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Environment, Rural Development and Disaster Risk Management
CSD/RND
SURINAME
Sustainable Agricultural Productivity Program (SU-L1052)

COMPONENT 1:

IRRIGATION AND DRAINAGE

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PART I – BACKGROUND AND INTRODUCTION

The Government of Suriname has requested the Bank's technical support in the preparation of an investment loan (SU-L1052). The main goal of this component of the loan is to increase agricultural productivity in Surinam through investments in infrastructure and management of the irrigation and drainage (I&D) systems.

The Vision paper for Irrigation and Drainage (**reference list** # 1.1) prepared under the IDB Policy loan in 2016 sets out the guiding principles to achieve increased agricultural production and diversification through rehabilitation and modernization of the irrigation and drainage systems and the introduction of sustainable and integrated water management ensuring the rights of all water users for access to adequate water of good quality and protection from excessive water and flooding, while achieving a greater engagement of water users to participate and contribute to the costs of operation and maintenance of the irrigation and drainage systems.

1 Introduction to Irrigated Agriculture in Suriname

The contribution of the agricultural sector to the overall economy has been about 6 to 7% of GDP. Broken down by subsector, crops made up for 53%, livestock for 23% and fisheries for 24% of agricultural GDP in 2009. Of the total economically active population 17% find its employment in the agricultural sector.

Main crops include rice, bananas, tuber crops, legumes, fruits and vegetables, covering 65,000 ha of arable land. In addition pasture areas for cattle grazing covers an additional area of 17,200 ha. (FAOStat 2015)

By far the most important crop in Suriname is rice, representing about 85% of the harvested cropland area. Most of the rice production capacity is concentrated in the Nickerie district. In addition, there are two smaller rice production areas in the Coronie and Saramacca districts. Rice production in Suriname is for local consumption as well as for export and about 64,000 ton was exported of a total production of 275,000 ton in 2014.

Functioning of many of the irrigation and drainage systems is presently hampered by inadequate maintenance and regulation of water supply. With inadequate funds available for necessary maintenance, completion or rehabilitation of the canal system, dams, dykes, regulating structures and pumps resulted in a deterioration of the irrigation and drainage infrastructure.

The poor conditions and often deficient system does not allow the proper regulation of the supply of irrigation water and the outflow of excess water resulting in wastage as well as shortages of irrigation water and inadequate drainage of the fields and inundations of homesteads and access roads preventing access of farm machinery for cultural operations. Crop productivity is negatively affected by and previously cultivated areas have been abandoned.

The project will focus on the restoration of the irrigation and drainage infrastructure in the Nickerie District which is the main agricultural area of the country and can play a main role to restore and improve productivity of the rice sector for the benefit of predominately smallholder farmers. The restoration of infrastructure and introduction of sustainable water management should go hand in hand with the introduction of adequate operation and maintenance procedures with greater involvement and participation of farmers would restore production levels that have been effected due to inefficient water management.

With improved water management there is also potential with better management and insight in the available water resources to develop the agricultural potential of the country and bring back into production previous irrigated lands also in other parts of the country that have been abandoned due to poor maintenance and inefficient water management and expand the irrigated crop areas. Considerable investments are however required to restore the irrigation and drainage system and are not directly addressed in this project.

2 Water Management for Agriculture in Suriname

With high rainfall well over 2000mm yearly in major areas in the country, Suriname possess abundant water resources but both shortage and excess of water determine agricultural productivity and water resources management for irrigation as well as drainage is an essential aspect of agriculture in Suriname, as illustrated in Figure 1

Total yearly rainfall amounts in average to 1750 mm for Nieuw Nickerie but with large variations (from 850 to 2650 mm), while average yearly crop evaporation is 1450 mm, allowing 2 rice crops, but with two distinct rainfall and cropping periods.

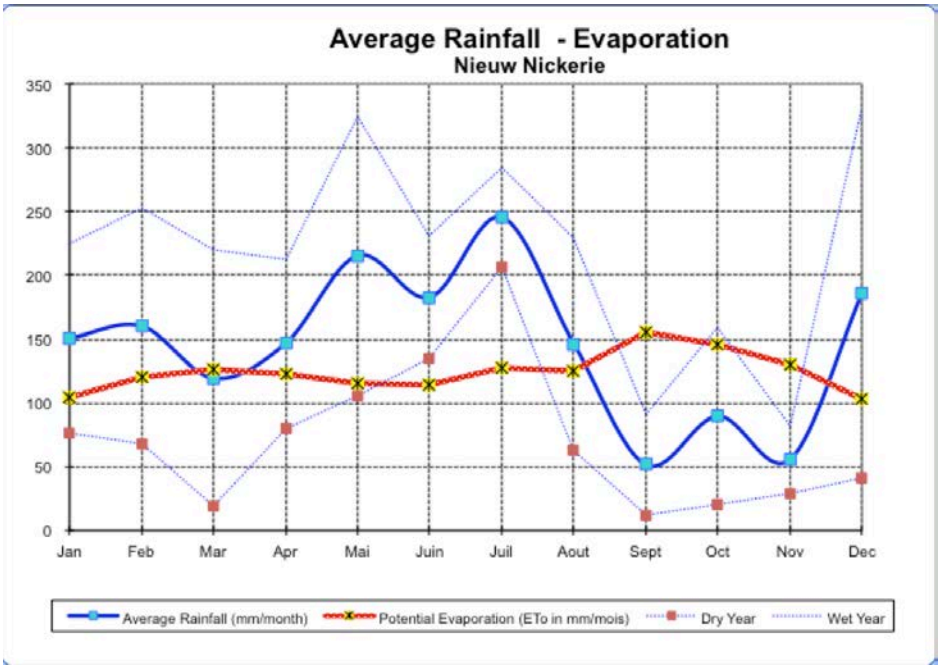

Figure 1 : Shortage and Excess of Rainfall for Crop production

The big rains in the April- August period show a large excess of rainwater, which require adequate drainage facilities to evacuate the excess rains and flood waters. In the short rain period of October-March period a shortage of water requires irrigation in particular for rice cultivation in the initial land preparation period of October-November period when water demand is highest.

With the colonization in the seventeen-century the first plantation polders were established in Suriname mainly for sugar, coffee, cocoa and cotton in the fertile northern coastal areas. The marshy conditions made drainage of the soils an essential condition to achieve successful production. Polders with protection dikes and a drainage canal system with simple sluices were established with excess water flowing out at low tide and gates closed at high tide.

In most of the old colonial polders in the districts along the Suriname, Commewijne en Saramacca rivers the irrigation and drainage infrastructure is still functional, although the traditional plantations have largely disappeared now and only part of the plantation polders is still cultivated mostly with vegetables, fruit trees (citrus, bananas) and tubers (cassava). Good drainage and flood protection remains important in particular also for the growing urbanization around the capital Paramaribo.

With the development of the smallholder agriculture in the beginning of the twentieth century the production of rice became increasingly important in particular in the Nickerie district. Introduction of irrigation made it possible to have two rice harvests per year. With the development of large scale irrigation and drainage system since 1950 large areas where put under mostly mechanized rice production which reached its peak in 1980 with a rice production on almost 60,000 ha that produced 136,000 ton of rice of which 105,000 ton exported.

The period of large public investments in irrigation and drainage infrastructure was discontinued in the eighties with public funding strongly reduced. Funds available were hardly able to cover the necessary operation and maintenance costs and often limited to emergency repairs and ad-hoc rehabilitations.

The lack of proper maintenance of the irrigation and drainage systems and inefficient water use has been a main reason for the strong reduction in effectively irrigated areas and rice production in addition to lower rice prices that made many farmers unable to serve their debts of high investments in agricultural machinery.

Of the original irrigated land of 47,000 ha in the Nickerie district an estimated 27,000 ha are presently in production.

Also in several other districts irrigation and drainage facilities were developed in particular for rice and horticultural production.

Coronie district has had a 4000 ha of polders, mainly rice of which only 200 ha is still under production. Saramacca district has an extensive I&D system with water control structures for an estimated 3500 ha of rice. Presently only 1000 ha is presently still under rice production. In the Commewijne district an estimated 7000 ha were originally cultivated mainly with plantation crops. Presently only 350 ha is cultivated mainly vegetables and fruit trees.

In addition to the irrigation and drainage of agricultural crops, water control is also important for pastureland and cattle grazing.

Growing urbanization in particular in the districts around the capital Paramaribo (Commewijne, Wanica and Saramacca) is taking increasingly actual and potential agricultural land out of production. Drainage infrastructure is therefore not only important for agricultural production, but also essential for floodwater control and inundations of residential areas.

In view of the importance of the production of irrigated rice production in the Nickerie District this project will focus on the rehabilitation of the Irrigation and Drainage Infrastructure in the Nickerie District on the left bank of the Nickerie river and introduce appropriate measures and means to increase rice productivity by a more efficient water resources management and to assure sustainability of operation and maintenance by transfer of responsibility in O&M to the Water Boards.

3 Irrigation and Drainage in Nickerie District

The development of the smallholder agriculture in Nickerie district for rice production dates back to the first part of the twentieth century. The introduction of irrigation made it possible to have two rice harvests per year.

The Nickerie rice irrigation and drainage infrastructure is located along the left and right bank of the Nickerie River, which together cover an area of approximately 45,000ha. Water for irrigation of the left bank was originally drawn from the Nanni swamp by the construction of retention dikes along the lower parts of the swamp. The right bank draws water from the Nickerie river.

The left bank is the largest part with a gross area of 35,000 ha divided into polders and are subdivided into the ‘Westelijke polders’, the ‘Oostelijke polders’, the ‘MCP polders in the South West part and the Autonoom polders in the Eastern part of the scheme, as shown in figure 2 and table 1.

The polders constitute the secondary units of the Irrigation and Drainage system, which were developed over time and are operated as sub-units with their own irrigation and drainage canal system.

On the right bank of the Nickerie river an additional area of 10,000 ha was established in the Wageningen polder (**reference list** # **4.2)** with water for irrigation pumped from the Nickerie river in the dry season. An estimated 6,000 ha is presently cultivated under rice mostly only one crop as only one out of four irrigation pumps is presently operational and salt water intrusion in the Nickerie is restricting water intake from the river. Many farmers use their own pumps to pump water out of the drains and Nickerie River

The Oostelijke and Westelijke polders on the Left Bank together cover presently an area of almost 24,000ha.. The major part of the total command area is cultivated by small holder farmers (17,090 ha gross area) grouped into the 12 Water Board polders. The average plot size per farmer of the small holder farms is 3.1ha. Originally plots issued were only 1,5 ha to be increased in later periods to 5-6 ha and ultimately to 10-12 ha plots. In addition there are several private companies and private farmers cultivating rice (8,794 ha) and bananas over a total area of almost 10,000 ha, as shown in table 1.

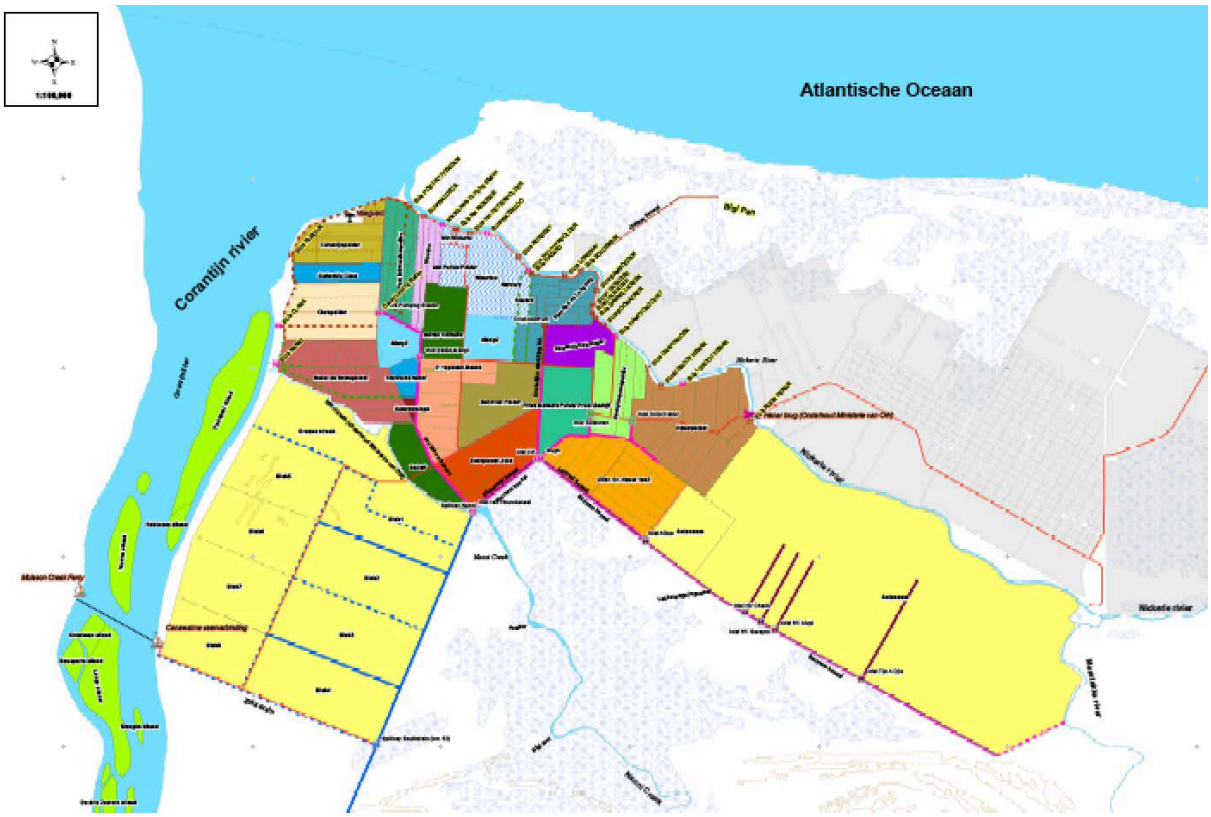

Figure 2: Overview Polders Left Bank Nickerie River

The expansion of the total rice area in Nickerie in the second half of the 20th century resulted in an increasing pressure on the natural fresh water sources of the Nanni Swamp and Nickerie River and severe water shortages were common practice.

The Multipurpose Corantijn Project (MCP) implemented in the early eighties was conceived to safeguard two rice harvests per year in the existing polders, to provide water to the new MCP polders, and to provide water to control the salt intrusion in the Nikerie river, thus effectively shifting the priority to the left bank of the Nickerie River. The major work carried out under the project was the construction of the 70 km long Corantijn canal and the Wakay pumping station at the Corantijn river securing an adequate water supply with a capacity of 30m3/sec.

The MCP project was however never completed due to shortage of funds in the eighties. Several of the essential distribution works were not constructed such as the Nanni weir and related structures to allow the proper regulation of intake of irrigation waters and the Maratakka Spillway to ensure adequate drainage capacity for the floodwaters from the Nanni swamp.

As a result the regulation of supply of irrigation water on the left bank is very inefficient and the available water sources are not being used optimally.

Polders	No	Gross area Ha
Western Polders		
WaterBoard Rice polders	7	8.629
Company Rice Polders	4	1.707
Banana Company	1	1.249
Livestock areas	3	1.134
Horticultural area	1	805
Urban Area (Nieuw Nickerie)	2	1.038
Total Western Polders	**18**	**14.562**
Eastern Polders		
Water Board Rice polders	5	8.461
Company Rice Polders	1	1.088
Total Eastern Polders	**6**	**9.549**
Autonoom Area		
Company Rice polders	**19**	**7.087**
MCP Polders		
Rice Company Zazoe	**1**	500
Livestock area	**3**	750
Forest		11.250
Total MCP Polders	**4**	**12.500**
Total Rice area		**21.135**
Total Area	**42**	**35.237**

Table 1: Overview of the I&D command area of the left bank of the Nickerie river

The MCP expansion area of 12,500 ha in the South West of the left bank was left largely undeveloped as infrastructure was only partly completed. Low paddy prices during many years, deteriorating infrastructure and increasing water wastage have resulted in a gradual decrease of the production area, now covering 21.000 ha, whereby still water shortages occur, and regular flooding due to insufficient drainage capacity further effects substantial areas. The number of farmers has likewise decreased.

The project will focus on the Irrigation and Drainage system of the Left bank, which constitutes the largest area and has a reliable supply of irrigation water and will benefit in particular the small holders. The project will address the shortcomings in the present infrastructure of both the main and secondary system and upgrade the regulating hydraulic structures to achieve a more efficient water supply and reduce flooding for improved crop productivity, the reduction of pumping costs and a possible expansion of the irrigated area.

4 Responsibilities in Operation and Maintenance in Irrigation and Drainage

The responsibilities for operation and maintenance and implementation of investments in the irrigation and drainage systems lies with the Ministries of Agriculture (LVV), Public Works (OW) and Regional Development (RO) who depending on their respective budgets available will carry out routine and often emergency operations for repair and rehabilitation works on the I&D system.

Funds made available by the respective ministries have been often inadequate for the essential maintenance works and been one of the main reasons for the deterioration of the I&D infrastructure.

General costs for Operation and Maintenance requested in 2015 for O&M in the Nickerie District by the different Ministries is indicated in the table 2 below.:

O&M Costs Government Agencies

AGENCY	SRD	USD	%	Specification of Expenses
OWMCP	5.827.780	1.442.520	41%	Wakay Pumping Costs + Personel
LVV	5.020.000	1.242.574	35%	Rehabilitation and Maintenace Secondary system
OW	3.120.000	772.277	22%	O&M Main system
RO	235.000	58.168	2%	Maintenance Secondary system
Total GoS	**14.202.780**	**3.515.540**	100%	Budget requested
Actually Disbursed	4.260.834	1.054.662	30%	Disbursement received (est.)
Required Expenses	18.908.683	4.680.367	23%	Required budget to cover O&M

USD/SRD =4,04 / 2015

Table 2 : O&M Costs Government Agencies[1]

The real amounts disbursed by the Ministry of Finance for O&M has been however lower and are estimated at only 30% of the requested and approved budget in recent years.

The actual costs required for O&M the I&D system are estimated at 18,908,683 (USD 4,680,367) as estimated by a study carried out by PropPlan for OWMCP (reference 5,5)

In the Nickerie I&D system responsibility for operation and maintenance is vested in five different agencies and intervene from different perspectives, as described below. For further details on the tasks and function of the Ministerial departments reference is made to document No 1.3.

The three ministerial departments directly engaged in the operation and maintenance works act, as shortly described below:

1) The Ministry of Agriculture, Animal Husbandry and Fisheries (LVV)

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.

The Ministry carries responsibility for the maintenance of 158 km of irrigation canals and 190m of drainage kanal and 330 km of clay dams and tertiary roads.

Within its mandate the Ministry is responsible for the water calendar and determines water supply to the various crops in line with cultural practices.

The Ministry also has had the primary responsibility in the planning and implementation of rehabilitations[2] of the Water Boards I&D system and tertiary[3] road system in Nickerie district.

2) Ministry of Public Works (OW).

[1] Source OWMCP/Study PROPLAN 2017, reference list # 5.5

[2] Rehabilitation works are defined here as the restoration of degraded WB I&D system into satisfactory conditions after years of inadequate maintenance, prior to transferring the I&D system to the WB which will be responsible after rehabilitation for regular O&M

[3] the tertiary road system refers to the internal road system of the WB polders and assures the access to all fields. Tertiary roads are mostly built on the clay dams shaped with the soil excavated from the canals. Their stability is often weak due to poor drainage conditions and requiring reshaping, heightening and a sand layer to improve drainage.

Main mandate of this Ministry relates to the planning, design and implementation of all major and technical more complex civil and hydraulic engineering works. They often maintain after construction operation and maintenance responsibilities of the main regulation structures in the primary canal systems and pumping stations.

The Ministry carries maintenance for a total of 83 km and 99 km of dams and dikes and 24

The Ministry of Public Works has been instrumental in line with its mandate in the description of works and cost estimates of deficient hydraulic structures in the main system to be repaired under this project.

3) Ministry of Regional Development (RO).

The RO Ministry is specifically responsible for the promotion and strengthening of local organizations and as such carries in the districts the main responsibility for the establishment, supervision and strengthening of the Water Boards.

The District Commissioner (DO) coordinates the inputs of the other Ministries in O&M of the Irrigation and Drainage and chairs the District Irrigation and Drainage Coordination Working group (DIDCWG). The District Administration has the responsibility for the approval of the annual O&M plans of the Water Boards and enforces payment of water fees by the individual WB members.

The Overlying Water Board of MCP in Nickerie carries out operation and maintenance of the main I&D infrastructure of the Nickerie I&D system and comes under the RO Ministry.

4) OWMCP (The Overlying Water Board of the Multipurpose Corantijn Project)

The Over-lying Water board of the Multipurpose Corontijn Project (OWMCP) in Nickerie District was established by State Decree in 2007. It differs largely from the other Water Boards (In-lying) in that it took over the tasks and responsibilities of the previous Multipurpose Corantijn Project in operating the irrigation and drainage system of the left bank of the Nickerie river, except for the Autonoom area. OWMCP was also assigned to provide services to the water boards in the various polders situated inside the Nickerie system. With this mandate the OWMCP with its director and the technical staff assigned was able to achieve a better coordination and local governance of the operation and maintenance of the important I&D system in Nickerie district.

The OWMCP has been strengthened in the implementation of its tasks by the EU financed project[4] :***Capacity Building for Integrated Water Resources Management*** " over the period 2013-2017, focusing in four key areas: i) Water governance, ii) Efficient water management including water quality iii) integrated water resources management, iv) Capacity building and training. Technical support in the execution of the project has been provided by the World Water Net Organization, the Water Board of Rijn en IJssel and the Wageningen University in the Netherlands.

With assistance of the EU project OWMCP has established a full inventory (Ledger) of all irrigation and drainage channels and roads complete with maps of all Water Board polders (reference no: 5.7, 5.11).

With the creation of the OWMCP an important step has been set to come to the establishment of a real Water Authority in the district with responsibilities for the overall supply of irrigation water and outflow of excess waters, for the coordination of the inputs of the different Ministries, and for the provision of relevant services to the 12 water boards in Nickerie district. (Reference No 8.4)

The results and recommendations of the EU Capacity Building project are of direct relevance to the implementation of this project and reference is made to the list of documents prepared by the project included in of this report.

[4] For a presentation of the achievements of the EU project reference is made to Reference No 5.1

Coordination among the Government Agencies

Coordination between the agencies in the planning, implementation and monitoring of operation and maintenance works have been limited in the past. The need for a better coordination have been an important condition under the IDB I&D Policy loan. and has resulted in the establishment of the Inter-Ministerial Irrigation and Drainage Coordination Working group (IMIDCWG) at national level (Reference Doc 1.12).The Working group has been instrumental to achieve a more coordinated approach and vision for the modernization of the irrigation and drainage sector and has been active in particular in the preparatory work and endorsement of the investment proposal under this project.

In line with conditions of the IDB I&D policy loan, a *Memorandum of Understanding* has been signed in 2016 (reference Doc no 1.5) for the establishment of a District Irrigation and Drainage Coordination Working group (DIDCWG) in Nickerie District between RO, OW and LVV, under chairmanship of the DC and the technical secretariat carried out by OWMCP (see reference 1.5). The District Working group has been instrumental in the preparations for the investments under this project and has been called up on a regular base. The flood problems in July 2017 showed the importance of a coordinated approach of the 3 ministries.

The project will provide special provisions to support the functioning of the DIDCWG and the District Water Commissions as well as provide support in assessing the interest and need in other districts for the establishment of I&D Coordination Working groups and establishment of water boards.

5 Transferring of O&M Responsibilities to Water Boards

Responsibility for the operation and maintenance of I&D systems was in the colonial period entrusted to Water Boards as defined in the original Governmental decree of 1932. With large public investment in irrigation and drainage since the 1950's, most investment and operation and maintenance works were carried out by the Government and respective departments. The contribution of farmers in O&M became negligible and the functioning of the water boards discontinued.

With the diminishing government funding and declining funds for operation and maintenance, water management conditions in many polders rapidly deteriorated.

Realizing the importance of engaging water users in the operation and maintenance of the I&D system, the concept of the Water Boards was revitalized in order to make farmers again responsible for the operation and maintenance of their I&D systems and contribute to the considerable costs of O&M and rehabilitation works.

A series of State decrees were made in 2006 for the establishment of 12 Water boards in the Nickerie district, as listed below. The state decrees are based for a large part on the old decrees and provided detailed provisions and guidelines for the responsibilities of the Water Boards related to

- the governance of the WB and election of a Water Board Committee (WBC) every 3 years responsible for the management and maintenance of the infrastructure
- the procedures for drafting and endorsement of Byelaws ('Keur") and rules and regulations which sets out the further details of rights and obligations of the members as well as its enforcement;
- the establishment of a Ledger ("Legger") that describes in detail the infrastructure and responsibilities for operation and maintenance of each canal and structure of the polder I&D network,
- the preparation of an annual budget for regular O&M expenditures to be approved by the District Administration and charged to each WB member according to the area cropped;

For further details on rules and regulations of the Water Boards reference is made to the documents prepared under the IDB Policy Loans[5]

Table 3 gives further information on the areas of the 12 Water Board polders with rice cultivated areas and number of farmers.

The size of the individual landholdings to the small holders have been changing over the years with in the early stages family plot sizes of 1,5 to 2 ha (f.i. van Drimmelen & Corantijn polders) , which increased in the sixties to plot sizes of 4 to 6 ha (Nanni-Bruto, Euro polders). The last small holder polder was the Uitbreiding Groot Henar, with plot size of 8 to 12 ha. The number of farmers effectively cultivating has been diminishing substantially and increasingly farmers have been been renting out their land to other farmers, as is shown in table 3.

With the establishment of the Water Boards the Ministry of Agriculture has embarked on the rehabilitation of the WB I&D systems. Since 2009 a total of 5 Water Boards systems have been completed, as indicated in table 3. (Rehabilitation of the Great Henar polder has been contracted but due to unavailability of funds has not started yet.)

The impact of the rehabilitation of the 5 WB completed has been important in terms of better regulation of irrigation water supply, drainage of excess water and access to the fields for farm machinery within the polder system. However due to the inadequate functioning of many of the hydraulic structures in the main system, the irrigation supply and disposal of drainage water has been still in many aspects inadequate. Moreover the non-functioning of the Water Boards makes that farmers are still depending on the government services for operation and maintenance of the secondary canals in the polders, resulting that planting is often late as water does not arrive in time and quantity, while poor drainage and flooding restricts planting and harvesting operations.

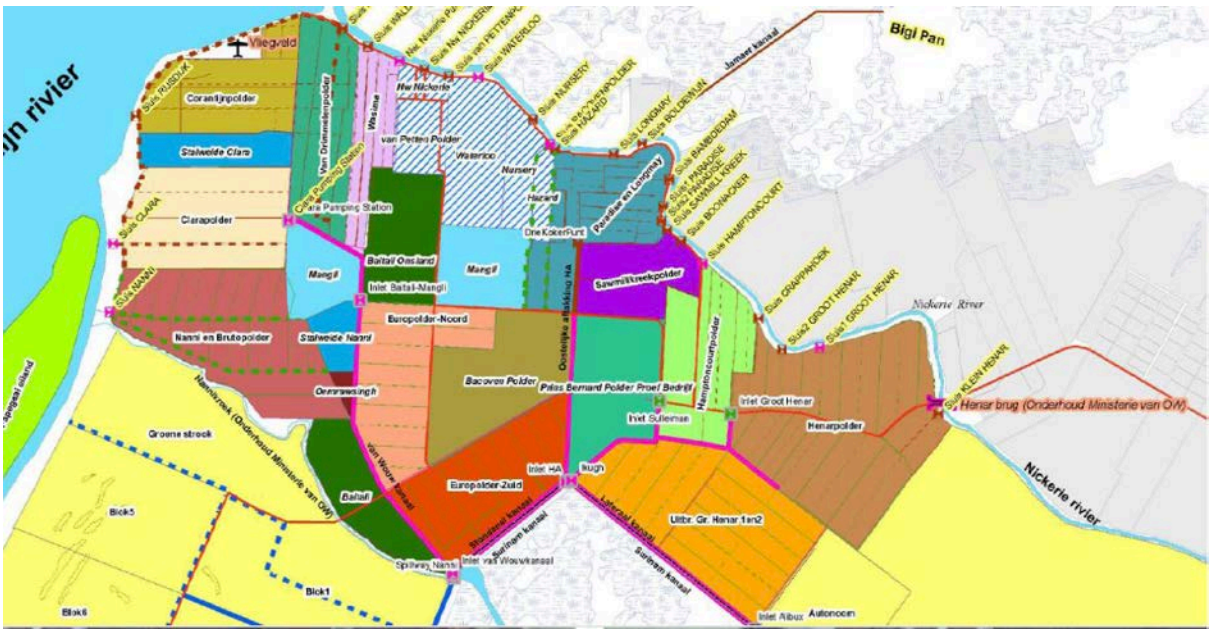

Figure 3 : Overview of WB Polders

The performance of most Water Boards in O&M has been disappointing so far as motivation of farmers to contribute to regular O&M is limited and irregular. As the By-laws, which set out the rules and regulations of the Water Board have not yet been approved, the Water Board Committees have no authority to enforce its members to contribute to O&M.

[5] See reference List of IDB I&D Policy Documents : "***Establishing 6 Water Boards***" and "***Water Board Legislation***" (**Reference list** # 1,8)

Water Board Polders: Area and No of Farmers

No WB	Water Board Polder	Status Rehabilitation	Ha	No Farmer Owners	Ha per farmer	No Farmers Cultivating	Ha per farmer
	Western polders		**6.937**				
1	Nanni-Bruto	study '16	1.447	262	5,52	131	11,0
2	Clara polder	study '16	1.366	365	3,74	169	8,1
3	Corantijn	2014	747	573	1,30	197	3,8
4	van Drimmelen	2011	850	568	1,50	582	1,5
5	Wasima	study '16	352	370	0,95	86	4,1
6	Euro-Noord	2013	1.035	160	6,47	93	11,1
7	Euro-Zuid	study '17	1.140	214	5,33	72	15,8
	Eastern Polders		**6.401**				
8	Paradise-Longmay	study '16	980	536	1,83	362	2,7
9	Sawmillkreek	2009	481	97	4,96	68	7,1
10	Hamptoncourt	2009	894	540	1,66	227	3,9
11	Henar	contracted	2.242	598	**3,75**	105	21,4
12	Uitbreiding-Groot Henar	study '17	1.804	172	10,49	80	22,6
	Total Rehabilitated		**6.249**				
	Total all WB		**13.338**	**4.193**	**3,18**	**2.041**	**6,54**

Table 3: Water Boards in Nickerie Districts

The project will provide major and important inputs in providing facilities and incentives to assist and motivate farmers to assume full responsibilities in operation and maintenance of the I&D infrastructure. A first requirement and condition will be the formal endorsement of the By-laws (Keur) by the Ministry RO.

Extensive provisions have been made in the project to provide adequate support and incentives to ensure the effective transfer of O&M responsibility to the Water Boards as described in detail in following chapters based on outlines provided in the IDB I&D Policy Document on Public Services to provide to WB [6]. .

6 Water Use Efficiency and Crop Productivity

A main objective of the project will be to improve water use efficiency and increase crop productivity. A range of factors determines the water use efficiency at various levels in the I&D system. These factors concern both infrastructure and management and are strongly interrelated and interdependent.

Furthermore deficiencies in the drainage system determine result in regular flooding and inundations as well as poor access to the fields and delays farm operations, resulting in substantial production losses.

Crop water productivity relates to the increase in production and reduction production costs due to improved water use efficiency both in irrigation and drainage.

a) Irrigation Water Use Efficiency

Irrigation water use efficiency relates to the amount of water lost in the conveyance and distribution of water from the source to the crop in the field and depends on both the conditions of the infrastructure and the way water flow can be regulated according to crop water requirements in the different parts of the system.

[6] as outlined in the IDB Policy document on "**Public Services to provide to WB**"

Water losses occur due to seepage, evaporation and spillage in the canal system but in particular due to poor operation of the system and lack or deficient regulating structures. Various operation systems are being practiced and are directly related to the regulation capacity of the hydraulic structures, that distribute water to the various canal outlets according to crop requirements. Responsibility of water distribution in the primary system is entrusted normally to the scheme authority, while the water boards arrange water distribution in the secondary.

Further losses occur at the tertiary system at farm level and at field level. At farm level efficiency is determined by the way farmers are handling the water flow received in their tertiary canals and distributed among along the field channels. At field level the irrigation method determines the field efficiency.

Irrigation efficiencies are normally defined at different levels of the irrigation system as the factors determining losses vary at main system, secondary system, farm system and field level. In line with international standards we may distinguish i[7]:

- **conveyance efficiency (Ec)**, representing the losses occurring in the conveyance from the head inlet to the farm. Values may vary from 60% for gravity system and 80% for lined canals or piped pressure systems. The condition of the regulating structures and management of water distribution plays an important role; Conveyance efficiencies in the primary and secondary canal system may have different efficiencies, depending on conditions and responsibility in operation.
- **Farm efficiency (Eb)**: representing losses in the farm distribution system. Efficiency values vary between 60% to 90% depending on conditions of the intake and tertiary canals, field channels and distribution of water within the farm system
- **Field efficiency (Ea):** representing the efficiency of field water applications. Values vary between 40 to 70% as determined by losses due to deep percolation, evaporation, soil type and in particular land.
- **Scheme efficiency (Es):** representing the efficiency of irrigation water supply for the total scheme from source to crop, combining the efficiencies of water supply in each of the subsystems, where Es=Ec x Eb x Ea. Typical values for Scheme efficiency vary between 40% for gravity systems to 70% for sprinkler system. Gravity rice Irrigation schemes are in general low and have values between 30 to 50% (See Bos & Nugteren)

In the case of the Nickerie Irrigation scheme water supply efficiencies can be evaluated at the different levels: at the primary intake, the main system and WB system as well as farm and field level:

a) The main intake of water is at the Nanni inlet where water is supplied from two sources: the pumped water from the Corantijn Canal and the water from the Nanni swamp. Losses will relate to conveyance losses in the 70 km long Corantijn canal and the evaporation in particular from the Nanni swamp which covers a large area. An important source of losses occur due to the lack of a weir, as foreseen in the MCP project that regulates the outlet of the Nanni swamp and closes off the water flow from the Corantijn canal which presently flows freely into the Nanni swamp. Construction of the Nanni weir will be therefore have an important impact on the losses of pumped water, which is lost at present through evapotranspiration in the Nanni swamp

[7] M, Bos en J. Nugteren, ILRI Wageningen "**On Irrigation Efficiencies**" http://edepot.wur.nl/71061

b) Conveyance and operational losses in the Main system from the Nanni/van Wouw intake to the various distribution points and intakes of the individual polder systems. Considerable losses occur in particular due to the lack or deficient regulating structures, which often cannot be closed resulting that much water is continuous flowing and lost into the drains. Moreover without adequate regulating structures the introduction of a rotational supply is not possible. Repair of the regulating structures is therefore a first priority and a condition for the introduction of a more efficient distribution system;

c) Conveyance and operational losses in the Secondary system of the WB Polder systems, with losses due to poor maintenance and clogged canal systems and operational losses due to the lack of proper arrangements and procedures on water distribution. The rehabilitation of the WB infrastructure is an important condition to achieve a more efficient system that can be operated and maintained by the WB assisted by a Water Master;

d) Field application losses due to inadequate field levels, which result in water and yield losses as part of the fields, receive either a shortage or an excess of water and poor drainage. The project will there promote land leveling as a mean to improve field water efficiencies

The overall irrigation efficiency of the Nickery Irrigation scheme is determined by the efficiency of the water supply by the Corantijn canal and the Nanni swamp to satisfy the requirements of rice for evapotranspiration and land preparation.

Estimating the efficiencies of the Nickerie irrigation system is difficult due to the lack of actual data on water supply. Data from the Wakay pumping station are available from OWMCP and provide information on the quantity of irrigation water supplied by the Wakay pumping station. (**reference list** # 7.1 - 7.6)

The pumps are only operational in the October- February short rain period, with peak requirements in November- December-January for the land preparation and inundations of the rice fields. The fluctuations in yearly rainfall correspond well with the yearly pumping volumes as indicated in the table 4.

Water Supply Short Rains			**21,000 ha**	**3 month**
Year	**Volume Water Pumped m3**	**Rainfall Oct Dec**	**Irrigation Applied mm**	**Average Discharge m3/sec**
Wakay Pumping Station				
2015-2016	155.001.600		738	19,9
2014-2015	230.094.000		1096	29,6
2013-2014	150.606.000	152	717	19,4
2012-2013	170.289.000	108	811	21,9
2011-2012	73.392.750	430	349	9,4
2010-2011	104.751.090	202	499	13,5
Average	**147.355.740**	**223**	**702**	**19,0**
Nanni Swamp				
Nanni Swamp Supply (estimated)	150.000.000		**714**	19,3
Total Irrigation Supply	**297.355.740**		**1416**	38,2
Rice Irrigation Requirements	84.000.000		400	10,8
Irrigation Efficiency	**28%**		**28%**	

Table 4: Irrigation water supply in the short rain period

The supply of water from the Nanni swamp is more difficult to estimate. Some estimates are provided based on the EU Masterplan[8] (**reference list** # 9.1) reflecting the amount of water, which is effectively stored in the swamp.

Rice irrigation requirements can be estimated based on average climate data from Nickerie using the FAO Cropwat program[9].

Based on the rice irrigation requirements and the total water supplied by the Wakay pumps and Nanni swamp a preliminary estimate on supply efficiency can be made.

Estimated irrigation efficiency in the short rainy period is approximately 30%.

Efficiencies in the secondary WB polder systems can only be estimated by an evaluation of the conditions of the infrastructure and the operational system. Losses in the canals are limited as the heavy soils do not result in high infiltrations. Clogging of the canals by heavy aquatic vegetation and siltation in particular hampers supply. Biggest losses occur due to poor water distribution as the lack of an adequate system of flow regulation, water is flowing continuously and if not used is wasted into the drain.

A study (**reference list** # 6.5) carried out in the framework of cooperation with Wageningen university in one of the WB polders show that a revised water allocation would result in water savings of up to 30%

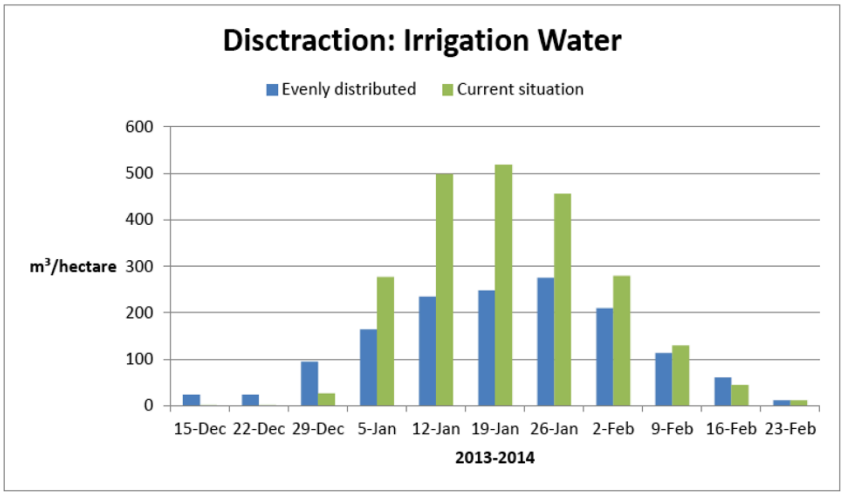

Figure 4 : Water use efficiencies in water distribution in the secondary WB system[10]

The project will provide assistance in the introduction of rotational delivery and the assignment of water masters to better regulate the water distribution within the polders.

At field level, water use efficiency is negatively affected by uneven field levels, which results in water shortages on the high end of the field and excess water levels at the low parts of the field. As farmers tend to continue irrigation until water has reached the highest level, considerable water losses and reduced productivity occur, due to excessive weed growth and poor drainage of the lower parts of the fields during harvest. Up till 70% of the fields are considered to be effected by poor field levels. (ADRON[11], Mardi Holdings 2017 **reference list # 12.1**).

Farmers are well aware of the advantages of goo field levels, but the costs and equipment requirements are important constraints.

The project will provide assistance in providing financial incentives and demonstrations of appropriate leveling techniques and equipment.

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[8] EU 2009, Master plan for the Supply and Distribution of Irrigation water for Agriculture in Nickerie district
[9] FAO 1993 CROPWAT a computer program for Irrigation water management
[10] BSc Thesis Koen Geenen Water : *"Water use efficiency of rice in Nieuw Nickerie"*
[11] ADRON, Information folder.

b) Efficiency of the Drainage System

For large part of the year rainfall will well exceed crop water requirements (see figure 1) requiring an appropriate drainage network to evacuate excess water and to address flood hazards. Inadequate conditions of drainage system will result in negative results in particular on crop yields and farm operations due to flooding and inundations as well as poor access to the fields for farm machinery.

The drainage system is therefore as important as the irrigation water supply and the whole scheme is therefore equipped with a primary, secondary and tertiary drainage system. The main drains of the eastern polders are discharging into the Nickerie river, while the western polders discharge into the Corantijn river. As the rivers are subject to tidal movements the outlets are equipped with sluices, which open at low tide and close at high tide. The sluices are either manually or equipped with automatic valves.

Many of the sluices are poorly functioning with broken and leaking sluice doors, causing restrictions in discharging excess waters and salt water intrusions from the Nickerie and Corantijn rivers.

Special provisions need to be made to evacuate the floodwaters from the Nanni swamp. Presently the floodwaters discharge over the Nanni spillway into the Nanni creek on the western side of the scheme. Deferred and lack of maintenance has caused blockages in the Nanni creek and a strongly reduced capacity to evacuate the floodwaters.

Moreover the Marataka spillway on the eastern side of the Nanni swamp, which was foreseen under the MCP project to allow adequate capacity to discharge the floodwaters on the eastern side, was never constructed.

The flood problems are aggravated by the floodwaters in the Nanni swamp over-spilling into the Corantijn canal. As a result the drain outlet at the South Drain is been seriously damaged.

As a result the strongly reduced capacity of the drainage capacity has resulted in the now frequent flooding of hundreds of hectares of rice field in the southern parts of the scheme.

c) Impact of the Project on Water Use Efficiency and Productivity

The project will address the shortcomings of the irrigation and drainage system at all levels and address both the rehabilitation of the infrastructure in main, secondary system as well as the introduction of improved operational procedures, which will have a large impact on the efficiency of the water management system and result in substantial gains in crop productivity and production costs.

- Rehabilitation of the I&D infrastructure will include
  - the repair of deficient hydraulic structures in the main system
  - The construction of two new structures the Nanni weir and related works regulating the inflow of water into the scheme and the Maratakka spillway to increase outflow capacity of flood waters;
  - The rehabilitation of the secondary irrigation and drainage system in 6 WB polders, that will importantly increase operation and maintenance within the polders
  - Improvement of field efficiency by promotion of field leveling
- Introduction of Appropriate Operational procedures
  - Introduction of rotational water supply and crop water calendar
  - Flow measuring and monitoring system through installation of water level recorders in main system and catchment areas
  - Optimizing water supply through flow modeling at Main system level and catchment areas;

- Transfer of management of O&M to Water Boards will lead to a more efficient operation of water inflow and outflow;
- Assistance in the introduction of improved water distribution and water allocation within the WB polders with the assignment of water masters

Indeed the investments for the repair and rehabilitation of the primary and secondary system will have an important impact on the water supply and disposal of excess water and flooding for the whole area, of the WB polders and the commercial farms.

The rehabilitation of the infrastructure impact will allow the introduction of a more rational supply of irrigation waters and results in

- Substantial water savings estimated at 20-30%
- Reduction of pumping costs at Wakay estimated at 25%
- Reduction of pumping costs by individual farmers who recycle water from the drains by private pumps (estimated at 450 SRD/ha)
- Potential Expansion of the irrigated areas of 20 to 30%
- Timely and adequate water supply for crop production and farm operations avoiding late planting

Improved water management will have a distinct impact on crop productivity, production and cost of production:

- An increase in productivity from 4,5 ton/ha to potentially 6 à 7 tons
- An expansion of the irrigated area towards the MCP and Autonoom polders
- An increase in harvested area in the dry season;
- Avoiding yield losses by excessive water not adequately drained, particularly in the wet season and delays in essential farm operations as farmers cannot access their fields
- Prevention of damage by floods due to reduced spillage capacity in the main drains,
- Adequate drainage of fields and access of farm machinery for farm operations
- Reduction of weed growth due to better water regulation

7 Hydrology of the Nickerie Water Resources base

The management of the present water resources of the Nickerie irrigation and drainage system is complex with three main water resources: the Nanni swamp, the pumped water of the Corantijn river and the Nickerie river. To ensure the optimal and sustainable development and management of the ecological sensitive water resource base it has become essential to obtain a better insight in the interaction between inflow and outflow of the three water sources.

Information on the water resource base is limited and only few detailed studies are available (**reference list** # 11.1 – 11.3) Lack of understanding of available water resources impede the development of adequate water resources management tools to operate and exploit the full potential of the I&D systems in varying drought and excessive rainfall and climate change scenarios

A better understanding of the hydrology will allow an assessment of the potential for a more efficient and sustainable use of available water resources. Moreover it will allow a possible expansion of the irrigated areas, the management of a more efficient irrigation supply, the evacuation of excessive floodwaters as well as the monitoring and management of salt intrusions through the Nickerie river;

The marshy areas of the Nanni swamps and the catchments of the Nickerie river are home to unique flora and fauna and require a better understanding of the impact of present and future water use of the resource base and necessitate appropriate safeguards for the sensitive eco-systems of the catchments;

A better understanding of the water balances of inflow and outflow would allow the modeling of water supply and evacuation of floodwaters under various climate conditions;

Water quality monitoring and assessment of environmental hazards, including the impact of saltwater intrusion by excessive water extraction of the Nickerie river;

The project will provide the means provide a better understanding of the water balances of inflow and outflow that would allow the modeling of water supply and evacuation of floodwaters under various climate conditions the modeling of the hydrology of the Nickerie water resources base. The inputs of an international consultancy in hydrology will be provided who under supervision and in cooperation of the specialized hydrology unit of IDB (Hydro-Bid) and the national competent agencies in the country will review the available climate and hydrology data and records, the relevant studies and literature available and assess the requirements for the establishment of a network of hydrological stations on climate and river flows to allow the monitoring and meaningful modeling of the water resources base to be included in the investment loan.

8 Water Rights of Multiple users and Integrated Water Management

Although agriculture is the main beneficiary of sustainable and efficient water management, several other stakeholders including women are directly concerned with good water management that takes into account their specific interests and rights for access to good quality water and protection against excess water and flooding.

Issues of securing good safe drinking water, minimizing water pollution and monitoring good water quality as well as securing water resources for ecological sensible areas form part of the need for an integrated approach for sustainable water management.

Under the EU financed project the OWMCP has made a start with a first set of measurement on water quality on different points at the scheme. Salinity, Acidity (Ph) and impact of pesticides on surface water quality has been measured (**reference list** # 5.9). Although the first results do not give reason for immediate concern, there is a need to carry out relevant studies and to establish a monitoring system on water quality.

Consultation of all stakeholders is an essential element of integrated water management. The EU financed Capacity building project has made a start of this consultative process by the establishment in 2014 of the District Water Platform (DWP), which sets the basis for this consultative process. The Statures [12] of the DWP (**reference list # 5.6**) have been approved in 2015 and set out the objectives and participation of all agencies with an interest in sustainable water management with the secretariat established in OWMCP.

Adequate legislation may be required to vest and ensure the rights of all water users for adequate access to good quality water for irrigation, drinking water supply, securing environmental safeguards and the protection from excessive water and flooding by adequate drainage and flood control.

To ensure the consultation of all stakeholders for an integrated approach in sustainable water management, a District Water Platform (DWP) may be established such as recently installed in Nickerie district. The Platform will in a structured manner allow to consult and involve all water users, stakeholders and sectors in the planning and operation of good water resources management, including drinking water companies, livestock and fisheries, and sensible eco-systems.

The various aspects of Integrated Water Resource Management are briefly described below.

[12] OWMCP 2015: : ***Reglement Waterplatform Nickerie";*** **reference list # 5.6)**

a) Assessment of Water Quality Risks and Management

Several hazards may effect water quality and impose risks to human health and agriculture and include:

- Agricultural chemicals used in intensive agriculture may negatively effect the water quality and impose risks for human health
- Waste water management and urban pollution may provide health risks as water quality becomes effected by outflow of waste water and garbage littering into irrigation and drainage canals
- Salty sea water intrusion into the river estuaries particularly in the dry season may negatively effect irrigation and drinking water supply

b) Assessing and improving flood control

Flooding and inundations in periods of heavy rainfall will negatively affect residential and urban areas and will require specific demands on drainage systems and flood control dikes and

- Assessing flood and inundation risks in urban areas
- Assessing problems in road access during rainy seasons

c) Water resources inventory and assessment

The inventory and assessment of adequate fresh water resources for all water users is an essential component of integrated water management.

Irrigated crop production will be the largest user of fresh water supplies. To satisfy actual and future irrigation requirements, measures for a more efficient water use in irrigation need to be taken and adequate safeguards built in that will take into account the specific needs of other water users.

An assessment is to be made of water requirements and specific provisions in water management to be made for other water users, including drinking water and sanitation, livestock watering, fisheries, conservation areas, tourism and urban wastewater management.

The project may actively contribute to the consultation and involvement of all water users to ensure the sustainable and integrated water management in the District. The promotion of regular meetings such as foreseen in the Statutes of the Water Platform initiated by the EU Capacity building project may be pursued.

PART II IRRIGATION & DRAINAGE PROJECT COMPONENTS

Main Objectives of the I&D Component

In line with the Vision the main objectives of the I&D Component are:

- To increase agricultural productivity through investment in infrastructure and improved management of I&D systems,
- To transfer responsibilities in O&M of the secondary systems to Water Boards and minimize government involvement and expenditures in the WB systems;
- To strengthen Government Agencies and WB capacity and coordination in improved water management at national and district level;
- To safeguard the integrated and sustainable development of available water resources for all users, including environmental control measures.

Sub-Components in the Modernization of Irrigation and Drainage in Nickerie

The project will finance the following sub components:

1. The upgrade of Infrastructure of the Main System on the left bank of the Nickerie river, of which the rehabilitation and repair of 15 existing regulating structures and two major new structures;
2. The rehabilitation of the Secondary I&D System in six WB polders
3. Support in the effective transfer of Operation and Maintenance of the Secondary system to the Water Boards with incentives mechanisms aimed at increasing willingness to cover O&M costs and at improving efficiency in farmers water use
4. Capacity building in I&D Management at National and District level by the concerned Government agencies in charge of water management and resource administration for irrigation and drainage, including better coordination and improved operation and maintenance procedures and monitoring of water resources;
5. Improved Water Management by introducing procedures for better Irrigation water distribution, installation of hydrometric network and flow modeling at system level as well as land leveling to achieve better water use efficiencies at farm level;
6. Conduct Hydrology Water resource monitoring for efficient and sustainable Irrigation supply and flood control;
7. Environmental control and Integrated Water Resources Control by developing procedures to measure and monitor the sustainable management in integrated water resource management for all water users;

In the following chapters the seven components are further described and a estimated project costs;

1 Main System Rehabilitation

1.1 Repair of Existing Hydraulic Structures

Due to neglected and deferred maintenance over the years, the present poor conditions of the I&D infrastructure of the main system, has resulted in considerable water losses, high pumping costs, increased production costs, and losses in production and flooding in times of excessive rainfall.

The rehabilitation of the secondary WB irrigation and drainage systems does not achieve is objective of more efficient water management if not at the same also the deficiencies in the main system are corrected.

A first condition to achieve a better efficiency in water supply and disposal of excess water is the rehabilitation and repair of the I&D infrastructure in the main system and to restore the proper functioning of a range of regulating structures. These investments will to a large part solve the main deficiencies in operation of the system and increase substantially water use efficiencies and crop production in the farmers operated systems and allow a further expansion of the irrigated areas and reduce flood hazards.

An inventory was made of the deficiencies of the different regulating structures in the main system and the type and costs involved of the repair works to be carried out. The survey was carried out in close consultation with the District Irrigation and Drainage Coordination Working Group (OW, OWMCP and LVV) and in particular with the maintenance unit of the District Public Works office and staff of OWMCP.

A total of 15 main structures have been listed for major repair works that will improve the efficiency of operation of irrigation water, reduce water losses and flooding hazards. These works include the repair of broken gates of drain sluices and inlet gates, spillways and distribution boxes, as well enlargement of the drainage capacity, as indicated in the table. (see table 5).

Details of the cost estimates are included in separate reports, prepared by the Department of Public Works in consultation with OWMCP and summarized and described in Annex 1 of this report. (**reference list** # 3.1, 3.2, 3.3)

1.1. Repairs Main System

	Hydraulic Structure	Materials & works	Contractor costs 30%	Design and supervision	Total Cost USD
1	Goot Henar Sluice	387.130	116.139	58.070	**561.339**
2	Clara sluice	48.000	14.400	7.200	**69.600**
3	Nanni/Van Wouw intake	**203.650**	**61.095**	**30.548**	**295.293**
4	Ikugh inlet	707.150	212.145	106.073	**1.025.368**
5	Nanni Sluice	22.140	6.642	3.321	**32.103**
6	Hazard Sluice	622.090	186.627	93.314	**902.031**
7	Hamptoncourt Sluice	27.340	8.202	4.101	**39.643**
8	HA Intake	9.870	2.961	1.481	**14.312**
9	Suleiman/Hamtoncourt Inlet	9.070	2.721	1.361	**13.152**
10	Clara Distribution Box	392.230	117.669	58.835	**568.734**
11	Drie Koker Punt Inlet	147.840	44.352	22.176	**214.368**
12	Syphons along Corantjin Canal	291.010	87.303	43.652	**421.965**
13	Nanni Outlet (sheet piling)	1.073.150	321.945	160.973	**1.556.068**
14	Nanni Spillway	**60.000**	**18.000**	**9.000**	**87.000**
15	Nanni kreek	500.000	150.000	75.000	**725.000**
	Total Repairs	**4.500.670**	**1.350.201**	**675.101**	**6.525.972**

Table 5 ; List of main system structures to be repaired

The design and planning of the repair works will be entrusted to a qualified consultancy firm with overall supervision carried out by the Public Works Department and the DIDCWG. Recruitment of the consultancy is expected to be completed in the first half year.

Implementation and procurement will be carried out in a phased manner over a period of 4 years, with a priority ranking of most urgent repairs and difficulties in procurement from abroad.

The District Irrigation and Drainage Coordination Working Group (DIDCWG) will define priorities and establish a time schedule in the repair of the structures based on proposals made by the consultancy firm entrusted the design and supervision of the works.

The implementation of the repair works will be carried out in line with standard government procedures in which part of the works will be commissioned to qualified local contractors. Implementation of urgent and easy to repair works are expected to be initiated already in the first year.

Procurement of certain equipment and materials (steel piling) will be from abroad where competitive bidding is required. In certain cases where more complex and specialized technical inputs are required technical agencies and consultants will be commissioned for detailed studies and tendering. All sub-contracting and procurement of equipment and materials from abroad will be carried out by the contractor with adequate proofs provided on the competitive procurement of services and equipment and supervision provided by the DIDCWG.

1.2 Construction of New Hydraulic Structures

The Multipurpose Corantijn Project (MCP) initiated in 1981 introduced major improvements in the infrastructure of the Nickerie I&D system with the construction of the Wakay pumping station and the 70 km long Corantijn canal, which allowed an adequate water supply for double rice cropping of the present irrigated area of 27,000 ha.

The MCP project was however was never completed due to shortage of funds. As a result some of the major and essential hydraulic structures were never accomplished, resulting in major deficiencies in water supply and inadequate drainage capacity.

The project will contribute to the completion of 2 major new regulating structures: The Nanni weir and related structures and the Maratakka spillway. The completion of the Nanni weir will achieve a substantial reduction of pumping costs and a more efficient and secure water supply that will benefitting more than 5000 mostly small-holder farmers of the left bank. Moreover the Maratakka weir will reduce recurrent floods effecting hundreds of hectares in the southern polders and prevent flood hazards of the city of Nieuw Nickerie.

The Nanni Weir

The absence of a weir at the outflow of the Corantijn canal causes the water from the Corantijn canal to spill directly into the Nanni swamp. As a result the water level in the whole Nanni swamp needs to be raised before irrigation water can flow into the irrigation canals. Substantial losses in evaporation occur in the large Nanni swamp estimated at 20 to 30% and the whole irrigation supply becomes very inefficient and difficult to manage in particular when irrigation supply is interrupted.

The new to construct Nanni weir situated at the outlet of the Corantijn canal will allow the regulation the inflow of irrigation water from the Nanni swamp into the irrigation system as well the outflow of excess water of the Nanni swamp into the Nanni creek through the existing Nanni spillway.

The Nanni weir will result in the closure of the Suriname canal and requires additional structures to be included in the canal system. These structures comprise the reconstruction of the Nanni Inlet structure into the Van Wouw canal and the Stondansi canals, the extension of the Stondansi canal, reconstruction of two intakes from the Stondansi canal into the HA and Lateral canals and strengthening of the swamp retention embankment and deepening of the Suriname canal.

The total preliminary estimated costs of the Nanni weir with additional structures and the Maratakka spillway amount to 6,5 million USD, including an estimated 30% costs for contractor and consultants services. .

The Maratakka Spillway

The main outflow of excess flood waters from the Nanni swamp is through the Nanni spillway into the Nanni Creek on the west side at the outflow of the Corantijn canal. The outflow on the eastern side of the swamp retention dike should have been through the Maratakka spillway that was however never constructed.

Excessive rainfall as occurred recently in the Nanni swamp has shown to cause serious flooding as the capacity of the Nanni spillway is insufficient. Construction of the Maratakka and related connection canal from the Suriname canal into the The construction of the Maratakka spillway and the reshaping and sediment removal of the Nanni creek under the repair structures will importantly improve the evacuation of floodwaters.

1.2 New Hydraulic Structures

	Structure	Contracted Works	Design and Supervision (18%)	Total costs
16	Nanni weir	2.413.667	425.940	2.839.607
17	Maratakka Spillway	463.257	81.751	545.008
18	Reconstruction and extension Stondansi Canal	1.326.000	233.999	1.559.999
19	Diversion Structure Stondansi/Lateral Canal 1	1.014.000	178.941	1.192.941
20	Reconstruction and extension Lateral canal 1	286.000	50.470	336.470
	Total New Structures	**5.502.924**	**971.104**	**6.474.025**

Table 6 : List of new hydraulic structures in the main system

In order to assist LVV and OW in the in the design, supervision and implementation of the works a qualified consultancy firm will be recruited for this purpose with further guidance and endorsement by the DIDCWG.;

2 Rehabilitation of the Secondary System operated by Water Boards

2.1 Rehabilitation Works for 6 Water Boards

Out of the 12 Water Boards established in in Nickerie, presently 5 systems have been rehabilitated by LVV since 2009, The Groot Henar polder is contracted already in 2015 but construction works have not been started. Release of funds by MoF need to be assured to complete construction works;

There are 6 Water Boards not yet completed and are proposed for implementation under the IDB investment loan, as indicated in the table below

	Water Board	Ha		Water Board	Year Compl	Ha
1	Paradise-Longmay	1.244	7	Sawmillkreek	2009	481
2	Nanni-Bruto	1.988	8	Hamptoncourt	2009	894
3	Clara polder	1.451	9	van Drimmelen	2011	850
4	Wasima	582	10	Euro-Noord	2013	1.035
5	Euro-Zuid	1.440	11	Corantijn	2014	747
6	Uitbreiding-Groot Henar	2.243	12	Henar	not compl	2.242
	Total TO BE Rahabilitated	**8.948**		**Total Rahabilitated**		**6.249**
12	**Total Rahabilitation**	**15.197**				

Table 7: Status of Rehabilitation of WB polders

Detailed studies have been prepared for the rehabilitation of the I&D system of the six remaining WB by the National I&D Consultant in close consultation with the Water Boards according to priorities and urgency of repairs. The lists of reports (in Dutch) are included in the References 2.1 – 2.6 and are available for consultations.

A review was made of the type of works to be implemented and unit costs executed by local contractors, as summarized in the table below:

Rehabilitation of tertiary [13] roads is part of the I&D infrastructure that resorts under the responsibility of the O&M in line with provisions under the *Keur* (Byelaws). Rehabilitation of the tertiary roads is given high priority by farmers, as access to the land for supervision and farm operations is an important cost factor. Delays in critical farm operations due to poor access will have considerable impact on productivity and production costs.

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The internal roads within the polder link up to the secondary roads maintained by the Public Works Department. They are mostly clay dams raised next to the canals and are often subject to flooding and become impassable for machinery.. Rehabilitation requires reshaping of the dam profile and sanding (in some cases paving) of the surface. The roads require siphons under the road for canal crossings. Road rehabilitation is often a major cost factor in the rehabilitation works.

Each of the WB Rehabilitation reports include a description of the characteristics of the polder and Water Boards with detailed cost estimates and specification of quantities and structures to be include. The cost estimates are at sufficient detail in quantities to allow preparation of tender documents for procurement of contractor services by staff of the LVV Project management division. (LVV capacity to be reinforced by national consultancy firm).

A summary of the rehabilitation costs is given in Table 8 with unit cost per ha.

Costs Specifications Rehabilitation 6 WB I&D Infrastructure

	REHABILITATION WORK	Quantity	Unit	Unit Cost	Total	%
1	Rehabilitation of Irrigation and Drainage Canals	327.000	meter	$6,80	$2.225.000	22%
2	Rehabiltation of clay dams and acces roads	84.280	meter	$10,70	$900.000	9%
3	Rehabilitation of Sand Roads	77.800	meter	$51,70	$4.025.040	39%
4	Pavement of Roads by concrete bricks	3.400	meter	$136,00	$1.972.000	19%
5	Rehabilitation of Regulating Structures	xxx	number		$247.090	2%
6	Extra Infrastructural Improvements (Bridges etc)	xxx	number		$490.395	5%
7	Contractor Mobilization Costs	6	unit	$6.500	$390.000	4%
	Total Rehabilitation Costs				**$10.249.525**	**100%**

Table 8 : Types and cost of rehabilitation works for 6 Water Boards

Supervision of the contractor work is proposed to be carried out by the Water Masters assigned by the project and WB committees and verified by the District I&D Committee IDIDCWG) .

A summary of the rehabilitation costs are given inTable 9 with unit cost per ha.

Rehabilitations Costs WB Systems

	Water Board	Rehabilit. Costs USD	Ha	USD/ha
1	Paradise-Longmay	$1.502.000	1.244	$1.207
2	Nanni-Bruto	$2.289.520	1.988	$1.152
3	Clara polder	$801.500	1.451	$552
4	Wasima	$575.170	582	$988
5	Euro-Zuid	$2.070.200	1.440	$1.438
6	Uitbreiding-Groot Henar	$3.046.135	2.243	$1.358
	Total Rehabilitation Costs by Contractor	**$10.284.525**	**8.948**	**$1.149**
	Consultancy costs (6%)	$600.000		
	Total Rehabilitation Costs	**$10.884.525**	**8.948**	**$1.216**

Table 9: Rehabilitation cost of 6 WB systems

Implementation of the rehabilitation works will be in a phased manner, such that in the first year of the project rehabilitation works for the first three Water Boards will be tendered for execution to start in the second year and to be completed in the third year. The remaining 3 water Boards will be tendered in the second year with execution to start in the third year to be completed in the fourth project year;

The priority in implementation of rehabilitation works will be determined by the District Water Board Commission who will review after consultation with all six water boards and the consultancy firm assigned to assist in the planning and tendering of the works, define the priority in execution taking into account the urgency of repairs, the motivation of farmers of the WB to cooperate and impact of the rehabilitation on productivity.

The rehabilitation works of first three WB will be completed after 2 project years, the remaining three to be completed after third year.

2.2 Tendering and Supervision of WB Rehabilitation works

In order to improve the transparency and quality control in the implementation of the Rehabilitation work, which has been a common complaint in previous rehabilitations by the WB, there is a need to involve the WB more directly in the planning and quality control of the works executed by the contractors

The feasibility studies prepared for the 6 polders are in sufficient detail to allow the preparation of the tender documents for the contractor directly by the LVV Project management division with the assistance of a competent national consultancy firm to be recruited under the project, in line with standard Government procedures and IDB policies and guidelines.

The supervision and control of the execution of works can be carried out by the Water Masters and WB committee and endorsed by the DIDCWG. In this way the Water Board will have direct control of the quality of executed works. Moreover the supervision will give them a much greater role and responsibility in the implementation and a feeling of ownership of the I&D infrastructure.

The recruitment of a national consultancy will be made who will be responsible for:

- the verification of the works to be carried out as specified in the Rehabilitation studies of the 6 Water Boards,
- the preparation of the tender documents and
- the evaluation of tenders
- Estimated costs for the services of the Consultancy firm 6% of the total construction costs : 6% x 10 million USD = 600,000 USD.

3 Support for WB's to take over O&M of the Secondary System

The **12 Water Boards** in Nickerie district have been established through a series of State decrees in 2006-7. (**reference list** # 12.13 – 12.18) In subsequent years elections have been held and Water Boards Committees (WBC) have been installed. However none of them have become effectively operational as the legal procedures for the endorsement of the Bye-laws (Keur) have not been completed (except for one: the Sawmillkreek Polder), awaiting the approval of the Ministry of RO. Farmers have shown so far little interest to cooperate and contribute to O&M costs through the WB. Attempts to promote initiatives in taking up O&M have been mostly in vain.
Paying water fees for O&M to WBC have not been recognized even though individual farmers have shown to spend individually substantial amounts in purchasing and operating pumping equipment to supplement irrigation if water supply is inadequate (private pumping is estimated at 450 SRD/ha)[14].

The approval of the Byelaws by the Ministry of RO is apparently shortly forthcoming, and will become in force when formerly announced in the Government paper and local media.

[14] Reference is made to table on rice production costs

Completion of this process will allow the formal legalization to ratify and implement the provisions made in the by-laws including the mandatory annual O&M plans.

- For a more elaborate introduction to the rules and regulation concerning the rights, duties, obligations and prohibitions of the WB membership as well as the enforcement of obligations, reference is made to the concerned IDB Policy Document of the Byelaws, prepared under the ISB policy loan (“*Water Board Legislation”, Febr 2016), (**reference list** # 1.8)*

It has become clear that without support, motivation and well-focused efforts and conditions, WB members will not be willing to take joint action for operation and maintenance and to contribute in the costs;

In order to get the WB on the way to take full responsibility of O&M there is a need to provide:

1) Adequate facilities and capacities to function and carry out O&M
2) Incentives to motivate WB members to contribute O&M
3) Clear Procedures and conditions as well as a clear time line to initiate and achieve the transfer of O&M process
4) Full transparencies in the use of funds provided and contributed for O&M and rehabilitation works

There should be a clear understanding from the beginning that all Operation and Maintenance works within the Water Board area, will be the sole responsibility of the Water Board and that none government support will be forthcoming for any further maintenance of the canal systems[15];

In the following proposals are made for provision of essential facilities, incentives and procedures to establish an effective capacity of WB to implement O&M:

3.1 Facilities to be provided to WB

1) **Assignment of 3 Water Masters** with adequate qualifications to provide technical assistance to **12 Water Boards** with the following tasks:
    - To assist the WB Committees in the effective execution of their tasks and responsibilities in the O&M of the WB I&D system;
    - To assist the WBC in the preparation of the Ledger (“Legger”) and auxiliary maps[16]: a mandatory document that provides a listing of all supply and drainage canals, regulating structures and roads and defines responsibility in operation and maintenance of each canal, structure dam and road;
    - To assist in the preparation of the O&M plans for WB system endorsed by the WB members and to be submitted for approval to the DIDCWG and DC ,
    - To supervise and ensure the day-to-day operation of the system (main and secondary water supply and disposal)
    - To supervise adherence of WB members to their O&M maintenance obligations and impose fines and enforcement of the rules set out in the Keur and Ledger;
    - To supervise and monitor the implementation and quality control of the rehabilitation works executed by contractors and WB members,

[15] It is understood that operation and maintenance of intakes to and outlets from the main system into the secondary canals of the WB area will still be the responsibility of the Government agency (OWMCP) responsible for the operation of the main system.

[16] The OWMCP has under the EU-project prepared for all 12 polders the maps with details on the boundaries and primary and secondary I&D infrastructure, including roads

One Water Master will serve 4 WB by clustering the WB into in three resorts in Nickerie district: the Westelijke and Oostelijke polders and Henar polders.

The Water Master will be assisted by 2 field assistants (*veldarbeiders*) who will carry out the physical services involved in operating the various gates and inlets and in inspecting the maintenance carried out by contractors and members.

The Water Master and his staff will be the first 4 years be employed by the Project Government and supervised by the DIDCWG and District Water Board Commission (OWMCP, LVV, OW)

- The estimated costs of the Water Master and his staff:
    - Water Master; monthly salary of 1200 SRD/month
    - 2 Assistants; monthly salary of 600 SRD/month
    - Monthly Expenditures (travel, communication etc) 1000 SRD per cluster
    - Total Yearly Staff costs + operational costs for 3 clusters = 122,400 SRD (16,320 USD), For 4 years: $ 65.280 USD
    - 3 Motorbikes per cluster: @ 9,000 SRD ($1,200 USD) and various materials SRD 2,250 ($300 USD) Total for 3 clusters: 3 x $ 1,200 + $300 = $4.500 USD
    - Total costs over 4 years: $ 65,280 + $ 4,500 = $ 69,780 USD

The Water Master and his staff will be assigned as government staff (LVV) over a four years period by the project. Afterward their costs should be included under the O&M budget of the Water Boards.

- Estimated costs for WB: SRD 122,400 /15,000 ha = 8 SRD/ha/year)

2) Office facilities for 3 clusters to accommodate**:**

- Meetings of WBC, archives of 4 WB, administration and office Water Master
- Estimated costs:
    - Construction and equipment of simple building with office, stores and meeting room at 200,000 SRD per cluster; total 600,000 SRD ($ 80,000 USD)

3) Training provisions

- Training of Water Masters in their new tasks (6 courses and materials)
- Training and consultation workshops for WB committees (6 seasons x 3 days)
- Motivation workshop for WB (6 general consultation and motivation sessions)
- Special consultation and training of women will be included in the training program
- Services of National consultant to develop training material and in-service training;
    - 2 month : 2 x 25x $200 = $ 10,000

Total Estimated training costs: 112,500 SRD ($ 18,000 USD)

3.2 Incentives to WB farmers to participate and contribute in O&M:

1) Subsidizing initial O&M costs

In order to motivate WB farmers, O&M should as from the first year be planned and implemented by the WB itself. Realizing that farmers will not be forthcoming in paying O&M costs, without being assured that indeed available funds on O&M are under their control, the project will subsidize for the first 3 years part of the O&M costs for a total of 250 SRD/ha ($ 33 USD/ha), according to the following schedule:

- **All 12 Water Boards** (15,000 ha) will initiate in the first year of the project the planning and implementation of O&M works in their system, both WB already rehabilitated as well the 6 new to be rehabilitated.
- **First year payment** of 100 SRD/ha without obligation yet to contribute financially, main objective to motivate farmers, to entrust the execution of O&M to WB and obtain experience and confidence in own capacity in O&M implementation
    - The WBC with assistance of the Water Master will prepare in the first year the annual O&M plan in line with the obligations of the Keur with detailed description of works to be implemented and with specification of the proposed implementation by WB members and contractors to execute the O&M works.
    - The O&M works will include in particular the short term rehabilitation works of canal deepening and reshaping of secondary canals, clay dam restoration, while sanding of roads, pavement and canal structures will be mostly included in rehabilitation works for the WB where full rehabilitation will be carried out;
    - The WBC will open a Bank account to be signed jointly with the District Administration (DA) as foreseen in the Keur, where the first year funds will be deposited for O&M works;
    - The O&M plan will be submitted to the DIDCWG and DA office for approval and an disbursement plan agreed upon
    - WBC and Water Master will jointly monitor implementation of works.
- **The Second year payment** of an additional 100 SRD/ha will be provided by the project to be complemented by a mandatory contribution (20-50 SRD/ha) by members as determined in the 2nd year annual O&M plan,
    - No project funds should be forthcoming if no contribution will be received from the WB members
- **Third year** payment will include 50 SRD/ha in subsidy, complemented with a substantial contribution (75-100 SRD) of WB members

The availability of funds as from the first year will motivate and convince in an important way farmers of the use and responsibilities of the WB to contribute to the O&M costs;

- **Estimated costs** for 15,000 ha x 250 SRD/ha = 3,750,000 SRD ($ 510,000 USD)

The normal annual contribution to O&M is estimated at 100 SRD/ha (see Table on Rice production costs in **reference list** # 4.4)…[17]). Due to deferred and neglected maintenance the first years more extensive repairs are required, estimated at a cost of 300 SRD/ha, which could be considered part of the rehabilitation costs.

Rehabilitation works (long term rehabilitation) for the six WB not yet rehabilitated will follow separate procedures for competitive bidding of contractor based on the feasibility studies prepared and adjusted for the works to be implemented by the WB's.

2) Contribution to Expenses of Water Board Committee members

The Water Board committee members devote considerable time and resources (telephone, travel) to carry out their functions. To motivate Committee members a contribution to their expenses is justified on a monthly or time basis to be agreed in the WB meeting **as part of the O&M expenditures plan;**

Contributions may include a monthly contribution of appr. 400 SRD/month for chairman and 200 SRD/month for secretary and treasurer.

[17] The EU Document on "***Kostenberekening Waterbeheer Nickerie"*** estimate average costs for O&M in the WB polders at 106 SRD/ha (**reference list** # 5.5)

- Costs of a contribution to WBC expenses for an average WB size of 1250 ha would be 8 SRD/ha

3.3 Procedures and time line ("Stappen plan") for implementation

The process of transferring full responsibilities in O&M to the WB will need to be well planned and follow clear procedures and conditions; In the following an outline of the different steps in the transfer process could be implanted:

i Clear procedures need to be designed with de detailed timeframe to assess a logical set-up of the 3 year transfer plan with the assistance of a National consultant in I&D management (see section 4.1) and the District I&D Committee;

ii Assignment of Water Master, who will receive adequate training in procedures in preparation of the annual O&M plans and disbursement procedures;

iii Provision of office facilities in first year (possibly improvised facilities the first year)

iv Motivation meetings in all 12 Water Boards by District WB Commission on procedures and stappen plan;

v Preparation of Annual O&M plan for 12 Water Boards by WB with assistance of Water Master with identification of priorities in short term rehabilitations works which can be subsequently carried out by the WB with the resources provided by project;

vi Presentation and approval of O&M plan by WB member meeting and subsequent approval of DIDCWG and submission to District Administrator as prescribed in By-Laws;

vii Opening of Bank account with DA as double signatory and payment of first installment of 100 SRD/ha into WB Bank account supervised by DA

viii In subsequent O&M annual work plans contributions of farmers will be asked as from second year to complement budget and carry out O&M works

ix Implementation of O&M rehabilitation works by WB with support of Water Master and procurement through DA and supervision by DIDCWG

x Full participation of WB and Water Master in the preparation of the Rehabilitation plans for 6 WB taking into account the O&M works already executed by the WB representing appr. 20% of total Rehabilitation costs

xi Implementation of Rehabilitation works with adequate quality control by WB and Water Master.

4 Capacity building of Government Agencies in charge of Water Management and Resource Administration

In order to achieve a more efficient system in the operation and maintenance of the system there is a need to strengthen the capacity of the Government agencies in charge of water distribution and resource administration. This include the following components:

1. Strengthening and Coordination of I&D management
2. Capacity building and Support to Water Boards
3. Improved Water Distribution and I&D management;
4. Introduction of Water efficient measures at field level

4.1 Coordination and Strengthening I&D management

At District Level (Nickerie):

The establishment in 2016 of the District I&D Coordination Working Group and the District Water Commissions at District Level which was initiated under auspices of the IDB policy loan need to further strengthened in order to ensure a better planning and monitoring of I&D management and to implement the activities of this project.

The IDB Policy document entitled "*Manual of Operation of Inter Departmental Commissions at District Level*" , (**reference list** # further elaborates on the functions and composition of the District Water Commissions, which include the District Water Board Commission, the District Water Management Commission and District Water Platform. The tasks and composition of the commissions are included in the document.

Activities to be initiated will include:

- Review of the tasks of the Working group and District Water Commissions (DCW) in all aspects related to the planning and supervision of I&D management of the system.
- Preparation of an annual and seasonal program with well-defined objectives and targets of I&D activities with specification by each Department of funds available for I&D;
- Define a monitoring and evaluation system to pursue objectives and to evaluate the results of the seasonal plans
- Review of staffing and tasks of different staff categories of the district agencies

Training, consultation and meeting requirements

- In order to support DIDCWG in convening regular meetings and organize training and capacity building programs for the respective DCW a budget is provided for training activities and assistance of a qualified national consultant:
  - 3 years x 2 seasons x 2 days x 500 x 6 persons = 36,000 SRD ($ 4,800 USD)
  - Assistance of a National Consultant in the review of the tasks of the respective district agencies and commissions and in the preparation and monitoring of the annual and seasonal program of the District ;
    - (3 years x 15 days : 1500 SRD/day = 67,500 SRD ($ 9000 USD)

At National Level:

- An Inter-Ministerial Irrigation and Drainage Coordination Working Group has been established in 2014 in a Memorandum of Understanding under auspices of the first IDB policy loan (**reference list** # 1.5). The Working Group has been instrumental to coordinate and provide guidance in the implementation of the second policy load and the preparations for the Investment loan. There is a need however to further strengthen their tasks in the preparation of a national plan to address, plan and monitor the issues of water management and national level in line with the provisions of the Vision on Irrigation and Drainage Development.
- The *Vision for Suriname Sustainable Development of the Irrigation and Drainage Development (**reference list** # 1.1)*, prepared within the framework od the IDB policy loan to support the modernization of Agricultural Public Services Program, defines that increased agricultural production and diversification is achieved through modernization of the irrigation and drainage systems and the introduction of sustainable and integrated water management ensuring the rights of all water users for access to adequate water of good quality and protection from excessive water and flooding, while achieving a greater engagement of water users to participate and contribute to the costs of operation and maintenance of the irrigation and drainage systems;
- In line with the Vision the project may further contribute to this through a review of the scope for development and improvement of the existing water management for modern agriculture and integrated and sustainable water management for urban development and the environment and further promote an Action Plan for I&D and integrated water resources management in the districts (see relevant IDD Policy document on the "***Proposal for establishment of new Water Boards" (reference list # 1.7)***:.

- Support in the development of a National and District Action plans in I&D management:
    - National Workshop to consult with the National agencies on the formulation of a National Action Plan for I&D management and integrated water resources management;
        - 2 times 2 days x 100 SRD x 60 persons = SRD 36,000 (= $3,600 USD)
    - Consultations with district staff, farmers, civil entities in 3 districts to assess the potential, issues and constraints in integrated water resources management and prepare district action plan:
        - 3 districts x 2 times x 2 days x SRD 60 x 30 persons = 27,000 SRD ($ 3,600 USD)
    - Assistance of a National Consultant in the review of the water management issues and constraints in three districts and in the preparation of a District Action plan for i&D management for agriculture and public services;
        - (4 years x 20 days : 1500 SRD/day = 120,000 SRD ($ 16,000 USD)

4.2 Capacity building and Support Services to Water Boards

In order to provide adequate support and services to the Water Boards in the transfer of I&D management, there is a need to strengthen the District Water Board commission and redefining its tasks and work plan in providing adequate support to the transfer of management operations to the WB and the implementation of the rehabilitation works.

The following inputs are required (see also support to I&D transfer in Chapter 3) :

- Assignment of Water Master and assistants and providing training and support in the implementation of its tasks to assist the water Boards
- Provide office facilities to the Water Master and WB Committees
- Design of training programs for Water Master and assistants
- Training of Water Masters in new tasks (6 courses and materials)
- Training and consultation workshops for WB committees (6 seasons x 3 days)
- Motivation workshop for WB (6 general consultation and motivation sessions)
- Services of National consultant to develop training material and in-service training;

Total costs for training in I&D transfer as specified in chapter 3 : 112,500 SRD (= $18,000 USD)

To carry out its tasks in the consultations, motivation, training and capacity building of the WB, the District Water Board Commission in which participate all concerned District Departments under chairmanship of LVV, the project will provide special resources to strengthen the capacity of the District Water Board Commission as specified below:

The Expenses for the District Water Board Commission for regular visits and consultations with the Water Boards, attendance of WB meetings and training workshops for Water masters and field staff and WBC members will be covered by the project, for which the following cost estimates:

- 4 years x 2 seasons x 5 days x 8 persons x 210 SRD = 67,500 SRD (= $ 9,000 USD)

5 Improved Water Distribution and I&D Management;

Presently the poor conditions of the I&D infrastructure and the regulating structures in the main system results in much water lost into the drains and outlet sluices, as many of the gates cannot be closed properly anymore and irrigation is in continuous flow at full capacity.

Repair of the regulating structures will allow a better control and regulation of the water flow through the schemes and the introduction of a rotational water delivery schedule to reduce water losses of expensive pumped water.

In the past a Crop Water calendar was applied in which the District Water management Commission in consultation with the farmer representatives and concerned district agencies determined the start of the planting period and set the sequence of water allocation. The practice has been discontinued since 2012, resulting in arbitrary water distribution, excessive water losses and late planting of certain areas, effecting yields and increased pumping costs.

Within the framework of the EU supported Capacity building project (2013-2017) a good start and proposals have been made in :

- Studies and introduction of rotational water delivery and irrigation scheduling according of the water calendar (**reference list** # 5.13, 6.2);
- The installation and calibration of 5 hydrometric stations (**reference list** # 6.1, 6.4, 5.10);
- Options and conditions for water flow modeling in irrigation and drainage (**reference list** # 6.3, 6.9, 6.10);

Relevant technical and capacity building was provided to the OWMCP over the project period to strengthen its mandate in water management of the scheme (4.18 -4.25).

Technical assistance was provided also under the EU project by the University of Wageningen (MSc Students program) in cooperation with the Hydrology department of de Anton de Kom University of Suriname. Reference is made to a range of relevant reports on the subject and are Listed in the Reference List of Annex 2.

With the objective to improve Water efficiency and better Water distribution and outflow in I&D management the following activities and inputs are foreseen:

5.1 Introduction of Rotational water distribution and Water Calendar

In line with recommendations of the EU-project (see EU report: *"OWMCP- Waterdistributie kalender* (***reference list** # 5.13"* and "*Options to introduce a Sowing schedule and Water Calendar in NIckerie* (**reference list** # 6.2) the project will provide the inputs for the introduction of a rotational water distribution and water calendar in which the allocation of water is rotating among blocks, receiving and closing water in alternative periods:

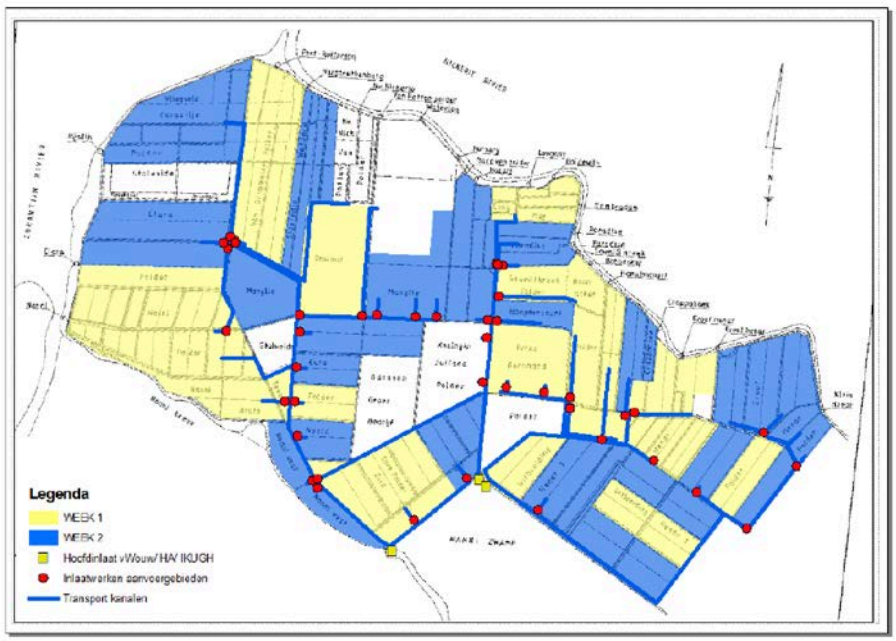

Figure 5 : Rotational Water Distribution as proposed by the EU-project [18]

[18] OWMCP- Waterdistributiekalender : reference list # 5.13)

- International consultant in Irrigation Scheduling and Irrigation management for 1 month:
  - Estimated Expenses for 1 month : SRD 200,000 (USD 22,500)
- In-service training and capacity building of District Water Commission and WBC in the introduction of Irrigation Scheduling and Rotational distribution
- Workshops for introduction, evaluation and monitoring of rotational distribution and scheduling in which participate District Water Calendar Commission and WBC
  - 4 years x 2 seasons x 5 days x 8 persons x 200 SRD = 64,000 SRD (= $ 8,533 USD)
  -

5.2 Installation and calibration of hydrometric network

The OWMCP with technical assistance of the EU-project has started with the installation of 8 hydrometric stations at key locations in the scheme to provide more precise information on the quantities of water deliveries to the main intake points of the scheme. A first start has been made in the calibration of the regulating structures and training of the OWMCP staff entrusted the measurement and processing of the data (**reference list** # 5.5.9, 5.10, 6.3, 6.4, 6.7). The present 8 stations are however inadequate still to allow a meaningful monitoring of the incoming water supply while information of outflow of water has not yet been included in the hydrometric network.

Figure 6 : Hydrometric station installed by OWMCP at 3 Koker Inlet

The project will further expand on the network and expand the network to a full set of stations to measure inflow and outflow of waters as follows:.

- Extension of network of hydrometric stations within the scheme and calibration of water discharge of the regulating structures which will allow monitoring and regulating water supply and disposal of excess water;
  - Costs of 10 hydrometric stations (USD 20,000) and related equipment for data processing
  - Procurement of 2 boats and outboards motor 2 x 20,000 USD = $ 40,000

- National Consultant to assist in the installation, calibration and training of national staff of OWMCP in the data collection and processing of the hydrometric data
    - Costs: 4 years x 2 times x 5 days x 2,000 SRD = 80,0000 SRD (= $ 10,667)
- Workshops and Training of staff in the calibration of the hydrometric stations and data processing
    - Training Costs 4 years x 3 times x 5 days x 5 persons x 200 SRD = SRD 40,000 (=$ 5,333 USD)
    - In-service training and study tour on the use and calibration of the hydro-metric equipment: Costs : 3 x 25,000 SRD = 75,000 SRD = $10,000 USD

5.3 Development of a model to interrelate and monitor flow rates through the intakes, outlets and canals

With the expanded network of hydrometric stations and the upgrade and repairs of the regulating structures in the main system the modeling of the water flows within the scheme, which will allow a more precise regulation, allocation and monitoring of water supply and largely improve the water efficiency.

The EU project in cooperation with the University of Wageningen has made a first assessment of the possibilities for flow modeling of the I&D system (**reference list # 6.9, 6.10**)

The Following inputs are foreseen to introduce the hydraulic modeling of the waterflow:

- Services International consultant in establishing procedures for installation, calibration and establishing flow rates, and modeling
    - Cost estimates, 4 visits of 10 days @ USD 800 = , USD 32,000)
- Procurement of international software on flow modeling,
    - Cost estimate USD 10,000
- Training and capacity building District Water Management Commission and staff OFMCP
    - Costs 4 years x 2 times x 5 days x 4 persons x 200 SRD = SRD 96,000 (=$ $12,800 USD)

Time schedule of implementation of the hydrometric stations and development of the rotational schedules and flow modeling is subject to the progress in the repairs of the regulating structures in the main system;

Water quality measurements need to be an additional element of the monitoring of water management within the Nickerie I&D system and will be covered under the Environmental aspects.

5.4 Promotion of Land leveling for more efficient Water use at field level

The irregularities in the level of the rice field have a distinct impact on rice productivity, as ponding of the fields will cause irregularities in water depth, resulting in part of the fields to be subject to drought and excessive weed growth other part being inundated by too much water. Yields will be reduced by 20 to 40% and water use will increase by a similar percentage as farmers will irrigate till the highest part are well inundated. It is estimated (Adron) that 40% of the rice fields require additional leveling.

In the EU Masterplan (**reference list** # 9.1) a special recommendation was made to promote land leveling. Also a recent mission (2017) of Mardi Holdings of the Suriname-Malaysia Reverse Linkage Project (**reference list** # 12.1) under auspices of the Islamic Development Bank recommended a land leveling program using laser controlled land leveling and initiated a pilot program to assess the feasibility of the land leveling techniques

Farmers are well aware of the importance of land leveling and are already implementing themselves land leveling. Cost and availability of machinery are however constraints for farmers. In view of the expected benefits the projects will provide demonstrations and a financial incentives to promote land leveling.

- The project will encourage in the 12 WB with a total area of 15,000 ha the implementation of land leveling by the introduction of appropriate techniques and technologies for land leveling;
- The costs of land leveling will depend on field level conditions. For average conditions costs are estimated at 600 to 00 900 SRD/ha ($ 80 - $120 USD/ha) carried out by bucket scraper tractor mounted and in some cases excavator and truck for longer hauls See **reference list** # 4.3 on estimated cost calculations;

In order to encourage farmers to embark on land leveling which will have an important impact on water use efficiencies the project may subsidize through the WB the provision of part of the land leveling costs (200 SRD/ha).

The following assumptions are made for the land leveling promotion program:

- It is assumed that an incentive of 200 SRD/ha representing one third of the investment is a ad adequate incentive to farmers;
- It is estimated that 20% of the farmers would make use of the subsidy;
- Estimated costs for 20% of the area x 15,000 ha x 200 SRD/ha = 600,000 SRD ($ 80,000 USD)
- The program should be introduced and planned through the WB annual O&M program. Funds could be channeled and reimbursed through the WB account

Adequate training, instructions and demonstrations need to be provided

- Input of national consultant to develop pilot program (2 month)
- Development of training materials and demonstrations
- Motivation meetings for 12 WB's
- Estimated training and demonstration costs SRD 112,000 ($ 15,000 USD)

The promotion and introduction of appropriate techniques for water savings and productivity increase through land leveling requires further support in capacity building and training, which will involve the following inputs on capacity building and training of staff, Water Master and WBC:

- National Consultant to assist in the preparation of a demonstration program with relevant instructions and training materials
  - Costs: 3 years x 2 times x 15 days x 1,500 SRD = 135,0000 SRD (= $ 18,000USD)
  - Workshop for WB members to introduce the benefits and improved techniques for land leveling ; 15,000 SRD= 2,000 USD
- Provisions for demonstrations (WB members), training (tractor drivers) and instructions booklets need to be prepared
  - Costs 3 years x 2 times x 12 days x 12 persons x 100 SRD = SRD 90,000 (=$ $12,000 USD)
  - Costs of training materials and brochures : 22,500 SRD (= $ 3,000 USD)

6 Water Resource Monitoring for Irrigation and Flood Control

Establishment of a water resources monitoring system

- to assess the available water resources for management of water for irrigation and potential to expand the irrigated areas
- to monitor and access the requirements for drainage and outflow of water and flood control

The activities will include:

- Implementation of a hydrometric system within the catchment areas of the Nanni swamp, the Nickerie river and the Corantijn canal
- Modeling of the Hydrology of the catchment water supply and flood control
- Assessment and monitoring of water quality
- Training of staff of OWMCP in the calibration of the hydrometric stations and modeling of the flow
- Procurement of equipment (hydrometers, boats etc)

Inputs are elaborated in the concerned report prepared by the National consultant Hydrology:

o Estimated costs: 750,000 USD

7 Design and implementation of a Sustainable and Integrated Water Resources Management Program

Environmental control and integrated water resources management, including water quality measurements and monitoring, waste water disposal, drinking water and eco-system protection

- Support and strengthening of Water platform activities as initiated by EU supported Capacity building project
- Gender awareness program

Reference is made to the establishment in October 2014 of a Water Forum to promote integrated water resources management and to consult and inform all concerned public and civil wateragencies in water development. OWMCP maintains the secretariat of the Water Platform

Inputs are elaborated in the concerned report prepared by International consultant on Environmental issues:

o Estimated cost : USD 500,000

8 Project Costs

		SRD 7,5	$1
	Component	**SRD**	**USD**
1	**Main System Rehabilitation**		
1.1	National consultancy for design and supervision of repair works	SRD 5.063.258	$675.101
1.2	Repair existing structures	SRD 43.881.533	$5.850.871
1.3	National Consultancy for detailed designs of New hydraulic structures	SRD 7.283.280	$971.104
1.4	Construction of new structures	SRD 41.271.930	$5.502.924
	Total Main System Rehabilitation	**SRD 97.500.000**	**$13.000.000**
2	**Rehabilitation WB Secondary System**		
2.1	National Consultancy Agency to assist Tendering and Supervision Rehabilitation works	SRD 4.500.000	$600.000
2.2	Implementation Rehabilitation	SRD 77.133.938	$10.284.525
2	**Total WB Rehabilitation Infrastructure**	**SRD 81.633.938**	**$10.884.525**
3	**Support for WB Transfer O&M**		
3.1	Staff Costs (water master+assistants) 4 years	SRD 498.600	$66.480
3.2	Equipment (motorbikes) and materials	SRD 33.750	$4.500
3.3	Office building + facilities	SRD 600.000	$80.000
3.4	Training provisions for WM&WBC by communication specialist	SRD 322.500	$43.000
3.5	Total O&M subsidies (250 SRD/ha)	SRD 3.825.000	$510.000
	Total Support WB Transfer O&M		**$703.980**
4	**Capacity building I&D Management**		
4.1.1	National consultant for ID management in Nickerie Disitrct	SRD 67.500	$9.000
4.1.2	Strengthening District I&D Coordination I&D commitee in Nickerie District	SRD 36.000	$4.800
4.1.3	Strengthening District Water Board Commission in introduction improved O&M at WB level	**SRD 67.500**	**$9.000**
4.1	**I&D Management Nickerie District**	**SRD 103.500**	**$13.800**
4.2.1	National Consultant Action Plans at national level and 3 districts	SRD 120.000	$16.000
4.2.2	National Workshop for formulation of National I&D Action plans in 3 Districts	SRD 24.000	$3.200
4.2.3	Formulation I&D Action plans in 3 Districtsd 3 districts	SRD 27.000	$3.600
4.2	**I&D Management National Level**	**SRD 171.000**	**$22.800**
	Total Capacity Building ID Management	**342000**	**$45.600**
5	**Improved Water Management;**		
5.1.1	International consultant in Irrigation Scheduling	SRD 168.750	$22.500
5.1.2	Training Introduction Water Calendar	SRD 64.000	$8.533
5.1	**Irrigation Water Distribution**	**SRD 232.748**	**$31.033**
5.2.1	Installation of additional 10 hydrometric stations + related equipment	SRD 150.000	$20.000
5.2.2	Provision of Boats and Equipemnt	SRD 300.000	$40.000

		SRD 7,5	$1
	Component	**SRD**	**USD**
5.2.3	National Consultant in Hydrometrie	SRD 80.000	$10.667
5.2.4.	Workshops Hydrometrie staff OWMCP	SRD 40.000	$5.333
5.2.5	Training of staff in calobration and data processing	SRD 75.000	$10.000
5.2	**Hydrometric network**	**SRD 645.000**	**$86.000**
5.3.1	International consultant in Flow modelling	SRD 240.000	$32.000
5.3.2	Software in flow modelling	SRD 75.000	$10.000
5.3.3	Training in Flow Modelling	SRD 96.000	$12.800
5.3	**Flow Modelling**	**SRD 411.000**	**$54.800**
5.4.1	National Expert Landleveling	SRD 135.000	$18.000
5.4.2	Training and demonstration Landleveling	SRD 15.086	$2.012
5.4.3	Land leveling subsidy	SRD 600.000	$80.000
5.4.4	Training/Demonstrations in Landleveling	SRD 112.500	$15.000
5.4	**Landleveling**	**SRD 862.586**	**$115.012**
	Total Improved Water Management	**SRD 38.246**	**$286.845**
6	**Hydrology Water resource monitoring for Irrigation and Flood control**		
6.1	Hydrology Consultancies (Naitonal Consultant & HydroBid)	SRD 1.125.000	$150.000
6.2	Procurement of Water Level recorders	SRD 105.000	$14.000
6.3	Procurement of New Telemetric Water Level recorders/ discharge measurements	SRD 900.000	$120.000
6.4	Procurement of Weather Stations	SRD 75.000	$10.000
6.5	Procurement of New Telemetric Weather Stations (Rainfall and Temperature)	SRD 1.537.500	$205.000
6.6	Procurement of Telemetry software, computers, laptops, Training and maintenance	SRD 525.000	$70.000
	Total Hydrology Studies	**SRD 4.267.500**	**$569.000**
7	**Environmental control and integrated water resources management**		
7.1	Environmental Consultant construction phase	SRD 300.000	$40.000
7.2	Pesticide survey and Water Quality Study	SRD 1.500.000	$200.000
7.3	Design and Implementation Water quality monitoring system	SRD 750.000	$100.000
7.4	Ecological assessment of the Nanni Swamp	SRD 300.000	$40.000
7.5	Design and consduct of Gender awareness program	SRD 300.000	$40.000
7.6	Design and implementation of Integrated Water Resources Mangament Plan	SRD 600.000	$80.000
	Total Environmental Control	**SRD 3.750.000**	**$500.000**
	Total	**SRD 194.924.621**	**$25.989.950**

Table 10: Component 1: I&D Project Costs

9 Issues

9.1 Approval of BYELAWS (Keur)

Byelaws have been submitted in October 2016 through DC Office to Minister of RO as prescribed in the State decrees of the WB. Approval expected soon after revision and correction by legal office RO

Announcement required in Government Gazette and Local media to become effective for which a budget is required

9.2 Rehabilitation of the Groot Henar Polder

The Rehabilitation of the Groot Henar polder with an area of 2,240 ha has been commissioned already in 2015, but work has stopped due to lack of funds.

9.3 Capacity of LVV for Project execution;

The Project Executing Agency is LVV. There is a need to review and strengthen the capacity of the Project Management section to proceed in a timely manner in procurement of consultant services, equipment, and competitive bidding of the contractors;

The feasibility studies prepared for the 6 polders are in sufficient detail prepared with general accepted unit prices and will allow the preparation of the tender documents for the contractor directly by the Project management division with the assistance of a competent national consultancy firm to be recruited under the project. The supervision and control of the execution of works can be carried out by the Water Masters and WB committee, which will have in this way direct control of the quality of executed works

9.4 Competence in Project Execution

Several of the project components involves the mandate of other ministries and agencies and include:

- Implementation of main system rehabilitation and repairs resort under the OW department and concerns also OWMCP. Procedures need to be worked out on procurement of equipment and services and contractors by LVV with approval and supervision at execution by OW. The capacity of both departments to carry out the procurement and preparation of contracts need to be verified;
- Support to WB is a joint –departmental activity of RO, OWMCP and LVV
- O&M of the Main system is formerly within the mandate of OWMCP in line with the State decree of 2007 for OWMCP
- Management of the hydro-metric system is the task of OWMCP

9.5 Tasks and Functions of the OWMCP

The State decree of 2007 for the establishment of the OWMCP stipulates as specific tasks of the Overlying Water Board of the Multipurpose Corantijn Project:

1. To manage the adequate supply of water for irrigation and the disposal of excess water out of the OW area
2. To provide services and ensure the common interests of all water Boards as well all other areas in the assigned area

The specific mandate of OWMCP as specified in the State decree is :

- Operation and Management of all primary irrigation and drainage canals and dams and dikes and regulating structures;
- Providing physical and administrative services to the WB

So far the obligation to prepare Bylaws and Rules and Regulations ("*Keur")* has not yet been made by OWMCP; The maintenance ledger ("*Legger")* has been however been completed with technical assistance of the EU capacity building project.

The Capacity and tasks of OWMCP in water distribution has been strengthened in the recently completed EU supported Capacity building project.

In the document ***Vision 2030 OWMCP*** (**reference list** # 8.4) of November 2014 an outline is provided how OWMCP sees it future role as a Water Authority in the Nickerie district.

The coordinating role of the OWMCP in the operation and maintenance of the I&D system is confirmed in its role as secretary in the DIDCWG and elaborated in the IDB Policy paper on "*The Manual of Operation of District Water Commissions* (**reference list # 1.3**).

Its role in providing services to the Water boards is enforced by the assignment by the project of the Water Masters and his assistants, which should be under the technical supervision of OWMCP and the DIDCWG.

As foreseen under the project the capacity of the OWMCP in the operation of the system and the provision of services to the Water Boards is strengthened by adequate provision of training for introduction of improved water management in rotational water delivery, introduction of the water calendar, the installation, calibration and management of the hydrometric network and the hydrological modeling.

The capacity of OWMCP to carry out the tasks as foreseen in the project for improved O&M of the main system need to be verified. Where appropriate the staffing of OWMCP need to be strengthened in order to be able to carry out its additional tasks.

9.6 Incorporation and Involvement of all Irrigated areas in the O&M

Presently only the 12 Water Boards covering an area of almost 14,000 ha are covered under a common O&M obligation by the corresponding state decrees and By-laws.

There are several large companies and estates cultivated by private owner as well as livestock, horticultural and urban area with a total area of around 10,000 ha of which 7000 ha in the Autonoom polder and 3000 ha in the Western and Eastern Polders. (see **Error! Reference source not found.**). All polders receive water and dispose of excess water through the primary I&D system without having any formal agreement for O&M as foreseen under the OWMCP state decree or being charged for any water use.

Most of the private areas have made their own arrangements for the installation and maintenance of their internal irrigation and drainage infrastructure, including the installation of privately owned pumps to supplement their irrigation water.

There is a need to include all these areas under the present OWMCP command area in a more formal framework of rules and regulations on O&M similar to the Water Boards and to participate in the District water commissions coordinated by OWMCP in line with provisions foreseen in the state decree for OWMCP.

9.7 The special position of the Autonoom and Wageningen polders

The Autonoom area situated in the south-eastern corner of the scheme and covers an area of approximately 7,000 ha which receives water from the Nanni swamp to a large extent through private pumps and indirectly receive water also from the Corantijn canal, the area is presently further extended towards the east towards the Maratakka river. The installation and O&M of the internal I&D infrastructure, including pumps, is fully carried out by the individual owners.

The newly proposed Nanni weir and related structures as well as the Maratakka spillway will in several ways effect the water management conditions of the Autonoom areas as supply of water will be arranged through the Stondansi canal in stead of the Suriname canal, while the discharge of excess water will be regulated through the new spillway to the Maratakka river.

In order to regulate the water supply and outlet of this area needs to be included under the command area of the OWMCP. A revision of the State Law is required as the Autonoom area is presently excluded under the State-decree for OWMCP.

The Wageningen polder (reference list # 4.2) and Middenstands polder **(reference list # 4.1)** on the right bank of the Nickerie river have presently an estimated irrigated area of 6000 ha but suffers from water shortages in the short rain period, as pumping is restricted due to salinity problems in the Nickerie river. The new to construct Maratakka will divert potentially more excess water to the Nickerie river and reduce somewhat the salinity intrusion.

The Wageningen pump costs and maintenance work is carried out by LVV .The Indian government is considering the provision of irrigation pumps under the EXIM Bank funding arrangement for the Wageningen polder.

A majority of farmers have their own pumps and recycle water from the drains. Salinity in the Nickerie river is a problem particularly in the dry season when the salt water reaches the Middenstands polders.

9.8 Annual Expenditures on O&M

In the framework of the justification of project investments there is a need to consider the overall costs in the operation and maintenance of the Irrigation and Drainage and to reflect how the considerable government resources devoted for these can be secured

An interesting study is carried out under auspices of the EU project on the estimated and desirable (OW, LVV, RO) yearly cost expenditures of the total I&D system in Nickerie, which include the Wageningen polders and total left bank of the Nickerie and are summarized in table below

Required Annual O&M Costs

7,5 = $1

	Total Expenditures		Unit Costs
Agency/Sector	**SRD**	**USD**	**SRD/ha**
LVV	SRD 3.120.000	$416.000	SRD 52
OW	SRD 5.020.000	$669.333	SRD 84
RO	SRD 235.000	$31.333	SRD 4
OWMCP/MCP	SRD 5.827.780	$777.037	SRD 97
Total Government	**SRD 14.202.780**	**$1.862.493**	**SRD 237**
12 Water Boards @ 105 SRD/ha	SRD 1.842.386	$245.651	SRD 31
Pump costs Private	SRD 2.863.517	$381.802	SRD 48
Total Private	**SRD 18.908.683**	**$2.521.158**	**SRD 315**
Total area sown		ha	60.000

Table 11: Required Annual O&M expenditures[19]

Considerable costs are still involved in O&M of the Total I&D system in Nickerie amounting to payment of almost 4,5 million USD of which government is supposed to pay a major part of 75 %, assuming maintenance cost by Water Boards of 62 SRD/ha annually

Proposals are made to find ways to charge more to producers by indirect charging through taxing on the import Ureum and taxing of rice export. Reference is made to the concerned report (**reference list** # 5.5).

[19] Source PROPLAN reference #5.5

9.9 Irrigation and Drainage Development in Suriname

The main emphasis of the project is the improvement of the functioning of the I&D system in Nickerie district, which has the most important agricultural area in the country.

However large parts of the northern plains in the Districts of Commewijne, Wanaca, Saramaca and Coronie have been equipped with an extensive Irrigation and drainage system developed in the past for plantation agriculture and later rice. Although agriculture is at present limited in those districts with some rice and horticultural crops, the infrastructure is still important for the water management conditions for agriculture and in particular for the disposal of excess water for the residential areas. Considerable potential still exits here also for the development of modern agriculture, in particular for rice and horticultural crops.

In the *Vision for Suriname Sustainable Development of the Irrigation and Drainage Development (**reference list** # 1.1)*, prepared within the framework to support the modernization of Agricultural Public Services Program, is stated that increased agricultural production and diversification is achieved through modernization of the irrigation and drainage systems and the introduction of sustainable and integrated water management ensuring the rights of all water users for access to adequate water of good quality and protection from excessive water and flooding, while achieving a greater engagement of water users to participate and contribute to the costs of operation and maintenance of the irrigation and drainage systems;

In line with the I&D Vision the project may further contribute to this through a review of the scope for development and improvement of the existing water management for modern agriculture and integrated and sustainable water management for urban development and the environment.

Support for the development and support of modern agriculture and in particular for horticultural development may be considered.

9.10 LVV Department for Agricultural Water Management *(" Cultuurtechnische Dienst")*

The Department for Agricultural Water Management (*Cultuurtechnische Dienst)* at central level has been abolished already since a number of years, although in several districts water management departments have been maintained and considerable resources and staff are still devoted to operation and maintenance of the I&D infrastructure.

In order to provide guidance and the pursue of modern agriculture and to develop and implement a strategy for modernization of the irrigation and drainage systems in the country, the reestablishment of a Department of Agricultural Departments need to be considered

ANNEX 1 HYDRAULIC STRUCTURES MAIN SYSTEM TO BE REPAIRED

An inventory was made of the deficiencies of the different regulating structures in the main system and the type and costs involved of the repair works to be carried out. The survey was carried out in close consultation with the District Irrigation and Drainage Coordination Working Group (OW, OWMCP and LVV) and in particular with the maintenance unit of the District Public Works office.

A total of 15 main structures have been listed for major repair works that will improve the efficiency of operation of irrigation water, reduce water losses and flooding hazards. These works include the repair of broken gates of drain sluices and inlet gates, spillways and distribution boxes, as well enlargement of the drainage capacity, as indicated in the table. (see table 12).

A short description of the deficiencies of the hydraulic structures is included in this report

Details of the cost estimates are included in the Annex of this report, prepared by the Department of Public Works in consultation with OWMCP. (**reference list # 3.2)**

In an additional reports the location and images of the various structures are included in a separate file (**reference list # : 3.3)**

	Regulating Structure	Amounts in USD			
		Repairs Gates	Wooden Embankment	Metal Piling	Total
	IRRIGATION INTAKE STRUCTURES				
1	Nanni-Inlaat	28.670	174.980		203.650
2	IKUGH Inlet	40.800		666.350	707.150
3	HA inlet	9.870			9.870
4	Suleiman/Hamtoncourt Inlet	9.070			9.070
	IRRIGATION DISTRIBUTION STRUCTURES				
5	Clara Distribution Box	14.540		377.690	392.230
6	Drie Koker Punt Inlet	10.670	137.170		147.840
	Atoeallah Gate & Syphon				
	DRAINAGE OUTLET SLUICES				
7	Nanni Sluice	22.140			22.140
8	Clara Sluice	48.000			48.000
9	Hazard Sluice	65.200		556.890	622.090
10	Hamptoncourt Sluice	27.340			27.340
11	Groot Henar Sluice	65.740	321.390		387.130
	FLOOD CONTROL STRUCTURES				
12	Nanni-uitlaat			1.073.150	1.073.150
13	Nanni Spillway	60			60.000
14	Nanni kreek	500.000			500.000
15	Syphons along Corantijn Canal	114.400	176.610		291.010
	Sub Total	680.200	498.000	1.073.150	4.500.670
	Additional Contractor Costs			0	1.350.201
	Design and Supervision Consultant			0	675.101
	Total				6.525.972

Table 12: List of Main Hydraulic Structures to be repaired

1 NANNI/VAN WOUW INLET

- **function**
  - Inlet structure to the van Wouw canal
    - Inlet to the Tondonsi canal serving Europolder Zuid
    - Inlet Eastern lateral van Wouw canal serving Europolder Noord
    - Inlet van Wouw Commercial farms of Mangli and Baitali
    - Inlet to Clara distribution box serving the 5 western WB polder systems (Corantijn, Clara, Nanni & Bruto, van Drimmelen, Wasima en Europolder Noord)
- **Structure description**
  - No of Gates : 2 Two gates with lift mechanism
  - Operating system: Mechanical Lifting by pulley block
- **Deficiencies and repairs required**
  - Steel gates require replacement,
  - Reconstruction roofing to allow safe installation of the pulleys
  - Wooden retaining walls (dam wand) on the outflow side are effected by woodlice and need to be replaced completely to reduce and restore erosion of canal dikes
  - Concrete retaining walls at the inflow side of the structure need to be stabilized;
- **Cost estimate:**
  - Replacement of 2 steel gates
  - Repair roofing and replacement pulley blocks by hoisting gear box.
  - Retaining walls outflow side

		Repairs Gates	Wooden Embankment	Metal Piling	Total
1	**Nanni-Inlaat**	28.670	174.980		**203.650**

2 IKUGH INLET STRUCTURE

- **function**
  - Inlet from the Suriname canal to the Lateral Canal and Suleiman canal
  - Serving “Hampton court polder” and “Groot Henar polder” (Suleiman inlet)
  - Serving “Uitbreiding Groot Henar” en “Autonoom” polders
- **Structure description**
  - 3 Inlet gates with gates opening by lifting devices
- **Deficiencies and repairs required**
  - The inlets gates need to be repaired or replaced
  - The lifting construction and devices need to be repaired/replaced
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
2	**IKUGH Inlet**	40.800		666.350	**707.150**

3 HA CANAL INLET STRUCTURE

- **Function**
  - Inlet structure from Surinam canal into the HA canal with flow regulating gate
  - HA canal serving Paradise-Longmay polder, Sawmillkreek and Bacoven polder
- **Structure description**
  - Regulating spindle gate installed in the swamp retaining dike of the Surinam canal
  - Inlet at the Suriname canal and culvert with outlet to HA canal
- **Deficiencies and repairs required**
  - Spindle gate non functional and need to be repaired and gate replaced
  - At high water levels at the Nanni swamp the gate overflows and need to be heightened
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
3	**HA inlet**	9.870			**9.870**

4 SULEIMAN/HAMPTONCOURT INTAKE

- **Function**
  - Inlet from Suleiman canal to Hampton Court polder
- **Structure description**
  - Inlet with culvert under the main road
- **Deficiencies and repairs required**
  - Gate is missing and need to be installed with spindle structure
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
4	**Suleiman/Hamtoncourt Inlet**	9.070			**9.070**

5 CLARA DISTRIBUTION STRUCTURE

- **Function**
  - Flow distribution and regulation structure
  - Serving 5 polders : Corantijn, Clara, Nanni-Bruto, van Drimmelen, Wasima polder
- **Structure description**
  - Outlet from the Clara pumping station into a concrete structure with 5 spindle operated gates that regulate the flow into 5 canals
- **Deficiencies and repairs required**

- All 5 spindle gates are non functional and need to be replaced completely
- Provisional outlet to Nanni-Bruto polder need to be closed

- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
5	**Clara Distribution Box**	14.540		377.690	**392.230**

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6 DRIE KOKER INLET

- **Function**
  - Inlets from HA canal to 3 lateral canals
  - Serving 2 polders : Longmay-Paradise and Sawmillkreek polders
- **Structure description**
  - 3 gates to 3 canal inlets serving 2 polders
- **Deficiencies and repairs required**
  - The 3 inlets lack closing gates and need to be repaired
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
6	**Drie Koker Punt Inlet**	10.670	137.170		**147.840**

7 DRIE KOKER INLET

- **Function**
  - Inlets from HA canal to 3 lateral canals
  - Serving 2 polders : Longmay-Paradise and Sawmillkreek polders
- **Structure description**
  - 3 gates to 3 canal inlets serving 2 polders
- **Deficiencies and repairs required**
  - The 3 inlets lack closing gates and need to be repaired
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
7	**Drie Koker Punt Inlet**	10.670	137.170		**147.840**

8 NANNI SLUICE

- **function**

- Drainage outlet from the Nanni polder into the Corontijn river

- **Structure description**
  - Structure equipped with 4 doors and lifting devices
  - Doors include automatic valves which close at high tide
- **Deficiencies and repairs required**
  - The doors require cleaning and slight repairs
  - Installation of lifting devices required
  - Retaining walls of inlet and outlet sides need to be repaired
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
8	**Nanni Sluice**	22.140			**22.140**

-

9 CLARA SLUICE

- **Function**
  - Drainage Outlet from Clara polder into Corontijn rivier
- **Structure description**
  - 3 Outlets fitted with automatic non-return valves
- **Deficiencies and repairs required**
  - Complete overhaul of the sluice required
  - Replacement of the gates and door frames
  - Concrete underground need no to be replaced
  - Outlet side need to be deepened
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
9	**Clara Sluice**	48.000			**48.000**

10 HAZARD SLUICE

- **Function**
  - Drainage Outlet from the Bacoven and Europolder into the Nickerie river
- **Structure description**
  - Outlet with 4 Gates originally equipped with electric lifting mechanism and overhead structure
- **Deficiencies and repairs required**
  - Doors are in poor state of operation and need to be replaced
  - Retaining walls at inlet and outlet side need to be repaired/replaced and protected to avoid scouring

- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
10	**Hazard Sluice**	65.200		556.890	**622.090**

11 HAMPTONCOURT SLUICE

- **Function**
  - Drainage outlet from the Hamtoncourt polder into the Nickerie river
- **Structure description**
  - Outlet with 3 gates fitted with mechanical lifting devices
- **Deficiencies and repairs required**
  - Outlet gates need to be repaired and cleaned
  - Retaining walls on inlet and outlet side need to be repaired
  - Outlet side need to be deepened
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
11	**Hamptoncourt Sluice**	27.340			**27.340**

12 GROOT HENAR SLUICE

- **Function**
  - Drainage Outlet from Groot Henar polder into Nickerie rivier
- **Structure description**
  - Outlet equipped with 4 doors with mechanical lifting device without overhead structure (1 door replaced by wooden door)
- **Deficiencies and repairs required**
  - 3 steel doors need to be replaced by wooden gates or repaired
  - Overhead structure need to be constructed to allow safe lifting;
  - Retaining walls need to be repaired on inflow and outflow side
  -
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
12	**Groot Henar Sluice**	65.740	321.390		**387.130**

13 NANNI SPILLWAY

- **function**

- to release excess floodwaters from the Nanni swamp at times of high rainfall

- **Structure description**
  - Three outlet gates equipped with wooden beams to regulate outflow
- **Deficiencies and repairs required**
  - Missing wooden beams
  - The retaining walls on the outflow side need to be repaired and reinforced
  - The earth dam on the south side need to be reshaped and heightened (temporally reinforced and heightened by sandbags)
  - The Nanni Creek outlet need to be cleaned to increase the outflow capacity
- **Cost estimate:**
  - Repair and replacement of the wooden beams
  - Repair of the retaining walls of the outlet
  - Reshaping of the connecting south dam

		Repairs Gates	Wooden Embankment	Metal Piling	Total
13	**Nanni Spillway**	60			**60.000**

14 NANNI CREEK

- **Function**
  - Drainage outlet of excessive flood waters in the Corontijn river
- **Structure description**
  - Natural drain with average width of 20 meter over a length of 13 km
- **Deficiencies and repairs required**
  - Canal capacity seriousy reduced due to sedimentation, vegetation and obstruction in the canal bed
- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
14	**Nanni kreek**	500.000			**500.000**

15 FLOOD OUTLET GATES CORANTIJN CANAL

9.11 ZUID DRAIN SPILLWAY CORONTIJN CANAL

- **Function**
  - Drainage outlet of excessive flood waters in the Corontijn canal into the Zuid drain
- **Structure description**
  - Gated outlet
- **Deficiencies and repairs required**

- Inlet side seriously damaged and requires full reconstruction
- Outlet retaining walls and foundation seriously damaged

- **Cost estimate:**

		Repairs Gates	Wooden Embankment	Metal Piling	Total
15	**Syphons along Corantijn Canal**	114.400	176.610		**291.010**

Annex 2 LIST OF REFERENCES

1 IDB Policy Documents SU-L1032 (2015-2016)

1.1 I&D Vision I&D Sector Suriname.docx
1.2 Plan to execute, monitor and evaluate maintenance and investments
1.3 Manual of Operation for Interdepartmental District Water Commissions
1.4 Establishment of Additional Interdepartmental commissions at a district level
1.5 Memorandum of Understanding for establishing DIDCWG in Nickerie district
1.6 Manual Operation Establishing Water Boards
1.7 Proposal for establishment of four new WBs
1.8 Water Board Legislation
1.9 O&M Manual and Work plans
1.10 Comparative Analysis O&M Reports
1.11 Proposal Public Services to Water Boards
1.12 Memorandum of Understanding for establishing the Inter-Ministerial Irrigation and Drainage Coordination Working Group

2 IDB Reports: Rehabilitation Plans 6 Water Boards in Nickerie district (SU-L1032 (2016), SU-L1052 (2017))

2.1 Rehabilitatie plan Waterschap Clarapolder (2016)
2.2 Rehabilitatie plan Waterschap Nanni- en Brutopolder; (2016)
2.3 Rehabilitatie plan Waterschap Paradise & Longmay (2016)
2.4 Rehabilitatie plan Waterschap WASIMA. (2016)
2.5 Rehabilitatie plan Europolder Zuid (2017)
2.6 Rehabilitatie plan Uitbreiding Groot Henar 1 & 2 (2017)

3 IDB Reports: Main system Repairs Left Bank Nickerie (2017-2018)

3.1 List of Repairs Deficient Hydraulic Structures Main System
3.2 Annex 1-Costs Main System repairs
3.3 Annex 2-List of Clarifying Maps and Photos

4 IDB National Consultancy Reports (2017-2018)

4.1 Description Middenstands polder
4.2 Description Wageningen polder
4.3 Cost of landleveling
4.4 Cost of paddy production

5 OWMCP - EU financed Capacity building project (2013-2014)

5.1 Presentation Project Results : Capacity building for Integrated Water Management in Nickerie

- **THEMA 1 : Water Governance and Coordinated Water use**

5.2 District Development Plan Nickerie 2017.pdf
5.3 Folder voor bestuursleden - Keur inliggende waterschappen
5.4 Keur inliggende waterschappen - folder voor burgers boeren
5.5 Kostenberekening Waterbeheer Nickerie final report 2 mei 2017.pdf
5.6 Reglement Water Platform Nickerie.pdf

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