

### **5.5.5 Region IV, High Plain Zone**

This central zone is located in the north part of the Region IV, and it is comprehended within a tableland with altitudes ranging from 300 to 800 m and an annual rainfall of 1,200mm. There aren't big rivers and the agriculture is developed reckoning on deep wells.

This is the closest zone to Managua (around 20 km) within the Study Area. The Pan-American Highway crosses this zone in the close limits, and the roads present good conditions. It has a relatively good climate presenting pleasant temperatures. In as much as it is close to commercialization markets, the agriculture there is having a good development. The main crops are; coffee, fruits, vegetables, etc., totally oriented to the capital city or for exportation purposes. Masaya volcano, a tourist spot in the country is also located within the zone.

## **5.6 Development Strategy by Each Zone**

### **5.6.1 Basic Concept for the Development Strategy by Zone**

#### **(1) Principle of Formulating Land Use Plan**

According to the MAG document, the land use of the Study Area is classified into annual crop, permanent crop, pasture, waist land(Tacotales), forest, structure(building and road), and lake·river·swamp. The forecast of the population growth in the Study Area is predicted from 1,374,000 in the year of 1995 to 2,352,000 in the year of 2015. To meet this situation, the principle of land use plan is taken account of a view of demand and supply for the basic grains, and an increasing demand of the land generated from the agro-industry sector as well as the housing sector, thus the land use of Agriculture and animal husbandry is formulated as mentioned below.

- 1) Land use plan is formulated based on the potential land use acreage for agriculture and livestock surveyed by MAG (see Table shown below).
- 2) Land use classification -"Tacotales" occupying a large portion over the study area should be made with the best use.
- 3) As the population in the Study Area is predicted to 2,352,000, 1.71 times of the current population size in the year of 2015, supporting the population and self-supply of the basic grain should be principally given to high priority.
- 4) From the Table shown below, the current land use for the agriculture and livestock in the Region II and IV evidently exceeds the potential land use area, thus the land use plan should be formulated within a range of the potential land use classification.
- 5) The existing forest area should be preserved by introducing the land use system like agro-forestry or silvo-pastoral systems in order to fit in a view of environmental conservation by protecting soil erosion.
- 6) Taking a countermeasure to protect farm land by employing agronomic and civil engineering approach in the soil erosion hazard area, a sustainable land use management should be carried out.

Potential Land Use by Each Zone

Land Use	Potencial del Uso de la Tierra										Porcentaje(%)					
	R (M <sup>2</sup> )					RIV (M <sup>2</sup> )					RIF		RV			
	Norte	Sur	Totales	Actia	Diferencia	Metafa	Uso Mensaj	Pacifico	Totales	Actual	Diferencia	Norte	Sur	Meseta	Larga	Pacifico
Agropecuaria	89107	411173	500280	339,563	160,717	45,828	87,903	44,854	178,235	201,631	-25,396	21	41	71	44	12
Pecuria	58256	154156	252412	267,348	-114,936		56192	80279	136461	218,333	-79,872	23	15	0	28	22
Arvo-silvo-pastral	33278	118230	151508		151508	8,531	33536	83583	126890			8	12	15	17	23
ASP			0		0			192	192			0	0	0	0	0
AF	27730	71252	99033		99033	6,610	7,858	2,528	17064			6	7	10	4	1
SP		3,119	3,119		3,119		3,295	5,237	8,596			0	0	0	2	1
SP-1	5408	6,592	12,000		12,000	2,920	21,025	26,512	56,457			1	1	5	11	7
SP-2		37,266	37,266		37,266		1,406	24,307	25,713			0	4	0	1	7
SP-3			0		0			24,728	24,728			0	0	0	0	7
SP-4			0		0			0	0			0	0	0	0	0
Forestal	188,342	164,260	352,602		352,602	1,461	10,217	161,520	173,258			44	18	2	5	44
Area de Conservacion	19,348	156,817	176,165		176,165	7,383	10,150		17,543			5	18	12	5	0
Totales (M <sup>2</sup> )	428,351	1,004,456	1,432,807		1,432,807	63,842	158,118	370,227	632,787			100	100	100	100	100

Definición of each Legend should be referred to the document Leyenda de Interpretación del Uso Potencial de la Tierra (Información del Mapa Agroecológico)

Along the land use principle mentioned above, the land use plan of agriculture and livestock by each zone was formulated based on the conditions mentioned below and compiled in the Table.

- 1) Area devoted to non-traditional crop like fruit and vegetable are not available in the MAG statistics, and its area is estimated to be 20 % of the current cropping area(B) and added to the total cropping area (D).
- 2) The potential land use for the agriculture and livestock mentioned before is estimated by adding 50 % of agro-forestry land classification area to the potential land use for agriculture and livestock farming.
- 3) Cropping intensity(CI) is established by considering each locality like rural population and fixed to 100 % during the rainy season and to the range within the irrigable area including the possible irrigable area during the dry season.
- 4) Cropping area for each zone is fixed within the potential land use area of "Agriculture and Animal husbandry", and the excessive current land use (annual and perennial cops) area(A) should be reduced to the extent of upper limit for the potential land use area, while in case of being less than the potential land use area, the current cropping area(A) is fixed as the maximum land use area, and is promoted by increasing agricultural production vertically.

## (2) Agricultural Development Program

Based on the above mentioned land use plan, the agricultural development program per each zone was formulated based on the principles mentioned below;

- ◆ Since the area of non-traditional crops such as fruits an vegetables (C) is not available with MAG statistics, the area was assumed as 20% of the present cropping area (B) and the present total cropping area (D) was calculated by summarising these two values B and C.
- ◆ The above potential area for agriculture and livestock farming includes 50% of the area of the agro-forestry.
- ◆ The cropping intensity is considered as 100% during the rainy season and during the dry season the it is calculated by considering percentage of irrigable area and the regional characteristics.
- ◆ The cropping area for each zone is fixed based on the limit of the potential area for agriculture and livestock farming. If the actual area (annual crops and fruits) is higher than

the potential area, then the potential area is considered. If it is less, then the actual area is considered.

Cultivated Area and Crop Intensity by Zone

Index	Unit	Region II			Region IV			
		Norte	Sur	Totales	Largo	Pacifico	Meseta	Totales
Potential Agropecuaria area	Mz	89,980.0	408,320.0	498,300.0	45,459.0	47,918.0	50,816.0	194,004.0
Presente clasificacion forestal de uso(Cultivo anuales)	Mz	82,071.7	187,192.3	269,264.0	39,840.9	71,334.2	15,304.0	126,479.0
Presente clasificacion forestal de uso(Cultivo perman)	Mz	21,274.7	48,524.3	69,799.0	24,302.9	43,513.7	9,335.4	77,152.0
Sub Totales(A)	Mz	103,346.4	235,716.6	339,063.0	64,143.8	114,847.9	24,639.4	203,631.0
Present cropping area(B)	Mz	40,314.0	112,897.0	153,211.0	32,953.0	33,478.0	24,783.0	91,214.0
Present Fruits & Vegetable cropping area(C)	Mz	8,062.8	22,579.4	30,642.2	6,590.8	6,895.8	4,956.8	18,242.8
Present Total cropping area(D)	Mz	48,376.8	135,476.4	183,853.2	39,543.8	40,173.8	29,739.8	109,456.8
Cropping ratio (N/D/A * 100)	%	46.8	57.5	54.2	81.6	35.0	120.7	56.4
Irrigable Area	Mz	13,477.0	30,739.0	44,216.0	8,984.0	16,049.0	3,443.0	28,456.0
Possible irrigable area	Mz	80,786.0	78,357.0	157,143.0	25,357.0	20,571.0	18,429.0	64,357.0
Total irrigable area(E)	Mz	94,263.0	107,096.0	201,359.0	34,321.0	36,620.0	21,872.0	92,813.0
Possible irrigable area(E/A*100)	%	100.0	45.4	59.4	53.5	31.9	88.8	45.6
Planning cropping rate(N)	%	160.0	145.0	155.0	150.0	130.0	160.0	150.0
Planning Pooled Cropping area(Mz)	Mz	143,988.0	341,789.1	525,547.7	96,215.6	62,294.7	39,423.0	305,446.5
Cropping Rate up to 2005	%	89.1	88.8	87.8	91.1	99.2	133.8	85.8
Cropping rate up to 2010	%	124.5	115.8	121.3	120.5	114.6	146.9	117.9
Cropping rate up to 2015	%	160.0	145.0	155.0	150.0	130.0	160.0	150.0

Fuente: Compilation of MAG Document by JICA

- 1) Considering an improvement of trade imbalance and food security of the country, increasing production of the basic grains should be given to the highest priority by focusing on the small-medium scale farmers as the target beneficiaries to improve their living of standard, and also to contribute much to the national economy with a maximum profit.
- 2) Attempting to improve income generation for the small-medium scale farmers in the Study Area, promotion of diversifying the farm management should be given to high priority by introducing non-traditional crops (fruits and vegetables: pitahaya, melon, citrus, mango, cassava) and increase its production, with consideration of existing the present farming system coupled to each locality.
- 3) Improving agricultural productivity should be given to the highest priority by introducing the farming system to be easily adopted by the small-medium scale farmers with consideration of natural and socio-economic aspect associated with each locality.
- 4) Implementing this development plan efficiently, the plans for the agricultural extension and the farmer's supporting organization as the farmers supporting plan should be formulated in order to meet a situation of the market oriented agriculture.
- 5) Countermeasure of solving a shortage of labor force followed by introduction of the formulated farming system is managed by shifting from animal traction farming to custom hired or communal use of agricultural machinery in terms of possible farm operations to reduce labor.
- 6) The degree of fulfilling the formulated plan is achieved by 30 % of the goal over every 5 years and accomplished fully in the year of 2015.

According to the above stated principle, the cropping plan with introduction of the crops by each zone was formulated as stated below.

### 5.6.2 Agricultural Development Strategy of the North Zone in the Region II

This zone is formulated under the development strategy based on the goal - "supporting and

developing the small-medium scale farmers in harmonious with environment". The most of this zone is occupied with mountainous landscape with much sloping area, which results in scarce flat land and less water resources. Access to the large city like capital Managua, Leon and Chinandega is not good as well. For this reason, this area is not much developed well.

Recently, the cultivated land is increased due to increasing of new settlers, which resulted in over cropping to 103,346 Mz , more than the potential land use area of 89,980 Mz for the agriculture and livestock farming. Consequently, cropping over the sloping area causes soil erosion problems. Therefore, it is necessary that within the potential land use area for the agriculture and livestock, the farming practice to mitigate soil erosion should be introduced by reducing farm operations such as plowing soil surface, and by planting perennial crops over the escarpment.

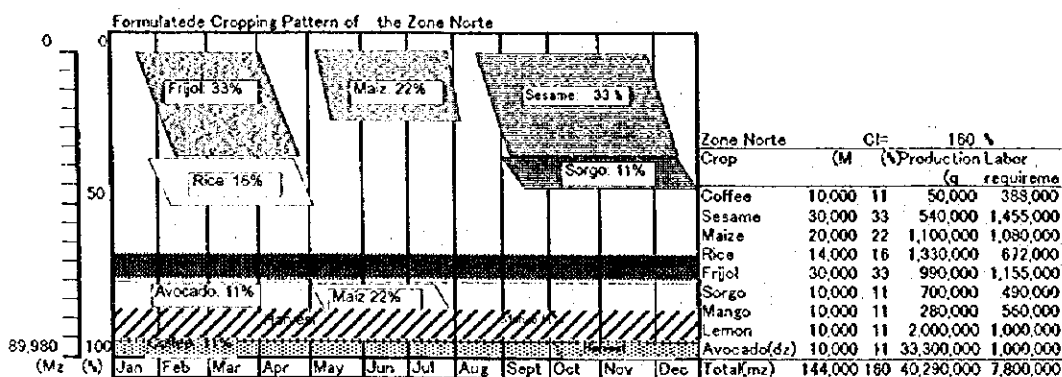
From the above mentioned reason, it is difficult to expand more arable land with irrigation facility. Therefore , sustainable development is the vital strategy in this zone by promoting to introduce valuable cash crops with small scale animal husbandry and its increasing production, and the formulated agricultural development program is proposed as follows;

**Introduced Crop(\* crop is new crop)**

Major crops for introduction in the future project site are basic grains(maize, frijol, sorghum), tree crop, and oil crop.

- Basic grains : maize, frijol, sorghum
- Traditional crop(sloping area) : coffee
- Non-traditional crop : melon\*
- Oil crop : sesame

**(2) Cropping Plan**



By implementing this plan, CI is increased from 46.8 % to 160 %, with 3 times more than the current cropping acreage and with 8.4 times more than current production of the basic grains. Further, the population engaged in agriculture is created to employment opportunity of 26,000 per year.

**(3) Introduced Farming Practice**

- improvement of agricultural productivity by introducing farmer's organization
- plowing/harrowing/inter-tillage operation by animal traction power
- improved seed, and proper application of chemical fertilizer, and agro-chemical
- irrigation technique from surface running water and underground water by pump
- Farming on the sloping area should be managed by planting perennial crop with sod culture

to reduce soil erosion as much as possible. If necessary, terracing work and contour farming should be applied.

- Coffee farming should be shifted to organic farming method because of high demand of consumption.

### 5.6.3 Agricultural Development Strategy of the South Zone in the Region II

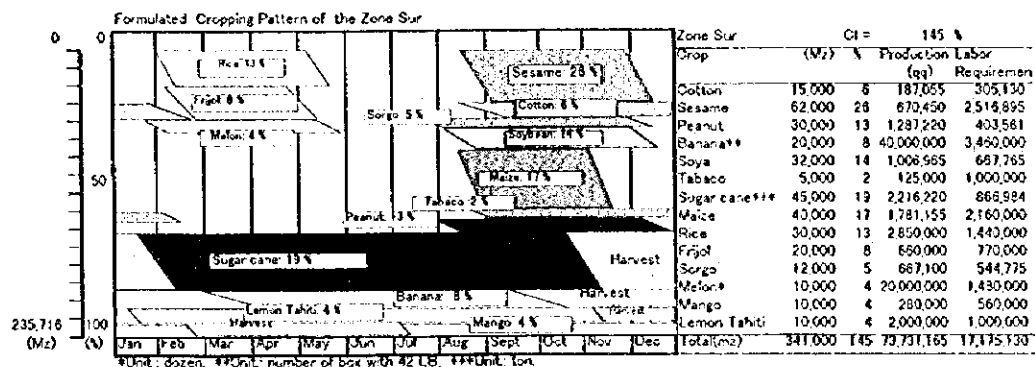
Development strategy in this zone is examined under the target of "Supporting small-medium scale farmer's technology based on the natural and socio-economic advantageous condition". Namely, this zone has vast flat land with fertile soils and large scale farmers coupled to high level of farming practice. Further, due to high potential of water resources and good access to the markets, this zone is located under better condition in comparison to other zone. Apart from basic grains production, traditional crops are cultivated with large scale for exportation.

From the above mentioned background, "Introduction of farming practice to support small-medium scale farmers based on the natural and socio-economic advantageous condition" should be development strategy for this zone and the following agricultural development program is proposed.

#### (1) Introduced crop(\* crop is newly introducing crop)

- Basic grain : maize, frijole, sorghum, rice(irrigation)
- Traditional crop : banana, tobacco
- Non traditional crop : mango\*, lemon\*, melon\*
- Industrial crop : sugarcane
- Oil crop : soybean, peanut, cotton, sesame

#### (2) Cropping plan



By implementing this plan, CI is increased from 57.5 % to 145 % with 1.4 times increase of total cropping acreage, which result in 5.9 times more than the current production of the basic grains. Further, the population engaged in the farming is created to 58,000 employment opportunities per year

#### (3) Introduced farming practice

- improvement of agricultural productivity by introducing farmer's organization
- introduction of plowing/harrowing/inter-tillage operation by animal traction power
- introduction of custom hired plowing operation, mechanized farming by forming farmer's organization

- improved seed, and proper application of chemical fertilizer, and agro-chemical
- irrigation technique by surface running water and underground water with pump
- Farming on the sloping area should be managed by planting perennial crop with sod culture to reduce soil erosion as much as possible. If necessary, terracing work and contour farming should be applied.
- Coffee farming should be shifted to organic farming method because of high demand of consumption.

#### 5.6.4 Agricultural Development Strategy of the Lago Nicaragua Zone in the Region IV

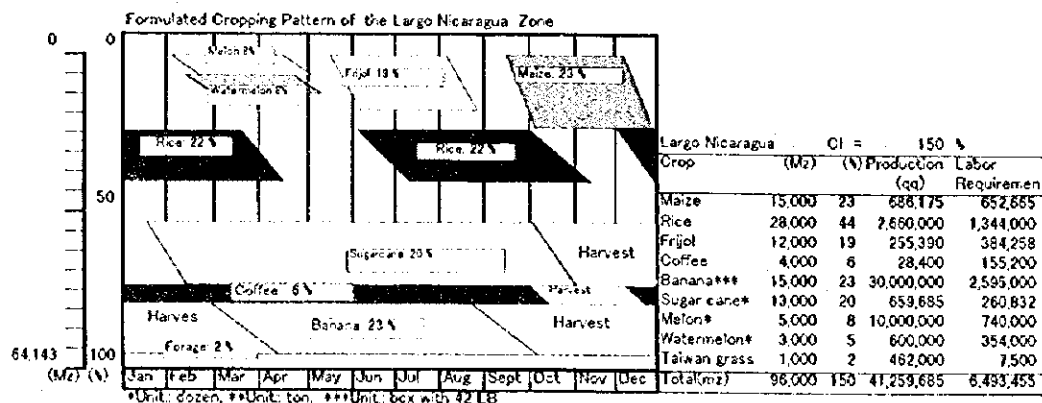
The development strategy in this zone is formulated under the target of "Agricultural Development as Grain granary base". This zone has almost flat landscape except for Ometepe island, and has high potential of water resources with good access to the markets. For this, most of the farm land is shared by the large scale farmers who are cultivating irrigation rice on a large scale by pumping irrigation water from Lake Nicaragua. Major crops produced in this zone are paddy rice, and beside the basic grains, the production of watermelon, plantain and organic coffee are increased in Ometepe island. On the other hand, the demand of cow milk is very high due to the large consumption area such as Masaya, Granada, Carazo and Managua, thus it appears to be a major dairy farming area by securing the forage crop during the dry season.

From this reason, the development strategy in this zone is directed to increase the basic grain production which contributes to improvement of self- sufficiency rate for the country and the following agricultural development program is proposed.

##### (1) Introduced crop(\*crop is newly introduced)

- Basic grain : maize, frijole, paddy rice(irrigation)
- Traditional crop : sugarcane, coffee, banana
- Non traditional crop : melon, watermelon
- Forage crop : Taiwan grass\*

##### (2) Cropping plan



By implementing this plan, CI is increased from 62.6 % to 150 % with 2.4 times increase of total cropping acreage, which results in 4.3 times more than the current production of the basic grains. Further, the population engaged in the farming is created to 22,000 employment opportunities per year

(3) Introduced farming practice

- improvement of agricultural productivity by forming farmer's organization
- introduction of plowing/harrowing/inter-tillage operation by animal traction power
- introduction of custom hired plowing operation, mechanized farming by forming farmer's organization
- improved seed, and proper application of chemical fertilizer, and agro-chemical
- introduction of irrigation technique by pumping water up from the lake Nicaragua

5.6.5 Agricultural Development Strategy of the Pacific Coast Zone in the Region IV

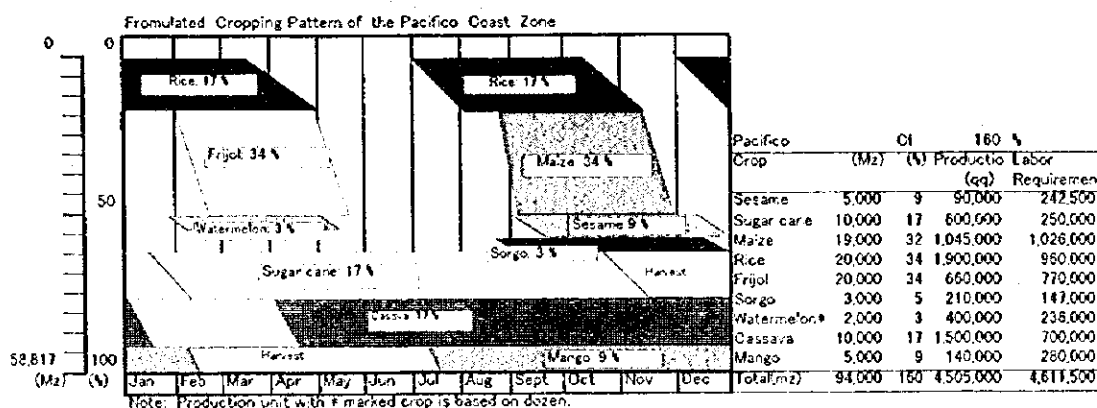
The development strategy in this zone is formulated under the target of "Agricultural support and development by overcoming disadvantageous condition in the agriculture". This zone is cultivated with large scale of plantain, sugarcane and pasture. Precipitation is varied with 600 mm in the Pacific coast area to 2500 mm in the border of Costa Rica, but the water resource potential in the zone is very low. Further, access of road is in a very poor condition along the international border to Costa Rica with less flat lands, thus this area is studded with small-medium scale livestock farmers. On the other hand, the current land use for farming and livestock exceeds considerably the potential use for them, thus it should be developed by restoring them to an appropriate range.

From this reason, this zone is not always disadvantageous in the agricultural development but first of all, improving standard of living for the small-medium scale farmers is a vital development strategy by overcoming its disadvantageous farming condition and the following agricultural development program is proposed.

(1) Introduced crop (\*crop is newly introduced)

- Basic grain : maize, frijole, rice, sorghum
- Traditional crop : sugarcane
- Non traditional crop : watermelon\*, cassava, mango

(2) Cropping plan



By implementing this plan, CI is increased from 31.9 % to 130 % with 1.6 times increase of total cropping acreage, which result in 3.6 times more than the current production of the

basic grains. Further, the population engaged in the farming is created to 11,000 employment opportunities per year.

(3) Introduced farming practice

- improvement of agricultural productivity by forming farmer's organization
- introduction of plowing/harrowing/inter-tillage operation by animal traction power
- improved seed, and proper application of chemical fertilizer, and agro-chemical
- improvement of productivity for the small scale of livestock farming

5.6.6 Agricultural Development Strategy of the High Plain Zone in the Region IV

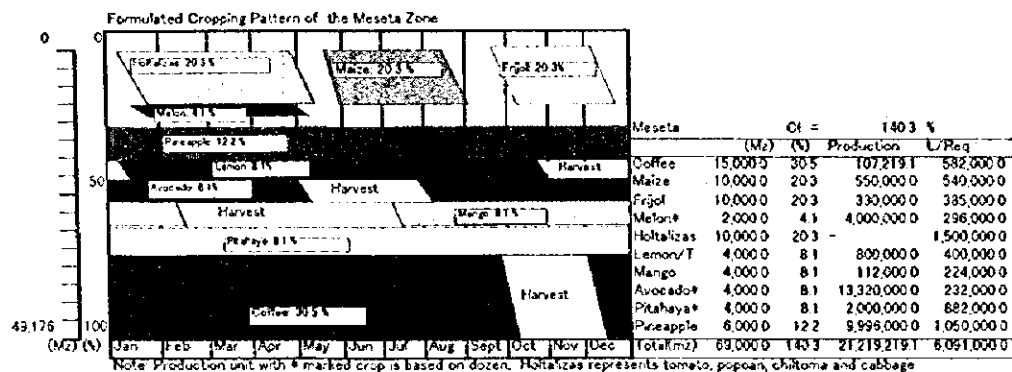
The development strategy in this zone is formulated under the target of "Support and development of the suburban farming type. This zone is successfully cultivated with coffee and non-traditional crops like fruits and vegetables under favorable natural condition with large consuming cities such as Managua, Masaya and Carazo Departments. However, this zone is occupied with hilly landscape and less flat land, thus land use plan focusing on soil conservation is vital. Therefore, cropping plan should be focused on the land use method based on tree crop and agro-forestry.

From this reason, the development strategy in this zone should be directed to promote crop production for the urban area and export by supporting the suburban farming type and the following agricultural development program is proposed.

(1) Introduced crop

- Basic grain : maize, frijole
- Traditional crop : coffee
- Non traditional crop : melon, green pepper, tomato, pipian, cabbage, lemon, mango, avocado, pitahaya, pineapple

(2) Cropping Plan



By implementing this plan, CI is increased from 120.7 % to 160 % with 1.3 times increase of total cropping acreage, which result in 3.6 times more than the current production of the basic grains. Further, the population engaged in the farming is created to 11,000 employment opportunities per year.

(3) Introduced farming practice

- improvement of agricultural productivity by forming farmer's organization



- introduction of plowing/harrowing/inter-tillage operation by animal traction power
- introduction of custom hired plowing operation, mechanized farming by forming farmer's organization
- improved seed, and proper application of chemical fertilizer, and agro-chemical
- introduction of small scale groundwater irrigation technique
- Farming on the sloping area should be managed by planting the covering crops and introducing agro-forestry method to reduce soil erosion as much as possible. If necessary, terracing work and contour farming should be applied.

## **5.7 Development Program**

Individual development projects will be formulated for the implementation of the guidelines for development of each individual zone and the basic development guidelines. In order to achieve the improvement of the life conditions of the small and medium scale farmers, there are three problems that must be solved: (1) improvement of the farming techniques of those farmers and transforming the way how they focus their activities by means of extension services; (2) how to provide a system for supporting services for the rehabilitation of basic infrastructure; (3) how to introduce and promote a farming system which matches the surrounding natural conditions.

To cope with these problems, individual development projects that aim to solve each of the mentioned problems must be established on a basis of mutual complementability and support. On the other hand, the project area is too much wide and the number of farming households is big; the projects must be formulated based on a strategy that takes into consideration of the low level of the basic farming abilities of the small and medium scale farmers; the farmers must be organized so to overcome the development problems in an organized and coordinated way.

However, the implementation of the projects could be difficult due to the fact that the aims are set too high and the implementation area is wide. Therefore, the scope and the target are of the development projects must be cut down to a size which guarantees a successful implementation. The main aim of the projects is to improve the farming management abilities and provide development opportunities for the small and medium scale farmers.

### **5.7.1 Development Project Model**

The development project model has the same goals mentioned above; it also aims at a later stage to spread its benefits to surrounding areas and to be applicable to other areas with similar conditions for development. For this reason, the contents of the development project model must be all-encompassing. However, for the effective and possible implementation of the project, the actual degree of public supporting services that the small and medium scale farmers are receiving at present and the degree of coverage must be taken into consideration at the moment of formulating the project.

#### **(1) Contents**

The present project has as central items: (1) improve agricultural productivity; (2) transformation towards farmers' organizations; (3) create more added value for the agricultural production.

- 1) Improvement of agricultural productivity
  - Introduction of new crops and farming techniques: aims to improve the farming techniques of the small and medium scale farmers

- Improvement of farm management techniques: Aims to stabilize the income of the small and medium scale farmers
  - Introduction of improved seeds: Aims to produce crops of high quality and increase production
  - Introduction of irrigation facilities: Aims to increase and stabilize the production volume of crops and improve their quality
- 2) Transformation of farmers' organizations
- Transformation of farmers' organizations: Aims to transform the way how the small and medium scale farmers focus their production activities and carry out their daily life in order to make it possible to produce under a communal basis.
- 3) Creation of more added value for agricultural production
- Improvement of marketing: Improvement of marketing activities centering on the producers, and create, in this way, more added value for agricultural products.
  - Processing of agricultural products: Simple processing activities will be introduced to create more added value.

In order to implement the above items, it will be necessary to strengthen other present supporting services besides the irrigation and processing facilities which will be provided through the project.

## (2) Selection of areas for the implementation of the development project model

There are three conditions for the selection of the area for the development project model: (1) Expected ripple effects of the development project model area to the areas; (2) possibility of implementation of the contents of the project; (3) Benefits of the project even if considered independently. Although there are many areas which satisfy the above requirements, the following areas (schemes) are selected as the main representative areas.

- Telica Scheme
- Malacatoya Scheme
- El Espino Scheme
- Carazo, Masaya Scheme

### 5.7.2 Sector Development Projects

#### (1) Important Items

In order to overcome the factors which curtail the revitalization of the present production potential, the present Master Plan has set up the basic guidelines which aims to improve the life conditions of the small and medium scale farmers; with this purpose in mind, the following items have been taken into consideration:

- Improvement of agricultural production and farming techniques  
Improvement will start with basic farming techniques and, at a later stage when the capabilities of the farmers have been up-graded, further modernization of farming activities can be carried out.
- Transformation of farmers' organizations  
In order to make it possible to transform the way of thinking of the farmers from an

individualistic point of view to a communal one, the merits of the working in an organized and communal way will be highlighted.

- Environmental protection  
To achieve sustainable farming, erosion and flood control activities and water resources saving actions will be taken based on the cooperation of the habitants of the benefitted area.
- Improvement of the living environment  
Basic life conditions will be improved.

## (2) Selection of Projects for each Sector

In order to attain the objectives of the Master Plan, the projects to fulfill the needs of each sector are necessary. The categorization of these projects was considered based both on the basic concepts for the Master Plan and on countermeasures for the problem tree. There are 11 (eleven) of these projects as shown in the following table. And, the problem tree for each sector is shown in the figure in Chapter 4.

Selection of the Projects Based on the Basic Concepts of the Master Plan

Sector	Concepts of the Master Plan	Maximized development of Regional Potential.	Improvement of Living Conditions of Small and Medium scale Farmers	Increase of the Production of Basic Grains	Extension of Farming for Marketing Purposes	Development of Sustainable Agriculture	Correspondence with the National Economy
Model Project		○	○	○	○	○	○
Irrigation		○	○	○	○	○	○
Road Rehabilitation Project			○	△	△		○
Seed Production Project			○	○	△		△
Experimental Research Project			○	○	△	△	○
Strengthening of Extension Services Project		○	○	○	○	○	○
Livestock Project			○				△
Marketing		○	○		○		○
Farmers Organization		△	○	△	○	○	△
Agricultural Credit			○	△	△		△
Environmental Protection Project		△	△			○	△

## (3) Relations among Projects

As mentioned before, development projects categorized sector by sector have been selected based on the concepts of the Master Plan. The objectives of the Master Plan, out of which the main one is the increase of living standards of small and medium scale farmers, shall be attained by carrying out the categorized projects. For every sector of this Master Plan, a project is proposed containing countermeasures for the corresponding sector conditions, having also an interrelation with other projects. This interrelation among projects will increase the potential of each individual project, reinforcing the projects impacts. The relations among the projects categorized sector by sector are shown in the table.

There are projects for 11 (eleven) sectors, which are divided into two categories; fundamental and complementary. The fundamental projects are oriented to 3 (three) sectors; 1) road rehabilitation for the efficient operation of agricultural activities, 2) extension services for agricultural technology, and 3) farmers' organization. The implementation of the fundamental projects is urgent considering that they will potentialize the implementation of the complementary ones. Likewise, the implementation of the model projects is also important because they corroborate the benefits of both the fundamental and complementary projects.

The Model projects as well as the fundamental ones are going to be implemented earlier than the others, so that to make it easy and efficient to carry out the other complementary projects.

#### (4) Strategy for the Development of each Region's Potential

The potential development plan for each region should be formulated considering the following items; 1)-development concepts of regional potential categorized by zone, 2) relations between on-going projects and sectors' projects of this Master Plan. The concepts for the development plan, according to zone, are described as follows.

##### - Northern Zone in Region II

The objective of the development plan is of "Supporting and Developing the Small-Medium scale Farmers in Harmony with the Environment". Under this guideline, it is necessary to improve the basis for agriculture such as land consolidation and protection of eroded area to make possible for sustainable agriculture, and improvement of agricultural productivity. It is also required to improve the abilities of farmers through the extension services and farmers organizations such as Water Users Association. As the most urgent task, it is necessary to implement the infrastructure and farmers organization.

At present, both PROTIERRA and PROCHI-LEON projects are being carried out in the northern zone. The PROTIERRA project was established to improve the living and production basis of small and medium scale farmers, and the project is managed with the farmers' participation. Due to aspects of the project concepts and to a restricted budget, it is difficult to cover the whole northern zone with this project. Besides, this project does not include extension services such as qualification of human resources and unrestricted support services for farming, which covers the whole Nicaragua. These extension services are supported by PROCHI-LEON, in which the qualification of human resources and the formulation of farmers' organizations are carried out.

As a part of the Master Plan, several projects categorized sector by sector shall be implemented, namely; 1) village road rehabilitation, 2) experimental research for seeds production and livestock with a reach beyond the zone, 3) supporting services such as agricultural credit, 4) establishment of farmers' organizations centralized in a central organization.

Although the establishment of farmers' organizations is the most important item for all zones of Regions II and IV, their implementation is difficult considering the present conditions of farmers abilities. Consequently, the formation of farmers organizations shall be carried out in cooperation with the PROCHI-LEON Project.

- Southern Zone in Region II

The concept for the development plan is: "Supporting Small and Medium scale Farmer's Technology based on Natural and Socio-economic Advantageous Conditions".

This zone has excellent potential for agricultural purposes from the point of view of meteorological and geographical aspects; There is a good potential land use compared to other zones. It is possible to improve the production basis for agricultural system by optimizing the utilization of that potential.

As mentioned before, PROCHI-LEON Project has been carried out in the northern zone, therefore the proposed projects should be also carried out in cooperation with PROCHI-LEON Project in this zone. Basically, the components of the proposed projects are the same as those projects of the northern zone. In addition to the above, this zone has good conditions for model projects such as the Telica Area Development Project Model for a surface water scheme, and El Espino Area Development Project Model for a groundwater scheme. Consequently, these model projects should be carried out at the initial stage of the Master Plan as it aims for an early dissemination of the development concept to the small and medium scale farmers, and related administrative organizations.

- Nicaragua Lake Coastal Zone in Region IV

The concept for the development plan is: "Agricultural Development to make this Zone the Country's Granary". Increasing of agricultural production can be possible for improvement of the agricultural basis, because characteristics of this zone are the same as those in the southern zone in the Region II

At present, there is no related project for the Master Plan which is on-going or/and at a planning stage in this zone.

Basically, the components of the proposed projects are the same as the projects for the Region II. In addition to the above, this zone has good conditions for implementation of a model project such as the Malacatoya Area Development Project Model utilizing Lake of Nicaragua for irrigation purpose. Consequently, these model projects should be carried out at the initial stage of the Master Plan as it aims for an early dissemination of the development concept to the small and medium scale farmers, and related administrative organizations.

- Mountain Range Pacific Zone in Region IV

The concept for the development plan is: "Agricultural Support and Development by Overcoming Disadvantageous Conditions for Agriculture". As could be inferred from the above mentioned concept, there are many unsuitable conditions for agriculture in this zone compared to the other zones, and these constraints should be overcome by the projects in this Master Plan.

At present, PROCESUR project has been carried out in the Mountain Range Pacific zone. PROCESUR project was established for the expansion of agricultural extension for small-scale farmers for items such as agro-technology, agricultural credit and environmental protection.



For a maximum impact of the PROCESUR Project, the projects which aims for the improvement of living standards of the small and medium scale farmers, should be carried out in the short term. In addition the above mentioned, projects of both fundamentally and complementary nature are necessary.

Especially, the project for formation of farmers organization must be carried out in cooperation with PROCHI-LEON Project and Model projects in other zones.

#### - High Plain Zone in Region IV

The concept for the development plan is: "Support and Development of the Suburban Farming Type". Geographical conditions for this zone are suitable for suburban-type farming, so it is possible to establish a farming which is responsive to the market needs.

At present, there is no related project to the Master Plan which is on-going and/or at a planning stage in this zone. As for the development plan, projects of both fundamentally and complementary nature are carried out. Besides, as mentioned before, this zone has good conditions for a model project such as a Suburban-Type Farming Group Project taking advantage of the geographical conditions. Consequently, these model projects should be carried out at the initial stage of the Master Plan as it aims for an early dissemination of the development concept to the small and medium scale farmers, and related administrative organizations.

Especially, the project for formation of farmers organization must be carried out in cooperation with PROCHI-LEON Project and Model projects in this zone.

### **5.8 Development Plan of Specific Projects**

The development plan (specific projects) is formulated sector by sector based on the categorization of the Master Plan.

#### **5.8.1 Development Plan of Model Projects**

As mentioned before, the development plan of model projects is the start of this Master Plan and aims at enhancing the specific projects in the study area. In order to disseminate the model projects in other parts of the study area, the following factors shall be considered;

- i) Dissemination of irrigation facilities
- ii) Formulation of farmers' associations
- iii) Consideration for zone characteristics

Although there are many schemes which satisfy the above factors, the following 4 (four) schemes are selected, and the characteristics of these representative schemes are described as follows;

- Telica Scheme: It is easy to provide a gravity irrigation system in this area comparing to the others from the viewpoint of intakeworks operation and stability of the river discharge for irrigation purpose throughout the year. Besides, this area has potential for the increase of agricultural production and is located near the city of Leon, in the Metropolitan region.

- Malacatoya Scheme: It is possible to irrigate the command area utilizing the water coming from the Nicaragua Lake through pumping facilities. However, at present, there are a few small and medium scale farmers in the area, and most of the irrigable area is shared by large scale farmers in the coast of the Nicaragua Lake. Therefore, to promote the development plan in this area it is necessary to orient the irrigation development towards the small and medium scale farmers.
- El Espino Scheme: There is abundant groundwater for irrigation purpose in this area. At present, as a common practice that individual farmers are installing groundwater irrigation systems, in the whole country. However, as mentioned before, intensive-farming system will require the development of cooperatively utilized deep wells in the future.
- Crazo, Masaya Scheme: It is difficult to install irrigation facilities because of the lack of perennial water resources for irrigation purpose throughout the year. However, this area is located near Granada city so that it is possible to promote the development of agricultural projects in suburban areas. The enhancing of the agricultural development in the suburbs is expected through the promotion of Model Projects.

#### (1) Objectives of the Model Projects

Objectives and contents of several model projects have been already described in the Chapter 5 (item 5.7.1). The model project covers facilities such as irrigation system and agro-industry facilities, taking into consideration of several conditions such as farming, geography and land use in each area. The components of these facilities are shown as follows;

##### - Irrigation Facilities

- Telica Scheme: Gravity irrigation system using river surface water from Telica river.
- Malacatoya Scheme: Irrigation system using pumping facilities from Lake of Nicaragua.
- El Espino Scheme: Groundwater irrigation system using deep well.
- Carazo, Masaya Scheme: Utilization of existing irrigation facilities after their rehabilitation.

Regarding the schemes for Telica, Malacatoya, El Espino, the operation of irrigation systems is described in the Chapter 5 (item 5.8.2 - Irrigation Plan). In Carazo and Masaya scheme, the irrigation system will be installed by MAG and INTA, within the Project provided by FAO, namely "*Special Project for Food Security*". The agricultural projects will be disseminated in suburban areas through the installation of irrigation facilities by MAG and INTA.

##### - Forwarding Facilities

- Telica, Malacatoya, El Espino Schemes

The cropping pattern for this model project mainly promotes the basic grains. Forwarding facilities are necessary for adding value to the agricultural production,



efficient operation of agro-processing, and for creating more job opportunities.

Facilities	Main Equipment
Forwarding	Transport conveyor, Bucket, Truck
Storage	Belt Conveyor

• Carazo, Masaya Scheme

Cash crops such as coffee and fruits have already been introduced in this area, thus it is a representative model of agriculture in suburban areas. In order to press for the improvement of value addition for some fruits, it is necessary to install transporting and processing facilities including storage facilities.

Facilities	Principle Equipment
Transport	Transport conveyor, Bucket, Truck
Fruits Processing Facilities	Washing facility, Cutter, Vaporizer Squeezer, Mixer, Washer • Pulper • Fumigator, Sealer,
Storage	Belt conveyor, Fork lift

- Others Facilities

It is necessary to construct a building for farmers' association in order to assure an efficient operation and maintenance of the irrigation system. Besides, this building can be utilized for discussions about farming practices and dissemination of agro-technology. The necessary equipment for this facility is basically office equipment, such as telephone and blackboard, desk and chair as educational equipment.

### 5.8.2 Irrigation Project

#### (1) Necessity of Irrigation

Increased agricultural production requires both agricultural infrastructure and farmers ability. Especially, most of the small and middle scale farmers have no irrigation facilities, therefore the provision of irrigation facilities will have an impact on their production.

There are two well defined seasons in Republic of Nicaragua, the rainy and the dry seasons, and it is impossible to carry out agricultural activities without irrigation facilities during the dry season. In the study area, the non-irrigable area is estimated to be about 470,021Mz except the area for pastures. This non-irrigable area is divided into 294,847Mz in the Region II and 175,174Mz in the Region IV. Irrigation facilities will be provided according to project aiming at the increase of agricultural production.

#### (2) Resources for Irrigation

##### 1) Surface Water

River: As described in the Chapter 3 (item 3.1.3 Meteo-Hydrology), there are four (04) rivers being utilized for irrigation purposes: *Rio Viejo*, *Rio*

*Sinecapa, Rio Villanueva (Rio Grande), and Rio Telica, in the Region II. On the other hand, there is no river being utilized for irrigation purposes in the Region IV. However, the discharge of these rivers becomes insufficient for irrigation during the dry season (Chapter 3 - item 3.1.3 Water Resources). The irrigable area is restricted according to the decrease of river discharges during the dry season. Hence, in the case of enhancing the irrigable area, storage facilities should be necessary for collecting surface water during the rainy season.*

A law regarding the water rights is under preparation at present. During the establishment of an irrigation plan, an important concern is that the existing water rights are not disturbed. Furthermore, although the law regarding to river maintenance flow is not clarified yet, it is necessary to supply water during drought periods for the maintenance of the river in order to keep its conditions and provide water for domestic use such as cloth washing, drinking water for animals, etc.

Lake: The Lake of Managua (water spread area: 1,042 km<sup>2</sup>) is located in the Region II and the Lake of Nicaragua (water spread area: 8,264 km<sup>2</sup>) is located in the Region IV. Although both of them are large-scale lakes with abundant water resources, the former is not suitable for irrigation due to poor water quality affected by the inflow of wastewater (refer to Chapter 3, item 3.1.3 - Water Quality Analysis). In order to utilize the water from Lake of Managua for irrigation purposes, the establishment of a wastewater treatment facility needs to be taken into consideration.

The water of Nicaragua Lake is suitable from the viewpoint of irrigation. Since the water from this lake started to be used for irrigation, it is regarded as a precious water resource considering water volume and water quality. However, pumping facilities are necessary for a better irrigation management. In the case of the installation of pumping facilities, operation and maintenance costs will be more than that of the present gravity irrigation system. Besides, since the unexploited irrigable areas are located a few km away from the coast of Nicaragua lake at higher altitudes, it presents a disadvantage in terms of higher construction and operation costs. Regarding the installation of irrigation facilities, the sediment transport should also be taken into consideration, due to high waves in the lake caused by eastern winds (average 3.0 m/sec).

Dam: The construction of dam facilities are necessary in order to store surplus water during the rainy season once most of the rivers are dried up and some others have reduced flow during the dry season. Since most of the rivers flows through the mountain valley in the study area, a high storage volume can not be expected since the water spread area is long and narrow at the dam site. In addition to the above, since a long canal is necessary due to the long distance between dam location and irrigable area, it will not be economical. Consequently, the stored water of the dam can directly flow into the river, and thus intake works such as headworks must be provided at downstream. As described before, rivers in the study area often go underground, so it is feared that the stored water does not reach the intake works at downstream. The adoption of the irrigation system including dam facilities shall be decided considering several

points in this plan. Through the field inspections, no suitable area was identified for dam site in the Region IV.

Although the geography of the dam sites can be adjusted for the construction works, it is necessary to further investigate the geological conditions by excavating borrow-pits during the elaboration of the detail plan.

Since the construction of dam facilities involves a high cost, the expansion of large-scale irrigable areas is necessary in due consideration to economic effectiveness. Consequently, the irrigation plan should take into account of both irrigable area and dam site.

**Spring Water:** There is spring water in the study area. However, the volume is not considerable enough for irrigation purpose. Besides, its discharge is not constant throughout the year. Hence, it can be considered as a supplemental resource for irrigation.

## 2) Groundwater

There is a high groundwater potential for irrigation use in both Regions II and IV. Irrigation utilizing groundwater as main source is possible in the whole of the study area. At present, deep wells for irrigation purpose are utilized as main water.

Although the well capacity shall be appraised considering several factors such as targeted crop, geographic conditions, at present this capacity per unit is estimated to be around 43 to 57Mz (30 to 40ha) in average (Chapter 3.1.3 Groundwater).

In case of the small-scale farmers, the well facilities are not suitable for individual farmers since landholding size is less than 10ha. Furthermore, the funds of farmers are limited regarding the necessary costs for well installation, operation and maintenance. Although the capacity of a shallow well is much smaller than the deep one, at present farmers are utilizing it as main irrigation facility.

For the improvement of small-scale farmers' living standards, it is necessary to formulate an intensive farming in which a deep well is utilized in partnership by a group of few farmers. As mentioned before, the capacity of a deep well for irrigation use is around 43 to 57Mz, thus the scale of intensive farming is the area covered by the well capacity.

For some areas a 10m depth shallow well is sufficient for irrigation, but for some other areas a 200m depth well is necessary. In case the water requirement for crops is satisfied, it should be provided with shallow well, which has lower construction cost than the deep well. Besides, a legal operation is required in accordance with the well capacity, to keep the balance of groundwater. Regarding the well installation, a good layout must be designed, considering the distance between wells so as for not disturbing the circle of influence of each well.

In the study area, the utilization of groundwater for irrigation purposes will be evaluated as main resource in the future. That is because the potential of surface water for irrigation purpose is restricted. However, the groundwater is not an inexhaustible

resource. If its domestic utilization (laundry, drinking water, etc.) is increased, it is feared that the groundwater for irrigation purpose can also be restricted.

The policy should be not to disturb the groundwater potential, once it is feared that groundwater can be exhausted due to uncontrolled logging. This policy comprehends forestation and logging control measures. In this Master Plan, this issue has been studied in order to assure a continuous existence of groundwater resources and, as a result, a plan for the future has been formulated.

### (3) Irrigable Area

#### 1) Surface Water

As mentioned before, there are few rivers, which have measurement facilities, in the study area. Based on the results of the analysis of the relation between irrigable area layout and hydro-meteorological conditions, surface water resource was estimated according to the irrigable area (refer to Chapter 3, item 3.1.3 Hydro-meteorology).

Region	Zone	Location	Water Resource	Irrigable Area (Mz)
II	Northern Zone	El Sauce	Río Grande	1,857
II	Northern Zone	Cayanlipe	Río Villanueva	1,714
II	Northern Zone	Zarzales	Río Sinecapa	1,714
II	Southern Zone	Telica	Río Telica	1,571
Total				7,713

Although no one of the above rivers are measured through measurement facilities, some of them will be utilized for irrigation purposes considering the present conditions. The irrigable areas are estimated as shown in the table. In the case of the exploitation of these rivers potential, an investigation for discharge and water level is necessary for design. Regarding the utilization of Nicaragua Lake, since the installation of pumping facilities will be necessary, the economical aspects must be taken into account by measuring the conditions of the Lake.

Region	Zone	Water Resource	Irrigable Area (Mz)
II	Northern Zone	River	930
II	Southern Zone	River	1,930
IV	Nicaragua Lake Coastal Zone	Nicaragua Lake	6,500
IV	Nicaragua Lake Coastal Zone	River	430
IV	Mountain Range Pacific Zone	River	2,140
Total			11,930

Note; The irrigable area using Nicaragua Lake as water resource was estimated as being an area less than 5km distant from Nicaragua Lake coast and lower than 60m altitude.

Irrigable area using surface water as water resource is estimated as 19,643Mz based on the results.

Region II	10,573Mz
Region IV	9,070Mz
Total	19,643Mz

## 2) Groundwater

Irrigable area is estimated through the characteristics of both groundwater and deep well, which are; a) groundwater potential in the study area, b) influence circle of well layout; and c) well capacity per unit.

Capacity for irrigation purpose is estimated as 1.8m<sup>3</sup>/min, in average, based on the collected data. In case the water requirement for crops is considered as 0.00049m<sup>3</sup>/Mz/sec (0.007 m<sup>3</sup>/ha/sec), one unit well covers about 61Mz (43ha) of irrigable area.

Unexploited irrigable area is estimated based on the well capacity. In case the influence circle of the well is 1000m, in the study area, the exploitable irrigable area will be about 143Mz (100ha). Consequently, the number of exploitable wells is 2,473 in total; 1,737 in Region II and 736 in Region IV. At present, there are about 130 wells for domestic use (drinking water) in the study area. In case the population growth rate is 3.5% up to the year 2015, the demand for domestic use (drinking water) will require about 240 wells, proportionally to the population growth. Consequently, groundwater development for irrigation purpose must also consider the domestic use, hence the number of exploitable wells for irrigation purpose is estimated to be around 1,617 and 616 wells in Regions II and IV, respectively. However, since there is a large area of farmland in the study area, it is estimated that another 50% of the above number of wells will be necessary. Therefore, the number of necessary exploitable wells raises to a total of 3,300; 2,400 and 900 wells in Regions II and IV, respectively, so that the capacity of wells in the study area is 8,550,000 m<sup>3</sup>/day. This water balance is considered taking into account of the exploitable groundwater volume (refer to Chapter 3 – item 3.1.3 Hydrology).

Estimated irrigable area is shown as follows;

Region II	146,400Mz
Region IV	54,900Mz
Total	201,300Mz

Irrigable area served by both surface water and groundwater is estimated as shown in the following table. Groundwater is considered as an important water resource, because the irrigable area served by groundwater is larger than that served by the surface water.

Estimated Irrigable Area (Mz)

	Total Irrigable Area	Existing Exploited Irrigable Area	Potential by Surface Water	Potential by Groundwater	Potential Irrigable Area	Total Potential Irrigable Area	Unexploited Irrigable Area
<b>Region II</b>							
Surface Water	—	11,512	10,573	—	10,573	22,085	—
Groundwater	—	32,704	—	146,400	146,400	179,104	—
Sub-total	339,063	44,216	10,573	146,400	156,973	201,189	137,874
<b>Region IV</b>							
Surface Water	—	6,948	9,070	—	9,070	16,018	—
Groundwater	—	21,509	—	54,900	54,900	76,409	—
Sub-total	203,631	28,457	9,070	54,900	63,970	92,427	111,204
<b>Total</b>	<b>542,694</b>	<b>72,673</b>	<b>19,643</b>	<b>201,300</b>	<b>220,943</b>	<b>205,920</b>	<b>249,078</b>

In case the unexploitable irrigable area is irrigated using both surface water and groundwater resources, the unexploitable area is estimated to decrease from 470,021Mz to 249,078Mz in the future. Regarding the utilization of groundwater, the irrigation volume is estimated for the utilization of exploitable wells.

As described before, wells are more appropriate considering the large farmland area. Although groundwater potential is abundant in the study area, the utilization of wells can be restricted by several characteristics such as efficient well circle of influence, well capacity and groundwater potential by geographical aspects. Unexploitable area should be utilized as pasture for cattle or single cropping utilizing rain water.

#### (4) Concept for Irrigation Plan

##### 1) Water Requirement

Formula:	Revised Penman Method
Rainfall:	The 5 years return period of rainfall based on the hydrological analysis is applied for the calculation of water requirement.
Crops:	Suitable cropping pattern is selected considering farmland conditions and program for increasing agricultural production zone by zone.
Irrigation Efficiency:	Conveyance Efficiency; Open canal (well) 90%, Open canal (surface water) 85%. Water Application Efficiency; Gravity irrigation system 57%, Sprinkling irrigation system 90%, Paddy field 70%.

##### 2) Irrigation Method

Basically, ponding irrigation system is adopted in the paddy fields. Sprinkling and dripping irrigation systems are superior to other systems such as furrow, border and contour ditch in upland irrigation. However, in the case of upland irrigation, the system requires large amount of initial cost necessary for pumping facilities for sprinkling, pipelines for irrigation network and farm pond. In addition to the above cost, running cost for operation and maintenance is also necessary. Consequently, the production cost will be affected by the selection of crop and irrigation method, which, by its turn, will be carried out according to several factors such as farm management, topographic conditions and land use.

The characteristics of irrigation methods are presented as follows;

Irrigation Methods

	Ponding Irrigation Method	Furrow Irrigation Method	Sprinkling Irrigation Method			Drip Irrigation Method
			Low-pressure	Medium-pressure	High-pressure	
Suitable Crops	Paddy	Ordinary crop	Fruits	Ordinary crop	Crops highly	Fruits
Pressure Need	None	None	Approx. 1.5kg/cm <sup>2</sup>	Approx. 3.0kg/cm <sup>2</sup>	Approx. 4.0kg/cm <sup>2</sup>	Approx. 0.5kg/cm <sup>2</sup>
Water Conveyance System	Open canal	Open canal	Pipeline	Pipeline	Pipeline	Pipeline
Water Conservation	Low	Rather low	Medium	Medium	Medium	High
Cost of Facilities	Cheap	Cheap	Expensive	Expensive	Expensive	Rather expensive
Running Cost	Cheap	Cheap	Expensive	Expensive	Expensive	Rather expensive
Irrigable area	Available	Available	Available	Medium Scale	Large Scale	Small Scale
Erosion	None	Slight	None	None	None	None
Operation	Easily	Rather easily	Easily	Easily	Rather difficult	Rather difficult
Land Reclamation	Necessary	Necessary	Rather necessary	Rather necessary	Rather necessary	Not necessary

Since it is difficult to propose a suitable cropping pattern to each farmland, it is proposed zone by zone in this Master Plan. Ponding irrigation method is adapted to the Paddy fields, and furrow irrigation method is applied to the upland irrigation in the initial stage. In the case of future increase of agricultural production benefits, the furrow irrigation method for upland is switched to sprinkling and dripping methods. However, these methods require some facilities such as farm pond and sprinklers.

### 3) Operation Hours for Irrigation

The irrigation operation hours are 24 hours in the peak, considering the scale of irrigation facilities, such as intakeworks, settling basin and canal.

## (5) Individual Irrigation Plan

### 1) Large Scale Irrigation Plan utilizing surface water

#### a) Selection of the Irrigable Area

The objective of this Master Plan is the stabilization and increase of small and medium scale farmers. An unexploited area for large-scale irrigation project was selected through the field inspection. The field inspection took into consideration of the following points;

- i) There shall be rivers or lakes with potential to cover the irrigable area. This water resource shall be located close to the irrigable area.
- ii) Irrigable area shall be more than 500ha.
- iii) There shall be a high density of small and medium scale farmers.
- iv) It shall be possible to install the gravity irrigation system, which is economical from the viewpoint of running cost.

As for water resources, there are 3 (three) river basins, which are Rio Villanueva, Rio Sinecapa and Rio Telica, in Region II, provided that Rio Villanueva is called Rio Grande from upstream of Villanueva. In addition, there is the Lake of Nicaragua in "Nicaragua Lake Coastal Zone" in Region IV. These water resources for irrigation are appropriate for the large-scale irrigation plan. The exploitable areas are tabulated as follows;

Basin	Department	Municipal	Irrigable Area
Rio Grande Basin*	Chinandega	El Sauce	Approx. 1,857Mz
Rio Villanueva Basin*	Chinandega	Villanueva	Approx. 1,714Mz
Rio Sinecapa Basin	Leon	Nagarote	Approx. 1,714Mz
Rio Telica Basin	Leon	Leon	Approx. 1,571Mz
Coastal of Nicaragua Lake	Granada	Malacatoya	Approx. 1,571Mz

Note; Marked basin is included in the same basin.

In Coastal of Nicaragua Lake, despite all the available water resources, only 1 (one) scheme is possible. The reason for this situation will be described as follows.

There are lots of suitable areas in the coastal of Nicaragua Lake, however most of the areas is occupied by large-scale farmers. In addition, in some irrigable areas, irrigation facilities had been already installed by large-scale farmers, and some others are being exploited for cattle breeding.

Furthermore, although the exploitable area is located at the west side of the national highway, few kilometers away from Nicaragua Lake, it is not economical for upland irrigation system. The reason is that, in case the Nicaragua Lake water level is 30 m, the total pump head will be more than 60 m high including the high head loss caused by the pipeline length to reach the irrigable area.

On the other hand, the Tisma scheme, which is located in the northern part of Nicaragua Lake coast, has good topographical conditions, however the irrigable area is covered with unsuitable soil for agricultural purpose.

Consequently, only Malacatoya scheme is available as exploitable area at the northern part of the Nicaragua Lake coast.

Large-scale irrigation projects are enumerated as shown in the table and figure.

Irrigation Projects

Name of the Project	Basin/Location of Intakeworks	Irrigable Area (Mz)	Discharge (m <sup>3</sup> /s)	Type of Intakeworks
EL SAUCE Irrigation Project	Río Grande Upper stream of the El Sauce	1,857	2.02	Earth Dam Headworks
CAYANLIPE Irrigation Project	Río Villanueva Upper stream of the Villanueva	1,714	1.87	Earth Dam Headworks
ZARZALES Irrigation Project	Río Sinecapa Upper stream of the Zarzales	1,714	2.80	Earth Dam Headworks
TELICA Irrigation Project	Río Telica Upper stream of the Quezalaguaque	1,571	0.78	Headworks
MALACATOYA Irrigation Project	Lake of Nicaragua Malacatoya	1,571	1.71	Pumping Facility

b) Potential for Irrigation Purpose

Low water-discharge for 5 years return period is tabulated as follows based on the data obtained during the phase I of the study (refer to Annex B - Meteorology).

Average Discharge of Monthly in Intake Site (m<sup>3</sup>/s)

Name of Project	Name of River	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EL SAUCE Irrigation Project	Río Grande	0.47	0.51	0.49	0.24	1.82	2.70	1.00	1.39	9.21	13.8	5.02	0.82
CAYANLIPE Irrigation Project	Río Villanueva	1.61	0.83	0.49	0.46	4.71	11.9	5.88	6.73	33.7	30.2	15.8	3.48
ZARZALES Irrigation Project	Río Sinecapa	0.40	0.20	0.12	0.11	1.16	2.96	1.45	1.66	8.32	7.46	3.91	0.86
TELICA Irrigation Project	Río Telica	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	1.20	1.20	1.20	1.00
MALACATOYA Irrigation Project	Lake of Nicaragua	None-restricted											



c) Discharge for Irrigation Purpose

Required water discharge for irrigation is estimated, in a monthly basis, as follows.

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
EL SAUCE Scheme	1.64	1.59	1.70	0.33	0.95	1.40	2.01	1.75	0.00	0.08	0.29	2.02
CAYANLIPE Scheme	1.52	1.47	1.57	0.31	0.88	1.29	1.86	1.62	0.00	0.07	0.26	1.87
ZARZALES Scheme	2.28	2.20	2.35	0.46	1.32	1.94	2.79	2.43	0.00	0.11	0.40	2.80
TELICA Scheme	0.63	0.61	0.65	0.13	0.37	0.54	0.77	0.67	0.00	0.03	0.11	0.78
MALACATOYA Scheme	1.39	1.34	1.44	0.28	0.80	1.19	1.70	1.48	0.00	0.07	0.24	1.71

Note: Details of the estimation are shown in Annex I.

In the case of 3 (three) schemes, which are El Sauce, Cayanlipe and Zarzales, it is impossible to intake the required (design) discharge for irrigable area during the dry season. There are two possible countermeasures for the above problem. One is to decrease the irrigable area in accordance with water availability, and the other is to install dam facilities, at upper stream, allowing the water supply of the irrigable area during the dry season.

In the case of the irrigable area decrease in accordance with the availability of water resources, the area of each scheme becomes about 400 ha. Consequently, in order to efficiently utilize cheap water resources, dam facilities are adopted in this plan.

d) Considerations of Dam Facilities

Site:

**Chapeton Dam:** Chapeton dam is located at Fila el Chapeton town, along the Rio Grande, and 45 km distant from the municipality of Villanueva. Since Rio Grande basin covers the irrigable area of both El Sauce scheme and Cayanlipe scheme, both areas are served by the Chapeton dam.

**Pilar Dam:** Pilar dam is located at El Pilar town, along the Rio Sinecapa, and 15 km distant from the municipality of Los Zarzales.

**Geology:** Geology of the dam site is of the andesite type in both schemes, thus it is suitable to install the dam facility. However, a deeper geological inspection is necessary for the detail design.

**Dam Capacity:** Dam capacity is estimated considering the water balance calculated on basis of relevant data of discharge, water requirement and maintenance flow of the river. In case irrigation design water flows out directly to the river, another 20% of irrigation water must be added to the design volume due to several head losses, such as evaporation from water spread area in dam, infiltration of irrigation water to underground and friction caused by river flow.

**Results:** The irrigable area which can be irrigated by the installation of dam facilities are 1,500 x 103m<sup>3</sup> and 1,300 x 103m<sup>3</sup> in El Sauce scheme and Cayanlipe scheme, respectively.

### c) Irrigation Facilities

**Intakeworks:** Due to the long distance between the irrigable area and the dam site, the stored water served by the dam must flow out through the river. Intakeworks must be installed close to the irrigable area in order to take the design water from the river. Besides, type of headwork appropriate for the case is the Mountain Stream Diversion Works type, considering river conditions such as dimensions and topography.

**Pumping Facilities:** Irrigation water is pumped up from Nicaragua Lake in Malacatoya scheme. Three pump sets are necessary to keep up with the water management of every season. The capacity of the pump is 31m<sup>3</sup>/min, 33m of total pump head and 340Hp (250kW) diesel engine as power resource.

**Irrigation Network:** The irrigation network is composed of canals lined with wet masonry in order to assure the irrigation efficiency and economical aspect, and comprehends conductive, main and secondary canals. However, a box culvert type conductive canal is applied in Malacatoya scheme for the installation of the pump irrigation system. The dimensions of the box culvert are 1.0m x 1.0m. This box culvert will be affected by about 7kg/cm<sup>2</sup> of water pressure, thus a due care must be taken during the construction of the joints.

### f) Consolidation for Farmland

Although farmland consolidation is not included in this plan, farm roads will be installed as a preparation for the irrigation facilities.

The farm roads will be installed in an arrangement comprehending a 200 m spacing between branch roads and 1000 m spacing between truck roads. The road density is 35m/Mz and 7m/Mz for branch roads and truck roads, respectively. Besides, a farm road will be installed along the canal, a non-paved road considering both economical and soil conditions aspects.

### g) Operation and Maintenance

Water Users Association (W.U.A) shall be established by the beneficiaries, so that operation and maintenance for irrigation facilities are carried out by it. The O/M annual cost shall be shared in accordance with the irrigable area share of each individual beneficiary.

Summary of Large-scale Irrigation Plans

	EL SAUCE Scheme	CAYANIJE Scheme	ZARZALES Scheme	TELICA Scheme	MALACATON A Scheme
Irrigable Area (Mz) (ha)	1,857 1,300	1,714 1,200	1,714 1,200	1,571 1,100	1,571 1,100
Water Resource Intakeworks	Rio Villanueva Chapeton Dam /Headworks	Rio Grande Chapeton Dam/Headworks	Rio Sinecapa Pilar Dam/Headworks	Rio Telica Headworks	Nicaragua Lake Pumping facility
Dam Capacity	1,500 × 10 <sup>3</sup> m <sup>3</sup>		1,300 × 10 <sup>3</sup> m <sup>3</sup>	-	-
Dam Height	21	<-	21	-	-
Design Discharge (m <sup>3</sup> /s)	2.0	1.9	2.8	0.7	1.5
Conduction Canal	7.5	7.0	5.5	3.5	4.0
Main Canal (km)	10.0	12.8	6.5	3.0	4.0
Secondary Canal (km)	16.0	15.0	15	5.5	5.0
Tertiary Canal	3 km <sup>2</sup> /km <sup>2</sup>	3 km <sup>2</sup> /km <sup>2</sup>	3 km <sup>2</sup> /km <sup>2</sup>	3 km <sup>2</sup> /km <sup>2</sup>	3 km <sup>2</sup> /km <sup>2</sup>

## 2) Groundwater for Irrigation Purpose

In case the irrigable areas are closely located and spread in a wide area, and do not utilize surface water, it is appropriate to adopt the groundwater irrigation system, which covers a large-scale irrigable area. Due to well capacity, this large-scale irrigation system becomes an aggregation of small-scale systems. In the case of promoting the irrigation for all the proposed area, it is appropriate to promote the irrigation development plan collectively considering the ability required and the management of the proposed area.

### a) Proposed Area (Irrigable Area)

As a model of large-scale irrigation plan, the proposed area was considered regarding to the following aspects; 1) irrigable area, which has abundant groundwater potential, 2) delay in the agricultural development due to insufficient rainy irrigation water, 3) the farmers are motivated to improve the farm management.

There are about 700Mz of irrigable area at El Espino scheme in Region II, therefore this scheme is suitable as a model of large-scale irrigation plan utilizing groundwater and considering the above factors.

### b) Basic Concept for Groundwater Irrigation System

Cropping pattern:	Basic grains and greenery can be cultivated depending on the farm management system adopted.
Water requirement:	Water requirement is estimated based on the suitable cropping pattern.
Well capacity:	2,000 m <sup>3</sup> /day
Well dimensions:	Although well dimensions can be different depending on topographic and geologic conditions, a standard

size for irrigation purpose will be applied. Its dimensions are 80m depth and 300mm diameter.

Pumping set:	Submersible motor pump Diameter; 125mm, Design discharge; 1.8m <sup>3</sup> /min, Total pump head; 90m, Output; 55Kw
Irrigable area:	Irrigable area is about 60Mz considering the discharge of the existing well. However, it is necessary to carry out pumping tests such as continuous and step by step pumping for the detail design.
Number of Wells:	15
Irrigation Network System:	Irrigation network system is made of wet-masonry, and is installed up to the last 14Mz (10ha) block in the tail end.
Related Structures:	Diversion works, Measurement facilities for water management and road for maintenance of main irrigation canal.
Operation and Management:	Water Users Association composed of the beneficiaries

### 3) Small Scale Irrigation Plan

At present, although 150Mz of irrigable area is unified at the Nicaragua Lake coast, the exploitable area utilizing groundwater is still not clear. The concepts for small-scale irrigation plan are described theme by theme, having the large-scale irrigation plan as a model.

#### a) Lake of Nicaragua as Water Resource

In the case of Nicaragua Lake as water resource, it shall be necessary to install a pump set in the irrigation system. Based on the economical and management aspects, an outlet box shall be installed at a high place in the irrigable area, so that the irrigation can be carried out through the gravity system. The exploitable area, utilizing this system, is estimated in about 6,500Mz. The lay-out shall be similar to the large-scale irrigation plan but in a smaller scale.

#### b) Small and Medium Scale Rivers as Water Resource

In the case of small and medium scale rivers as water resource, there are 2 (two) possible irrigation systems according to topographic conditions. One is the gravity irrigation system and the other one is the pump irrigation system. The former system can conduct the required water using intakeworks in the river, but the latter can not. Basically, after the outlet box both systems utilize the gravity method. The exploitable area is estimated to be about 5,430Mz. The lay-out shall be similar to the large-scale irrigation plan but in a smaller scale.

#### c) Groundwater as Water Resource

Since the irrigable areas are scattered in the plan proposed area, the wells shall be installed every 10 farm households. Based on the existing well data, the standard depth of the well shall be 80m. Therefore, the exploitable area is estimated in about 201,300Mz. The lay-out shall be similar to the large-scale irrigation plan but in a smaller scale.

#### 4) Orientation towards Small Scale Irrigation Facilities

As mentioned before, in the case of utilization of surface water as water resource, the exploitable area is restricted by the river discharge in large-scale irrigation systems. Furthermore, in the case of utilization of Nicaragua Lake, the exploitable area is also restricted because of the location of the irrigable area, a few kilometers from Nicaragua Lake, and the difference of altitude between the area and the water level of the Lake.

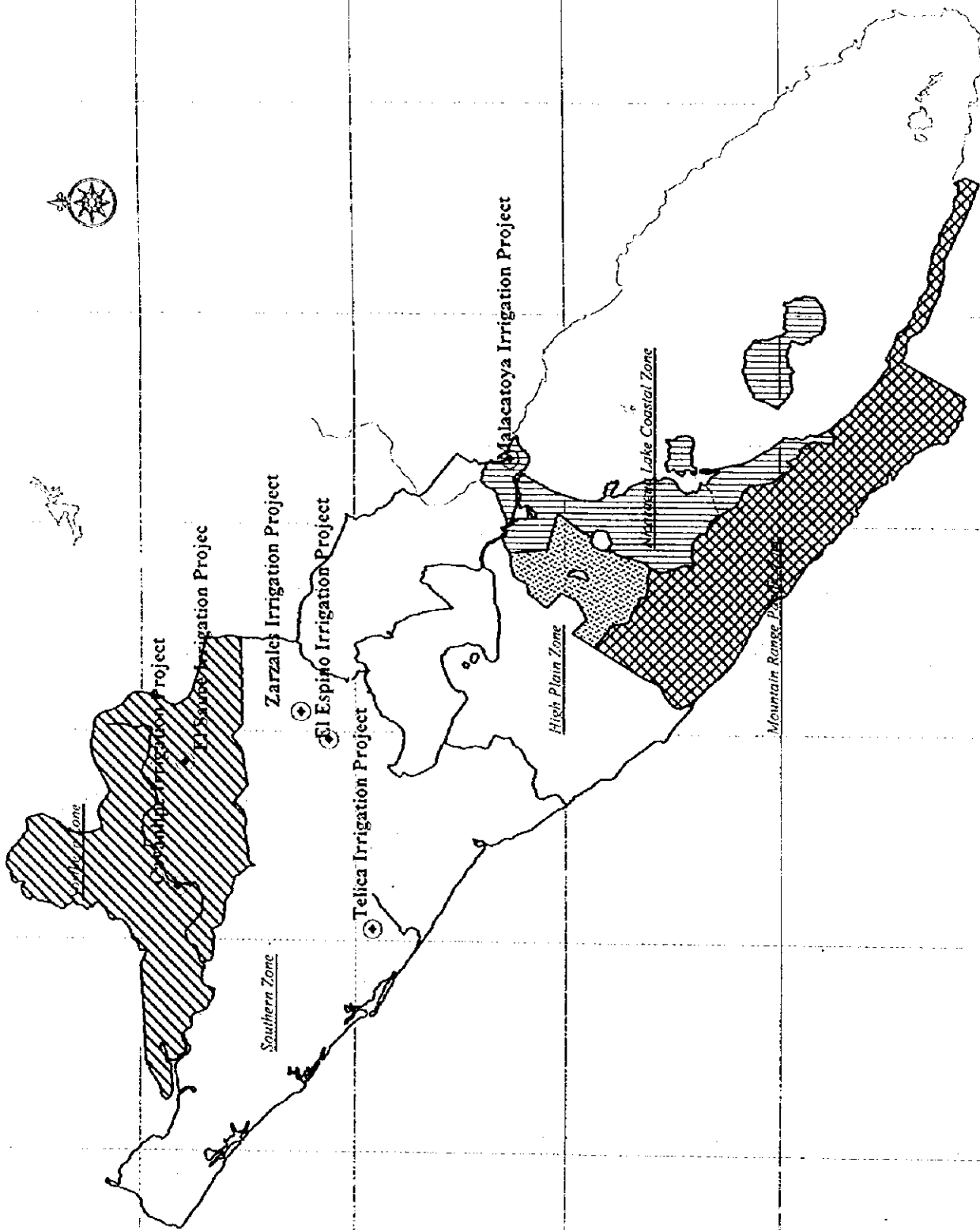
Consequently, the small-scale irrigation facilities utilizing abundant groundwater shall be promoted as the main irrigation system. The well is the irrigation unit and shall be installed for a group of few farm households. Besides, it is necessary to give guidance to the farmers about the operation and management of the system, by organizations such as MAG and INTA.

Although the volume of surface water is restricted, it is a precious water potential for the future. Consequently, it is recommended to promote a development plan which maximizes the utilization of this potential.

It is difficult to estimate the river conditions for irrigation purpose (bed slope, discharge, water route and others) because some rivers' water often flows into the underground (underground water), and some others obtain spring water from neighboring sites. It was impossible to estimate the rivers conditions in the study area during the Phase I of the Study. On the viewpoint of the utilization of the surface water potential, it shall be stressed the importance of measuring river data to evaluate its conditions. Although, at present, some rivers were judged unexploitable as water resource due to lack of information, the judgment can change as far as there are measurement facilities available.

#### (6) Operation and Maintenance

In order to assure an efficient operation of the irrigation facilities during a long period, the W.U.A, consisted of beneficiaries, shall carry out an adequate management of the irrigation system. For this purpose, the technical transfer of about irrigation techniques carried out through several organizations is necessary.



**Figure. Location Map of Large scale Irrigation Projects in the Study Area**  
 Scale: 1/1,500,000

### 5.8.3 Road Network Plan

#### (1) Objective

At present, the conditions of roads are not good due to lack of regular maintenance, therefore the delay in the transportation of agricultural production and equipment is very frequent.

Consequently, the increase of agricultural production and improvement of living standards of the beneficiaries can only be attained through a plan of rehabilitation of the existing road network.

#### (2) Proposed plan

A plan for the installation and rehabilitation of main roads, national highway and provincial roads, has already been prepared. Therefore, the present rehabilitation plan is oriented to rural roads (Camino Rural) which branch off from the provincial roads.

The proposed length for rehabilitation is shown in the following table.

Region	Zone	Length of Road Rehabilitation (km)
Region II	Northern Zone	369
	Southern Zone	963
	Nicaragua Lake Coastal Zone	347
Region IV	Mountain Range Pacific Zone	548
	High Plain Zone	204
Total		2,431

#### (3) Rehabilitation Concept

##### 1) Implementation of the Rehabilitation Plan

The MCT (*Ministerio de Construcción y Transportes*) has prepared the improvement plan for national highway and other roads for the whole Nicaragua, and the roads proposed in the present plan are included in the MCT's plan. Considering the above, the road rehabilitation plan in this Master Plan supports MCT's plan in assuring the acceleration of works.

The road rehabilitation itself is not enough to assure good transportation conditions. A continuous maintenance needs to be carried out to guarantee such conditions. The MCT controls all road networks in the Republic of Nicaragua and carries out the maintenance. Therefore, the present plan shall include the procurement of equipment for the realization of roads' maintenance.

The MCT shall supply such equipment to the Municipalities, so that they burden the costs of equipment and operation.

## 2) Rehabilitation Works

The rehabilitation plan comprehends pavement works and installation of shoulders in the roads. Regarding to roads pavement, gravel shall be utilized considering the importance of the road network and the economical aspects. According to field inspection carried out during this study, the total road width is estimated in 10m although it is not clear due to insufficient conditions. The rehabilitation plan includes the paving of a 7.0m width, considering the convenience for large size trucks. Besides, in Nicaragua, the rural roads already have a 20 m width protection band for rehabilitation and maintenance works.

## 3) Equipment for Road Maintenance

Road maintenance works are required, at least, every 3 (three) years, and therefore 6 sets are necessary to carried out the service; 3 sets in Region II and another 3 sets in Region IV.

Equipment	Type	Quantity	Remarks
Dump Truck ( <i>Camiones Volquetes</i> )	10m <sup>3</sup>	5	
Motor Grader ( <i>Moto Niveladoras</i> )	140B, G	2	
Fork lift ( <i>Cargador Frontal</i> )	2.2 m <sup>3</sup>	1	
Vibratory Rollers ( <i>Vibro Compactadoras</i> )	12 Ton.	1	
Water Truck ( <i>Camión Cisterna</i> )	2000Gf (8000 L.)	1	
Bulldozer ( <i>Tractor</i> )	D-155-A	1	
Bulldozer ( <i>Tractor</i> )	D-6-D	1	
Drainage Pump ( <i>Bomba Succionadora</i> )	1,000 L./min	1	
Lubrication Truck ( <i>Camión Plataforma de Engrase</i> )		1	
Fuel Truck ( <i>Camión Cisterna de Combustible</i> )	(9000L.)	1	
Mobile Workshop ( <i>Camión Taller</i> )		1	

### 5.8.4 Seed Production

One of the constraints to improve agricultural productivity in the study area is derived from lack of the improved seeds. This problem appears to result from a lack of knowledge among the farmers and absolutely lack of the improved seeds to a demand. Although, it is necessary to carry out the extension activity to convince farmers of its advantage but it is also indispensable to increase production of the improved seeds. Area-specific farming prevails in each region, where the Region II is oriented to the basic grains farming while the Region IV is prevailing crop diversification including a large portion of vegetables production with the basic grains. In addition, a demand of the improved seeds in both regions is expected to increase very much by implementing the Master Plan. For this purpose, seed production base for the improved seeds are constructed in the both regions.



(1) Basic Grain Seed Production Project (Region II)

- Objectives

One of the constraints to improve productivity in the agriculture sector is derived from lack of the improved seeds. In order to promote a productivity of basic grains, it is inevitable to increase and disseminate the improved seeds. Therefore, this project is aimed at multiplying and diffusing the improved seeds by constructing a seed production center with organizing seed production association coupled to the farmer's training program.

- Outline of the Project

Diffusion rate of the improved seeds, especially maize and sorghum is less than 3 % in 1996/97 and a majority of the farmers is using seeds from their products. In order to improve this situation, in the municipality of Larreynaga in Leon Department which is a granary in the country, facilities of the seed production center shall be constructed in order to multiply and diffuse the improved seeds in collaboration with the concerned governmental entities for the selection and training of the seed production farmers.

This project consists of the following 3 components.

- Construction of seed processing center
- Selection of the seed production farmers for maize and sorghum seeds with training program for the seed production technology
- Collection of produced seeds, processing, marketing and distributing to the farmers

Necessary facilities, equipment and a fixed goal to carrying out the above components are as follows.

1) Facilities

Facilities	Equipment
Office	Material and equipment for seed test lab
Storehouse for seeds	Vehicles
Seed processing plant management	One lot of equipment for production
Drying place for seeds	
Seed test Lab	

2) Seed Production Farmers and the Farm

The improved seeds of maize and sorghum are produced by giving a guidance of the seed production technology to the farmers who are selected in collaboration with MAG and INTA. Size of seed production farm is expected to 200 Mz per each maize and sorghum seed production which are comprised with 0.5 Mz per seed production farmer and the number of farmers are around 800 farmers.

3) Seed Production

Projected amount of the certified seeds for sorghum and maize is as follows;

- Maize 8800 qq
- Sorghum 12000 qq

4) Responsible organization: MAG, INTA

- Expected effects of the Project
  - Stabilization and improvement of standard of living for the seed production farmer
  - Improvement of agricultural productivity by diffusing the improved seeds
  - Generation of employment opportunity for the rural idle labor forces
- Others
 

It is necessary to make this project compatible with the on-going plan of CEO project which involves in breeding, preservation of stock line and research of farming practice for the oily crops like cotton, peanut, sesame and soybean.

(2) CESASUR (Centro de Servicio Agropecuario del Sur) Supporting Project

- Objectives

One of the constraints to improve a productivity in the agriculture is derived from lack of the improved seeds. In order to improve the agricultural productivity for the Region IV, it is inevitable to increase production of the improved seeds for the grains and vegetables and diffuse them. For this purpose, it is aimed at increasing production of the improved seeds by strengthening the existing facility. Selecting and training the seed production farmers proceed in collaboration with the concerned governmental entities in order to multiply and diffuse the improved seeds.

- Outline of the Project

Diffusion rate of the improved seeds, especially maize and sorghum is less than 3 % and a majority of the farmers is using the seeds from their products. Vegetable seeds are almost depending on the expensive imported seeds. Therefore, a seed production center for the basic grain and vegetable seeds shall be constructed by strengthening the La Campaña station, a branch of the Campo Azules Research Station. Function imposed to the project is comprized with analysis of soil, water and plant tissue, seed test, and processing of the seeds produced. In addition, necessary seed production farmers are selected in collaboration with the concerned governmental entities in order to increase production of the improved seeds. Necessary facilities/equipment for renovation of the existing facility is as follows;

Facilities	Equipment and materials
Office	One lot of materials and equipment for the lab analysis
Storage house for seeds	Vehicles
Seed processing plant	One lot of equipment for production management
Drying place for seeds	
Labs for seed test, analysis of soil, water and plant	

Renovation of the experimental field;      Experimental farm of 60 ha  
 Target Crop;                                      Maize, frijol, vegetables (water melon, melon, tomato, green pepper, onion, beat, pumpkin, etc)

- Expected effects of the Project;

The target beneficiaries for the project is around the 5000 small-medium scale farmers scattered over the urban area closed to Managua metropolitan city. Also, the Region IV has 4 non-conventional seed production associations which produce frijol seed and are supposed to receive technical assistance. Further this project is expected to stabilize and improve standard of living for the seed production farmers, to improve an agricultural productivity and to generate employment opportunities for the rural idle labor forces.

### 5.8.5 Research and Development

Introduction of oil crop among the small-medium scale farmers are promoted in the Study Area of the Master Plan. The oil crops are ranked as the important cash crops for the small-medium scale farmers in this Master Plan as well. These oil crops, however, are scarcely studied in the country in terms of farming practice and variety at present. Thus, establishing research and development organ for the oil crops is required in the future.

The study for the other crops like basic grains are sufficiently carried out by the international organs and other donor countries in large scale. Thus the Master Plan is managed to utilize the output of research results by the said organizations.

#### (1) Reactivating Plan of the ex-Cotton Research Experimental Center (CEA)

It is aimed at establishing a base of technology generation and human resource development by reactivating CEA at Posoltega in Leon Department in the Region II, by focusing on the oil crops like sesame, soybean, peanut and cotton as the research crops in order to promote the north western agriculture of the country.

##### - Outline of the Project

The cotton research center established in Posoltega, Leon Department played an important role to promote cotton production during the peak of cotton cultivation. However, this station is currently managed and utilized by MAG to produce soybean seed only. Therefore, the project is aimed at implementing the programs based on the strategy mentioned below by renovating the existing facilities. The strategy for the Plan is as follows;

- Based on the demand projection from the year of 1998 to 2002, reactivating of the agricultural sector in the northwestern of the country is promoted by developing agronomic technology for the oil crops.
- It is carried out to introduce new varieties and genetic resources, with improvement of the current varieties of the oil crops as well as preservation of breeding stocks
- It is carried out to breed new varieties of the oil crops and disseminate them.
- It is carried out to breed basic seeds of the oil crops and their preservation.
- It is carried out to study and generate technology of integrated pest management (IPM), including a training program for technicians and farmers.

While implementing this project, the necessary renovation or reparation of the existing facilities is as follows;

1) Contents of renovation and reparation

- Renovation of office and equipment
- Renovation of laboratories
- Grant of training equipment and materials
- Grant of equipment & materials for public relation
- Construction of seed processing plant
- Grant of equipment & materials for extension activities
- Renovation of experimental fields
- Renovation of research facilities

2) Target crops for research work

Oil crops (soybean, peanut, sesame and cotton)

(2) Responsible organizations MAG, INTA, UNAN-Leon

- Expected effect of the Project

As a countermeasure to promote the agriculture sector in the Region II, this project enable to generate agricultural technology which fit to the agro-ecological environment in the north-western area and to improve the standard of living for the farmers cultivating oil crops indirectly.

**5.8.6 Strengthening of Extension Services**

(1) Project for the Strengthening of the Extension Services System

1) Objectives

The extension offices in each study area are facing difficulties to carry out the extension activities due to the limitation of equipment such as telephone and typing machine. Therefore, this projects aims at making them efficient through the provision of a training room, office equipment and a training program.

2) Contents

This project aims at the implementation of a training program to develop the technical human resources as well as the farmers themselves, with the objective to facilitate the task of the extension personnel in the existing 8 extension offices in the Study Area. For this purpose, the link between the generation of technology and the extension activity shall be strengthened through the provision of the training room, offices and equipment.

3) Required Equipment

The required equipment, materials and facilities are the following;

- Personal computers (desktop) with printer and software
- Tel/Fax equipment
- Training materials (OHP, slides projector, videos and educational materials for both agriculture and livestock farming)
- Pickup truck
- Training room for 20 to 30 people

#### 4) Effects of the Project

The number of expected beneficiaries is around 8,500 farming households. It is possible for the strengthening of the extension system by means of the efficient work of the extension agencies in Regions II and IV.

Official organizations of the agricultural sector including INTA have been analyzed aiming at their reformulation. Under this frame, the task of INTA shall be limited to the generation of technology and development of human resources, transferring the extension work to the private sector.

The existing extension agencies shall be the base for the generation of technology and training of farmers.

#### 5.8.7 Livestock Farming

##### (1) General

Pastures have been over produced in lands with potential for such cultivation. On the other hand, due to the high animal density by pasture unit, 1 Mz/Cattle head, the feeding conditions of cattle are very low to assure a good reproduction. In order to increase the cattle population in the future, it is necessary to improve the cattle raising techniques through the following measures; 1) supply of a better forage, 2) improvement of breed through the introduction of new cattle breeds, 3) establishment of proper markets, 4) improvement of the animal reproduction technology. As for the marketing, at present, since the domestic market doesn't demand a too high quality meat which means its price is low, this meat could be commercialized in the international market as a low price meat.

The above mentioned situation is not expected to be changed in the medium term. Therefore, the proposed plan comprehends aspects of animal health and improvement of the existing cattle breeds, not concerning to increase the cattle population.

As for other animals' consumption, recently it is being observed that the chicken has become the main consumed animal product in the domestic market and the continuation of this trend is expected for the future. Nevertheless, the production of chicken at the commercial level is being carried out by large scale companies. The production of chicken by individual farmers is carried out merely for self-consumption. The present plan aims at improving and increasing the production of chicken by small and medium scale farmers so that the production surplus, after deducting the self-consumption portion, is destined to the market.

##### (2) Supporting Plan for the Production of Animals by Small and Medium Scale Farmers

###### 1) Objective

The small animals such as chicken and swine are raised in the farms in a traditional way, not becoming a source of income to the small and medium scale farmers. The selling price of these animals is too low and thus their creation is not commercially exploited. Besides, this activity is carried out mainly aiming at the self-consumption and at complementing the daily nutritional diet. Due to the important role the chicken meat plays as for nutritional aspects, the plan proposes to distribute young chicken to be raised by the farmers so that they can complement their nutritional requirements.

Due to the easiness and low cost involved in the traditional chicken raising activity, the plan has good chances to be largely accepted by the farmers in comparison with another type of small animal raising.

## 2) Outline of the Project

Ten (10) young chickens will be distributed for each small and medium scale farming family, including the landless farmers. At present, the Northern Zone of the Region II and the Cordillera del Pacifico Zone present a lower agricultural potential comparing with other zones in the Study Area. Considering that there are 8,000 small farmers in these zones, the project could be applied in an initial stage of 5 years. It is expected that the project is diffused to other zones afterwards. In order to attain an efficient diffusion of this project, the MAG and other concerning agencies shall supply the necessary support services.

## 3) Effects

This project aims at stabilizing the farmers living conditions through the improvement of the nutritional conditions of those suffering from extreme poverty. The expected effects are as follows;

- i) To improve the nutritional conditions of the beneficiary farmers of the project.
- ii) To increase the farmers' income through the selling of chicken and eggs production surplus.

## (3) Supporting Plan for the Cattle Raising Activity Investigation and Extension

### 1) Objectives

There is a cattle investigation center (CENAMEGE) in Managua in which several investigation activities are carried out. The present plan aims at supporting and complementing the investigation activities of this center specifically in the following fields; 1) improvement in the cattle production and animal health; 2) support to the investigation about agricultural technology.

### 2) Outline of the Plan

The plan should support the CENAMEGE in its investigation activities providing programs and resources to carry out these activities. The investigation themes shall be the obtainment of high quality forage and the technology for animal health control, which can be diffused to farmers through the agricultural extension system.

### 3) Effects

The basic expected effects are that, through the results of the investigation and their diffusion, the beneficiaries, in particular the small and medium scale farmers and also the landless farmers, can attain an increase in their productivity and consequently improve their life conditions

### 5.8.8 Commercialization

#### (1) Facilities for the Commercialization

In order to attain the increase of income of the Study Area farmers, the development of commercialization and processing aspects of the agricultural products is indispensable. However, there are several accumulated problems which are related to the conditions affecting the transition towards a market oriented economy and which need to be solved.

##### a. Public Sector

Regarding to the free market economic system, in between the production and consumption steps, there are several other steps which require market information in order to allow a fair participation of industrial or individual producers in the system. Therefore, the public organizations shall create proper regulations and conditions so that the market economic activities as well as the population activities are oriented towards the above mentioned system. For this purpose, the government shall adopt an agriculture and livestock development program as mentioned below.

Name of Program	Content	Expected Effects	Agency concerned
Improvement of Infrastructure for Information	Expanding telephone line network and increasing saturation level of telephone especially in regional area. Increasing number of relay stations and receivers for radio and TV broadcasting.	To extend market information and basic knowledge and technology. To promote proper distribution of commodities.	Broadcasting Agencies MEDE MAG INTA MED
Improvement of Market Facilities	Arranging enough area of market attached with proper access roads. Improving utility and sanitary facilities. Attaching storage facility.	To promote efficient distribution and handling of commodity. To improve quality control of commodity. To decrease losses generated in handling and storage.	MEDE Municipality MCT
Establishment of Cold Chain	Attaching cold storage facility to airport and markets.	To expand area and promote efficiency of distribution for fresh commodity. To decrease losses of fresh commodity during distribution. To improve quality control for fresh commodity. To promote exportation of fresh commodity.	MEDE MAG Municipality

##### b. Private Sector

In order to attain its development, the public sector shall carry out efforts to create proper marketing conditions. Under these conditions, investment shall be carried out in the field of commercialization. Besides the investment of local entrepreneurs' own funds, the reinforcement of the promotion of foreign capitals introduction, low cost funds, etc. are indispensable.

A very important aspect to attain the development objectives is that the small and medium scale farmers shall be associated to carry out their commercialization and products processing activities; the following described program shows such a purpose. In Fig. J-5 of Annex J, the coordination of several steps from the production step until the commercialization of products, centered by the farmers organizations, is schematically presented.

- Commercialization Sector

Program Name	Content	Expected Effects
Facility for Information Collection and Analysis	Collecting and accumulating the market information. Analyzing and knowing the condition and tendency of trading in each market. Carrying out expectation of the future condition from the trend of the market condition by analysis of information accumulated and knowing the most profitable crops, sales time and destination places. Formulating a production and sales plan among the member farmers.	To ensure the foundation of sustainable and self-reliant activities for farmers group. To strengthen market oriented economic activities on farmers. To create the activity that is the most important one for all economic activities and the know-how. And the information accumulated in this activity can play the role that leads the future condition of agricultural production in the area.
Facility for Collection, Storing and Forwarding of Products	Carrying out the adjustment in a harvest day with each production farmer in advance and collect products jointly by a truck. Classifying collected products in terms of destination place, packing and/or binding in case, and forwarding by a truck. Keep the products which can be stored in the storage and forwarding it on suitable time and to suitable place while observing the condition of markets.	To strengthen bargaining power and increase profitability. To be expected that such practice as grading by presence of damage, size, color etc. of products to seek more profit would be diffused and treated as an individual and private standard of trading in this area. It means that the activities in the Project have contribution of improvement on trading condition in the area under the free market system. To reduce post-harvest losses of products.

- Agricultural Products Processing Sector

In order to introduce agricultural products processing facilities, the agricultural production system of the farmers associations to be benefited shall be investigated. Basically, the guidelines are the following:

Program Name	Content	Expected Effects
Facility for Processing Products	Processing products and adding value to seek more profit according to market needs.	To Increase competitiveness and profitability. To show the directions to other producers in the area by which they can make more profit other than improvement of their farming. To increase efficiency of utilization of natural resources.

(2) Public Support

The continuity of adequate conditions for the development of a market oriented economy is necessary in order to produce a real contribution to the national economy. The contribution will be given through the increase of farmers' income as a result of the development of market oriented economic activities by them. With such a purpose, the government should take measures in order to minimize its participation in the economy and to allow the market forces to act freely; for instance, the government should reduce its size and the public



budget. However, at present, considering the small and medium scale farmers' difficulties to access the market information and credit, to allow the market free action could mean the risk of only benefiting the large scale farmers through the projects proposed by the Master Plan, i.e., improvement of market information collection and diffusion, agricultural credit project, etc.

For the reasons above mentioned, the government can not totally eliminate its participation within the market activities' mechanism, and otherwise shall support the small and medium scale farmers in their economic activities so that they can participate in the market. Furthermore, the government shall create and reinforce the adequate and sustainable conditions so that the farmers can have qualification to carry out their activities under a fair competition.

The programs mentioned below are proposed taking into account of the above mentioned conditions about the support needs.

Name of Program	Content	Expected Effects	Agency concerned
Strengthening Activities of Market Information Dissemination	Increasing volume and improving quality of information collected. Improving ability of processing and analysis for information. Establishing information distribution system by which people as much as possible can be access.	To lead economic activities to meet market needs. To increase efficiency of economic transactions and distribution of commodities. To generate fare competition circumstance among people and firms concerned, avoiding partial distribution of information.	MAG MEDE INTA
Establishment of necessary law and regulation, and it's application system	Establishing law and regulation and ensuring it's application necessary for promoting proper market economy system.	To ensure appropriate market economy system.	MEDE MAG MINSA MIPRES Police Municipality
Establishment and Improvement of Agricultural Products and Food Standard	Establishment and improvement of agricultural products and food standard and improving monitoring and controlling activity in market.	To generate efficient circulation of commodities reflected market needs. To promote exportation. To apply to consumers requirement.	MAG MEDE INTA
Establishment and Improvement of Food Sanitary Standard	Establishment and improvement of food sanitary standard, and strengthening application system.	To protect health of population. To promote exportation.	MINSA MAG MEDE
Improvement of Market Function	To separate function between wholesaling and retailing in big markets.	To generate effective handling of commodity in market. To stabilize pricing function.	MEDE Municipality

### (3) Individual Projects

As mentioned before, for a smooth implementation of the Master Plan commercialization sector development plan, the private sector shall develop within proper market conditions which shall be stimulated by the public sector. The proposed projects are closely related to other projects such as roads' rehabilitation, raising of farmers' education level, improvement of the financial system, etc., and shall interact among them. These programs also have concerns or include aspects related to the improvement of the legal ambit, education, urban rehabilitation, etc.

The Master Plan also considers that once this program is implemented and a high agricultural production level is attained by the small and medium scale farmers, then attention must be paid to the market future actions and the production processing activities. Nevertheless, the scale of the required facilities for the processing of products essentially depends on the demand capacity of each farmers association and on their ability to manage the production and products processing. That is the reason why the commercialization project was formulated based on the support it can provide to the agricultural activity from the standpoint of the production management.

#### Project of Strengthening of Market Activities Information Collection and Diffusion

a. Objective

In order to offer up to date and useful information to the beneficiaries, regarding to market activities and agricultural extension services, facilities shall be constructed and equipped in the following places; main wholesale market of Nicaragua, the Mayoreo Market; three stations (one in a market) in Chinandega, Region II; three stations in the Rivas Market, Region IV. These facilities will be installed in the DGIAP (MAG) stations.

b. Contents

At present, market prices information is collected only twice a week in the region. It is proposed that this activity is carried out twice a day, morning and afternoon, every day. The collected information shall be sent through the on-line system of the DGIAP and all the 7 stations shall be kept informed.

All the information daily collected will be processed and analyzed so as to be utilized by the users. Furthermore, in the stations, there will be a place where all the persons involved in the market, specially the farmers, can consult about the required market information.

c. Facilities

- . Building: consulting room and information processing room.
- . Equipment: telephone line linking the stations to the DGIAP central office, copy machine.
- . Others: placard to display information to the public, office equipment, etc. (it is expected that each station has its own computer set equipped with modem for the on-line communication with the central office and among them.)

d. Required Actions

Each station shall have personnel in charge of the market information collection; besides such personnel, there shall be one person in charge of this information diffusion to the beneficiaries.

There shall be a close coordination with the COMMEMA, which is the public organization in charge of the markets supervision, and with the municipality.

In parallel, the organizations in charge of the agricultural extension activities are required to carry out the diffusion of market information utilization techniques to the beneficiaries.

### 5.8.9 Farmers' Organizations

Farming and cattle raising by most small and medium size farmers in both Regions II and IV, at present, can be characterized as subsistence agriculture conducted with limited resources. Farm operators usually have low levels of education, and have limited access to training opportunities and credit. During the 1980s, however, small farmers organized as agricultural cooperatives had a preferential treatment from the government, in terms of access to land and credit. The preferential treatment was rooted in political expediency, rather than in economic efficiency, and caused distortions in farmer organization and peasant attitude. One consequence was farmer expectation for continued paternalistic actions from the government. This farmer expectation has become a bottleneck paralyzing farmer entrepreneurship.

Consequently, there is a strong need to get peasants to become self-reliable farm operators with business mind, who can effectively utilize information to identify and take advantage of new opportunities. Agricultural development projects can be formulated as means to solve small holder problems in Regions II and IV, but no project, large or small, can achieve desired results unless farmers are fully involved. An efficient way to achieve peasant involvement in development projects is through farmer organizations. More than the intrinsic merit of farmer organizations, organized farmers facilitate many support services, such as technical assistance, financing and marketing. Bottlenecks to the development of small farmers could be more effectively removed through an integrated approach, in which farmer organizations can play a key role. An integrated approach involves at least the following aspects.

- (1) Changing the mind-set of farmers, to get them to understand their rights and obligations, as individuals and as members of farmer organizations
- (2) Provision of technical/financial assistance, and production/marketing infrastructure and information that are appropriate to the absorptive capacity of farmers
- (3) Properly regulated market economy in which individual or collective efforts in agricultural production/marketing can be adequately rewarded

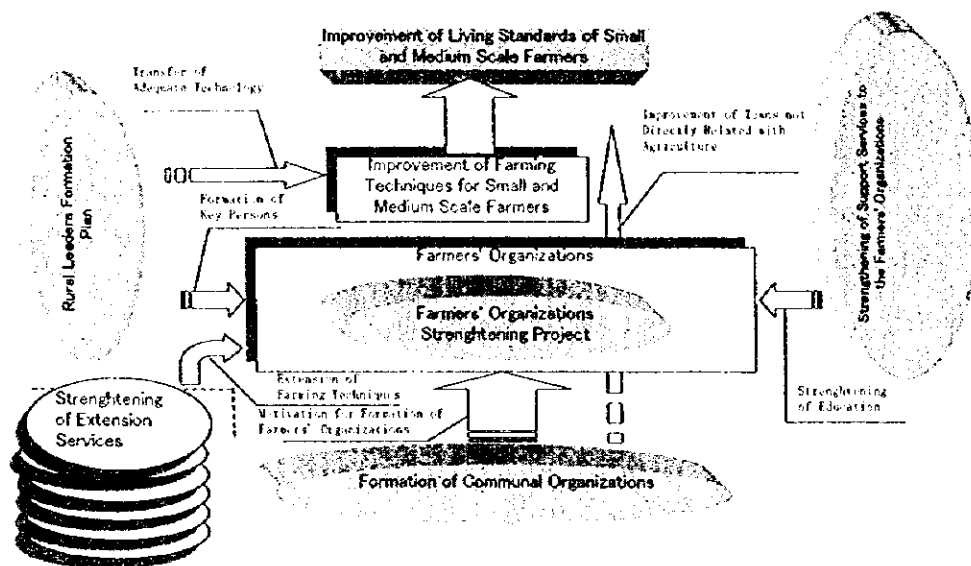
A given agricultural development project can deal with aspects (1) and (2) mentioned above, both of which can be better implemented through farmer organizations like agricultural cooperatives. However, aspect (3) refers to exogenous factors, which can not be dealt with within the confines of a given project. These exogenous factors refer to policy decisions, enactment of legislation and regulation, agricultural credit policy, macroeconomic policies, e.g., foreign exchange rate, price stabilization, interest rate, import duty on agricultural inputs, export duty on agricultural products.

- The strategy to improve farmer organizations is based on the following considerations.

- a) Self-motivated group  
Formation of farmer organizations is to give priority to groups that show own initiative, rather than to those groups that depend on inducement from outside.
- b) Homogeneous and appropriate size  
Members of farmer groups are to be as similar as possible under some set criteria. Moreover, these farmer groups are to be large enough to overcome individual weakness, but small enough to be homogeneous and cohesive.
- c) New farmer groups  
Priority is to be given to new farmer groups, rather than to existing farmer groups that are formally constituted and may already be recipient of aid.

- d) Organisations based on the objectives/details of tasks  
Multiple number of farmers organizations shall be set up based on the objectives and the details of their work.
  - d) Step-wise approach  
New farmer organizations are to start with simple purposes that are specific to each group, and then build up gradually to more complex collective activities that are proper for an agricultural cooperative.
- The objectives in the improvement of farmer organizations are the following.
- a) To promote formation of self-reliable and business oriented farmer organizations, minimizing reliance on subsidies and aid
  - b) To minimize bottlenecks hampering development of small and medium scale farmers, thereby opening up new opportunities for imaginative farmers
  - c) To achieve efficient production and sound marketing, thereby making farming profitable for small and medium scale farmers, as individuals and as farmer organizations
  - d) To form active economic agents that can compete in a global economy
  - e) To improve living standards of small and medium scale farmers

The four projects above mentioned are not independent from each other but are related to each other as indicated in the figure shown below. The project aims to strengthen the training of the framers' organizations; formation of farmers' organizations which have a motivational leader; and to motivate the farmers to get organized. The reason for promoting the formation of the farmers' organizations are the improvement of the living conditions of the small and medium scale farmers which can be attained through a joint and coordinated action.



## (1) Farmers' Organizations Strengthening Project

### - Objective

As mentioned before, in the Study Area there are many disadvantages from the production point of view due mainly to the low capability of the farmers to get organized. For that reason, it will be necessary to create farmers' organizations through which the public supporting services are channeled and, on the other hand, could produce and market the agricultural products in an organized and coordinated way. One of the main objectives will aim to make self-sufficient the agriculture practiced by these organizations and to possess enough self-motivation to become the engine for the agricultural development of the region. A subordinated organization, a "Water Users Group" (WUG) will be required in order to operate and maintain the irrigation facilities.

### - Contents

In the past, many farmers organizations have failed due to the lack of adequate members or orientation and guide. Therefore, in order to avoid the past mistakes, it will be required that at the first stage, the farmers' organizations should receive guide and orientation from the related public institutions. It is important for these organizations to be officially registered in order to receive the supporting public services. During the first five years from the formation of the organization, it will receive the public guidance but after that time, it is expected that it will operate in an independent way.

The members of these farmers' organizations who are officially registered will be benefitted by the spread and diffusion of new production and management technique so that the individual skills of the members will be upgraded. On the other hand, there are also the advantages of the communal production and marketing of agricultural products.

The services provided will be:

- . Education and training of interested farmers before the formation of the organization
- . Training of the organizations' members in production techniques in order to increase their income
- . Training of the members on interpreting market information in order for them to identify new commercial opportunities for marketing of their production

### - Expected Effects

It is expected that through the improvement of the productivity and the price of the agricultural products due to the improvement in their processing, the income of the farmers will raise. It is also expected that from the improvement of the self-sufficiency in farming activities of the small and medium scale farmers, the transformation of the Nicaraguan economy will be achieved. Through the Project it will be possible to accomplish a regional development by means of the reactivation of the economic activities of the farmers' organizations.

### - Related Organizations

The WUAs will be organized as a subordinated organization within the main farmers' organizations. The WUAs will operate and maintain in good conditions the irrigation facilities and will be formed by the beneficiaries of the irrigation facilities. The activities

of the farmers' organizations will be carried out financed in part by the water charges colled through the WUAs for a continuous maintenance of the irrigation facilities. The WUA will have to be officially registered as a subordinated organization within the farmers' organizations.

## (2) Project for Strengthening of Supporting Institutions of Farmers' Organizations

### - Objective

As mentioned in the above section, for the formation of the farmers' organizations it is required that at a first stage the guide and orientation form the related public institutions must be provided. the institutions will advise on the formation of the WUAs, their registration, orientation and monitoring. The Project aims to achieve the modification of laws and policies related to the farmers' organizations in response of changing circumstances; the coordination with public institutions and related NGOs will be also achieved.

### - Contents

It will be possible to monitor the farmers' organizations from the moment they are being formed until the time of their dissolution; they will be benefited by timely guidance. Also, through the extension services the training of the members of the farmers' organizations will be achieved and their individual skills will be up-graded. Also, within the program, the farmers' groups will receive training on communal production activities, i.e., collective collection and forwarding of products).

- . Monitoring
- . Information management of related farmers' organizations
- . Implementation of training and guidance activities
- . Modification of legislation for these organizations when required

### - Expected Effects

The Government will provide the main thrust for the implementation of the project for the strengthening of the farmers' organization; with this help, each organization will be able to contribute to increase the productivity of the members who are small and medium scale farmers. With the monitoring of the farmers' organization activities, it will be possible to identify, at an early stage, any problem faced by them and adopt adequate countermeasures; it will be part of a feedback process between the supporting organizations and the farmers' organizations which will allow them to achieve their development goals.

## (3) Project for the Formation of Communal Leaders

### - Objectives

The possibility of development of the small and medium scale farmers lays on the strengthening of the farming management and technology based on the relationship among the farmers. At present, the relationship among the farmers is very weak and the level of technology is also low. The truth is that the farmers have not yet reached the point where their own development could take-off. Based on this situation, the program proposes the following main points: formation of communal leader with optimal skills;

incentive for the participation of the whole population; strengthening of the farmers' organizations; transformation of the farm management concept; raising the level of farming technology. The final objective of this program is to implement an integral development of the region through the achievement of the above mentioned points.

Because at present most of the areas do not have a farmers' organization, at those places where these organizations can be found, the leaders will take part of such associations or new associations that will be organized within the program; the leaders could be also chosen from the cooperatives and other relevant associations.

Contents:

- 1) Transmission of new farming techniques
- 2) Transmission of new farm management techniques
- 3) Transmission of new procedures for rural development
- 4) Support for the acquired technology (orientation visits to the community)

The points mentioned above will be considered as the main ones, but they will be complemented with the access to information to create the basis for the implementation of a new type of agriculture. This plan may be carried out during the 4 off-season months.

- Expected Effect

The program will look to strengthen the relationships among the inhabitants of the region; increase the potential for agricultural management and techniques; raise the farmers' income and promote the development of the community by promoting the farmers' organizations.

- Administrative Support

For the implementation of this program, it is necessary for the assistance of experienced instructors who will know the problems faced by the small-scale farmers. Therefore, the personnel could be hired from technical colleges or universities.

At present, there are no training centers for the farmers managed by the government; also, there no places where the farmers could get instructed on farming techniques, management, etc.; therefore, it is necessary to construct facilities for the implementation of the program.

The beneficiaries will be poor small-scale farmers who will need to be provided with living allowances, lodging and transport while attending the training sessions.

(4) Communal Association Formation Strengthening Project

- Objectives

The land, capital, and labor resources owned by the small-scale farmers in Nicaragua are quite limited; this factor restrains its development. Therefore, in order to attain the development of small farmers, it is indispensable to strengthen their organizations. In the Study Area, the connection between the small scale farmers and the organization forces is weak; this is one of the restraining factors for the development. In order to solve this problem, the objective of this program is the formation of communal associations utilizing the donations received.

- Contents

A "Communal Development Fund" will be created, gathering small-scale donations. It is also intended to propose to the communities the elaboration of a communal development plan with the participation of all the population. In case this plan is idoneous, it will reckon on the "Development Fund" and support will be provided for that the people can carry out the plan themselves. Through the elaboration and execution of the plan, if the communal association is formed and strengthened, its capital will increase and thus the opportunity of a higher development and strengthening will be created. In case the funds are unfaithfully utilized, this association will not have another opportunity.

Based on the analysis of the results of the survey carried out during this Study, it was considered necessary for an improvement plan of the main public services, namely, drinking water, roads, schools, health centers, and agricultural materials and implements.

Expected effects

- Formation and strengthening of the communal association
- Development of a will to excell by the producers
- Strengthening of the relationship among farmers
- Promotion of the community development

- Administrative Support

Present this program to the international cooperation agencies and require the necessary donation funds. Maximum of US\$ 20,000 by case

### 5.8.10 Agricultural Credit

As for the financial market for small and medium scale farmers in the Study Area, at present credit services are almost not offered to these farmers by public agencies. The percentage of small and medium scale farmers who have received credit is very low. In general, these farmers do not utilize the services of the official financial agencies but reckon on informal credit channels such as NGOs, cooperatives, "bancos comunales", etc.

In order to expand the agricultural activities and to change the crops patterns among others, an agricultural credit which allows the transformation of the production activities is indispensable. Furthermore, it is also necessary to provide to the small and medium scale farmers a supporting system for their activities and thus allowing an effective utilization of the agricultural credit.

(1) Project of Development of an Agricultural Credit System for Small and Medium Scale Farmers.

- Objectives

The project aims at the creation of an agricultural credit system which takes into consideration of the present conditions of the agricultural production and is applicable for the community organizations of small and medium scale farmers who perform agricultural activities. In reactivating the agricultural production through the credit, the improvement of life conditions of benefited areas populations will be attained.



- Contents

The new credit system will be basically based on the principle of "credit in two steps". The financial public institution in charge of the project should not directly finance either the farmer or the community organization but should have the main functions of obtaining funds to finance the new system and informing the farmers and their organizations about the marketing conditions.

The financing operations to farmers and their organizations shall be carried out through the existing channels presently being utilized by them; in case of no existence of such channels, new ones shall be created to channelize the new credit. Furthermore, besides assuring that the credit conditions obey the actual production conditions, the system shall be established in such a way that the agricultural credit cost is affordable by the users.

In order to carry out these projects, the following are required;

- (a) Low cost international funds shall be obtained. It is specially aimed at international donations or cooperation funds at a low interest rate in such a way to lower the funds costs.
- (b) Debentures will be issued at the national and international levels in order to expand the available financial resources basis for investment and loans.
- (c) The credit conditions shall be coordinated between the financial public institution and the regional financial channel which is being or will be utilized directly by the farmers.
- (d) For a smooth implementation of the credit, a credit operation manual shall be elaborated for the regional financial channels utilized by the farmers and this shall be adjusted to the actual production conditions.
- (e) The regional financial channels personnel shall be trained about the credit operations; the training program shall be carried out by a financial specialist contracted as a consultant. This training program will contribute to improve the credit promotion and granting operations.

- Beneficiaries

- (a) Benefited area; All the areas in Nicaragua in which agricultural and livestock production is carried out.
- (b) Beneficiaries; Community organizations formed by small and medium scale farmers. Those small and medium scale farmers or their organizations which agricultural production is recommended by regional financial institutions are also going to be supported. Therefore, all those persons will become beneficiaries of the new financial system.

- Executing Agencies and Administration

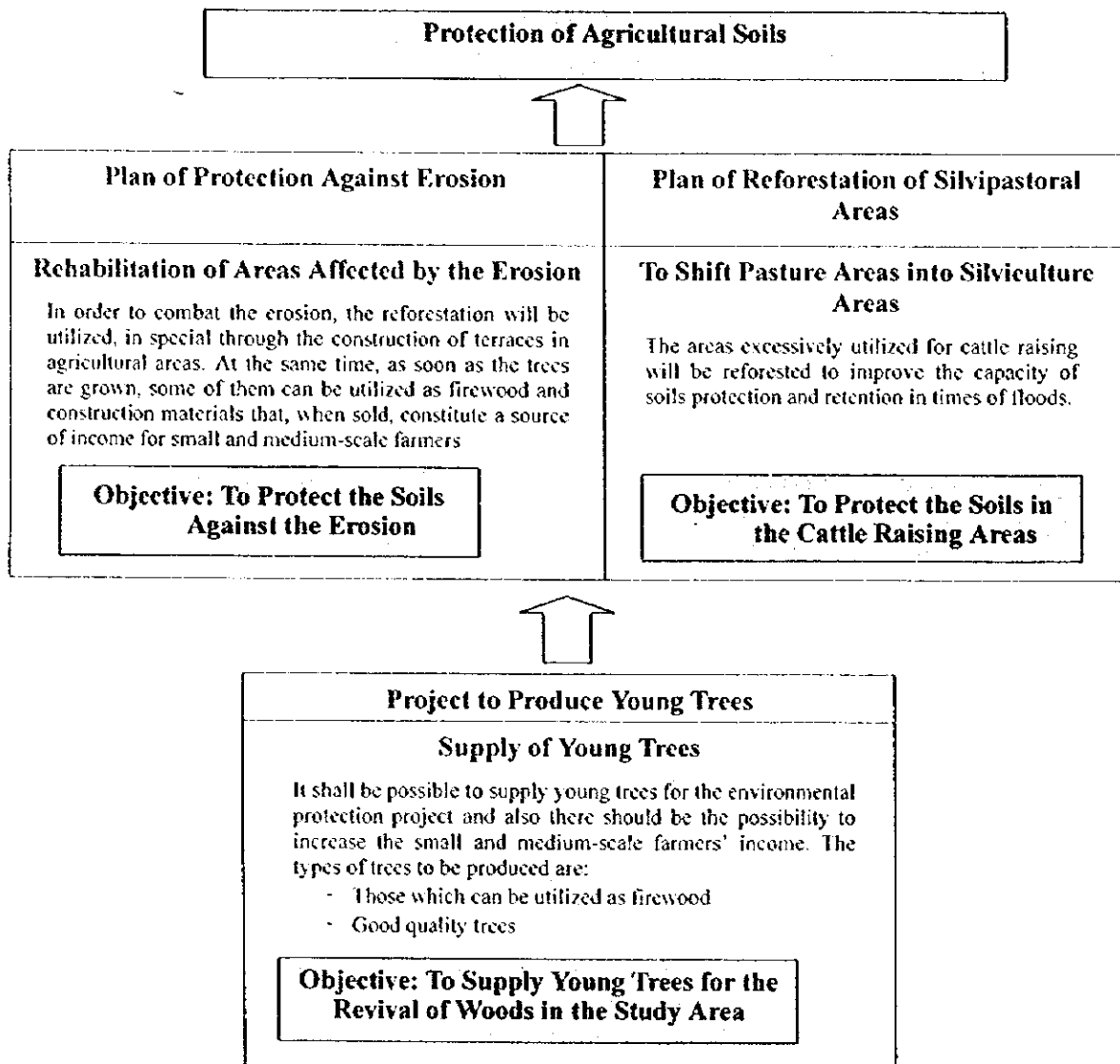
- (a) Executing agency; The MAG should be the main executing agency and should reckon on the participation of financial organizations and others related to the credit, i.e., community groups, cooperatives, etc. It is specially indispensable the participation of the Nicaragua Central Bank, private banks, regional banks, cooperatives, NGOs, etc.
- (b) Initial fund; An amount of approximately US\$ 100 million are required as initial fund.

- (c) Administrative actions; The executing agency will be in charge of searching for financial support from international support organizations or obtaining donations or long term and low interest rate loans in order to gather the funds to be the project initial funds.

#### 5.8.11 Environmental Protection

In the Study Area, many problems are being verified due to the reduction of swampy and woods areas, erosion, which by its turn are caused by the excessive deforestation process. The main reason for the excessive deforestation process is because the small scale farmers with few economic resources need to utilize the firewood as the only accessible combustible resource and thus cut the trees to obtain it.

The individual projects concerning about the environmental protection issue which are proposed in the Master Plan aim at the solution of the excessive deforestation causes; it also aims at protecting soils against erosion.



These objectives are closely related to the improvement of life conditions of small and medium scale farmers. The following three projects are proposed:

- Project of production of tree seedlings in nurseries in Regions II and IV
- Project of reforestation in Regions II and IV
- Project of protection against erosion in Regions II y IV

**(1) Project of Production of Tree Seedlings in Nurseries in Regions II and IV**

- Objective

The present situation of forest resources in Regions II and IV accounts for an over deforestation for the production of firewood and construction materials. This deforestation is the cause for soils erosion and floods. The project objective is to renew the already existing facilities for the production of nursery trees and to provide trees for the plantation in potential areas.

- Contents of the Project

The nursery trees species to be produced in the Project will be classified into two classes according to the following characteristics;

- 1) Rapid growth species; eucalyptus, acacia, leucaena, casuarina, etc.
- 2) High quality species; "pochote", nim, mahogany, teak, etc.

The produced species will be taken and transplanted into deforested areas, agro-forestry areas and silvipasture areas.

- Results

- . To produce abundant plants to be transplanted into deforested areas, agro-forestry areas and silvipasture areas.
- . To improve the production and investigation techniques of new and adequate species for forestal re-population.
- . To increase the farmers income through the selling of firewood and vegetal charcoal.
- . To contribute to the environmental education through the planting activities.

**(2) Project of Forestal Re-population in the Regions II and IV**

- Objective

As mentioned before, there is a situation of over deforestation in Regions II and IV due to the production of firewood, construction materials and pastures exploitation. This deforestation causes soils erosion and floods. The project objective is to reforest the silviculture areas dividing into three strata; production of pastures, production of fruits, production of construction materials and firewood

- Contents

The area in which the forestal re-population project is going to be implemented will be divided into three strata according to its utilization;

- . Lower stratum: Production of pastures
- . Middle stratum: Fruits such as "jícara"
- . Upper stratum: Construction materials and firewood

The trees seeds species which will be produced and grown to be introduced in the project will be classified into two classes according to the following characteristics;

- 1) Rapid growth species; Eucalyptus, Acacia, Leucaena, Causarina, etc., for soil conservation, production of firewood and vegetal charcoal.
- 2) High quality species: "Pochote", Nim, Mahogany, Teak, etc., for construction and furniture materials.

The species of trees produced will be transplanted into deforested areas, agro-forestal areas and silvipasture areas.

- Effects

The effects and benefits of this project are as follows;

- . Construction materials, firewood and fruits are going to be obtained from agro-forestal and silvipasture areas.
- . Through the reforestation, it will be possible to control erosion.
- . The reforestation techniques will be improved, tree species will be developed and silvipasture techniques will be improved.
- . The diffusion of education and attainment of environmental consciousness as for the forestal activities will be possible.

(3) Project of Protection Against Erosion in Regions II & IV

- Objective

As mentioned before, there is a situation of over deforestation in Regions II and IV due to the production of firewood, construction materials and pastures exploitation. This deforestation causes the reduction of the vegetation cover and is one of the biggest reasons for the soils erosion and floods. The project objective is to reforest the project areas which are affected by erosion and land sliding and aims at controlling these processes; once the trees grow, they can be utilized as income source by the farmers.

- Contents

The nursery tree species to be produced by the Project to be utilized in the control of erosion and land sliding will be classified into two classes according to the following characteristics;

- 1) Rapid growth species; Eucalyptus, Acacia, Leucaena, Causarina, etc.
- 2) High quality species: "Pochote", Nim, Mahogany, Teak, etc.

The produced species of trees will be taken and transplanted into areas to be reforested (those suffering from erosion and land sliding) in which terraces will be constructed. The trees will be planted in the borders of these terraces.

- Results

- . Construction materials, firewood and fruits are going to be obtained from agro-forestal and silvipasture areas, contributing to improve the farmers' income.
- . Through the reforestation, it will be possible to control erosion.
- . The reforestation techniques will be improved, tree species will be developed and silvipasture techniques will be improved.
- . The diffusion of education and attainment of environmental consciousness as for the forestal activities will be possible.