepared for the United Nations Institute for Training and Research, separation of wastes is not practiced and chemical household, industrial, laboratory, and construction debris are all dumped into uncontrolled municipal garbage dump sites.³⁶

Nickerie has an uncontrolled waste dump – Rijdsdijk, where occasional grading and compacting are practiced.³⁷ There is also a metals recycling facility on the outskirts of Nieuw Nickerie.

There are no specific national laws or regulations governing hazardous (chemical) waste treatment and disposal, nor is there capacity for treatment and disposal. A recycling company called AMRECO was involved in recycling of used/rinsed pesticide containers for a pilot project with LVV and still accepts empty, triple rinsed pesticide containers for recycling the plastic, compacted into flattened bundles. The company is now requiring certification that pesticide applicators have been trained by LVV in triple rinsing techniques.³⁸

Suriname has no standards for air emissions, wastewater treatment or discharge quality, or ambient water quality.

3.3.6 Occupational Health and Safety

The Ministry of Labour is responsible for occupational health and safety legislation and inspection with broad authority to inspect and require safe workplaces, for both the private and public sectors. Its authority comes from the Safety Act of 1947 ('Veiligheidswet G.B. 1947 no. 142, z.l.g. bij SB. 1980 no. 116 - Safety Act G.B. 1947 no. 142, as amended by SB. 1980 no. 116) and a later law that requires employers to provide insurance for workplace health and safety problems. The Department of Labour Inspection has 60 inspectors who conduct regular unannounced inspections of work places as well as inspections in response to complaints. There is a Labour Tribunal that can levy fines for violations of workplace safety. Employers are required to provide personal protective equipment, but health and safety plans are not required, although large companies generally have plans. The 1947 law excluded

³⁴ Note that the LVV residue laboratory will be completed and equipped starting in 2018 under an IDB project related to Plant and Animal Health and Food Safety. In addition to analyzing agricultural products for pesticide residues before export, it will also have the capacity to test pesticide formulations being imported to verify their contents.

³⁵ PAHO, 2013.

³⁶ United Nations Institute for Training and Research, 2006.

³⁷ PAHO, 2013.

³⁸ Personal communication, Carmen VanDyk, LVV Pesticide Division Director, October 5, 2016.

farming activities because most farms were small family operations. However, the law would apply to construction activities by contractors.³⁹

Suriname is a member of the International Labour Organization (ILO) and has ratified several conventions related to workmen's compensation, safety standards for construction, and labour inspections⁴⁰. In the absence of its own regulations regarding health and safety practices in the workplace, Suriname depends largely on the codes of practice published by the ILO.

3.3.7 Gender and Indigenous Populations

Suriname is party to the Convention on Elimination of all Forms of Discrimination against Women (CEDAW) and created a National Gender Policy Bureau in the Ministry of Home Affairs, as well as an Integrated Gender Plan of Action (2001 with an update for 2006-2010). Focal Points on Gender were created in all Ministries under the Action Plan. The Multi-Annual Development Plan for 2001 to 2005 identified policies on gender for rural areas which included adult education, health care, agriculture, crafts and markets. The focus of the Bureau is to mainstream gender policies into the policies and programs of the government through each ministry.⁴¹

Suriname does not recognize collective rights to land of indigenous population or Maroon communities. In some cases their traditional fishing and hunting practices are allowed in protected areas, in other cases when Natural Reserves have been proposed, where all such activities are supposed to be prohibited, there have been conflicts around the use of the land by these communities.

3.3.8 Water Boards

The Water Board Act of 1932 (Waterschapswet G.B. 1932 no.32, z.l.g. bij S.B. 2005 no.28 -Water Board Law G.B. 1932 no. 32 as amended by S.B. 2005 no.28) provided a framework for the functioning of the oldest forms of local government in Suriname - water boards. The purpose of establishing water boards was to delegate responsibility of water management systems to stakeholders. Water boards were local, independent public bodies entrusted with a special government task given by law.⁴²

Water boards were functional until the 1950s when large public investments in irrigation and drainage began. From that point on, operation and maintenance was gradually taken over almost completely by the different ministries involved and the water boards ceased to operate effectively. The realization that water users should and could contribute to operation and maintenance of their systems led to the revival of the concepts of the old Water Board law of 1932 by a new law on Water Boards in March 2005, opening the way for the reestablishment of water boards. Accordingly, 14 Water Boards were established between 2005 and 2009 with the issue a series of decrees formalizing the establishment of 13 water boards in the Nickerie district and one water board in the Reeberg polder in Wanica district.⁴³

The current legislation stipulates that the operation and maintenance of the main inlet canals and regulating structures and tertiary inlets as well as dams and tertiary roads in the defined Water Board area (i.e., within each water board polder area) are the responsibility of the water board. Each individual member of the water board is responsible for all maintenance activities of the canals and

³⁹ Personal communication Dr. John Courtar, June 17, 2016.

⁴⁰ Labour Inspection Decree from 1947; personal communication Dr. John Courtar, Ministry of Labour, Technological Development & Environment, June 17, 2016.

⁴¹ Personal communication, Ellen MýLand, LVV Focal Point, October 5, 2016.

⁴² Del Prado, N., 2013.

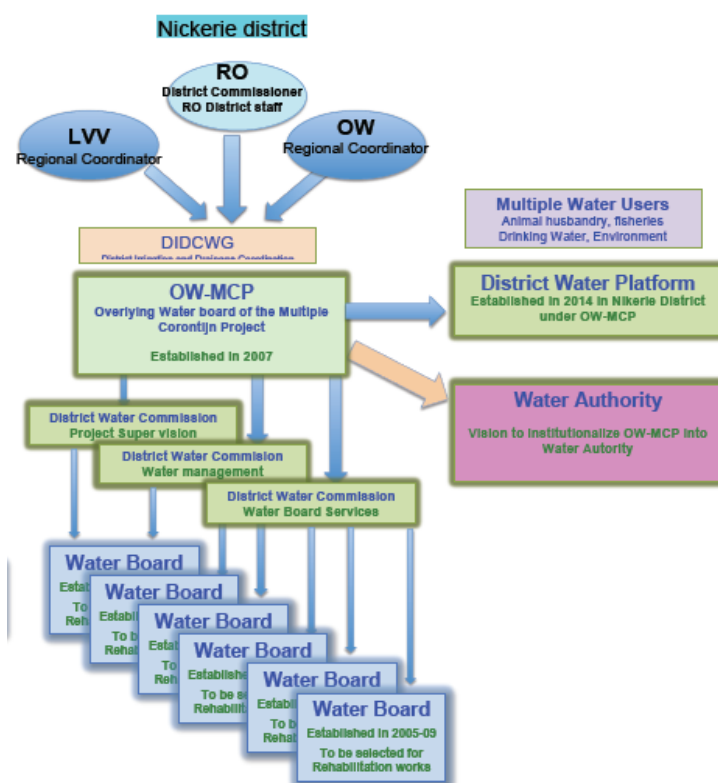
⁴³ Smith, Martin, 2017.

ditches, dams and access roads that are bordering directly his/her plot and parcel. The water board is required to keep a list of all water users within its area with specification of areas owned, cultivated or occupied.

The By-laws (*Keur*) and rules and regulations of the WBs specify the obligations of all WB members in the operation and maintenance of the I&D system, define responsibilities for O&M of all canal, embankments, roads and infrastructures of the I&D system (Legger); set penalties and waivers for violations and establish annual contributions and payments of each member. The annual O&M plan to be prepared by each water board will be the basis for the annual contributions (water tax assessment) for each member, with the annual amount for each farmer based on number of hectares each member uses. The average cost of operating and maintaining the Water Board polders is estimated at \$(SRD)100 per hectare per year, but the actual cost will depend on each Water Board's annual operation and maintenance plan.⁴⁴ Maintaining appropriate administrative and financial records of all activities and works implemented is to be supervised by the District Financial Administrator.

In addition to establishing the water boards, the formal creation of an Inter-Ministerial District Irrigation and Drainage Coordination Working Group (DIDCWG) has been realized. It will propose relevant inter-ministerial commissions at the district level, referred to as District Water Commissions (DWC). The DWCs will address specific issues in the operation and maintenance and investment priorities of the irrigation and drainage systems in the district. An organizational diagram of how the water board system would work at the District Level is provided in Figure 3.

Figure 3. Diagram Showing Organization of Water Board System at District Level⁴⁵



⁴⁴ Smith, Martin, personal communication March, 2018.

⁴⁵ Inter-Ministerial Irrigation and Drainage Coordination Working Group, 2015.

3.3.9 Socio-Environmental Management Capacity of Executing Agency

The Ministry of Agriculture, Animal Husbandry and Fisheries (LVV), which will be executing this Project, does not have an environmental management unit, program or plan. In 2016 Ministry created an Environmental Focal Point within the Planning Sub-Directorate in response to a request from the former National Environmental Policy Office for information about LVV's environmental management procedures and initiatives.⁴⁶ The role of this position for LVV has evolved into one of carrying out climate change initiatives and not as an environmental manager for LVV or as an environmental manager for this Project.

An environmental specialist was hired in 2017 to work in the Project Executing Unit of the IDB/LVV's Agricultural Competitiveness Program with responsibility for supervising the implementation of the ESMP for that specific project, in collaboration with other Sub-Directorates of LVV. The skillset needed for that position primarily involves hazardous materials management, working knowledge of occupational safety and health issues related to laboratories and pesticides, and biological waste management. These are different skills than what is needed for the socio-environmental management of this Project. The specialist currently holding this position needs formal and on-the-job training in order to carry out the responsibilities for the Agricultural Competitiveness Program.

LVV does not have a health and safety officer, policy or program, however the LVV Pesticide Coordinator has been conducting workshops for LVV staff on appropriate management procedures and personal protective procedures for pesticide use and has been inspecting LVV facilities in preparation for upgrading pesticide storage facilities to meet international environmental and occupational health and safety standards.

There is a designated Gender Focal Point in LVV whose responsibilities include incorporation of gender mainstreaming policies into LVV policies and programs. To date, because of lack of resources to assist the Gender Focal Point, there are no policies or programs developed within LVV.⁴⁷

Thus, it can be concluded that LVV is not equipped to manage the environmental and social aspects of this Project because the skills needed for this Project are highly specialized and the Project requires personnel with existing expertise and ability to carry out the required environmental and health and safety tasks without needing training in the necessary skills.

3.3.10 Best Practices in Irrigation and Drainage for Improving Sustainability in Rice Production

Much research has been conducted in a variety of countries, especially Asia and to some extent in South America, to develop irrigation and drainage practices that improve the sustainability of rice production. They include reducing water use, improving water distribution, and mitigating for climate change impacts.

Reducing water use in rice production can contribute to more sustainable use of water resources by minimizing water waste through improved irrigation management and use of precision irrigation to apply water only when the plant needs it for best efficiency in water use and plant growth.

⁴⁶ Personal communication, Anand Ramkisoensing, June 16, 2016.

⁴⁷ Personal communication, Ellen MjLland, LVV Focal Point, October 5, 2016.

Reducing water use and improving drainage also contributes to reducing the use of nitrogen fertilizers, which may need to be applied more frequently when drainage problems cause uneven applications or when flooding produces runoff that carries away the fertilizers. Thus, improving irrigation and drainage can reduce water quality problems due to over-fertilization.

Improving management of irrigation water supply through efficient water use and water calendars, as well as improving drainage are beneficial to plants and increases yields, as consistent water depths across fields improve the plants ability to resist pests and compete against weeds. Related to that, practicing quality field leveling has been shown to improve yields and reduce the presence of weeds, like red rice, which grows on the higher portions of unlevelled fields. This, in turn can reduce the use of herbicides in polders.

The Sustainable Rice Platform (SRP), a partnership of the International Rice Research Institute (IRRI) and the United Nations Development Program (UNDP) with several non-profit and for-profit members, has drafted and has been testing standards (currently under revision after field testing) for sustainable rice production with principles, criteria and recommended practices, along with a system for scoring farms as to the level of sustainability each farm is practicing.

The standards and criteria related to sustainable irrigation and drainage are listed in Figure 4.

Figure 4. SRP Examples of Irrigation and Drainage Standards for Sustainable Rice Production⁴⁸

<p>Measures are in place to enhance water use efficiency, as appropriate to the local production system category</p> <p>For irrigated systems subject to flooding:</p> <ul style="list-style-type: none"> - At least one dry-down event, if possible, and - Effective leveling with provision for minor drainage conditions, and - Use of appropriate flood-tolerant varieties, and - Timely crop establishment (well before expected floods), and <p>For irrigated systems not subject to flooding:</p> <ul style="list-style-type: none"> - One dry tillage before flooding if soil is cracked, and - Land soak, puddling, and tillage within a 1-week period, and - Effective leveling and strong bunds, and - Alternate wetting and drying (AWD) either on fixed day basis or SMP-based (soil matric potential), and - Use of short-duration varieties, and - Cessation of irrigation at least 10–15 days before harvesting. - Land soak, puddling, and tillage within a 2-week period, and - Effective leveling and strong bunds, and - Continuous flooding for 40–60 DAT (days after transplanting) followed by intermittent irrigation either on fixed day basis or SMP based. <p>The farm irrigation system complies with the following conditions:</p> <ul style="list-style-type: none"> - the irrigation system has sufficient internal canals for supply and draining, - there are no leakages in dikes, and - sluices are functioning well. <p>Water extraction is legal and sustainable. Sustainable water extraction avoids depletion of water resources beyond the watershed recharge capacity, and balances the competition for its use.</p> <p>Subsurface drainage after surface application of agrochemicals is sufficiently delayed to avoid contamination from agrochemical runoff.</p>
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⁴⁸ SRP, 2015

Because paddy-produced rice has been shown to generate methane and nitrous oxides due to the practice of flooding fields for long periods and the use of nitrogen fertilizers, research has examined alternative approaches to reduce the generation of these compounds. It has been found that alternate wet/drying approaches, where soils are allowed to dry out periodically can significantly reduce methane generation. Allowing periodic drying of the soil reduces the activity of methane producing bacteria, thereby reducing methane production overall (some reports state a range of between 30 and 70% reduction) without reducing yields.⁴⁹ Allowing fields to periodically dry out may also help to reduce the presence of snails that damage the rice plants. This would, in turn, reduce the use of molluscides.

Integrated Production and Pest Management (IPPM) is another approach to improving overall sustainability in rice production and in addition to proper fertilization, weed management, timing and density of planting, monitoring for pests and diseases, and the judicious use of inputs, includes water management as an important factor in sustainability.⁵⁰

IV. AGRO-ECOLOGICAL CHARACTERISTICS IN THE NICKERIE DISTRICT

The Nickerie District is located in the northwest part of Suriname in the coastal plain as shown in Figure 2. The District is bordered by the Corantijn River on the west (the border with Guyana), the Atlantic Ocean on the north, the Coronie District on the east and the Sipaliwini District on the south. Nieuw Nickerie, bordered on the west by the mouth of the Corantijn River and surrounded on the north, east and south by polders, is the principle city in the District, and is the third largest city in Suriname.

The Project area is shown in the northern part of Figure 5, which also shows some of the regional hydrology contributing to irrigation supply.

The Nickerie climate is humid with an average annual rainfall of around 1800 mm and two rainy seasons: the “long” rainy season lasting from April to August and a shorter one from November to February.⁵¹

Rice is the predominant crop produced in Nickerie and it depends heavily on irrigation as described in the following sections. There is, however, significant horticultural production by small family farmers, including women. Fruits and vegetables are primarily aimed at local consumption and are sold at the Nickerie market. However, buyers from neighboring areas, and even Paramaribo often purchase produce for re-sale. An example of such production is the Kooperatie Groente Verbouwers van Pettenpolder (KGVP), a cooperative of 150 families located in the former Waterloo polder, each with 3,000 m² of land for producing a wide variety of fruits and vegetables. There are also small independent women farmers who grow fruits and vegetables near their homes in the rice polders to supplement their family income.

⁴⁹ IRRI, <http://ghgmitigation.irri.org/technologies/awd>

⁵⁰ Calvert et.al., 2006

⁵¹ Ritzema et.al., 2012

Figure 5. Regional View of Project Area Showing Water Resources and Polders⁵²



4.1 Hydrological and Ecological Characteristics Nanni Swamp Basin

4.1.1 Hydrology

The Nanni Swamp, which is a freshwater wetland located in the Young Coastal Plain in the Nickerie District, provides the main source of water supply for irrigation in Nickerie (see Figure 6). Its size has been reported as 107,000 ha.⁵³ Per a European Commission estimate Nanni Swamp has a water storage capacity of 230,106 m³.⁵⁴ The basis for this calculation is not known.

As can be seen in Figure 6, Nanni Creek flows northerly through the center of the swamp and the Marantakka River flows northerly through the eastern edge of the swamp and discharges to the Nickerie River. There is a natural lake, Nanni Lake, located in the southern portion of the swamp. The Nickerie

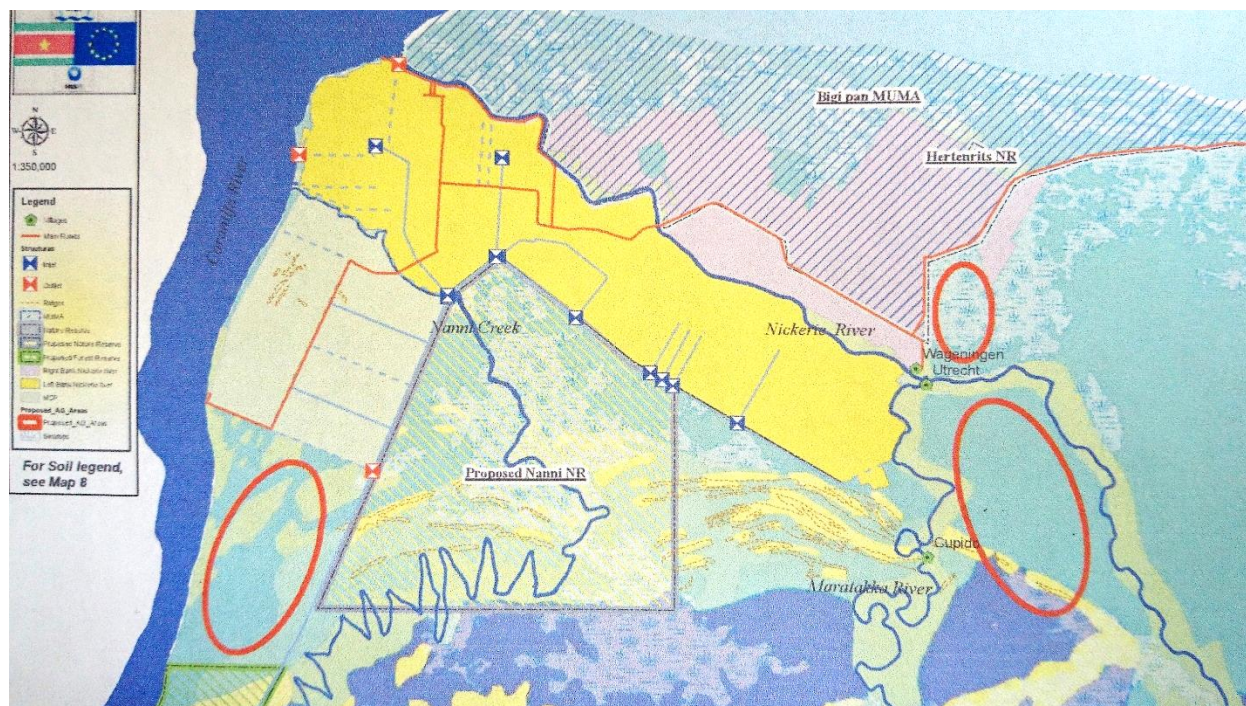
⁵² Source: European Commission, 2009.

⁵³ Naipal et.al, Estimating the Evapotranspiration Rates in Wetlands in Suriname, a Case Study of the Nanni Swamp, 2013

⁵⁴ European Commission, 2009.

River flows from the east near the eastern edge of the swamp, and based on some maps and aerial photos, appears to intersect the eastern-most edge of the swamp north of Tapoeripa. The Corantijn River flows northerly on the western side of the swamp and the Corantijn Canal, a 66.7 km long irrigation supply canal lies between the swamp and the river.

Figure 6. Nanni Swamp and Protected Areas in Vicinity of Project⁵⁵

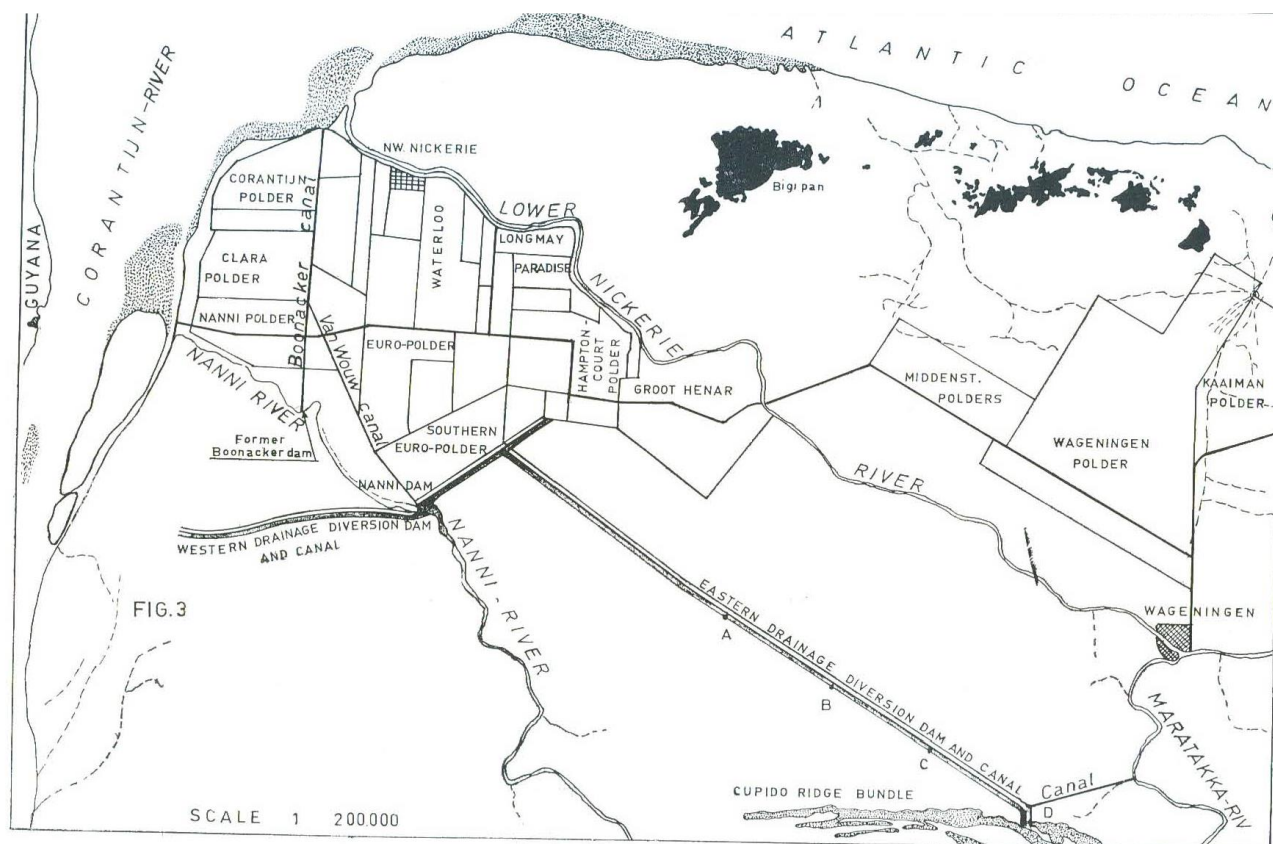


Nanni Swamp and Nanni Creek have been significantly altered over decades in order to provide for irrigation. Figure 7 shows some of the alterations, as described herein.⁵⁶ The creek was dammed at about 6 km from its mouth in 1926 to direct water through the Boonacker Canal. In the early 1940s the Nanni dam was built to direct irrigation water into the Van Wouw Canal. To meet expansion of the polders, the Nanni dam was improved in 1965 and the 11 km long Lekbeteugelingsdam (dam/canal – shown as “Western Drainage Diversion Dam and Canal” in the figure) was built to prevent drainage into the lower Nanni Creek. The Nanni swamp was then dammed between 1971 and 1972 with an earthen dike running from east to west that is some 33 kilometers long (shown as the Eastern Drainage Diversion Dam and Canal in the figure). The intent was to create a reservoir for dry season gravity flow into the irrigation systems and to prevent the swamp from discharging into the Nickerie River and instead to be directed to the Nanni water distribution station shown in Figure 8.

⁵⁵ European Commission, 2009.

⁵⁶ Sevenhuisen

Figure 7. Diversion Dams in Nanni Swamp⁵⁷



Excavation of material to build the dam formed a depression on the upstream side, known as the Suriname Canal (see Figure 8 – the canal is approximately in the middle of the photo). The dam was designed for a maximum water level of 4.45 NSP⁵⁸, with a freeboard of 1.1 meters. The construction of the dam reportedly caused the swamp to be 20 cm higher over 190 km² during high water seasons than its previous normal maximum water levels and reportedly damaged over 70 km² of swamp forest (reported to be primarily *Pterocarpus* – a leguminous tree).⁵⁹ A spillway and canal at the east end of the Nanni Swamp retention dam is shown as a dotted line in Figure 8⁶⁰ but was never constructed and as a result, during significant rain events, the Nanni dam is often overtopped causing flooding of polders and even Nieuw Nickerie.

⁵⁷ Tenuissen, 1974.

⁵⁸ Nationaal Surinaams Peil – National Suriname Level.

⁵⁹ Ouboter, 2012.

⁶⁰ This will be the approximate site of the proposed construction of the Maratakka Spillway to be financed under this Project.

Figure 8. Current Condition of Nanni Inlet (left) retention dam and Suriname Canal (middle) and ponded portion of Nanni Swamp (right).⁶¹



Some of Nanni Creek, the Nickerie River and possibly part of Maratakka River have been deepened, channelized and constrained by levees over many years.

No current information was found about the Nanni basin hydrology and the relationship of the swamp to the associated rivers or to groundwater. Current conditions are unclear to what extent the swamp is characterized as open water, shrub, emergent, or forested, or to what extent the hydrology is characterized by permanent or seasonal inundation.

There was an automated weather station in the swamp (location unknown) to collect meteorological data, but its status is not known. As of 2013, there were also stations in the Nickerie River, Corantijn River and some areas of the irrigated polders.⁶⁴ Flow measurements have been made in the rivers and creek in the past, but there is reportedly only one permanent water level monitoring station in the swamp (apparently not automated and location not available).

A hydrology study was done in 1977 which reported that the swamp is mostly fed by rainwater and to a lesser extent groundwater originating from the Zanderij soil formation^{65 66} on the south edge of the swamp, but no recent data have been produced and it is not known if groundwater determinations were made using piezometers. Outflow from the swamp is from irrigation removal, leakages, canals discharging to the Corantijn Canal during high water seasons (south drain and P and E drain), and from plant transpiration and evaporation from the stored water in the swamp. Outflow from the southern portion of Nanni Swamp is towards the Maratakka River on the east and to Kaboerie Creek and the Corantijn River to the south.⁶⁷

An evapotranspiration study was done in 2013, using existing data and modeling, which estimated the evapotranspiration rate at 1 mm h^{-1} .^{68, 69}

⁶¹ Smith, Martin, Nov 2017

⁶² DHV and AFco, 2008.

⁶³ DHV and AFco, 2008.

⁶⁴ Personal communication and map, Department of Hydrology, Ministry of Public Works, Transport and Communication, 2013.

⁶⁵ Sevenhuisen, June 1997.

⁶⁶ A land formation with an outcropping aquifer.

⁶⁷ Mertens, 2008.

⁶⁸ 1 mm per hour.

⁶⁹ Naipal, et.al., 2013.

4.2.2 Soils, Topography and Ecology

Ground elevations in Nanni Swamp vary depending on the area of the swamp, and range from 1.5 NSP in the northern swamp area; 2.0 in the young coastal plain of the southern swamp; 2.5-5 in the old coastal plain of the southern swamp; and 3.5-5 on the ridges.⁷⁰

Soils in much of Nanni Swamp basin are mostly clays, classified as “freshwater clay swamp soils”. Soils along river levees along the Corantijn, Nanni, Nickerie and Maratakka Rivers consist of marshy fine sandy, silty and heavy clays and are classified as “river levee soils”. There are also peat layers in the wetter areas of the swamp.

In the southern and northwestern part of the Nanni basin, there is Kwatta landscape, which are fan-shaped bundles of ridges. Soils in the higher parts of the ridges consist of fine sands, classified as “ridge soils”. Soils in the lower parts of the ridges are marshy and are characterized as heavy, fine, sandy loam classified as “ridge flank soils”. Inter-ridge swamps occur between the ridges.⁷¹

In the northern, lower area of the swamp, vegetation has been described as a low swamp forest dominated by Erythrina fusca (a leguminous tree). The upper Nanni swamp has been characterized as high swamp forest, dominated by Mauritia flexuosa (also known as Buriti Palm), as well as species of Virola (a myrtle), Symphonia (tree used for timber and medicinal applications) and Euterpe (a genus of palm trees).^{72,73} The high swamp forests have been characterized as being shallowly inundated with surface water fluctuations of between 0 and 80 cm.⁷⁴ The current make-up of plant communities in the swamp is not known, but it is believed that the Buriti Palm is still present.⁷⁵

Figure 9 is a photo in an unknown location in the swamp, indicating that at least part of the swamp was still characterized by young forest habitat as of 2011. Photos of the lower portions of Nanni Creek taken in 2009 as part of the preparation of the European Commission Master Plan (Figures 10 and 11) show varying types of vegetation along the creek banks.

Nanni Swamp was mapped in 1978 along with other wetlands in the coastal lowlands.⁷⁶ It has been proposed as a Nature Reserve by the Nature Conservation Department of the Ministry of Spatial Planning, Land and Forestry Management because it provides important freshwater wetland habitat for a variety of flora and fauna, some internationally endangered or threatened. The adoption of this designation has not moved forward, although the proposal is still valid.⁷⁷ The Kaburikreek area, which is upstream of Nanni Swamp but flows into Nanni Lake was also proposed as a Nature Reserve in the 1970s but no action on this has taken place.

⁷⁰ EC, 2009.

⁷¹ Tenuissen, 1974.

⁷² Ottema, 2012.

⁷³ Wikipedia.com

⁷⁴ Ottema, 2012.

⁷⁵ Sakimin, Claudine, personal communication March, 2018.

⁷⁶ Tenuissen, 1978

⁷⁷ Sakimin, Claudine, personal communication, March 25, 2018.



Figure 9. Nanni Swamp (Source: OWMCP via Panoramio.com, 2011)



Figure 10. Vegetation along Lower Nanni Creek⁷⁸



Figure 11. Vegetation along Nanni Creek⁷⁹

The Bigi Pan Multiple Use Management Area (67900 ha) and the Hertenrits Natural Reserve (100 ha) are located near the project area along the coast and to the north of the rice polders and along part of the right bank of the Nickerie River (see Figure 5), Bigi Pan is also designated (2009) as an Important Bird Area (IBA) by Birdlife International and STINASU and is part of the Western Hemisphere Shorebird Reserve Network. Bigi Pan has a Management Plan that allows for sustainable uses such as fishing and tourism. The Management Plan also states that draining and converting land to agricultural use is “incompatible” as an allowed activity in the protected area. It also requires approval from the Ministry of Spatial Planning, Land and Forestry Management for any new dikes or waterways through the protected area.⁸⁰

⁷⁸ European Commission, 2009

⁷⁹ European Commission, 2009

⁸⁰ <https://info.undp.org/.../Bigi%20Pan%20Management%20Plan%20March%2014%20>

Another site in the project area designated as an IBA is southwest of Wageningen. Known as the Northwest Suriname site, it appears to include part of Nanni Swamp, but has not received any special protection from the Suriname government.⁸¹ It should be noted that another proposed reserve can be seen in the lower left portion of Figure 5 (green hatching), known as the Mac Clemen Forest Reserve. It was proposed as a natural area to reconnect Nanni Swamp with the Corantijn River after the construction of the Corantijn Canal, but it was never realized and is apparently now used for agriculture by one producer. Also, worth noting is that the areas circled in red are part of the European Commission's Master Plan for Irrigation and are not proposed by this Project, nor are these areas likely to be developed as a result of this Project.

Few studies of fauna that exist in the Nanni basin were found for this analysis and no current studies were located. One study from 1978 observed the presence of giant river otters (Pteronura Brasiliensis) in the upper reaches of Nanni Creek, Nanni Lake and the Maratakka River.⁸² Nickerie River. The International Otter Survival Fund reports the presence of these otters in the Corantijn and Nickerie Rivers as well.⁸³ Also, a study done in 2000 of the Kaburi Creek area noted the presence of several groups of giant river otters, as well as a sighting of a pair of Neotropical Otters.⁸⁴ The giant river otter is listed as Endangered in the International Union of Conservation of Nature and Natural Resources (IUCN) Red List.⁸⁵ The Neotropical otter (Lontra longicaudis) is listed as "Near Threatened" in the IUCN Red List. At least three species of macaw (4 Ara species) likely inhabit the swamp, as they depend on Buriti Palms for food and nesting habitat⁸⁶ Six species of macaw (Red and green, Scarlett, Red-bellied, Red shouldered, and Blue and green) were sighted in the Kaburi Creek area in 2000.⁸⁷

Nanni Swamp is reportedly home to populations of spectacled caiman (Caiman crocodilus) and manatees (Trichechus manatus).⁸⁸ These species have not been evaluated for the IUCN Red List.

No information has been found regarding the presence of aquatic species in the irrigation or drainage canals, however at least two species of cichlids (Crenicichla Nickeriensis and saxatilis), locally known as "datrafisi", and another species – Geophagus brachybranchus, have been found in the upper Nickerie River.⁸⁹ The cichlids have not been evaluated for the IUCN Red list. The Geophagus is listed as of "least Concern". Nanni swamp is also known as being the largest nursery for kwie kwie's (Hoplosternum littorale), also known as "armored catfish".⁹⁰ Local fishermen and residents prize this fish as an important food source and the Nickerie River is an important fishing spot for kwie kwie. This species has not been evaluated by the IUCN. There is anecdotal evidence of a variety of fish presence in many of the canals in the Nickerie district, and it is reported that many local residents fish from the canals. Species information was not available for this report.

4.2.3 Irrigation and Drainage Systems

The Young Coastal Plain area along the entire width of the country was diked and drained, by canal systems to form polders for agriculture and settlements by early Dutch and Scottish settlers who grew principally sugar cane and some coffee, cacao and cotton on large plantations. When the plantations

⁸¹ Spaans, et. al., 2015.

⁸² Duplaix, N., 1980.

⁸³ http://www.otter.org/Public/AboutOtters_OttersAroundTheWorld_SouthAmerica.aspx, accessed Dec 8, 2017.

⁸⁴ Duplaix, et.al, 2001?

⁸⁵ IUCN, 2017.

⁸⁶ Sakimin, Claudine, personal communication, March 25, 2018.

⁸⁷ Duplaix, N, et.al., 2001?

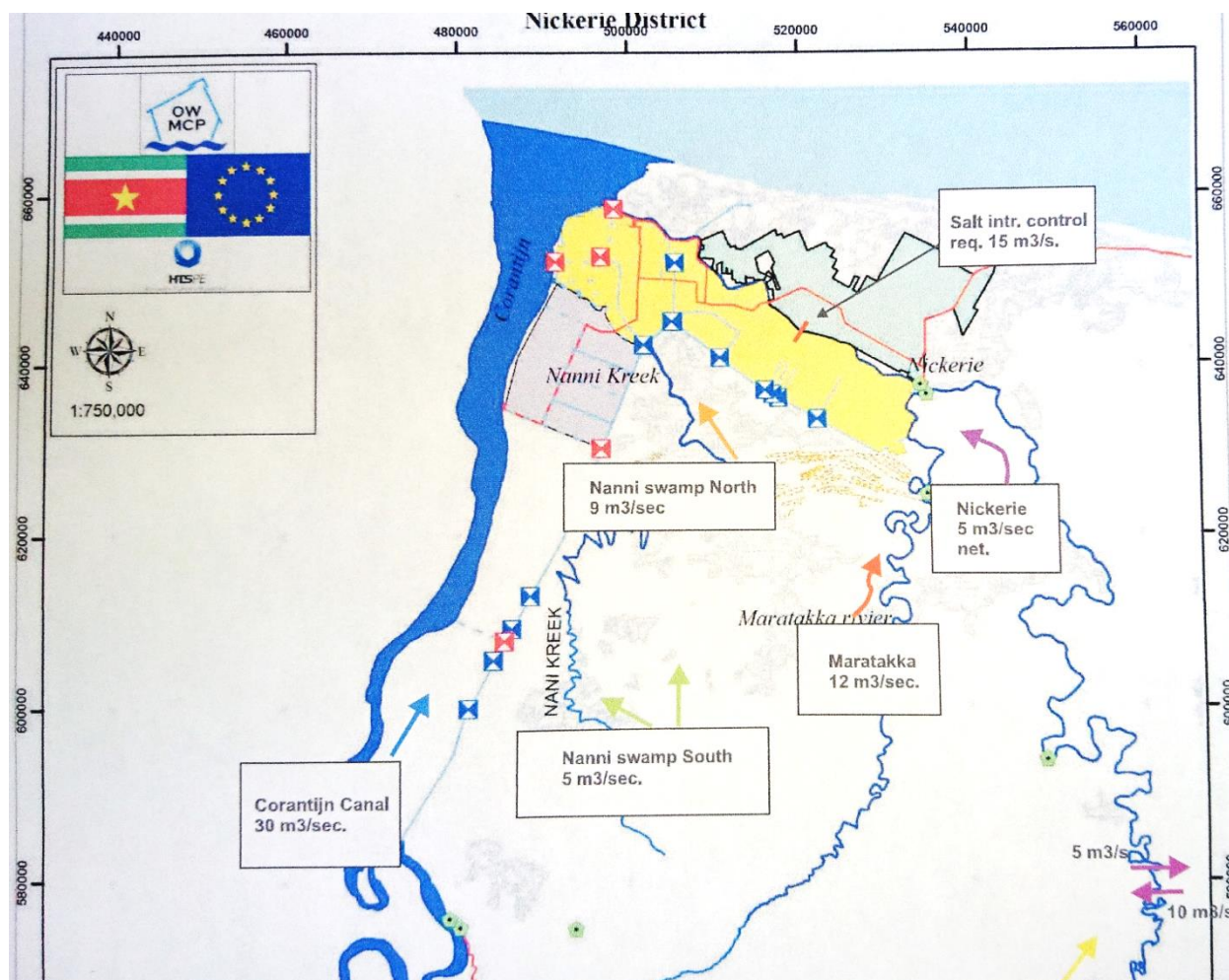
⁸⁸ Ritzema et.al., 2012.

⁸⁹ Mol, J.H., 2012.

⁹⁰ Sakimin, Claudine, personal communication, March 25, 2018

were abandoned, many of these agricultural areas fell into disrepair, but some were converted to rice production and horticultural use. Beginning in 1915, the Nickerie District began producing rice and has now become the principal rice production area of the country providing rice for export and local consumption. Areas actively being used for rice production at this time are shown in Figure 12 in yellow (left bank) and pale green (right bank) of the Nickerie River. The area shown in the light gray area along the Corantijn River ("MCP" area – Figure 12) is reportedly used for cattle grazing, because it does not receive sufficient water in dry seasons to allow for rice production.

Figure 12. Irrigation and Drainage Sources and Main Infrastructure⁹¹



The irrigation and drainage systems in use today are based on the original systems installed by settlers. The main infrastructure making up the system is shown in Figure 12. The blue squares represent inlets and the red squares, outlets. Water for irrigation on the left bank of the Nickerie River comes from Nanni Swamp via gravity flow. Polders on the right bank of the Nickerie River receive water via pumping from the Nickerie River through the Wageningen pump station. The Corantijn River provides irrigation water through the Corantijn Canal to the right bank of the Nickerie River during the dry seasons via a pump station (Wakay station) located upriver well beyond the point where the saltwater wedge moves into the river (as much as 75 km inland from the mouth of the river). It should be noted that the original

⁹¹ After European Union, 2009.

planned construction for the Corantijn canal was not completed, leaving the north end discharging directly to Nanni Swamp and not to irrigation canals.

The overall system for irrigation water supply is listed in Figure 13. It has been reported that, in addition to these “official” canals for water supply, some large farmers in the eastern part of the area have punched through the Nanni Swamp retention dam to obtain water directly from the swamp during dry seasons, potentially adversely affecting the dam stability and the swamp hydrology. It is not known how much water is withdrawn, nor at what depth. Reportedly nothing has been done to stop this practice, nor has an evaluation of the dam’s integrity been performed.

Figure 13. Irrigation Conveyance System and Existing Water Calendar⁹²

Gravity flow from the Nanni Swamp through the Nanni inlet to the Van Wouw canal and Stondansi canal. The Van Wouw canal conveys the water to:

- Nanni bruto
- Europolder Noord
- Baitali (Van Dijk and Coop W.S, Tewarie)
- The Clara pumping station

Clara pumping station and distribution structure delivers water to the following polders:

- Clara polder
- Corantijn
- Van Drimmelen
- Sidoredjo
- Waldeck
- Margarethenburg Polder
- Nanni polder

HA takes water from the Nanni swamp and conveys (in a non-regulated manner due to unmaintained infrastructure) to:

- Sawmill creek Polder,
- Hamptoncourt Polder and
- Henar Polder.

The IKUGH inlet conveys water from Nanni Swamp to the Uitbreiding Groot Henar Polder

The distribution is according to an existing water calendar, developed by LVV, but it has been reported that the calendar is not necessarily followed, leaving farmers not knowing when they will receive water.

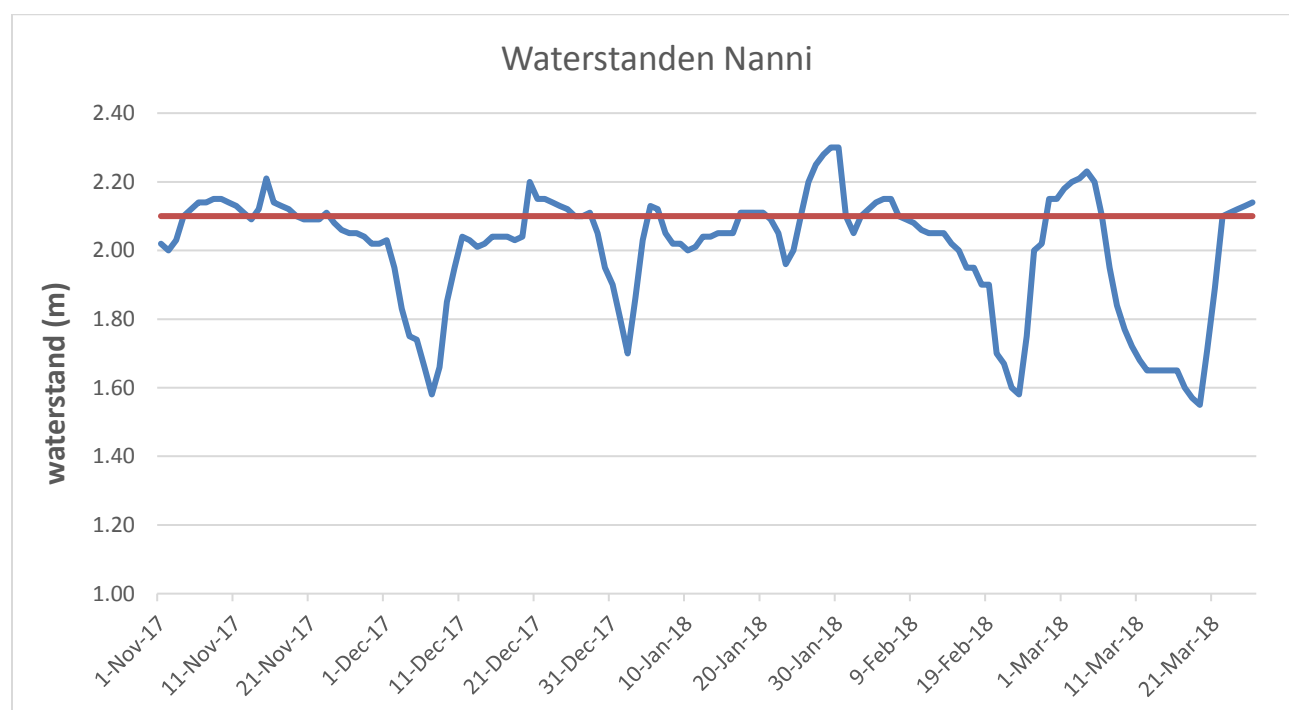
- Non-rice polders
- Van Petten polder (residential area)
- Clara-stalweide (grazing area)
- Nanni-stal weide (grazing area)
- Nanni bruto (upland crops)
- Manglie stal weide
- Manglie Waterloo
- Waterloo non-rice and Nursery (grazing area and upland crops)
- Banana Polder
- Euro Polder Zuid receives water via the Stondansi canal which is a branch of
- Van Wouw canal.

⁹² Source, EC, 2009.

The proposed project will primarily benefit the polders on the left bank of the Nickerie River, in other words, using water from the Nanni Swamp when water levels are sufficiently high to allow for gravity flow into the irrigation canals, and from the Corantijn River via the Corantijn Canal, when the Nanni Swamp can no longer supply gravity flow water during the dry season. This means that when water levels in the swamp drop below 1 meter from the top of the dam, water is then pumped from the Corantijn Canal.⁹³

The maximum water level between 1962 and 1985 was measured in 1983 at 3.31 NSP. The minimum level measured in 1984 was 0.59 NSP.⁹⁴ Some current water level information (shown in Figures 14 and 15) is available reportedly from a single station in the swamp (see Figures 14 and 15).

Figure 14. Water Levels Measured in Nanni Swamp, Nov 2017 through Mar 2018



There are no data for the associated creeks/ rivers during the dry seasons. It is believed that the swamp does not completely dry out⁹⁵, but there is insufficient information to determine this. As shown in Figure 14 water levels dropped to less than 1.6 meters during some periods between December 2017 and March 2018. These water levels, when compared to swamp elevations suggest that some parts of the swamp are not submerged during dry periods. The European Commission Master Plan for Irrigation states that Nanni Swamp is “very sensitive to drought.”⁹⁶ This Plan also states that Nanni Creek still has

⁹³ Personal communication Mr. van der Kooye, LVV, November 2017.

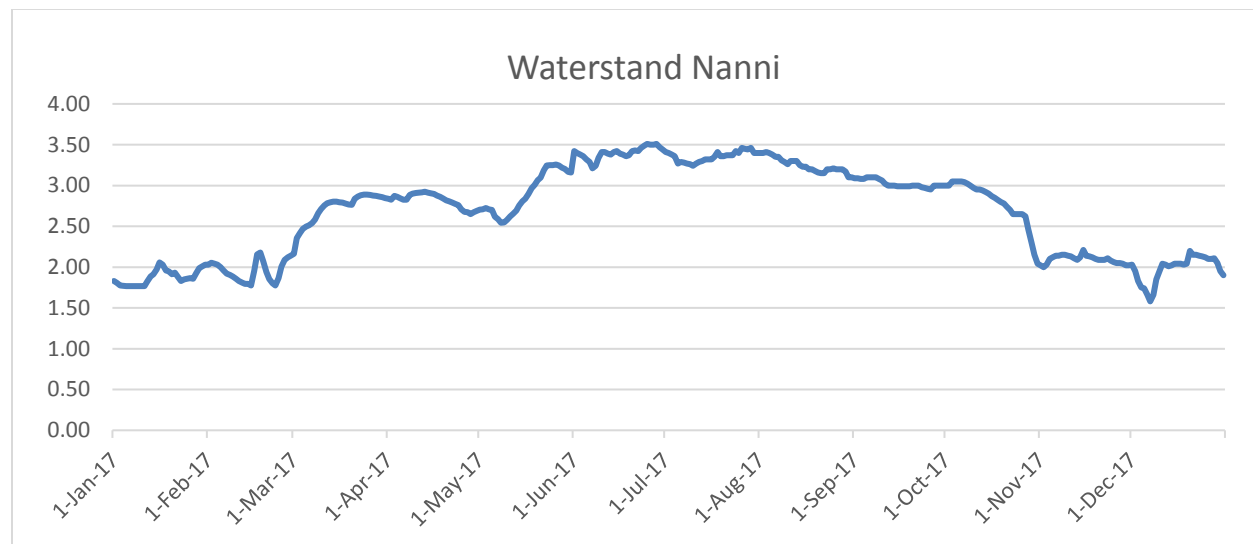
⁹⁴ Mertens, 2008.

⁹⁵ LVV, personal communication, Nov 2017.

⁹⁶ European Commission, 2009.

water withdrawn from it in the dry season, without regard to any environmental baseline flow. Due to the lack of sufficient hydrological data for Nanni Swamp and its associated creeks and rivers, it is not possible to verify this statement or to fully understand the complex hydrological system.

Figure 15. Water Levels Measured in Nanni Swamp, January – December 2017



It should be noted that there is insufficient water available in the Nickerie River to adequately supply the polders on the right bank of the River during the dry seasons. This problem is compounded by the fact that saltwater intrudes into the River during low flow periods when the saltwater wedge can reach as far as 75-80 km upriver. When salinity levels reach 1000 ppm at the pump station, pumping is stopped to avoid damaging the rice crop. It is reported that the frequency of salt water reaching that far into the river has been increasing in recent years. This Project will not address this problem, as a change in practices or a new water source will likely need to be developed to increase flows, although there is some belief that construction of the Maratakka Spillway (see Section 5.2) to allow for release of water from Nanni Swamp during periods of heavy precipitation, will also contribute fresh water to the Nickerie River during dry periods to help control the saltwater intrusion. This will depend on the elevation of the spillway, which has not yet been designed.

An estimated 30,000 ha of land is currently irrigated, but potentially 55,000 ha could be irrigated by improving water management and investing in infrastructure. Much of the irrigation and drainage infrastructure suffers from lack of maintenance, including broken or absent gates, canals clogged with sediment and weeds, eroded dike banks, and faulty equipment for safely lifting gates. The backlog of maintenance, as well as lack of budget resources has resulted in poor control of irrigation water distribution and significant water waste, with some farmers receiving too much water (which then has to be pumped out of their fields to avoid damaging the crop) and others not receiving enough, thus affecting yields. Some areas only receive sufficient water for one annual crop. Other fields receive so little water, they are abandoned or have been converted to grazing cattle.

Flooding has also become a problem in recent years, due to increased precipitation during the rainy season. The system was not designed to handle significant increases in rainfall. The main outflow of the Nanni swamp is through the Nanni spillway into the Nanni Creek on the west side at the outflow to the Corantijn canal (note that the outflow to the Corantijn Canal at about river kilometer 25, is a secondary outflow and is at a higher elevation than the Nanni Spillway). The outflow on the eastern side of the Nanni swamp retention dam should have been through the Maratakka spillway that was never constructed. Excessive rainfall as occurred recently in the Nanni swamp caused serious flooding and damage to infrastructure as the capacity of the Nanni spillway is insufficient to handle the excess water. As an emergency response to prevent flooding of Nieuw Nickerie and polders, the government broke through several dikes in the “MCP” area to allow discharge to the Corantijn River, which, in turn, damaged the south drain infrastructure.

4.4 Water Quality

There have been sporadic water quality studies done in the Nickerie District irrigation system, but there is no system of comprehensive water or sediment quality testing, aside from some salinity monitoring in the Nickerie River. The few water quality reports found during this environmental assessment only include conventional parameters such as pH, suspended solids, conductivity, and dissolved oxygen. No information on sediment quality or chemical contamination have been found for this report.

Some water quality sampling was done in 2008 in the Corantijn Canal and in Nanni Swamp near the canal, using field analytical equipment to test pH, conductivity and temperature. The pH levels ranged from 4.8 to 5.5. Temperatures (measured at only 3 locations) ranged from 25-28°C (the highest at the South Drain).⁹⁷

A more recent water quality study was done by a student as part of a vegetation survey in the inlet and outlet canals, but did not include any pesticide or heavy metals testing. Again, measurements were made using field meters.⁹⁸ Samples were collected in areas outside of the direct influence of the irrigation system, including one from Kaburikreek⁹⁹, as well as in water supply canals and drainage canals in various polders. Results for pH included 4.4 at Kaburikreek, and ranged from 5.5 to 6.6 in supply canals and 5.7 to 6.7 in drainage canals. Dissolved oxygen levels, which were very low, ranged from 0.22 to 2.47 ppm in the supply canals and 1.5 to 2.12 mg/l in drainage canals (only 1.2 mg/l in Kaburikreek). Turbidity levels in the discharge canals were orders of magnitude higher than in supply canals. Temperatures were similar in all samples ranging from 26 to 30°C. As would be expected due to the use of nitrogen fertilizers, nitrate and ammonium levels were significantly higher in drainage canals compared to supply canals.

Despite reports that excessive pesticides are used in Nickerie for rice production (see Section 4.5), no data are available to indicate if pesticides are present in the water column (most likely in the suspended solids), if there is any accumulation of these chemicals in canal sediments, or if pesticide use is affecting the freshwater environment or the estuarine area of the Corantijn River or other coastal areas.

⁹⁷ Mertens, 2008.

⁹⁸ Doergawaterplanten, S., 2010

⁹⁹ A small black water creek north of the village of Washabo that flows into Nanni Lake.

4.5 Rice Production Practices and Pesticide Use

In the Nickerie District, farmers who have full access to irrigation water throughout the two dry seasons plant two crops of rice annually. The spring planting season is generally from the second week of November until end of December and the fall planting season is from the second week of May to end of June. Timing varies to some extent depending on the weather.

Fields are prepared when submerged, which accounts for the highest water use in the rice production cycle. Farmers sometimes attempt to level the fields at this time using heavy equipment and sometimes dragging boards across the field with a tractor, but this approach is reported as being not very effective. The rice is then seeded while the field is still submerged. Plants are irrigated throughout the dry seasons, as needed. Water demand increases again during harvest.

Chemical pesticides to control pests and diseases in rice, fruits and vegetables are widely used in Suriname, but also misused (i.e., higher and more frequent doses than recommended, mixing pesticides, and using prohibited pesticides).¹⁰⁰ Rice farmers (especially larger operations) use pesticides in a preventative manner, before a problem has even been diagnosed. Decisions about what pesticides to use when is largely based on tradition and recommendations received from pesticide dealers (not from government agricultural extension agents). LVV reports that rice farmers typically use higher dosages of pesticides than the packaging instructions state, as well as mix various pesticides into cocktails.¹⁰¹ Rice polders and banana plantations are sprayed aerially for insect and weed control on both large and small farms, and planes often pass directly over homes that are adjacent to the rice fields, as well as horticultural production areas, while spraying.¹⁰²¹⁰³ Insecticides used in rice production in the Nickerie region include: diazinon, lambda-cyhalothrin, alpha-cypermethrin, and imidacloprid, among many others. It should be noted that all of these insecticides are classified as Moderately Hazardous (Class II), primarily to human health, by the World Health Organization (WHO). Fungicides and molluscicides are also used.

Herbicides are routinely used for cleaning weeds from irrigation and drainage canals by LVV and farmers (as much as four times per year), and generally are applied using backpack sprayers from small boats. According to LVV, glyphosate represents the largest volume of herbicide used in rice production areas (but it is reportedly not the formulation approved for aquatic use, which means the formulation being used may be toxic to aquatic life). Glyphosate has recently been determined to be a potential human carcinogen. Other herbicides used/imported include 2,4-D, paraquat, glufosinate ammonium, and bispyribac-sodium (of these the first three listed are classified as Moderately Hazardous by WHO – Class II

It should be noted that the Ministry of Public Works, Transport and Communication has been prohibited from herbicide use to maintain canals under its jurisdiction, apparently out of caution to prevent any groundwater contamination to a drinking water well installed to supply Nieuw Nickerie. Therefore, weed control in the primary canals which are the responsibility of this Ministry is done mechanically with hydraulic equipment from each side of the canal (when there is funding).¹⁰⁴

¹⁰⁰ LVV, Open Field, Aug 2016.

¹⁰¹ LVV, Rice, Aug 2016.

¹⁰². Personal observation and personal communication, Carmen vanDijk, October 6, 2016

¹⁰³ Mr. Remington, KGVP Polder, personal communication, April 4, 2018.

¹⁰⁴ Personal Communication, Ministry of Public Works, Transport and Communication, Mr. Berg, November, 2016.

Herbicides are also used by farmers in the rice fields to combat red rice, an invasive weed that tends to grow in the higher, drier areas of unlevelled rice fields. It has been reported by LVV that herbicide applicators seldom, if ever, use personal protective equipment when mixing or spraying chemicals.¹⁰⁵

No specific information is available on how farmers use pesticides or which pesticides are used for which pests, except for some information on registered pesticide imports.¹⁰⁶ There have been many rejections of fruit and vegetable exports to Europe due to pesticide residuals in excess of allowed limits, suggesting improper use of pesticides for these crops.^{107/108} There have been anecdotal reports of accidental pesticide poisonings, but no recorded data are available. There are also reports of suicides by using pesticides in the Nickerie District, prompting the formation of a commission to try and educate farmers about proper pesticide storage to keep pesticides out of reach of family members. No information is available as to how farmers dispose of excess pesticides or empty containers.

ADRON, with FAO funding, has carried out IPM demonstrations and farmer schools in the past in an attempt to rationalize and reduce pesticide use, but when the funding ran out, the program ended and farmers reportedly went back to their traditional methods of using pesticides in a preventative manner, and not when pest levels warrant their application.¹⁰⁹

4.5 Socio-Economic Characteristics Nickerie District

4.5.1 Population and Land Use

According to the 2012 census about 34,000 people live in the Nickerie District. Rice production is by far the most important economic activity in Nickerie. Of the 27,000 ha of land currently irrigated, most of it is in rice production, which accounts for nearly 90-95% of total rice production in Suriname.¹¹⁰

The number of small to medium rice farmers in the Nickerie District was not available for this report, but their average plot sizes range from 3.5 to 12 ha. Farms are classified as small if they are less than 24 ha and medium if they are less than 250 ha. Most rice farmers also have second jobs or run small businesses.¹¹¹ There are six major rice producers, a large banana producer (12000 ha) and some ranchers raising cattle.¹¹²

According to the Suriname Agricultural Census of 2008, the total amount of land under production between 2000 and 2010 by small farmers compared to those over 12 ha was similar - ranging from about 17000 to 25500 ha for small farmers and between 18000 and 30000 ha for farmers with over 12 ha each of land. Production in tons for the same period for small farmers ranged from about 71000 to 114,000 and for large farmers from 74,000 to 112,000.¹¹³ In fact, small farm production exceeded the larger farm production between 2003 and 2008 and again in 2010. Thus, it can be seen that the contribution of small farmers is significant. Despite this, many small farmers have stopped producing due to low rice prices and relatively low yields and have begun renting out their land to farmers with

¹⁰⁵ Personal Communication, LVV, November 2017.

¹⁰⁶ CAHFSA, www.cafsa.org/registered-pesticides/Suriname, 2016.

¹⁰⁷ Wijngaarde, Jenna, Aug. 2016.

¹⁰⁸ Abdoel, W, May 2016.

¹⁰⁹ ADRON, Personal Communication, October, 2016.

¹¹⁰ Garrido et al, 2013.

¹¹¹ Personal communication, Mr. van der Kooye, LVV, November 2017

¹¹² World Water Net, 2013.

¹¹³ Data are for entire country and not only for Nickerie region, but this region accounts for as much as 95% of total rice production.

more resources.¹¹⁴ There is room for improvement of yields for all farmers, as rice yields (averaging between 3 and 5 tons per ha) are well below their potential (5 to 8 tons per ha) due to various factors, including rice prices, unreliable availability of irrigation water and drainage problems.¹¹⁵¹¹⁶

Suriname exports rice primarily to the Caribbean and competes against Guiana for export markets. Since the 1980s rice exports have lagged below domestic consumption, largely due to a reduction in the number of hectares in production.¹¹⁷ Exports have ranged from 75 thousand tons in 2011 (compared to 240 thousand tons produced) to 150 thousand tons in 2010 (compared to 225 thousand tons produced) and to 64 thousand tons in 2013.

4.5.2 Cultural Characteristics and Education

Most of the population and the rice farmers are of Hindustani origin, the descendants of indentured servants brought from British India to work on the agricultural plantations after slavery was abolished. They represent about 60% of the total population of the Nickerie District and an even higher percentage of the rice farmers.¹¹⁸ Census data from 2012 indicate that in the Nickerie District, there were nearly 41,000 Hindustani compared to 11,750 Javanese. The population of people of Chinese origin was only around 560 and of creole and Marron and mixed races was a little over 5,000. The different cultures do not tend to mix and tend to keep their traditional languages, religions and cultural practices.

The most recent agricultural census of 2008 showed that among the 1365 farmers, 714 had only completed primary school, followed by 40 that had completed junior secondary school and 58 that completed full secondary school. Obviously, this information is very dated and may no longer be accurate.

There are reportedly no members of vulnerable indigenous or Marron populations significantly participating in rice production, although the agricultural census of 2008 (the most recent) did not track ethnicity of farmers, aside from questions about nationality for contracted farmworkers (98% of whom were Surinamese and a small percentage were reported as Guyanese and Haitian).¹¹⁹¹²⁰ The indigenous villages of Apoera, Section and Washabo are located on the Corantijn River, about 150 kilometres from the coast, and well outside the impact area of this Project. The people in the villages are mostly Arowak (Lokono) Indigenous peoples, but there are also Carib (Kariña) and Warau inhabitants. The communities practice the traditional activities of hunting, gathering, fishing, and agriculture and grow crops such as cassava, plantains, peppers, and sugar cane for their own consumption and in some cases to sell in Nieuw Nickerie.¹²¹

As previously mentioned, rice farming became highly mechanized starting in the 1950s, which changed the involvement of women in rice farming. Prior to that time, women and other family members were involved in planting and harvesting. Now, mostly the men of the families work on and manage their polders, leaving women the responsibility of taking care of the home and raising children in this traditionally patriarchal culture. This is reflected in agricultural census data: of the total number of farmers in Nickerie (2008, the most recent agricultural census), 76 out of 1365 were women. Female

¹¹⁴ EC, 2009.

¹¹⁵ Garrido et. al., 2013

¹¹⁶ Derlagen, et.al., 2013

¹¹⁷ Rodríguez, 2012,

¹¹⁸ 2012 Suriname census

¹¹⁹ Garrido, et al., 2013

¹²⁰ LVV personal communication 2016.

¹²¹ IDB, 2008.

contracted labor at that time was 246 women compared to 3906 men. Eight women reported that they operate irrigation and drainage equipment, compared to 535 men. Overall only 1% of farmers that operate any kind of farm machinery were women.

It should be noted that women traditionally did not work outside the home, but this has been changing and women are starting to do so more and more. Some grow fruits and vegetables on small plots around their homes (an exact number is not available), which are sold for local consumption.

Many women are involved in the largest horticultural cooperative of small farmers in Nickerie (Kooperatie Groente Verbouwers van Pettenpolder – KGVP) involving 150 families with about 3000 square meters of land each. Because the husbands have to depend on second jobs, it is primarily women who work in the fields of this cooperative. These families are mostly of non-Hindustani origin and include descendants of Indonesian (“Javanese”) indentured servants, as well as mixed races.

All of the horticultural activity also depends on irrigation water and drainage services, but water is not always available to fruit and vegetable farmers during dry seasons, and excess water due to lack of maintenance of drainage canals has been a problem.¹²² In fact, the KGVP cooperative had its water supply cut off by a neighboring large rice farmer, who also turned a main irrigation canal into a drainage canal. They were forced to seek another temporary solution by getting water from a different rice farmer, who does not provide water during dry periods, when the rice crop needs it. To partially solve this problem, the cooperative has begun storing water temporarily in unused old canals. In addition, this cooperative has experienced problems with crop loss due to indiscriminate spraying of herbicides applied to the neighboring rice polder. Because of the political power of the large rice farmers, small farmers like these have little power to change the system.

Based on interviews with various water boards, women do not participate in water board meetings, although they may attend the meetings.

4.5.3 Incomes and Poverty

Information on poverty among farmers in the Nickerie District is lacking. Information from a 2011 report on gender, based on 2009 data indicated that about 700 people were receiving government welfare payments (aimed at residents with up to \$40 SRD of income per month) and just over 3000 were receiving government child benefits.¹²³ It is not known how many, if any, recipients of these benefits were rice farmers. These numbers represent about 2 and 9 percent of the total population, respectively. This level of poverty is much lower than other districts in Suriname.

An estimate of the average costs and profits for rice production has been developed for the Project and indicates an average profit of SRD \$545.50 per hectare (9% profit). The requirement for water boards to contribute an estimated SRD\$100 per hectare for operation and maintenance would obviously reduce this profit margin. However, this does not take into account any improvement in rice yields due to the implementation of the Project. There is not enough information to be able to assess how the payment of the fee would impact small or lower income farmers.

When the proposed fee was discussed during the public consultation, no objections or concerns were raised as to the impact of the cost on farmers, however there were questions as to what the fee included and/or guaranteed (see stakeholder consultation discussion in Section IX).

¹²² LVV, Mr. van der Kooye, personal communication, Nov 2017.

¹²³ Heemskreek et.al., 2011

4.4 Water Boards, Nickerie District

Twelve water boards were established in Nickerie in 2006 (see Figure 13 – the established water boards are those on the left bank of the Nickerie River that are not designated in yellow). Of those only one has adopted its bylaws, but has not begun assessing fees for performing its own maintenance of the irrigation and drainage systems. Five water boards have had their polders rehabilitated by LVV. A contractor has been selected for the rehabilitation of the Groot Henar polder, but the work has not moved forward because of lack of funding. Of the 6 remaining polders, 4 have had feasibility studies completed to identify the needed rehabilitation and two still need studies to identify the rehabilitation needs. The status of the 12 water boards is summarized in Table 1.

Figure 16. Water Boards in Nickerie District ¹²⁴

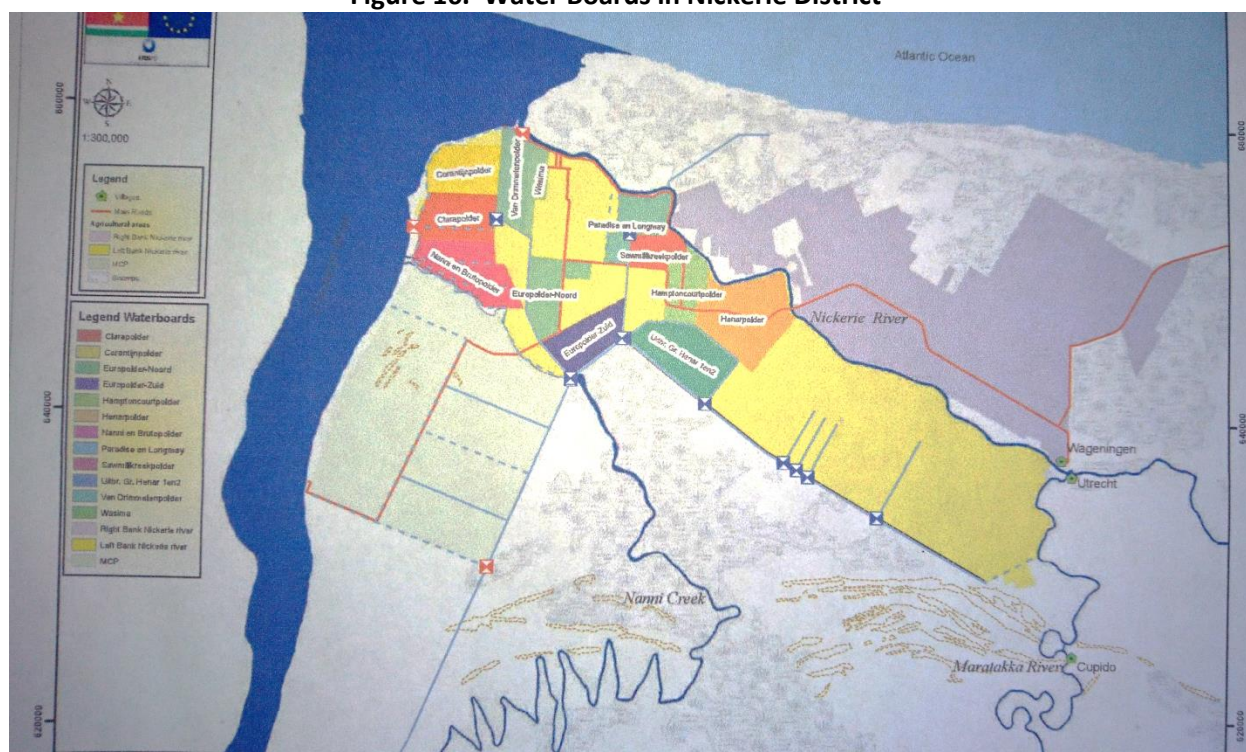


Table 1. Water Boards & Status of Polder Rehabilitation ¹²⁵

Water Boards	Area (ha)	Number Parcels	Number Farmers ¹²⁶	Status of Rehabilitation
Groot Henarpolder	2,242	605	598	Study complete, contractor selected, no funding available
Europolder-Noord	1,035	164	160	Completed 2013
Corantijnpolder	747	573	573	Completed 2014

¹²⁴ Source: European Commission, 2009.

¹²⁵ Modified from Garrido et.al, 2013 and Smith, Martin, Oct 2017

¹²⁶ Note that the numbers of farmers shown in the water boards does not correspond with the number of farmers reported in the 2008 agricultural census.

Sawmillkreekpolder	481	219	97	Completed 2009
Hamptoncourt polder	894	591	540	Completed 2009
Van Drimmelenpolder	850	568	568	Completed 2011
Clarapolder	1,366	455	365	Study completed
Uitbr. Gr-Henarpolder 1 & 2	1,804	172		Study needed
Europolder-Zuid	1,140	214	214	Study needed
Paradise & Longmay	980	922	536	Study done 2016, contractor selected
Nanni & Brutopolder	1,447	266	262	Study completed
Wasima (Waldeck,Sidoredjo & Margarethenburg)	352	370		Study completed
Totals	13,438	5,119	3,913	

V. PROJECT ACTIVITIES

The present situation of the drainage and irrigation system - poor water management and damaged or non-functioning infrastructure due to deferred maintenance - is resulting in considerable water losses, high pumping costs, increased production costs and losses in production. To improve this situation the Project will fund rehabilitation of irrigation and drainage systems of six water boards' polders (those that have not been rehabilitated recently with other funding sources), as well as repair key infrastructure of the main irrigation and drainage system. In addition, the Project will provide support for water board operations and institutional strengthening for water resource management as explained in Sections 5.3 and 5.4 below.

5.1 Rehabilitation of Water Board Polders

The Project will finance the rehabilitation of up to six water board polders. The result of this rehabilitation will cover 7000 ha and will benefit nearly 2,000 farmers. The activities will include studies to develop plans and cost estimates, where not completed already, and construction. Construction activities will include all structural improvements for the appropriate regulation and operation of the I&D system of each water board (canals, hydraulic structures) as well as functioning of the drainage systems (dams and dikes) and improvement of the internal road systems to ensure adequate access to agricultural land and cultural operations.

To be eligible to receive funding for rehabilitation water boards must meet certain criteria including: By-Laws approved and published; agreement signed between the Water Board and LVV detailing the financial support offered for rehabilitation and ongoing O&M support; and agreement signed with the District Commissioner for management of the Water Board financial account.

Activities likely as part of the rehabilitation include¹²⁷:

- Clearing of blocked siphons (debris and vegetation)
- Replacement of siphons
- Repair and/or reshaping of clay levees
- Repair of access roads (sanding and reinforcement with shells)
- Installation of sluice gates
- Deepening and reshaping of canals

¹²⁷ Activities will depend on the specific needs identified in the studies for each water board,

While the planning and detailed design of the rehabilitation works will be awarded to specialized consultants and implementation of the rehabilitation projects will be tendered and awarded to qualified contractors, the goal is to have each water board involved in establishing priorities, having input into the designs and implementation, and formal approval of the completed projects before transferring them back to the water boards.

5.2 Main Irrigation and Drainage System Infrastructure Repair and Construction

Table 2 lists the repair and construction activities that are planned to be financed by the Project.

Table 2. Infrastructure Projects Main Irrigation and Drainage System

Infrastructure	Description	Proposed Work
Groot Henar sluice	Drainage outlet from Groot Henar polder into Nickerie River	<ul style="list-style-type: none"> • Repair 3 of 4 steel doors with wooden gates, or repair existing • Construct overhead structure to allow safe lifting; • Repair retaining walls on inflow and outflow sides
Clara sluice	Drainage outlet from Clara polder into Corantijn River	<ul style="list-style-type: none"> • Completely overhaul sluice • Replace gates and door frames • Replace concrete • Deepen outlet
Nanni/Van Wouw inlet structure	Inlet structure to: van Wouw canal; Tondonsi canal serving Europolder Zuid; Eastern lateral van Wouw canal serving Europolder Noord; van Wouw Commercial farms of Mangli and Baitali; Clara distribution box serving the 5 western WB polder systems (Corantijn, Clara, Nanni & Bruto, van Drimmelen, Wasima en Europolder Noord)	<ul style="list-style-type: none"> • Replace steel gates • Reconstruct roofing to allow safe installation of the pulleys • Replace wooden retaining walls (causing erosion of dikes) • Stabilize concrete retaining walls at the inflow side of the structure
Ikugh inlet structure	Inlet from the Suriname canal to the Lateral Canal and Suleiman canal, serving “Hampton court polder” and “Groot Henar polder” (Suleiman inlet) and “Uitbreiding Groot Henar” en “Autonoom” polders	<ul style="list-style-type: none"> • Repair or replace 3 inlets gates • Repair or replace lifting devices
Nanni sluice	Drainage outlet from Nanni polder into the Corantijn river	<ul style="list-style-type: none"> • Clean and repair 4 doors • Install lifting devices • Repair retaining walls of inlet and outlet
Hazard sluice	Drainage outlet from Bacoven and Europolder into the Nickerie River	<ul style="list-style-type: none"> • Replace 4 gate doors • Repair or replace retaining walls at inlet and outlet and install protection to avoid scouring
Hamptoncourt sluice	Drainage outlet from the Hamptoncourt polder into the Nickerie River	<ul style="list-style-type: none"> • Clean and repair outlet gates • Repair retaining walls on inlet and outlet side • Deepen outlet
Ha canal intake structure	Inlet structure from Surinam canal into the HA canal with flow regulating gate which	<ul style="list-style-type: none"> • Repair & replace non-functioning spindle gate

	serves Paradise-Longmay, Sawmillkreek and Bacoven polders	<ul style="list-style-type: none"> • Increase height of gate to prevent overflows during high water events
Suleiman Hamptoncourt link	Inlet from Suleiman canal to Hampton Court polder	<ul style="list-style-type: none"> • Replace missing gate and install spindle structure
Clara distribution box	Flow distribution and regulation structure serving 5 polders : Corantijn, Clara, Nanni-Bruto, van Drimmelen, Wasima	<ul style="list-style-type: none"> • Replace all 5 non-functional spindle gates • Close provisional outlet to Nanni-Bruto polder
Drie Koker Punt inlet	Inlets from HA canal to 3 lateral canals serving Longmay-Paradise and Sawmillkreek polders	<ul style="list-style-type: none"> • Repair 3 inlets which lack closing gates
Corantijn Canal siphons		No information available, project added after assessment completed
Nanni outlet	Information not made available, new project	
Nanni spillway	Function is to release excess floodwaters from the Nanni swamp at times of high rainfall	<ul style="list-style-type: none"> • Replace missing wooden beams • Repair and reinforce retaining walls on the outflow side • Reshape and increase height of earthen dam on the south side • Clean out Nanni Creek outlet to increase the outflow capacity
Nanni Kreek	Portion of creek located downstream of Nanni Swamp, functions as main outlet to the Corantijn River from the Nanni spillway	Cleaning (dredging out silt and vegetation) and reshaping of 13 km of the creek to improve drainage and reduce flooding
Nanni weir	No information available – newly added project	<ul style="list-style-type: none"> • Construct new weir and all related earthwork. Project was not evaluated as part of ESA because it had not been identified at the time of the assessment.
Maratakka spillway and canal	Planned spillway from Suriname canal into the Maratakka River which flows into the Nickerie river to evacuate excess flood waters from the Nanni swamp in the event of heavy rains	<ul style="list-style-type: none"> • Construct spillway and canal to connect to Maratakka River to Nickerie River
Stondansi Canal	Details not available, newly added project	<ul style="list-style-type: none"> • Widen and raise embankment • New intake
Diversion structure Stondansi/Lateral Canal	Exiting canal that receives water from Nanni Swamp via Suriname Canal	<ul style="list-style-type: none"> • New regulator structure at end Stondansi to connect with Lateral
Lateral Canal 1	Details not available, newly added project	<ul style="list-style-type: none"> • Widen and raise dam embankment level, 7 km long

5.3 Support for Water Board Operations¹²⁸

Water boards will need assistance and support in order to take over the irrigation and drainage maintenance operations and to function effectively. The Project proposes to finance various institutional strengthening activities designed to provide this support.

Such measures will likely include:

- Completion of legal procedures and certification by RO of individual water board bylaws (Keur and Legger) to formally transfer O&M;
- Provision of meeting and office facilities for clusters of water boards;
- Assignment of an independent Water Controller paid by the Government to assist in 1) the preparation of annual O&M plans; 2) development of water distribution and operational procedures; and 3) control of the maintenance obligations of the water board farmers

In order to help promote the payment of fees by water boards, based on their annual O&M plans the following type of support will be provided:

- assistance in the development of legislation and procedures for collection of fees through the District Administration;
- provision of transitional financial support by the Government to assist water boards in the preparation and implementation of O&M works; and
- provision of training and capacity building for the Water Board Committee and the proposed Water Controller.

To further incentivize and support Water Boards, the Project will consider financing some ongoing O&M activities after Water Board rehabilitation for up to three years. This may take the form of 100% financing of O&M in the first year after rehabilitation; 75% in the second year; and 50% in the third year.

Despite the fact that there have been capacity building programs, such as one funded by the European Union, to inform farmers about water board operation, further training and capacity building through provision of information, instruction manuals, courses and in-service assistance are needed that could include the following procedures to help water boards operate:

- Scheduling and running water board and the Water Board Committee meetings, creating agendas, determining the quorum, voting, decision-making and responsibilities for execution of decisions.
- Creating record-keeping procedures, such as maintaining lists of water board members and the ledger.
- Norms, standards and unit costs for determining annual budgets for ongoing maintenance of irrigation and drainage infrastructure.
- Establishment of the water tax assessment (“kohier”) and dispatch of water tax bill for each member;
- Hiring consultants and contractors to carry out specific studies and construction work
- Inspection (“schouw”) of completed maintenance and rehabilitation works carried out by members and contractors.

¹²⁸ Smith, Martin, 2016

Although the focus of the Institutional Strengthening program will be on capacity building of water boards and the Water Board Committee, training and guidance to staff from the Ministries, members of the District Water Commissions, and the Water Controller will also be financed. Training would focus on clarifying responsibilities of the DIDCWG and DWC; identifying water board and the Water Board Committee's training needs; and technical aspects of sustainable irrigation and drainage management.

The Project may also provide for some start-up working capital as an incentive to kick-off water board operation that would pay for:

- Advertising costs included in the approval procedures for the By-laws;
- Basic office and administration supplies;
- Rent of office and meeting space;
- Specialized training;
- Communication expenses (telephone, newspaper, internet, notice boards)
- Travel to meetings or events; and
- Emergency budget for urgent repairs.

5.4 Institutional Strengthening for Improved Water Resources Management

In addition to the institutional strengthening activities mentioned for supporting the water boards the Project will provide strengthening activities to the OWMCP and LVV to improve water resource management over the long term. This could include support for the introduction of operational plans under various water supply and climate scenarios and the implementation of rotational water supply and crop water calendars.

5.5 Incentives to Farmers to Support Sustainable Agriculture

Leveling of rice fields is being offered to farmers. Leveling rice fields has been shown to increase yields and is effective at reducing the presence of red rice, an invasive weed of rice fields that typically grows in the drier/higher micro-elevations of the rice fields. The Bank will finance 100% of the cost of leveling fields, but will require 50% repayment of this cost into the water board funds for improving future land management in other fields.

The Project will also provide training to farmers in pesticide and fertilizer management.

VI. ASSESSMENT OF SOCIO-ENVIRONMENTAL IMPACTS AND PROPOSED MITIGATION MEASURES

The activities proposed for each of the components and activities within them were analyzed to assess the potential for both positive and adverse socio-environmental impacts and risks, with a focus on the issues identified in the Bank's Environmental Safeguard Screening report.

No adverse socio-environmental impacts are expected from the implementation of Component 2. Instead this component will contribute to improved data collection and therefore management of agricultural information.

The impacts and risks that were identified in the socio-environmental analysis for Component 1 are discussed below, together with the recommended mitigation or compensation measures for reducing risks and impacts. They are also summarized in Table 3.

6.1 Potential Impacts to Water Resource Supply and Hydrology

The proposed rehabilitation projects for the six water boards as well as the proposed projects in the main irrigation and drainage system will result in significant reductions in water waste and water loss. These reductions, coupled with an improved and more efficient irrigation water distribution system (even if the Corantijn Canal extension is not completed) is expected to supply all the irrigation water necessary for the additional 27,000 ha that can be irrigated, without withdrawing any additional water from Nanni Swamp or its tributaries.¹²⁹ Therefore, there should be no net increase in irrigation withdrawals either from the swamp or from the Corantijn River via the Corantijn Canal. This assumption is based on the fact that only so much water can be withdrawn from Nanni Swamp due to the fact that it is operated via gravity flow and once the water level drops below the elevation of the withdrawal canals, no more water can be withdrawn during the dry seasons. This is when pumping through the Corantijn Canal begins.

The Nanni Kreek project involves dredging 13 km of the creek, located outside and downstream from Nanni Swamp, using a dragline and floating excavator. There will be unavoidable short term environmental impacts to aquatic and creek-side vegetation, benthic fauna, fish and possibly other wildlife from this action that cannot be mitigated. However, this section of the creek functions as part of the irrigation system to drain water from the swamp into the Corantijn River and it has been dredged many times in the past. Impacts could be reduced by scheduling cleaning activities to avoid key spawning and nesting seasons, if important species are likely to be present.

The Nanni weir, which was added to the project list for financing after the ESA was completed has not been defined or evaluated in terms of its socio-environmental impacts. Therefore, an environmental impact assessment of this project will be required prior to commencing construction to evaluate potential impacts and identify mitigation requirements.

Construction of the Maratakka Spillway will help to control flooding during high rainfall events and is unlikely to cause an increase in water withdrawal from Nanni Swamp during the dry seasons, even though it has been stated that it will provide water to the Nickerie River to help with saltwater intrusion during dry periods. A level of 3.65 NSP has been proposed for this spillway, although there is no final design for this project yet. This elevation compares to the existing crest level of the Nanni Swamp retention dam of 4.45 NSP, and would not exceed the amount of water currently withdrawn from Nanni Swamp during dry season irrigation (when water levels drop to 1 meter below the crest of the dam). It will be important to monitor the design and construction process for this project to ensure that the height of the spillway will not cause an increase in water withdrawals from Nanni Swamp during dry seasons. The project will cause permanent changes in the existing vegetation of the area and must, therefore be evaluated in terms of its potential environmental impact, as well as determining potential mitigation measures. Therefore an EIS for this project will be required prior to construction.

As previously mentioned, there is insufficient hydrological data and no ongoing hydrological monitoring to predict with certainty how the swamp hydrology or that of its tributaries will be affected, if at all by this Project. In order to provide information for decision-makers for future planning, especially if the

¹²⁹ Personal communications, M. Smith, G. van der Kooye, November 2017.

European Commission Master Plan for Irrigation were fully implemented or there were other proposals to increase water supply in order to expand to new polders it was recommended in the draft ESA that the Bank finance installation of a permanent hydrological data collection system, along with the necessary support software and hardware and training to operate the system and provide real time as well as historic hydrologic information to inform operation of the irrigation system as well as future expansion. It would also be useful to install a permanent water level monitoring study in the irrigation system to assist managers in regulating water distribution. Financing of 10 water level monitoring stations has been included in the Project, with the locations and type of equipment to be specified upon completion of the water balance modeling being done by Hydro-BID.

6.2 Impacts or Risks to Fragile or Protected Ecosystems

No expansion of agricultural activities into protected areas (Bigi Pan and Hertenrits) is expected due to the Project, because there is already a large supply of formerly agricultural land available, as well as existing agricultural land that is underutilized due to lack of irrigation on the left bank of the Nickerie River that will benefit from the Project. It is expected that the Project will benefit the existing polders on the left bank of the Nickerie River.

Significant long-term adverse impacts to Nanni Swamp ecosystems are not expected, as they are already highly disturbed by current and historical activities and water levels in the swamp are not likely to be significantly changed by implementing the Project. However, no current information is available to assess potential impacts to fish, wildlife or vegetation if there is future expansion of polders beyond what is expected due to this Project, or for assessing impacts from the Maratakka Spillway construction or the Nanni Weir construction. Conducting full environmental impact assessments for these two projects will be needed and must include assessing impacts to Nanni Swamp ecosystems through an ecosystem study.

6.3 Hazardous Materials

In terms of direct impacts, there will be no use of pesticides to implement the infrastructure work to be carried out for the Project. All cleaning of canals to be financed by the operation will involve manual/mechanical removal of sediments with heavy equipment and not herbicides.

In the long-term however, because of the irrigation and drainage improvements implemented by the Project will likely cause an increase in the amount of land to be put into rice production (as many as an additional 28,000 ha) because of improved irrigation and drainage. As a result, it is probable that there will be a corresponding increase in the use of pesticides and chemical fertilizers by farmers, in keeping with their current practices, since pesticide applications are usually preventive and not based on monitoring for pests or diseases. Pesticide use will include chemical control of weeds in canals, and weed, insect, fungus, mollusk and other pest control in the polders. The high cost of manual or mechanical control of weeds in canals makes it unlikely that farmers will abandon chemical use for this purpose.

This Project is not designed to directly address ways to reduce pesticide use by farmers, but training in pesticide and fertilizer management will be offered to interested farmers. Nonetheless, as a mitigation measure the Project should finance a water and sediment quality study of the discharge canals and other locations in the polders to better evaluate the impacts of pesticide use in the rice growing region of Nickerie. It is further recommended that a survey of farmers be carried out in conjunction with the

sampling program to interview them about their pesticide use practices to gain a better understanding of the pesticides used and how they are applied, which would then inform the sampling plan.

Supporting farmers in land leveling their polders would help reduce herbicide use for controlling red rice and other weeds, and even without land-levelling, more controlled water levels in the polders may help to reduce the occurrence of red rice and thus reduce herbicide use for this purpose.

It should be noted that the IDB will be providing support to LVV for its Pesticide Management Program through the Agriculture Competitiveness Program slated to begin in early 2018. The Program will contribute to better control of pesticides on a national level by strengthening regulations, inspection capacity, public information campaigns, and laboratory capability for testing pesticide residues and pesticide content. In addition, the Program will fund a small innovation project to develop and promote IPM in rice farming in collaboration with ADRON.

6.4 Potential Temporary Impacts from Infrastructure Repairs and Construction, Pollution Abatement

Short-term temporary impacts from construction of the proposed infrastructure projects are possible. They could include: removal of vegetation (aquatic and terrestrial), disruption of habitat for aquatic and terrestrial fauna, dust generation, erosion and sedimentation into canals and rivers, noise generation, and discharge of liquid waste materials (such as excess concrete or waste water from concrete mixing) into water bodies or other uncontrolled locations. It should be noted that total suspended solids in the irrigation and drainage canals are already high under normal operation, therefore the impact of increasing sediment loads during construction activities is likely to be minimal. There are potential risks of pollution to soils, surface water and groundwater if hazardous materials or petroleum products are used and not properly managed. If companies contracted for the rehabilitation works establish a works yard where hazardous materials or bulk quantities of petroleum products will be stored, these materials should be properly stored to prevent accidental releases from spills or leaks.

There are potential adverse environmental impacts if materials needed for construction (gravel, sand, shells, lumber) are extracted from unauthorized locations such as riverbanks, beaches, and forests.

There will be unavoidable short-term impacts to flora and fauna (aquatic and terrestrial) due to cleaning and dredging of canals and construction activities as part of this Project. However, such impacts are common and recur frequently as part of the maintenance of the irrigation and drainage canals. A possible mitigation measure to reduce impacts would be to avoid doing work during fish spawning seasons and bird nesting seasons (which would need to be determined on a species by species basis).

All these potential impacts and risks can be reduced and managed by requiring that contractors use best construction practices for environmental management, perform work during the dry season and/or when canals are not full and only obtain bulk construction materials from locations licensed by the Ministry of Natural Resources.

6.5 Solid and Hazardous Waste Generation

Construction wastes will be generated as a result of the infrastructure rehabilitation, which if not properly managed, could block canals, interfere with irrigation and drainage infrastructure and create visual pollution. This can be mitigated by ensuring that contractors be required to dispose of all

construction wastes in the Nickerie landfill, recycle metal waste at the local salvage yard, or other authorized location. This requirement should be spelled out in tender and contract documents and monitored during construction activities.

6.6 Occupational Health and Safety Risks

The rehabilitation, construction and repair projects will all create risks to construction workers and potentially the public. Risks include slips and falls, accidents due to operation of heavy equipment, lifting accidents, accidents from using power tools, cave-ins from excavations, heat exhaustion, insect and snake bites, working over water, and others. To minimize such risks, contractors should be required to use appropriate procedures to protect workers, provide personal protective equipment (PPE) and ensure that they are used and comply with all Ministry of Labour policies related to occupational health and safety, and ILO Code of Practice for Health and Safety in Construction. This requirement should be specified in tender and contract documents and compliance should be monitored as part of the supervision of construction activities.

6.7 Potential Social Impacts and Risks

Positive social impacts are expected from implementation of the Project over the long term because of increased rice yields and resulting increases in incomes for farmers. It is expected that productivity will increase as a result of irrigation and drainage improvements.

There is no resettlement required for the implementation of this Project. Similarly, there is no anticipated loss of livelihoods as a result of the Project

If the Project provides some cost-sharing incentives for farmers to level their fields, this would also represent a positive social impact due to the likelihood that it would increase rice yields and reduce the costs of applying herbicides and the health risks involved in their application to combat weeds like red rice. If other farmers see the benefits of land-leveling and adopt the technology, it would multiply the positive social benefits.

The key social impact of this Project is related to the goal of having water boards become responsible for the costs of maintaining their internal irrigation and drainage infrastructure through the payment of an annual fee to cover the costs of the annual operation and maintenance plans of their polders. While medium and large farmers may not find this payment to be a hardship, small farmers may. However, the fees will be based on the number of hectares each farmer uses within the water board, which are generally less than 12 and as much as 24. Per hectare cost of annual operation and maintenance activities will be developed and discussed during Project preparation, as will the issue of capacity of small farmers to afford the fees.

The idea of having water boards take on the cost of maintenance and operation of the irrigation and drainage systems in their polders is well known among the affected farmers and OWMCP has carried out a capacity building project in conjunction with the European Union in integrated water resource management to train the trainers who, in turn, were to train farmers. To further ensure that farmers are well prepared and have the necessary support to carry out the tasks assigned to water boards, adequate training and resources must be provided as described in the proposed Project activities in Section 5.3.

For small farmers who may adversely affected by having to make the annual payments, one way to mitigate impacts to this group is to allow for in-kind contributions to the maintenance and operations activities – in other words allowing them to do some of the labor as partial payment of the annual fee. The value of their in-kind labor would need to be studied and an equitable dollar amount established.

Farmers will experience changes in the delivery of water due to the implementation of improved distribution plans and water calendars and should be involved in the decision-making for their development.

No adverse gender-related impacts are expected from the Project but it will be important to ensure that small farmers who grow fruits and vegetables (who are mostly women), participate in the relevant water boards and have a voice to ensure access to irrigation water when needed for vegetable and fruit production.

Given that vulnerable Marron or Amerindian populations are not involved in rice production and that the proposed Project activities will not impact upstream water resources or traditional hunting or fishing grounds, there are no expected impacts to these populations.

VII. CLIMATE CHANGE AND DISASTER RISK ASSESSMENT

7.1 Climate Change Evaluation

7.1.1 National Climate Change Policies and Planning

Suriname is party to the Kyoto Protocol for the United Nations Framework on Climate Change (UNFCC). The country's 2012-2016 National Development Plan, the 2013 Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) and the 2012-2016 Environmental Policy Plan all recognized the significance of climate change impacts on Suriname, with special emphasis on developing opportunities for low carbon emission development.¹³⁰

Initiatives are underway by the government as a result of the 2008 Integrated Coastal Management Plan and the 2012-2016 National Development Plan (improving drainage in some areas, rehabilitating and enhancing infrastructure such as dikes) and NGOs (restoring mangrove swamps along the coast).¹³¹¹³²

The most recent Suriname National Climate Change, Policy, Strategy and Action Plan for the period 2014-2021 took into account the CARICOM Liliendaal Declaration of July 2009 and the Regional Framework for Achieving Development Resilient to Climate Change of July 2009 (along with its Implementation Plan of March 2012).¹³³ For the agriculture sector the 2016-2021 National Climate Change Plan established objectives, outcomes and programs, assigning lead responsibility to LVV for ensuring food safety and food security. One major outcome that is hoped for is ensuring that agricultural crops, livestock and fisheries are protected from water shortages and salt water intrusion.

In April of 2016, Suriname signed the COPS21 climate agreement negotiated in Paris, pledging to reduce greenhouse gas emissions by 0.01 percent.

¹³⁰ Ministry of Labour, 2015.

¹³¹ Conservation International, 9/18/16.

¹³² Intended National Contribution under UNFCC from the Republic of Suriname, September 2015.

¹³³ Ministry of Labour, 2015

Suriname contributes little to greenhouse gas generation but does have potential for low carbon emission development. Agricultural activities contribute an estimated 12% to greenhouse gas emissions, but Suriname's forests act as a sink, sequestering greenhouse gases. These numbers could change if there is significant deforestation, or agriculture becomes more unsustainable.¹³⁴

7.1.2 Climate Changes Expected in Suriname

Climate modelling projections for Suriname predict future changes including:

- an increase in average atmospheric temperature (between 0.8 and 3.x degrees C by 2060 and 1.3 to 4.7 degrees C by 2090¹³⁵);
- increased intensity of rain events as well as reduced average annual rainfall¹³⁶;
- increased sea surface temperatures;¹³⁷ and
- sea level rise by between 0.18 and 0.56 meters by 2090.¹³⁸

The country's water resources may experience stress as a result of climate change through the combined effects of reduced annual rainfall, increased evapotranspiration, and prolonged dry periods. Reduced rainfall and the resulting reduced discharge will lead to saltwater intrusion in the rivers, creeks and streams that flow directly into the Atlantic Ocean.¹³⁹ In fact, per LVV and OWMCP the Nickerie region is already experiencing longer dry periods, and increased saltwater intrusion into the Corantijn River and the Nickerie River, which is also experiencing lower flows in the dry season.

Seawater penetration in the coastal area will trigger a number of changes, such as the decline of water quality, the dislocation of freshwater fish species, higher water levels and hyper-salinization in the case of stagnant water.¹⁴⁰ Saltwater intrusion into aquifers may also increase with continued extraction from groundwater sources and pollution. If the sea level continues to rise, replenishment rates into the Zanderij aquifer may decrease.

The Nickerie region has also experienced increased intensity of rain events, resulting most recently in damage to irrigation and drainage infrastructure from Nanni Swamp flooding in 2016. ADRON has reported that there has been a significant increase in the number of rice pests over the last few years and that increases in temperatures have caused problems with rice seed production (no seed formation) in some varieties.

7.1.3 Project Contribution to Climate Change

The proposed Project may contribute slightly to climate change due to the increase in area devoted to rice cultivation with improved irrigation and the corresponding increase in methane from rice cultivation. An increase in methane production due to an increase in area to be put into rice production, as well as an increase in the number of hectares that can produce two crops per year is likely. It is well known that flooded rice production generates methane. Further, a 2012 study by Trinity College, UC

¹³⁴ Ministry of Labour, Technology and Environment, 2015

¹³⁵ McSweeney, et.al., 2015

¹³⁶ Depending to some extent on El Nino and La Nina weather patterns

¹³⁷ CARIBSAVE, Climate Change Risk Profile for Suriname, March 2012.

¹³⁸ McSweeney, C.; M. New; G. Lizcano, UNDP, Climate Change Profile, Suriname, Dec. 15, 2015

¹³⁹ Del Prado, 2013...

¹⁴⁰ Del Prado, 2013....

Davis and Northern Arizona University found that methane production from rice is likely to increase as temperatures rise due to global warming.¹⁴¹

However, the Project will improve water management, which will help to reduce the amount of time fields are unintentionally flooded and will allow for the possibility of introducing new technologies such as alternate wet drying of fields, which would reduce methane release. It is not known if this technology would be appropriate for soil and climate conditions in Nickerie and would have to be tested.

Although the area in rice or other crop production is expected to increase due to the more reliable availability of irrigation services. This will result in a corresponding increase in the use of nitrogen fertilizers, but it is expected that the more efficient distribution of irrigation water and improved drainage from the polders will also make fertilizer use more efficient, thus reducing the unit rate of nitrogen application per polder. This will help to mitigate the expected increase in fertilizer use and resulting nitrous oxide emissions due to increased areas of production.

7.1.4 Project Contributions to Climate Resilience

The Project will improve climate resilience in the Nickerie region in several ways. It will promote more efficient use of water as a result of the infrastructure rehabilitation by significantly reducing the water waste that characterizes the current irrigation system. The Project will also contribute to the more efficient distribution of water to farmers, thus increasing productivity and efficiency with less water than is currently distributed to the irrigation system. In addition, the Project will improve climate resilience for rice production by improving the availability and reliability of water during the dry seasons, thus promoting improved yields and allowing more farmers to produce two crops per year.

More efficient distribution and use of irrigation water and the reduction in water wasted will also reduce the amount of pumping needed during the dry season. This will in-turn reduce the amount of petroleum fuels used for operating the main pumps, as well as that used by individual farmers to pump excess water from their fields.

7.2 Natural Disaster Risk Management Evaluation

7.2.1 National Plans and Programs

Suriname is a member of the Caribbean Disaster Management Agency (CDEMA), a regional inter-governmental agency for disaster management in the Caribbean Community (CARICOM). Its role, in addition to assisting countries with disaster relief efforts, is to facilitate and motivate its members to plan and carry out Comprehensive Disaster Management. This includes the adoption of disaster loss reduction and mitigation policies. Suriname has not submitted a Country Profile to CDEMA or any other information on its activities.¹⁴² It has not signed on to the United Nations Sendai Framework for Disaster Risk Reduction or adopted a National Platform under the Hyogo Framework.

The National Coordination Center for Disaster Relief (NCCR) within the Ministry of Defense was created in 2006 and is tasked with planning for disaster prevention as well as response. The NCCR has participated in training offered through CDEMA and has begun: collecting data on vulnerabilities to disasters; creating an early warning system (pilot programs with UNDP support); and increasing public awareness about preparing for disasters in collaboration with other organizations including the

¹⁴¹ Kees, et.al., 2102

¹⁴² CDEMA, <http://www.cdema.org/>, accessed Oct. 24, 2016.

Suriname Red Cross and the Fire Brigade.¹⁴³ To date, no national policy for disaster prevention has been formulated.

The National Climate Change Policy, Strategy and Action Plan for Suriname for 2014-2021 has established several outcomes and action items for natural disaster management to be carried out by the NCCR including increased climate change research, integration of climate resilience into disaster risk management infrastructure and operations, public outreach to raise awareness and legislation and policies to integrate climate change and climate resiliency into disaster risk management.

7.2.2 Project Risks Related to Natural Disasters

During the environmental safeguards screening process the Bank identified the risks of natural disasters for the Project as moderate due to the potential for:

- Risk of hurricanes and tropical storms
- Risk of inland flooding
- Risk of droughts
- Sea level rise

The Project will contribute to reducing natural disaster risks related to flooding and drought. The proposed infrastructure projects such as the Maratakka Spillway and the Zuid (south) drain will reduce the risk of flooding from overflows from Nanni Swamp (as happened in 2016). These projects will provide additional outlet capacity from the swamp during high water periods, such that excess water will be safely discharged to the Nickerie River and to the Corantijn River. Further, the Maratakka spillway will slightly increase flow into the Nickerie River during dry periods, perhaps helping to reduce somewhat salinity levels in the River that interfere with pumping irrigation water to the polders on the right bank of the Nickerie River. However, the amount of water that could be directed into the Nickerie River in the dry seasons has not been calculated and it is uncertain if it will be enough to have any impact on the saltwater wedge.

While Suriname lies outside of the historical hurricane belt, severe storms with high winds and heavy rains have been increasing in the country. During a major storm in 2012, unlike any previous storm experienced in the country, there were winds of 80 kph which caused power outages, blew down trees and power poles, damaged houses in the Galibi area (near Paramaribo) and damaged boats.¹⁴⁴

The likelihood of more storms of this magnitude occurring due to climate change could adversely affect the infrastructure improvements to the irrigation and drainage systems to be financed by this Project. It is difficult to reduce the risks of such natural disasters, except to ensure adequate construction of structures and adequate protection of the banks of dams and dikes.

¹⁴³ Karijokromo, Caitlan, 2011.

¹⁴⁴ Reuters, accessed 2017

VIII. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

8.1 Purpose

The purpose of the Environmental and Social Management Plan (ESMP) is to establish principles and procedures of socio-environmental management to ensure that all Project activities have the necessary social and environmental safeguards to prevent or minimize adverse impacts and risks, and to promote social and environmental sustainability in the short and long-term.

The ESMP identifies the mitigation measures to be applied to the Project activities, the institutional organization and responsibilities for ensuring they are implemented, a monitoring plan, a budget for their implementation (to be incorporated into the overall Project budget) and the stakeholder consultation plan.

The ESMP will be incorporated into the Project's Operating Procedures and its implementation will be a contractual obligation in the loan contract between the IDB and the Suriname authorities, to ensure Project compliance with Bank and local environmental policies, as well as applicable international norms. The ESMP will also be included into the tender documentation for the construction contractors, and be included as a requirement in the resulting contractual agreement.

8.2 Mitigation Measures

The potential adverse impacts and risks and their corresponding mitigation measures described in Section VI and in Section VII (Climate Change Evaluation) are summarized in Table 3. There are no mitigation measures identified for disaster risks or preparedness. Recommended actions to improve socio-environmental sustainability are also shown in Table 3 and are discussed in more detail in Section 8.7.

The mitigation measures form part of the requirements of this ESMP. The mitigation and risk reduction measures can be categorized into four major themes: 1) those intended to reduce short term, direct impacts and risks related to the construction phase of improvements to irrigation and drainage infrastructure; 2) those intended to reduce or compensate for long term impacts related to the likely increase in the use of agrochemicals due to the Project; 3) those short and long-term social impacts related to the transfer of O&M to water boards; and 4) those intended to assess and mitigate ecosystem impacts from the Nanni Weir, the Maratakka Spillway project, or other projects that may be proposed later under the Project with potential significant impacts on hydrology and ecology.

8.2.1 Mitigation Measures Related to Construction Phase

To implement the mitigation of impacts and risks during the construction phase, contractors must be required to comply with international best practices for environmental management during construction as described in Figure 14 and in accordance with the type and scale of each infrastructure project. These best practices include: control of erosion and sedimentation; dust suppression; management of any hazardous materials or petroleum products to avoid releases into the environment; proper disposal of construction wastes; and use of licensed sites for provision of bulk construction materials.

Figure 17. Best Management Practices for Environmental Management of Construction

Standard Best Management Practices for Environmental Management will include (as applicable) but not be limited to:

Site/Equipment Management

- Designate limits of work for each project site using flagging, staking or other method and do not disturb anything outside these boundaries.
- Locate equipment wash down areas so as to avoid polluting streams, rivers and lakes.
- Keep construction equipment in good operating condition (e.g. hydraulic lines, emission control systems) to help minimize environmental impacts.

Flora and Fauna Impacts

- Avoid dredging in canals and creeks during fish spawning seasons and bird nesting seasons (if it is determined that sensitive or important species are present)
- Ensure all work involving dredging or constructing new sluices, spillways, and other projects are done in the dry season and/or when canals are not full (whenever possible)
- Stop work if sensitive fauna are seen in the immediate work area and contact a government wildlife representative
- Avoid unnecessary removal of mature native trees

Erosion Prevention and Control

- Keep surface disturbance to the minimum needed for the project in order to reduce erosion potential.
- Ensure all work is performed during the dry season and/or when canals are not full and
- Store raw materials or excavated material stockpiles well away from surface waters, whenever possible, or provide containment measures.
- Do not deposit soil into wetlands or on stream banks, or into stream corridors or water bodies.

Materials

- Obtain bulk construction materials from locations licensed by the government for that purpose.

Air Quality

- Control dust to prevent air pollution with water spraying or other techniques.

Hazardous & Waste Materials Management

- Refuel vehicles in designated areas.
- Handle and dispose of wastes in compliance with international best practices.
- Identify what materials are hazardous & ensure they are labeled & in original containers.
- Prevent contamination by storing hazardous materials away from waterways and in secure locations
- Periodically inspect areas where hazardous materials are handled or stored & clean up spills promptly

To reduce risks to construction workers, contractors must comply with the Code of Practice for Safety and Health in Construction¹⁴⁵ of the International Labour Organization and Ministry of Labour norms regarding employee insurance. Bid documents must include these requirements, and this must be verified prior to issuing them. Inspections during construction will also be required to ensure that safety measures are being provided and used, including those listed in Table 4, as appropriate for the types of risks likely from each infrastructure project. At a minimum, workers should be provided with and use personal protective equipment such as hard hats and adequate construction boots (preferably steel-toed), as well as adequate work gloves. The contractors will also be responsible for ensuring safety during construction by providing engineering controls, such as shoring up of walls of excavations, as necessary. In addition, the provision of adequate drinking water, sanitation facilities and other measures to prevent heat exhaustion will be the responsibility of the contractors.

Finally, contractors should be made responsible for traffic control, as necessary and for control of public access to construction sites.

LVV will establish a grievance process to receive and act on any complaints received from the public during construction activities (as detailed in Section 9.2.4), as well as be responsible for monitoring contractor compliance, including compliance with the environmental, social, health and safety measures stipulated in the contract and in this ESMP.

8.2.2 Mitigation Related to Long-Term Increase in Agrochemical Use

There are no baseline data available on the quantity and frequency of pesticide use in the polders or of agrochemical impacts to water and sediment quality, only anecdotal claims that farmers excessively use pesticides, and information that many of the pesticides are considered to be moderately toxic. Since the Project will likely cause an increase in pesticide use due to the expansion of rice or other crop production, when irrigation and drainage systems are rehabilitated, a study will be done to establish a baseline for this information. It is possible that there will be a reduction in the use of herbicides for combatting red rice due to more consistent water levels during irrigation, as well as among farmers who adopt land-leveling technology. In addition, there may be a small reduction in the use of other insecticides if rice crops become healthier due to more reliable water, and therefore more resistant to pests. However, given that rice farmers do not monitor for pests, but apply pesticides as preventative measures, such a reduction is not very likely, unless there is significant adoption of integrated pest management or other pesticide management techniques.

The study will carry out surveys of farmers to identify their pesticide practices including: what pesticides are used for what pests, what volumes and how frequently they are applied, if any pest monitoring is done, what personal protective equipment is used, and where farmers obtain their information about what pesticides to use. The study should, if possible, include interviews with the companies that perform aerial spraying, if they are willing to share this information and interviews with pesticide distributors. Coordination with the LVV Pesticide Department and ADRON will be part of developing the study. To accompany the pesticide use study, the Project will finance a sampling and analysis study to evaluate water, soil and sediment quality in the canals. Such a study could also include tissue sampling of fish and a survey of insects to determine the presence of pests and of natural predators if there were sufficient funding. The mechanisms for carrying out these studies and the budget for them are discussed later in this ESMP.

¹⁴⁵ ILO, 1992. Available at: http://www.ilo.org/safework/info/standards-and-instruments/codes/WCMS_107826/lang--en/index.htm

8.2.3 Mitigation Related to Social Impacts

Mitigation measures for the potential temporary adverse social impacts during the construction phase are identified in the construction phase section.

There are potential long-term social impacts to small farmers related to the required payment of the annual water board operation and maintenance fees. There is not enough information about the economic status of small farmers to determine the likelihood of this impact. Nonetheless, it will be mitigated in the short term by the Project financing part of these costs for the first three years after the Water Board polders have been rehabilitated. This will help function as a bridge between when costs are incurred and farmers experience increased incomes due to increased yields. After the three-year period of financial assistance from the Project, mitigation will involve ongoing monitoring of small farmer participation and identification of any hardships realized for having to pay the annual O&M fee, along with development of measures to help alleviate any hardships caused by the fee payment. Although no discrimination on the basis of gender or ethnic groups in terms of their participation in the water boards is expected, special efforts should be made to reach out to women to encourage participation, as apparently, they don't routinely participate in discussions or decision-making. Their participation in the water boards should be monitored to identify any constraints if they are not participating. A Gender Action Plan will be developed to identify activities and mechanisms to involve women. In order to support development of this plan, the Bank has funded a Gender Assessment as part of the preparation of this Project.

Finally, the Project needs to ensure that small fruit and vegetable growers (many of whom are women) have representation in water board decisions and access to irrigation for their crops, and management approaches for provision of irrigation and drainage services and development of a new water calendar must take into account the different irrigation needs of these crops compared to rice (timing, quantity). Short of that, funding of cisterns for temporary collection and storage of water could be considered for small horticultural farmers, where feasible.

8.2.4 Mitigation for Newly Identified Projects and Those with Potential Adverse Impacts

In order to determine potential socio-environmental impacts from the Maratakka Spillway project (because insufficient detail was available to evaluate them) and newly identified projects (including the Nanni Weir project) that were not included in the original list of projects assessed under this ESA, separate EIAs will be required before beginning construction. These studies will not only evaluate impacts, but will identify mitigation measures or avoidance measures to reduce or eliminate adverse impacts which will be described in project-specific Environmental and Social Management Plans.

Table 3. Key Socio-Environmental Impacts and Risks and Mitigation Measures

Activity	Potential Environmental Impacts	Potential Social Risks or Impacts	Mitigation Measures	Responsibility (see Section 8.4 for explanation)	Monitoring Methods & Indicators	Recommended Additional Studies/Programs (LVV) See #8.7 for more information
Component 1.						
Water resources and hydrology	Positive long-term, permanent impacts for water resource use due control of leaks and reduction of water waste from infrastructure repairs & improved water management due to implementation of water distribution plans & calendar	Reduced costs for operation of irrigation and drainage system and for operation of pumps, both at polder level and from the Corantijn Canal.	Ensure that institutional improvements to water management (operational plans under various climate and water supply conditions; crop rotation and crop irrigation calendars) are implemented	Institutional Strengthening Consultant for preparation of plans and calendars. LVV, OWMCP to implement on ongoing basis	Preparation of plans and calendars, review by PEU, IDB	
		Changes in delivery of water to farmers due to improved distribution plans and water calendar Potential adverse impacts also to small fruit and vegetable farmers (mostly women) who don't receive enough water now for their crops, and will continue to need water in the future	Implement a Stakeholder Engagement and Communications Plan and Gender Action Plan to ensure that farmers and women are kept involved in decision-making about water distribution and decision-making by their respective Water Boards	Preparation: Consultant for Institutional Strengthening Implementation: LVV, OWMCP, District Water Boards	Plan developed & approved by Bank Progress reports to Bank	
	Unlikely adverse impacts to hydrology of Nanni Swamp basin, except possible impacts from:	Reduced potential for flooding during high water seasons, if Maratakka spillway is installed	Carry out EIAs (including ESMPs) for Maratakka Spillway, & Nanni Weir projects (or other projects proposed	Environmental Coordinator in PEU to supervise	Review of ESIA/ESMPs by PEU & Bank to assess impacts and develop	Install sufficient number of permanent hydrological monitoring in Nanni Swamp basin to improve understanding of

Activity	Potential Environmental Impacts	Potential Social Risks or Impacts	Mitigation Measures	Responsibility (see Section 8.4 for explanation)	Monitoring Methods & Indicators	Recommended Additional Studies/Programs (LVV) See #8.7 for more information
	<p>1) Maratakka spillway is installed at too low of an elevation, allowing increased withdrawals in dry seasons.</p> <p>2) Nanni Weir project causes significant impacts (not yet defined).</p> <p>Note that there is insufficient hydrological and ecologic data to adequately evaluate this.</p>	and Nanni spillway repaired.	after Project approval), to include impacts to hydrology and ecosystems and vulnerable flora and fauna.		mitigation measures	hydrology and establish ecological minimum base flow for use in defining potential future irrigation expansion
Fragile or protected ecosystems	<p>No expected adverse impacts to protected areas in vicinity of Project.</p> <p>No expected adverse impacts to Nanni Swamp ecosystems (except as noted above regarding hydrologic/ecological impacts) as they are already disturbed by historical activities. However little current information is available to assess potential impacts to fish, wildlife or vegetation if there is future expansion of polders beyond what is</p>	No adverse impacts expected to traditional hunting or fishing areas used by upstream vulnerable populations	Carry out EIAs and identify and implement mitigation measures, identified in ESMPs for Maratakka Spillway and Nanni Weir projects.	Environmental Coordinator in LVV PEU to oversee studies	Reports to PEU and to Bank on scope and completion of EISs. Monitoring of implementation of any mitigation measures identified	Carry out an ecosystem study of Nanni Swamp basin (included in Component 1 of the Project).

Activity	Potential Environmental Impacts	Potential Social Risks or Impacts	Mitigation Measures	Responsibility (see Section 8.4 for explanation)	Monitoring Methods & Indicators	Recommended Additional Studies/Programs (LVV) See #8.7 for more information
	<p>expected due to this Project.</p> <p>There will be unavoidable adverse impacts to existing flora and fauna (aquatic and terrestrial) due to dredging and reshaping canals and repairing infrastructure.</p>		Avoid carrying out work during fish spawning seasons and bird nesting seasons, if there are sensitive or important species present. Stop work temporarily if endangered species present during construction.	Environmental Coordinator in PEU to determine species presence and sensitivity in consultation with relevant NGOs and Ministries	Monitoring of construction schedules, monitoring in field by Environmental Coordinator	
Hazardous materials use	No expected adverse short-term impacts due to infrastructure rehabilitation/construction as no herbicides will be used for canal cleaning.		Ensure that all canal cleaning financed by the Project is done mechanically/manually	LVV/PEU	Review of construction documents & contracts, field inspections during construction	
	Possible long term impacts due to increase in area to be planted in rice and resulting increase in pesticide use, including herbicide use for cleaning canals.	Corresponding risks to pesticide applicators and families living in polders due to expected increase in pesticide use.	Conduct a pesticide use survey during Project implementation and water/sediment quality study to evaluate current practices and current levels of environmental contamination & communicate findings to the public	Pesticide Consultant Team under supervision of PEU	Review terms of reference, work plan, meetings with consultant, progress reports, final report, public information campaign	Support farmers in land leveling of polders to reduce herbicide use for controlling red rice and other weeds

Activity	Potential Environmental Impacts	Potential Social Risks or Impacts	Mitigation Measures	Responsibility (see Section 8.4 for explanation)	Monitoring Methods & Indicators	Recommended Additional Studies/Programs (LVV) See #8.7 for more information
Temporary impacts from infrastructure repairs and new construction, Pollution abatement, solid and hazardous waste, noise	Short-term temporary construction impacts – dust generation, erosion and sedimentation, waste generation, discharges of waste materials or hazardous materials to water bodies.	Risks to the environment if hazardous materials or petroleum products are released intentionally or accidentally	Apply standard environmental construction management practices as listed in Figure 14.	Construction contractors	Environmental Coordinator in PEU will provide verification and supervision via review of terms of reference, contracts, pre-construction meetings, site inspections, mechanisms to correct problems. Progress reports to be provided to Bank.	
	Use of small quantities of hazardous materials (such as paints and solvents) is possible.	Disturbance/damage to crops during construction	Ensure that construction schedules be coordinated via LVV with water boards so that farmers have input into schedules to avoid crop damage.			
		Noise that could impact residents living near construction sites (some noise will be unavoidable)	Restrict hours of construction to the typical business hours practiced in Nickerie to avoid noise impacts	Construction contractors	PEU will supervise via site inspections & develop complaint resolution mechanism	
	Environmental damage due to mining of construction materials (sand, gravel, shells) from unauthorized sites		Ensure contractors use only sites licensed by the Ministry of Natural Resources	Construction contractors as supervised by PEU/LVV	PEU will provide verification and supervision via review of terms of reference,	

Activity	Potential Environmental Impacts	Potential Social Risks or Impacts	Mitigation Measures	Responsibility (see Section 8.4 for explanation)	Monitoring Methods & Indicators	Recommended Additional Studies/Programs (LVV) See #8.7 for more information
					contracts, pre-construction meetings, site inspections, mechanisms to correct problems. Progress reports to be provided to Bank.	
Occupational and community health and safety risks		<p>Moderate risks to construction workers during construction activities</p> <p>Risk of accidents to residents or farmers during construction</p> <p>Temporary traffic impacts in Nieuw Nickerie</p>	<p>Apply standard construction safety measures and use of PPE (hardhats, steel toed boots, work gloves, etc.) in compliance with Ministry of Labour policies and the ILO Code of Practice for Health and Safety in Construction</p> <p>Ensure that work zones are set up to restrict access to unauthorized persons</p> <p>Ensure adequate traffic control and notice to residents about temporary road closures</p>	Construction contractors	PEU to ensure requirement is in terms of reference and contracts. Will conduct site inspections to ensure compliance.	

Activity	Potential Environmental Impacts	Potential Social Risks or Impacts	Mitigation Measures	Responsibility (see Section 8.4 for explanation)	Monitoring Methods & Indicators	Recommended Additional Studies/Programs (LVV) See #8.7 for more information
Implementation of Water Board Law requiring water boards to finance O&M of polders		<p>Potential long-term adverse impacts to small farmers if paying annual fee for O&M to cause financial hardship</p> <p>Potential adverse impacts to small fruit & vegetable farmers (especially women) if they don't have a voice in water boards, or access to irrigation.</p>	<p>Ensure availability of some start-up funds for the water boards made up of mostly small farmers</p> <p>Allow for in-kind contributions for small farmers to cover at least part of the annual fee, where possible. Should be incorporated into individual water board bylaws.</p> <p>Implement a Farmer Engagement and Gender Action Plan which will outline specific outreach activities to all farmers and women farmers in particular</p>	<p>Plans & institutional arrangements & monitoring programs to be developed by Institutional Strengthening Consultant</p> <p>Ongoing implementation by LVV/OWMCP, District Water Boards</p>	<p>Plans and programs approved by PEU & Bank</p> <p>Activities reported via progress reports throughout loan execution period</p>	
Climate Change Impacts						Fund studies to evaluate alternate wet and drying approaches to irrigation and drainage.

8.4 Institutional Strategy and Responsibilities for Plan Implementation

LVV will have overall responsibility for execution of the project and will be responsible for ensuring the implementation of the ESMP. As pointed out in Section 3.3, LVV does not have capacity for providing environmental or occupational health and safety supervision of the Project. Therefore, qualified consultants will need to be hired to manage the ESMP under the overall supervision of a Project Executing Unit to be established within LVV for execution of the Project. An environmental, health and safety coordinator/officer will be needed in the PEU to manage overall implementation of the ESMP. In addition, a specialized consultant team for the pesticide study will be needed as discussed below.

Because the nature of the mitigation measures require different types of qualifications and expertise, it is recommended that consultants be hired to work under the PEU as follows: 1) one full-time environmental, health and safety (EHS) consultant to serve as the Environmental Officer or Coordinator for management of the ESMP and to supervise mitigation measures during the construction phase and 2) a short-term Pesticide Consultant Team for preparing the pesticide survey and water and sediment quality sampling and analysis program and providing support for its execution and data review.

The social impact mitigation measures, predominantly that of implementing ongoing consultation and engagement with interested and affected stakeholders, including women, will be incorporated into the role of the Institutional Strengthening consultant(s) hired to undertake the support activities planned for water boards, LVV and OWMCP staff. Responsibilities for carrying out the mitigation measures for managing impacts and risks are discussed below and summarized in Table 4.

8.4.1 Environmental Coordinator/Officer in PEU

The role of the Environmental Coordinator/Officer will be to oversee implementation of the ESMP and will also include responsibility for the environmental and health and safety (EHS) construction supervision. A detailed Terms of Reference for this position is provided in Annex A. Tasks will include:

- Establishing a work plan;
- Supervising the work of the specialized Pesticide Study consultant team, in coordination with the LVV Pesticide Program Director, and assisting the team with logistics
- Supervising any environmental and social impact studies needed for infrastructure projects and coordinating with other Ministries as appropriate, as well as ensuring stakeholder consultation and ensuring that mitigation plans are carried out.
- Monitoring implementation and compliance with the ESMP
- Managing problems
- Reporting to the PEU on progress and how problems were resolved
- Coordinating with other departments within LVV (such as the Pesticide Department), as needed to implement the ESMP
- Coordinating with other ministries and NGOs with wildlife management and endangered species expertise
- Participating in and/or coordinating stakeholder involvement planning and events, as relevant
- Reviewing bid and contract documents to ensure that mitigation measures are included;

- Reviewing construction drawings and construction sites to understand the scope of each project and its potential risks to the environment and to health and safety;
- Meeting with contractors before starting work to ensure work schedules do not adversely impact farmers and to ensure that health and safety and environmental management procedures are understood;
- Inspecting active construction sites to ensure compliance with health and safety requirements;
- Reporting problems to the PEU director and making recommendations on how to achieve compliance; and
- Keeping records of inspections during construction and steps taken to ensure compliance with the ESMP.

The Environmental Coordinator position requires the following areas of expertise:

- Environmental and social impact assessment and mitigation
- Management of environmental mitigation requirements
- Familiarity with environmental best management practices and experience with occupational health and safety management of construction activities, including familiarity with ILO Code of Practice for Health and Safety in Construction.
- Knowledge of hydrology and wetland ecology, including ability to assess hydrologic data, and familiarity with flora and fauna of Nanni Swamp ecosystem
- Familiarity with pesticide toxicity and fate in the environment
- Understanding of irrigation and drainage principles, infrastructure and maintenance practices
- Familiarity with bid documents & ability to review of engineering plans and contract documents;
- Knowledge of worker and public health and safety during construction,

8.4.2 Pesticide Survey and Water/Sediment Quality Study

For the Pesticide Survey and Water/Sediment Quality Study a Pesticide Consultant Team will be hired to design both studies, including preparation of a farmer survey as well as a water and sediment quality sampling and analysis plan. The consultant team will be supervised by the PEU Environmental Coordinator. The Pesticide Consultant Team will prepare a detailed work plan for conducting study activities, including identifying staffing, equipment, sampling protocols, schedules and work products. For carrying out the field part of the survey, a local non-profit environmental organization, quasi-governmental agency or a local university (or some combination), would be hired and trained for carrying out the surveys and the sampling program under the supervision of the consultant team. This would not only provide local work and training opportunities, but institutional strengthening of involved organizations. Local laboratories would be contracted for analyses whenever possible, but in the event that local capacity is lacking, samples will be sent out of country for analysis. Field analytical instruments will be used for basic parameters (such as for pH, DO, temperature, conductivity, etc.) when available and useful to the study.

Expertise and experience necessary for the consultant team include:

- knowledge of agricultural pesticides, toxicities, pest management in rice production, pesticide fate and behavior in environment;

- experience in water quality and sediment sampling and knowledge of sample preservation and analytical procedures;
- experience in designing surveys, interview techniques, and training of field staff;
- statistical analysis;
- Dutch and English language capacity

Detailed qualifications requirements, consultant responsibilities, and scope of work is provided in the Terms of Reference in Annex B.

8.4.3 Social Impacts

To carry out mitigation measures to reduce any risks of social impacts the Institutional Strengthening Consultant(s) hired to provide support to the water boards and ministries will be responsible for developing a stakeholder involvement plan and for overseeing initial implementation of the Gender Action Plan (currently under development) and associated monitoring plans to ensure that:

- consultation and communication activities are undertaken throughout construction activities and Project operation with interested and affected stakeholders, so that they remain informed and engaged;
- the needs of small farmers and their capacity to pay the annual O&M fees are adequately evaluated and addressed;
- there is no gender or ethnic discrimination in the water board activities, and ensuring that there are mechanisms in place so that women participate fully in decision-making; small fruit and vegetable farmers are consulted about proposed water calendars and have access to irrigation for their crops; and
- addressing equity and transparency issues for the irrigation and drainage system, to ensure that all farmers in the Project area have access to irrigation and drainage services, can count on a reliable water calendar that is fair, and that Ministries responsible for operation of the system have the tools to enforce the procedures to be developed.

These plans should be developed early in the Project execution phase and prior to the beginning of any construction.

Because increased use of pesticides due the Project also have possible social impacts due to health risks, the approach to be used and the results of the Pesticide Study should be communicated to the residents of Nickerie in an understandable way. The Pesticide Consultant Team hired for these studies will be responsible for developing materials and presenting information regarding the study approach and results and their potential health and environmental implications.

8.5 **Monitoring and Reporting**

The Environmental Coordinator in the PEU will be responsible for monitoring the implementation of the ESMP for the length of the Project and during the construction phase will inspect sites and report on

compliance to the PEU Director on a at least a weekly basis during the active construction phase. In addition, serious unresolved problems identified will be reported immediately to the PEU Director and Contracts Officer for further action. This information will be reported to the Bank in accordance with reporting frequency established in the operating procedures for the Project.

The Environmental Coordinator will also be responsible for supervising the Pesticide Study and will oversee the Pesticide Consultant Team contract and will monitor activities and report to the Bank on progress in accordance with the operating procedures for the Project.

Implementation of the ESMP will also include overseeing and evaluating the environmental impact studies required for the Maratakka Spillway and Nanni Weir projects, as well as any additional projects added after Project approval.

The Environmental Coordinator in the PEU will also monitor the activities of the Institutional Strengthening consultants responsible for providing support to water boards and the ministries to ensure that the stakeholder involvement and gender action plans are prepared and provisions for ongoing monitoring established.

Table 4. Responsibilities for Executing and Supervising Implementation of the ESMP

Activity	Responsible	Primary Tasks
ESMP Implementation and environmental & occupational health and safety supervision of construction phase	Environmental Coordinator in PEU, full-time	<p>Oversee implementation of ESMP</p> <p>Supervise specialized consultants involved in Pesticide Study</p> <p>Supervise environmental and social impact studies where required for projects</p> <p>Review tender documents, contracts and construction drawings to identify potential environmental and health and safety risks</p> <p>Meet with contractors to discuss requirements, including requirement to consider farmer's needs in relation to construction schedules</p> <p>Develop inspection schedule and reporting and corrective action mechanisms</p> <p>Supervise compliance in field & prepare reports</p>

Activity	Responsible	Primary Tasks
		<p>Supervise ESA studies for infrastructure projects and evaluate adequacy of the analyses</p> <p>Coordinate with other Ministries and other departments within LVV as necessary</p> <p>Participate/initiate stakeholder information and events in coordination with capacity building consultants</p>
Pesticide Study	<p>Pesticide Consultant Team contracted (supervised by PEU Environmental Coordinator)</p> <p>NGOs, quasi-governmental organizations or university teams for field work</p> <p>Analytical laboratories</p>	<p>Design, plan, organize all work and present a work plan,</p> <p>Hire/train local field staff in protocols, including health and safety for field sampling</p> <p>Conduct farmer/pesticide applicator & distributor surveys, data recording & processing</p> <p>Conduct field sampling (soil, water, sediment)</p> <p>Arrange & oversee chemical analyses (field and laboratory)</p> <p>Interpret data & prepare draft and final reports</p> <p>Develop communication plan for explaining results to government officials and public & hold public meeting</p>
Social impact mitigation	Institutional Strengthening Consultant(s) hired to support Water Boards	<p>Carry out Gender Action Plan</p> <p>Develop mechanisms to ensure small vegetable and fruit farmers have access to irrigation</p> <p>Prepare ongoing monitoring program and stakeholder participation plan, including monitoring of small farmer capacity to pay annual fees.</p>

Activity	Responsible	Primary Tasks
	LVV	Ensure grievance mechanism in place for public complaints during construction
Monitoring and Reporting	Progress reporting to PEU Director by Environmental Coordinator.	PEU will compile monitoring information and provide progress reports to the Bank per Project Operating Manual

8.6 Compliance with Local Environmental and Health and Safety Requirements

This EA and ESMP meet the spirit of Suriname's voluntary environmental assessment guidelines that were established by NIMOS.¹⁴⁶ No local environmental permits are required for this Project, unless the proposed environmental law is passed and made effective prior to Project execution. No other environment related permits are required.

The Project will comply with and/or support Suriname's environmental international conventions. It will not cause significant adverse impacts to biological diversity as the area of work is mostly confined to pre-existing infrastructure repair and maintenance of canals (including the portion of Nanni Kreek that is located downstream from Nanni Swamp. Where there are possible impacts to biological diversity from proposed construction projects that have not been evaluated under this ESA, socio-environmental impact studies are required to be completed prior to beginning any construction. The Project will provide information on pesticide use in rice production and resulting possible environmental contamination, which will assist the Suriname government in its decision making related to pesticide management and the Rotterdam Convention. The Project will also contribute to the mitigation of climate change impacts, consistent with Suriname's goals in view of the Kyoto Protocol.

8.6 Budget

Budget resources needed for implementation of the ESMP are shown in Table 5 and will be incorporated into the overall Project budget

Table 5. Budget for ESMP Implementation

Activity/Mitigation Requirement	Year of Project	Estimated Cost(\$US) (Over 6-year Project Period)
PEU Environmental Coordinator beginning Year 1	1-6	\$90,000
EIAs for Maratakka Spillway and Nanni Weir	2-3	150,000 (included in Component 1 budget)

¹⁴⁶ Available at: <http://www.nimos.org/smartcms/downloads/Final%20Wegwijzer%20NIMOS%202017.pdf>

Pesticide Survey and Water/Sediment Quality Study <ul style="list-style-type: none"> • Consultant fees, travel, expenses • Field teams (stipends, travel, equipment) • Laboratory analyses 	2	\$90,000 \$50,000 \$60,000 (included in Component 1 budget)
Ecosystem study of Nanni Swamp basin	2-3	\$100,000(included in Component 1 budget)
Social impact mitigation and monitoring/community engagement and communication through Institutional Strengthening activities	1-6	Included in Institutional Strengthening (Component 1) budget
Total expenditures ESMP implementation		\$540,000

8.7 Additional Recommendations

This section presents recommendations related to improving socio-environmental management within LVV and to improve the sustainability of rice production in the Nickerie District that are beyond the scope of the Project but could be funded by others or by the IDB in separate funding mechanisms.

8.7.1 Socio-Environmental Management within LVV

It is recommended that LVV create a permanent environmental management office or function to develop ministry-wide environmental management programs that would identify goals and objectives, identify problem areas and risks, develop action items and prioritize them, create staff training plans, and prepare budgets for their implementation. Such environmental programs and plans would involve waste management (solid, biological, chemical), pesticide and hazardous materials management, climate change adaptation and mitigation, and environmental sustainability in technical advances in agriculture applicable to all LVV facilities and activities.

In addition, it is recommended that LVV undertake a similar effort for management of occupational health and safety for LVV employees which would include identification of risks, plans and budgets for policies and procedures as well as engineering solutions and personal protective equipment to minimize risks. It should also establish ongoing and periodic health and safety training programs for existing as well as new staff members.

Creating these LVV-wide functions would also allow for LVV to more fully participate in assessing the socio-environmental impacts of internationally funded projects, have input into the development of new agricultural technologies to ensure their sustainability, and ensure implementation of environmental management plans.

Some funding for institutional strengthening is already being provided to LVV by the IDB under the Agricultural Competitiveness Program to assist in:

- improving LVV pesticide management facilities;
- improving human health and safety by purchasing equipment and supplies and funding occupational health and safety training for LVV laboratories;
- purchasing PPE and providing training for pesticide applicators in LVV experimental gardens;

- purchasing equipment for the safe treatment of biological wastes from the LVV veterinary laboratory

It is hoped that the contracting of the consultants recommended in the ESMP for this project will contribute to the institutional strengthening of LVV in the long term, particularly for the Pesticide Program.

It is also recommended that support be provided to LVV for developing a gender mainstreaming diagnosis and plan to assist LVV in this function not only for LVV employees, but for LVV “clients”.

8.7.2 Improving Sustainability of Rice Production in Nickerie

Water resources and hydrology: There is no current comprehensive baseline of information for the hydrological conditions of the Nanni Swamp Basin and no environmental base water levels or river flows have been established. Even though the present Project is not expected to cause significant adverse impacts to Nanni Swamp basin hydrology (with a couple of exceptions, depending on impacts identified through future environmental impact studies), having such a baseline would help LVV, OW and OWMCP better understand the system’s hydrological characteristics to evaluate future needs and anticipate problems. In addition, future expansion of water resource use could occur with other projects, as suggested in the European Commission’s Master Program for Irrigation. The Project will finance installation of 10 permanent monitoring stations. Recommendations for equipment and station locations will be provided by the Hydro-Bid team once the water balance modeling has been completed. It is recommended that the proposed permanent electronic hydrological monitoring system have a sufficient number of stations in Nanni Swamp to ensure that the hydrology of the basin provides for an understanding of its complex hydrology and leads to establishing ecological minimum base water levels and flows. Such a system would also allow for improved monitoring of hydrological conditions due to climate change and allow for system adjustments as needed to address irrigation and drainage needs.

Fragile or protected ecosystems: There is no baseline to understand the Nanni Swamp basin ecosystem. No current information on vegetation communities, or fauna that use the system is available, although previous information indicated the presence of numerous wildlife species of international concern. It is, therefore, recommended that an ecological survey of the Nanni Swamp basin be carried out to identify habitats, ecosystem functions, species (including those that are threatened or sensitive) and their interactions with hydrological conditions. Such a survey would require a team of wetland biologists, botanists, hydrologists and zoologists and may involve both on-the-ground surveys as well as aerial surveys. Evaluation of current hunting and fishing practices by indigenous groups should be included in the study, as well as identification of potential threats to the ecosystem and its species. Subsequent to the original recommendation provided in the draft ESA, budget for this study has been incorporated into Component 1 of the IDB loan.

Climate Change: Fund studies to evaluate alternate wet and drying approaches to irrigation and drainage.

IX. PUBLIC CONSULTATION/INFORMATION PROCESS

The Bank requires that project documents be made available to the public for review and that there be consultation with affected parties to ensure that they have an opportunity to provide input on the design and impacts of the Project.

In this case directly affected parties include those who will benefit from or be directly affected by the Project and those who could be influenced by or have influence on the project. As part of this environmental and social analysis process a stakeholder analysis was conducted, identifying a series of project beneficiaries, as well as other stakeholders that may influence or be influenced by the project:

Project beneficiaries include:

- rice farmers and their families
 - water board members who will directly benefit from rehabilitation of their polders
 - and farmers not currently in water boards who will also benefit from the infrastructure improvements to the main irrigation and drainage system);
- fruit and vegetable farmers and their families who depend on irrigation and drainage services;
- women's groups;
- banana and cattle producers and related associations or cooperatives
- local irrigation and drainage staff of LVV, RO and OW (some of whom are also farmers); and
- potential contractors.

Other stakeholders possibly influencing or being influenced by the Project include:

- ADRON;
- Nickerie general population;
- environmental governmental and non-governmental groups, such as NIMOS, World Wildlife Fund, and Conservation International;
- industry representatives and associations such as exporters, agrochemical distributors; and
- Ministries with possible interests or influence in the project, such as Ministry of Labour; Ministry of Spatial Planning, Land and Forestry Management, and Ministry of Natural Resources

9.1 Public Information

The draft ESA report and ESMP was made available for review and public comment on the Bank's website (in English). A summary of the ESA was developed and also put on the Bank's website. The summary was translated into Dutch, because it is the official language of Suriname, and most farmers do not speak much English, but understand a little. The Dutch version of the summary was put on the LVV Facebook Page. Hard copies of this summary were provided to attendees of the stakeholder meeting event (see below). A hard copy of the full draft ESA report was provided in the OWMCP library in Nickerie.

Notice of the availability of the draft ESA report and summary and the link to the Bank's website was emailed directly to NIMOS and the Nature Conservation Department of the Ministry of Spatial Planning, Land and Forest Management. The general public will be able to comment on the report and ESMP via the LVV Facebook page, the Bank's website and directly to the LVV representative in Nickerie.

Written comments were received by NIMOS on May 18, 2018 and were incorporated into this ESA report.

9.2 Stakeholder Consultation

9.2.1 Stakeholder Involvement

The IDB Irrigation and Drainage consultants worked closely with many of the Water Boards to understand the issues and develop detailed rehabilitation plans and cost estimates leading up to the preparation of this Project. In addition, some preliminary operations and monitoring plans were developed, as well as the elements of capacity building that will be needed to support farmers in Water Board management.

Also, during the preparation of Component 1, the Project team informally met several times with local rice farmers, particularly those in water boards; local representatives of LVV, OW, and RO; and the National Association of Rice Growers to gain input on the key issues, concerns and priorities for infrastructure improvements. Many farmers expressed the desire to be more involved in contracting and overseeing the work that was done to rehabilitate their water boards, as in some cases, it was reported contractors did not understand the work or do quality work. Other farmers expressed a willingness to start charging their water boards the new annual fee so they could begin maintenance operations, but were stymied by the long delays in having OW approve their bylaws.

It should be noted that NIMOS has received a complaint from the village of Washabo, located about 5 km upstream from the beginning of the Corantijn Canal, regarding the use of pesticides in rice production and during chemical weed control in the canal. The villagers fear that any contamination in the water in the canal could move into the Corantijn River.¹⁴⁷ This Project is not designed to fully evaluate or control pesticide management in the Nickerie area. However, it does fund some pesticide and fertilizer management training for farmers and it will fund a Pesticide Study to assess current pesticide use and the presence of persistent pesticides in the environment in some locations. The sampling program under the Pesticide Study may include a water sample upstream of the Project area, but it will be up to the consultant team to determine the need for this.

9.2.2 Stakeholder Consultation Event

A meeting with stakeholders was held in Nieuw Nickerie on April 5, 2018, the week prior to the Bank's Analysis Mission. LVV and OWMCP provided logistical arrangements, sent out written and verbal invitations, provided Dutch/English translation during the event and took notes on the meeting. Invitations were sent to the stakeholder's list and the press. Thirty-nine people (not including LVV and OWMCP or IDB facilitators) attended and included: Water Board members (5 Water Boards represented); an NGO that works with women fruit and vegetable farmers, a banana producer, a horticultural cooperative, a student, a representative of the Nickerie Water Platform, members of rice producing and export associations, representatives of the three ministries involved in irrigation and drainage (some of whom are also rice farmers), and the press.

¹⁴⁷ NIMOS electronic letter "Review on Draft ESIA", May 17, 2018.

At this meeting, the results of the draft ESA and ESMP were presented and an opportunity was provided for attendees to ask questions and provide input on Project priorities, impacts, mitigation measures, implementation procedures and other issues. There was ample participation from the audience during the question and answer portion of the meeting. Input from that meeting was summarized and provided to the Bank's mission team in advance of the mission. Substantive comments and recommendations have been incorporated into this final ESA and ESMP, as appropriate.

Meeting participants were encouraged to continue to ask questions and provide comments to the Nickerie LVV drainage and irrigation representative as Project preparation proceeds, who would then send any comments on to the LVV/IDB Project team for consideration. The participants were also encouraged to review the full draft of the ESA either on the IDB website (a link was provided) or by reviewing the hard copy placed in the OWMCP library.

A separate report of the stakeholder meeting was prepared, which included the attendance list, meeting minutes, photos and the list of questions and responses.¹⁴⁸ Key comments, responses and resulting actions/plans are summarized in Table 6.

Table 6. Key Stakeholder Comments and Questions, Responses and Actions

Comment or Question	Response	Actions Taken or Planned in Response to Comments
1. Lack of enforcement or control of actions of farmers acting on their own within the main irrigation and drainage system without regard to other users	The long term goal of the project is to have an integrated, comprehensive water management system where all farmers are incorporated and water is managed according to a water calendar.	Added emphasis to ESMP that capacity building include ways for OWMCP/LVV/OW to manage all water/drainage users so that the system is comprehensive and fair.
2. Capacity building for water boards: - should be ongoing for a while and include an annual get together to share experiences and ideas - must ensure that water boards actually function instead of doing nothing.	Will be included in ESMP and passed on to Bank/LVV team An important objective of the Project is to provide sufficient support so that Water Boards will function well	Included in ESMP Include in TOR for consultant(s) who will do institutional strengthening/capacity building
3. Annual water board payments for O&M: - When would farmers have to start paying?	Payments would not start at the beginning of project but after rehabilitation was complete. Even then the Bank is considering helping farmers with the first year's payment and perhaps future years for a period of time.	Incorporated explanation of ongoing Project financial support to Water Boards for O&M into ESA To be incorporated into Operating Manual

¹⁴⁸ [Stakeholder Consultation Report, SI-L1052, April 17, 2018](#)

<ul style="list-style-type: none"> - Will payment of annual fee guarantee water by gravity flow? 	<p>Annual fee is for operation and maintenance of water board polders, not a payment for water. Project will finance repairs and maintenance of main irrigation and drainage system that will contribute to more reliable water supply and drainage</p>	<p>No action needed, but capacity building for Water Boards needs to help members understand the purpose of the annual fee.</p>
<ul style="list-style-type: none"> - Do farmers have to repay rehabilitation and/or the loan? 	<p>Farmers are not required to repay the costs of rehabilitation and the loan will be repaid by the Government of Suriname</p>	<p>No action needed.</p>
<ul style="list-style-type: none"> - Are the water board annual payments and rehabilitation for all farmers or just rice farmers? 	<p>All farmers that are farming in the water boards, whether rice or other agricultural activity. And all farmers on left bank will benefit from the main system infrastructure improvements</p>	<p>Ensure that non-rice farmers in water boards (such as family horticultural farmers) are encouraged to participate in water board decision-making through Institutional Strengthening activities</p>
<p>4. Flooding problems, will Project finance solutions?</p>	<p>Some projects have been identified to address the flooding problems, like installing the Maratakka spillway and repairing Nanni spillway.</p>	<p>The installation of the Maratakka Spillway and the Nanni spillway are planned.</p>
<p>5. Contracting process and timing of construction:</p> <ul style="list-style-type: none"> - Contractors will need to coordinate with farmers on timing of infrastructure projects to avoid disrupting the production cycle and damaging crops. - How will the Bank ensure that contractors are qualified?¹⁴⁹ 	<p>Very good point.</p> <p>The Bank has criteria for this and will require minimum qualifications for contractors through the bidding process so that contractor selection is transparent.</p>	<p>Requirement that there be communication and consultation with farmers to be affected by construction activities before construction Incorporated into ESMP. However, this will be done through the water boards for water board rehabilitation projects and through LVV for other main system projects.</p> <p>Need to include requirement in contract conditions and monitor contractor performance</p> <p>IDB oversight of contractor selection needed.</p>
<p>6. Women horticultural farmers currently don't receive all the irrigation water needed during dry seasons. How will the project improve this situation?</p>	<p>The possible impact of the Project on small horticultural farmers was identified in the draft ESA. The ESMP states that these farmers' needs must be considered in</p>	<p>Emphasized in ESMP. Gender Analysis being undertaken to prepare Gender Action Plan to help ensure women horticultural farmers and others have a voice.</p>

¹⁴⁹ Contractor competence has been perceived as a problem and has been raised before by water board members in the past related to water board rehabilitation carried out with LVV funds.

	developing the future water calendar.	Stakeholder Involvement Plan will help ensure that all farmers have input into decision-making about water calendar.
7. Excessive pesticide use; illegal imports; management and environmental contamination from that and discharges from rice and banana fields into canals later used by other farmers; as well as direct run-off into Nickerie River; and existing soil contamination from toxic pesticides used in the past especially in small horticultural plots.	The Project is not specifically designed to help farmers better manage pesticides. But, because it is possible that pesticide use could increase due to the Project, a pesticide study is proposed as a mitigation measure. The study will help to identify what pesticides are being applied, how often, what volumes and whether there is environmental contamination. This will provide a baseline for future decision-making. LVV has other initiatives to help with pesticide management, including a planned IPM project for rice farmers.	Some soil sampling in horticultural areas has been included in the TOR for Pesticide Study. Project will include pesticide and fertilizer management training for interested farmers.

9.2.3 Ongoing Interaction with Stakeholders

A key part of the Project, as described in Sections 5.3 to 5.5 is to provide support, training and incentives to water boards so that they are equipped to take on the operation and maintenance of their polders. Thus, there will be ongoing involvement with stakeholders as this part of the project is implemented as laid out in a Stakeholder Engagement and Communication Plan – to be developed during Project execution – including mechanisms for ongoing monitoring of stakeholder involvement in the water board activities. In addition, a Gender Action Plan is currently being developed, resulting from a Gender Analysis being performed by a consultant.

9.2.4 Grievance Mechanism

LVV will establish a mechanism to receive and act on complaints received from the public about activities, impacts, risks, and results of construction activities. The mechanism should make it easy for the public to report problems and could include means for reporting complaints in person, electronically or in writing, or a combination of all three approaches, as appropriate to the customs of Nickerie residents. The grievance mechanism should establish who is responsible for receiving and researching complaints and determining causes and impacts, as well as for responding to the members of the public who have lodged a complaint. There should also be a transparent record-keeping system that logs complaints and tracks solutions and communication with the public.

X. CONCLUSIONS, CONSISTENCY OF PROGRAM WITH BANK SOCIO-ENVIRONMENTAL POLICIES

As a result of the analysis of environmental and social impacts and risks, it has been concluded that in general the Project will result in positive environmental and social impacts due to:

- Positive environmental benefits to water resources due to reduction of water waste and improvement of water distribution. The Project will do much to help the Nickerie rice production area achieve international standards (such as those developed by SRP and explained in Section 3.3.10) for irrigation management and sustainable rice production.
- Positive social benefits due to reduced flooding risk if the Maratakka spillway is constructed and the Nanni spillway is repaired.
- Positive social benefits to all farmers due to expected increases in rice yields and, therefore, incomes due to better water management and more polders provided by reliable irrigation.

There will be temporary short-term impacts and risks due to construction activities that can be easily managed by using standard environmental and occupational health and safety management measures and ensuring that contractors coordinate construction schedules closely with water boards and LVV who will be in touch with farmers to avoid damaging crops or interrupting key cultivation practices.

The main negative environmental impact from the Project is the expected increase in pesticide use due to the anticipated increase in acreage put into rice production. As a mitigation measure studies will be financed to allow for better understanding of how pesticides are used and what their possible impacts are to water and sediment quality. This information will allow for more informed policies and practices about pesticide use for promoting more sustainable rice production in the future.

Other potentially significant impacts are from the completion of the Maratakka spillway and the Nanni Weir project, which could adversely affect hydrology and/or important plant and animal species and their habitat. To evaluate the potential impacts and develop mitigation plans, EIAs will be required that will assess impacts to the hydrology as well as ecological impacts to Nanni Swamp and the Maratakka and Nickerie Rivers.

Another potential adverse social impact, is the possibility that small farmers may find annual payments for financing water board operations are a hardship. Measures to mitigate such potential hardships (including continued Project financing of O&M in the Water Boards for a period of time after rehabilitation is completed) are included in the Project and discussed in the ESMP.

Potential gender impacts or impacts on non-rice farmers will be addressed in the Gender Action Plan and the Stakeholder Involvement Plan.

The assessment of environmental and social impacts presented in this report, as well as the mitigation and management measures proposed in the ESMP for this Project, will comply with Bank policies and be consistent with the spirit of Suriname's currently voluntary environmental assessment and mitigation guidelines.

Specific Bank policies that were determined to be applicable to the Program are shown in Table 7, along with an explanation of how each is addressed in this environmental and social analysis to ensure Program compliance.

Table 7. Project Compliance with Bank Policies

Policy Identified in Safeguard Screening	Project Compliance
B-1 (OP-102) Availability of Documents to the Public	Section IX presents the plan for making the draft and final ESMP document and summary available to stakeholders and the general public
B-1 (OP704) Management of Risks of Natural Disasters	Risks of Natural Disasters and an assessment of the level of risk are presented in this report in Section 7.23. The Project will help reduce the risk of flooding if Maratakka spillway is installed. A detailed Natural Disaster Risk Assessment or Management Plan is not necessary.
B-1. Climate Change Adaptation	The EA addresses risks due to climate change and assesses the Project's contribution to climate change adaptation in Section 7.1. Additional recommendations are provided in Section VIII.
OP-761, Gender Equality & Indigenous People's Rights	Information on women's role in agricultural activities and indigenous and other vulnerable populations is provided in Sections 2.3 and 3.3. Assessment of potential impacts of the Project on women and vulnerable populations is provided in Section 6.7 with mitigation measures in Section 8.2.
B-2, Compliance with Country Laws and Regulations	Section III describes Suriname's institutional setting for environmental and social management. Section ESMP discusses the requirements for compliance with the applicable laws and regulations
B-4, Other Risk Factors – Weak Institutional Capacity for Environmental and Social Management	Institutional capacity of the Project executor is assessed in Section 3.3. Mechanisms for addressing the weak capacity are provided in the ESMP, Section 8.4 and recommendations for improving executor capacity are provided in Section 8.71.
B-5, Environmental Assessment	A socio-environmental analysis was carried out for the operation and the results presented in this report. Additionally, project specific EIAs will be undertaken for two projects (Maratakka Spillway and Nanni Weir)
B-6, Stakeholder Consultation	Stakeholders are identified and the consultation plan and activities completed are presented in Section IX, as well as a summary of the stakeholder consultation meeting.
B-7, Supervision and Compliance Monitoring	Requirements for supervision and monitoring and reporting of the implementation of the ESMP are provided Sections 8.4 and 8.5. In addition, a budget is estimated in Section 8.6 to provide resources for carrying out these activities.
B-9. Critical Natural Habitats	The Nanni Swamp is considered critical natural habitat. The impacts of the Project are conceptually anticipated to be positive, with little impact on the swamp hydrology or ecology. However the lack of current data about the ecosystem and hydrology that supports it prevents a precise evaluation of

Policy Identified in Safeguard Screening	Project Compliance
	the potential impacts or conversely, whether there may be negative impacts from carrying out the proposed infrastructure and maintenance projects.
B-10, Hazardous Materials Management	Use of and management of hazardous materials are addressed in Sections 6.3 and VIII.
B-11, Pollution Prevention and Abatement	Prevention of pollution and waste management are related to the construction phase of the Project, and are addressed in Sections 6.4, 6.5 and VIII.
B-17, Environmentally Responsible Procurement	Opportunities for environmentally responsible procurement are limited, however, if wood is used for structures or levee protection, the Project could insure that certified, local wood be purchased, if feasible. In addition, the ESMP contains provisions to monitor the sources of raw materials such as sand and shells, to ensure they are procured from licensed facilities.

APPENDIX 1. REFERENCES

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ANNEX A.

TERMS OF REFERENCE FOR ENVIRONMENTAL/HEALTH AND SAFETY COORDINATOR IN PEU

Background

The Inter-American Development Bank (Bank) and the Suriname Ministry of Agriculture, Animal Husbandry and Fisheries, Animal Husbandry and Fisheries (LVV) have prepared the Sustainable Agricultural Productivity Program, which is designed to increase agricultural productivity in Suriname through investments in infrastructure and management of irrigation and drainage (I&D) systems; the transfer of these system's operation and maintenance (O&M) responsibilities to farmers organized in water boards; and to improve the conditions for information-based policy-making by increasing the amount and quality of agricultural information on a national level.

The Program (hereinafter referred to as "Project") is expected to result in: an increase in rice productivity in I&D areas; water boards operating and contributing to O&M; and improved statistics and information systems. The Project consists of two components: Irrigation and Drainage and Agricultural Statistics and Information. The first component will focus its efforts in the Nickerie District, primarily in rice polders, to benefit rice production and other crops. The second component will involve agriculture in the entire country.

Three ministries share responsibility for maintenance and repair of irrigation and drainage systems in Suriname: Agriculture, Public Works, and Regional Development. The three ministries have formed an inter-ministerial working group to improve communication and coordination in their respective activities. LVV, which is responsible for development of plans, policies and programs in the areas of agricultural research and extension, livestock, and fisheries, as well as irrigation, will implement the Project and is forming a Project Executing Unit for that purpose.

The Irrigation and Drainage (I&D) Component will finance:

- rehabilitation/modernization of irrigation and drainage infrastructure, both in the main system and in six water board polders;
- support for developing and strengthening water boards' capacity to take over the operation and maintenance of canals and sluices in the polders of each water board;
- capacity building of government bodies in charge of water resource administration for irrigation and drainage;
- design and implementation of incentive mechanisms, including cost sharing for land levelling costs and training in pesticide and fertilizer management, aimed at improving efficiency in farmers' water and agrochemical use and increasing their willingness to cover O&M costs;
- a water balance project using existing water level data to be carried out by the Bank's Hydro-BID Modelling Program;
- installation of a permanent water level monitoring system;
- a stakeholder engagement and communications plan;
- a Gender Action Plan which will contain measures to assist women in participating in water boards, as well as ensure that their horticultural activities have access to irrigation when needed;
- a pesticide survey and water quality/sediment assessment.

Environmental and Social Assessment and Management Plan

As part of the preparation of the Project environmental and social impacts were assessed and presented in an Environmental and Social Assessment (ESA) report. An Environmental and Social Management Plan (ESMP) was prepared and is incorporated into the report to reduce identified risks and increase environmental sustainability. The consultant should refer to these documents for more detail about the scope of the Project and the required mitigation measures. However the key mitigation measures include ensuring the implementation of health and safety measures for construction of drainage and irrigation projects; carrying out a pesticide study that includes field surveys of farmers and pesticide applicators and a sampling and analysis program to evaluate environmental contamination from past pesticide use; ensuring stakeholder (including women) participation in water board and other decisions related to operation and maintenance of irrigation and drainage and monitoring small farmer's ability to pay for O&M; and ensuring the socio-environmental viability of certain projects slated for rehabilitation and construction.

Consultancy Objectives

The consultancy will assist LVV in implementing the ESMP by providing management, oversight and compliance monitoring services for implementation. This will include supervising construction health and safety measures being implemented by contractors and management of specialized consultants, as well as ensuring the evaluation of environmental and social. The consultant will work within the Project Executing Unit and will collaborate closely with the Institutional Strengthening consultants charged with preparation and execution of the Stakeholder Engagement Plan, as well as the Construction Manager in the PEU. The consultant will also coordinate with LVV counterparts including: the Pesticide Manager as well as other Ministries responsible for environmental impact assessment and protection of natural areas.

Main Activities

The consultant's responsibilities will include:

1. Overall supervision of the implementation of the ESMP.
2. Establishing a work plan, schedule, monitoring plan, forms and other documents needed to complete the work in an organized manner.
3. Supervising the work of the specialized Pesticide Study consultants, in close coordination with the LVV Pesticide Program Director.
4. Supervising any environmental and social assessments needed for infrastructure projects and coordinating with other Ministries as appropriate (such as the Environment Coordination and/or NIMOS, and the Ministry of Spatial Planning, Land and Forestry Management, as well as ensuring stakeholder consultation for those projects and ensuring that mitigation plans are carried out.
5. Participating in and/or coordinating stakeholder involvement planning and events with the Institutional Strengthening consultant(s), as relevant.

6. Reviewing bid and contract documents for irrigation and drainage infrastructure and maintenance to ensure that mitigation measures are included.
7. Reviewing construction drawings and construction sites to understand the scope of each project and its potential risks to the environment and to health and safety.
8. Meeting with contractors before starting work to ensure work schedules do not adversely impact farmers and to ensure that health and safety and environmental management procedures are understood.
9. Inspecting active construction sites to ensure compliance.
10. Reporting problems to the Environmental Coordinator in the PEU and making recommendations on how to achieve compliance.
11. Monitoring implementation and compliance with the ESMP.
12. Managing problems and reporting to the PEU on progress and how problems were resolved
13. Coordinating with other departments within LVV (such as the Pesticide Department), as needed to implement the ESMP.
14. Keeping records of inspections during construction and steps taken to ensure compliance with the ESMP.

Qualifications

The consultant shall have a Bachelor's Degree in biological sciences, ecology, engineering or agronomy and at least three years of experience and or training in:

- Pesticide management issues, management and disposal of hazardous materials and wastes, working knowledge of biological waste issues, understanding of occupational health and safety risks and protective measures related to chemical and biological exposure
- Environmental and social impact assessment and mitigation and understanding of endangered species and habitat issues
- Environmental management best practices and occupational health and safety management of construction activities, including familiarity with ILO Code of Practice for Health and Safety in Construction
- Irrigation and drainage principles, infrastructure and maintenance practices
- Review of bid documents & ability to review engineering plans and contract documents;
- Fluency In Dutch and English
- Good organizational and management skills
- Good communication skills

Knowledge of Hydrology and wetland ecology, including ability to assess hydrologic data and understanding of pesticide toxicity and fate in the environment are also desirable skills.

Characteristics of the Consultancy

The consultancy will be for a period of approximately six years, on a full-time basis.

Payment

The fees for this consultancy will be up to \$1,250 US per month, depending number of hours worked and qualifications.

ANNEX B.

Suriname Sustainable Agricultural Productivity Program, SU-L1052

TERMS OF REFERENCE FOR PESTICIDE STUDY

Background

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The Program (hereinafter referred to as "Project") is expected to result in: an increase in rice productivity in I&D areas; water boards operating and contributing to O&M; and improved statistics and information systems. The Project consists of two components: Irrigation and Drainage and Agricultural Statistics and Information. The first component will focus its efforts in the Nickerie District, primarily in rice polders, to benefit rice production and other crops. The second component will involve agriculture in the entire country.

Three ministries share responsibility for maintenance and repair of irrigation and drainage systems in Suriname: Agriculture, Public Works, and Regional Development. The three ministries have formed an inter-ministerial working group to improve communication and coordination in their respective activities. LVV, which is responsible for development of plans, policies and programs in the areas of agricultural research and extension, livestock, and fisheries, as well as irrigation, will implement the Project and is forming a Project Executing Unit for that purpose.

Environmental and Social Assessment and Management Plan

As part of the preparation of the Project environmental and social impacts were assessed and presented in an Environmental and Social Assessment (ESA) report. An Environmental and Social Management Plan (ESMP), which is and is incorporated into the report, was prepared to reduce identified risks and increase environmental sustainability. The consultant should refer to these documents for more detail about the scope of the Project and the required mitigation measures.

A key socio-environmental impact expected from the project is a likely increase in the use of pesticides. The Project will result in an increase in the amount of land available for rice production as a result of providing more reliable and frequent irrigation for rice and reducing flooding problems by improving drainage. The ESMP identified the need to better understand pesticide use and to establish a baseline of information about pesticide practices and environmental quality. General information on pesticide use in rice production is provided below, but the study will help to provide more detailed information.

Characteristics of Rice Production and Pesticide Use in Nickerie

In the Nickerie District, farmers who have full access to irrigation water throughout the two dry seasons plant two crops of rice annually. The spring planting season is generally from the second week of November until end of December and the fall planting season is from the second week of May to end of June. Timing varies to some extent depending on the weather.

Fields are prepared when submerged, which accounts for the highest water use in the rice production cycle. Farmers sometimes attempt to level the fields at this time using heavy equipment and sometimes dragging boards across the field with a tractor, but this approach is reported as being not very effective. The rice is then seeded while the field is still submerged. Plants are irrigated throughout the dry seasons, as needed. Water demand increases again during harvest.

Chemical pesticides to control pests and diseases in rice, fruits and vegetables are widely used in Suriname, but also misused (i.e., higher and more frequent doses than recommended, mixing pesticides, and using prohibited pesticides). Rice farmers (especially larger operations) use pesticides in a preventative manner, before a problem has even been diagnosed. Decisions about what pesticides to use when is largely based on tradition and recommendations received from pesticide dealers (not from government agricultural extension agents). LVV reports that rice farmers typically use higher dosages of pesticides than the packaging instructions state, as well as mix various pesticides into cocktails. Rice polders and banana plantations are sprayed aurally for insect and weed control on both large and small farms, and planes often pass directly over homes that are adjacent to the rice fields, as well as horticultural production areas, while spraying. Insecticides used in rice production in the Nickerie region currently include: diazinon, lambda-cyhalothrin, alpha-cypermethrin, and imidacloprid, among many others. It should be noted that all of these insecticides are classified as Moderately Hazardous (Class II), primarily to human health, by the World Health Organization (WHO). Fungicides and molluscicides are also used.

Herbicides are routinely used for cleaning weeds from irrigation and drainage canals by LVV and farmers (as much as four times per year), and generally are applied using backpack sprayers from small boats. According to LVV, glyphosate represents the largest volume of herbicide used in rice production areas (but it is reportedly not the formulation approved for aquatic use, which means the formulation being used may be toxic to aquatic life). Glyphosate has recently been determined to be a potential human carcinogen. Other herbicides used/imported include 2,4-D, paraquat, glufosinate ammonium, and bispyribac-sodium (of these the first three listed are classified as Moderately Hazardous by WHO – Class II).

It should be noted that the Ministry of Public Works, Transport and Communication has been prohibited from herbicide use to maintain canals under its jurisdiction, apparently out of caution to prevent any groundwater contamination to a drinking water well installed to supply Nieuw Nickerie. Therefore, weed control in the primary canals is done mechanically with hydraulic equipment from each side of the canal (when there is funding).

Herbicides are also used by farmers in the rice fields to combat red rice, an invasive weed that tends to grow in the higher, drier areas of unlevelled rice fields. It has been reported by LVV that herbicide applicators seldom, if ever, use personal protective equipment when mixing or spraying chemicals.

No specific information is available on how farmers use pesticides or which pesticides are used for which pests, except for some information on registered pesticide imports. There has been very limited water quality sampling done, and virtually no sampling for pesticide contamination in water, soils or sediments from the canals. Water quality sampling has been limited to standard parameters such as pH, TSS, DO, conductivity, and temperature (see the ESA report for additional details). Thus there is no baseline for evaluating their use or the potential environmental contamination or risks to applicators or residents.

Despite the heavy use of pesticides and the past reluctance of farmers to adopt integrated pest management strategies, there appears to be considerable concern by farmers (rice and horticultural producers) and Nickerie residents about pesticide contamination and risks to health.

Consultancy Objectives

A qualified international consultant will be hired to carry out the Pesticide Study, which includes two phases: an assessment of current pesticide use practices and a field sampling and analysis program to evaluate environmental contamination.

Assessment of Current and Past Pesticide Practices

The consultant will form a team to carry out surveys of farmers to identify their pesticide practices including: what pesticides are used for what pests, what volumes and how frequently they are applied, if any pest monitoring is done, what personal protective equipment is used, and where farmers obtain their information about what pesticides to use. The study should include interviews with the companies that perform aerial spraying, if they are willing to share this information and with pesticide distributors. Coordination with the LVV Pesticide Department and the Anne van Dijk' Rice Research Organization (ADRON) will be a required part of developing the study. In addition, interview questions should also gather information about pesticides used in the past, with a focus on those that are likely to be persistent in the environment.

For carrying out the survey interviews, personnel from a local non-profit environmental organization, quasi-governmental agency or a local university (or some combination), would be hired and trained for conducting the surveys under the consultant's supervision. This will not only provide local work and training opportunities, but institutional strengthening of the involved organizations.

Identification of farmers to participate in the survey will involve working closely with LVV, Overliggend Waterschap (Overlying Water Board) of the Multi-Purpose Corantijn Project (OWMCP) and the newly formed water boards.

Water, Soil and Sediment Quality Evaluation

The pesticide survey will inform the environmental sampling plan. The consultant will conduct a sampling and analysis study to evaluate water and sediment quality in the canals. Again for this phase of the study, local university students or members of non-governmental organizations will be hired and trained to assist with sample collection. Such a study could also include a survey of insects and or tissue sampling of fish found in the drainage canals to determine the presence of pests and of natural predators, if funding is sufficient.

Local laboratories would be contracted for analyses whenever possible, but in the event that local capacity is lacking, samples will be sent out of country for analysis. Field analytical instruments will be used for basic parameters (such as for pH, DO, temperature, conductivity, etc.) when available and useful to the study.

The consultant will prepare a detailed work plan for conducting study activities, including identifying staffing, equipment, sampling protocols, schedules and work products.

Main Activities

The consultant's responsibilities will include:

1. Preparation of a detailed work plan for conducting all study activities, including identifying staffing, equipment, schedules and work products.
2. Close coordination with the LVV Pesticide Program staff and consultation with LVV irrigation and drainage staff and ADRON to gain input into the design of the studies.
3. Review of existing water quality, soil or sediment data.
4. Design of the farmer/pesticide applicator and distributor surveys.
5. Selection, training and supervision of survey staff, including procedures for paying stipends and expenses.
6. Analysis of data and report on findings and conclusions regarding pesticide use.
7. Development of an environmental sampling plan (water, sediment, soils, etc.) based on the findings of the farmer survey, and taking into account the irrigation and drainage system design, the rice production schedule, climate considerations and the likely fate of the pesticides used currently and in the past. The sampling plan will include identification of sampling protocols, parameters to be tested and test methods, locations for sample collection, number of samples, preservation requirements and maximum holding times, quality control and assurance, health and safety requirements, in accordance with international standards (such as USEPA protocols), etc. The consultant shall use the results of the pesticide survey to design the sampling program, taking into account the behavior and fate of the various categories of pesticides possibly present in the environment and with a particular focus on sediment samples from appropriate locations. The sampling program will include at least two soil samples analyzed for persistent pesticides collected from an area where horticultural production is done, in consultation with the local NGO Moederhart¹⁵⁰. The consultant will determine the appropriate mix of field analytical procedures and laboratory testing and will be responsible for locating/renting or purchasing necessary field equipment.

¹⁵⁰ A local NGO that works with small women horticultural farmers

8. Assessment of local laboratory capacity to determine which samples must be shipped out of the country for analysis. The consultant will be responsible for the preparation of samples for shipping out of Suriname, following all requirements of the host country (such as proper labeling, permits from departments of agriculture, customs requirements, etc.).
9. Data analysis and reporting of findings, including dates of sampling, sampling and analysis methods, maps of sample locations, interpretation of results, identification of potential risks to farmers, flora and fauna from exposure to the pesticides found in the environment.
10. Preparation of a report for a lay audience regarding the findings of the Pesticide Study and carrying out a public meeting in Nickerie to report the findings. The consultant will coordinate with LVV to set up the meeting.

Deliverables

The consultant will develop a work plan and schedule will provide reports to the PEU Coordinator for subsequent reporting to the Bank. The work plan will include the measures to be taken to ensure communication in Dutch. The technical plans and reports may be in English. Other deliverables will include:

1. Farmer and pesticide applicator/distributor interview plan and questions (draft and final).
2. Report of findings of farmer and pesticide applicator (draft and final)/distributor surveys
3. Sampling plan (draft and final).
4. Report of findings of sampling and analysis program, including maps (with G.P.S coordinates) of sampling locations, media, parameters, sampling methods, dates, test methods, test results, QA/QC report, data interpretation, analysis of possible risks from pesticides present in the environment, etc. (draft and final).
5. Report in English and Dutch designed to inform a lay public about the study and the results, with emphasis on possible risks from pesticides present in the environment during different activities (cultivating, dredging of canals, eating fish from the canals, swimming, etc.) and to wildlife.
6. Presentation at a public meeting to communicate the results of the study to a lay audience.

Qualifications

The consultant will be qualified and experienced in both aspects of the study – the field surveys with farmers and pesticide distributors and the environmental sampling and analysis and will be able to demonstrate at least 10 years of experience in this type of work. Specific qualifications and expertise include:

- experience in designing surveys, interview techniques, and training of field staff;
- knowledge of agricultural pesticides, toxicities, pest management in rice production, pesticide fate and behavior in environment, risk assessment;
- experience in developing sampling plans and carrying out water quality, soil and sediment sampling, use of field analysis equipment and knowledge of sample preservation and analytical procedures;
- statistical analysis;

- public communications and ability to explain complex environmental and pesticide chemistry to a lay audience; and
- English language capacity, with Dutch speaking capacity preferred (either through in-house staff or through local interpreters)

Characteristics of the Consultancy

The consultancy will be a short-term contract carried out over several months and will involve two or three trips to Nickerie, Suriname.

The consultant will be supervised by the Environmental Coordinator in the Project Executing Unit and will work closely with the LVV Pesticide Program Director in developing and carrying out the work plan, survey and field sampling and analysis program. The draft and final plans and reports will be subject to review by the Inter-American Development Bank.

Contracting and Payment

The contract will be a lump sum for all services. Fees for this consultancy will be up to \$200,000.00 (USD). This amount is to include:

- consultant staff time (assumes two or three staff persons involved in day to day work in Suriname)
- all international travel (based on economy class fares, assuming two or three trips to Suriname);
- local travel (auto rental);
- lodging, meals, and other incidental expenses;
- stipends and expenses for local field staff;
- field equipment;
- sample collection and preparation;
- laboratory analyses (including shipping costs)
- report preparation expenses (electronic reports for drafts, hard copies for finals)

The number of samples to be collected and analyzed shall be prioritized when preparing the budgets for individual components and overhead costs shall be kept to the minimum necessary.