

- a. Gross farm income is estimated based on the farmgate prices of the farm products and crop yield obtained by the farm survey by the Team, MAG, INIAP and BNF.
- b. Production costs are expressed in financial prices.
- c. Family labor is excluded from production costs.
- d. For production costs, the credit conditions of BNF are applied. Borrowing period is set at six months for annual crops and nine years (grace period of four years is included) for fruit (tree crops). Annual interest is 50.0%.
- e. Production value with the Project is estimated based on the target yield.
- f. Repayment of interest concerns only the credit interest for production costs.
- g. Living expenses with Project situation are estimated based on the Encuesta de Hogares 1991, INEC.
- h. Water charge is estimated at 545,553 Sucre/ha/year.

Table 6.3.8 Profit and Loss Statements of Model Farmers

(Unit: 1,000 Sucre)

Model Farmer	Gross Income	Production Cost	Living Expense	Repayment Interest	Water Charge	Surplus	
						Gross	per ha
1	w/o	520	310	3,044	0	-2,834	
	w	15,080	4,336	3,044	481	6,673	6,673
2	w/o	3,714	1,439	3,750	0	-1,475	
	w	71,311	9,313	3,750	3,043	53,567	17,856
3	w/o	12,738	5,843	4,620	0	2,275	
	w	145,767	28,429	4,620	7,763	99,499	9,950

Note: w/o = Without Project  
w = With Project

Taking the above result into consideration, the substantial improvement of the farm household economy in the Project Area can be expected as a result of the Project implementation. Furthermore, the high surplus per hectare shows the remarkable

improvement can be expected in the small scale farmers.

The results of cash flow estimation of the model farmers are shown in Table 6.3.9, showing that in the case of small-scale farmer, own fund or credit/loan from BNF of some 2.4 million Sucre will be required in the initial farming period immediately after the completion of the Project facilities.

#### **6.4 COMPREHENSIVE EVALUATION**

With the Project implementation, the improvement of agricultural productivity such as elevating of cropping intensity and increase of unit crop yield will be made possible. Even the small-scale farmer (model 1) can expect the annual farm earnings of 6,673 thousand Sucre. Moreover, the following secondary benefits such as generation of employment opportunities for construction works of the Project and agricultural production, and positive impact on the related sectors will also be anticipated:

- a. Increase of employment opportunities in the construction works of the Project.
- b. Increase of employment opportunities due to expansion of the planted area for own farming. It is expected that the Project will generate the job opportunities of 969,101 man-year (80,758 man-month).
- c. Expansion of agricultural processing and distribution sectors with the increase in agricultural output and input. It is noted that the deal of about 37,400 tons will be expected due to the introduction of fruit production.
- d. Improvement and expansion of social foundation and promotion of vitalizing economy in Sierra (highland) region and also the Province of Imbabura through the improvement of living standards by stable agro-economy and increase in distribution volume of agro-related materials.
- e. Decrease of woman's household labor due to the distribution of irrigation water to each farm.

Table 6.3.9 Cash Flow of Model Farm

Model	Item	Year										Unit: 1,000 Sucre
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	
Model 1	Initial Fund	0	3,407	9,356	16,029	22,702	29,375	36,048	42,721	49,394	56,067	
	Farm Credit	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	1,905	
	Farm Income	11,814	14,356	15,080	15,080	15,080	15,080	15,080	15,080	15,080	15,080	
	Sub Total	13,719	19,668	26,341	33,014	39,687	46,360	53,033	59,706	66,379	73,052	
	Production Cost	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	4,336	
	Living Expense	3,044	3,044	3,044	3,044	3,044	3,044	3,044	3,044	3,044	3,044	
	Interest/Repay.	2,386	2,386	2,386	2,386	2,386	2,386	2,386	2,386	2,386	2,386	
	Water Charge	546	546	546	546	546	546	546	546	546	546	
	Sub Total	10,312	10,312	10,312	10,312	10,312	10,312	10,312	10,312	10,312	10,312	
	Balance	3,407	9,356	16,029	22,702	29,375	36,048	42,721	49,394	56,067	62,740	
Model 2	Initial Fund	0	8,469	24,055	52,286	85,022	121,841	162,672	209,748	263,582	317,495	
	Farm Credit	5,266	3,282	3,282	3,301	3,767	3,756	3,756	3,756	3,756	3,756	
	Farm Income	24,679	29,969	43,020	48,646	52,446	56,846	64,418	71,311	71,311	71,311	
	Sub Total	29,945	41,720	70,357	104,233	141,235	182,443	230,846	284,815	338,649	392,562	
	Production Cost	11,258	7,240	7,438	8,362	8,058	8,190	9,313	9,313	9,313	9,313	
	Living Expense	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	3,750	
	Interest Repay.	4,830	5,037	5,245	5,461	5,948	6,193	6,397	6,532	6,453	6,438	
	Water Charge	1,638	1,638	1,638	1,638	1,638	1,638	1,638	1,638	1,638	1,638	
	Sub Total	21,476	17,665	18,071	19,211	19,394	19,771	21,098	21,233	21,154	21,139	
	Balance	8,469	24,055	52,286	85,022	121,841	162,672	209,748	263,582	317,495	371,423	
Model 3	Initial Fund	0	23,490	64,816	114,144	168,987	234,591	310,024	396,151	495,794	595,595	
	Farm Credit	15,213	11,246	11,246	10,850	11,316	11,305	11,305	11,305	11,305	11,305	
	Farm Income	66,190	80,373	89,184	100,437	108,036	116,836	131,981	145,767	145,767	145,767	
	Sub Total	81,403	115,109	165,246	225,431	288,339	362,732	453,310	553,223	652,866	752,667	
	Production Cost	32,317	24,282	24,677	29,526	25,918	26,183	28,429	28,429	28,429	28,429	
	Living Expense	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	
	Interest Repay.	15,520	15,935	16,349	16,842	17,754	16,449	18,654	18,924	18,766	19,234	
	Water Charge	5,456	5,456	5,456	5,456	5,456	5,456	5,456	5,456	5,456	5,456	
	Sub Total	57,913	50,293	51,102	56,444	53,748	52,708	57,159	57,429	57,271	57,739	
	Balance	23,490	64,816	114,144	168,987	234,591	310,024	396,151	495,794	595,595	694,928	

- f. Impact on agricultural production activities and stabilization of regional public welfare, and contribution to the national economy.
- g. Acceleration of other agricultural development projects in Ecuador.

The above consideration leads to the conclusion that the Project implementation is justified to be feasible from the economic and financial evaluations for which tangible benefits are employed. In addition, socio-economic effects are also fully expected. Accordingly, it is recommended that the Project be implemented in the early stage.

***CHAPTER 7***

***INITIAL ENVIRONMENTAL  
ASSESSMENT***

## CHAPTER 7 INITIAL ENVIRONMENTAL ASSESSMENT

The objective of this initial assessment on environment is to determine if it is necessary or not to make a further detailed assessment for the realization of the Project.

There is great difference in social and natural environmental impacts between the dam and head race construction areas (Water Resources Area) and the beneficial area (Project Area). Therefore, the forecast of the environmental changes and assessment of the influence by those changes have been made for the above respective areas.

### 7.1 ENVIRONMENTAL BACKGROUND OF THE PROJECT

The present social and natural environments of the Water Resources Area and the Project Area are as follows:

#### 7.1.1 Social Environment

##### (1) Water Resources Area

The construction site of the dam and reservoir is located at the altitude of 3,000 – 3,100 m and presently covered with natural pasture. There is a small house in the reservoir area but it is occupied only temporarily. In the dam construction site, there is also a small house in which two families live. These areas including the watershed area of the dam are owned by the Hacienda El Hospital. The natural highland pasture called "paramo" is being used as grazing land and the steep sloped area in which some small trees exist is not used.

The natural pasture is currently burnt in dry season in order to promote sprout germination and extermination of harmful insects. The present land use in the Area is summarized as follows:

- . Natural pasture: 90.0 ha (used as grazing land)
- . Wood land: 0.5 ha (along the Pinan River)

Trouts have their habitat in the Donoso Lake and Pinan River. Although the fishing rights have not specifically been established, the catching of small fishes and use of

casting nets are banned. But sport fishing is allowed. There are no houses or historical interests along the head race construction site.

## **(2) Project Area**

There are 1,491 farm households in the Project Area and the total population is approx. 12,000. The total area of the farm land is approx. 9,700 ha, 2,500 ha of which are irrigated. The main crops in the Area are maize, kidney bean, potato and wheat. The remaining farm land is used as grazing land.

The farmers who do not have an irrigation system have not been able to harvest enough in the past years due to the catastrophic weather. This fact reveals such social phenomena as abandonment of farming by small-scale farmers, increase of immigration to the large cities and lower population growth rate in the Area compared with the Provincial average.

### **7.1.2 Natural Environment**

#### **(1) Water Resources Area**

Presently the Area is vastly covered with "paramo" and there are a few small trees on the steep sloped land. No particularly important species are found in the Area; 28 vegetable species have been identified in the "paramo" zone over a four square meter (2 m x 2 m) area. However, these species may have been reduced due to the yearly burning practice and cutting trees, especially epiphytic plants such as orchid and plants of the Ananas family.

The dam construction site is located in the protected wild life area and in contact with the Cotacachi-Cayapas Ecological Reservation. This area is covered with "paramo".

There is no animal habitat in the area, but it has been confirmed that the puma and condor have their habitat in the areas of Mt. Cotacachi and Mt. Yanahurcu Negro located 15 km southeast and 10 km east of the dam site, respectively. The main water resources are the rivers of Pinan and Pantavi. According to the water quality laboratory test conducted by the Team, the water quality of these rivers is good enough for irrigation use and also for drinking. The main fish dwelling in these rivers is trout.

The overall length of the head race connecting the dam and the Project Area is

approx. 23 km including four tunnels of 9 km in total. The head race passes through the Cotacachi–Cayapas Ecological Reservation by a long tunnel. The vegetation of the open canal section of the head race is shrubs and that of the long tunnel section is the mountainous area of 3,800 m covered with "paramo". These mountains are covered with volcanic ash over coarse lava; for this reason, the soil is very permeable. There are two seasons, dry and rainy. Under severe weather conditions exhibiting significant temperature variations between day and night, only "paramo" can grow in these mountains.

Since almost all the mountainous areas of Cotacachi are assigned to pasture, the habitat of wild animals becomes very narrow and the species of them are fewer at present. The condor lives at the cliff of Mr. Cotacachi and Mt. Yanahurcu and in the latter only seven or eight condors in the last years have been confirmedly living. Its number has been annually reduced due to the use of agrochemicals and raticides. The puma has been living on the mountains. In spite of the fact that the hunting of these animals is banned in the wild animal reservation area, they tend to become fewer year by year due to the hunt of them by the cowboys.

## **(2) Project Area**

Most of the Project Area are used for the farm land or grazing land excluding the steep sloped area. The trees exist only in this steep sloped area covering only 5.3% of the overall area. The most of the trees are eucalyptus. Therefore, there is neither natural flora nor wild fauna. Most of the farm land are located on the gentle sloped area and the mild soil erosion by wind is significant on the land due to the soil characteristics in the area and weather conditions.

## **7.2 RELATED ORGANIZATIONS AND LAWS**

The organizations and laws in Ecuador in connection with the environmental assessment are as follows:

### **7.2.1 Organizations**

The organizations and their functions concerning the national environment are as shown below. Among these organizations, SUFOREN is the one that has direct connection with the evaluation of the Project.



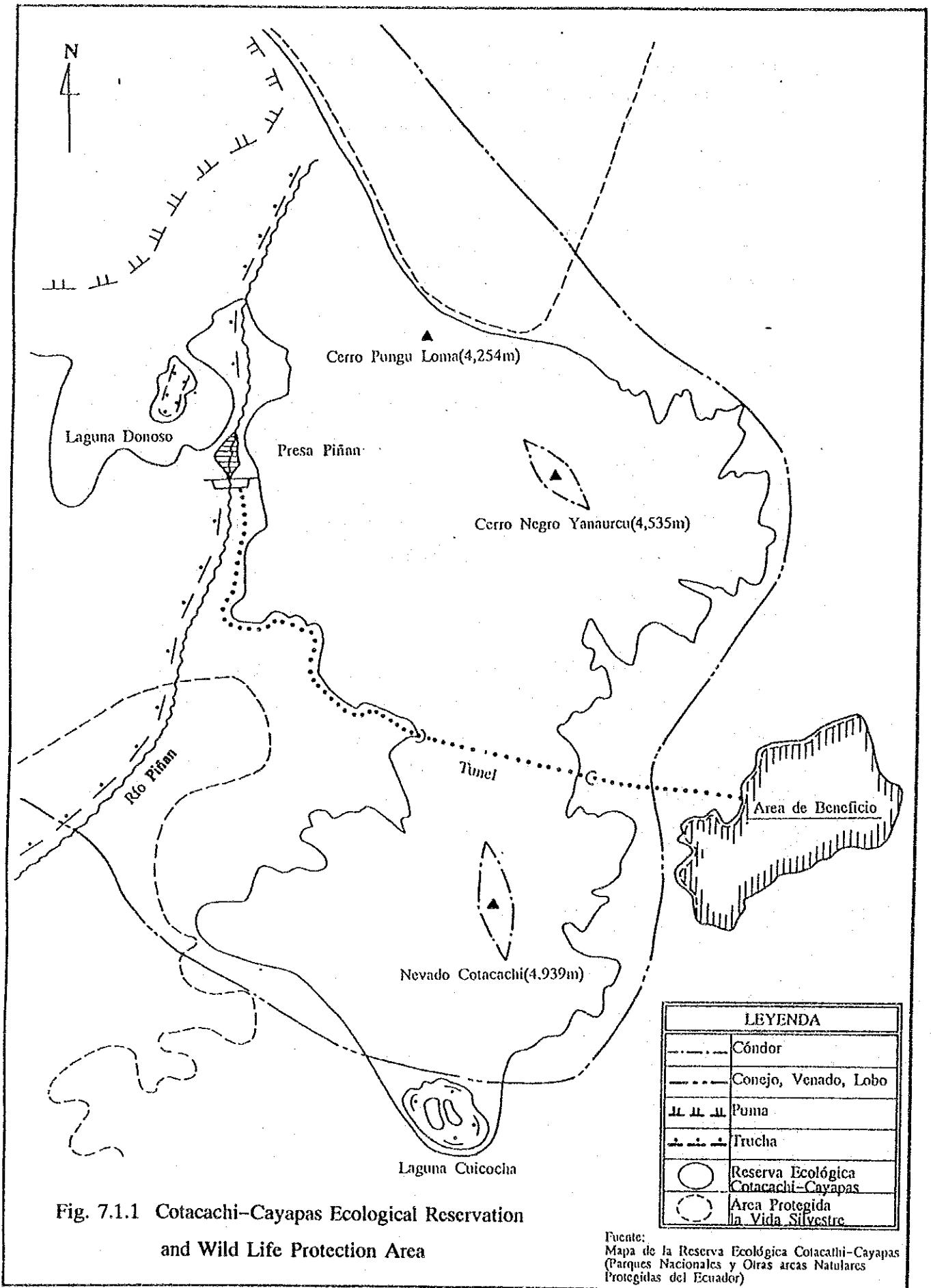


Fig. 7.1.1 Cotacachi-Cayapas Ecological Reservation  
 and Wild Life Protection Area

Organization	Governing Ministry	Functions
Agency of Forestry and Renewable Natural Resources (SUFOREN)	Ministry of Agriculture and Cattle-Raising (MAG)	Administration of national parks and protected natural areas
Agency of the Environment (SUMEAN)	Ministry of Energy and Mining	Mine and oil pollution
Izquierda Perez National Hygiene Institute (INNAHI)	Ministry of Public Health	Air and water pollution
Ecuadorian Standardization Institute (INEN)	Ministry of Industry, Commerce, Integration and Fishery	Industry-related pollution

### 7.2.2 Laws and Regulations

The following are the laws and regulations related to the implementation of the Project.

#### (1) Forestry, Natural Resources and Wild Life Preservation Law

This law was issued in August 1981 as the Presidential Decree and is the overall law concerning the administration of the national natural properties. In order to administrate the natural resources, the protection areas are established and the actual administration and protection of these areas are being made by MAG. It is necessary to obtain the permission of MAG for some development activities within the areas and the best recovery of the destroyed natural resources in connection with the development is the obligation of the developer.

The classification of the administration for the protection of the natural resources is as follows:

- a. National park
- b. Ecological reservation
- c. Wild life protection area
- d. Biological reservation
- e. Natural recreation area
- f. Flora and fauna production area
- g. Hunting and fishing area

**(2) General regulation for application of the above law**

This regulation was issued at the same time when the above law was ordered in order to enforce the law.

**(3) Decree for Watershed Management**

This decree is to establish a national committee for a watershed management, to make a plan and order for protection of mountains and rivers, to administrate the large rivers, etc. The committee is to be formed by the representatives of MAG, Ministry of Social Welfare, National Development Council and INERHI. The actual administration and operation are to be performed by MAG and INERHI. However, the committee has not been established and functioned.

**(4) Agreement for the construction of a road in the Cotacachi-Cayapas Ecological Reservation**

This is the agreement among INERHI, SUFOREN and Imbabura Province regarding the construction of the investigation road between Conaqui and Pitura within the Cotacachi-Cayapas Ecological Reservation in connection with the study of the Project. The main contents of the agreement are as follows:

- On April 1, 1991, SUFOREN gave the permission to INERHI and Imbabura Province by its document No.22P-911626 for the construction of the investigation road which was necessary for the prefeasibility study on the Tumbabiro Irrigation Project.
- The total length of this road should be 15 km and effective road width be 4 m with 1 m shoulder for both sides.
- In connection with the road construction, INERHI and Imbabura Province should strictly follow the laws and their regulations concerning the protection of natural forest and resources and wild lives, and perform the initial environmental assessment.
- The countermeasures for minimizing the influence to ecology in connection with the road construction should be taken.

**(5) International Treaties**

The international treaties on environmental preservation which Ecuador has signed are as shown below:

Name of Treaty	Year	Purpose, Regulation, Restrictions
Washington Treaty (U.S.A.)	1973	Protection of some animal and vegetal species to limit import and export and transport thereof
Ramsar Treaty (IRAN)	1971	Protection of birds, aquatic species and moors that are important for their survival

**7.3 PRESENT SITUATION OF ENVIRONMENTAL MANAGEMENT**

The Cotacachi-Cayapas Ecological Reservation extends from the Cotacachi mountains which have Cotacachi (EL 4,944 m), Yanahuru (EL 4,535 m) and Pungu-Loma (EL 4,254 m) ranging north-south for about 20 km as the east limit to the Cayapas River basin in Esmeraldas Province as the west limit. This is one of the reservations established in 1968 among six national parks and seven ecological reservations controlled by SUFOREN, and its boundaries were reformed in 1979. This reservation occupies approx. 200 thousand ha extending from the western part of Imbabura Province to Esmeraldas Province.

Most of the Cotacachi-Cayapas Ecological Reservation are owned by the Hacienda El Hospital and these lands have been developed since the beginning of this century as the grazing land of cow and horse, even though this area has been designated as the ecological protection area. The natural grazing land extends over the wide highlands and a small village which has a elementary school is formed in the Hacienda. The wild life protection area is established on the north and southwest outer environs of the Ecological Reservation. The construction sites of the dam and head race contained in the Project are within the wild life protection area but they are outside of the Ecological Reservation.

## **7.4 EFFECT OF THE PROJECT IMPLEMENTATION**

### **7.4.1 Effect by Construction of Dam and Head Race**

#### **(1) Social Environment**

##### **1) Relocation of Dwellers**

There are two small houses that will be submerged by the dam construction. However, there will be no problem about this. Because the agreement between INERHI and the land owner will be obtainable concerning the relocation of these small houses. In addition, nobody is living in the construction site of the head race.

##### **2) Economic Activities**

The natural pasture of approx. 90 ha will be submerged by the dam construction. However, the economic effect due to this submergence will be minimal because of low productivity of this pasture and its very small area compared with overall pasture area owned by the Hacienda. Furthermore, the disposal area of the dam excavated materials can be used as a part of the substitutional land of the submerged pasture.

##### **3) Transportation and Public Facilities**

There is a path of 1 – 2 m wide in and around the submerged area connecting the small house near the dam site and the grazing land with the Pinan Village. Therefore, the construction of a substitutional path will be required for the submerged section of the existing path. No public facilities other than the path exist in the submerged area.

##### **4) Archeological and Cultural Treasures**

It has been confirmed that there are no archeological and cultural treasures such as remains within the proposed construction sites. Given the present situation of the area, it is believed that no cultural treasures to be preserved will be found in the future.

**5) Water Right and Right of Common**

There is no water right for the Pinan River in the downstream section of the proposed dam site. Therefore, there will be no problem on water usage by maintaining some discharge as the river maintenance flow which will minimize the negative influence on the water course. Furthermore, there is no right of common for the submerged area.

**6) Sanitation Aspect**

There are no works that will produce negative effect on sanitary conditions, causing waste and plagues. Furthermore, there will not be any changes in the environment affecting dwellers' activities during the operation and maintenance period of the Project.

**7) Waste**

The dam construction will produce the residual materials. However, it is possible to dump them in the disposal area which will be utilized for the grazing land in the future. There will not be any problematic industrial waste.

**(2) Natural Environment**

**1) Topography**

Since some hills located at the right bank of the proposed dam are to be cut down in order to obtain the embankment materials, the land topography will be changed. However, these areas will be reusable as pasture lands.

**2) Soil**

Temporary land erosion will occur during the dam construction works. However, permanent erosion will be avoided through the germination of new grass on the excavated land. The collapse and erosion of the cut surface of land along the open canal section of the head race will possibly occur. Because the big cut of the steep sloped land will be required for the construction of the head race due to the topography of the construction site. Therefore, it is necessary to minimize the cut surface by selecting the best canal route. The countermeasures such as surface protection works may be required for some sections of the head race in order to

minimize the bad effect in connection with the construction works of the head race.

### **3) Groundwater**

Since it is anticipated that there will not be any change in the groundwater level in connection with the dam construction, there will be no problem concerning groundwater. Furthermore, the problematic effect due to the possible drop of the groundwater level caused by the tunnel construction will not be expected due to the following reasons:

- The rock of the tunnel construction site is included in the volcanic rock zone and its permeability is high.
- The present groundwater level is very low compared with the altitude of the construction site.

### **4) River**

The discharge of the Pinan River will be reduced at the downstream section of the dam. Therefore, it is necessary to minimize the bad effect at the downstream section by discharging the minimum flow from the dam for maintaining the flow course of the river.

Regarding the erosion of the river bed at the downstream section due to the dam construction, no considerable negative effect will occur because of the Pinan River joining with its branch stream at the junction 2 km downstream of the dam.

### **5) Water Quality**

The water quality of the river will be contaminated to some extent due to the implementation of the construction works. Therefore, it is necessary to minimize the bad effect of water contamination by providing some water treatment devices at the site, if required.

The water quality of the reservoir will not become bad due to the following; reservoir area is covered with pasture and water temperature is low because of high altitude; thus, water eutrophication will be low.

## **6) Fauna and Flora**

There are no wild animals in the reservoir area. Thus, there will not be any problem against the reservoir construction. Since the habitat of condor and puma is more than 10 km far from the construction site, the noise caused by construction works will not disturb their lives. Most of the vegetation in the area is "paramo" and it is believed that any important species may not exist.

The head race passes through the wood land zone making it unavoidable to cut some small trees. Although there are no tree species for preservation, after the construction, it will be required to reforest the vegetation or to provide the protection works in order to prevent as much as possible the negative effect caused by the construction works, in case of necessity.

At the tunnel section, the earth cover is thick and it is believed that the vegetation on the ground will not be affected by the tunnel construction.

## **7) View**

The excavation of hills which will be used as the dam embankment materials will change the landscape but these hills occupy a small part of the pasture. Thus, it will not be considered as the problematic matter.

### **7.4.2 Effect by Irrigation and Agricultural Activities**

#### **(1) Social Environment**

##### **1) Farmer's Move**

Some farmers may emigrate into the Project Area after the completion of the Project facilities, which may bring about problems such as land ownership and housing right. These possible problems always arise with the implementation of a project, and it is possible to provide countermeasures. In this case, the cooperation of the large-scale farmers is badly required.

##### **2) Economic Activities**

The economic activities in the Project Area will be activated with the implementation of the Project and the economic structure will be changed.



However, with the introduction of the irrigation farming, the agricultural production will be stabilized, farmer's income will increase and these farmer's household economy will be stabilized. The problem of farmer's emigration should be settled in consideration of the above plus effects to be brought by the Project implementation.

### **3) Transportation and Public Infrastructures**

With the activation of the Area, it is also necessary to improve the public infrastructures such as roads, schools and hospitals. The administration of the area should take action for these public requirements.

### **4) Archeological Remains and Cultural Treasures**

There is no news as to the existence of any cultural treasures or remains in the Area. The main Project facility is the main canal and the land required for the construction of the canal will not give any problems.

### **5) Water Right**

Presently there are some large-scale farmers who have the water rights for respective irrigation waters. However, according to INERHI, the farmers have agreed that these water rights be canceled and rearranged to the new beneficial farmers. Therefore, any problems in connection with the existing water right will not occur when the Project is implemented.

### **6) Sanitation Aspect**

The deterioration in the sanitary conditions such as increase of rubbish and excrements and outbreak of plagues will be increased due to the increase of the dwellers in the Area. However, this matter should also be discussed with the administration in the Area.

### **7) Waste**

The residual materials will be produced as a result of the construction of irrigation canals, but this matter will be settled by nominating some disposal areas.

## **(2) Natural Environment**

### **1) Topography**

With the construction of the irrigation canals, a slight topographic change will occur, but it is not considered as a problematic matter.

### **2) Soil**

Presently most of the farm land is not being cultivated due to the shortage of irrigation water and there is a hazard of soil erosion by wind. However, with the implementation of the Project, it will become possible to cultivate year round. Therefore, the farm land will be covered with crops and soil erosion by wind will remarkably be reduced.

With the introduction of the irrigation system, the surface soil may be eroded by water at both farm land and canal, and the collapse of the side slopes of the canals may occur. However, these problems will be avoided by adopting and extending the appropriate water management.

The possibility of the damage of farm land due to the water logging caused by possible salinity accumulation can be avoided by appropriate water management. The use of agrochemicals will cause the soil pollution, but it is important to minimize the pollution by controlling the amount of the chemicals.

### **3) Groundwater**

No works that will cause a change of groundwater movement will be executed in the Project.

### **4) Water Quality**

The deterioration of groundwater quality due to the use of agrochemicals cannot be avoided, but the countermeasures can be taken to minimize the deterioration.

### **5) View**

The landscape will change in some sections of the main canal, but such changes will not give a remarkable problem against the Project implementation.

## 7.5 RESULT OF THE INITIAL ASSESSMENT

The social and natural environmental impacts in connection with the implementation of the Project have been assessed for respective areas; Water Resources Area (reservoir area, and dam and head race construction sites) and Project Area.

Table 7.5.1 summarizes the estimation of the environmental changes and the assessment of the influence by those changes. Since very few people live in the Water Resources Area, the implementation of the Project will have little impact on its dwellers as far as resettlement of the dwellers is concerned.

The reservoir and surrounding area is covered mainly with natural pasture (paramo) and the submerged pasture area is very small compared with the total pasture land in the reservoir and surrounding area. There are no important animal species on which the Project implementation will give the influence. Consequently, it is judged that the dam construction will give little impact on the area. However, there are a path of 1 – 2 m wide and small houses in the reservoir area. Thus it is necessary to consider the construction of their substitute.

The head race has to be constructed along the steep sloped mountainsides due to its topography. Most of the construction site belong to the woodland. Therefore, cutting of trees is unavoidable, but there are no important tree species. In order to construct the head race, the excavation of the steep sloped mountainsides is unavoidable. The cut surface of these mountainsides will still be stable even after the completion of the head race, judging from the cut slope stability along the existing canals in similar site.

The dam, head race and temporary construction roads are to be constructed within the Cotacachi-Cayapas Ecological Reservation and/or the Wild Life Protection Area. The construction of these facilities will be legally permissible if the contents of the agreement regarding the construction of the investigation road up to the dam site, judging from the fact that the construction of the above investigation road was permitted with the intention that the Project would be implemented.

Since the collapse and erosion of the cut slope are unavoidable during the construction works, it is necessary to minimize the negative impact on the environment by minimizing the cut of trees and excavation of the mountainside.

The Project Area is the existing farm land and will bring the positive effect like the increase of agricultural products with the implementation of the Project. And it is

judged that the Project will not bring any remarkable negative effects on the environment in the Area.

As mentioned above, the social and natural impacts with the implementation of the Project on the environment in the Water Resources Area and the Project Area will be a little even not nil, and it is judged at this moment that the detailed environmental assessment will not be necessary. However, the detailed assessment may be required in the future when the national policy on the environment is changed.

Table 7.5.1 Screening and Scoping

Environmental Items	Content	Applic- ation	Notes	Marks	Remarks
Social Environment	1. Move	Yes	One occupied house and one unoccupied house	C	Owner has agreed
	2. Economy	Yes	Loss of production opportunities and change in economic structure	C	Disposed area becomes substitutional land
	3. Transportation Public Facilities	Yes	Impact on existing transit, school, hospitals, etc.	C	Since it is a small road, its substitution is easy
	4. Area Isolation	No	Isolation of the community due to traffic interruption	-	
	5. Cultural Treasures	No	Losses and depreciation of archeological and cultural treasures	-	
Natural Environment	6. Water Right and Common Right	Yes	Obstacles to fishing, irrigation and water usage rights	C	Since the maintenance flow is kept, its impact is deemed little
	7. Sanitation Aspects	No	Deterioration of sanitary conditions such as rubbish and outbreak of plagues	-	
	8. Waste	Yes	Appearance of residual wood, soil, turbid water, general waste, etc.	C	Transferred to disposal area to be used as grazing land
	9. Risks	No	Increase in risks such as collapse, cave-ins and accidents	-	
	10. Topography and Geology	Yes	Change in topography and geological structure due to excavation and embankment	C	To be transferred to pasture area
	11. Erosion	Yes	Loss of surface layer due to excavations and precipitations after tree-cutting	C	Selection of canal route, countermeasures on slopes, water management, etc.
	12. Groundwater	No	Change in groundwater conditions	-	
	13. River Flow	Yes	Change in discharge and quality	C	Since the maintenance flow is kept, its impact is deemed little
	14. Flora and Fauna	No	Interruption in fertility due to change in life condition and extermination of species	-	
	15. Meteorology	No	Change in temperature, rainfall, wind, etc.	-	
Pollution	16. View	No	Landscape changes caused by excavations and constructions	-	
	17. Air Pollution	No	Gas emitted by vehicles, etc.	-	
	18. Water Pollution	Yes	Water turbidity caused by drilling and execution of the works	C	Turbid water shall be treated during the construction works
	19. Soil Pollution	No	Pollution due to emission and dispersion of sewage and harmful materials	-	
	20. Noise	No	Noise and vibrations during construction works	-	
	21. Foundation Sink	No	Sink of foundation due to lowering of groundwater level	-	
	22. Unpleasant odor	No	Appearance of emitted gas and material with foul smell	-	
Overall Evaluation: It is a development project wherein execution of Environmental Impact Assessment is required?		No	It is possible to deal with these matters safely and economically	-	

Mark classification: A: Impact is deemed strong; B: Some impact; C: Impact is very small and not subject to Environmental Impact Assessment.

***CHAPTER 8***  
***RECOMMENDATIONS***



**1. Implementation of the Project**

It has been concluded that the Project will be feasible judging from both economic and financial view points. Therefore, it is recommended that the Project should be implemented as soon as possible in consideration of such facts that the Project Area plays the important role as the food supply base to Quito, the capital city of the country and that great contribution to the activation of the area can be expected through the Project implementation.

It is also expected that the direction or method of the agricultural developments in Ecuador will be cleared through the implementation of the Project.

**2. Present Water Right**

The Project is formulated with the assumption that the water rights of the rivers/streams presently owned by the large-scale farmers in the Project Area are to be canceled and rearranged to the new respective beneficiaries of the Project. Therefore, if this assumption is given up, the Project itself cannot be formulated. In this connection, it is necessary to clarify the cancellation of the present water rights by the documents between INERHI and the large-scale farmers prior to the commencement of the Project.

**3. Land**

The main Project facilities such as a dam, head race and head works are to be constructed in the land owned by Hacienda El Hospital. Furthermore, some construction roads necessary for the construction works of the above facilities are also to be constructed in the above land.

Therefore, the Project construction works cannot be performed without the cooperation of Hacienda El Hospital. The use right or ownership of INERHI of the above construction sites should be clarified by the documents between INERHI and the Hacienda prior to the commencement of the Project.



In the Project Area, the Branch and Tertiary Canals pass through the private farm lands. Therefore, the use rights of these canals should be clarified by the documents between INERHI and the respective land owners.

**4. Agricultural Credit to the Small-Scale Farmers**

Even though the big benefit will be born by the implementation of the Project, the introduction of fruit trees which requires the initial investment is planned in the Project even for the small-scale farmers. Therefore, for the successful implementation of the Project, the agricultural credit to the small-scale farmers is badly necessary. In this connection, the mitigation of the credit conditions and magnification of credit amount of BNF to the small-scale farmers are strongly recommended.

**5. Utilization of Surplus Water**

The Project is formulated in order to supply the irrigation water to the Project Area shown on the map. However, it is possible to discharge a part of the irrigation water led from the dam through the head race to the Cariyacu River when the rainfall in the Project Area side is more than the design rainfall. Therefore, this surplus irrigation water can be utilized in order to supplement the water shortage in the Salinus Project area. The implementation of the Project is very significant not only for the Project Area but also for the Salinus project area.

**6. Geological Investigation**

The detailed geological investigations including boring are indispensable for the detailed design of the main Project facilities especially the dam and tunnels. Furthermore, the additional geological investigations will be required from time to time during the construction of these facilities.

Especially these investigations are very important for the tunnel construction works in order to grasp the geological changes which cannot be foreseen during the design stage. According to the result of such investigations, the construction method may be changed or modified. Furthermore, the permeability at the left bank of the dam should be carefully investigated.

## **7. Excavated Soil and Rock**

Much soil and rock are to be excavated in the construction of the dam and tunnels. Even in the construction of the canals, the excavated soil and rock will become huge because of the embankment for the canals being not allowed due to the steep topographic conditions at the construction sites. Therefore, in both the detailed design and construction works of the required facilities, much attention should be paid in order to reduce the excavated soil and rock in consideration of the conservation of the environment of the construction sites and their surrounding areas. Furthermore, it is recommended that monitoring of the effect of the excavated soil and rock is conducted and that the system that the countermeasures can be taken from time to time when necessary is established.

## **8. Hydrological Data**

The hydrological analyses have been conducted using the hydrological data for the limited period in both Water Resources Area and Study Area, and the results of these analyses are used as the basis of the design of the Project facilities in the Study. Therefore, it is very important that the collection of the hydrological data shall be continued, and that the results of hydrological analyses such as design discharge and flood discharge of the Pinan River shall be checked by adding the hydrological data newly collected in the detailed design of the required facilities.

## **9. Strengthening of Supporting Services**

The production and extension of the improved seeds and the strengthening of the technical extension services are important in order to make more effectively the irrigation farming which will be introduced by the Project and to improve the agricultural productivity. Furthermore, in order to achieve the high price exportation of the products, the strengthening of the operation of the Marketing Centers which will be installed by the Project is badly necessary especially for the small-scale farmers.

## ***APPENDIX***

*A.1*

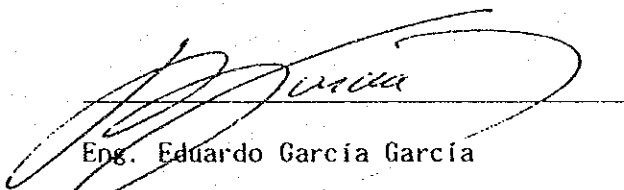
***SCOPE OF WORK AND  
MINUTES OF MEETING***



SCOPE OF WORK  
FOR  
THE FEASIBILITY STUDY  
ON  
THE TUMBABIRO IRRIGATION PROJECT  
IN  
THE REPUBLIC OF ECUADOR

AGREED UPON BETWEEN  
ECUADORIAN INSTITUTE OF WATER RESOURCES  
OF  
THE REPUBLIC OF ECUADOR  
AND  
JAPAN INTERNATIONAL COOPERATION AGENCY

Quito,  
April 16, 1992



Eng. Eduardo García García

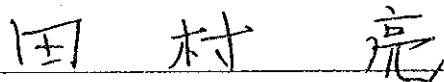
Executive Director

Ecuadorian Institute of

Water Resources

"INERHI"

Republic of Ecuador



Eng. Akira Tamura

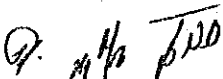
Leader

Preparatory Study Team,

Japan International

Cooperation Agency

"JICA"



## I. Introduction

In response to the request of the Government of the Republic of Ecuador (hereinafter referred to as "the Government of Ecuador"), the Government of Japan has decided to conduct the Feasibility Study on the Tumbabiro Irrigation Project in the Republic of Ecuador (hereinafter referred to as "the Study"), in accordance with the relevant laws and regulations in force in Japan.

Accordingly, the Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programmes of the Government of Japan, will undertake the Study in close cooperation with the authorities concerned of the Government of Ecuador.

The present document sets forth the Scope of Work with regard to the Study.

## II. Objectives of the Study

The objectives of the Study are as follows:

1. to conduct feasibility study in order to formulate the Tumbabiro irrigated agricultural development plan including water resources development in Imbabura province and
2. to undertake on-the-job training of the Ecuadorian counterpart personnel in the course of the Study.

## III. Study Area

The Study covers the Tumbabiro district ( about 10,000ha ) in the northwest of Ibarra city, Imbabura province.

#### IV. Scope of the Study

In order to achieve the above objectives, the Study will cover following items.

##### 1. Phase I

1.1. Collection of relevant existing data and information and field survey on the following items:

- (1) natural condition (topography, meteorology, hydrology, geology, soil, water resources, and environment);
- (2) socio-economic situation (population, regional socio-economy, social infrastructure, and education);
- (3) agriculture (farming, land use/tenure, cultivation, cropping patterns and yield, livestock, and support and extension services);
- (4) agro-economy (farmers economy, farmers organization, farm inputs and productivity, credit, machinery, and processing and marketing system) and
- (5) agricultural infrastructure (irrigation and drainage, rural road, and operation and maintenance of the existing irrigation systems).

1.2 Analysis of the data/information collected through 1.1 mentioned above.

1.3 Review of the existing development projects in the Study area.

1.4 Formulation of basic plan including water resources development for the Study.

1.5 Topographic mapping and ground survey.

Q. *M. J. J. J.*



2. Phase II

2.1. Field survey for collection of supplementary data and information.

2.2. Formulation of the irrigated agricultural development plan consisting of the followings:

- (1) water source plan;
- (2) land use plan;
- (3) cropping pattern and farming system plan;
- (4) irrigation and drainage;
- (5) processing and marketing plan and
- (6) support and extension services plan.

2.3. Preparation of a preliminary design of main facilities.

2.4. Formulation of operation and maintenance plan.

2.5. Preparation of the project implementation schedule.

2.6. Estimation of the project costs and benefits.

2.7. Overall evaluation of the project, including environmental impact study.

2.8. Recommendation.

② JWS  
M/H

## V. Study Schedule

The Study will be executed in accordance with the attached tentative work schedule.

## VI. Reports

JICA shall prepare and submit the following reports to the Government of Ecuador.

### 1. Inception Report

Ten (10) copies in Spanish at the commencement of the Phase I field work.

### 2. Progress Report (I)

Ten (10) copies in Spanish at the end of the Phase I field work.

### 3. Interim Report

Ten (10) copies in Spanish at the commencement of the Phase II field work.

### 4. Progress Report (II)

Ten (10) copies in Spanish at the end of the Phase II field work.

### 5. Draft Final Report

Ten (10) copies in Spanish at the end of the Phase II home office work. The Government of Ecuador shall provide its comments on the Draft Final Report to JICA within one (1) month after the receipt of the Draft Final Report.

### 6. Final Report

Twenty (20) copies in Spanish and in English (only Main Report) within two (2) months after the receipt of the comments of the Government of Ecuador on the Draft Final Report. In case any doubt

arises in interpretation, the English text shall prevail.

VII. Undertaking of the Government of Ecuador

1. To facilitate a smooth conduct of the Study, the Government of Ecuador shall take necessary measures:

- (1) to secure the safety of the Japanese study team (hereinafter referred to as "the Team");
- (2) to permit the members of the Team to enter, leave and sojourn in Ecuador for the duration of their assignment therein, and exempt them from foreign registration requirements and consular fees;
- (3) to exempt the members of the Team from taxes, duties and any other charges on equipments, machinery and other materials brought into Ecuador for the implementation of the Study;
- (4) to exempt the members of the Team from income tax and other charges of any kind imposed on or in connection with any emoluments or allowances paid to the members of the Team for their services in connection with the implementation of the Study;
- (5) to provide necessary facilities to the Team for remittance as well as utilization of the funds introduced into Ecuador from Japan in connection with the implementation of the Study;
- (6) to secure permission for entry into private properties or restricted areas for the implementation of the Study;
- (7) to secure permission for the Team to take all data and documents (including photographs and maps) related to the Study out of Ecuador to Japan;
- (8) to provide medical services as needed. Its expenses will be chargeable on the members of the Team.

2. The Government of Ecuador shall bear claims, if any arises, against the members of the Team resulting from, occurring in the course of, or otherwise connected with, the discharge of their duties in the implementation of the Study, except when such claims arise from gross negligence or willful misconduct on the part of the members of the Team.

*Handwritten initials:*  
D. J. B.  
M. H.

3. Ecuadorian Institute of Water Resources (hereinafter referred to as "INERHI") shall act as counterpart agency to the Team and also as coordinating body in relation with other governmental and non-governmental organizations concerned for the smooth implementation of the Study.
4. INERHI shall, at its own expense, provide the Team with the followings, in cooperation with other organization concerned:
  - (1) available data and information (including photographs and maps) related to the Study;
  - (2) counterpart personnel;
  - (3) suitable office spaces with necessary equipments in the study area and
  - (4) credentials or identification cards.

#### VIII. Undertaking of JICA

For the implementation of the Study, JICA shall take the following measures:

1. to dispatch, at its own expense, the Team to Ecuador and
2. to pursue technology transfer to Ecuadorian counterpart personnel in the course of the Study.

#### IX. Consultation

JICA and INERHI shall consult with each other in respect of any matter that may arise from, or in connection with the Study.

#### X. Translation

The Scope of Work is prepared in both Spanish and English. In case any doubt arises in interpretation, the English text shall prevail.

*Q* *BDS*  
*M/10*

TENTATIVE SCHEDULE

Month	Month in order																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
Work in Ecuador	[ ]			[ ]											[ ]							
Topographic Mapping	[ ]																					
Work in Japan	[ ]	[ ]			[ ]										[ ]							
Reports	Δ	Δ						Δ						Δ	Δ				Δ	Δ		
	IC/R	P/R(I)						IT/R						P/R(II)	DF/R	F/R						
Phase	←----- Phase I -----→							←----- Phase II -----→														

Remarks

IC/R: Inception Report

IT/R: Interim Report

DF/R: Draft Final Report

P/R(I) :Progress Report(I)

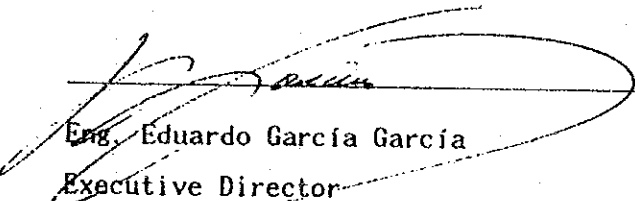
P/R(II):Progress Report(II)

F/R :Final Report

*Handwritten notes:*  
 2/28  
 12/2

MINUTES OF MEETING  
OF  
THE SCOPE OF WORK FOR THE FEASIBILITY STUDY  
ON  
THE TUMBABIRO IRRIGATION PROJECT  
IN  
THE REPUBLIC OF ECUADOR

Quito,  
April 16, 1992



Eng. Eduardo García García  
Executive Director  
Ecuadorian Institute  
of Water Resources  
"INERHI"  
Republic of Ecuador

田村 亮  
Eng. Akira Tamura  
Leader  
Preparatory Study Team,  
Japan International  
Cooperation Agency  
"JICA"

9/12 JWB

In response to the request of the Government of the Republic of Ecuador (hereinafter referred to as "the Government of Ecuador"), the Government of Japan dispatched a preparatory study team for the Feasibility Study on the Tumbabiro Irrigation Project in the Republic of Ecuador (hereinafter referred to as "the Study"), from the 08 to the 21 of April, 1992, through the Japan International Cooperation Agency (hereinafter referred to as "JICA"), official Agency responsible for the Government of Japan.

The preparatory Study Team headed by Eng. Akira Tamura, Director of Agricultural Water Administration Office of the Ministry of Agriculture, Forestry and Fisheries and officials concerned of the Government of Ecuador headed by Eng. Eduardo García García, Executive Director of Ecuadorian Institute of Water Resources (hereinafter referred to as "INERHI"), had a series of discussions and exchanged their views on the Scope of Work for the Study prepared by both sides through collecting first-hand information regarding the project.

As a result of the discussion, both sides mutually agreed on the Scope of Work and the salient results are as follows:

1. "The Tumbabiro district" in the Scope of Work as the Study Area contains Urcuqui, Tumbabiro, San Blas and Imantag zones.  
Total surface is about 10,000 hectares.
2. Both sides confirmed that INERHI will provide office necessary for the Study in Quito city and Ibarra city.
3. INERHI requested that technical training in Japan be given to the counterpart personnel of the Study. Japanese side took note of such request.
4. INERHI requested that the following equipment necessary for the Study will be procured by JICA and donated to INERHI after the termination of the Study. Japanese side took note of such request.
  - Four wheel drive vehicles
  - Micro computer
  - Copy machine
  - Copy machine (blue print)
  - Meteorology equipment
  - Hydrology equipment

La lista de asistentes es la siguiente:

[REPUBLICA DEL ECUADOR]

Ing. Eduardo García García	Director Ejecutivo, INERHI
Ing. Washington Terán	Director Técnico, INERHI
Ing. Gonzalo Navarrete	Director de Estudios, INERHI
Ing. Bolivar Muños	Programas Internacionales, INERHI
Ing. Angel Cárdenas	Jefe de Proyecto, INERHI

[EQUIPO DEL ESTUDIO PREPARATORIO DE JICA]

Ing. Akira Tamura	Líder del Equipo
Ing. Yoshio Tokura	Encargado de Agricultura
Ing. Kenshoo Ohsawa	Encargado de Irrigación y Drenaje
Ing. Tadao Ito	Coordinador
Lic. Harushi Kobayashi	Traductor

[EXPERTO DE JICA EN INERHI]

Ing. Korefumi Amano

[EMBAJADA DEL JAPON]

Ing. Tokurou Masudome                      Segundo Secretrio

*MH*  
*JEB*



A.2

***MEMBER LISTS OF ADVISORY TEAM,  
STUDY TEAM AND ECUADORIAN  
OFFICIALS CONCERNED***

**MEMBER LIST OF ADVISORY TEAM**

<b>COORDINADOR GENERAL</b>	<b><i>AKIRA TAMURA</i></b>	Director General, Departamento de Planificación, Oficina Administrativa Regional de Agricultura de Kanto, Ministerio de Agricultura, Silvicultura y Pesquería (MASP)
<b>MIEMBRO</b>	<b><i>TSUNEO MATSUTOMI</i></b>	Sub-Director, División de Diseño, Departamento de Construcción, Agencia de Mejoramiento de Estructura Agrícola, MASP
<b>MIEMBRO</b>	<b><i>KENSHU OHSAWA</i></b>	Especialista en Cooperación Técnica Internacional, División de Cooperación Internacional, Departamento Internacional, Agencia de Economía, MASP
<b>MIEMBRO</b>	<b><i>YOSHIO TOKURA</i></b>	Sub-Director, División de Asuntos Generales, Secretaría de Ministro, MASP

**STUDY TEAM AND ECUADORIAN OFFICIALS CONCERNED**

	<b>EQUIPO DEL ESTUDIO DE JAPON</b>	<b>CONTRAPARTE DE ECUADOR</b>
JEFE DEL EQUIPO/ COORDINACION Y MANEJO	<i>MASAHITO YAMANAKA</i>	<i>GONZALO NAVARRETE B. BOLIVAR MUÑOZ R. ANGEL CARDENAS C.</i>
SUB-JEFE DEL EQUIPO/ RIEGO Y DRENAJE	<i>TAKAHISA ISOZUKA</i>	<i>PEDRO LOYO</i>
INSTALACIONES/ SUPERVISION DE LEVANTAMIENTOS	<i>KAZUNARI NAGATA</i>	<i>PEDRO LOYO MIGUEL MONTALUISA</i>
RECURSOS HIDRAULICOS	<i>TSUNEO KUDO</i>	<i>CARLOS AGUILAR RAMIRO GOMEZ</i>
GEOLOGIA	<i>TERUO TAHARA</i>	<i>MILTON NONO GUILLERMO BELTRAN</i>
AGRICULTURA	<i>MICHIAKI HOSONO</i>	<i>MIGUEL CANTOS</i>
MEDIO AMBIENTE	<i>YASUO KATO</i>	<i>RAMIRO NAVAS MARGARITA ESPINOZA</i>
ECONOMIA AGRICOLA/ EVALUACION DEL PROYECTO	<i>YOSHIHIRO UCHIDA</i>	<i>MARGARITA ESPINOZA JORGE PINTO</i>
DISEÑO/ESTIMACION DE COSTOS	<i>HIRONORI HONMA</i>	<i>MARIO PALACIOS</i>



JICA