DEVELOPMENT OF THE FLOODPLAINS IN THE GUAYAS RIVER BASIN EN ECUADOR

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Each 100 hectares unit would require a loan of 2.2 millions sucres which would be repaid in 10 years from the additional rice production.

All the internal farm level drainage and irrigation systems would be provided for this loan together with the necessary machinery. Operating costs include the services of professional rice production specialists. Additional public investment would be required only for the principal irrigation and drainage canals which should be planned to utilize and complement the farm level investment in so far as possible at a minimum cost. By the eleventh year the additional output generated from 22,500 hectares would be more than the national average production between 1970 and 1975.

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People familiar with Asia's best rice land are dismayed at the poor use of the tropical lowlands of Latin America. The apparent reason is that almost all transfer of technology has been from the mechanized less labor intensive temperate zones of Europe, North America, and Latin America to the American tropics, while there has been very little transfer of modern labor intensive Asian Technology. Ecuador is an exception in the Daule area where intensive rice production with irrigation, soil puddling and transplanting are practiced by many small farmers with good results. The level of technology in the Daule area can still be raised by careful selection and local adaptation of the best technology from Asia. This same locally adapted technology can also be used to develop other nearby areas in Ecuador.

In the rainy season of 1972, the National Rice Program, in Ecuador, made a survey of the area sown in rice. A total of 55,061 hectares were sown during the rainy season of which 30,450 were in the Providence of Guayas. In general a low level of technology was utilized which resulted in low yields with an average of 2,625 kg/ha. The soil was well prepared in only 5.3 percent of the area, while 58.7 percent was partially prepared, and 35.9 percent was not prepared mechanically. Manual methods of sowing were used on 84.5 percent of the area sown os which 62.2 percent was traditional by "espeque" or pointed stick and 22.3 percent was transplanted. Nitrogen fertilizers were used in only 31.4 percent of the area sown and complete fertilizer in only 13.6 percent of the total area. Insecticides and herbicides were used in about 40 percent of the area sown. Only 19.9

rural labor to the urban areas where unemployment or underemployment is chronic. The available capital investment would be best used in providing more small producers with a clear land title, and means to prepare the land and to control the water to shallow depth by drainage during the rainy season, and irrigation during the dry season.

A clear land title can be obtained most rapidly and with a minimum of social unrest by direct purchase for cash at reasonable prices. Land preparation and water control are possible through the careful selection and full utilization of tractors and accessories such as rototillers, harrows, and pumps.

Significant opportunities exist in the Guayas basin for the use of low protective levees and low lift pumps powered by a tractor to control flooding during the rainy season and to provide irrigation during the dry season. The tractor can pump water at night and be available for land preparation and transportation during the day. Experience at CIAT in Colombia indicates that one 60 to 80 horsepower rated tractor can provide services for about 80 to 100 hectares. The most difficult period is during the first two crops when extensive land leveling is necessary. The use of two operators to utilize the tractor 60 to 80 hours per week may be necessary during the initial two crops.

A minimum project area of about 80 to 100 hectares is suggested by the standard 60 to 80 horsepower unit presently available in Ecuador. Also in order to better apply modern technology a large operational unit and specialized labor is preferable. The policy of establishment of cooperatives in Ecuador makes larger units of operation possible and preferable from

the view point of water control, equipment usage, specialized labor, loans, purchases, storage, processing, marketing, schools, roads, health centers, churches, potable water and sewage, electrification, mail services, etc.

One standard tractor equivalent to the Ford 5000 is suggested to prepare for weekly plantings of about 5 hectares of rice and still provide services for pumping at night and transportation of rice, fertilizers, and heavy materials. A total area of about 100 hectares would permit about 85 hectares of rice land after allowing for roads, drains, levees, canals and housing sites. A land preparation and planting cycle of 17 weeks at five hectares per week would fully utilize the tractor and the 85 hectares of rice land.

During the rainy season harvesting and drying of the rice crop is costly and risky. Planting cycles to avoid harvest through January to April seems advisable. In the Babahoyo project, land preparation is at the end of the dry season with direct seeding in a short period of time during January to avoid harvesting during the rainy season, but this approach provides a minimum of employment during the rainy season and an excessive labor or machinery requirement for harvesting during May. Followed by other peaks of land preparation and harvest in September and October.

A second approach is suggested for consideration and trial in order to provide stable employment, attractive incomes and a weekly work load as uniform as possible throughout the year. Planting weekly during about 17 weeks of the rainy season seems to be advisable to spread the harvest season over a 17 week period starting in May. The labor used for the

rainy season planting could then be transferred to harvesting from May through December. Manual harvesting requires about the same labor as transplanting, thus the area could be transplanted during the rainy season as necessary and direct seeded during the dry season. Transplanting would probably be necessary for many but not all areas during the rainy season where the precision water control for direct seeding is not reliable. Broadcasting of pregerminated seed will be reliable for part of the rainy season and for all of the dry season from May to September which will coincide with the first harvest season. Since broadcasting pregerminated seeds requires only about one man day per hectare while growing seedling and transplanting requires about 30 man days per hectare, the change over in planting methods would thus release the 30 man day per hectare labor needed for harvest. Other labor would be necessary for irrigation, application of fertilizers, pesticides, hauling, etc. The total number of members of a minimum size cooperative and their specialization is estimated as follows:

1. Area to be planted each week for 17 weeks periods January-April and May-August	5.0 ha
2. Labor requirements	
a. Transplanters January-April and harvesters May-December (Note: these may be mem and women over a wide age group to utilize family labor)	30
b. Irrigators and men to build, repair, and clean levees, drains, canals, etc. and also manually weed rice crop	8
c. Men to precision broadcast fertilizers, and seed and to broadcast or spray pesticides and assist in manually weeding rice	4
d. General labor for transportation, cleaning, drying, construction and misc.	4
e. Tractor driver-mechanic for operation and maintenance of equipment	2
f. General manager chosen by members for purchases, sales, and record keeping as necessary	1
g. Agronomist (one day per week technical advice)	1
Total members	50

Area per cooperative member 2.0 hectares gross with two crops of 1.7 hectares of rice per year for a total of 3.4 hectares per member per year.

Initial capital cost of the cooperative is estimated as follows:

1.	Land purchase - 100 hectares of land at 2,500 sucres per hectare including survey and legal title	S/. 250,000
2.	Buildings - 200 square meters of covered and enclosed area for general use as storage, repair shop, and a small office	150,000
3.	Earth movement for construction of productive levees, drains, roadbed and irrigation canals within the 100 hectare area. Estimated as 30,000 cubic meters at 20 sucres per m^3	600,000
4.	Road ballast to place on roadbed for all weather access. Estimated 4000 linear meters with 3 meter wide surface to require 2000 cubic meters of ballast at 50 sucres per m^3	100,000
5.	Machinery	
	1 - Ford 5000 tractor or equivalent with 23.1" x 26" rice and cane tires	375,000
	1 - Malleti 200 cm wide rototiller or equivalent	100,000
	1 - Levee maker attachment to rototiller	15,000
	1 - Blade attachment to rototiller	15,000
	1 - Three point mounted heavy duty grader blade	15,000
	1 - Spike tooth harrow	15,000
	1 - Low lift high volume propeller pump for drainage and irrigation	100,000
	2 - Trailers of 5-ton capacity	50,000
	1 - Seed cleaner of 1 ton per hour capacity	25,000
	20 - Portable threshers	25,000
	1 - Set of mechanics tools, grease gun, and lubricating equipment	25,000
	Spare parts and miscellaneous small equipment	40,000
	Subtotal machinery	800,000
6.	Other capital costs unforseen	100,000
7.	Technical assistance on engineering, agronomy and administration for first two years for development of project	200,000
	Grand total capital cost	2,200,000
	Capital per cooperative member	44,000

Annual amortization of capital is estimated as follows:

Item	Payment period years	Annual interest percent	Original loan sucres	Annual interest and amortization sucres
Land	10	10	250,000	40,686
Buildings	10	10	150,000	24,412
Earth movement	10	10	600,000	97,464
Road ballast	10	10	100,000	16,274
Machinery 1/	4	10	800,000	252,377
Miscellaneous	10	10	300,000	48,822
			2,200,000	480,035

1/ Every four years a new machinery loan is required to purchase new equipment. Old equipment is kept to use in case of emergencies or sold and used to buy additional equipment not listed. Depreciation and interest is charged as an operating cost for machinery.

Indirect and direct costs for machinery, materials and transport are estimated as follows when in full operation planting 200 hectares per year:

A.	INDIRECT COSTS		S/. 600,000
	1. Interest and depreciation on machinery	S/. 252,377	
	2. Amortization and interest on capital except for machinery for first 10 years	227,658	
	3. Average on operating capital is 1/2 x 1,200,000 x 1/2 x 0.10	30,000	
	4. Administrative insurance, accounting, legal services, fees and supplies	50,000	
	5. Unforeseen	39,965	

B. DIRECT COSTS

1.	Machinery		S/. 250,000
	a. Fuel cost for 75 rated horsepower tractor used at 75 percent of rated load for 2500 hours per year = 75 Hp x 75 x 2500 hours x 0.064 gallon/Hp hr x 5 sucres/gallon	S/. 45,000	
	b. Lubricants = about 10 percent of fuel cost	5,000	
	c. Repairs = 25% original cost per year	200,000	
2.	Materials cost		950,000
	a. Seed - 100 kg/ha x 170 ha x 10 sucres/kg	170,000	
	b. Herbicides		
	8 liters/ha Propanil x 100 sucres/ liter x 170 ha	136,000	
	2 liters/ha MCPA x 90 sucres/liter x 170 ha	30,600	
	c. Fertilizers		
	200 kg/ha Urea x 5.10 sucres/kg x 170 ha	173,400	
	d. Insecticides		
	2 kg/ha Dipterex x 195 sucres/kg x 170 ha	66,300	
	200 kg Furadan x 40 sucres/kg x 170 ha	136,000	
3.	Transportation cost 60 sacks/ha x 10 sucres/sack x 170 ha	102,000	
4.	Miscellaneous supplies and services	135,700	
	Total direct costs		S/. 1,200,000
	Total costs except administration and labor of the 50 members of the cooperative		S/. 1,800,000

Production sales, and income of the cooperative will vary with area planted, yields per unit area and sales price. The first two years will be the most difficult since the land development will not be completed enough to give complete protection and maximum yields. Also, the cooperative members and technical personnel will still lack experience in how to best utilize the resources available. After the second year the rice yields should average 5,400 kilograms per hectare over the two crops of 85 hectares for a total of 918 tons per year for the cooperative. At a sales price of 4,000 sucres per ton the gross income would be 3,672,000 sucres per year. After paying the 1.2 million sucres direct operating cost plus the 0.6 million sucres indirect costs there would be an estimated 1,872,000 sucres for an income of 37,440 sucres per cooperative member. The cooperative would also have an amortization of the capital in land and infrastructure which would be small for the first few years but would probably average about S/. 3,000 per year per member.

The income and amortization accumulated by the cooperative can be utilized for additional loans to pay for housing, electricity, health care, potable water, schools, etc. as the cooperative becomes better developed and organized. However, the initial investment and cooperative efforts should be to best utilize the labor, land, and capital available to create production and income. Rapid repayment of the loan should be an objective to permit other rural producers to benefit from similar projects with the overall intention to rapidly develop additional areas of the Guayas Basin and to increase the total rice production and rural income significantly.

The technology is available to increase the small rice farm family income on an average of two hectares of land per family with a low capital investment and rapid repayment of the capital with interest. This is a strong statement which deserves a thorough testing before acceptance and promotion on a large scale. The technology must first be validated and adapted to Ecuadorian conditions on several small pilot projects. These small pilot projects would train agronomists, engineers, economists, technicians, and farmers in a region while detailed studies were being made on how to implement a larger project.

For simplicity and round units of estimate it is suggested that five pilot units of 100 hectares each be established to validate and adapt labor and land intensive rice technology. It is further suggested that these units be located in the central area of the Guayas Basin between the Puntilla at the bridges over the Guayas and the village of Juan Bautista Aguirre on the Rio Tinto near Salitre. The new highway that has opened up this area provides a protective levee on one side. The area seems to represent a large area of over 10,000 ha of level land subject to easy water control at a minimum capital cost. Land prices are low and the land is poorly utilized. Further studies on the site will be necessary before a final project proposal can be made however guidelines are given in this report as a basis for a preliminary proposal subject to revision by CEDEGE and others.

One engineer with experience in irrigation, machinery, land development and rice production should be contracted to initiate and guide five pilot projects for the first two years with the assistance of five young Ecuadorian agricultural engineers and agronomists. At the end of two years at least

Development of land area, cooperative members and professionals, and additional production

Year	Professionals		Non-professional cooperative members	Hectares area developed	Anticipated yield increase [a]	Additional production (Paddy)	Additional production as a percentage of national output 1970-1975 [b]
	Senior	Junior					
					ton/ha	tons	%
1	1	5	245	250	7.5	1,875	0.9
2	1	5	245	500	7.5	3,750	1.8
3	1 + 2	10	735	1,000	7.5	7,500	3.6
4	1 + 2	10	735	1,500	7.5	11,250	5.4
5	3 + 4	20	1,715	2,500	7.5	18.750	9.0
6	3 + 4	20	1,715	3,500	7.5	26,250	12.6
7	7 + 8	40	3,675	5,500	7.5	41,250	19.8
8	7 + 8	40	3,675	7,500	7.5	56,250	27.0
9	15 + 16	80	7,595	11,500	7.5	86,250	41.5
10	15 + 16	80	7,595	15,500	7.5	116,250	55.6
11	31 + 32	160	15,435	23,500	10.0	235,000	113.0
12	31 + 32	160	15,435	31,500	10.0	315,000	151.4
13	63 + 64	320	31,115	47,500	10.0	475,000	228,4
14	63 + 64	320	31,115	63,500	10.0	635,000	305.3
15 [c]	127 + 128	640	62,475	95,500	10.0	955,000	459.1
16	127 + 128	640	62,475	127,500	10.0	1,275,000	613.0
17	255 + 128	640	93,835	159,500	10.0	1,595,000	766.8
18	255 + 128	640	93,835	191,500	10.0	1,915,000	920.7
19	383 + 128	640	125,195	223,500	10.0	2,235,000	1,074.5
20	383 + 128	640	125,195	255,500	10.0	2,555,000	1,228.4

[a] Assumes that the land incorporated during the first ten years has a present yield of 2.5 ton/ha. Before 10 years, new lands would be incorporated.

[b] Average annual national production between 1970 and 1975 was about 208,000 tons paddy.

[c] From 15 to 20 years the rate of development is 32,000 hectares per year.

professional staff than could likely be meet. Some immediate increase may be possible from the application of improved seeds, inputs and better water control to existing rice areas which at present produce one crop per year.

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Financial Appendix

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FINANCIAL APPENDIX

The purpose of this appendix is to extend some aspects of the financial analysis presented in the report entitled "Development of the Floodplains in the Guayas River Basin in Ecuador" by Grant M. Scobie and Loyd Johnson, CIAT, July 1, 1976.

Table 1: An extension of the budget analysis, showing annual incomes and costs in detail, for a unit of 100 hectares. In the last row, we present net incomes per member after amortization of the loan. During the first 2 years there are 600, 000 sucres available for land development; a part of these funds may be used as payment to the members of the cooperative who will perform manual labor involved. Beyond the 5th year, net income per member is 34, 000 sucres per year, which by far exceeds the gross income of 11, 505 sucres in 1971 for farms between 0-5 hectares in the sub-zone 3-A. A part of the members' net incomes may be capitalized for the construction of social facilities (e.g. housing).

Table 2: Benefits and costs of a 100 hectares unit are summarized on the basis of table 1. These values have been discounted at 10 per cent in order to calculate the benefit-cost ratio. The net cash flow was used in order to compute the internal rate of return.

Table 3: Annual debit balances of the totality of the project loans are presented. These figures show the amount of funds that the bank has lent each year, and the amortization of the total loans required for the project.

APPENDIX TABLE 1

DETAILED FINANCIAL PLAN FOR 100 HECTARES

Sucres

Year	1		2		3 - 4 [c]	5 - 10	11 and following
Semester	A	B	A	B			
Area (has) [a]	85	85	85	85			
Yields (t/ha)	2.6	3.3	3.8	4.5	5.4	5.4	5.4
Production (t)	221	281	323	383	918	918	918
Semestral gross income	884,000	1,124,000	1,292,000	1,532,000			
Annual gross income [b]	2,008,000		2,824,000		3,672,000	3,672,000	3,672,000
INDIRECT COSTS							
Sinking fund [e]	172,376		172,376		172,376	172,376	172,376
Interest working capital	15,286		25,602		30,000	30,000	30,000
Administration	50,000		50,000		50,000	50,000	50,000
Unforeseen	40,000		40,000		40,000	40,000	40,000
Total	277,662		287,978		292,376	292,376	292,376
DIRECT COSTS							
Machinery	125,000	125,000	125,000	125,000	250,000	250,000	250,000
Materials	85,000	85,000	280,000	280,000	950,000	950,000	950,000
Transport	24,555	31,167	35,889	42,500	102,000	103,000	102,000
Others	67,850	67,850	67,850	67,850	135,700	135,700	135,700
Total annual direct costs	611,422		1,024,089		1,437,700	1,437,700	1,437,700
ANNUAL NET INCOME [d]	1,118,916		1,511,933		1,941,924	1,941,924	1,941,924
Loan amortization	480,035		480,035		480,035	227,658 [f]	0
Net income after the amortization	638,881		1,031,898		1,461,889	1,714,266	1,941,924
Net income per member	12,778		20,638		29,238	34,285	38,838

a. Of 100 hectares, 85 hectares are effectively utilized.

b. The annual data is equal to the total value for the two semesters.

c. From the 3rd year on the semestral data are equal, and the annual data has been taken.

d. The net annual income is equal to the annual gross income less the total annual direct and indirect costs.

e. The total annual value needed for replacing machinery every four years.

f. In the 5th to 10th years the amortization is decreased because the loan period for machinery is only 4 years.

APPENDIX TABLE 2

COMPARISON OF GROSS BENEFITS AND COSTS OF A 100 HECTARES UNIT

Millions sucres

Capital Required	Indirect Costs [a]	Direct Costs [a]	Salaries [b]	Gross Incomes [a]	Net cash Flow
2.2	0.3	0.6	0.8	2.0	-1.9
0	0.3	1.0	0.8	2.8	0.7
0	0.3	1.4	0.8	3.7	1.2
0	0.3	1.4	0.8	3.7	1.2
0	0.3	1.4	0.8	3.7	1.2
0	0.3	1.4	0.8	3.7	1.2
0	0.3	1.4	0.8	3.7	1.2
0	0.3	1.4	0.8	3.7	1.2
0	0.3	1.4	0.8	3.7	1.2
0	0.3	1.4	0.8	3.7	1.2

Taken from Table 2.

The salary is 60 sucres/day, 260 days/year, 50 members.

Beyond the 10th year the capitalized value was utilized, $\left(\frac{\text{Quantity}}{\text{Rate of discount}}\right)$, in this case $\frac{\text{Quantity}}{0.10}$.

-cost ratio at 10% = 1.34:1
l rate of return = 42%
esent value at 10% = 8.65 millions sucres

APPENDIX TABLE 3

ANNUAL DEBIT BALANCES OF THE TOTALITY OF THE PROJECT LOANS

Millions sucres

Year	Last balance	Loan [a]	Balance before amortization [b]	Amortization [c]	Balance [d]
1		11	12.1	2.4	9.7
2	9.7	0	10.7	2.4	8.3
3	8.3	22	33.3	7.2	26.1
4	26.1	22	28.74	7.2	26.1
5	21.54	44	72.1	15.54	56.56
6	56.56	0	62.2	15.54	46.67
7	46.67	88	148.13	32.22	115.92
8	115.92	0	127.51	32.22	95.29
9	95.29	176	298.42	65.58	232.84
10	232.84	0	256.12	65.58	190.54
11	190.54	352	596.80	131.16	465.64
12	465.64	0	512.20	131.16	381.03
13	381.03	704	1,193.54	262.32	931.22
14	931.22	0	1,024.35	262.32	762.03
15	762.03	1,408	2,387.03	524.64	1,862.38
16	1,862.38	0	2,048.63	524.64	1,523.98
17	1,523.98	1,408	3,225.18	742.08	2,483.11
18	2,483.11	0	2,731.41	742.08	1,989.33
19	1,989.33	1,408	3,737.06	869.76	2,867.31
20	2,867.31	0	3,154.04	869.76	2,284.28
21	2,884.28	0	2,512.70	672.0	1,840.71
22	1,840.71	0	2,024.78	672.0	1,352.78
23	1,352.78	0	1,488.05	437.76	1,050.29
24	1,050.29	0	1,155.33	437.76	717.57
25	717.57	0	789.32	291.84	497.48
26	497.48	0	547.23	291.84	255.39
27	255.39	0	280.93	145.92	135.01
28	135.01	0	148.51	145.92	000.00 [e]
29 and following	0.00	0	0.00	0.00	0.00

a. Based on an investment of 2.2 millions per each 100 hectares unit.

b. The balance before amortization is equal to the last balance, plus new loans, plus interest.

c. The amortization includes: interest (10% per year) and loan repayment. The loan for all capital, except for machinery, is paid over 10 years. The initial loan for machinery is paid in 4 years, at an annual rate of 10%; after this initial period, a sinking fund is used for replacing machinery, which is included in the indirect costs.

d. The balances are equal to the balances before amortization less amortization value.

e. The results are not exactly zero, due to rounding errors.