New Partnership for Africa's Development (NEPAD)

Comprehensive Africa Agriculture Development Programme (CAADP)

Food and Agriculture Organization of the United Nations

Investment Centre Division

GOVERNMENT OF THE REPUBLIC OF SIERRA LEONE

SUPPORT TO NEPAD–CAADP IMPLEMENTATION

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Volume II of IV

BANKABLE INVESTMENT PROJECT PROFILE

Sustainable Land and Water Resources Development

March 2005

SIERRA LEONE: Support to NEPAD–CAADP Implementation

Volume I: National Medium–Term Investment Programme (NMTIP)

Bankable Investment Project Profiles (BIPPs)

Volume II: Sustainable Land and Water Resources Development

Volume III: Freetown Fisheries Harbour Complex

Volume IV: Market–oriented Forestry and Tree Crop Agroforestry Production Systems

NEPAD–CAADP BANKABLE INVESTMENT PROJECT PROFILE

Country: Sierra Leone

Sector of Activities: Land and Water Resources

Proposed Project Name: **Sustainable Land and Water Resources Development**

Project Area: Port Loko, Koinadugu, Moyamba, Kenema, Mountain. Rural Districts

Duration of Project: 5 years

Estimated Cost: Foreign Exchange ..... US$22.50 million
Local Cost ..... US$9.79 million
Total ..... US$32.29 million

Suggested Financing:

Source	*US$ million*	*% of total*
Government	2,052	12
Financing institution(s)	22,505	73
Beneficiaries	5,512	6
Private sector	2,223	9
Total	***32,292***	***100***

SIERRA LEONE:

NEPAD–CAADP Bankable Investment Project Profile

"Sustainable Land and Water Resources Development"

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Abbreviations

ADB	African Development Bank
APPROTEC	Appropriate Technology for Enterprise Creation
ASR	Agriculture Sector Review
CAADP	Comprehensive Africa Agriculture Development Programme
CDE	Center for the Development of Enterprise Expert
CRF	Credit Revolving Fund
DFID	Department for International Development
EAP	Eastern Area Project
EDF	European Development Fund
EEC	European Economic Community
EU	European Union
FAO	Food and Agriculture Organisation
FASP	Farmers' Associations Support Programme
Ffag	Food for Agriculture
FFS	Farmer Field School
GOSL	Government of Sierra Leone
IAEA	International Atomic Energy Agency
IDA	International Development Association
IDB	Islamic Development Bank
IDRC	International Development Research Centre
IRDP	Integrated Rural Development Project
IVS	Inland Valley Swamp
IWMI	International Water Management Institute
KAR	Knowledge And Research
KIADP	Koinadugu Integrated Agricultural Development Project
LWDD	Land and Water Development Division
MAFFS	Ministry of Agriculture, Forestry and Food Security
MAI	Moisture Availability Index
MD	Meteorological Department
MIADP	Moyamba Integrated Agricultural Development Project
MIRDP	Moyamba Integrated Rural Development Project
NaCSA	National Commission for Social Action
NCDB	National Cooperative Development Bank
NCU	National Coordinating Unit
NEPAD	New Partnership for Africa's Development
NERICA	New Rice for Africa
NGO	Non–Governmental Organisation
NMTIP	National Medium–Term Investment Plan
NUC	Njala University College
OFTN	Operation Feed The Nation
PLADP	Port Loko Agricultural Development Project
PODWACO	Port Loko District Women's Agricultural Cooperative
PRSP	Poverty Reduction Strategy Paper
R&D	Research and Development
ROSCA	Rotary Savings and Credit Association
SALWACO	Sierra Leone Water Company
SHIDA	Small Holder Irrigation Development Authority

SLEDIC	Sierra Leone Export Development and Investment Corporation
SPFS	Special Programme for Food Security
TCP	Technical Cooperation Programme
UNDP	United Nations Development Programme
UNICEF	United Nations Children's Fund
WATSAN	Water and Sanitation
WFP	World Food Programme
WRC	Water Resources Centre
WSD	Water Supply Division

I. PROJECT BACKGROUND

A. Project Origin

I.1. This project was identified following the preparation of the *National Medium–Term Investment Programme* (NMTIP) for Sierra Leone, and a stakeholders' workshop which reviewed the NMTIP and ascertained development priorities. The NMTIP was prepared within the framework of NEPAD's *Comprehensive Africa Agriculture Development Programme* (CAADP).

I.2. This project falls within the ambit of the *Land and Water Development Division* (LWDD), which is the arm of the *Ministry of Agriculture, Forestry and Food Security* (MAFFS) that has the main responsibility for the appraisal of the land and water resources of the country, providing information and technical support for improving the use of land, soil, water and climate resources so as to make possible sustainable agriculture. The division has a vital role in addressing the critical issues of agricultural development and protection of the land–based environment.

I.3. Some components of this project were also featured in the recently concluded national stakeholders' workshop on the *Agricultural Sector Review* (ASR).

B. General Information

I.4. ***Physical Resources and Climate.*** Sierra Leone lies in the west coast of Africa, between latitudes 6º55′ and 10º00′N and longitudes 10º16′ and 13º18′W. It covers a geographical area of 72,000 km^2 with four main physiographic regions ranging from Coastal Plains (elevations less than 50 m) to the Guinea Highlands at elevations in excess of 500 m. The geographical area comprises two main agro–ecologies, the uplands (80 percent) and the lowlands (20 percent).The population is estimated at 4.5 million (1994 figure), about 70 percent of which live in the rural areas; there are about 400,000 farm families.

I.5. The climate is a monsoon type humid tropical with two distinct seasons: a rainy season from May to October and a dry season from November to April. The annual rainfall averages about 3,000 mm, ranging from 2,000 mm in the North to 4,000 mm in the South. The Western Area peninsula can experience annual rainfall in excess of 4,500 mm. Rainfall distribution is unimodal, with a peak in August; about 95 percent of the total annual rainfall occurs during the months of July, August and September. Despite the abundant annual rainfall, about 20–50 percent is generally "lost" as surface runoff, contributing to the discharges of the nine main river systems. Even though the country has a very high rainfall, it also has a prolonged dry season in which many streams and rivers cease to flow, and water deficits are a common feature, amounting to about 500 mm per annum and persisting for 160–170 days, in some agro–climatic regions (UNDP/FAO, 1980). Furthermore, the start of the rains is quite variable and this has important consequences since much of the country's agricultural production is rain–fed.

I.6. Average monthly temperature ranges from 23ºC to 29ºC but it can rise to a maximum of 360 C in the lowlands towards the end of the dry season, while in the highlands (particularly in the North) the average monthly temperature could be as low as 150 C at the beginning of the dry season. The number of sunshine hours per day varies from 6 to 8 in the dry season, and from 2 to 4 during the rainy season. Relative humidity is generally high throughout the year, with an average of 95–100 percent during the rainy season, but can drop from 100 percent to 20 percent during the Harmattan in the dry season. Figure 1 in Annex 1 shows the main agro–climatic regions of the country.

I.7. ***Water Resources.*** The country has an estimated total water resources potential of about 160 km^3/yr comprising both surface and ground water. Surface water is contributed by nine major river systems which have a total catchment area of about 72,080 km^2 within Sierra Leone. The annual recharge is estimated to be about 10 km^3. River discharges vary widely according to the seasons: from 10 to 1,296 m^3/s during the rainy season, and from 8 to 500 m^3/s during the dry season. Such a wide variation in river regime is not conducive to irrigation development. Only about 0.37 km^3/yr of the total water potential is used mainly in agriculture, for irrigating about 28,000 ha of equipped lowlands, 1,000 ha of sugar cane and about 217 ha (1980 figures) of vegetable gardens in inland valleys, stream/river terraces and dry river beds in the urban and peri–urban areas in the North/Northwest and the Western Area. This level of utilization is low (i.e. < 2 percent) in relation to the total estimated potential.

I.8. ***Hydrometeorological Service.*** The principal department responsible for the collection and processing of climatological data is the *Meteorological Department* (MD) which is under the *Ministry of Transport and Communication*. Such data is also collected by the MAFFS's LWDD and by *Guma Valley Water Company*, the latter for its water supply system in Freetown, the capital. The *Water Supply Division* (WSD) of the *Ministry of Energy and Power* collects hydrological data for rural water supply and for the development of hydro power in various parts of the country.

I.9. The hydrometeorological network of the country is shown in Figure 2 in Annex 1. It comprises seven synoptic stations, ten agro–climatological stations, a further two climate and rainfall stations and a weather radar station which is not operational at present. The justification for setting up the agro–climatic stations was the usefulness of the data, among other factors, in improving crop yields in Sierra Leone. There were tangible benefits to be obtained from taking account of weather conditions in determining the best time for sowing and transplanting certain crops. Major problems confronting the hydrometeorological service include: the low density of precipitation stations (2 per 104 km^2), evaporation stations (1.7 per 104 km^2); non existence of repair and maintenance shops for meteorological equipment; low density of hydrological network, including gauging and discharge stations (0–3.4 per 104 km^2); lack of spare parts for equipment; the lack of coordination among the various bodies involved in hydrometeorological data collection and use, the loss of valuable climatic and hydrological data during the war.

I.10. ***Land Resources and Agricultural Production.*** About 5.365 million hectares of the total land area are considered arable, comprising 4.20 million ha of upland, and 1.165 million ha are lowlands. The lowlands are differentiated into 4 main agro–ecologies, of which the Inland Valley Swamps (IVS) are the most widespread and have the largest areal extent. However, only about 12 percent of the total cultivable land was cultivated in 1992 (FAO, 1995), comprising 500,000 ha of upland and 155,000 ha of lowland. The breakdown of cultivable and cultivated land, as at 1992, is shown in Table 1.

Table 1: Breakdown of Cultivable and Cultivated Land

Ecology	Suitable for cultivation (ha)	Cultivated in 1992 (ha)	Cultivated as % of suitable
Upland	4,200,000	500,000	11.9
Lowland	1,165,000	155,000	13.3
• *IVS*	*690,000*	*100,000*	*14.5*
• *Boliland*	*145,000*	*10,000*	*6.9*
• *Riverain Grassland*	*130,000*	*20,000*	*15.4*
• *Mangrove*	*200,000*	*25,000*	*12.5*
TOTAL	5,365,000	655,000	12.2

Source: FAO (1995). Water Reports 7.

I.11. The IVS contribute approximately 20 percent of the food growing area in the country (NCU, 1999). They have an estimated potential of 690,000 ha and are found in all the geographical regions of the country. Their productivity potential is greater than that of the uplands due to higher organic matter content and a more favourable water regime for a longer period during the year. Under traditional farming practices, yields of rice, the country's staple food crop, average about 1 ton/ha. However, under improved water management practices, rice yields in the range 2–3.2 tons/ha have been achieved.

I.12. Recognition of the productive potential of the IVS, coupled with the pressure on uplands (fallow periods declining from 15 years to 7 years or less), led government to place emphasis on the exploitation of this agro–ecology for the attainment of self–sufficiency in rice. Several IVS development projects were initiated, starting in the mid–seventies. Over a period of about two decades, some 40,000 ha of swamps were developed and equipped for low land rice cultivation. However, a number of developed swamps were abandoned due to several factors, including poor planning and design, socio–economic constraints and the lack of basic understanding of the bio–physical characteristics of IVS.

I.13. Although IVS are found in all 14 agricultural districts of the country, about 45 percent (i.e. 312 136 ha) are concentrated in 4 districts, i.e. Port Loko and Koinadugu in the North; Moyamba in the South, and Kenema in the East. Figure 3 in Annex 1 shows the location of the districts, which are also targeted in this project. Based on a hydrological characterization of the IVS in Moyamba district, carried out by LWDD, the total area of developable IVS is 152,000 ha, comprising perennial swamps and swamps flooded for up to 7 months (Table 2).

Table 2: Status of IVS Development and Additional Potentially Developable Area in Target Districts

District	Area (ha)	Developed (ha)	Rehabilitated (ha)	Needing rehab. (ha)	Perennial (ha)	Seasonal (ha)	Flooded for 7+ months (ha)
Port Loko	62,309	3,240	490	2,750	14,767	44,301	15,062
Koinadugu	116,816	2,430	100	2,330	28,597	85,791	29,169
Moyamba	68,014	2,330	224	2,106	16,421	49,263	16,749
Kenema	64,997	3,208	188	3,020	15,447	46,342	15,756
Total	312,136	11,208	1,002	10,206	75,232	225,697	76,736

I.14. The current state (i.e. up to July 2004) of IVS rehabilitation is summarised in Table 3. The period from April 2002 to June 2004 was devoted mainly to the rehabilitation of developed swamps, with the financial support of the *Islamic Development Bank* (IDB) which had a target of about 12–16 ha per chiefdom in each district, making a total targeted area of 132–256 ha per district. Tables 2 and 3 show that only a small proportion of the previously developed area was rehabilitated/re–developed. In some cases, even the area targeted for rehabilitation was not achieved.

Table 3: Status of Inland Valley Swamp Rehabilitation in target districts in Sierra Leone

District	IVS hectarage	Of which, re–developed or rehabilitated	Implementing organisation	Financing agency	Years of operation
Port Loko	62,309	490	PLADP	EEC	1989–93
			FASP	EEC	1994–96
			IRDP/NaCSA	IDB	2000–04
Koinadugu	116,816	100	KIADP	EDF	1978–82
			FASP	EEC	1994–96
			IRDP/NaCSA	IDB	2004

Table 3: Status of Inland Valley Swamp Rehabilitation in target districts in Sierra Leone					
District	IVS hectarage	Of which, re–developed or rehabilitated	Implementing organisation	Financing agency	Years of operation
Kenema	64,997	188	EAP IRDP/NaCSA	IDA IDB	1972–82 2002
Moyamba	68,014	224	MIADP MIRDP IRDP/NaCSA	ADB IDB	1980–84 2002
Total	312,136	1,002			
Sources: Water Resources Section, LWDD; Miscellaneous Field Notes					

I.15. Table 4 shows that IVS account for about 29 percent of total rice production in the four Districts, and about 85 percent of swamp rice production. These are higher than the national averages, indicating that IVS are more important in the selected Districts than in other Districts in Sierra Leone.

Table 4: Contribution of IVS Paddy Production in the Targeted Districts in 2002						
District	Upland	All swamps	IVS only	Total upland + swamplands	IVS as % of total swamp production	IVS as % of total land production
Moyamba	12,983	7,185	5,699	20,168	78.90	28.26
Kenema	50,713	7,285	7,285	57,998	100.00	12.56
Port Loko	21,971	24,172	18,580	46,143	76.87	40.27
Koinadugu	16,643	12,553	12,239	29,196	97.50	41.92
Total of 4 districts	102,310	51,195	43,803	153,505	85.56	28.54
Country Total	269,679	152,185	106,633	421,864	70.07	25.28
Production in mt. Source: Figures computed using data obtained from MAFFS/FAO 2002 Crop Survey Report (March 2003)						

I.16. ***Small–scale Irrigated Food Crop Production (or Market Gardening).*** Market gardening or, more generally, peri–urban agriculture, has become an important socio–economic activity in Sierra Leone. The activity is carried out in most towns and villages, but is concentrated in the urban/peri–urban centres of the country and in the traditional "vegetable baskets" of the nation around Kabala and Makeni in the north, around Lungi–Mahera in the north west of the country and in the mountain villages of Regent, Leicester and Bathurst in the Western Area of the country. Crops that are commonly grown include green leafy vegetables (cassava, sweet potato, spinach, lettuce and cabbage), cucumber, maize, pepper, okra, garden eggs and onion. These crops not only contribute to urban dwellers' daily nutritional diets, but also generate family income.

I.17. Market gardening is practised more intensively during the dry season (i.e. November–April) when water resources are generally scarce but the demand for vegetable crops is higher (and prices are at their peak) than during the rainy season (i.e. May–October). As a result of the scarce water resources during the dry season, gardeners are generally compelled to move to the valley bottom in IVS or they have to rely on hand dug wells for tapping ground water.

I.18. Various methods are used to irrigate crop beds and/or conserve applied water: scooping water from a well/stream using a container, conveying and applying it to the crop beds by sprinkling; applying water to crops on constructed sunken beds to conserve moisture. Simulation studies carried out locally have revealed that as much as 56 percent of total irrigation time is spent on fetching and conveying water from the source to the crop beds, while 44 percent is spent on actually applying the water to the crops. As market gardening is done mostly by women, this level of labour input represents

an enormous burden on the gardeners. Furthermore, this method of irrigation is not only very debilitating, but it also limits the area that a farm family can cultivate effectively to only a few hundred square meters, on the average.

I.19. The practice of moving to the valley bottom with the receding surface water means that the vast area of the upland slopes is left uncultivated during the dry season. There is generally a scramble for the valley bottom where there may not be enough land for all gardeners to cultivate. In similar situations, the introduction of shallow bore holes and simple hand pumps has resulted in an increase in the potential area of vegetable production back across the flood plain to cover virtually the whole of the plain (*fadama*)

I.20. The *International Atomic Energy Agency (IAEA)* is currently supporting a technical cooperation project, *Improved Water Management Technologies in the Inland Valley Agro–ecology in Sierra Leone*, based at Njala University College (NUC), University of Sierra Leone. The aim of this project is to use nuclear and related techniques for the identification and implementation of simple and appropriate technologies for utilizing soil water resources in inland valley fringes and slopes, towards extending crop production into the dry season. The activities of this project have resulted in the identification of simple water management technologies and/or practices that appear to have some potential applications in the Sierra Leonean farming environment. Using these technologies, farmers in East Africa have been able to cultivate about 15,000 acres of food and ornamental crops, generating additional revenues of US$30 million annually. Although these technologies are new in Sierra Leone and have not yet been evaluated, their application has the potential to impact positively on urban and peri–urban agriculture by reducing drudgery, generating employment for youths and contributing to food security and poverty alleviation.

I.21. ***Land and Water Institutions.*** The *Land and Water Development Division* (LWDD) is the arm MAFFS that has the main responsibility for the appraisal of the land and water resources of the country, providing information and technical support for improving the use of land, soil, water and climate resources so as to make possible sustainable agriculture. It has a vital role in addressing the critical issues of agricultural development and protection of the land–based environment. LWDD pursues this broad mandate through the activities of two of its sections, the *Water Resources Section* and the *Agro–climatology Section.* In addition to the collection of agro–climatic data from its network of 10 stations (most of them vandalized during the decade–long war), the Division also undertakes research and related activities, in collaboration with the University of Sierra Leone and the national research institutes, in such aspects as soil and hydrological inventories of swamps, characterization of inland valley swamps in a few districts; socio–economic studies in some key swamps. These studies have contributed to a re–focusing of the Division's work and a modification of its approach to IVS development which is now being applied to current IVS development projects.

I.22. The division is however hampered by several factors including the lopsided current establishment which has resulted in inadequate staff in LWDD's *Water Resources Section*. At present there is only one water resources engineer and one irrigation engineer, both holding M.Sc. degrees. The officers who are currently implementing the swamp development projects are not trained in water resources, except for in–service training courses which ran for only a few weeks at any one time. Furthermore, the division's agro–met stations, which were vandalized during the war, have not so far been rehabilitated although there are plans to do so. Nonetheless, even when these stations are rehabilitated, the national coverage will still be inadequate. There is also a high staff attrition rate, especially at the senior level, and there is very little collaboration between LWDD and aid agencies executing IVS development projects.

I.23. The proposed new Njala University has prepared plans for the establishment of a school of technology that will have a water resources section/unit within the present *Department of Agricultural Engineering*. This is to give focus to this important national resource. It is envisaged that the unit will eventually grow into a *Water Resources Centre*, which will be mandated to carry out training, research and development activities in the water resources sector.

I.24. Other institutions/organisations that have been and/or are involved in the water resources sector include: the *Meteorological Department* of the *Ministry of Transport and Communication*, which has the primary responsibility for the collection and processing of climatological data in the country; *Guma Valley Water Company*, which collects climatological data as a way of monitoring the water resources that the company develops for the nation's capital, Freetown; the *Water Supply Division* (WSD) of the *Ministry of Energy and Power* collects hydrological data for planning and developing hydro–electric schemes; *Sierra Leone Water Company* (SALWACO) is responsible for the development of rural water supply systems; UNICEF has a water and sanitation (WATSAN) unit that has contributed to the provision of water to rural communities, including the monitoring of water sources and their periodic treatment. Several development projects have also been involved in the development of water sources, especially ground water, for the provision of water supplies to the rural areas of the country.

II. PROJECT AREA

II.1. The proposed project area covers four agricultural/administrative districts in the in the provinces and the Rural Mountain District in the Western Area of the country, as shown in Figure 2 in Annex 1. The four provincial districts were selected because, together, they have about 45 percent of the total IVS area in the country and have had a fair amount of project experience. In 2002, three of these districts — Kenema, Moyamba and Port Loko — were among the top six rice producing districts in the country. However, two of the districts, Koinadugu and Port Loko, are among the extremely vulnerable districts where the estimated cereal self reliance was below 40 percent in 2002. Furthermore, Port Loko and Kenema districts have the highest incidence of poverty, 11.5 percent and 11.1 percent, respectively; the incidence in Koinadugu and Moyamba districts is, respectively, 8.0 percent and 7.6 percent. Also, the Districts selected are complementary to those which are the focus of other projects, such as the one supported by ADB. The Mountain district in the Western Area was selected because it has a very high concentration of market gardeners who are actively engaged in intensive vegetable production and serve Freetown, which is the largest urban centre. The main agricultural characteristics of the districts are outlined in the following paragraphs.

II.2. Port Loko District is located partly in the Coastal Plains and partly in the Savannah Woodland agro–climatic regions, and is a major rice growing district, having also some bolilands. It is also the district in which the current *Rhombe Swamp Development* project is based. The western part of the district is the onion belt of the country where viable women's organizations have developed for the production and marketing of this and other crops. The main market outlet is Freetown, the nation's capital. The district is also served by several market outlets both towards the Guinea border and along the main highway to other parts of the north.

II.3. There are over 100 women's groups/associations in the district, each having a membership of 25–30. They are engaged mainly in market gardening activities, cultivating and marketing a wide variety of food and cash crops including onion, pepper, okra, eggplant, cucumber, melon, green leafy vegetables (potato leaves, cassava leaves, green, etc.) and salad crops (cabbage, carrot, lettuce) mainly as second crops during the dry season, after the main rice crop. As a way of building the spirit of

cooperation in the women, they are encouraged to engage in food crop production, as an association, in an area of not less than 1 acre. All inputs given to the association are targeted to this farm. Emergency relief assistance in the form of seeds and tools were provided by numerous organisations such as UN donor and NGOs. An umbrella organization, *Port Loko District Women's Agricultural Cooperative* (PODWACO), has been formed to organize the activities of women's associations in the district, from the village level up to district level.

II.4. Onion is a major cash crop in the country and is cultivated most intensively in Kafu Bullom Chiefdom which is also the location of the country's international airport at Lungi. There are about 85 women's groups in this chiefdom, each having a membership of at least 25, engaged in the production of this crop and other food/cash crops. Typically, individual gardeners cultivate 20–30 beds of onion.

II.5. Major problems include the arduous nature of the work involved due to the use of manual methods, lack of appropriate facilities for curing onion, and marketing in the face of competition from onion imported from other countries during the peak period of harvesting.

II.6. ***Koinadugu District*** is located almost entirely in the Savannah woodland agro–climatic region and has very fertile soils. Farmers have developed unique techniques of farming the very steep upland farmlands (that are a characteristic feature of the district) using appropriate soil /water conservation measures. In addition to having the largest area of IVS, the district is also one of the bread baskets of the nation as far as food crops, other than rice, are concerned. The so–called "Irish" potato has been successfully grown in the district on a trial basis. The occurrence of water deficits during the dry season in this agro–climatic region make it ideally suited for the introduction of small–scale community irrigation for the production of vegetable and other food crops, for home consumption and, possibly for export.

II.7. There are some 305 women's groups in the district. They comprise 30 groups in the Intensive Category, each group having 30 members who are engaged in intensive vegetable production (lettuce, cabbage, carrot, etc.); 275 groups of 30 members each in the Traditional Category who are engaged in the cultivation of traditional crops like onion and groundnut. In addition to their individual gardens/plots, members also work on the group's farm to demonstrate new technologies. The groups were supported initially by the FAO. Marketing of the produce in Freetown was facilitated by the provision of 2 trucks and establishing links with major hoteliers in the capital. Upon the phasing out of FAO's assistance and after the end of the war, both categories of women joined to form the Koinadugu District Women Farmers Cooperative which now caters for its members, including the procurement of seeds and other logistical requirements mainly from Conakry, Guinea. The UK *Department for International Development* (DFID) has assisted by providing 1 truck and 1 tractor but spare parts for the truck have to be procured from Guinea.

II.8. The *Center for the Development of Enterprise Expert* (CDE), which is based in Brussels, recently conducted a training course in Sierra Leone on the processing and preservation of fruits and vegetables, to which women gardeners from Koinadugu district participated. Participants also came from the *Sierra Leone Export Development and Investment Corporation* (SLEDIC) which is the antenna for CDE in this country. As a follow–up to this training, SLEDIC is currently preparing a project proposal for assistance from CDE in this area of post–harvest technology. Thus, there is an opportunity for women gardeners to benefit from SLEDIC's proposed project. This should provide women farmers with the opportunity to expand the areas under vegetable production and also expand their markets.

II.9. Major problems encountered include the drying up of some water sources during the dry season, the high labour rate (Le 2,500 per day) and the lack of cold room facilities for temporarily preserving vegetables after harvesting.

II.10. ***Moyamba District*** is located partly in the Savannah Woodland and partly in the Coastal Plains agro–climatic regions; has all four main types of inland valley swamps and has been the focus of UNDP/FAO demonstration swamps in which rice yields of 7 t/ha have been attained. A hydrological characterization of the IVS in several chiefdoms in this district, carried out by LWDD, shows that about 13–36 percent of the swamps are perennial, while 64–87 percent are seasonal; 18–50 percent of the seasonal swamps are flooded for up to 7 months. There are opportunities therefore for cropping these swamps under various water management practices.

II.11. ***Moyamba*** is one of two districts (Tonkolili being the other) that are regarded as the main maize producing areas of the country. A privately funded animal feed mill, once established in the district but vandalized during the war, is now being rehabilitated; the closeness to the mining company of Sierra Rutile Ltd and to NUC ensures ready access to potential markets for the sale of maize and/or vegetable crops.

II.12. ***Kenema*** is located in the rainforest agro–climatic region and has experience (of at least 10 years) with the first IDA–supported projects in IVS development. The IVS rehabilitation project that was supported by the IDB targeted 67 communities, although there are over 200 communities requiring rehabilitation of their swamps. The project's target was 16 ha per chiefdom or 256 ha for the district. However only about 73 percent (i.e. 188 ha) of the target was achieved.

II.13. Each farmers' association has a membership of 25–35, each community operating with one association. Sometimes 2 or 3 associations are brought together to work in one swamp, on a rotational basis with work on individual swamp plots. Supervision in IVS work is done by staff of LWDD. Some smart farmers pick up skills readily and they then take up the supervision of the construction.

II.14. A major problem is the lack of food to sustain farmers during swamp rehabilitation. This often limits the effective labour force to only six.

II.15. The LWDD is the main agent that has supervised the implementation of the swamp rehabilitation projects that were supported by the IDB in the above districts. Although this assistance has now been phased out, LWDD staff are continuing to monitor farmers' activities and interacting with the agricultural extension /women in agriculture personnel towards the provision of technical advice to both beneficiary and non–beneficiary farmers.

II.16. ***Western Rural Mountain District*** Farming in this district is dominated by market gardeners who have developed, over the years, innovative methods of land preparation, in an effort to utilise the characteristically mountainous farm lands. The mid slopes and crests of the valleys are terraced for the cultivation of a wide variety of crops, but predominantly lettuce, cabbage, radish and pepper. The market outlet is Freetown. Presently, a research project on peri–urban agriculture, sponsored by the *International Development Research Centre* (IDRC) and based at NUC, is being implemented in some of the villages in the district.

II.17. One major problem confronting the market gardeners is the drudgery involved in crop irrigation during the dry season: in several situations, gardeners are compelled to haul water upslope from the valley bottom for watering their gardens. This practice is very debilitating.

III. PROJECT RATIONALE

III.1. The upland–inland valley continuum is a very dynamic agro–ecology not only for food crop production but also as the ecology where high risk of degradation of the land resource and a depletion of the catchment's water resources can easily take place and have severe impact on the environment. One of the major technical reasons for the abandonment of the earlier developed IVS schemes was the inappropriate development approach which, in turn, was a consequence of the lack of understanding of the biophysical characteristics of this ecology. This approach, which aimed at complete development of every IVS using the same design, irrespective of IVS specific characteristics, resulted in some swamps with coarse textured soils becoming excessively drained. In some cases, such swamps reverted to bush after a few years. In other cases, the indiscriminate clearing of adjacent upland areas led to accelerated soil erosion, leading to siltation of reservoirs and clogging of peripheral canals and drains; this, in turn, negatively affected the hydraulic behaviour of developed swamps, resulting eventually in reduced crop yields. There is a need therefore to approach IVS development and/or rehabilitation and utilisation from the perspective of the whole catchment, encompassing the upland crests, slopes, valley fringes and valley bottoms.

III.2. Furthermore, given the water deficiency in the dry season, poor drainage, flooding of lowlands and the hazards of water erosion, water control and soil management measures remain the most suitable vehicle for future development. Such measures would help resolve many of the problems currently faced by the country and usher in the prospect of self–sufficiency, and eventually, possible export. The focus on the development of water control technology is also critical from the perspective that the traditional form of farming — shifting cultivation — is not sustainable in the long run, has serious implications with respect to the environment and needs to be modified. This focus is directly linked to CAADP Pillar 1 *(Extending the area under land management and reliable water control systems)* and complements Pillar 3 *(Increasing food supply and reducing hunger).*

III.3. The focus on land and water resources development is further buttressed by the *Vulnerability Assessment* carried out in 2002/2003 (MAFFS/FAO, 2003) which revealed that, among the causes for the low production levels of crops, are the lack of irrigation structures in rice swamp farming due to lack of maintenance during the conflict, and unfavourable climatic conditions, such as heavy or insufficient rains. Sierra Leone has a comparative advantage in domestic production of rice for import substitution, thereby providing economic justification for the country's emphasis on the attainment of self–sufficiency in rice production (see ASR). This therefore justifies the rehabilitation of existing, and the development of new inland valley swamps, since this agro–ecology has been found to have the highest potential (among all the swamplands) for contributing towards the realisation of this national goal.

III.4. Furthermore, with the increasing importance of small–scale market gardening, especially in the urban and peri–urban centres of the country, there is the need to upgrade the capacity of the operators in this sector of agriculture as most of these are women who are presently severely constrained by the lack of appropriate technologies.

III.5. Given the currently poor state of the country's hydrometeorological service, an improved network of agro–climatic stations can lead to more efficient agriculture by, for example, enabling the best seeding and transplanting times to be determined. In order to optimise agriculture, it is also necessary to have a good idea of crop water requirements, especially with respect to the development of irrigated agriculture in the Savannah woodland agro–climatic region and in other areas that are suited to this form of agriculture. Incidence of pest attacks and major plant diseases can be forecast by using climatic data. For all these purposes, it is essential that the country possesses a good network of climate and rainfall stations. The proposed project would provide for the strengthening of LWDD in

terms of re–equipping and expanding the coverage of the agro–climatic stations; upgrading the competencies of the existing technical staff, training of additional staff in water resources development at the higher level; and, providing for the training of the ultimate beneficiaries of the project, the farmers, in relevant aspects of agricultural water management.

III.6. Several projects have been formulated and/or are being implemented that will be reinforced by the proposed project. These include:

- The recent *Agriculture Sector Review* (ASR) identified a project on urban and peri–urban agriculture with the targeted beneficiaries being 1,000 women farmers and 50 youth groups.

- The *IAEA* is currently supporting a project on water management and has provided an initial set of micro–irrigation equipment (i.e. treadle irrigation pumps and drip kits) for pilot testing and demonstration — initial responses are very positive. With one treadle pump, a gardener can irrigate about 8 times the area that can be irrigated using the traditional watering can method, within the same time of about 20 hours per week. This technology can therefore make an immediate impact in parts of the country where there are viable associations engaged in intensive food crop production for both local and outside markets. However, experience elsewhere shows that, where such technologies have been introduced, significant human and financial resources are required to train and support the farmers who adopt these technologies. The on–going *Special Programme for Food Security* (SPFS) or *Operation Feed the Nation* (OFTN) was initiated to assist the country in improving food security. The initial focus is on raising the productivity of small–scale farmers farming, reducing inter–annual variation in output and expanding food access for families suffering from chronic hunger and malnutrition. The programme pursues this goal through the *Farmers' Field Schools* (FFS). A major component of the training carried out within the FFS is in water management, crop intensification and diversification.

- A project on the rehabilitation of IVS in seven other agricultural districts is in the pipeline, with the potential sponsor being the *African Development Bank* (ADB).

- CDE recently conducted a training course in Sierra Leone on the processing and preservation of fruits and vegetables. As a follow–up to this training, SLEDIC is currently preparing a project proposal for assistance from CDE in this area of post–harvest technology. Thus, there is an opportunity for women gardeners to benefit from SLEDIC's proposed project. This should provide women farmers with the opportunity to expand the areas under vegetable production.

III.7. There is a strong political commitment to agricultural development. The on–going exercise of preparing the *Poverty Reduction Strategy Paper* (PRSP) gives strong recognition to the pivotal role agriculture can play in the reduction of poverty. Several strategies and activities have been identified to achieve this, including: the adoption and dissemination of policies to encourage, among others, soil & water conservation and irrigation; identification and development of specialized ecologies for intensive food production through effective land use planning; development/rehabilitation of key lowland agro–ecologies for large–scale production of rice; promotion of multiple cropping and integrated agriculture including local and commercial vegetables. The project will therefore contribute to achievement of the central objective of poverty alleviation in the country.

III.8. Furthermore, there is now a draft policy on water resources management, whose objectives are to: undertake a comprehensive development of both underground and surface water resources for multi–purpose use; undertake measures for the control of erosion or floods and for watershed management, including afforestation and prevention of pollution of water bodies; and construct and maintain boreholes, irrigation and drainage systems and other works necessary for food production and human water needs. The project will contribute to achievement of the policy objectives.

IV. PROJECT OBJECTIVES

IV.1. The ***overall objective*** of the project is to develop and utilise the land and water resources of the country in a sustainable manner for increased agricultural production and watershed protection.

IV.2. The project has the following ***specific objectives***:

- To rehabilitate and put into food production previously developed/partially developed IVS;
- To promote small–scale community irrigation, especially by women market gardeners, for the production of non–rice food crops, as a contribution to food security and poverty reduction; and
- To strengthen institutional capacity in water resources management, with a focus on agriculture.

V. PROJECT DESCRIPTION

V.1. The project has three main ***components***:

- Rehabilitation of inland valley swamps and development of new swamps
- Promotion of small–scale community irrigation
- Strengthening institutional capacity in water resources management

V.2. These components constitute the first phase of a medium–to–long term programme on land and water resources development for agriculture. The components will be implemented in the short/medium term to address the urgent needs of the population in terms of food security and capacity building. The institutional strengthening component will lay the foundation for the initiation and implementation of follow up projects, which will focus on the establishment of a water resources commission and the development of large–scale irrigation schemes in identified suitable agro–ecologies for the production of crops for home consumption and for export.

V.3. The three components will be implemented concurrently but in stages as far as location is concerned. The IVS rehabilitation component will be implemented in Port Loko, Moyamba, Koinadugu and Kenema districts while the small–scale community irrigation component will be implemented, in Koinadugu, Port Loko, Moyamba and Mountain Rural districts with possible extension to Kenema district at a later stage. The specific goals and activities of these components are outlined below.

Component 1: Rehabilitation of Inland Valley Swamps and Development of New Swamps

V.4. This component is linked directly to CAADP Pillar 1 (*Land and water Management*), with a complementary linkage to CAADP Pillar 3 (*Increasing Food Supply and Reducing Hunger*). It will be implemented in two phases, as outlined below.

Phase 1: Rehabilitation of Developed Inland Valley Swamps

V.5. The goal of this sub–component is to bring back into production 10,300 ha of swamps that have so far not been rehabilitated in the four districts. The aim is to raise rice production levels in the districts as quickly as possible, as a contribution to the achievement of the national goal of food availability. The above target can be achieved within 2 years, for an effective working period of 12 dry–season months (i.e. January–June each year) and at an average of about 208 ha per month per district or an average of 2,500 ha per district. This would benefit directly about 17,200 farmers (or a total households population of about 137,600).

Phase 2: Development of New Swamps

V.6. The goal of this subcomponent is to develop and put under rice production about 14,400 ha of new and potentially developable IVS in the target districts, over a period of 3 years. By the end of the project (i.e. year 5), a total of about 24,700 ha of IVS would have been fully equipped for both rain–fed and irrigated rice production. Cropped to rice varieties such as ROK 11, ROK 14, ROK 31, and ROK 32, which are suitable for double cropping, this combined area would contribute about 173,000 metric tons paddy per annum. This phase would benefit directly about 24,000 farmers (or a total households population of 192,000).

Activities for Both Phases

1. Inventorise, select and survey swamps

V.7. Surveys will be carried out in each district to identify the location of developed swamps that are to be rehabilitated and virgin swamps that are to be developed including the farmers' associations that are using these swamps. Existing area and topographic maps, backed by additional surveys, where necessary, will be used to determine the actual magnitude of the rehabilitation/development work to be accomplished.[1] LWDD also has its technical personnel in all the districts and has been responsible for implementing the IDB–funded rehabilitation projects. The rehabilitation is expected to involve head bunds, internal bunds, regulators and some levelling.

V.8. Factors to be considered in the identification of undeveloped swamps for new development would include: nature of the water regime, potential number of croppings per year, current state of utilization (if any), farmers' set up ability and community organization. Depending on the type of swamp (i.e. cultivated or virgin), land clearing may be done on selected swamps, followed by detailed engineering and soils surveys for the purpose of designing appropriate water control facilities.

[1] Preliminary visits have already been made to at least three developed and partially rehabilitated swamps (5–10 ha in size) in each of the districts. The visits were made during the period 19–24 July 2004 which coincided with the period of peak swamp cultivation. All the communities utilising these swamps had viable farmers' associations that possessed experience in swamp development/rehabilitation.

V.9. For the purpose of assessing the suitability of swamps for water control development, certain water availability indices are computed for agro–climatic stations in the targeted districts. These parameters are then considered together with recognized categorizations of IVS in terms of their surface water regime and soil physical properties. A summary of the water availability indices is given in Annex 3. Site specific surveys and measurements of selected swamps will be carried out in order to obtain data that will be required for the design of each swamp.

V.10. Categorization of IVS, in terms of their amenability to water control development, which has been made on the basis of the observations and results of recent characterization studies carried out in a few key sites in the country, is summarized in Annex 4.

2. Train swamp construction facilitators

V.11. Presently, facilitators are being trained, nation–wide, in various aspects of rice production, using the FFS, as part of the OFTN, and under the sponsorship of MAFFS and FAO. These facilitators will be identified in each district/area and given appropriate training/refresher training in the basic aspects of swamp rehabilitation and/or development. The target will be one facilitator per swamp site/community. After graduation, the facilitators will be empowered to train 20–30 farmers in their various localities. Training will be scheduled to coincide with normal land development activities in each locality. LWDD's land and water resources technical staff in each district will serve as trainers/resource persons. The training will focus on the acquisition of technical skills in swamp construction and in the management of runoff water during the rainy season.

3. Plan and supervise the field construction

V.12. This will involve determining quantities of earth work required after field layouts have been prepared, estimating realistic targets based on farmers' ability, and the mobilization of the farmers. It is estimated that, on average, about 1,000 m of internal and peripheral bunds per hectare would be rehabilitated/constructed. The bulk of the labour force will be provided by the farmers, while the supervision of the construction will be done through arrangements with the technical staff of LWDD assigned to each district. The project would make suitable arrangements for the farmers to access *Food for Agriculture* (Ffag) inputs that may be available in each district or locality. The *World Food Programme* (WFP) has given a strong commitment to support this agricultural activity once details of specific plans and requirements are made available to them and as long as the project covers large areas.

4. Provide farmers with crop production and post–harvest facilities

V.13. The aim of activities 1–3 is to build up the capacity of farmers so that they can undertake the production of rice and other food crops in their respective communities. In order to enable farmers make full use of the rehabilitated swamps, there will be a need to provide them with production inputs such as seed rice, fertilizers, and support facilities such as single–axle tractors (or power tillers), small–scale crop processing machinery, crop drying floors and stores. The drying floors and stores that had been constructed in some communities will become inadequate as more swamp area is rehabilitated. At least one drying floor and one store will be constructed in communities that do not have these facilities. The size of these facilities will be determined on the basis of the crop quantities to be handled in each community. These inputs and facilities will be provided through a loan scheme, managed by appropriate rural financial institutions.

V.14. Specific training courses will be organized for the operators of agricultural machinery in relevant aspects such as operation, care and maintenance of equipment. The operators will be identified and selected by the farmers themselves.

V.15. The anticipated facilities for the activities of Component 1 above are summarized in Table 5.

Table 5: Developed IVS areas and facilities to be provided under Component 1

District	IVS area under rice production (ha)	Facilities to be provided (in numbers)				
		Power tillers	Rice threshers	Rice hullers	Multipurpose stores	Drying floors
Port Loko	5,700	120	40	76	11	11
Koinadugu	7,800	160	55	104	15	15
Moyamba	5,300	110	38	70	10	10
Kenema	6,100	125	44	80	12	12
Total	24,900	515	177	330	48	48

V.16. The distribution of the targeted areas by District is shown in Table 6.

Table 6: Area of Swamps Targeted for Rehabilitation and Development

District	Phase 1 (years1–2)	Phase 2 (years 3–5)	
	Rehabilitation (ha)	*Developable (ha)*	*Targeted (ha)*
Moyamba	2,100	33,170	3,143
Kenema	3,100	31,203	2,957
Port Loko	2,800	29,829	2,827
Koinadugu	2,300	57,766	5,474
Total	10,300	151,968	14,401

Outputs of Component 1

Table 7: Rice (Paddy) Production per Year under Component 1

District	Phase 1 (years1–2)		Phase 2 (years 3–5)	
	Area rehabilitated (ha)	*Production (mt)*	*Area developed (ha)*	*Production (mt)*
Moyamba	2,800	8,400	2,900	8,700
Kenema	2,300	6,900	5,500	16,500
Port Loko	2,100	6,300	3,200	9,600
Koinadugu	3,100	9,300	3,000	9,000
Total	10,300	30,900	14,600	43,800
Note: Assumed 2 crops per year and average yield of 1.5 mt/ha per crop.				

<u>Component 2:</u> Promotion of Small–scale Community Irrigation

V.17. This component is linked directly to CAADP Pillar 1, with complementary linkages to Pillar 3 and Pillar 4 (*Agricultural Research, Technology Dissemination and Adoption*)

V.18. The component will have three sub–components: introduction and dissemination of ***micro–irrigation technologies***; introduction of ***water harvesting technology***; and, implementation of a pilot activity in the ***processing and marketing of food/cash crops***. As the first two sub–components involve new technologies in Sierra Leone, they will be implemented, initially, as pilot activities in selected communities in the targeted districts. The aim will be to identify key determinants for the successful

dissemination of these technologies to other areas, and to assess economic viability of the use of the technologies. The preliminary introduction of the treadle pump to a few farmers in the Western Area of the country indicate that, technically, the pumps will fit into current production activities and make an impact in terms of alleviating the drudgery involved in crop irrigation and in the expansion of cultivated acreages.

Sub–component 2.1: Introduction and Extension of Simple Irrigation Technologies

V.19. This sub–component is linked directly to the *Technology Dissemination and Adoption* component of CAADP Pillar 4. The main focus is the modernization of current traditional methods of irrigated crop production (i.e. use of the bucket/watering can manual technology) by introducing simple, low–cost technologies that would help to remove the drudgery from labour while also expanding the cultivable area.

V.20. The goal of this sub–component is to equip 5,000 women gardeners in the targeted districts with 1,250 sets of micro–irrigation pumps, shallow tube wells and reservoirs in order to enable them intensify the production of food/cash crops in existing lands.

Activities

1. Identify and select participating women's groups

V.21. The targeted women gardeners will be selected in stages and in proportion to suitable available IVS areas and/or the intensity of cash crop production activities during stage 1. Two thousand women will be selected from the various groups in each district as follows: 500 from Koinadugu, 500 from Port Loko, 300 from the Mountain Rural district, 300 from Moyamba and 400 from Kenema district The experience gained in stage 1 will be used to select an additional 3,000 gardeners in each district during stage 2. The selection will be carried out by the women leaders and their executives with the guidance of project implementers and local leaders. Important factors such as loan repayment ability of individual groups will be considered in the selection process.

2. Introduce and demonstrate irrigation technologies.

V.22. The technologies will comprise appropriate medium micro–irrigation systems such as *Super Money Maker Plus Micro–irrigation* pump from *Appropriate Technology for Enterprise Creation* (APPROTEC) of Kenya, shallow tube wells and concrete and/or plastic reservoirs. This activity will be carried out in farmers' community gardens in each district using the FFS approach. The purpose would be to raise awareness about the existence of the technologies and to make initial assessment of the requirements, interests and number of the potential beneficiaries. The demonstration will feature the different modes of applying the irrigation pump for crop irrigation and, possibly, for other uses such as livestock watering; and it will be carried out in fields having different layouts, topography and sources of water.

3. Train farmer facilitators

V.23. This activity will be implemented in 10 association/group farms in each district. In order to avoid the current practice of excavating many wells in a developed swamp, small–diameter, shallow tube wells will be developed at strategic locations in each swamp site in such a way that one well–

and–pump set would serve 4 farmers. The most appropriate lay out would be adopted based on topography and layout of plots.

V.24. Two farmers will be selected from each association/group farm to take part in a training course, which will focus on the correct installation, operation, care and minor routine maintenance of the irrigation systems; crop agronomy (seed bed preparation, nursery care, compost making, the use of green manures, fertilizer application); and, irrigation water management. Training will be done during the dry season to coincide with the peak period of vegetable production. In addition to farmer facilitators, interested local artisans having the potential for providing major repair services to farmers will be trained in the repair of certain components of the irrigation technologies.

V.25. Following this initial training, each graduate facilitator will be assigned to one group of 30 gardeners in each district for the purpose of training the latter. Each trainer will be provided with a pump and other hardware to facilitate the training course. Project personnel will monitor the performance of the trainers and provide any assistance that may be required.

4. Provide farmers with micro–irrigation technologies and other production inputs

V.26. Individual as well as groups of farmers will be provided with credit for one pump–well–reservoir set, which will be installed in gardens in the targeted pilot locations to enable these farmers undertake crop production. Farmers will also be provided with seeds and fertilizers by credit institutions as in Component 1.

5. Monitor the use and performance of the systems

Sub–component 2.2: Introduction of Water Harvesting Technology

V.27. This sub–component is linked directly to the *Technology Dissemination and Adoption* component of CAADP Pillar No. 4.

V.28. The goal is to develop 5 "tanks"/farm ponds in feasible swamp sites in Moyamba district to serve a pilot area of 20 ha each. Moyamba district is selected for this pilot activity because hydrological characterization data show that it has all 4 types of IVS, which have been categorized in terms of their water regime.

V.29. The sub–component will be implemented in seasonal swamps sites that have a potential for supporting an extra crop of rice/other food crop by using runoff water stored in a "tank" or farm pond. The inland valleys constitute an appropriate ecology for impounding both direct precipitation and runoff during the period of declining rains. The impounded water can later be used for the irrigation of crops grown downstream in the valley bottom or it can be lifted using the micro–irrigation pumps in sub–component 2.1 above, for irrigating crops grown on the slopes and fringes of the inland valley. The water can also be used for establishing fast –growing tree species on the crests, thus conserving this part of the landscape.

Activities

- Identify and select suitable swamp sites;
- Survey selected sites and design water harvesting facilities;

- Mobilise and train beneficiary farmers in basic construction skills;
- Undertake and supervise construction;
- Train farmers in the operation and maintenance of the facilities;
- Empower farmers to undertake crop production activities;
- Monitor the use and performance of the systems.

Outputs of Component 2

V.30. The anticipated facilities needed and outputs from the activities of the above component are summarized in tables 8 and 9.

Table 8: Number of Beneficiaries and Facilities to be Provided under Component 2

District	Phase 1 (years 1–2)				Phase 2 (years 3–5)			
	Gardeners	*Pumps*	*Wells*	*Reservoirs*	*Gardeners*	*Pumps*	*Wells*	*Reservoirs*
Port Loko	500	125	125	125	750	188	188	188
Koinadugu	500	125	125	125	750	188	188	188
Moyamba (*)	300	75	75	75	450	113	113	113
Kenema	400	100	100	100	600	150	150	150
Mountain Rural	300	75	75	75	450	113	113	113
Total	2,000	500	500	500	3,000	752	752	752

(*) The water harvesting sub–component, which will be implemented only in Moyamba district, is estimated to cost about US$12,000 for 5 farm ponds and to directly benefit 50 farmers in the district.

Table 9: Vegetable Production from Small–scale Irrigation Activities

District	No. of gardeners	Area cropped (ha)	Crop yield (mt/ha)	Production (mt)
Port Loko	1,250	250	0.94	235
Koinadugu	1,250	250	1.09	273
Moyamba	750	150	1.00	150
Kenema	1,000	200	1.00	200
Mountain Rural	750	150	1.00	150
Total	5,000	1,000		1,008

V.31. The small–scale community irrigation component of the project is expected to benefit directly about 5,050 small–scale market gardeners (or a total households population of about 40,400) in the targeted districts.

Credit Arrangements for Components 1 and 2 of the Project

V.32. The experience in Sierra Leone on the delivery of credit to farmers, generally, makes dismal reading. Several studies have identified the main problems associated with this poor performance of credit delivery mechanisms. One of the main ones is the lack of bankable collateral by small farmers to enable them access credit. IVS farmers are no exception. This project will have a credit component, which will help to provide a basis for continuity of the activities of two of the components of the project, the IVS rehabilitation/development and utilisation component and the small–scale community irrigation component.

V.33. In addition, it is important that we have in place successful innovative products that are sustainable and can be replicated in other areas where IVS are located with a view to alleviating the problems associated with financial exclusion of small holder producers in the rural communities.

V.34. The majority of Sierra Leoneans live and work in the rural areas of the country. In spite of this, formal financial institutions have not, up to the turn of the century, provided adequate financial services within these areas. Banks contend that the incomes derived from these services in rural areas are very low compared to the costs involved. Furthermore, the poor infrastructure, low population density, high levels of illiteracy and limited business activities further restrain formal financial institutions from addressing the financial needs of the rural population. On the other hand, rural inhabitants face high transaction costs in travelling to the nearest bank and often can not meet the minimum requirements set by the banks for their services such as: opening of savings accounts and or securing a loan. A general problem is the inability of many low–income earners to meet lenders' collateral requirements.

V.35. Two main sources of rural financial services exist in Sierra Leone: the formal, which is regulated by the Bank of Sierra Leone, and the informal, which operates unofficially without regulation. This sector, which comprises a multitude of different institutions and activities, plays a more significant role in the rural economy than does the formal sector. Small holder producers often rely on the informal sector for their financial needs.

V.36. Among the institutions that have been established for providing financial services are the *National Cooperative Development Bank* (NCDB) and the Community banks. The NCDB has developed an instrument for disbursing loans to individuals or groups through a *barray*, a local name for a meeting place for chiefs and elders or a group with the same objective. The group or *barray* constitutes up to 25 but not more than 30 individuals. Through this mechanism, NCDB had, by the end of 2001, disbursed 3,500 loans. The total amount disbursed was over Le 600 million, 90 percent of which was micro finance type credit. It is expected that NCDB will soon venture into the rural areas in the regions with this new product. If NCDB establishes contact with the districts that are targeted in this project, it would be necessary for the farmers associations/groups identified to be linked with the organisation in order to facilitate access to available funds.

V.37. Farmers/trader groups already exist in the targeted districts of this project and there is evidence that some of these groups are already involved in some forms of *Rotating Savings and Credit Associations* (ROSCAs). Their knowledge of how a ROSCA operates, its perceived advantages and imperatives, makes it a more acceptable and better understood channel for credit to the small–scale farmers who are targeted in this project. This experience will be utilised by the Project to establish a financial service for use by the farmers.

V.38. For the purpose of assisting farmers to access resources to implement the components of this project, a *Credit Revolving Fund* (CRF) will be established, with a starting value of about 20 percent of the cost of the IVS and small–scale community irrigation components, from which farmers' groups could be provided with credit to finance their activities. The CRF will endeavour to utilise the modus operandi of NCDB's *barray* system. Factors that will be considered in the disbursement of loans will include: size of the group, acreage to be rehabilitated/developed/cultivated. As far as possible, farmers will be encouraged to pay market interest rates to make sure that the Fund maintains its purchasing power over time.

Component 3: Strengthening Institutional Capacity in Water Resources Management

V.39. This component is linked to CAADP Pillar 4. The goal is to build the capacity of relevant local institutions for the more effective planning and implementation of water resources development.

Activities

- Convert LWDD into a *Smallholder Irrigation Development Authority* (SHIDA);
- Rehabilitate LWDD's existing agro–meteorological stations;
- Expand the coverage by establishing additional agro–met stations in key agro–ecological zones;
- Upgrade the skills of LWDD senior personnel and field technicians in agro–met data collection, recording, processing, packaging and dissemination;
- Train additional senior personnel in water resources development at higher level;
- Establish hydrological equipment in key lowland agro–ecologies for continuous stream gauging and monitoring;
- Facilitate the establishment of a *Water Resources Centre* (WRC) at NUC.

V.40. The above activities will be phased as shown in Table 10.

Table 10: Phasing of the Activities of Component 3 of the Project

Activity	Years of implementation				
	1	2	3	4	5
1. Establish *Smallholder Irrigation Development Authority* (SHIDA)	X	X			
2. Rehabilitate/ Expand Agro–met stations	X				
3. Upgrade skills of technicians	X				
4. Upgrade skills of senior staff		X			
5. Train additional senior staff to M.Sc. level		X	X		
6. Install Hydrological equipment			X	X	X
7. Establish *Water Resources Centre* at NUC		X	X		

V.41. The proposed SHIDA would be a semi–autonomous, parastatal organisation mandated to plan and implement this project, as well as the engineering and socio–economic aspects of land (i.e. upland and lowland) and water development projects at the smallholder sector of agriculture. It will have the authority to identify and source funding from donor/private organizations and have access to an agricultural development fund for its day–to–day activities. Both SHIDA and the WRC, will collaborate in planning and implementing the following activities:

- Provide the Project Management Unit for this project
- Train field technicians in data collection, recording and processing
- Mount short–term training courses for agricultural extension personnel and farmers in relevant aspects of water management

- Develop a comprehensive package for the development of the country's surface and ground water resources
- Undertake relevant R &D projects in water resources assessment, planning, development and monitoring (with a focus on bolilands, riverain grasslands and IVS).
- Establish linkages with other organizations, such as the *International Water Management Institute* (IWMI), for collaborative activities in agricultural water management.

Outputs of Component 3

V.42. The anticipated outputs are summarised in Table 11.

Table 11: Anticipated Outputs from the Activities of Component 3 of the Project

Activity	Outputs
1. Establish and empower *Smallholder Irrigation Development Authority* (SHIDA)	LWDD converted to SHIDA and equipped with hydrological and land resources mapping facilities for implementing projects
2. Rehabilitate existing Agro–met stations	10 rehabilitated and re–equipped Agro–met stations
3. Expand coverage of Agro–met data collection	2 new stations established and commissioned
4. Upgrade data collection skills of LWDD field technicians	24 water/land resources technicians trained in hydro–met data collection and processing
5. Upgrade skills of senior water resources personnel	2 existing senior staff trained in relevant aspects of water resources management
6. Train additional senior staff in water resources planning and management	2 new staff trained in water resources to M.Sc. level
7. Facilitate establishment of *Water Resources Centre* (WRC) at NUC	WRC established and empowered to undertake training, Research & Development activities in water resources management

VI. ESTIMATED PROJECT COSTS

VI.1. The costs of the various components of the project, together with the contributions by the identified partners are summarized in the table below. The details of these costs are given in Tables 1–5 of Annex 2.

Summary Costs of the Project (US$)

Component	Financing Institutions	GOSL contribution	Beneficiaries' contribution	WFP contribution	Total	% Total Base Costs
1. IVS Rehabilitation and Development	16,807,000	1,681,000	5,507,000	2,117,000	26,112,000	84
2. Small–scale Community Irrigation	734,000	3,000	4,500		741,500	2
3. Strengthening Institutional Capacity	1,096,000	15,500			1,111,500	4
4. Project Management (15 %)	2,796,675	254,925			3,051,600	10
Total Baseline Costs	21,433,675	1,954,425	5,511,500	2,117,000	31,016,600	100
Contingencies (5 %)	1,071,684	97,722		105,850	1,275,256	4
Total Costs	22,505,359	2,052,147	5,511,500	2,222,850	32,291,856	104

VII. PROPOSED SOURCES OF FINANCING

VII.1. The expected financiers of the project are:

- ***World Food Programme*** (WFP) has indicated a strong interest to support the IVS rehabilitation/development component of the project by providing *"Food for Agriculture"* (Ffag) packages to enable farmers carry out the field activities. They are interested, however, in only large rather than piece–meal development activities.

- The ***International Atomic Energy Agency*** (IAEA) can be requested to partly support the small–scale community irrigation sub–component of the project, through their *Technical Cooperation Programme* (TCP). The Agency may provide additional treadle irrigation pumps and similar technologies that can be used for the pilot activities in the targeted districts. IAEA maintains a Reserve Fund for which application can be submitted at any time during the year. Project requests can be submitted for an amount of up to US$50,000 per project.

- ***Islamic Development Bank*** (IDB) and ***European Union*** (EU) have supported IVS development/rehabilitation projects in several districts in the country, including the provision of logistics and the training of farmers and/or swamp development designers and implementers. The two organisations can be requested to re–focus and extend the coverage of their support to the targeted districts in order to benefit a greater number of farm families.

- ***African Development Bank*** (ADB) has earmarked about US$15 million for the *Agricultural Sector Rehabilitation Project* during the period 2005–2009. The main objective of the project is to reduce poverty and enhance food security. Another project that is also to be supported by the Bank and which will complement the IVS rehabilitation/development component of this proposal is the *NERICA Rice Dissemination Project*, which aims to contribute to poverty reduction and food security through enhanced access to high yielding NERICA rice varieties.

- ***Government of Sierra Leone*** (GOSL): contribution is expected to be the re–assignment of agriculture personnel as counterpart staff for the management and implementation of the various components of the project. Staff are expected to include subject matter specialists in: agronomy, irrigation and water management, agricultural mechanisation and post–harvest technology; provision of office space for the project management team; waiver or reduction of import duties on project's agricultural machinery and other inputs.

- ***Department for International Development*** (DFID) is supporting a *Knowledge and Research* (KAR) *Programme* globally in water resources and in other areas of development. Its Water and Sanitation research is focused on several themes including: improved assessment, development and management of water resources; improved availability of water for sustainable food production and rural development. DFID, together with its development partners, can be requested to partly fund the establishment of the *Water Resources Centre* at NUC and some of the identified research activities that will be undertaken by the WRC and SHIDA.

- ***Other*** multilateral and bilateral funding agencies committed to financing the PRSP of Sierra Leone.

- ***Beneficiaries:*** specific contributions will include: (a) the provision of community labour for the implementation of the IVS rehabilitation/development activities; the construction/installation of small–scale lift irrigation hardware (i.e. pumps, tube wells, reservoirs); the construction of farm ponds; (b) the provision of some building materials (i.e. bush poles, sand) required for the construction of community stores, farm ponds, crop processing sheds, etc.; and (c) the formation of water users' groups within existing farmers' associations for the maintenance of rehabilitated/developed swamps.

VIII. PROJECT BENEFITS

VIII.1. The main beneficiaries of this project would be:

- The vulnerable farm families in the rural areas, through increased availability of food;
- Women market gardeners: reduced drudgery, increased household incomes, potentially better nutrition and improved health status at household level;
- Youths in the rural areas who will benefit from increased employment opportunities in the areas of: the use of crop production and post harvest machinery, the development of a community–based cadre of farm machinery maintenance technicians, the construction of stores and the installation, operation and maintenance of lift irrigation technologies;
- Enhanced technical capacity at the rural level in the areas of swamp construction, water management, equipment operation and maintenance;
- The development of permanent irrigation facilities at the various swamp sites is expected to contribute to the conservation of the natural resource base by minimizing the current practice of indiscriminate construction of many dugouts in inland valleys;
- Overall, the project would further bolster, at the community level, the re–integration efforts of government and its international donor partners;
- The total number of farmers who will benefit directly from the swamp rehabilitation/development and small–scale community irrigation components of the project is 46,250, in all the targeted districts;
- The analysis done for the IVS component (given in Annex 2), which is the largest of the three components, shows that with double cropping of about 24,400 ha of rehabilitated and new swamps, the project could realise a positive net present value, indicating that this component is viable.

IX. IMPLEMENTATION ARRANGEMENTS

IX.1. There will be a two–tier structure for the administrative management and technical execution of the project, with the MAFFS having overall responsibility for project execution. The project will be managed by a newly established *Smallholder Irrigation Development Authority* which would have a team of senior professionals recruited from outside, and local professional counterparts who could be re–assigned from MAFFS or contracted outside the Ministry specifically for the project.

IX.2. A technical implementation team will be drawn from professionals in Irrigation, Water resources development, Crop production, Post–harvest mechanization and Agricultural extension. The team will be responsible for planning and implementing all the technical aspects of the project, including: the identification of the potential participating communities, the conduct of surveys, design and construction, mobilization and training of farmers, scheme and machinery operation and maintenance.

IX.3. The technical team will have the mandate to identify suitable local contractors or work gangs from within the various communities in each district and make appropriate recommendations for their engagement on contractual terms.

IX.4. The main responsibility of the beneficiating communities is the organization of their members for effective participation in the activities of the project in their respective locations. In order to ensure sustained commitment by the beneficiaries, their leaders (i.e. chiefdom/village farmers' association executives and local government authorities) will be encouraged to be part of the planning team at that level. Through these leaders, the beneficiaries will be required to pay for some of the irrigation facilities that would be developed in their locations, and contribute towards their maintenance. Payment for the lift irrigation hardware will be phased over the life of the project. Such commitments will be obtained by means of signed agreements, which will be endorsed by the local leaders.

X. TECHNICAL ASSISTANCE REQUIREMENTS

X.1. The major Technical Assistance inputs that would be required, in the medium/long–term, for project management and implementation are as follows:

- ***Overall Project Management***
  - One agronomist;
  - One socio–economist;
  - One financial controller;
  - One agricultural engineer (expertise in small–scale irrigation and water management projects).
- ***Technical Implementation***
  - One land and water resources development specialist;
  - One irrigation engineer;
  - One land use specialist;
  - One environmental specialist;
  - One agricultural engineer (mechanization/post–harvest).

X.2. In addition to the above requirements, an expert would also be required to advise on and assist in setting up a water resources authority, under Component 3 of the project, and water users' associations. This expert will be contracted for only a short–term assignment, i.e. 2–3 months.

XI. ISSUES AND PROPOSED ACTIONS

XI.1. ***Environmental Concerns.*** This project will involve the development of some 14 400 ha of new swamps in the targeted districts. During the initial phases of IVS development in the sixties and seventies, mistakes were made in swamp selection, design and construction that led to severe degradation of the land resource. This was due mainly to a lack of understanding of the bio–physical and socio–economic aspects associated with each swamp type and community. There was also the political urge to develop every swamp, irrespective of its inherent capability.

XI.2. This approach has now changed and LWDD has the staff, albeit lopsided in structure and inadequate in number, with the requisite experience to undertake the required studies to identify and select swamps for development/improvement. Furthermore, environmental monitoring in developed/rehabilitated swamps will now become part of the routine activities of LWDD; this will be facilitated by the establishment of hydrological measuring equipment in key swamps, and by the training of field technicians in data collection and reporting.

XI.3. ***Introduction of New Micro–irrigation Technologies into the Farming System.*** The use of micro–irrigation pumps and farm ponds in the present farming system is relatively new among farmers in Sierra Leone, especially the former. The introduction of these technologies is expected to induce some changes in the socio–economic set up within farm families, with respect to the realization of increased incomes from the sale of products by women market gardeners. Furthermore, experience elsewhere has shown that where such technologies are introduced for the first time, beneficiaries will have to be supported technically during the first few seasons of production through field visits and advice. These issues will be dealt with by adequate sensitization of all participants, including spouses and community leaders. Regular visits by agricultural extension personnel and interaction with farmers will ensure the exchange of information.

XI.4. ***Sustainability of Technologies.*** The useful life span of the micro–irrigation pumps is about 5 years which is also the life of the project. There will be the need to ensure that the technologies do not "die" with the phasing out of project inputs, and that farmers do not allow developed swamps to revert to "bush" after the project is phased out. Beneficiaries will be urged to contribute towards defraying part of the development/investment cost of the technologies so that, where appropriate, the accumulated funds can be used to procure additional technologies and/or to develop new ones locally. Emphasis will also be placed on the training of farmers in technology maintenance. Identified and interested artisans in the respective communities will be trained in the repair of the micro–irrigation pumps.

XI.5. Furthermore, the project's implementation team would encourage and facilitate the formation of water users' groups within existing farmers' associations. In order to ensure early success, such groups would be formed at the level of the catchment so that all farmers/other users of water within the catchment become members of the group. Each such group will be encouraged to develop by–laws which can be incorporated into the by–laws of the participating communities.

XI.6. Quite a wide range of types of crop production and post–production processing machinery will be made available for use by the beneficiary farmers. To ensure proper use and maintenance of the machinery, project management will facilitate the formation of viable teams of machinery operators and maintenance technicians in the various communities. These teams will be provided with adequate tools to enable them maintain the machinery. A suitable reward system will be agreed with the beneficiaries.

XI.7. ***Inducement Packages.*** Interaction with field officers involved in past swamp rehabilitation projects revealed that *"Food for Agriculture"* (Ffag) packages were a motivating factor in getting farmers to work longer than normal hours in the projects. Where farmers did not have access or have very limited access to such packages, they would spend very little time on the project, being compelled instead to spend the "extra" hours in search of food for their families. In order to access Ffag packages, WFP and other interested organizations will be requested to provide participating farmers with the required food packages during project implementation. The packages could be tied to the achievement of specified targets in swamp rehabilitation or development.

XII. POSSIBLE RISKS

XII.1. The Government plans to establish a senior executive cadre in the Civil Service, with improved conditions. Should the proposals be implemented, it could minimise staff attrition in the new SHIDA as well as in MAFFS, especially at LWDD, which had suffered from this in the past. Failure to improve work conditions generally in the country, or to provide additional incentives to re–assigned staff, could affect project implementation adversely.

XII.2. The anticipated increases in crop production, especially of non–rice food crops, through the use of the new irrigation technologies, could pose problems for marketing the surplus produce. The lack of adequate market outlets will serve as a disincentive to farmers to fully take advantage of the new developments in water management.

XII.3. The establishment of a smallholder irrigation development authority will require political commitment on the part of government, backed by the requisite legislation. Failure to take the steps required for the creation of such authority may not give the proper focus that the sector deserves.

XII.4. The assumption that increased rice production would come from double cropping developed swamps is dependent on a number of other assumptions, such as the timely availability and affordability of production inputs — fertilizers, seeds. The lack of these inputs has hampered full utilization of previously developed swamps. Project management, with the collaboration of NAFSL, will ensure the timely procurement and availability of these inputs.

XII.5. For developed swamps to achieve their expected output, farmers would need critical support, especially in terms of sustainable credit mechanism. The ability of the rural financial sector to meet the challenges is a risk factor for this project

XII.6. Bureaucratic red tapes, such as delays in granting duty waivers, can adversely affect implementation schedules. Government should ensure that such delays do not arise.

XII.7. The provision of rural financial services to smallholders is inherently costly in reaching a large number of spatially dispersed producers. Infrastructure and communication are poor, which further increases cost.

XII.8. Smallholder producers' capacity to save or pay economic process for financial services is limited and is caught in a vicious cycle of incapacity.

ANNEXES:

Annex 1: Maps of Sierra Leone and the Project Area

Annex 2: Estimates for the Components of the Project

Annex 3: Water Availability Indices for Climatic Stations in the Targeted Districts

Annex 4: Categorisation of and Approach for the Development of New Inland Valley Swamps

Annex 5: Financial Analysis for the Inland Valley Swamp Component of the Project

Annex 1: Maps of Sierra Leone and the Project Area

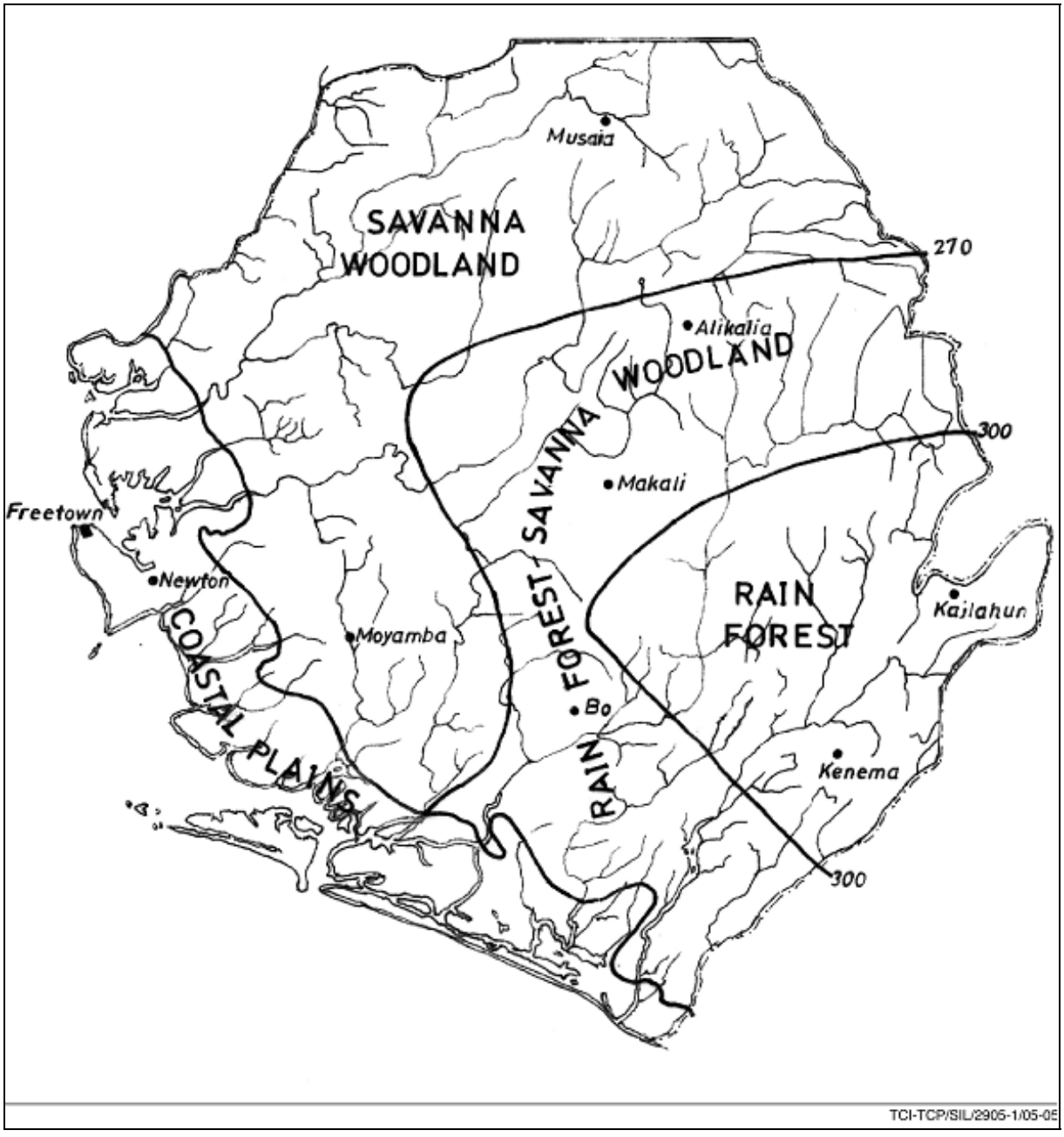

Figure 1: Agroclimatic Regions of Sierra Leone

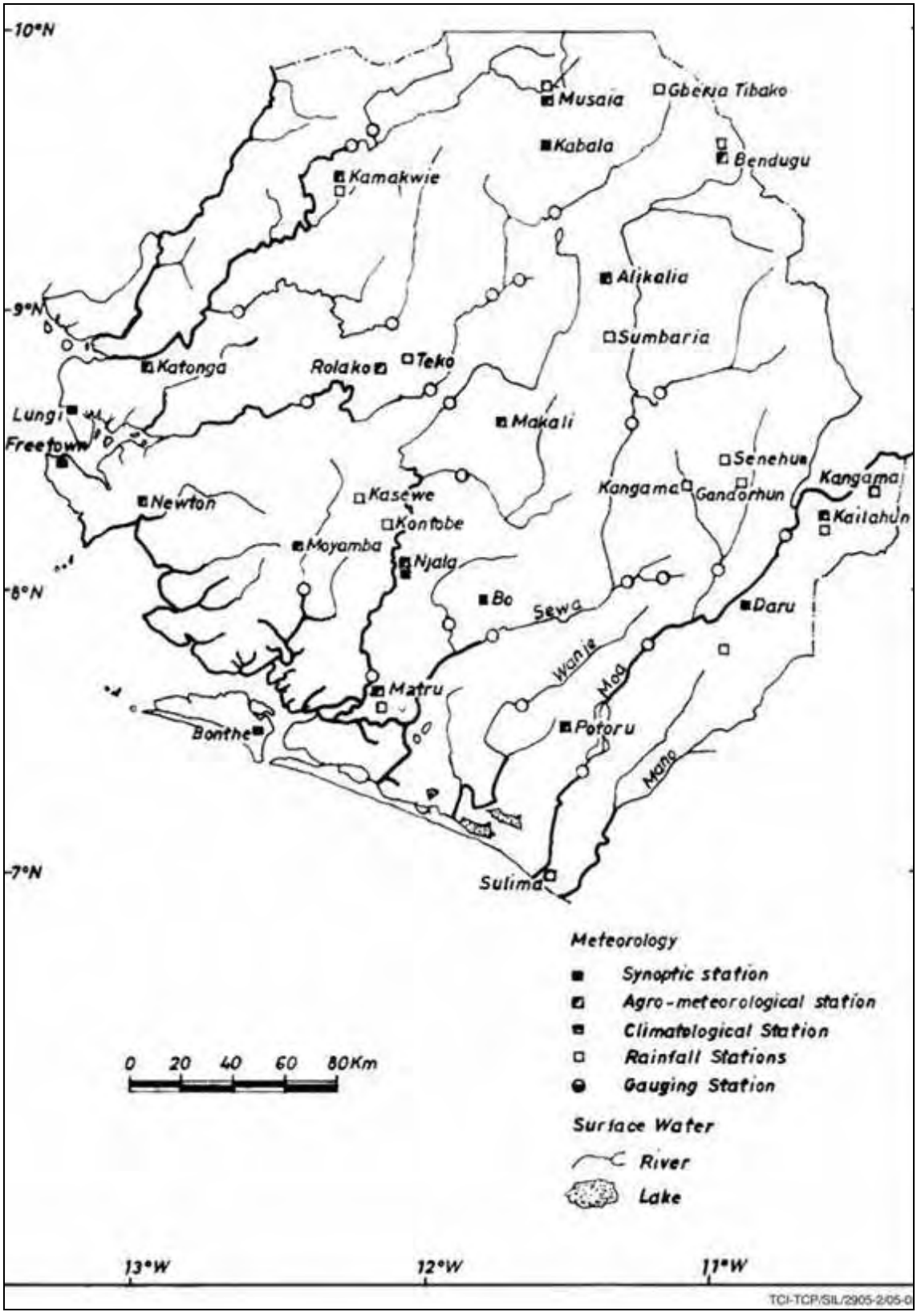

Figure 2: Hydrometeorological Map of Sierra Leone

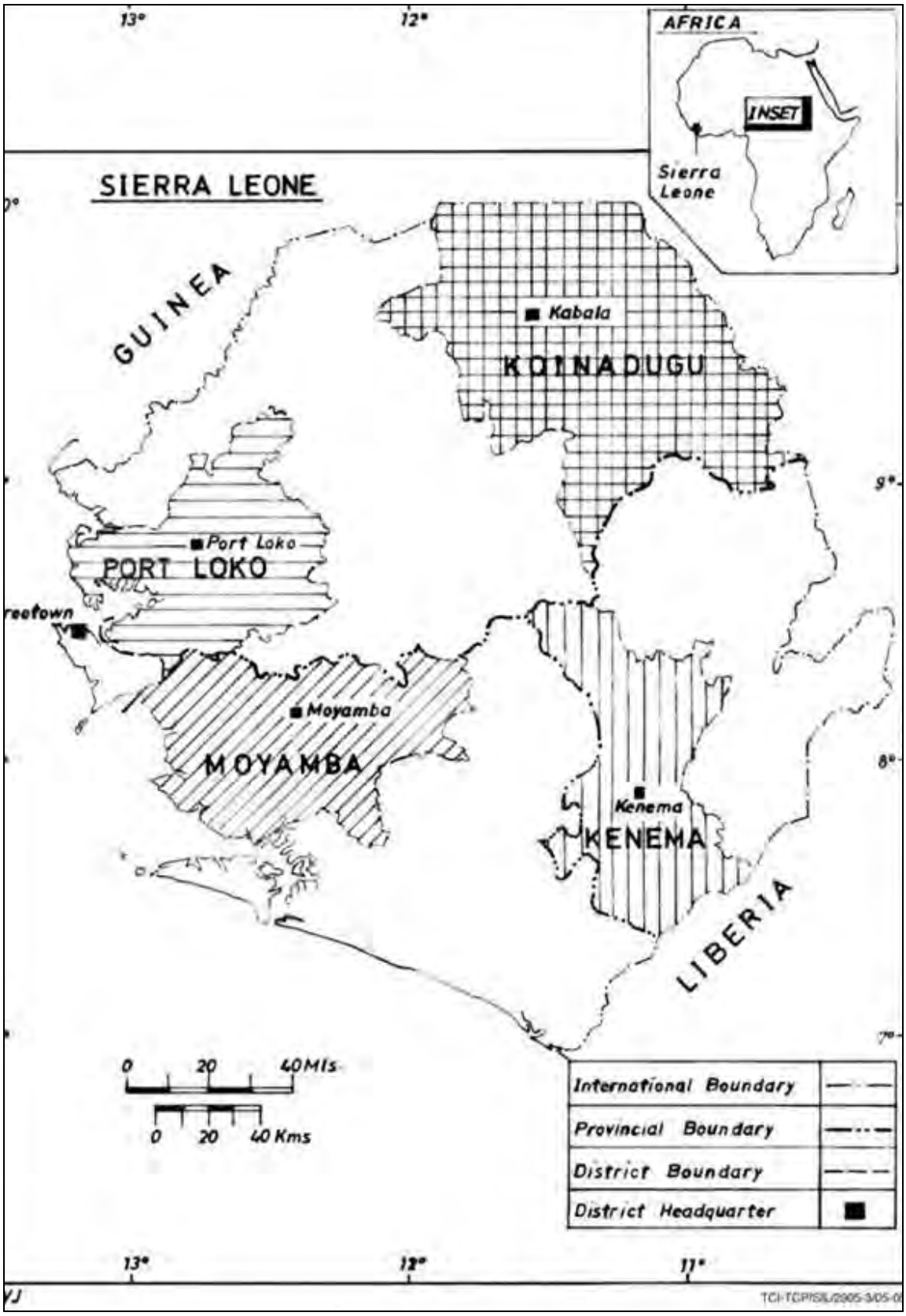

Figure 3: Location of the Districts Targeted in the Project

Annex 2: Estimates for the Components of the Project

Table 1: Cost of IVS Rehabilitation and Development Component of the Project (US$)							
District	Total IVS area (ha)	Contribution from Financing Institution			GOSL contribution	Beneficiary's contribution	WFP contribution
		Tools	Materials	Training	Personnel	Labour	Ffag
Port Loko	5,700	924,000	850,000	500	376,000	1,260,000	485,000
Koinadugu	7,800	1,264,000	1,162,000	500	530,000	1,725,000	663,000
Moyamba	5,300	860,000	790,000	500	360,000	1,172,000	450,000
Kenema	6,100	990,000	910,000	500	415,000	1,350,000	519,000
Total	24,900	4,038,000	3,712,000	2,000	1,681,000	5,507,000	2,117,000

Table 2: Cost of Crop production and Post–harvest Activities of Component 1 of the Project (US$)								
District	Total IVS area (ha)	Power tillers + Spares	Threshers + Spares	Hullers + Spares	Multipurpose stores	Drying floors	Fertilisers per year	Seeds per year
Port Loko	5,700	1,008,000	192,000	128,000	77,000	27,000	430,000	215,000
Koinadugu	7,800	1,344,000	264,000	175,000	105,000	36,000	590,000	295,000
Moyamba	5,300	924,000	183,000	118,000	70,000	24,000	400,000	200,000
Kenema	6,100	1,100,000	212,000	135,000	84,000	29,000	460,000	230,000
Total	24,900	4,376,000	851,000	556,000	336,000	116,000	1,880,000	940,000

Table 3: Cost of Small–scale Lift Irrigation Technologies (US$)										
District	Phase 1					Phase 2				
	No of gardeners	Pumps	Wells	Reser-voirs	Total	No of gardeners	Pumps	Wells	Reser-voirs	Total
Port Loko	500	27,000	13,000	32,000	72,000	750	40,608	19,552	48,128	108,288
Koinadugu	500	27000	13,000	32,000	72,000	750	40,608	19,552	48,128	108,288
Moyamba	300	16,200	7,800	19,200	43,200	450	24,408	11,752	28,928	65,088
Kenema	400	21,600	10,400	25,600	57,600	600	32,400	15,600	38,400	86,400
Mountain Rural	300	16,200	7,800	19,200	43,200	450	24,408	11,752	28,928	65,088
Total	2,000	108,000	52,000	128,000	288,000	3,000	162,432	78,208	192,512	433,152

Table 4: Cost of Perishable Crop Processing and Farmers' Training (US$)					
No of Communities	Facilities		Farmers' Training		Total
	Multi–fruit press + spares	Processing shed	Logistics	Facilitators	
5	3,000	2,000	2,500	4,200	11,700

Table 5: Cost of Strengthening Institutional Capacity in Water Resources (US$)			
Sub–component/Activity	Phase 1 (years 1 – 2)	Phase 2 (years 3 – 5)	Total
1. Rehabilitation and extension of Agro–met stations	121,000	11,000	132,000
2. In–service training of technicians	17,000		17,000
3. Upgrading of skills of senior staff	24,000		24,000
4. Training of 2 senior staff in water resources management (M.Sc. level)		100,000	100,000
5. Installation of Hydrological equipment		102,000	102,000
6. Establishment of *Smallholder Irrigation Development Authority* (SHIDA)		415,000	415,000
7. Establishment of *Water Resources Centre* (WRC) at NUC		306,000	306,000
Total	162,000	934,000	1,096,000

Annex 3: Water Availability Indices for Climatic Stations in the Targeted Districts

Station	Agro–climatic region	Mean annual rainfall (mm)	80 % probability annual rainfall, R (mm)	Mean annual evapotran-spiration, ET_o (mm)	Moisture availability index (R/ET_o)	Climatic water surplus (mm)	Effective rainfall (mm)	Growing period duration (days)
1. Kenema	Rainforest	2,915	2,703	1,389	1.95	1,694	1,221	317
2. Moyamba	Savannah woodland	2,451	2,247	1,440	1.56	1,351	1,100	275
3. Marampa (Port Loko District)	Savannah woodland	2,662	2,454	1,442	1.70	1,592	1,070	259
4. Kabala	Savannah woodland	2,216	2,017	1,403	1.44	1,211	1,005	259

Annex 4: Categorisation of and Approach for the Development of New Inland Valley Swamps

IVS can be categorised into the following broad groups:

1. Swamps having surface water throughout the year and 60–90 cm of medium/heavy textured top soil over light–textured soil.

Such swamps are generally to be found in the eastern part of the country where the moisture availability index (MAI)[2] is comparatively higher (i.e. 1.95) than in other regions of the country; the effective rainfall is about 1,221 mm per annum and the duration of the growing period, more than 300 days[3]. In terms of requirements for development, swamps in this category would require very little water storage for a second crop but provision must be made in the design for the control of flood waters entering the swamp from the side and head catchments. The main design features for such swamps are: a low head bund (i.e. 25–40 cm above high flood level) to control the head waters and divert it into the peripherals, which will also intercept and drain the runoff from the side catchments of the swamp; a trapezoidal–shaped weir (i.e. an overflow structure) constructed of palm logs/sand bags/timber and gravel to serve as a safety valve for the head bund in times of intense rain storms and hence increased flood flows; a main drain to receive and convey excess water from the rice plots.

Swamps in this category would be given top priority for development where ever they are located, provided also that the farming communities that are utilizing them are well organized and motivated to contribute to the project implementation.

2. Swamps having surface water till January/February and less than 60 cm of fine–textured top soil overlying a coarse textured sub–soil.

In general, swamps in this category are to be found in the north/north eastern part of the country. The moisture availability index is comparatively lower (i.e. less than 1.50); the effective rainfall is also lower (i.e. 1,005 mm /annum) and the duration of the growing period shorter (i.e. 259 days). In terms of water control development, IVS in this category would require storage to provide water for extending the growing period beyond January/February for 2–3 months; control of the inflow to the rice plots, and of the outflow from the main drain at the cessation of the rainy season. The main design features for such swamps are: a head bund to impound the head waters and create storage; gated intake canals with controllable level so that outflow from the reservoir can be regulated; a main drain no deeper than the depth of the overlying fine textured top soil to avoid excessive drainage of the paddies; and a check dam to control plot water level during the dry season.

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[2] Moisture Availability Index (MAI) is the ratio of the 80 percent probability rainfall to the reference evapotranspiration (ET_o). The 80 percent probability rainfall was computed by using the empirical model

$$Y = -157.0 + 0.981 \cdot X$$

where: Y = annual rainfall at the specified probability level; X = mean annual rainfall.

[3] See Annex 3 for comparative figures on water availability for climatic stations located in other parts of the country.

3. Inland valley swamps receiving sand–laden runoff from the side catchments and subject to excessive flooding

Swamps in this category are commonly found in the Coastal Plains agro–climatic region of the country and are characterized by coarse–textured soils that are easily eroded by runoff waters. They may also be found in the interior depending on the geologic formation from which the soils are derived. As a result of the high infiltration rates of these soils, there is also appreciable sub–surface flow into the valley bottom. The basic requirements for development are: improved drainage in the existing water course and prevention of the direct entry of sand–laden runoff from the side catchments into the cultivated area. There may not be a need to develop the swamp fully, i.e. with head bund, peripherals, interior bunds, etc. The main design features for such swamps are: an interceptor bund and channel placed at the edge of the swamp to trap and lead the sand–laden runoff away from the cultivated area; a dyke along the main water course to prevent the flood waters entering the cultivated area. The dyke should be at least 25 cm above the design flood depth in the channel.

4. Within the above broad categories, there are several combinations of local climatic factors, individual IVS hydrology/hydrogeological factors and farmers' practices that may dictate a different type of water control development.

Such cases will be handled individually by carrying out detailed soils, topographic, hydrological surveys, backed by discussions with farmers to determine the extent to which existing practices can be modified to bring about improved land and water management within the catchment.

Annex 5: Financial Analysis for the Inland Valley Swamp Component of the Project

Input/Output Item	Year 1 (4,992 ha)	Year 2 (9,984 ha)	Year 3 (14,784 ha)	Year 4 (19,584 ha)	Year 5 (24,384 ha)
1) Land preparation					
Fuel	80,030.24	160,060.47	237,012.63	313,964.78	390,916.93
Oil	8,003.02	16,006.05	23,701.26	31,396.48	39,091.69
Operator's wages	27,142.04	54,284.08	80,382.19	106,480.30	132,578.42
2) Labour for agronomic activities	1,224,452.83	2,448,905.66	3,626,264.15	4,803,622.64	5,980,981.13
3) Seed	271,263.40	542,526.79	803,356.98	1,064,187.17	1,325,017.36
4) Fertiliser	678,158.49	1,356,316.98	2,008,392.45	2,660,467.93	3,312,543.40
5) Repairs & Maintenance of machinery	122,674.89	245,349.78	363,306.41	481,263.04	599,219.66
6) Rice processing	1,345,014.34	2,690,,020.68	3,983,311.70	5,276,594.72	6,569,877.74
Total cost	3,756,739.15	7,513,478.49	11,125,727.77	14,737,977.06	18,350,226.33
Revenue	8,305,463.55	16,610,927.09	24,596,949.74	32,582,972.38	40,568,995.02
Net revenue	4,548,724.40	9,097,448.60	13,471,221.97	17,844,995.32	22,218,768.69

Exchange Rate: US$1.00 = Le 2,650

Notes:

1) Diesel fuel use by 1 single–axle tractor (or power tiller) is 1 gallon/acre @Le8,600/gallon; cost of oil is 10 percent of fuel cost; operator's wages @Le3,000/man–day.

2) Labour for agronomic activities (brushing, nursery preparation, transplanting, fertilizing, weeding, harvesting, drying and bagging) is estimated at 130 man–days/ha, or about half that required for IVS development and utilization, at an average of Le2,500/man–day.

3) Recommended seed rate for newer rice varieties is 60 kg/ha @Le30,000/bushel of 25 kg.

4) Recommended fertilizer rates are: 40 kg P2O5 /ha and 60 kg N/ha @Le90,000/50 kg bag.

5) Repairs and Maintenance cost on machinery is 10 percent of cost of machinery (US$6,119,000) proportionate to the cropped area each year

6) Rice processing includes parboiling, drying and milling @Le3,000/bushel of 25 kg.

8) Revenue calculated on assumption of 15 percent losses of paddy, 65 percent milling recovery and an average price of Le57,000/50 kg bag.

9) It has been assumed that each rehabilitated/developed IVS is double cropped each year using short/medium rice varieties.

Net Present Value Analysis			
Year	Cash Flow (US$)	Discount Factor (*)	Present Value (US$)
0	-26,112,000.00	1	-26,112,000.00
1	4,548,724.40	0.789	3,497,969.06
2	9,097,448.60	0.592	5,385,689.57
3	13,471,221.97	0.455	6,129,406.00
4	17,844,995.32	0.350	6,245,748.36
5	22,218,768.69	0.269	5,976,848.78
		Net Present Value	1,123,661.77

(*) Lending rate for capital = 30 percent/annum.