

**FIGURES**

SCALE

0 2 4 6 8 10km

LEGEND  
River  
● Runoff Points

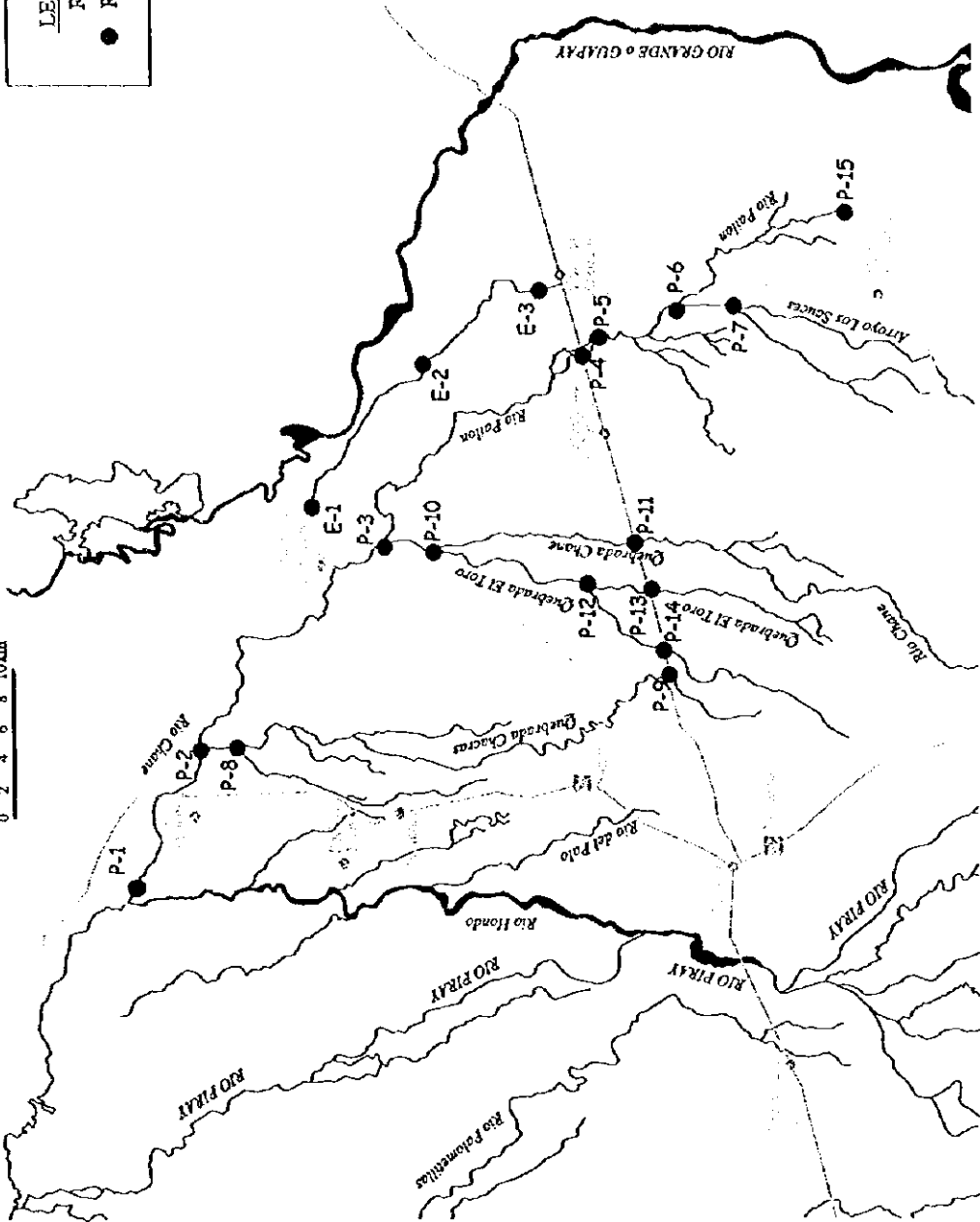
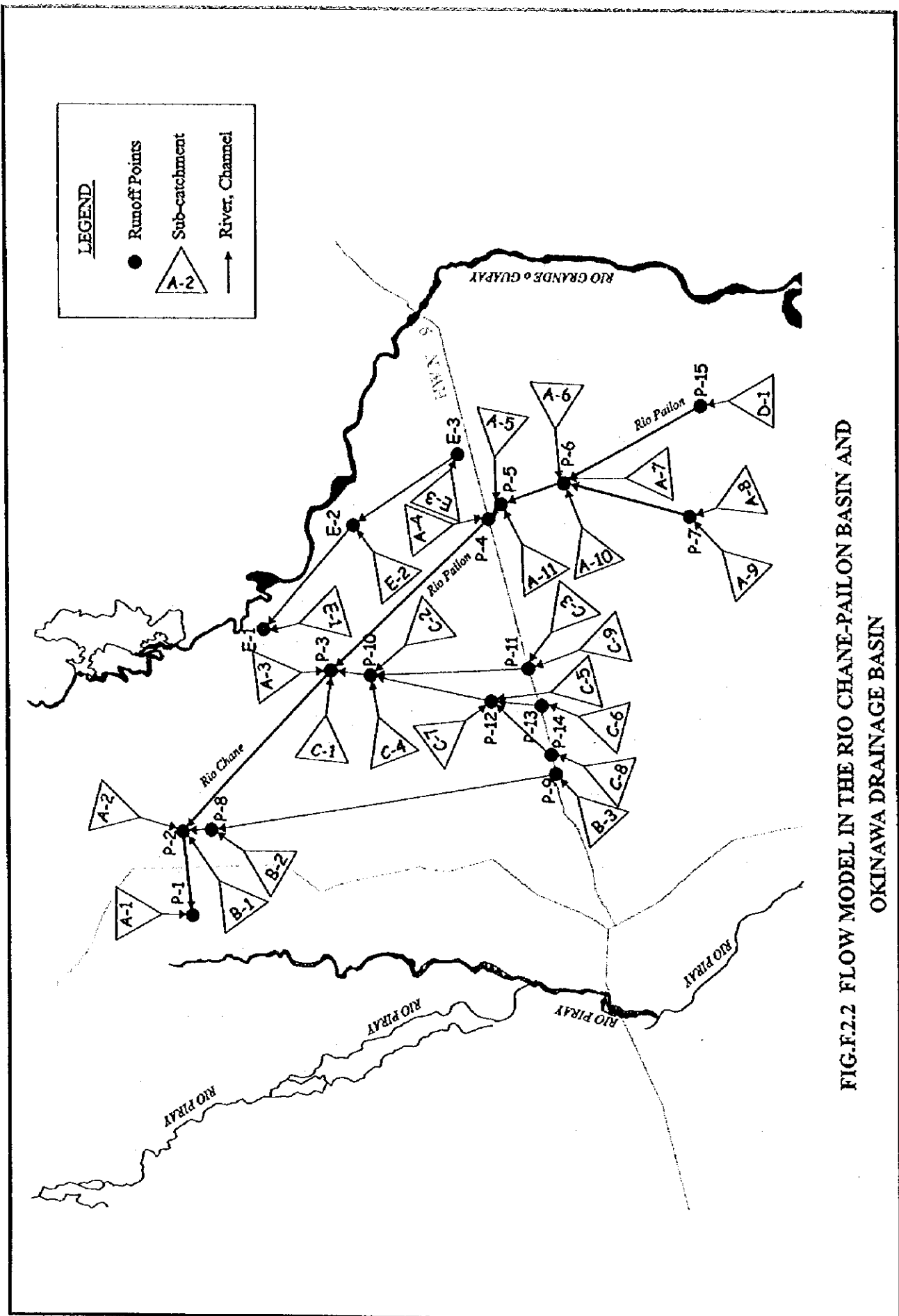


FIG.F.2.1 RIVER SYSTEM IN THE RIO CHANE-PAILON BASIN AND THE OKINAWA DRAINAGE BASIN

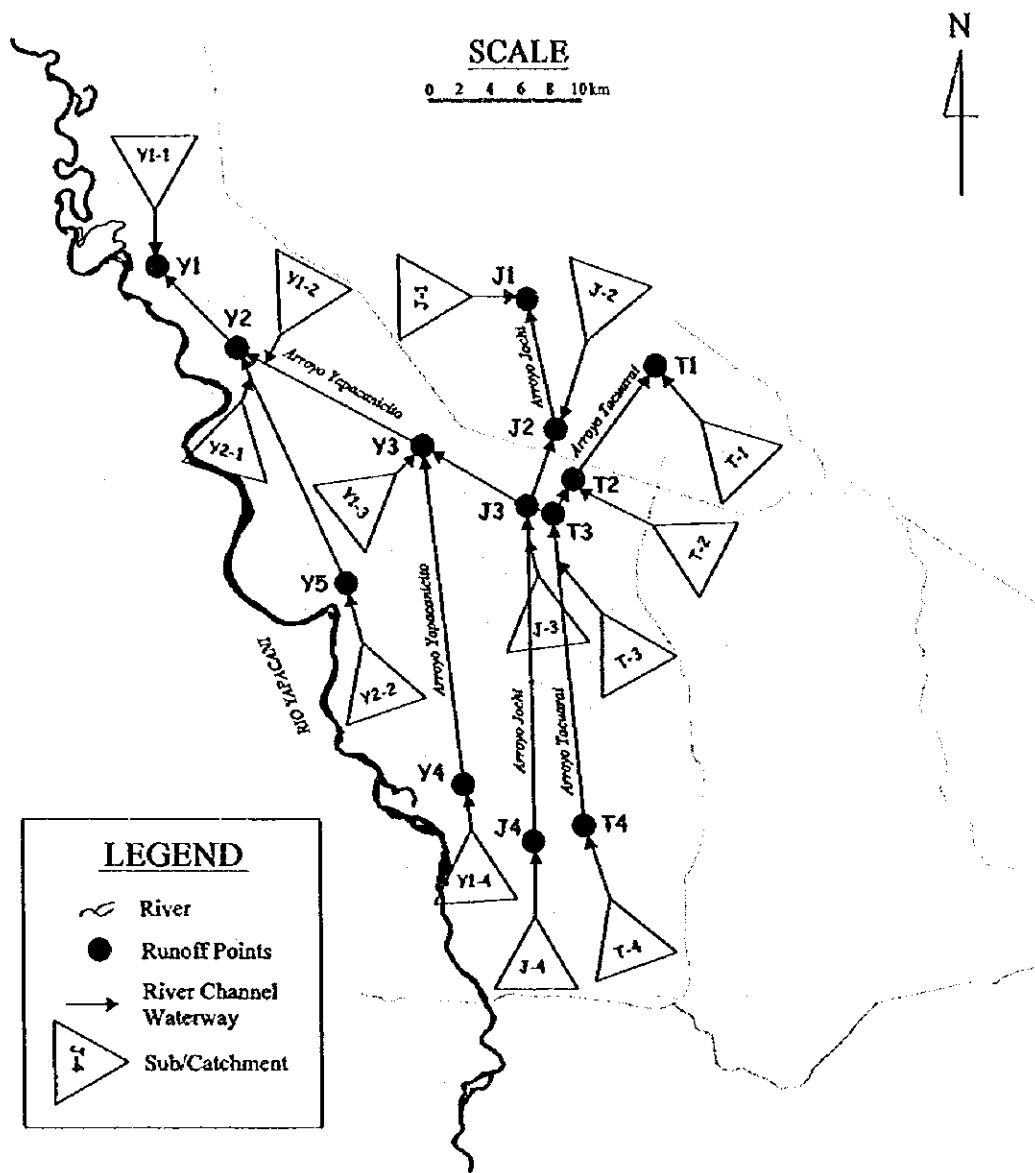


**LEGEND**

- Runoff Points
- △ Sub-catchment
- ↑ River, Channel

**FIG.F.2.2 FLOW MODEL IN THE RIO CHANE-PAILON BASIN AND OKINAWA DRAINAGE BASIN**





**FIG.F.2.4 FLOW MODEL IN THE ARROYO YAPACANICITO, JOCHI AND TACURAL BASIN**

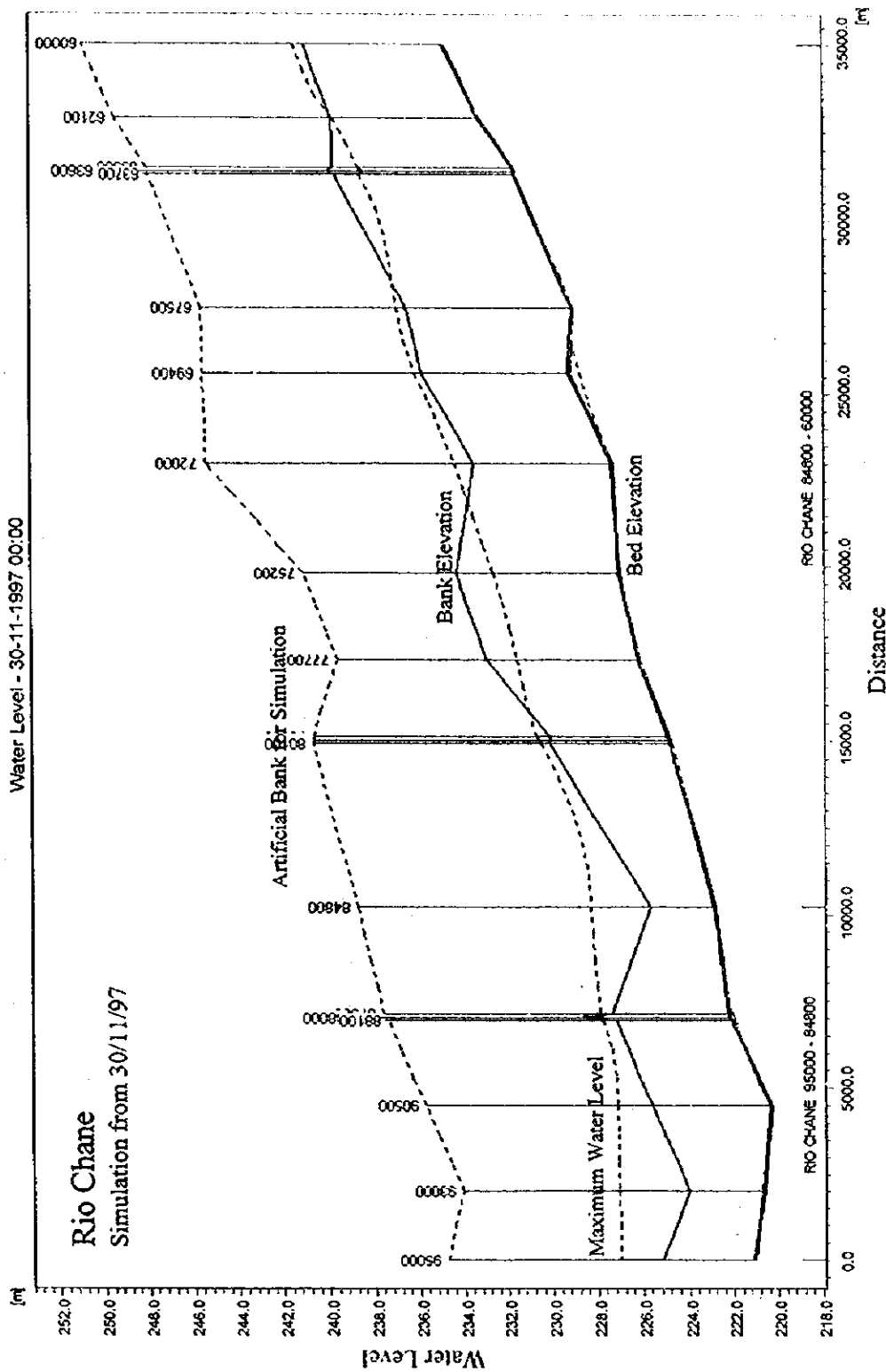


FIG.F.3.1(1) SIMULATION RESULTS IN THE RIO CHANE-PAILON BASIN,  
CASE I-WATER LEVEL SET UP FROM THE QUESTIONNAIRE SURVEY

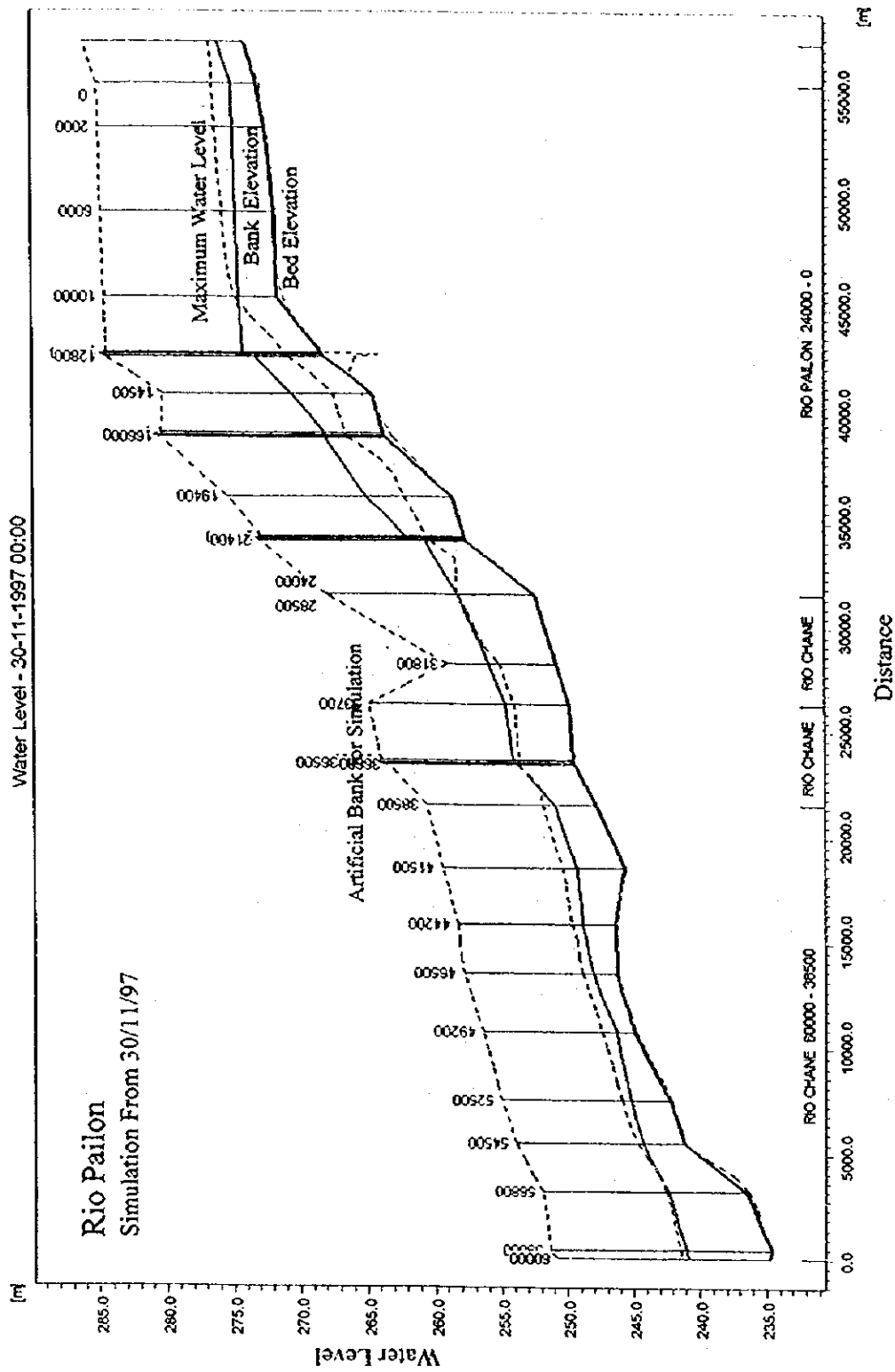
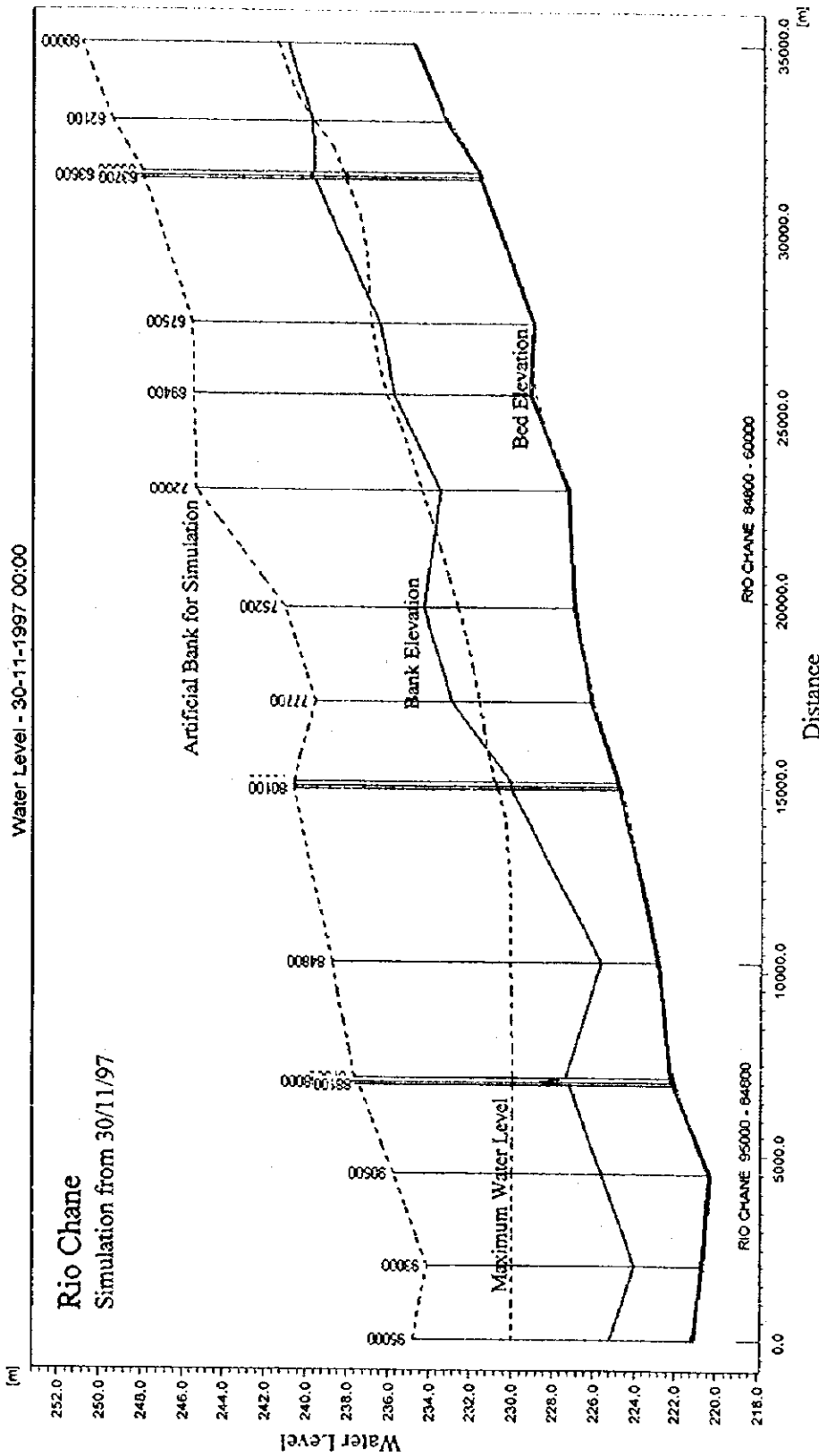
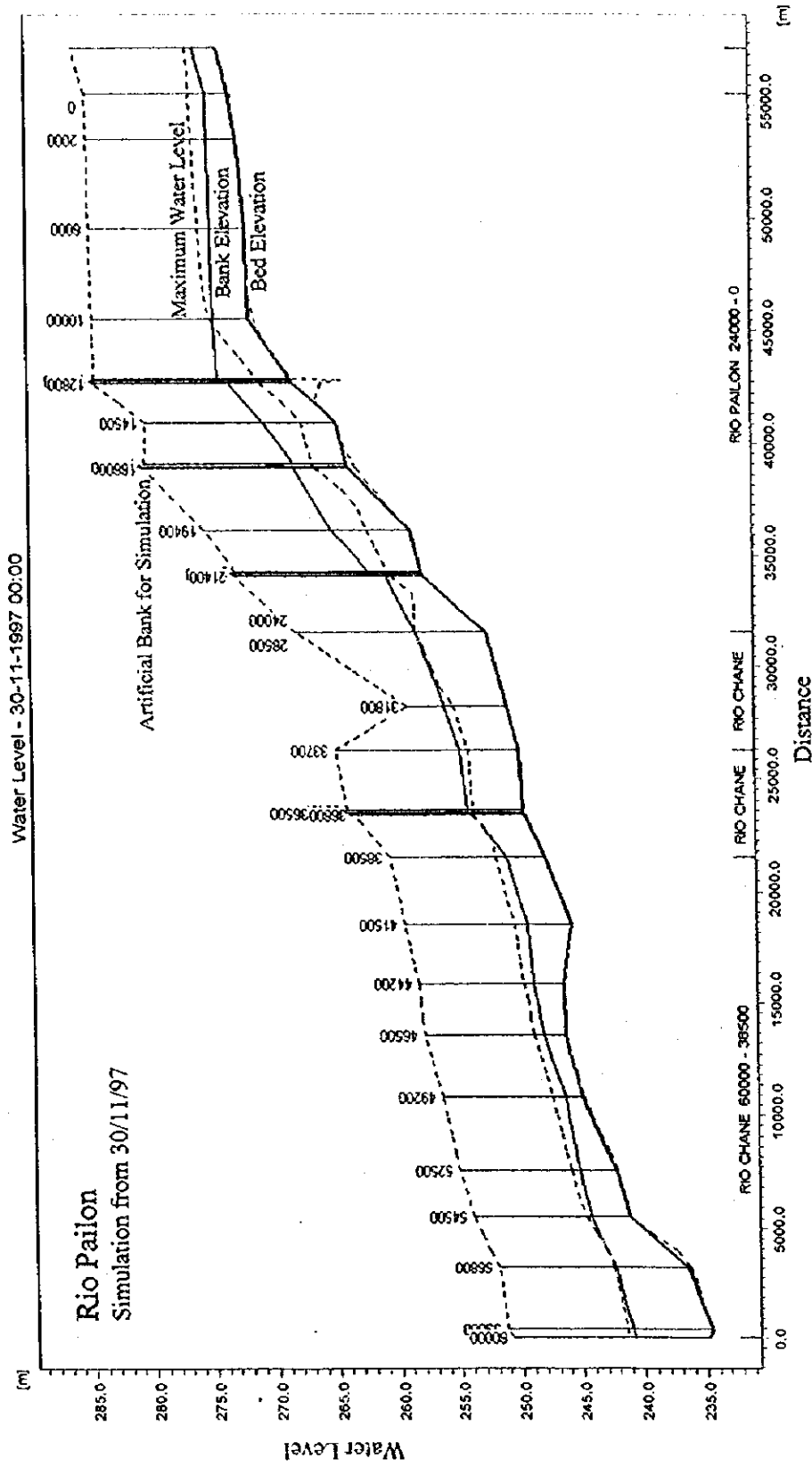


FIG.F.3.1(2) SIMULATION RESULTS IN THE RIO CHANE-PAILON BASIN,  
CASE I-WATER LEVEL SET UP FROM THE QUESTIONNAIRE SURVEY

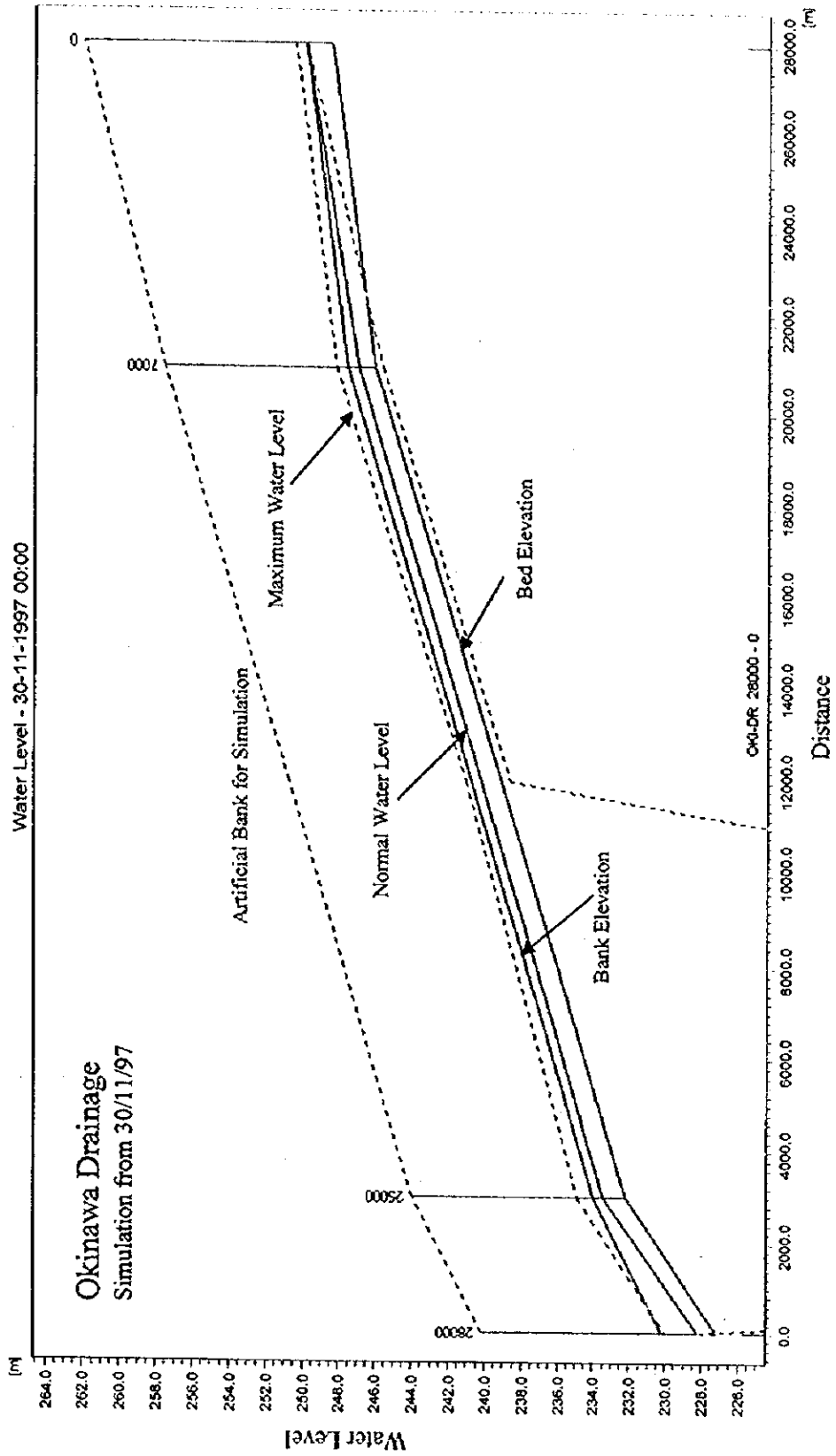


**FIG.F.3.2(1) SIMULATION RESULTS IN THE RIO CHANE-PAILON BASIN,  
 CASE II-VERY HIGH WATER LEVEL**

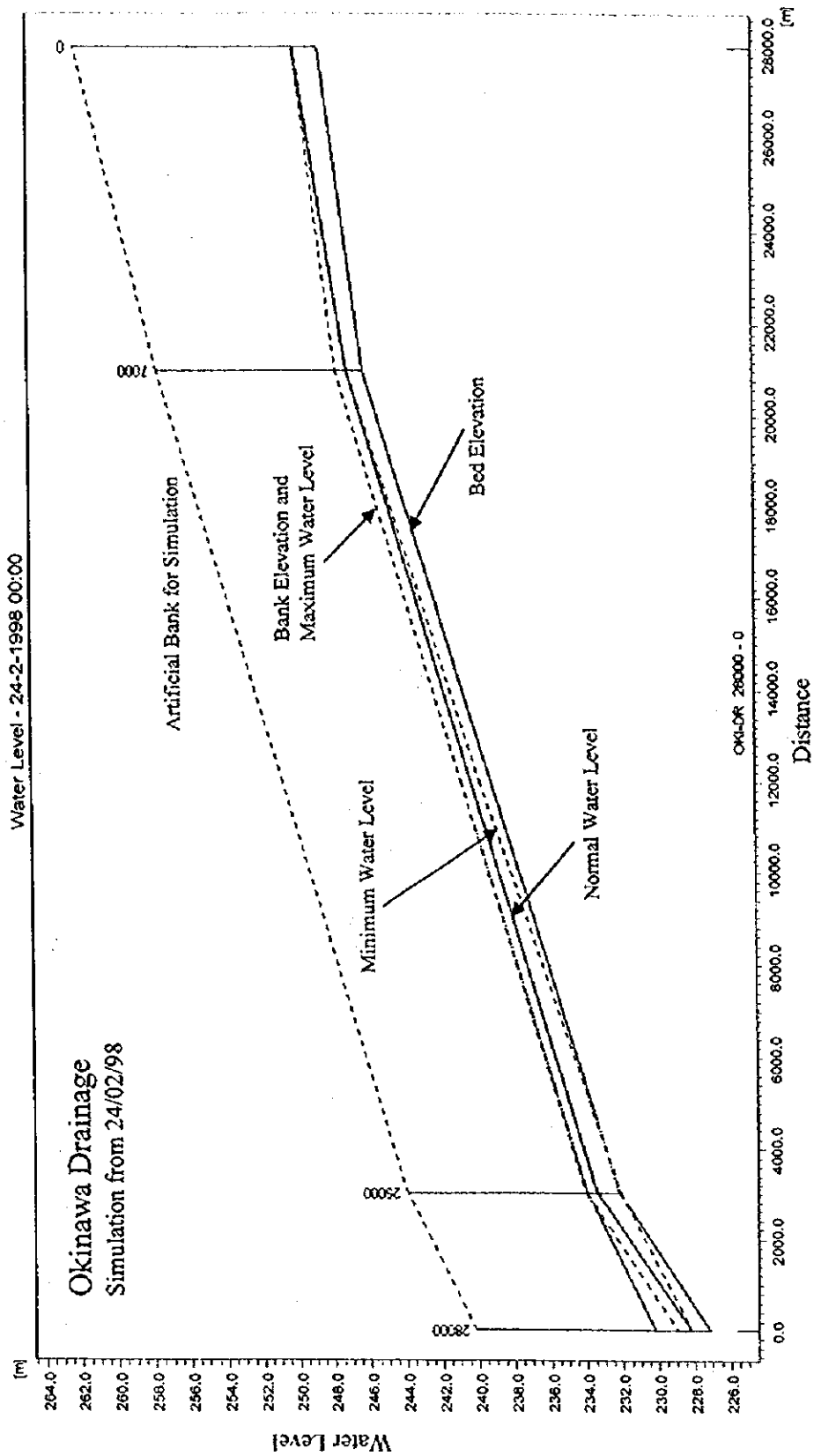




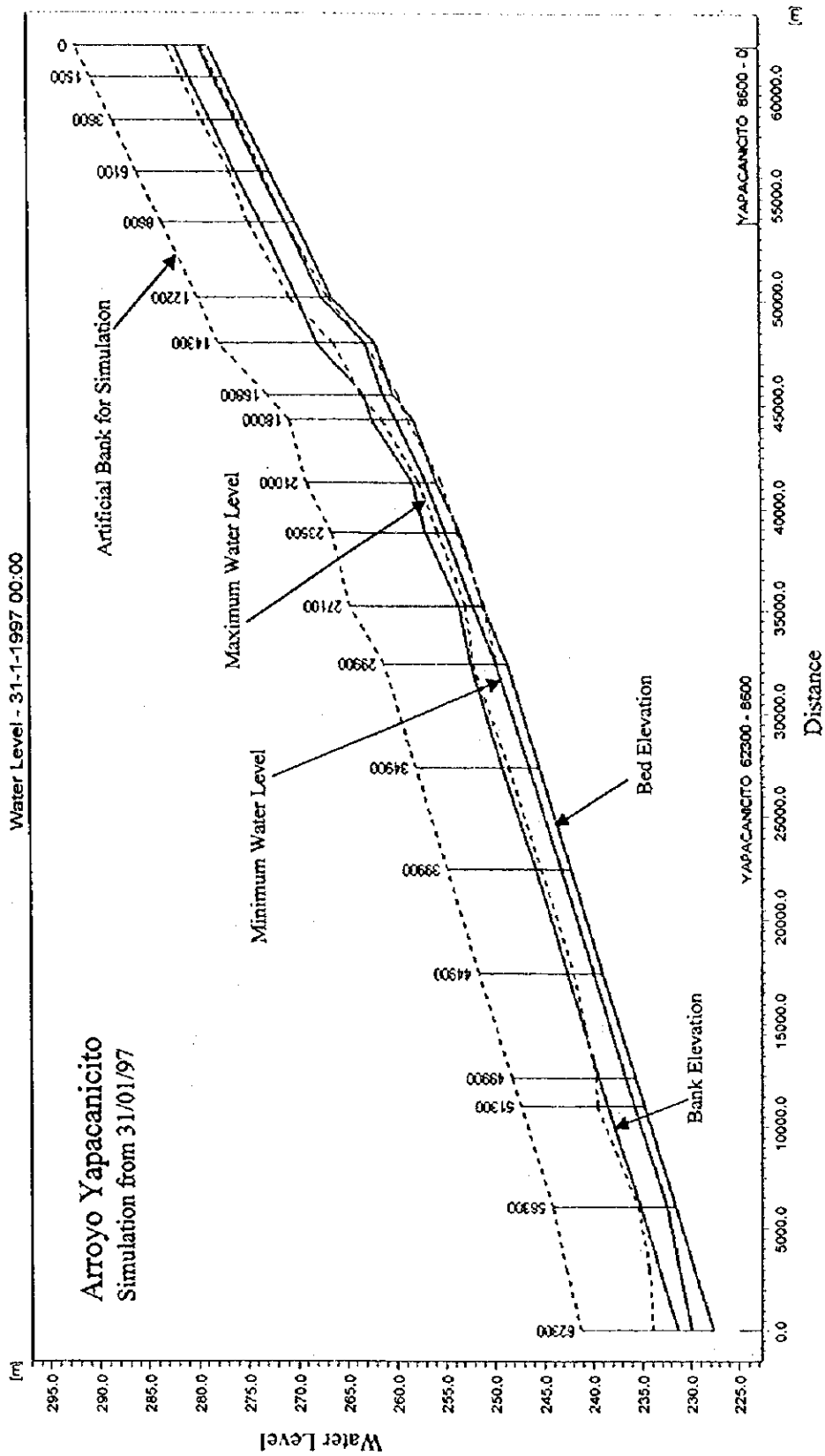
**FIG.F.3.2(2) SIMULATION RESULTS IN THE RIO CHANE-PAILON BASIN,  
CASE II-VERY HIGH WATER LEVEL**



**FIG.F.3.3 SIMULATION RESULTS IN THE OKINAWA DRAINAGE BASIN,  
 CASE I-FLOOD DURING NOVEMBER-DECEMBER 1997  
 (WITH OVERFLOW FROM RIO GRANDE)**



**FIG.F.3.4 SIMULATION RESULTS IN THE OKINAWA DRAINAGE BASIN,  
CASE II-FLOOD DURING NOVEMBER-DECEMBER  
(WITH OVERFLOW FROM RIO GRANDE)**



**FIG.F.3-5(1) SIMULATION RESULTS IN THE ARROYO YAPACANICITO, JOCHI AND TACURAL BASIN**

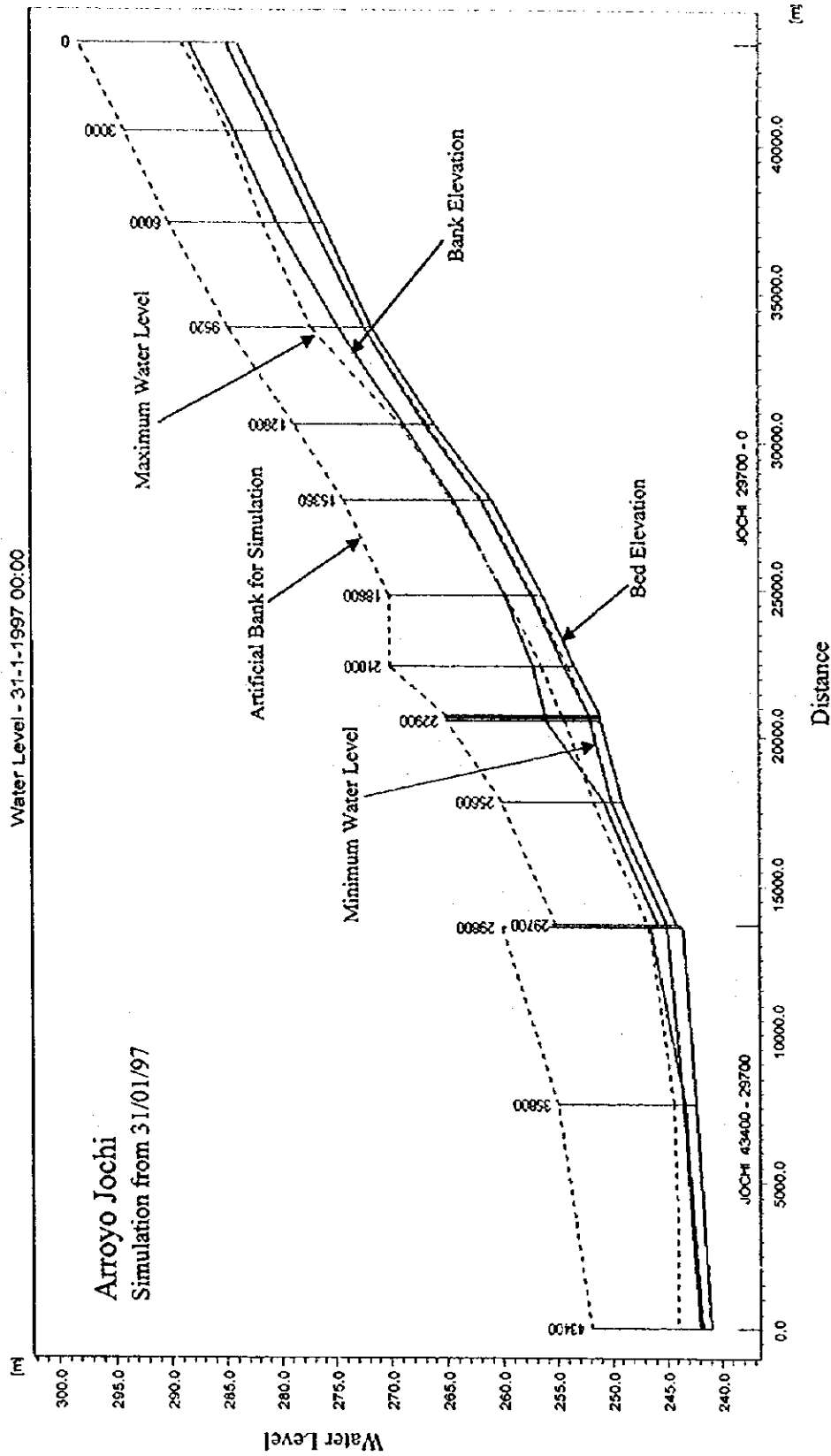


FIG.F.3.5(2) SIMULATION RESULTS IN THE ARROYO YAPACANICITO,  
JOCHI AND TACURAL BASIN

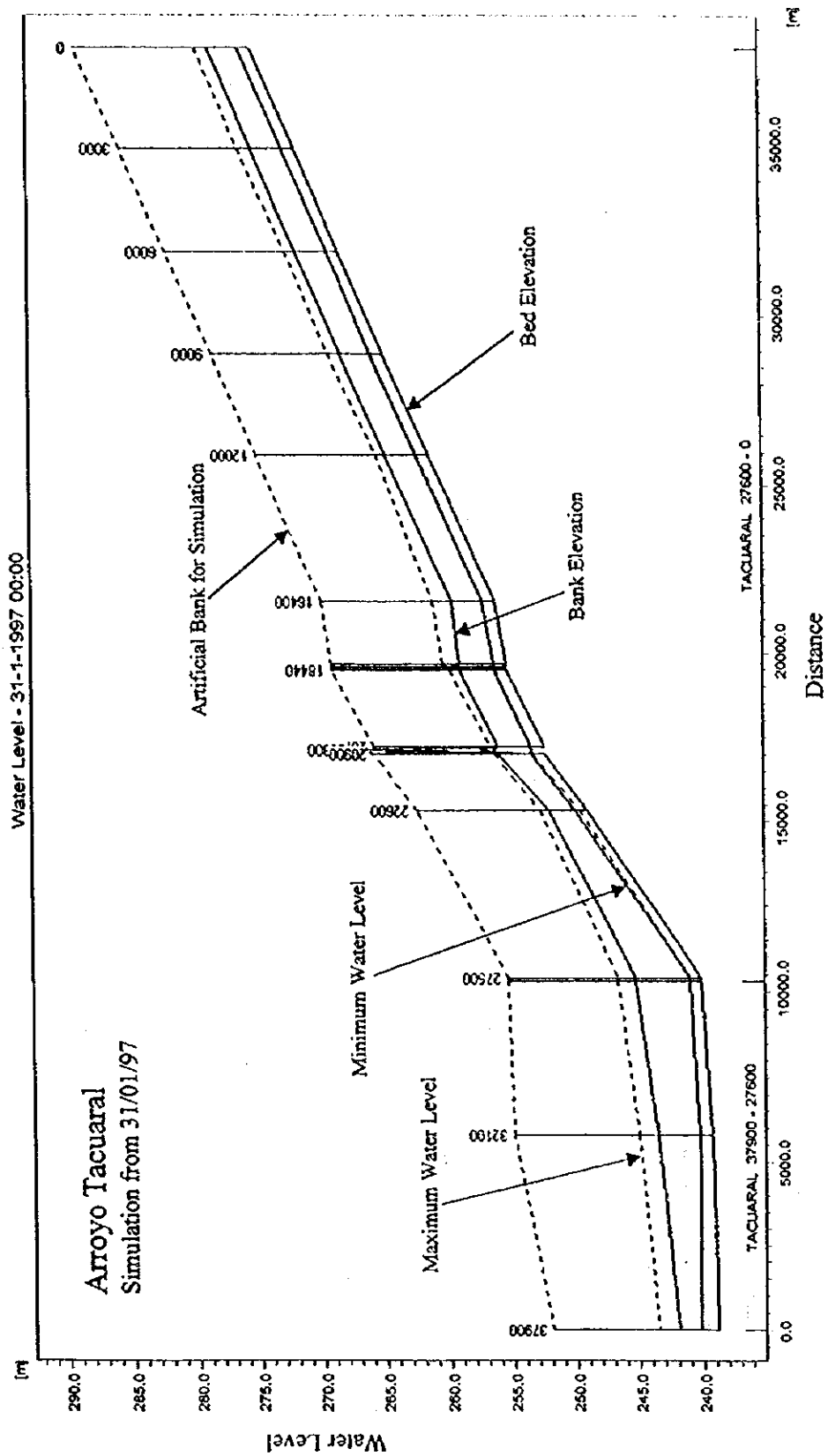
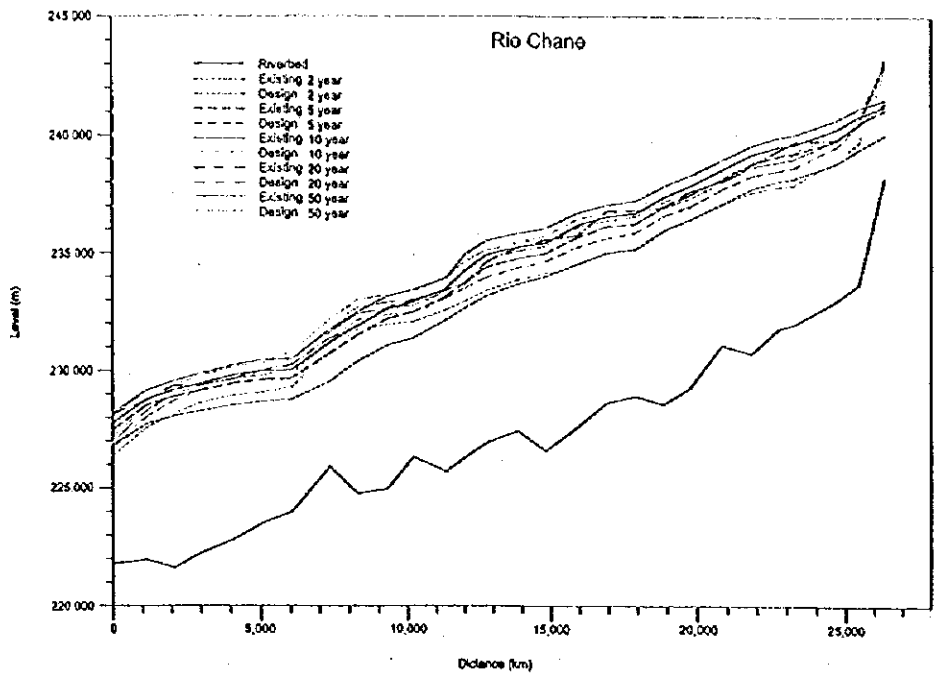
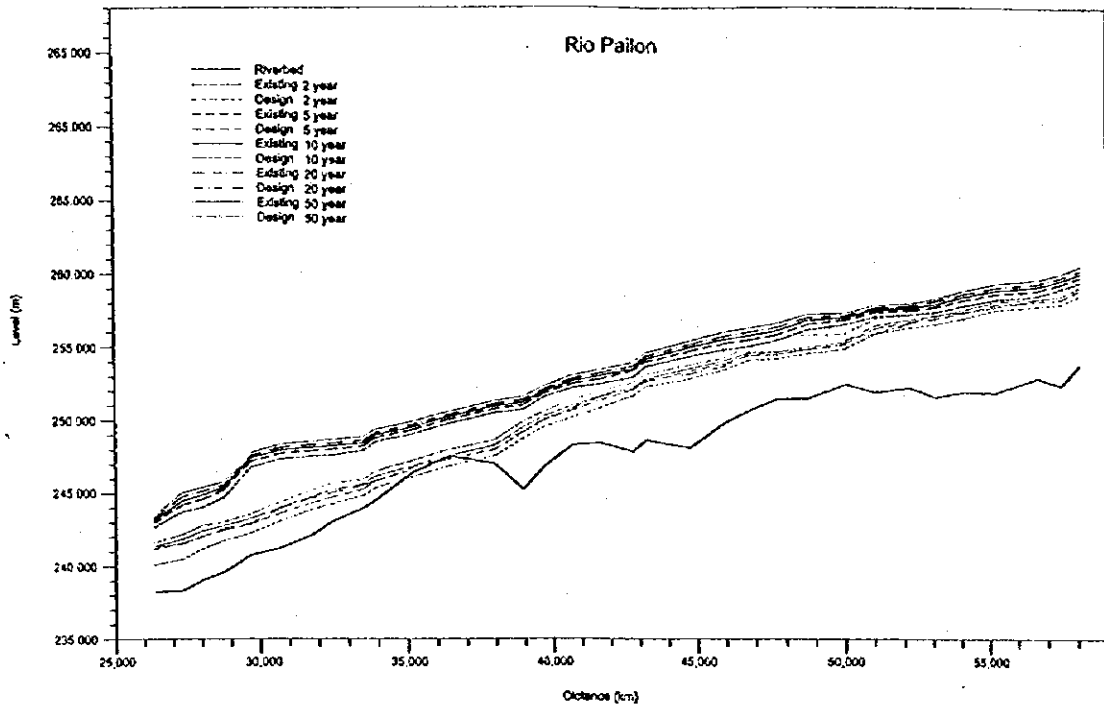


FIG.F.3.5(3) SIMULATION RESULTS IN THE ARROYO YAPACANICITO,  
JOCHI AND TACURAL BASIN



**FIG.F.4.1(1) WATER LEVEL FROM HD CALCULATION IN THE CHANE-PAILON AREA**



**FIG.F.4.1(2) WATER LEVEL FROM HD CALCULATION IN THE CHANE-PAILON AREA**

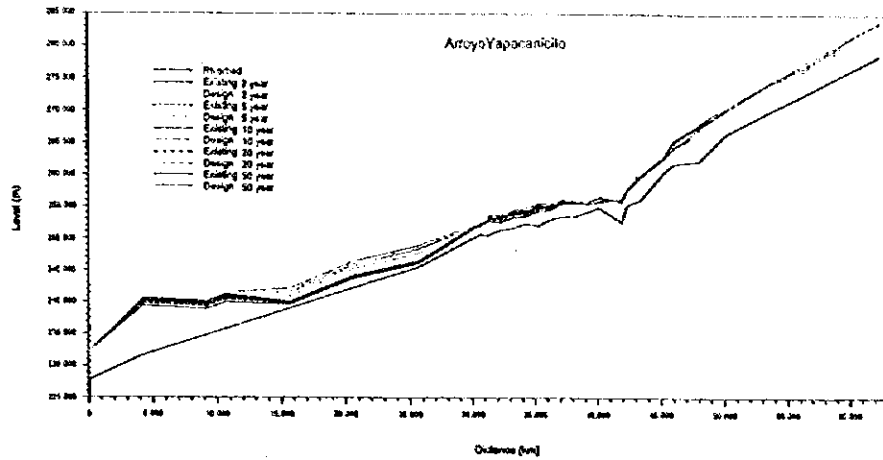


FIG.F.4.1(3) WATER LEVEL FROM HD CALCULATION IN THE SAN JUAN-ANTOFAGASTA AREA

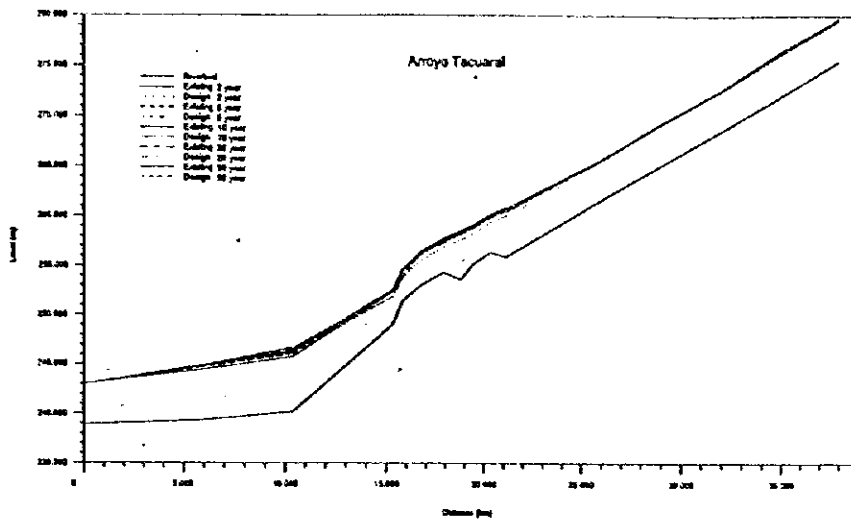


FIG.F.4.1(4) WATER LEVEL FROM HD CALCULATION IN THE SAN JUAN-ANTOFAGASTA AREA

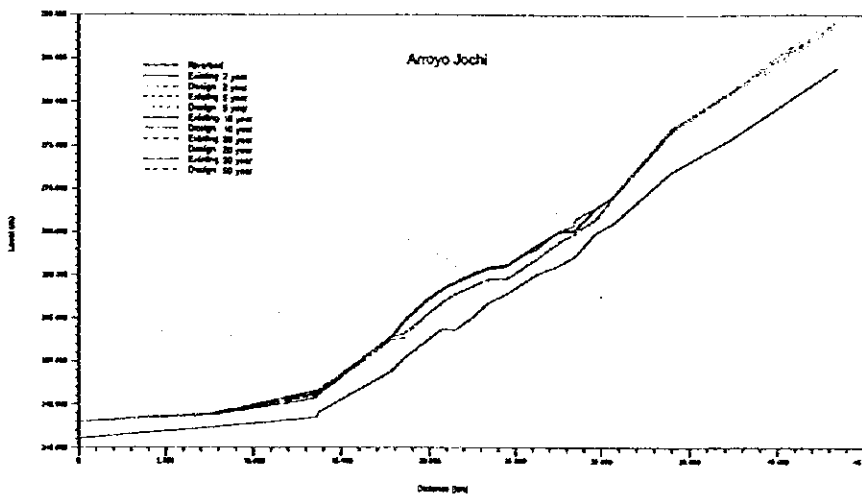


FIG.F.4.1(5) WATER LEVEL FROM HD CALCULATION IN THE SAN JUAN-ANTOFAGASTA AREA



**SUPPORTING REPORT G**  
**ENVIRONMENTAL STUDY**

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## SUPPORTING REPORT G ENVIRONMENTAL STUDY

### 1 Environmental Regulation

The Environmental Law (Ley General del Medio Ambiente, DL 1333 del April 27, 1992) is the initial document to deal with the environmental issues in a global and systematic manner. The objective of the law is the protection and conservation of the natural environment and resources.

The law consists of the following regulations (Reglamento):

- Environmental control,
- Environmental conservation,
- Air pollution,
- Water pollution,
- Radioactive dangerous objective.

Other related laws are as follows:

- The forest law (Promulgation in 1996),
- The mining law (Promulgation in 1925),
- The law of decentralization (Promulgation in 1996).

Main regulation related to the Study is described as follows:

#### 1.1 Regulation of Environmental Impact Assessment

The regulation of the environmental impact assessment is enacted in the Article 25 of the Environmental Law. According to the regulation, all projects or activities, irrespective of public or private, require an environmental sheet (Ficha Ambiental) and must be classified as follows:

Category I	:	Require integrated EIA
Category II	:	Require specific EIA
Category III	:	Require no EIA but advisable conceptual EIA
Category IV	:	Require no EIA

The National Secretary of the Natural Resources and Environment, Ministry of Sustainable Development, is in charge of the categorization. After the decentralization,

the environmental unit of the departmental office has been responsible for it since 1997. However, the Ministry evaluates only the project implemented by the Department to avoid the same organization both for the implementation and for the evaluation.

## **1.2 Regulation of Land Use**

The Article 35 of the New Forest Law, Nueva Ley Forestal No. 1700, del 12 de Julio de 1996, regulates a right to the use of land for conservation and sustainable use of the natural resources.

The areas regulated by the Act in the Study Area are as follows:

- Humid soil, swamps, marsh and their 50 meters around, except temporary flooding area,
- 20 meters on both banks of the flooded stream,
- 100 meters of both banks of the flooded river.

## **2 Environmental Organizations**

The organization of the department in charge of environment is attached to the Natural Resource and Environmental Direction, consisting of following six divisions and main roles of the divisions are as follows:

### **(1) Natural Resources and Territorial Arrangement Division**

- Coordinating and supervising national and departmental policies of environment,
- Integrated management of protected areas, bio-diversity and river basin.

### **(2) Environmental Education Inspection and Follow Up Division**

- Implementing environmental education and inspection for appropriate use of natural resources.

### **(3) Environmental Management Division**

- Evaluating Ficha Ambiente,
- Monitoring of air, water and soils.

### **(4) Forestry Division**

- Management and development of forest resources for the sustainable use,
- Investigation of forest species.

(5) Irrigation Division

- Research and development of irrigation.

(6) Native Affairs and Originally People Division.

- Providing supporting services for consolidation of the native municipal districts,
- Studying characteristics of native costumes.

The evaluation of the F.A. by the Environmental Management Division has started since 1997 after decentralization. The Division categorized 180 cases of F.A. by 1998.

### **3 Environmental Considerations for the Study**

The IEE (Initial Environmental Examination) was implemented in the Master Plan Study and concluded that there was no important impact on the environment by the implementation of the works proposed in the Master Plan Study. However, followings were pointed out in the IEE to reconsider in the feasibility study.

- Land tenure and existing commons,
- Change of the downstream flow condition,
- Change of the ground water table,
- Change of the water quality,
- Impact on the flora and fauna along the river forest.

To response the moderate impacts identified in IEE, the feasibility study considers them as follows to avoid or alleviate impacts for them.

(1) Land tenure

There is an agreement between the corporation and the members to donate land for public works without any compensation in the Okinawa and San Juan areas. These two areas, therefore, have no any problem for the land acquisition of the project because the cooperation agreed to the results of the Master Plan Study.

The other area required land acquisition for the project is almost covered by the forest, where severe floods occur annually and can not use for any agricultural activities. This means that there is no or a few settlements and the area is regulated rights to use land by the forest law.

(2) Impact on downstream conditions

The implementation of the improvement of the Arroyo Jochi and the Tacuaral is not expected to have an impact on the hydrological situation of the down stream because the downstream end of the rivers is a swamp area.

In the case of the Rio Pailon, the hydrological situation in the downstream areas is mainly affected by the Rio Chane. The project, therefore, has a few impacts on the downstream area.

The drainage main of the San Juan and Tejeria area do not have any impact on the down stream area because they are drained water away to the Rio Yapacani.

(3) Ground water table

To avoid impacts for ground water table, the improvement plan is proposed mainly to widen the rivers rather than digging.

(4) Change of the water quality.

Pollution caused by the inflow of sediment during river works is expected to occur. However, the plan is considered to hold a minimum pollution by the implementation during the dry season

(5) Impact on the flora and fauna in riverside forests

Deforestation in the river bank area is indispensable to widen the river and affects to fauna and flora. However, the reforestation is proposed in areas where is no vegetation area of the riverside. 20 m width on both banks of the river is proposed for the reforestation in accordance with the Forest Low. Area for the reforestation by river is shown in Table G.3.1.

#### **4 Social Environmental Survey**

Social environmental survey was implemented by the Study Team to clear peoples' awareness for the project. The questionnaire and result of the survey is shown in Table G.4.1.

The result shows almost same tendency of the IEE screening which implemented in the Master Plan Study.

The main findings of the survey are as follows:

- (1) 100 percent of the interviewee want to alleviate the flood condition.
- (2) The implementation does not damage to value of archaeological remains or cultural assets because there is no such a value in the area.
- (3) 62 % of the interviewee in the Chane-Pailon area consider that the project would obstruct water and fishing rights. According to detail survey to response the result, however, there are no concrete water and fishing rights in the area. Water in the river is not used for agricultural purposes such as irrigation and drinking.
- (4) About 40 % of the interviewees in both areas worry that the project expected to affect wild fauna and flora because the river improvement areas are covered by natural forest. However, reforestation is proposed in the project to compensate the impacts.
- (5) Most of habitant, 85 % in Chane-Pilon area and 100 % in San Juan-Antofagasta area, consider that topography would be changed by the implementation. However, the project area is almost reclaimed and the topography is almost flat and is not valuable. The plan, however, is well considered about the change through the treatment of the soil etc.

## **5 Environmental Impact Assessment**

In accordance with the environmental law, the environmental impact assessment ( Ficha Ambiental ) of the project was prepared by the study team and was categorized by the Ministry of Sustainable Development and Environment. The screening sheet by project is shown in Table G.5.1 and 2, and results of the evaluation of the screening by the ministry are in Table G.5.3.

The Ministry evaluated the project as category III, which does not require a specific Environmental Impact Assessment (EIA). According to the results, however, PPM



(Program of Prevention and Mitigation ( Programa de Prevencion y Mitigacion)) and PASA (Plan of Environmental Application and Follow Up( Plan de Aplicacion y Seguimiento Ambiental)) regulated by Articles from 29 to 32, regulation of prevention and control of environment, should be prepared during a final design stage to get permission for the implementation by the Ministry. The sheet also pointed out items to consider in the feasibility study and detail design stages. The contents are described in the feasibility study report.

It is recommended that the Department should prepare official documents of PPM, PASA and response of the items in accordance with the regulations and present to the Ministry to get the permission for the implementation.

## **6. Environmental Considerations for the Study**

The IEE (Initial Environmental Examination) was implemented in the Master Plan Study and concluded that there was no important impact on the environment by the implementation of the works proposed in the Master Plan Study. However, followings were pointed out in the IEE to reconsider in the feasibility study.

- Land tenure and existing commons,
- Change of the downstream flow condition,
- Change of the ground water table,
- Change of the water quality,
- Impact on the flora and fauna along the river forest.

To response the impacts identified in IEE, the feasibility study considers them as follows to avoid or alleviate.

### **(1) Land tenure**

There is an agreement between the corporation and the members to donate land for public works without any compensation in the Okinawa and San Juan areas. These two areas, therefore, have no any problem for the land acquisition of the project because the cooperation agreed to the results of the Master Plan Study.

The other area required land acquisition for the project is almost covered by the forest, where can not use for any agricultural activities because severe floods occur annually. This means that there is no or a few settlements and the area is regulated the rights to use land by the forest law.

(2) Impact on downstream conditions

The implementation of the improvement of the Arroyo Jochi and the Tacuaral is not expected to have an impact on the hydrological situation of the down stream because the downstream end of the rivers is a swamp area.

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**TABLES**

**TABLE G.3.1 PROPOSED REFORESTATION AREA**

	Length Km	Area Ha
1) Chane-Pailon Area		
Chane River	2.9	5.8
Pailon River	1.5	3.0
2) San Juan-Antofagasta Area		
Yapacanicito River	6.6	13.2
Jochi-Tacuarak Rivers	6.4	12.8

**TABLE G.4.1 RESULTS OF SOCIAL ENVIRONMENTAL SURVEY**

Question	Answer	Chane-Pailon	San Juan-Antofagasta
Number of interviewee*	No.	13 %	10
If you want to alleviate flood condition.	Yes	100 %	100 %
	No.	0 %	0 %
	No answer		
Loss of base of economic activities, such as land, and change of economic structure.	Yes	39 %	40 %
	No.	62 %	50 %
	No answer		10 %
Impacts on schools, hospitals and present traffic conditions, such as the increase of traffic congestion and accidents.	Yes	39 %	30 %
	No.	62 %	60 %
	No answer		10 %
Community split due to interruption of area traffic	Yes	8 %	0 %
	No.	46 %	40 %
	No answer	46 %	60 %
Damage to or loss of value of churches, temples, shrines, archaeological remains or other cultural assets.	Yes	23 %	0 %
	No.	69 %	100 %
	No answer	8 %	0 %
Obstruction of fishing rights, water rights and rights of common.	Yes	62 %	10 %
	No.	39 %	90 %
Worsening of public health and sanitation conditions due to the generation of habitat conditions.	Yes	31 %	1 %
	No.	69 %	80 %
	No answer		10 %
Generation of construction waste, debris and logs.	Yes	31 %	20 %
	No.	23 %	10 %
	No answer	46 %	70 %
Obstruction of breeding and extinction of species due to changes of habitat conditions.	Yes	39 %	40 %
	No.	46 %	50 %
	No answer	15 %	10 %
Change of topography and vegetation due to reclamation.	Yes	85 %	100 %
Deterioration of aesthetic harmony by structures.	No.	15 %	0 %

\*: Include CAICO, CAISY, Municipal office etc.

**TABLE G-5.1 MATRICES OF ENVIRONMENTAL IMPACT(CHANE-PAILON AREA)**

	Environmental Factor																																																																																																																																																																																																																																																																											
	Air			Water				Soil				Ecology		Noise		Socio-economy																																																																																																																																																																																																																																																												
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Positives: 1=Low, 2=Moderate, 3=High  
 Negatives: A=Low, B=Moderate, C=High

TABLE G.5.2 MATRICES OF ENVIRONMENTAL IMPACT(SAN JUAN-ANTOFAGASTA AREA)

Environmental attribute	Environmental Factor																																						
	Air					Water							Soil				Ecology							Noise		Socio-economy													
Stage: Implementation																																							
River improvement	A																																				1		
Main drainage	A																																				1		
Secondary drainage	A																																				1		
Stage: Operation																																							
Utilization of infrastructure																																							
Stage: Maintenance																																							
Maintenance of infrastructure	A																																					A	

Magnitude of impact  
 Positives: 1=Low, 2=Moderate, 3=High  
 Negatives: A=Low, B=Moderate, C=High

**TABLE G.5.3 EVALUATION FOR ENVIRONMENTAL IMPACT ASSESSMENT**

**Ministry of Sustainable Development and Planning**

La Paz, November 11, 1998

MDSP -- VMARNDF No. 1002/98

DGICSA - UEIA - FA No. 1107/98

Lic. Tito Guido Rojas

Head of Planning Division

Prefectura of Santa Cruz

Santa Cruz.

REF: EVALUATION OF THE FICHAS AMBIENTALES OF THE PROJECTS "STUDY ON FLOOD CONTROL FOR THE AREAS OF CHANE - PAILON AND SAN JUAN - ANTOFAGASTA", TO BE IMPLEMENTED IN THE DEPARTMENT OF SANTA CRUZ.

In relation to the referred fichas ambientales, we must inform you that, this Office, after reviewing the documents, considers that the projects will have positive impact, this is why besides minimizing the negative impacts, it is necessary to prioritize the maximization of opportunities or positive impacts, for this reason and in accordance to Article 25 of the Environmental Law we can establish that the projects belong to **CATHEGORY III**, which means that it is not required a specific analytical Environmental Impact Assessment. Nevertheless, a Program of Prevention and Mitigation (PPM) must be formulated along with its respective Plan of Environmental Application and Follow Up (PASA), for each project, covering the requirements of Articles 29 to 32 of the Regulations of Prevention and Environmental Control.

At the same time, in order to maximize the opportunities that the projects will provide, the following aspects shall be considered, which more than limiting aspects are perfectible and orientation aspects:

- As first preventive measure, a study of territorial arrangement of the whole

inundation area shall be implemented, taking into account the basin as a natural arrangement unit of the resources. For this reason the study should take into account: The land use plan, hydrological, hydraulic and hydrogeological studies, natural river courses, flood analysis for return periods that cover historical records, risk and contingencies analysis, and socioeconomic and cultural analysis. Isolated studies should be avoided and an integral study should be considered.

- Planning of infrastructure should be considered as a response to residual impacts and only after the analysis of the first preventive measure. At the same time, the civil works should contemplate a risk and contingency analysis, which should be oriented to the safety of the civil works (bridges, works of regulation and control).
- Knowing that a Chapter on Environment will exist for each of the projects, it is important that a Program of Prevention and Mitigation along with its respective Plan of Environmental Application and Follow Up be proposed for each project. Both the PPM and the PASA shall contain an objective detail of the measures and its budget.
- The report shall include a Plan of Maintenance and Contingencies.
- The criterion of the inhabitants of the area shall be gathered, and analysis of resettling and compensations shall be made.
- Measures for the installation of work camps and places of work. Justified locations of borrow pits and exploitation of materials. Measures for handling, restoration and abandonment. Location of areas of final disposal of residues and debris that come from movement of soil. Measures for handling, restoration and abandonment. Measures for health and occupational safety of workers and technicians involved in the construction (watching the quality of life of the workers). Handling, transport and final disposal of materials used in the works.
- For the stage of operation and maintenance a study of induced development shall be performed.



- The Program of Prevention and Mitigation shall detail each of the identified impacts, the measures for prevention and mitigation that are proposed in each case with its respective cost.
- Provide in detail the Plan of Environmental Application and Follow Up of the prevention and mitigation measures, oriented to guarantee the implementation of the measures distinguishing the stages (implementation, operation, maintenance and induced development) with their respective budget, schedule of execution in accordance to the engineering of the project. The responsible persons or agencies of each of the execution actions shall be identified.
- The presentation of the environmental reports must be performed after the feasibility studies and final design, in order to get an adequate harmonization of the environmental considerations and the engineering of the project. Also, progress reports of the project shall be provided in order to verify the fulfillment of the recommendations.
- It is necessary the participation of professional experts in the study and elaboration of the report, this means: experts in hydraulics, hydrology, hydrogeology, experts in risk and contingencies, socioeconomists, etc., all of these under an integral point of view.

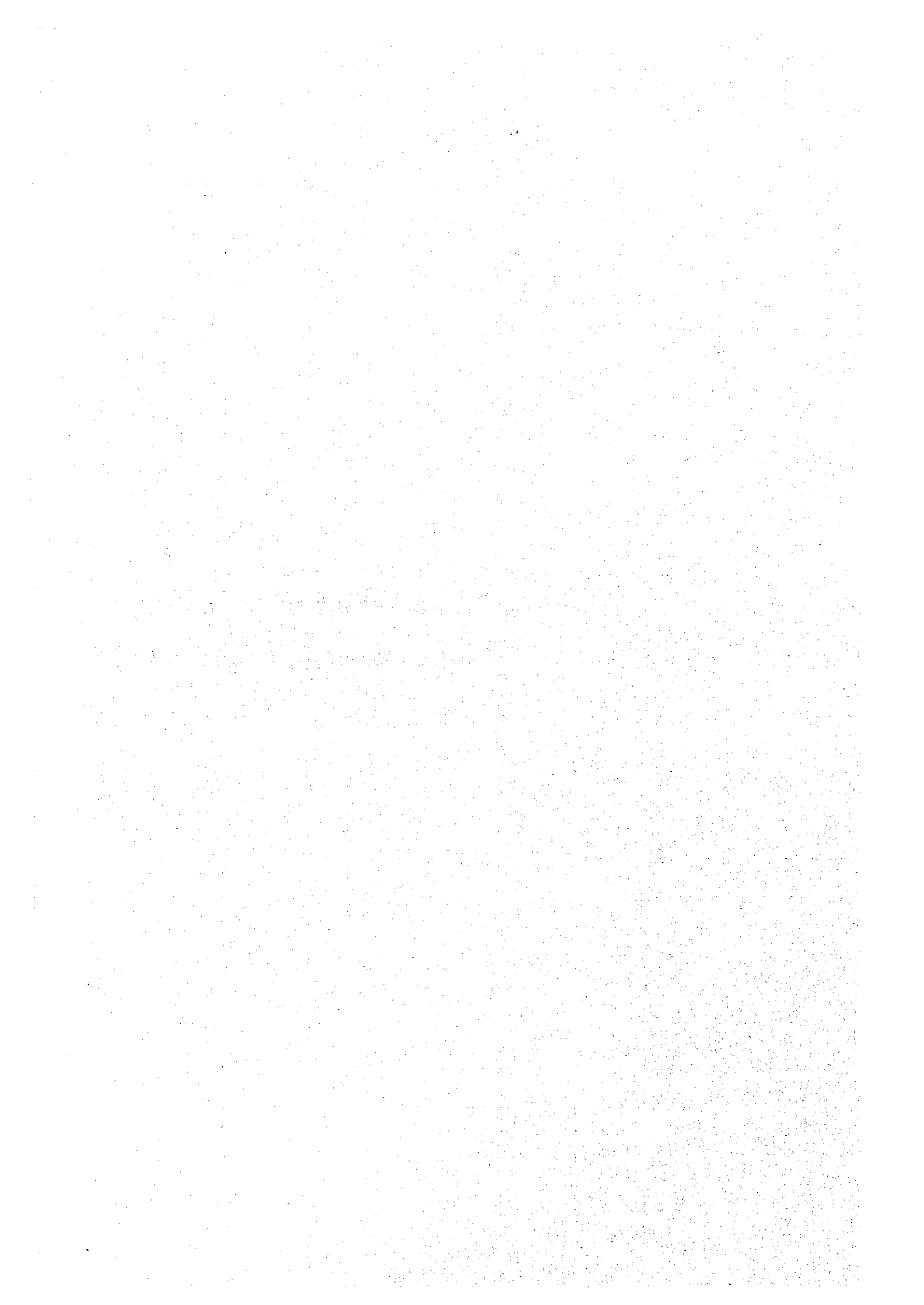
Sincerely yours;

Dr. Ing. Walter Flores

Viceminister of Environment, Natural Resources and Forestal Development.

Ministry of Sustainable Development and Planning.

**SUPPORTING REPORT H**  
**AGRICULTURE AND LAND USE**



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## **SUPPORTING REPORT II      AGRICULTURE AND LAND USE**

### **1.    Agriculture and Livestock**

#### **1.1   Roles of Agriculture of the Department in National and Regional Economy**

Agro-economic index is summarized in Table H.1.1. According to the Table, roles of agricultural sector of the department in economy are summarized as follows:

- (1) The agriculture sector in Santa Cruz plays an important role not only in the regional economy but also in the national economy, which contributes to 23 % of the total GRDP and 39 % of agricultural GDP. The importance increased during the 1991-95.
- (2) The importance of agricultural sector in the regional economy is higher than that of national average, 23 and 15 % respectively.
- (3) The sector of the department contributes to much foreign currency earning because more than 90 % of industrial crops; soy bean, sugar cane, cotton and sun flower etc., are produced in the department and they contributed 18 % of the total export earnings in 1995.
- (4) The main agricultural products in Santa Cruz are soy bean, rice, maize and sugarcane, which shared 31 %, 13 %, 9 % and 8 % of the total crop production of the department in 1995, respectively. The top three crops contributed more than 50 % to the Agricultural GRDP, which was equivalent to about 10 % of the total GRDP.

#### **1.2   Role of the Study Area in the Agricultural Production of the Department**

Due to the high soil fertility endowed by nature, the Study Area has become the center of crop production of the department. The main crops in the area are soybean, rice and wheat, which shares 12 %, 43 % and 41 % of total production of the department in 1997/1998, respectively as shown in Table H.1.2 and the representative cropping calendar is shown in Fig. H.1.1. During the 1994 – 1998 period, however, the share of soybean decreased from 19 % to 12 % and the share of rice and wheat, on the other hand, increased with expanding their planted area; rice from 33 to 43, wheat from 25 to 41 %. These crops play a very important role in the national economy, soybean for export and wheat for import substitution.



Other crops produced in the area are maize and sunflower, which share 13 % and 7 % of total production in the department, respectively.

Crop production of the area is characterized by the high productivity compared to that of the average of the department. The main reasons are as follows:

- High soil fertility,
- Well organized technical extension service especially in the Japanese colony.

However, the production is fluctuated because their yields in summer, especially soybean, are much affected by the floods. Table H.1.2 shows, for example, that the summer soybean yield in 94/95 was lower than that of the other year.

### **1.3 Agriculture by Sub-area**

The Study Area consists of 5 sub-areas and agricultural features by area is discussed based on the results of interview survey by JICA and the Study Team as follows:

#### **1.3.1 The Chane – Pailon Area**

##### **(1) Okinawa**

Agricultural features of the sub-area are discussed based on the data of Okinawa I and II by JICA because the Study Area includes Okinawa I and a part of Okinawa II.

Agriculture in the area is characterized by well mechanized and a large scale management. Average land tenure per family is 421 ha and average number of tractor is 3 per family.

Upland area is the widest land use, sharing 76 % of the total area, and the second being grazing land, 9 % (as shown in Table H.1.3).

Table H.1.4 shows that total planted area was expanded during the past five years because farm land of the colony extended from 21,800 ha in 1955 to about 50,000 ha in 1996. The area invaded into the outside area of the colony, mainly opposite side of the Rio Grande and the northward of Okinawa.

Soybean is by far the most wide spread crop in the area, sharing 51 % of the total crop planted area in 1997 (as shown in Table H.1.5). However, the share has

sharply decreased since 1992, although the planted area has increased during the same period. In contrary to the soybean, wheat and sorghum, which are the winter crops and forage crops, expanded during the 1992-96 (as shown in Table H.1.4).

Potential for crop cultivation in the area is very high because the soils of the area consist of alluvial soils and class II soils, most fertile soils in the area, covers 45 % of total land. Soybean introduced in the middle of the 1980's. The area enjoyed the highest productive area of soybean in the department during 1980s, about 3 ton per hectore. However, it has decreased in recent years, 2 ton per hectore in 1997 (as shown in Table H.1.6).

Unarable land caused by salt accumulation in soil has expanded in the area. The deterioration of soil fertility is the main problems in the agriculture. The causes induced the problems may be as follows:

- Continuous cropping of soybean,
- Deterioration of soil fertility by cropping without fertilizer application for 40 years,
- Deterioration of soil physical conditions by the soil compaction using a heavy agricultural machinery,
- Over development.

In recent years, the non-tillage cultivation method has been introduced in the area since 1991 to avoid or to alleviate the expanding of salt accumulation area and to increase the yield by improving soil conditions. The method expands 11,117 hectors in 1996. According to the CAICO, the area would be reduced because the effects on the yield is not clear and the cost of defoliant (Round up) is too expensive, although the salt accumulation area decreased.

Number of livestock and the production in 1997 are shown in Table H.1.7 and H.1.8. In recent year, chicken and swine farming have expanded sharply to diversify farm income source for stabilization of farm economy (as shown in Table H.1.5). The share of the total farm income per family was only 4 % in 1997.

## (2) Other area

The area is located in the downstream area of Okinawa. Main land use is sugar cane area on the left bank of the Chane River, upland area on the right bank of the river, and primary forest on the river bank.

Small scale farmers are distributed in the upland area, such as Carmen, Caimanes and Puesto Fernandez etc., where characterize very severe flood condition, and the actual agricultural situation is unknown. The interview survey implemented by the Study Team, therefore, was focused on them to clear the agricultural activity under the severe flood conditions and to find countermeasure for alleviating of flood damage.

Table H.1.9 shows the results of farm interview survey about agricultural situations in summer season.

The land used of the area is not used effectively because of high ratio of unused land (28 %) and low ratio of annual crop area (56 %). Severe flood condition may reduce the intensity of land use.

Main crop planted in summer season is rice and soybean, which shares 45 and 40 % of the total planted area, respectively and the third being maize, sharing 14 %. Yields of all crops planted in the area are far below that of the department, because the ratio of harvested area per planted area is low, especially the area planted by small scale farmer less than 20 hector is remarkable.

Main reasons for the low productivity are as follows:

- Inappropriate cropping system.  
The results may show that crop cultivation of the area during the flood season should be avoided because the area more than 50 cm of flood depth in 1997/98 covers about 90 percent. Appropriate cropping calendar, therefore, should be established to avoid and to alleviate the damage.
- No technical extenuation services  
The farmer cultivate non water tolerant crop such as soybean and maize under the condition, sharing 40 percent and 14 percent of total planted area respectively, because of lack of knowledge. According to interview survey only 12 percent of farmer have an experience of receiving technical extension survives. To alleviate the damage, the extension system should be improved to expand appropriate technology.

Livestock is not popular in the area and is mainly raising for self-consumption. Average number raising per family is very low, cow 1.4 head, swine 1.0 head and chicken 4.6 head.

### 1.3.2 The San Juan – Antofagasta Area

#### (1) San Juan de Yapacani

Agriculture in the area is well diversified and mechanized. Main farm income sources are rice, soybean, egg and fruits, which shares 32, 17, 47 and 3 % respectively. The diversification makes farm economy stable by sharing risk of flood damage and price fluctuation of the products. Average agricultural machine per family is 2.6 of tractor and 1.4 of combine. Average land tenure is 299 hectares, which is equivalent to 70 percent of Okinawa.

Upland area is the most wide spread land use in the area, sharing 62 % of the total area, and second is grazing, 11 % (as shown in Table H.1.10). The high sharing of grazing land is due to grazing-upland rotation to sustain soil fertility because the natural fertility of the soils in the area is rather low. Unclear land, sharing 21 %, mainly distributed along rivers and wet land in the northern part, is developed in recent years to expand rice cultivation because of jumping the price. Main crops cultivated in the area are rice in summer and soybean in winter (as shown in Table H.1.11, 12 and 13). The cropping rotation is well suited for the natural conditions to alleviate flood damages because rice is characterized water tolerant. These yields have increased, especially rice yield is 1.7 times of the Okinawa, because of the improving of farming technology by the extension, although the original soil fertility is not so high.

San Juan is also well known as a high quality egg production area in the country and the production increased during the past five years (as shown in Table H.1.12, 14 and 15). Number of caw also increased during the same period.

The CAISY puts the effort to accelerate the further diversification by extension of the citrus fruits and macadamia nuts, expanding 900 ha and 200 ha in 1996, respectively.

#### (2) Antofagasta

Antofagasta is characterized severe flood and the area more than 50 centimeters depth shares almost 80 % of the total area. The area consists of local immigrants and average land tenure is small, 41 hectare per family. Main land use is upland crop, sharing 83 % and second being unused land, 15 %.

Main crop cultivated in summer is rice and soybean, which shares 56 and 44 % of total planted area, respectively (as shown in Table H.1.16). Soybean yield in the area is much lower than that of the departmental average, 0.7 t/ha in the area and 1.8 in Santa Cruz. However, rice is not so lower compare to the departmental average in 1997/98, 1.9 t/ha in the area and 2.3 t/ha in the province. These show that rice may be more suitable for the natural conditions than others planted in the area. Ratio of harvested area per planted area also proves it: the ratio of rice is higher than that of soybean, 82 and 52 %, respectively.

Livestock is raising mainly for self-consumption and property. However, egg production is expanding affecting by San Juan.

## 2 Land Use and Land Potentiality

### 2.1 Land Use

The Study Area covers 1,207 km<sup>2</sup> of the northern rural region of Santa Cruz, consisting of the Chane - Pailon and the San Juan – Antofagasta areas as shown in following Table.

STUDY AREA

Drainage Area	Area (km <sup>2</sup> )	Province
1) Chane – Pailon	599.6	
Chane	143.7	Obispo Santistevan
Pailon	270.9	Warnes
Okinawa drainage	185.0	Warnes
2) San Juan - Antofagasta	607.3	
San Juan	369.3	Ichilo
Antofagasta	238.0	Ichilo
Total	1,206.9	

Source: Study Team

Land use map, as shown in Fig. H.2.1, is prepared by the Study Team based on the land use map in 1995 and the field survey. Characteristics of land use are as follows:

#### (1) Chane - Pailon

- Forests distribute mainly on river bank areas, where characterize an unarable land with poor drainage,

- Grazing distributes mainly in an unarable land such as low fertility and severe flood areas,
- Sugar cane distributes in an arable land with severe flood, where flood depth is more than 50 cm in 1997/98 flood,
- Upland distributes in an arable land with less severe flood.

**(2) San Juan - Antofagasta**

- Forest distributes on river bank areas, where characterize an unarable land due to poor drainage,
- Grazing distributes in a severe flood area,
- Upland distributes in an arable land with less severe flood.

Land use in 1995 and 1998 is shown in Table H.2.1 and 2. Main findings based on the field and the interview survey and data analysis during the period are as follows:

**- Chane – Pailon**

Land use in the area has not changed since 1995 because agricultural land fully expanded by 1995.

**- Northern part of San Juan**

Forest and grazing was dominant land use in the area because of the drainage problem. However, the area was reclaimed to expand rice cultivation in summer season because of jumping of the price in the recent years.

**2.2 Land Classification**

Land classification in the Study Area is shown in the Table H.2.3 and Fig. H.2.1 and summarized in Table H.2.4.

The land potentiality is classified into the following five categories.

## LAND CLASSIFICATION CATEGORY

Category	Land Classification	Criteria
1	I - III	Land suited for crop cultivation
2	IV	Land marginally suited for crop cultivation
3	V	Land suited for grazing
4	VI - VII	Land marginally suited for grazing
5	VIII	Land unsuited for any agricultural activity

Source: UFD-PLUS

The main existing land use by classification is summarized as follows:

### THE MAIN LAND USE BY CLASS

Class	Chane – Pailon	San Juan - Antofagasta
II	Upland field	-
III	Upland field	Upland field
IV	Sugar cane	Upland field
V	Upland field, Forest, Sugar cane	Forestry, Grazing land
VI	Forest, Upland field	-

Source : Study Team

Land classification by area is characterized as follows:

#### (1) The Chane – Pailon Area

Arable area, from class I to III, shares about 60 % of the Chane – Pailon.

This means that the agricultural development potential in the area is higher than that of the San Juan – Antofagasta area. However, the area is widely covered by class V, sharing 33 %, where has a severe limitation for the agricultural activities and is not suited for crop cultivation.

#### (2) The San Juan – Antofagasta Area

Arable land covers 37 % of the area. Class IV-08 is dominant class, sharing 47 percent of the area and it characterizes marginally arable land. The class, however, is arable for rice cultivation in summer (rainy season), water tolerant crop, because the limitation is only drainage. Actually, the yield is much higher than

that of the provincial average, 3.1 and 2.3 t/ha respectively. Considering the situation, the arable land may covers 83.5 % of the area.

However, in the case of Class IV-07, distributing in the Chanc - Pailon area, the class is marginally arable because the limitation is water capacity and soil nutrition, which are impossible to improve.

### 3. Land Use Zoning

Land use zoning is prepared based on the information of the land classification by Proyecto Plan de Recursos Naturales de Santa Cruz and the flood conditions in 1997 by the Study Team. The zoning aims to show appropriate land use for alleviation of flood damage.

The zoning overlays with information of land classification and flood depth in 1997/98 and the maps are shown in Fig. H.3.1. Zoning factors and its category by zone and existing and recommended land use are shown in Table H.3.1. Characteristics by zone are explained as follows:

- Zone 1** : The area has no or slight limitation for agricultural land use through a year.  
Soils of the area are arable and floods uncommonly occur. The area, therefore, can grow crops and there is no or a slight limitation to select crops for cultivation through a year.
- Zone 2** : The area has a moderate limitation of inundation and is restricted crop selection during summer season.  
Soils of the area are arable but less severe floods, less than 50 cm depth, commonly occur. The area has limitation for crop selection during the summer to alleviate the flood damage. Water tolerant crops, such as paddy, are suited for the area during summer.
- Zone 3** : The area has a severe limitation of inundation for agricultural activity during summer season but has no or slight limitations during winter season.  
Soils of the area are arable but severe flood, more than 50 cm depth, commonly occurs. Floating rice, however, could not introduce because flood duration is too short to cultivate it, recording less than one month. New cropping calendar, avoiding flood season, should be introduced to reduce the flood damage.



Zone 4 : The area has medium limitations of soils and is restricted agricultural activity due to low soil fertility through a year.

Soils are marginally suited for crop cultivation and flood does not occur commonly in the area. However, the area is not suited for crop cultivation commercially because the area can not expect to get high yield due to low soil fertility. The area is recommended to use grazing and perennial crops.

Zone 5 : The area is unsuitable for crop cultivation because of severe limitations of soils and inundation.

Soils of the area are not or marginally suited for crop cultivation and severe flood, less than 50 cm in depth, commonly occurs. The area, therefore, recommend to use grazing land.

Zone 6 : The area is unsuitable for agricultural activities because of very severe limitation of soils.

Soils of the area are not suited for agricultural use and the area should be used for conservation purposes. Existing forest in the area, therefore, should be conserved.

Distribution of each zone and recommendations for decreasing flood damage are discussed as follows:

(1) The Chane – Pailon Area

The area along the river is covered by Zone 5 and existing forest area should be conserve because the area can not use for crop cultivation due to severe floods and poor soil fertility.

Zone 2 shares more than Zone 1 in the Okinawa drainage and Pailon areas although soybean is dominant crop during summer. The area should be converted soybean into the water tolerant crop for cultivation during summer.

Chane area is mainly covered by Zone 3 although the area is cultivated soybean and sugar cane. The area should introduce new cropping calendar because the zone characterizes severe flood and fertile soils.

**(2) The San Juan – Antofagasta Area**

Zone 2 is dominant zone distribute in the San Juan area and rice is the most wide spread crop in summer. The land use is suitable for the condition because of slight flood and fertile soils.

Most of Antofagasta area is covered by Zone 3 and the area needs the introduction of new cropping calendar because of severe flood and fertile soils.

Zone 6 distributed in the northern area is covered by forest and wet land. The forest should be conserved because the area is not suited for agriculture due to poor drainage etc.

**4. Development Policy of the Department**

Development plan of the department was prepared by Santa Cruz Prefecture in 1998 (Plan Departamental De Desarrollo De Santa Cruz 1.998 – 2.008). Following aspects are emphasized in the plan:

- Transformation of economic structure,
- Human resource development,
- Protection of natural resources.

Economic target in the plan is to achieve 5 percent of GRDP annual growth rate during 1998 – 2008.

The main objectives and strategies to achieve the target are:

- To accelerate production for exports and import substitutions by diversification,
- To manage the natural resources based on the Land Use Plan established by the departmental office in accordance with the potential,
- To activate the potential for economic development in order to improve income level for rural poverty,
- To create equal opportunity for education, health and other services.

**5. Results of the Interview Survey**

The interview survey was conducted by the Study Team in order to obtain the information as the supplementary data to the existing data and to identify the agricultural problems under the flood conditions, which could not find in statistics.

Number of interviewee by area is shown in following table and the results are shown in Table H.5.1 and 2.

#### NUMBER OF SAMPLE BY AREA

Area	Okinawa	Carmen	Caimanes	Minero	Total
Chane-Pailon	6	9	9	15	39
	San Juan		Antofagasta		
San Juan-Antofagasta	13		24		37

The section focuses on the relationship between flood and agriculture, irrigation and supporting services for non-structure measure because agriculture and land use by sub-area are discussed in the section H.1.3. Main findings from the results are discussed as follows:

**(1) Relationship between flood and agriculture**

Most of farmer, 94 % in the Chane - Pailon area and 81% in the San Juan - Antofagasta area, have experience of flood and it occurs annually in the most of study area. In comparison with the situation between these areas, the depth is almost same but the period in the Chane - Pailon area is longer than that of the San Juan - Antofagasta area, 20 days and 9 days respectively.

Important results on relationship between agriculture and flood are as follows:

All crop yields of summer season in the Chane - Pailon area are much lower than those of the department because flood is very severe, average depth is 74 cm and average duration is 20 days.

Ratio of harvested area per planted area is very low in the Chane - Pailon area, soybean 36 %, rice 68 % and maize 18 %. These mean that the flood damage for crops is huge in the area.

Rice yield, main crop in the summer, in the San Juan - Antofagasta area is much higher than that of the departmental average, 2.9 and 2.3 t/ha respectively. Soybean yield, however, is lower, 1.3 and 1.8. Especially, in the San Juan area, characterizing less severe flood area (average depth 30 cm and duration 4 day), rice yield records much higher than that of the department, 3.3 t/ha and 2.3 t/ha respectively.

The difference of the yield between the both areas may suggest that the damage could be alleviated by crop selection because rice records higher yield in the less severe flood area and crop cultivation during flood season should be avoided in the severe area because the damage is huge.

The crops, which are desirable for the cultivation by farmer after improving drainage condition, are soybean and vegetables in the Chane - Pailon area, and soybean and rice in the San Juan - Antofagasta area.

## (2) Irrigation

There is only a case to apply irrigation into the farm in the survey. However, it is not real irrigation but rainfed cultivation because the case applies polder for rice cultivation during summer season. Followings may be reasons why most of farmer does not apply irrigation.

- Large farm management per family,
- Insufficient water resource and no water reservoir,
- Unsuitable water quality for irrigation because of high salt content.

However, many farmers want to apply irrigation to their farm, 65 % in the Chane - Pailon area and 87 % in the San Juan - Antofagasta area. Main crops, which they want to apply irrigation, are rice, maize and vegetables. Special attention of the results is that small scale farmers want to cultivate vegetables with using irrigation.

## (3) Supporting Services

The distribution rate of technical extension services is rather low, especially the Chane - Pailon area is very low, only 15 % of farmer receive the services. Generally, source of the service is different from the scale of management, large scale farmer receives from farmer's cooperation such as CAICO and CAICY, the medium from producer's organization and the small from NGO such as CIPCA (Centro de Investigacion y Promocion del Campesino).

## (4) Low application ratio of agriculture inputs.

Application ratio of improved seed, fertilizer and chemicals is low and the small scale farmers applied less the inputs than those of the large scale farmers. This

may be the one reason for low yield of the small holders and may be caused by insufficient extension services.

(5) Low ratio of organized farmer

The ratio of organized farmer, belonging to the farmer's organization, is about 50 % in average. It is very important for farmers to belong to the farmer's organization in order to get an appropriate technology for avoiding or alleviation of flood damage.

(6) Selection of the same crops for cultivation among different farm sizes and flood conditions.

There is no difference in selection of crops among different farm sizes. The main crops are rice and soybean, which are rather advantageous for the large farmers to get profit.

There is also no much difference of crop selection and cropping calendar by flood condition. These agricultural situations may prone to be damaged by flood.

## 6 Recommendations

The importance of the Study Area and necessity of measurement for flood are discussed as follows:

- (1) Main products in the area are exports (soybean and rice) and import substitutions (wheat) and their share in total production of the department are high. The flood damage, therefore, is much affected for national and regional economy.
- (2) The development plan of the department gives priority to expansion of exports and import substitutes to grow regional and national economy. To achieve the target, the stabilization of agricultural production of the area should essential.
- (3) The area has functioned as a center of agro-industry, such as edible oil, concentrated feed stuff and rice milling etc. The industry is one of the most promising industries in the department and is expected to be main sector in the regional economy in the future.
- (4) The area, especially Japanese colonies, is an agriculturally advanced area and plays important roles as a technical extension for the surrounding farmers, through

well managed their fields and technical consultations for local farmers. The area is very influential in agricultural development of the surrounding areas.

Considering the situations, alleviation of flood damage is essential to sustain economic development not only regional and national economy through stabilization of agricultural products in the study area.

According to results of farm interview survey there is much potentials to alleviate the flood damage by non-structure measures as follow.

- (5) Cultivation of appropriate crops in accordance with soil and flood conditions, such as from non-water tolerant crops to water tolerant crops.
- (6) Introduction of appropriate cropping calendars or farming systems by flood condition.

For example, crop cultivation should avoid in the severe flood area during flood season because crops can not grow remuneratively in the area.

Land use zoning, which indicates appropriate land use by land condition, is prepared in the study to show the idea of nonstructural measures. These measures are easier than structure measures to implement. It is recommended that followings should be improved to expand these non-structural measures.

- (7) Improving agricultural technical extension services, especially for small scale farmers.
- (8) Organizing farmers for smooth implementation of extension services.
- (9) Improving agricultural research to study on local agriculture, such as establishing crop calendar by area and introduction of appropriate crop and variety.

(The CIAT implemented the trials if rice could grow after the flood season to avoid the flood damages. Though the flood situation by area is clarified in the Study, it is recommended that the CIAT should continue the trials for each flood condition to establish the appropriate cropping pattern and to introduce the appropriate crops and variety by zone)

**TABLES**

TABLE II.1.1 MAIN AGRO-ECONOMIC INDIX

Item	Unit	1991	1992	1993	1994	1995
<b>Whole Country</b>						
GDP	Million Bs	16,256	16,524	17,230	18,034	18,877
Share of agricultural GDP*	%	16.0	15.1	15.1	15.4	14.9
Share of industrial crops	%	2.1	1.7	2.0	2.4	2.6
Share of nonindustrial crops	%	7.7	7.2	7.0	7.0	6.6
Livestock	%	4.2	4.2	4.2	4.2	4.0
<b>Santa Cruz</b>						
GRDP*	Million Bs	4,070	4,100	4,292	4,577	4,818
Ratio of the GRDP to the GDP	%	27	27	27	28	28
Ratio of the agricultural GRDP to the agricultural GDP	%	34	33	35	37	39
Share of agricultural GRDP	%	22	20	21	23	23
Share of industrial crops	%	7.4	6.1	7.2	8.7	9.3
Share of nonindustrial crops	%	7.4	7.5	7.1	7.5	7.3
Livestock	%	5.0	5.0	4.9	4.8	4.6
Share of crop in crop production						
Crop production	Million US \$	283	296	349	411	512
Soybean	%	16	25	32	32	31
Rice	%	19	8	7	7	13
Maiz	%	9	11	8	7	9
Sorghum	%	2	3	1	3	4
Wheat	%	3	6	2	3	2
Sun Flower	%	1	1	1	2	1

\* : 1990 Constant Price

Source : Numeros de Nuestra Tierra 1998



TABLE II.1.2 MAIN CROP PRODUCTION BY AREA-(1)

		93/94	94/95	95/96	96/97	97/98
<b>Soy Bean(Summer)</b>						
Santa Cruz	Ha	242,000	330,000	390,120	428,700	483,000
	T/Ha	2.45	2.15	1.92	2.03	1.80
	TM	592,900	710,000	747,629	871,260	869,400
Montero-Okinawa	Ha	30,835	34,500	35,000	35,000	35,000
	T/Ha	2.60	2.00	2.10	2.20	2.00
	TM	80,171	69,000	73,500	77,000	70,000
Montero-Yapacani	Ha	4,000	3,500	2,450	2,500	5,000
	T/Ha	2.40	1.94	2.28	2.00	2.00
	TM	9,600	6,800	5,575	5,000	10,000
<b>Soy Bean(Winter)</b>						
Santa Cruz	Ha	65,231	89,000	63,600	82,652	90,000
	T/Ha	1.50	1.60	1.57	1.79	2.05
	TM	97,847	142,930	100,000	147,690	180,000
Montero-Okinawa	Ha	8,540	14,300	4,500	2,500	5,000
	T/Ha	1.90	1.80	1.60	1.70	1.80
	TM	16,226	25,920	7,200	4,250	9,000
Montero-Yapacani	Ha	15,223	22,000	18,600	19,152	16,500
	T/Ha	1.70	1.50	1.51	1.74	2.20
	TM	25,880	33,000	28,000	33,302	35,000
Total	Ha	307,231	419,000	453,720	511,352	573,000
Santa Cruz	T/Ha	2.25	2.04	1.87	1.99	1.83
	TM	690,747	852,930	847,629	1,018,950	1,049,400
Study Area	Ha	58,598	74,300	60,550	59,152	61,500
	T/Ha	2.25	1.81	1.89	2.02	2.02
	TM	131,877	134,720	114,275	119,552	124,000
<b>Share</b>						
Planted Area	%	19.1	17.7	13.3	11.6	10.7
Yield	%	100	89	101	101	110
Production	%	19.1	15.8	13.5	11.7	11.8

Source: Numeros de Nuestra Tierr 1998

TABLE II.1.2 MAIN CROP PRODUCTION BY AREA-(2)

		93/94	94/95	95/96	96/97	97/98
<b>Rice</b>						
Santa Cruz	Ha	96,500	87,850	87,650	81,000	99,977
	T/Ha	2.00	2.38	3.22	2.33	2.32
	TM	193,000	208,650	282,642	188,904	231,539
Okinawa	Ha	6,000	6,000	2,500	2,000	5,000
	T/Ha		2.60	3.53	2.83	3.00
	TM		15,600	8,825	5,660	15,000
Saavedra-Sagrado	Ha			6500	3800	4500
	T/Ha			2.97	1.90	2.20
	TM			19,318	7,220	9,900
San Juan de Yapacani	Ha	7,000	6,000	6,000	8,000	10,000
	T/Ha		2.50	4.06	3.18	3.18
	TM		15,000	24,360	25,440	31,800
Enconada Punta Rieles	Ha	8,000	10,850	11,000	8,000	9,000
	T/Ha		2.00	3.28	2.73	2.30
	TM		21,700	36,070	21,840	20,700
Antofagasta	Ha	7,000	7,000	7,000	8,800	9,000
	T/Ha		2.50	3.09	2.34	2.41
	TM		17,500	21,640	20,592	21,700
Study Area	Ha	28,000	29,850	33,000	30,600	37,500
	T/Ha		2.34	3.34	2.64	2.64
	TM		69,800	110,213	80,752	99,100
<b>Share</b>						
Planted Area	%	29	34	38	38	38
Yield	%		98	104	113	114
Production	%		33	39	43	43
<b>Wheat</b>						
Santa Cruz	Ha	35,115	53,550	53,000	73,860	112,250
	T/Ha	0.95	1.40	0.73	1.36	1.07
	TM	33,360	74,970	38,500	100,669	120,414
Zone I	Ha	4,600	9,500	14,800	19,010	29,100
	T/Ha	1.80	1.95	1.50	1.90	1.69
	TM	8,280	18,525	22,200	36,119	49,241
<b>Share</b>						
Planted Area	%	13	18	28	26	26
Yield	%	189	139	206	139	158
Production	%	25	25	58	36	41

Source: Numeros de Nuestra Tierra 1998

TABLE II.1.2 MAIN CROP PRODUCTION BY AREA-(3)

		93/94	94/95	95/96	96/97	97/98
<b>Maize</b>						
Santa Cruz	Ha	85,600	89,000	98,700	100,000	66,350
	T/Ha	3.18	3.06	3.12	3.60	2.83
	TM	271,950	272,000	307,800	359,960	187,771
Obisp Santistevan	Ha		3,000	3,500	4,000	3,000
	T/Ha		4.00	3.20	4.00	3.00
	TM		12,000	11,200	16,000	9,000
Warnes	Ha	2,000	5,500	6,500	8,000	3,000
	T/Ha	3.20	4.00	3.50	4.50	3.67
	TM	6,400	22,000	22,750	36,000	11,010
Ichilo	Ha	1,000	1,500	1,500	1,800	1,500
	T/Ha	3.00	2.50	2.50	2.50	2.50
	TM	3,000	3,750	3,750	4,500	3,750
Study Area	Ha	3,000	10,000	11,500	13,800	7,500
	T/Ha	3.13	3.78	3.28	4.09	3.17
	TM	9,400	37,750	37,700	56,500	23,760
<b>Share</b>						
Planted Area	%	4	11	12	14	11
Yield	%	99	124	105	114	112
Production	%	3	14	12	16	13
<b>Sanflower</b>						
Santa Cruz	Ha	60,000	41,000	89,000	143,350	
	T/Ha	0.96	0.80	0.91	0.80	
	TM	57,300	33,000	80,700	114,680	
Norte	Ha				4,500	
	T/Ha				1.56	
	TM				7,000	
Montero/ Yapacani	Ha	50	500	350		
	T/Ha	1.00	1.50	0.57		
	TM	50	750	200		
Montero/ Okinawa	Ha	1,780	6,250	1,500	500	
	T/Ha	1.70	1.09	0.77	1.40	
	TM	3,026	6,832	1,150	700	
Study Area	Ha	1,830	6,750	1,850	5,000	
	T/Ha	1.68	1.12	0.73	1.54	
	TM	3,076	7,582	1,350	7,700	
<b>Share</b>						
Planted Area	%	3	16	2	3	
Yield	%	176	140	80	193	
Production	%	5	23	2	7	

Source: Numeros de Nuestra Tierra 1998

**TABLE H.1.3 EXISTING LAND USE IN 1997(OKINAWA)**

Area	Unit	Upland	Fruits	Grazing Land	Reforestation Area	Uncleared Land	Others	Total
Okinawa 1	Ha	24,126	23	911	1	4,078	551	29,690
	%	81	0	3	0	14	2	100
Okinawa 2	Ha	7,390	6	2,814	140	969	231	11,550
	%	64	0	24	1	8	2	100
Study Area	Ha	31,516	29	3,725	141	5,047	782	41,240
	%	76	0	9	0	12	2	100

Source : JICA

**TABLE H.1.4 PLANTED AREA AND NUMBER OF LIVESTOCK(OKINAWA)**

		92	93	94	95	96
Planted Area						
Soybean	Ha	20,363	24,241	22,980	23,689	26,856
Maize	Ha	1,380	1,298	1,298	2,454	2,205
Wheat	Ha	2,492	2,200	4,032	8,597	9,750
Rice	Ha	1,917	2,141	2,141	1,550	1,733
Sunflower	Ha			4,390	1,530	1,760
Sorghum	Ha	1,674	2,233	2,964	5,831	8,344
Total	Ha	27,826	32,113	37,805	43,651	50,648
Ratio						
Soybean	%	73.2	75.5	60.8	54.3	53.0
Maize	%	5.0	4.0	3.4	5.6	4.4
Wheat	%	9.0	6.9	10.7	19.7	19.3
Rice	%	6.9	6.7	5.7	3.6	3.4
Sunflower	%	0.0	0.0	11.6	3.5	3.5
Sorghum	%	6.0	7.0	7.8	13.4	16.5
No. of cow	Head	6,820	7,626	7,317	6,930	8,500
No. of chicken	Head	6,000	9,053	16,000	12,020	15,000
No. of poultry	Head	2,352	3,250	3,117	3,316	5,200

Source: CAICO

**TABLE H.1.5 PLANTED AREA BY CROP IN 1997(OKINAWA)**

Area	Unit	Soybean	Rice	Wheat	Maize	Sorghum	Sunflower	Total
Okinawa 1	Ha	18,419	405	10,789	4,252	1,183	1,270	36,318
	%	51	1	30	12	3	3	100
Okinawa 2	Ha	5,511	0	2,445	1,057	725	505	10,243
	%	54	0	24	10	7	5	100
Study Area	Ha	23,930	405	13,234	5,309	1,908	1,775	46,561
	%	51	1	28	11	4	4	100

Source: JICA

**TABLE H.1.6 CROP PRODUCTION AND YIELD IN 1997(OKINAWA)**

Area	Unit	Soybean	Rice	Wheat	Maize	Sorghum	Sunflower
Okinawa 1	T	37,608	820	17,398	13,452	2,822	1,682
	T/Ha	2.0	2.0	1.6	3.2	2.4	1.3
Okinawa 2	T	9,458	0	3,654	3,649	1,825	632
	T/Ha	1.7	-	1.5	3.5	2.5	1.3
Study Area	T	47,066	820	21,052	17,101	4,647	2,314
	T/ha	2.0	2.0	1.6	3.2	2.4	1.3

Source : JICA

**TABLE H.1.7 NUMBER OF LIVESTOCK IN 1997(OKINAWA)**

	Unit	Cow	Swine	Chicken
Okinawa 1	Head	4,342	2,425	8,000
	%	52	81	42
Okinawa 2	Head	3,989	576	11,050
	%	48	19	58
Study Area	Head	8,331	3,001	19,050
	%	100	100	100

Source : JICA

**TABLE H.1.8 NUMBER OF LIVESTOCK SOLD IN 1997(OKINAWA)**

	Unit	Cow Head	Milk T	Swine Head	Egg Dozen	Chicken
Okinawa 1		216	7	1,859	167,900	500
	%	17	1	95	52	17
Okinawa 2		1,083	716	90	156,517	2,393
	%	83	99	5	48	83
Study Area		1,299	723	1,949	324,417	2,893
	%	100	100	100	100	100

Source : JICA

**TABLE H.1.9 RESULTS OF INTERVIEW SURVEY FOR FARMERS IN THE  
CHIANE-PAILON AREA EXCEPT OKINAWA**

<b>(1) Land Use</b>						
Land Tenure	Unit	Annual crop	Perennial crop	Grazing	Others	Total
20 H >	%	79	1	2	18	100
21 - 100	%	45	9	14	32	100
Average	%	56	7	10	28	100
<b>(2) Crop Production</b>						
		Soybean	Rice	Maize	Others	Total
Ratio of Planted Area in Summer Season						
20 H >	%	32	39	28	1	100
21 - 100	%	46	50	4	0	100
Average	%	40	45	14	0	100
Crop Yield in Summer Season						
20 H >	T/Ha	0.0	0.4	1.2	-	-
21 - 100	T/Ha	1.6	0.7	0.2	-	-
Average	T/Ha	1.1	0.6	1.0	-	-
Ratio of Harvested Area per Seeded Area in Summer Season						
20 H >	%	50.0	44.9	27.3	-	-
21 - 100	%	87.1	79.1	9.1	-	-
Average	%	74.5	66.5	24.2	-	-
<b>(3) Number of Livestock Raising per Family</b>						
		20 Ha >	21-100Ha	Average		
Caw	Head	1.0	3.1	1.4		
Swine	Head	0.7	1.8	1.0		
Chicken	Head	3.3	8.8	4.6		
<b>(4) Agricultural Input</b>						
		20 Ha >	21-100Ha	Average		
If farmer use following input						
Improved seed	Yes	46	50	47		
	No	54	50	53		
Fertilizer	Yes	31	38	32		
	No	69	62	68		
<b>(5) Agricultural Supporting Services</b>						
		20 Ha >	21-100Ha	Average		
If farmer receives extension service						
Yes	%	10	25	12		
No	%	90	75	88		
If farmer joins farmers organization.						
Yes	%	37	75	47		
No	%	63	25	53		

Source: Study Team

**TABLE II.1.10 EXISTING LAND USE IN 1997(SAN JUAN)**

Area	Unit	Upland	Fruits	Grazing Land	Reforestation Area	Uncleared Land	Others	Total	
Nishikawa	Ha	1,998	221	383		6	266	40	2,914
	%	69	8	13		0	9	1	100
Chuo	Ha	2,887	358	1,229		0	789	44	5,307
	%	54	7	23		0	15	1	100
Fuji	Ha	3,916	118	590		0	1,599	190	6,413
	%	61	2	9		0	25	3	100
Sakaecho	Ha	2,959	114	484		0	542	50	4,149
	%	71	3	12		0	13	1	100
Kyourei	Ha	3,040	174	32		1	1,828	114	5,189
	%	59	3	1		0	35	2	100
Victor	Ha	1,496	108	32		1	304	35	1,976
	%	76	5	2		0	15	2	100
Yamato	Ha	2,970	198	737		0	1,200	97	5,202
	%	57	4	14		0	23	2	100
Total	Ha	19,266	1,291	3,487		8	6,528	570	31,145
	%	62	4	11		0	21	2	100

Source : JICA

**TABLE II.1.11 PLANTED AREA BY CROP IN 1997(SAN JUAN)**

Area	Unit	Soybean	Rice	Maize	Sorghum	Fruits	Total
Nishikawa	Ha	875	944	0	20	249	2,088
	%	42	45	0	1	12	100
Chuo	Ha	750	1,090	0	0	360	2,200
	%	34	50	0	0	16	100
Fuji	Ha	1,435	1,980	0	0	121	3,536
	%	41	56	0	0	3	100
Sakaecho	Ha	1,245	2,220	40	0	114	3,619
	%	34	61	1	0	3	100
Kyourei	Ha	1,636	1,586	30	6	168	3,426
	%	48	46	1	0	5	100
Victor	Ha	1,021	795	7	0	108	1,931
	%	53	41	0	0	6	100
Yamato	Ha	3,050	1,629	90	10	198	4,977
	%	61	33	2	0	4	100
Total	Ha	10,012	10,244	167	36	1,318	21,777
	%	46	47	1	0	6	100

Source : JICA

**TABLE H.1.12 AGRICULTURE PRODUCTION(SAN JUAN)**

		92/93	93/94	94/95	95/96	96/97
<b>Soybean</b>						
Summer	Ha	750	2,050	1,980	1,960	1,416
Winter	Ha	2,761	7,150	7,350	9,274	8,182
Total	Ha	3,511	9,200	9,330	11,234	9,598
	T/Ha	1.4	1.8	1.7	1.7	2.0
	T	4,825	16,181	15,686	18,557	19,591
<b>Rice</b>						
	Ha	7,110	7,350	8,559	9,868	8,112
	T/Ha	1.9	2.8	3.1	3.3	3.4
	T	13,810	20,410	26,420	33,014	27,670
No. of chicken		564,000	590,000	626,000	690,000	719,000
Egg production		146,376,000	160,778,000	177,123,000	189,972,000	203,342,000
No. of cow		1,530	1,950	1,957	2,024	2,057

Source : CAISY

**TABLE H.1.13 CROP PRODUCTION AND YIELD IN 1997(SAN JUAN)**

Area	Unit	Soybean	Rice	Maize	Sorghum	Fruits
Nishikawa	T	1,676	2,930	0	59	840
	T/Ha	1.9	3.1	-	3.0	3.4
Chuo	T	1,216	4,208	0	0	360
	T/Ha	1.6	3.9	-	-	1.0
Fuji	T	2,570	6,223	0	0	478
	T/Ha	1.8	3.1	-	-	4.0
Sakaecho	T	2,360	6,634	92	0	436
	T/Ha	1.9	3.0	2.3	-	3.8
Kyourei	T	3,391	4,641	90	0	530
	T/Ha	2.1	2.9	3.0	-	3.2
Victor	T	1,878	2,400	9	0	312
	T/Ha	1.8	3.0	1.3	-	2.9
Yamato	T	5,977	4,941	184	20	415
	T/Ha	2.0	3.0	2.0	2.0	2.1
Total	T	19,068	31,977	375	79	3,371
	T/Ha	1.9	3.1	2.2	2.2	2.6

Source : JICA



**TABLE H.1.14 NUMBER OF LIVESTOCK IN 1997(SAN JUAN)**

	Unit	Cow	Swine	Chicken
Nishikawa	Head	391	5	101,900
	%	8	3	11
Chuou	Head	1,518	0	189,000
	%	33	0	21
Fuji	Head	1,223	0	124,810
	%	26	0	14
Sakaecho	Head	270	0	61,500
	%	6	0	7
Kyourei	Head	462	0	105,000
	%	10	0	11
Victor	Head	95	40	62,600
	%	2	27	7
Yamato	Head	662	105	272,300
	%	14	70	30
Total	Head	4,621	150	917,110
	%	100	100	100

Source : JICA

**TABLE H.1.15 NUMBER OF LIVESTOCK SOLD IN 1997(SAN JUAN)**

	Unit	Cow Head	Swine Head	Egg Dozen	Chicken Head
Nishikawa		100	0	1,788,605	62,292
	%	10	0	11	11
Chuo		226	0	3,455,182	130,982
	%	23	0	21	23
Fuji		117	0	2,322,220	73,501
	%	12	0	14	13
Sakaecho		120	0	1,256,990	43,300
	%	12	0	8	8
Kyourei		329	0	1,790,309	66,362
	%	34	0	11	12
Victor		20	39	1,087,130	40,340
	%	2	41	7	7
Yamato		70	55	4,791,510	146,320
	%	7	59	29	26
Total		982	94	16,491,946	563,097
	%	100	100	100	100

Source : JICA

**TABLE H.1.16 RESULTS OF INTERVIEW SURVEY FOR FARMERS IN ANTOFAGASTA**

**(1) Land Use**

Land Tenure	Unit	Upland crop	Perennial crop	Grazing	Others	Total
20 H >	%	85	0	0	15	100
21 - 100	%	82	0	2	16	100
Average	%	83	0	2	15	100

**(2) Crop Production**

		Soybean	Rice	Total
<b>Ratio of Planted Area in Summer Season</b>				
20 H >	%	15	85	100
21 - 100	%	49	51	100
Average	%	44	56	100
<b>Crop Yield in Summer Season</b>				
20 H >	T/Ha	1.0	1.5	
21 - 100	T/Ha	0.6	2.0	
Average	T/Ha	0.7	1.9	
<b>Ratio of Harvested Area per Planted Area in Summer Season</b>				
20 H >	%	67	84	
21 - 100	%	51	81	
Average	%	52	82	

**(3) Number of Livestock Raising per Family**

		20 Ha >	21-100Ha	Average
Caw	Head	1.5	2.1	1.9
Swine	Head	0.1	4.4	2.6
Chicken	Head	1.0	8.9	4.7

**(4) Agricultural Input**

		20 Ha >	21-100Ha	Average
<b>If farmer use following input</b>				
Improved seed	Yes	10	21	17
	No	90	79	83
Fertilizer	Yes	0	14	8
	No	100	86	92

**(5) Agricultural Supporting Services**

		20 Ha >	21-100Ha	Average
<b>If farmer receives extension service</b>				
Yes	%	50	50	50
No	%	50	50	50
<b>If farmer joins farmers organization.</b>				
Yes	%	50	50	50
No	%	50	50	50

Source: Study Team

**TABLE H.2.1 LAND USE IN THE STUDY AREA IN 1995**

		Upland field	Sugarcane field	Grazing land	Primary forest	Secondary forest	Urban area	Lake & river	Total
Chane - Pailon	Ha	302.9	106.8	80.6	92.5	12.5	1.4	2.9	599.6
	%	50.5	17.8	13.4	15.4	2.1	0.2	0.5	100.0
San Juan - Antofagasta	Ha	305.1	0.0	83.6	98.7	117.3	2.7	0.0	607.3
	%	50.2	0.0	13.8	16.3	19.3	0.4	0.0	100.0

Source : Study Team

**TABLE H.2.2 LAND USE IN THE STUDY AREA IN 1998**

	Unit	Upland field	Other* crop field	Grazing land	Primary forest	Secondary forest	Urban area	Lake & river	Total
Chane - Pailon Area	Km <sup>2</sup>	336.9	94.4	58.8	93.3	13.4	2.6	0.3	599.3
	%	56.2	15.7	9.8	15.6	2.2	0.4	0.0	100.0
San Juan - Antofagasta Area	Km <sup>2</sup>	407.9	10.8	64.5	70.9	51.6	1.7	0.0	607.3
	%	67.2	1.8	10.6	11.7	8.5	0.3	0.0	100.0

\*: Sugarcane field in the Chane - Pailon Area and Fruits field in the San Juan - Antofagasta area

Source: Study Team

**TABLE H.2.3 LAND CLASSIFICATION BY SUB-AREA**

Unit: Km<sup>2</sup>

Legend	Chane-Pailon Area				San Juan-Antofagasta Area			
	Chane	Pailon	Okinawa	Total	San Juan	Antofagasta	Total	Limitation*
II-02	29.3	43.1	83.2	155.7	0.0	0.0	0.0	T,N
III-01	0.0	53.8	33.9	87.7	5.7	78.6	84.3	N,DI
III-06	14.6	99.4	0.0	114.0	0.0	0.0	0.0	N
III-07	0.0	0.0	0.0	0.0	63.6	74.0	137.6	DI
IV-07	0.0	11.9	0.0	11.9	0.0	0.0	0.0	N,CA
IV-08	19.3	0.0	0.0	19.3	240.5	45.2	285.7	DI
V-02	44.2	59.3	52.8	156.4	0.0	0.0	0.0	DI,IN
V-05	14.7	0.3	8.0	23.0	0.0	0.0	0.0	DE,DI,N,IN
V-09	17.5	3.1	0.0	20.6	0.0	0.0	0.0	DI,CI,P
V-10	0.0	0.0	0.0	0.0	30.6	0.0	30.6	DI,N,X,CA,IN
V-11	0.0	0.0	0.0	0.0	28.9	28.3	57.2	DI,S,X
V-17	0.0	0.0	0.0	0.0	0.0	12.0	12.0	DE,DI,X
VI-05	0.0	0.0	7.1	7.1	0.0	0.0	0.0	DI,IN
VII-05	4.0	0.0	0.0	4.0	0.0	0.0	0.0	DE,N,CA,IN
	143.7	270.9	185.0	599.6	369.3	238.0	607.3	

\*: T: Topography, N: Nutrition, DE: External Drainage, DI: Internal Drainage, CA: Water Capacity, IN: Inundation, CI: Hardness, P: Soil Depth, X: Toxic Substance, S: Salt

Source: Departmental Office

**TABLE H.2.4 SUMMARY OF LAND CLASSIFICATION**

Area	Class	II	III	IV	V	VI	VII	Total
Chané-Pailon	Km2	155.7	201.7	31.2	400.0	7.1	4.0	599.6
	%	26.0	33.6	5.2	66.7	1.2	0.7	100.0
San Juan-Antofagasta	Km2	0.0	221.9	285.7	99.8	0.0	0.0	607.3
	%	0.0	36.5	47.0	16.4	0.0	0.0	100.0

Source: Departmental Office

**TABLE H.3.1 ZONING CATEGORY AND RECOMMENDED LAND USE**

Zone	Flood Depth	Soil Classification	Existing Land Use	Recommended Land Use	
				Summer(Flood season)	Winter
1	No flood	II-02,III-01,06,07,IV08	Upland crop,	Any crops	Any crops
2	50 cm >	II-02,III-01,06,07,IV08	Upland crop, Sugar cane, Forest,	Water tolerant crops such as rice	Any crops
3	50 cm <	II-02,III-01,06,07,IV08	Upland crop, Sugar cane, Grazing land	Crop rotation keeping away from flood season	Any crops
4	No flood	IV-07	Grazing land, Upland crop	Perennial crop, Grazing land	Perennial crop, Grazing land
5	50 cm >	IV-07	Grazing, Forest, Upland crop	Grazing land	Grazing land
6	-	V-02,V-10,11,17,VI-09,05, VII-05	Forest, Grazing, Sugar cane	Grazing land, Forest	Grazing land, Forest

Source: Study Team

**TABLE II.5.1 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE CHANE-PAILON AREA-(I)**

Items/ Farm Size	Unit	20>	21 - 100	101<*	Average	Total
<b>Number of farmers</b>		26	8	5		39
	%	66.7	20.5	12.8		100.0
<b>No. of farm family living in farm</b>		20	7	5		32
	%	76.9	87.5	100.0		80.0
<b>No. of person per family</b>		6.0	6.4	5.0	5.8	
<b>Land tenure per family</b>	Ha	5.9	42.5	369.6	60.0	
<b>Total farm land per family</b>	Ha	6.4	46.3	369.6	61.1	
<b>Income per family</b>	US\$/Y	1,456	1,357	8,303	2,458	
<b>Income per hectore</b>	US\$/Hé	227.5	29.3	22.5	40.2	
<b>Employee for agricultural activity</b>						
No. of employee per farm family		0.3	5.3	4.6	1.8	
No. of employee per 100 Ha		4.7	11.4	1.2	2.9	
Wage per month	US\$	97.0	97.0	166.7	121.9	
<b>Land use</b>						
Annual crop	%	79.0	45.4	60.8	59.6	
Perennial crop	%	1.2	8.9	5.4	5.7	
Grazing	%	2.1	13.5	29.2	25.0	
Fallow	%	4.3	11.9	4.6	5.7	
Idle	%	6.1	3.2	0.0	0.9	
Other	%	7.3	17.0	0.0	3.1	
<b>Total</b>		<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	
<b>Crops planted in summer season</b>						
<b>Ratio of planted area by crop in summer season</b>						
Soy bean	%	32.2	26.8	65.3	50.0	
Rice	%	39.3	28.9	10.2	19.2	
Maize	%	27.7	2.4	24.5	18.8	
Sugarcane	%	0.0	41.9	0.0	11.9	
Others	%	0.8	0.0	0.0	0.1	
<b>Total</b>		<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	
<b>Yield</b>						
Soy bean	T/Ha	0.0	1.6	0.2	0.4	
Rice	T/Ha	0.4	0.7	1.1	0.8	
Maize	T/Ha	1.2	0.2	0.8	0.9	
<b>Ratio of harvested area to seeding area</b>						
Soy bean	%	50.0	87.1	25.0	36.4	
Rice	%	44.9	79.1	70.0	67.6	
Maize	%	27.3	9.1	16.7	18.3	

\*: All farmers are living in Okinawa

**TABLE II.5.1 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE CHANE-PAILON AREA-(2)**

Items/ Farm Size	Unit	20>	21 - 100	101<	Average	Total
<b>If farmer uses an improved seed</b>						
Yes	%	46.0	50.0	100.0	52.6	
No	%	54.0	50.0	0.0	47.4	
<b>Crops using an improved seed</b>						
Soy bean	%	20.0	14.3	44.4	25.8	
Maize	%	33.3	42.9	11.1	29.0	
Rice	%	20.0	42.9	22.2	25.8	
Vegetables	%	26.7	0.0	0.0	12.9	
Others	%	0.0	0.0	22.2	6.5	
Total		100.0	100.0	100.0	100.0	
<b>If farmer uses following agricultural imputes</b>						
Fertilizer	Yes %	31.0	37.5	25.0	31.6	
	No %	69.0	62.5	75.0	68.4	
Insecticide	Yes %	70.0	62.5	80.0	70.0	
	No %	30.0	37.5	20.0	30.0	
Herbicide	Yes %	34.8	100.0	60.0	50.0	
	No %	65.2	0.0	40.0	50.0	
Fungicide	Yes %	13.0	50.0	40.0	23.5	
	No %	87.0	50.0	60.0	76.5	
<b>To whom does farmer sell the products.</b>						
<b>Soybean</b>						
Wholesaler	%	20.0	100.0	0.0	33.3	
Retailer	%	0.0	0.0	0.0	0.0	
Cooperative	%	40.0	0.0	100.0	50.0	
Others	%	40.0	0.0	0.0	16.7	
Total	%	100.0	100.0	100.0	100.0	
<b>Rice</b>						
Wholesaler	%	11.1	50.0	0.0	15.4	
Retailer	%	0.0	50.0	50.0	15.4	
Cooperative	%	22.2	0.0	50.0	23.1	
Others	%	66.7	0.0	0.0	46.1	
Total	%	100.0	100.0	100.0	100.0	
<b>Agricultural machinery</b>						
<b>If farmer plows his farm by tractor</b>						
Yes	%	75.0	100.0	100.0	85.0	
No	%	25.0	0.0	0.0	15.0	
Total		100.0	100.0	100.0	100.0	
<b>If farmer plow by rental tractor</b>						
Yes	%	28.6	28.6	0.0	37.5	
No	%	71.4	71.4	100.0	62.5	
Total		100.0	100.0	100.0	100.0	
Rental fee per hector	US\$/Ha	24.1	10.7	-	20.0	

**TABLE II.5.1 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE CHANE-PAILON AREA-(3)**

Items/ Farm Size	Unit	20>	21 - 100	101<	Average	Total
<b>Agricultural machine owned by farmer</b>						
Tractor	No./F	11.5	37.5	60.0	23.1	
Combine	No./F	3.8	25.0	20.0	10.3	
Track	No./F	0.0	25.0	20.0	7.7	
Light track	No./F	3.8	0.0	0.0	2.6	
Iron Plough	No./F	3.8	0.0	20.0	5.1	
<b>Irrigation</b>						
If farmer irrigate his farm						
	Yes	%	0.0	0.0	0.0	0.0
	No	%	100.0	100.0	100.0	100.0
If farmer want to irrigate his farm						
	Yes	%	66.7	50.0	80.0	64.7
	No	%	33.3	50.0	20.0	35.3
To what crop does farmer want to apply irrigation						
Soybean	%	10.0	0.0	33.0	13.0	
Rice	%	36.7	57.1	22.2	37.0	
Maize	%	23.3	28.6	22.2	23.9	
Vegetables	%	23.3	0.0	0.0	15.2	
Others	%	6.6	14.3	22.2	10.8	
Total		100.0	100.0	100.0	100.0	
If farmer has a drainage problem						
	Yes	%	96.0	100.0	100.0	97.4
	No	%	4.0	0.0	0.0	2.6
What crop does farmer want to grow after improving drainage						
Soybean	%	20.0	28.6	0.0	20.0	
Rice	%	13.3	7.1	0.0	10.8	
Maize	%	8.9	7.1	16.7	9.2	
Sorghum	%	6.7	14.3	50.0	12.3	
Vegetables	%	24.4	7.1	0.0	18.5	
Others	%	26.7	35.8	33.3	29.2	
Total		100.0	100.0	100.0	100.0	
<b>No. of livestock raising per family</b>						
Caw	Head	1.0	40.3	24.0	12.0	
Swine	Head	0.7	1.8	170.0	22.6	
Chicken	Head	3.3	8.8	0.0	4.0	
<b>Supporting services</b>						
If farmer receives extension service						
	Yes	%	10.0	25.0	40.0	15.4
	No	%	90.0	75.0	60.0	84.6
If farmer want to receive extension service						
	Yes	%	50.0	0.0	0.0	20.0
	No	%	50.0	100.0	100.0	80.0

**TABLE II.5.1 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE CHANE-PAILON AREA-(4)**

Items/ Farm Size	Unit	20>	21 - 100	101<	Average	Total
<b>If farmer has a credit</b>						
Yes	%	95.2	57.1	20.0	69.4	
No	%	15.4	42.9	80.0	30.6	
<b>If farmer wants to receive a credit</b>						
Yes	%	54.2	66.7	100.0	62.9	
No	%	45.8	33.3	0.0	37.1	
<b>If farmer joins farmers organization</b>						
Yes	%	37.5	75.0	100.0	54.1	
No	%	62.5	25.0	0.0	45.9	
<b>Flood</b>						
<b>If farmer has an experience of flood in your field</b>						
Yes	%	100.0	75.0	100.0	94.6	
No	%	0.0	25.0	0.0	5.4	
<b>Frequency of flood</b>						
Annual	%	95.2	100.0	75.0	74.0	
Duration of inundation	Day	20.3	12.6	30.0	20.2	
Depth of inundation	cm	66.3	85.7	92.8	74.0	
<b>What crop does farmer wants to cultivate after improving inundation</b>						
Soybean	%	22.7	30.8	0.0	22.6	
Rice	%	11.4	7.7	0.0	9.7	
Maize	%	9.1	7.7	20.0	9.7	
Sorghum	%	6.8	15.4	60.0	12.9	
Vegetables	%	24.1	0.0	0.0	22.6	
Others	%	25.9	38.5	20.0	22.6	
	Total	100.0	100.0	100.0	100.0	
<b>Living conditions</b>						
<b>Type of water supply</b>						
Aqueduct	%	25.0	57.1	0.0	27.8	
River	%	0.0	28.6	0.0	0.0	
Well	%	33.3	0.0	60.0	36.1	
Other	%	41.7	14.3	40.0	36.1	
	Total	100.0	100.0	100.0	100.0	
<b>Distribution of electricity</b>						
Yes	%	72.2	100.0	100.0	82.1	
No	%	27.8	0.0	0.0	17.9	
	Total	100.0	100.0	100.0	100.0	
<b>Type of toilet</b>						
Sewerage system	%	0.0	0.0	0.0	0.0	
Septic well	%	37.5	37.5	83.3	44.7	
Latring	%	29.2	12.5	16.7	23.7	
No toilet	%	33.3	50.0	0.0	31.6	
	Total	100.0	100.0	100.0	100.0	



**TABLE II.5.1 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE CHANE-PAILON AREA-(5)**

Items/ Farm Size Unit	20>	21 - 100	101<	Average	Total
<b>If farmer has following problems</b>					
Low Productivity %	3.8	14.3	0.0	5.1	
Water shortage %	38.5	71.4	0.0	41.0	
Farm size %	42.3	71.4	0.0	41.0	
Technical assista %	92.3	85.7	40.0	82.1	
Agricultural cred %	80.8	85.7	0.0	69.2	
Improved seed %	65.4	85.7	0.0	59.0	
Price of products %	73.1	100.0	0.0	66.7	
Infrastructure %	61.5	85.7	0.0	56.4	
<b>Desire to cultivate in the future</b>					
Rice %	18.2	6.7	0.0	13.8	
Soybean %	25.0	26.7	0.0	23.1	
Maize %	13.6	13.3	16.7	13.8	
Sorghum %	6.8	13.3	50.0	12.3	
Vegetables %	4.5	0.0	0.0	3.1	
Others %	31.9	40.0	33.3	33.9	
Total %	100.0	100.0	100.0	100.0	
<b>Reason to select above crops</b>					
Profitability %	67.6	46.2	50.0	61.1	
Technical aspect %	32.4	53.8	0.0	35.2	
Others %	0.0	0.0	50.0	3.7	
Total %	100.0	100.0	100.0	100.0	

**TABLE II.5.2 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE SAN JUAN-ANTOFAGASTA AREA-(1)**

Items/ Farm Size	Unit	20>	21 - 100	101<*	Average	Total
Number of farmers		12	17	8		37.0
	%	32.4	45.9	21.6		100.0
No. of farm family living in farm		8	14	8		30.0
	%	66.7	82.4	100.0		81.1
No. of person per family		5.0	5.4	4.9	5.0	
Land tenure per family	Ha	14.0	52.1	295.0	92.2	
Total farm land per family	Ha	14.8	59.4	298.8	96.7	
Income per family	US\$/Y	12,686	14,150	26,533	15,495	
Income per hector	\$/Ha	857.1	238.2	88.8	160.2	
<b>Employee for agricultural activity</b>						
No. of employee per farm family		5.5	4.0	3.7	4.4	
No. of employee per 100 Ha		37.2	6.7	1.2	4.8	
Wage per month	\$	114.5	126.5	113.2	118.0	
<b>Land use</b>						
Annual crop	%	75.2	79.7	87.1	84.3	
Perennial crop	%	11.3	0.1	7.5	5.6	
Grazing	%	0.0	4.5	2.1	2.7	
Fallow	%	11.8	4.3	1.5	2.8	
Idle	%	1.1	0.5	1.0	0.9	
Other	%	0.6	10.9	0.8	3.7	
Total		100.0	100.0	100.0	100.0	
<b>Ratio of planted area by crop in summer season</b>						
Soy bean	%	14.7	40.4	53.0	48.5	
Rice	%	85.3	59.6	47.0	51.5	
<b>Yield</b>						
Soy bean	T/Ha	1.0	0.7	1.5	1.3	
Rice	T/Ha	1.5	2.4	3.3	2.9	
<b>Ratio of harvested area to seeding area</b>						
Soy bean	%	66.7	52.9	83.6	77.0	
Rice	%	83.9	84.8	88.3	87.1	
<b>If farmer uses an improved seed</b>						
Yes	%	8.3	29.4	87.5	35.1	
No	%	91.7	70.6	12.5	64.9	
<b>Crop using an improved seed</b>						
Soy bean	%	100.0	55.6	50.0	55.0	
Rice	%	0.0	44.4	40.0	40.0	
Vegetables	%	0.0	0.0	10.0	5.0	
Total		100.0	100.0	100.0	100.0	

\*: All farmers are living in San Juan.

**TABLE H.5.2 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE SAN JUAN-ANTOFAGASTA AREA-(2)**

Items/ Farm Size	Unit	20>	21 - 100	101<	Average	Total
<b>If farmer uses following agricultural imputes</b>						
Fertilizer	Yes	%	8.3	23.5	75.0	29.7
	No	%	91.7	76.5	25.0	70.3
Insecticide	Yes	%	41.7	94.1	87.5	75.7
	No	%	58.3	5.9	12.5	24.3
Herbicide	Yes	%	66.7	70.6	62.5	67.6
	No	%	33.3	29.4	37.5	32.4
Fungicide	Yes	%	8.3	35.3	37.5	27.0
	No	%	91.7	64.7	62.5	73.0
<b>Soybean</b>						
Wholesaler		%	33.3	80.0	14.3	26.1
Retailer		%	0.0	0.0	0.0	0.0
Cooperative		%	0.0	20.0	85.7	30.4
Others		%	66.7	0.0	0.0	43.5
Total		%	100.0	100.0	100.0	100.0
<b>Rice</b>						
Wholesaler		%	20.0	30.8	50.0	31.0
Retailer		%	10.0	15.4	0.0	10.3
Cooperative		%	0.0	0.0	50.0	10.3
Others		%	70.0	53.8	0.0	48.3
Total		%	100.0	100.0	100.0	100.0
<b>Agricultural machinery</b>						
<b>If farmer plows his farm by tractor</b>						
Yes	%	90.0	100.0	100.0	97.0	
No	%	10.0	0.0	0.0	3.0	
Total		100.0	100.0	100.0	100.0	
<b>If farmer plow by rental tractor</b>						
Yes	%	66.7	41.2	0.0	40.5	
No	%	33.3	58.8	100.0	59.5	
Total		100.0	100.0	100.0	100.0	
Rental fee per hector	US\$/Ha	83.6	75.0	-	80.0	
<b>Agricultural machine owned by farmer</b>						
Tractor	No./F	25.0	82.4	100.0	67.6	
Combine	No./F	8.3	5.9	62.5	18.9	
Track	No./F	0.0	0.0	12.5	2.7	
Light track	No./F	0.0	11.8	37.5	13.5	
Iron Plough	No./F	0.0	5.9	25.0	8.1	

**TABLE II.5.2 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE SAN JUAN-ANTOFAGASTA AREA-(3)**

Items/ Farm Size	Unit	20>	21 - 100	101<	Average	Total
<b>Irrigation</b>						
If farmer irrigate his farm						
Yes	%	0.0	0.0	12.5	2.7	
No	%	100.0	100.0	87.5	97.3	
If farmer want to irrigate his farm						
Yes	%	91.7	88.2	75.0	86.5	
No	%	8.3	11.8	25.0	13.5	
Which crop does farmer want to apply irrigation						
Soybean	%	29.4	45.8	14.3	35.4	
rice	%	35.3	37.5	71.4	41.7	
Vegetables	%	23.5	12.5	14.3	16.7	
Others	%	11.8	4.2	0.0	6.3	
Total		100.0	100.0	100.0	100.0	
If farmer has a drainage problem						
Yes	%	83.3	88.2	75.0	83.8	
No	%	16.7	11.8	25.0	16.2	
What crop does farmer want to grow after improving drainage						
Soybean	%	22.2	17.2	18.2	19.0	
Rice	%	33.3	10.3	18.2	19.0	
Maize	%	5.6	20.7	9.1	13.8	
Sorghum	%	5.6	20.7	18.2	15.5	
Vegetables	%	11.1	0.0	0.0	3.4	
Others	%	22.2	31.0	36.4	29.3	
Total		100.0	100.0	100.0	100.0	
No. of livestock raising per family						
Caw	Head	8.0	9.4	1.4	8.2	
Swine	Head	0.1	3.6	1.9	2.1	
Chicken	Head	834	1,831	2,502	1,653	
<b>Supporting services</b>						
If farmer receives extension service						
Yes	%	45.5	52.9	62.5	52.8	
No	%	54.5	47.1	37.5	47.2	
If farmer want to receive extension service						
Yes	%	36.4	47.1	62.5	47.2	
No	%	63.6	52.9	37.5	52.8	
If farmer has a credit						
Yes	%	66.7	76.5	75.0	73.0	
No	%	33.3	23.5	25.0	27.0	

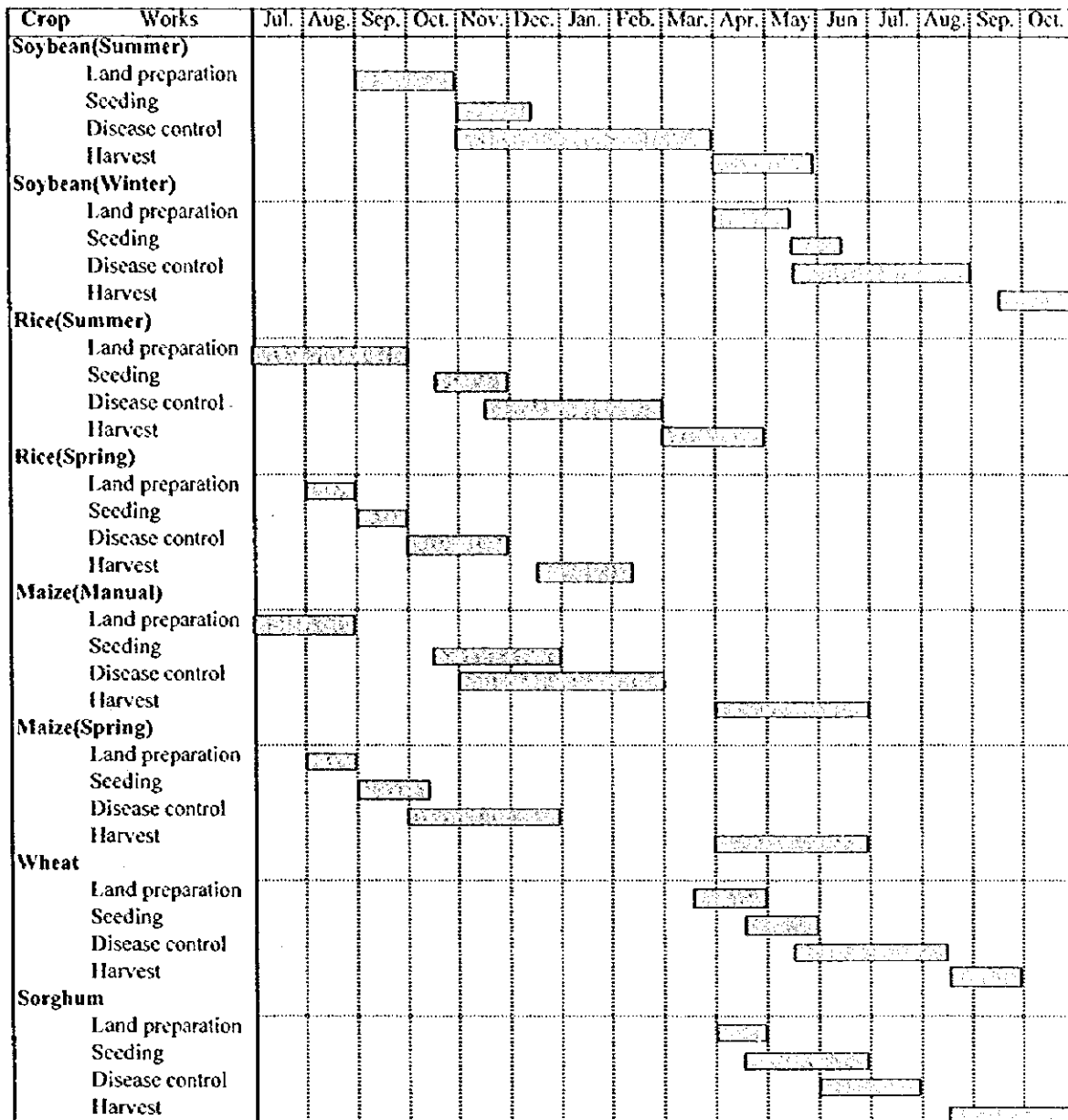
**TABLE II.5.2 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE SAN JUAN-ANTOFAGASTA AREA-(4)**

Items/ Farm Size	Unit	20>	21 - 100	101<	Average	Total
<b>If farmer wants to receive a credit</b>						
Yes	%	45.5	47.1	50.0	47.2	
No	%	54.5	52.9	50.0	52.8	
<b>If farmer joins farmers organization</b>						
Yes	%	58.3	58.8	87.5	64.9	
No	%	33.3	41.2	12.5	35.1	
<b>Flood</b>						
<b>If farmer has an experience of flood in your field</b>						
Yes	%	91.7	88.2	50.0	81.1	
No	%	8.3	11.8	50.0	18.9	
<b>Frequency of flood</b>						
Annual	%	81.8	86.7	100.0	86.7	
Duration of inundation	Day	13.6	6.1	4.3	9.2	
Depth of inundation	cm	89.1	78.0	30.0	79.7	
<b>What crop does farmer wants to cultivate after improving inundation</b>						
Soybean	%	33.3	25.0	23.1	26.7	
Rice	%	33.3	18.8	15.4	21.6	
Maize	%	0.0	15.6	15.4	11.7	
Sorghum	%	6.7	15.6	15.4	13.3	
Others	%	26.7	25.0	30.7	26.7	
Total	%	100.0	100.0	100.0	100.0	
<b>Living conditions</b>						
<b>Type of water supply</b>						
Aqueduct	%	41.7	23.5	25.0	29.7	
River	%	0.0	11.8	0.0	5.5	
Well	%	41.7	35.3	50.0	40.5	
Other	%	16.7	29.4	25.0	24.3	
Total		100.0	100.0	100.0	100.0	
<b>Distribution of electricity</b>						
Yes	%	25.0	52.9	87.5	51.4	
No	%	75.0	47.1	12.5	48.6	
Total		100.0	100.0	100.0	100.0	
<b>Type of toilet</b>						
Sewerage system	%	0.0	0.0	0.0	0.0	
Septic well	%	41.7	58.8	75.0	56.8	
Latring	%	8.3	11.8	0.0	8.1	
No toilet	%	50.0	29.4	25.0	35.1	
Total		100.0	100.0	100.0	100.0	

**TABLE II.5.2 RESULT OF INTERVIEW SURVEY FOR FARMERS  
IN THE SAN JUAN-ANTOFAGASTA AREA-(5)**

Items/ Farm Size	Unit	20>	21 - 100	101<	Average	Total
<b>If farmer has following problems</b>						
Low Productivity	%	36.4	11.8	12.5	19.4	
Water shortage	%	45.5	64.7	50.0	55.6	
Farm size	%	63.6	41.2	50.0	50.0	
Technical assistance	%	81.8	82.4	75.0	80.6	
Agricultural credit	%	72.7	76.5	62.5	70.3	
Improved seed	%	81.8	76.5	25.0	68.6	
Price of products	%	90.9	94.1	75.0	91.4	
Infrastructure	%	72.7	88.2	37.5	72.2	
<b>Desire to cultivate in the future</b>						
Rice	%	26.7	12.5	25.0	18.6	
Soybean	%	20.0	25.0	16.7	22.0	
Maize	%	6.7	15.6	8.3	11.9	
Sorghum	%	6.7	15.6	16.7	13.6	
Vegetables	%	39.9	15.6	16.7	22.0	
Others	%	0.0	15.6	16.7	11.9	
Total	%	100.0	100.0	100.0	100.0	
<b>Reason to select above crops</b>						
Profitability	%	52.4	60.7	66.7	59.1	
Technical aspect	%	47.6	35.7	33.3	39.3	
Others	%	0.0	3.6	0.0	1.6	
Total	%	100.0	100.0	100.0	100.0	

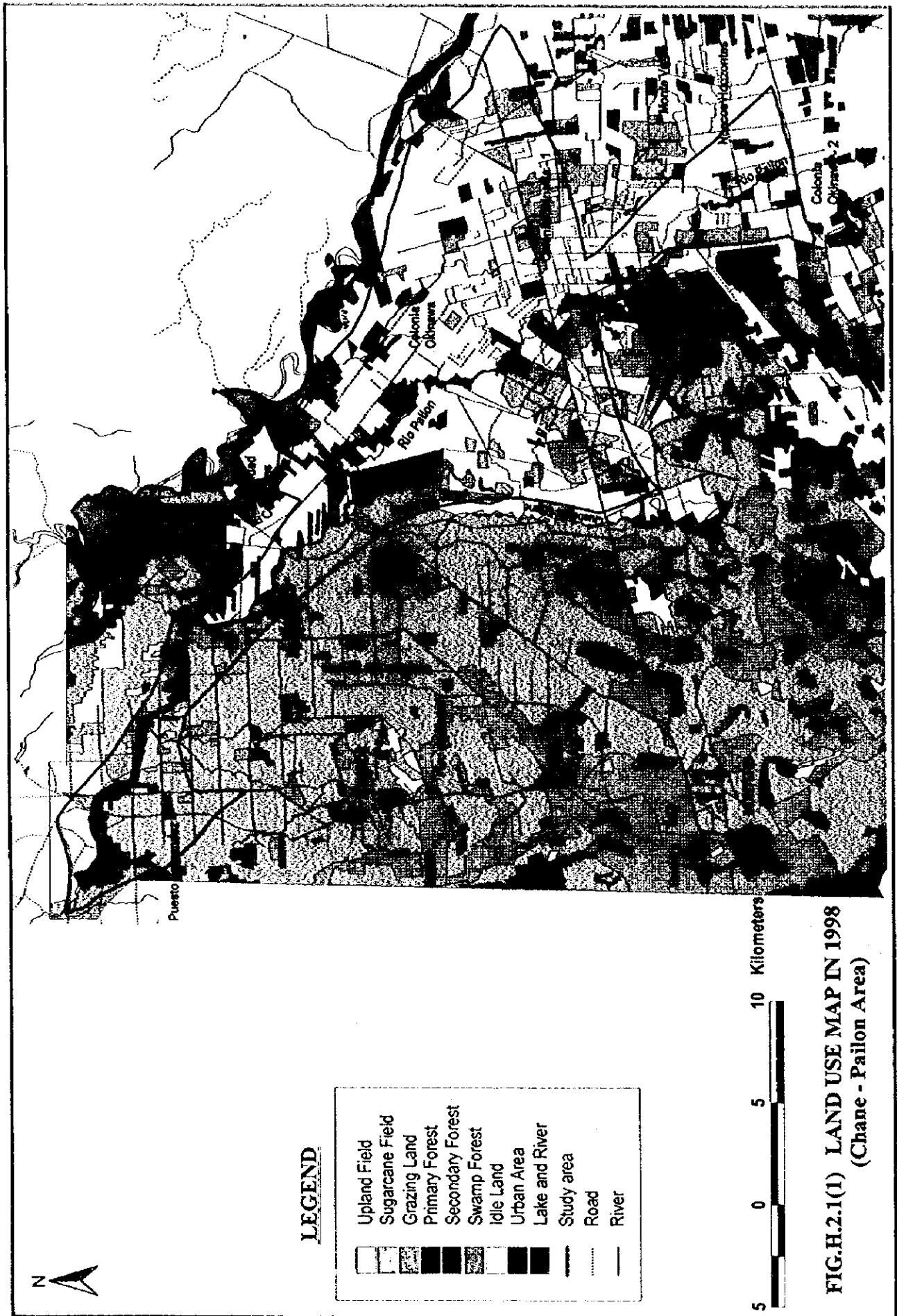
**FIGURES**

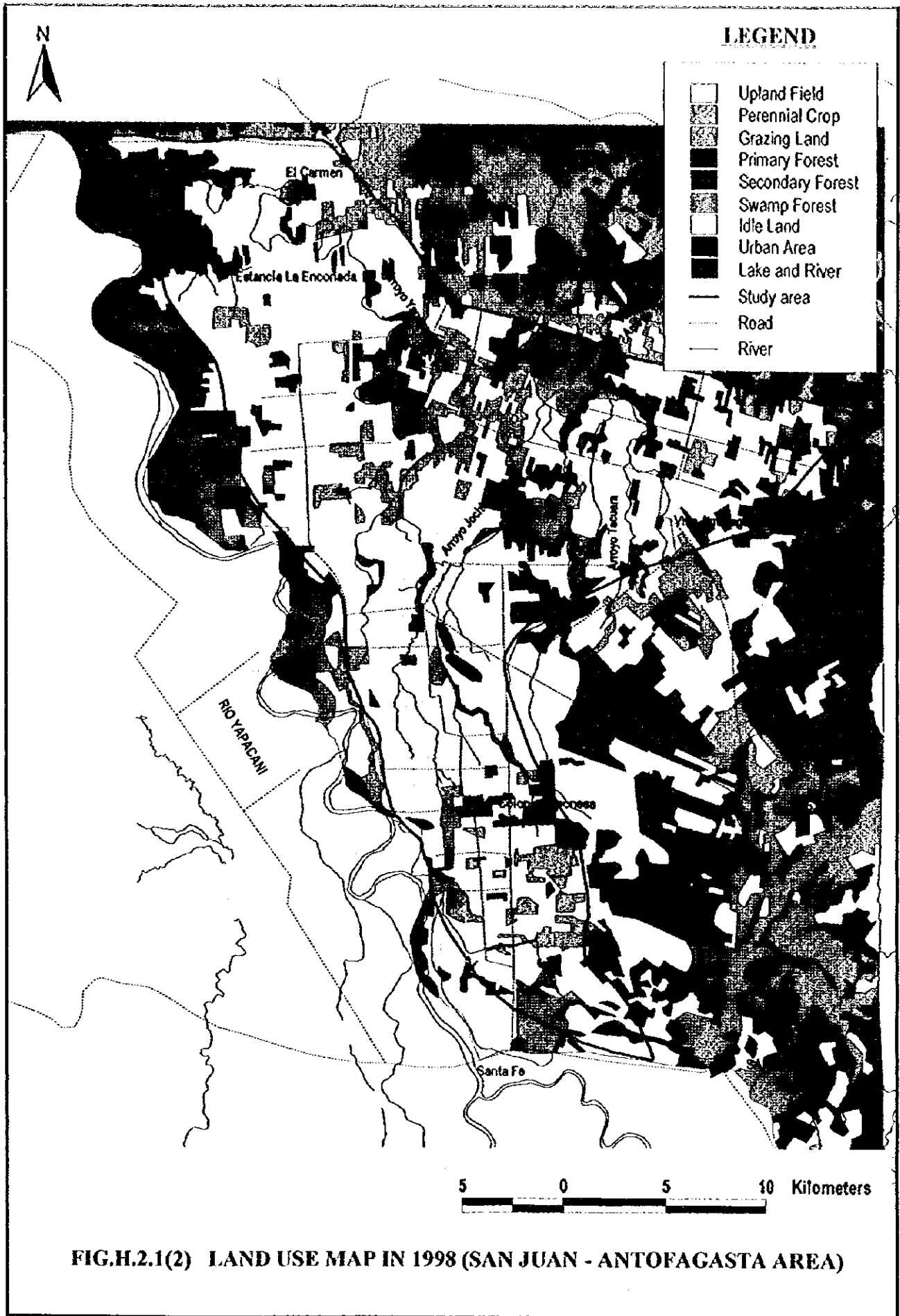


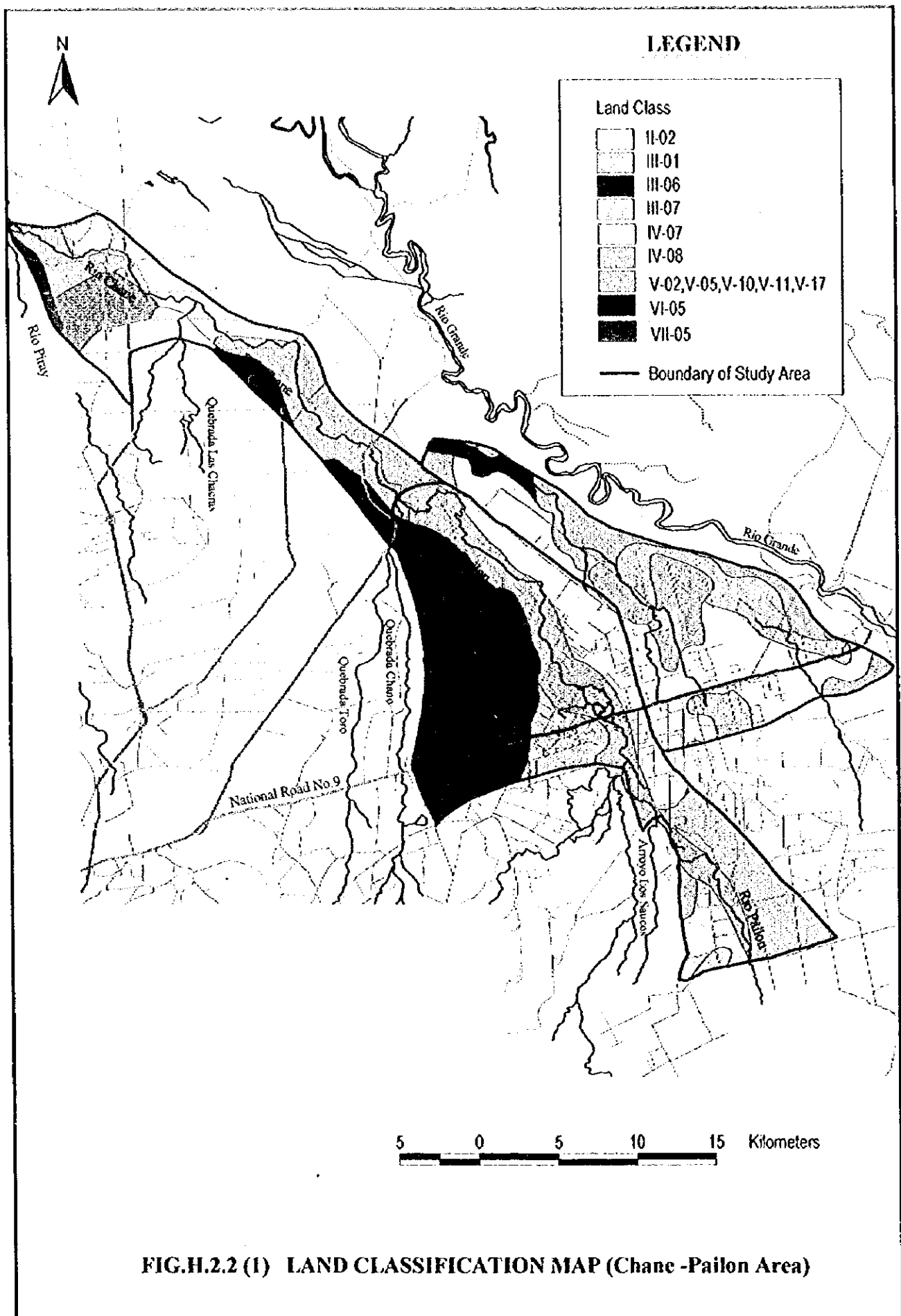
Source: Numeros de Nuestra Tierra 1998

FIG.H.1.1 REPRESENTATIVE CROPPING CALENDAR
















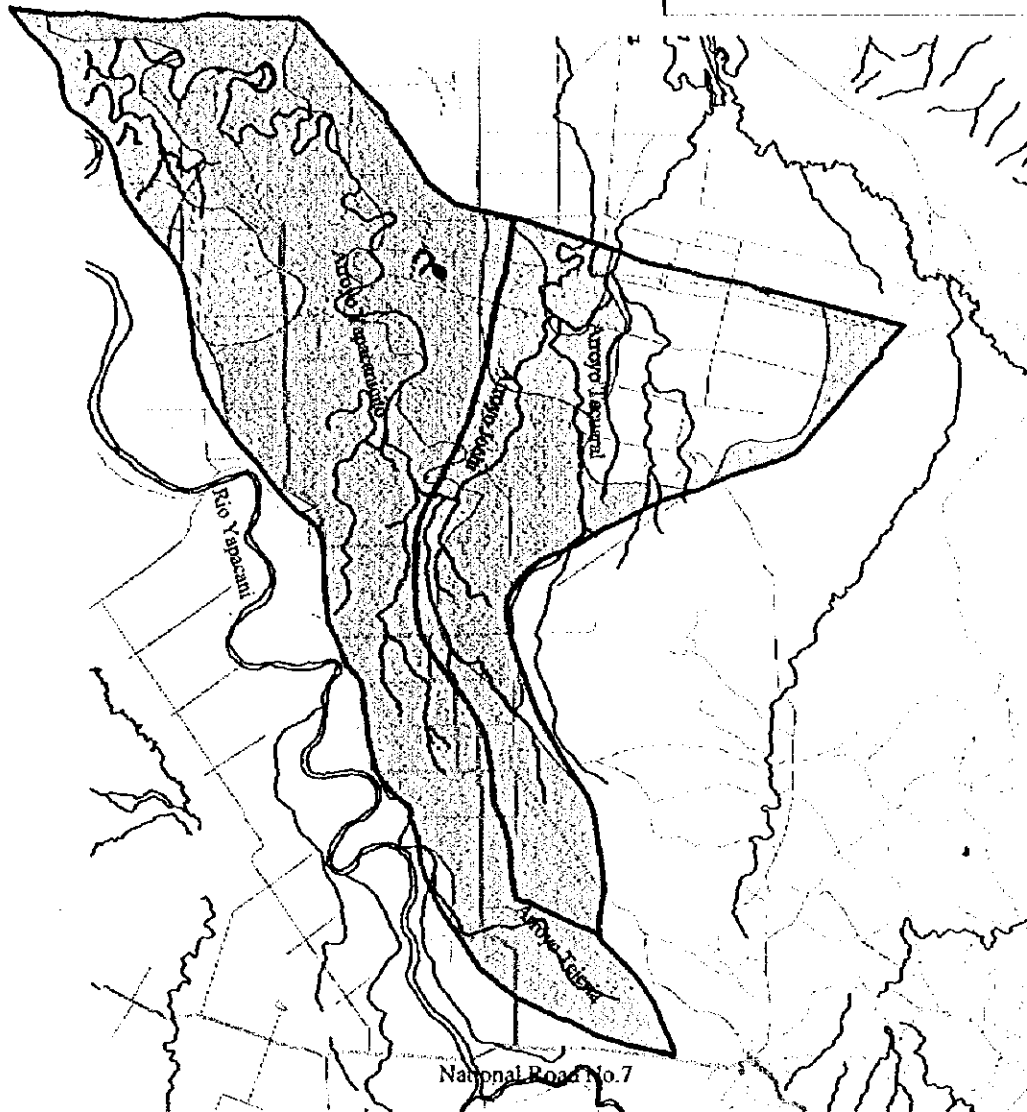


### LEGEND

Land Class

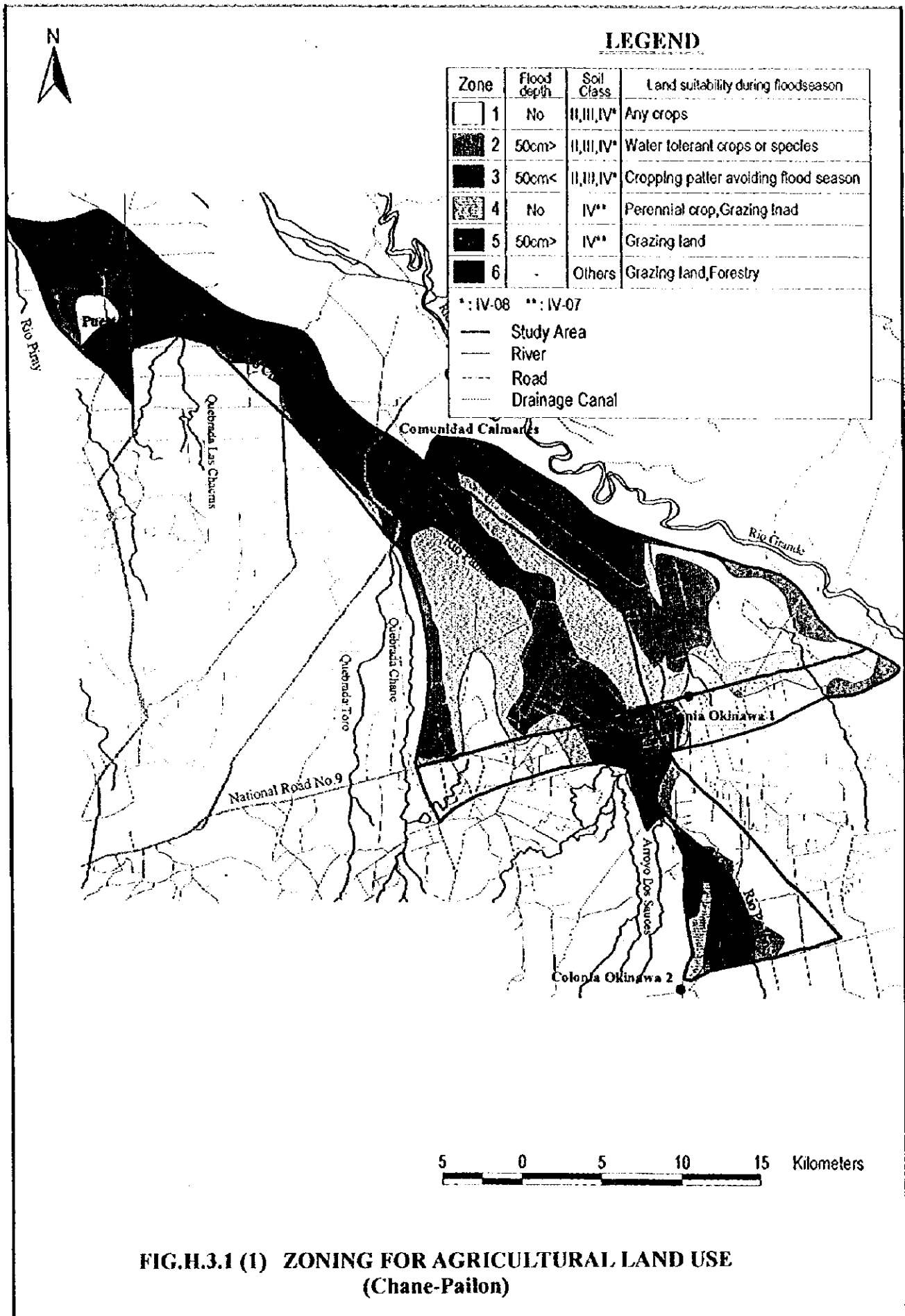
-  III-01
-  III-07
-  IV-01
-  IV-08
-  V-10,V-11,V-17,V-19
-  VII-04

 Boundary of Study Area



5 0 5 10 15 Kilometers

**FIG.H.2.2 (2) LAND CLASSIFICATION MAP (Sun Juan - Antofagasta Area)**



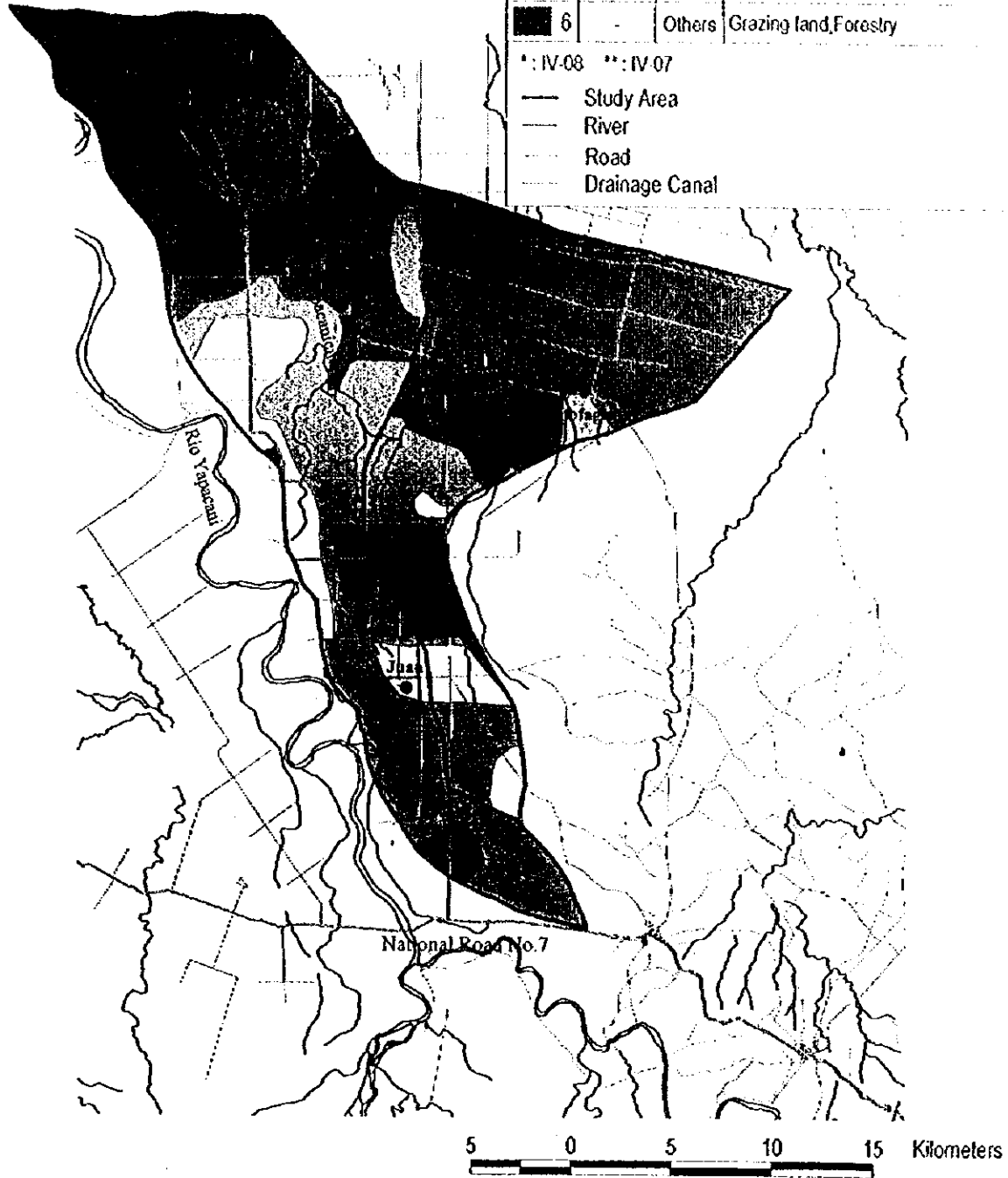


**LEGEND**

Zone	Flood depth	Soil Class	Land suitability during floodseason
1	No	II,III,IV*	Any crops
2	50cm>	II,III,IV*	Water tolerant crops or species
3	50cm<	II,III,IV*	Cropping patter avoiding flood season
4	No	IV**	Perennial crop,Grazing Inad
5	50cm>	IV**	Grazing land
6	-	Others	Grazing land,Forestry

\*: IV-08 \*\*: IV-07

- Study Area
- River
- Road
- Drainage Canal



**FIG.H.3.1 (2) ZONING FOR AGRICULTURAL LAND USE  
(San Juan-Antofagasta)**