THE VISAYAS COMMUNAL IRRIGATION PROJECT

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ABSTRACT

This paper deals with the feasibility of a communal irrigation project in the Philippines where the farmer beneficiaries pay for the infrastructure cost and are responsible for the operating and maintenance cost of the irrigation system. A financial analysis from the investment, equity, and budget points of view and an economic evaluation are conducted on the incremental benefits of the project. Sensitivity and risk analyses are made to determine the variables that have high impact on the project's net present value. The analyses show that the project is very sensitive to the incremental palay production. The NPV from the investment point of view has a 15% chance of being negative. These points to the importance of the project components that address the constraints to higher farm productivity such as limited technology transfer, unavailability of high yielding variety seeds, lack of applied research, poor water management, inadequate farmer training and large post-harvest losses. The NPV from the equity and economic points of view are very robust and they do not have a chance of being negative. The former is due to the subsidy given to the farmer beneficiaries while the latter is the result of the high economic value of palay. Aside from the farmers the other major beneficiary of the project is the landowners who lease their farms because they get 25% of the gross value of production as lease payment.

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Key words: communal irrigation, integrated investment appraisal, palay cultivation, Visayas, Philippines

FARMER PARTICIPATION, A KEY INPUT TO SUCCESS: THE VISAYAS COMMUNAL IRRIGATION PROJECT

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LIST OF ABBREVIATIONS USED

CIS	Communal Irrigation Systems
DA	Department of Agriculture
DAR	Department of Agrarian Reform
GOP	Government of the Philippines
IA	Irrigators Association
IFAD	International Fund for Agricultural Development
NGO	Non-Governmental Organization
NIA	National Irrigation Association
O&M	Operating and Maintenance

I. INTRODUCTION

The Visayas Communal Irrigation Project is located in the Visayas region of the Philippines. Visayas is one of the three main island groupings in the Philippines and it includes the provinces of Negros Occidental, Capiz, Aklan in Region VI (Western Visayas); Negros Oriental, Cebu and Bohol in Region VII (Central Visayas); and Leyte and Samar in Region VIII (Eastern Visayas) which are the project's target areas (Figure 1).

The location of the project in the Visayas is primarily due to the fact that its regions have one of the most economically depressed areas of the country. Visayan regions have one of the highest incidences of poverty in the country (Table 1).

Most rural households depend upon very small plots of land for their livelihood. In the project area, the average farm holding size is only .85 hectare compared to the national average of 2.9 hectares. The productivity and sustainability of these small farms is threatened by adverse natural condition (e.g. typhoons) and floods that arise as a result of denuded watersheds. Many also suffer from a lack of access to support services such as trading facilities, welfare services and government agencies. However, the area has numerous sites suitable for small scale irrigation. Communal irrigation schemes represent one of the few ways of capitalizing upon the land resource and of raising substantially the living standards of the rural people.

TABLE 1
RURAL FAMILIES BELOW POVERTY THRESHOLD BY REGION, 1985

Rural Families below Poverty Threshold

Regions	Number ('000)	Percentage, %
Bicol	405.6	76.4
Western Visayas	487.2	76.3
Central Visayas	397.0	74.1
Eastern V	314.6	70.4
Central Mindanao	235.1	65.5
Northern Mindanao	272.2	65.0
Western Mindanao	264.6	63.6
Southern Mindanao	276.1	60.2
Southern Tagalog	475.2	58.4
Cagayan Valley	224.6	56.7
Ilocos	277.2	50.6
Central Luzon	238.2	42.8

Source: Agricultural Indicators System, 1991, p.64 Bureau of Agricultural Statistics Department of Agriculture, Philippines

II. PHILIPPINE IRRIGATION

In the Philippines, irrigation systems are generally categorized into three types: national, communal, and private. National systems are owned by the government while the communal and private systems are owned by groups and individual farmers respectively. As of 1986, national systems covered 595,000 hectares while communal and private systems covered 640,000 and 220,000 hectares respectively.[1]

The National Irrigation Administration (NIA) is the government agency responsible for irrigation in the Philippines. It plans, constructs, operates and maintains national systems; extends financial and technical assistance to groups of farmers in the planning, construction, and management of communal systems; and when requested renders technical advice to private irrigation systems.

NIA was established in 1964 as a government corporation. Although NIA was a corporate organization, it functioned as a department system because its operation and maintenance costs were financed by a general appropriation of the government and not by its own resources. It remitted the irrigation fees it collected to the Treasury and its budget was appropriated by Congress.

A. Financial Arrangements

The formal financial arrangements specified at the time of NIA's formation, called for the farmers to pay both for the initial capital costs and recurrent operating and maintenance (O&M) expenses. The capital costs are to be amortized over a 50-year period at no interest. The NIA is

[1]Benjamin Bagadion, "Farmer Participation in Irrigation Management: The Philippine Experience," chapter in Farmer Participation and Irrigation Organization, Studies in Water Policy and Management No. 17. (Colorado, USA: Westview Press, Inc., 1990), 173.

supposed to charge an annual irrigation fee that, if entirely collected, would be great enough to the total O & M costs plus a portion of the capital investment cost. In practice, however, NIA's ability to collect has been weak, so that total collections amounted to only about 75% of O & M costs. The effect has been for the total capital costs and a portion of the O&M costs to be subsidized by the government.[2]

The de facto subsidy of the full capital costs of irrigation was generally accepted by the government. Investment decisions were made as part of an overall planning process with little or no direct concern over the levels of farmer payments for irrigation services.

B. Reforms

In the initial years NIA was plagued with poor performance and lack of viability of the irrigation systems it managed. In the national systems, only about 80% of the service area was irrigated during the wet season, and about 30% during the dry season.[3]

Farmers often complained of unsatisfactory service, distribution of water was generally inequitable, production was below expectation and irrigation fee collections were poor and totaled less than O&M expenses. In the communal irrigation systems, farmers were becoming more dependent on government and losing their initiative for self-reliant operation and maintenance of their irrigation systems.

In 1974, NIA's charter was amended with the end in view with transforming it into a financially autonomous agency with respect to its operation and maintenance activities. Under the arrangement, NIA was allowed to retain all the funds it collected from water users. The new

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[2]Leslie Small and Ian Carruthers, Farmers-Financed Irrigation: The Economics of Reform (Great Britain: Cambridge University Press, 1991), 106.

[3]Bagadion, 174-175.

financial arrangements gave NIA a much greater incentive to collect fees than had previously existed, and led to a considerable increase in the importance that it attached to this activity.

C. Development of Communal Irrigation Systems

Philippine government policy on assistance to communal systems, issued in 1975, provides construction assistance to communal associations in the form of subsidized loans. The associations are expected to pay back their loans within a period not exceeding 50 years. In addition, the associations have to provide a contribution or equity amounting to 10% of systems construction costs. The policy further requires that upon completion of construction, the system is to be turned over to the association.[4]

NIA encountered difficulties in implementing this policy conditions. However, when the association would not provide the required equity, NIA could not simply shut down the irrigation system when the association failed to remit their amortization payments.

In the 1980s the government, worried about how it would pay its mounting foreign debts, directed NIA to assume responsibility for the repayment of foreign loans for irrigation investments. In response to this policy and the dwindling government budgetary support NIA initiated measures to achieve financial viability. One of the measures undertaken was to make the water users more responsible for funding irrigation systems.

In the communal irrigation systems, the water users were made responsible for O&M costs and the repayment for the infrastructure component of the construction costs. The requirement for the repayment was implemented through contractual arrangements whereby the irrigators

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[4]Romana de los Reyes and Sylvia Jopillo, "An Evaluation of NIA's Participatory Communal Program", in Public Intervention in Farmer-Managed Irrigation Systems, (Colombo, Sri Lanka: International Management Institute, 1989), 104-105.

associations agree in writing to repay the costs that NIA incurs in their behalf. NIA found out that the irrigators associations (IAs) would sign such agreements only when they were given authority to monitor and control costs incurred by NIA.

II. PROJECT OBJECTIVES, COMPONENTS, AND TIMETABLE

A. Project Objectives and Components

The project seeks to provide for continuity and improvements in the implementation of the Philippines' ongoing communal irrigation development program, based on experience gained under previous small scale communal irrigation schemes. Communal irrigation systems (CIS) are usually small gravity systems with service areas of at least 40 but not more than 1000 hectares. They are traditional systems and rely on the active participation of the beneficiaries in all phases of their development. At present there are about 6200 CIS throughout the country with an average service area of 113 ha and serving a total of 715,000 ha or 48 percent of the total irrigated area.

An irrigators association (IA) rather than a government agency, owns, operates and maintains the facilities of most of CIS. When NIA is involved, its assistance takes the form of financial and technical assistance to the IAs in the planning and construction of the system and training in group organization and management. Farmers in the CIS are charged an irrigation fee within which they amortize the chargeable cost of the investment, excluding roads, drainage and some of the NIAs overhead costs.

The project would rehabilitate existing systems and construct new schemes in a set of rural locations where a high proportion of farm households live below the poverty threshold, thus contributing to the government's goals of poverty alleviation and food self-sufficiency. The project would also strengthen the implementation capacity of NIA and the capability of the IAs to fully participate in the design, construction and maintenance of irrigation facilities. The project targets to increase the incomes and welfare of about 11600 farm families both in the lowlands and uplands as a result of increased farm output. Finally, the project is designed to foster self-sustaining development by combining appropriate resource management and environmental conservation practices.

The proposed project would include the following components:

1. The rehabilitation of 55 existing (7700 ha) and construction of 25 new (3250 ha) communal irrigation systems including the provision of new access roads;

2. Watershed protection and erosion control surrounding selected irrigation areas and covering about 3500 ha.

3. the strengthening of IAs with particular emphasis on the development of mechanisms to improve system performance and maintenance, increased self-reliance through organizational development and rationalization and improvement of self-monitoring in order to make the system more cost effective and responsive to IAs' operational needs; and

4. the strengthening of agricultural support services with particular focus on the establishment of a network of supporting agricultural institutions, the provision of demonstration plots, improved access to farm inputs and strengthened cooperation among NIA, the Department of Agriculture (DA), and the Department of Agrarian Reform (DAR).

The component for watershed development and erosion control goes hand in hand with the irrigation component. The current survival strategies of the poor farmers in the upland areas of the Visayas, dictate unrestrained deforestation and degradation of the natural resource base through expansion of unsuitable cultivation in the watersheds to optimize short-term gains at the cost of long term sustainable development. The resulting soil loss through erosion causes downstream sedimentation of irrigation infrastructure, seriously reducing its economic life. The project would aim to change those elements of the production system that are not conservation oriented through a series of planned interventions and would foster an awareness among the beneficiaries of the dependency of such systems on the wider environment in order to make them self-sustaining and viable. The project would provide for village water development schemes to provide clean water to households in the watersheds. The farmers would also be provided with extension and training activities relating to reforestation, soil and water conservation and on-farm production systems.

The main activity under the component for the strengthening of the agricultural support services would be the strengthening of the agricultural extension services. This component would provide for the salaries and allowances of field staff, extension aids and materials for the establishment of a demand driven extension service. The component would also provide for a demonstration farm and applied research on new technological packages, seed production and post-harvest facilities. Farmers would also be provided with training in various aspects of crop production, water scheduling and preparation of agricultural plans.

B. Project Timetable

The project will be implemented over five years. The number of new and rehabilitated irrigation system undertaken each year and their corresponding areas are shown in Table 2.

TABLE 2
NUMBER AND HECTARAGE OF PROJECTS IMPLEMENTED

	(Year)				
	1	**2**	**3**	**4**	**5**
Number of Projects					
New Systems	2	7	7	6	3
Rehab. Systems	6	15	15	12	7
Hectare					
New Systems					
Annual	260	910	910	780	390
Cumulative	260	1,170	2,080	2,860	3,250
Rehab. Systems					
Annual	840	2,100	2,100	1,680	980
Cumulative	840	2,940	5,040	6,720	7,700
Total					
Annual	1,100	3,010	3,010	2,460	1,370
Cumulative	1,100	4,110	7,120	9,580	10,950

Source: International Fund for Agricultural Development (IFAD), Philippines, Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report, Working Paper 6, p.22.

IV. PROJECT COST ESTIMATES AND FINANCING

Total project costs, including physical and price contingencies, are estimated at about 441.20 million pesos (US$19.78 million), with a foreign exchange component of US$ 5.14 million (26%). A summarized breakdown of the total project cost is shown below in Table 3:

TABLE 3
PROJECT COSTS AND FINANCING

	US$M	PesosM
Project Costs		
Irrigation Construction and Rehabilitation	12.646	307.42
Watershed Management	1.317	32.02
Strengthening of Irrigators Association	.554	13.47
Strengthening of Agricultural Support Services	1.015	24.67
Institutional Support of NIA	2.244	54.55
Monitoring and Evaluation	.373	9.07
Total Baseline Costs	18.149	441.20
Physical Contingencies	1.630	39.63
Total Project Costs	**19.779**	**480.83**
Financing		
IFAD	15.100	367.08
Philippine Government	4.679	113.75
Total Financing	**19.779**	**480.83**

Source:IFAD, Philippines, Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report, Working Paper 6, p.22.

The project will be financed with a US$ 15.1 million loan from the International Fund for Agricultural Development (IFAD) which would cover all the foreign exchange components of the project. The remaining funding costs would be met by the Philippine government.

V. PROJECT'S SPECIFIC BENEFITS AND COSTS TO FARMER BENEFICIARIES

The project will enable the farmer beneficiaries who are presently only cultivating in the wet season to plant crops in the dry season. It will also increase the irrigation intensity of farmer beneficiaries who are presently constrained from limited irrigation water. These benefits for farms in both the new and rehabilitated systems in the four different climate regimes in the Visayas are shown in Tables 4 and 5.

TABLE 4
CROPPING AND IRRIGATION INTENSITY FOR FARMS IN THE NEW IRRIGATION SYSTEMS

	Percentage of Area Planted			
	Without Project		*with Project*	
	Wet Season	**Dry Season**	**Wet Season**	**Dry Season**
Climate Regime 1				
Rain fed paddy	100			
Irrigated paddy			100	50
Corn				25
Pulses				25
Climate Regime 2				
Rain fed paddy	100	25		
Irrigated paddy			100	50
Corn				25
Pules				25
Climate Regime 3				
Rain fed paddy	100			
Irrigated paddy			100	50
Corn				25
Pulses				25
Climate Regime 4				
Rain fed paddy	25			
Irrigated paddy			100	50
Corn	75	75		25
Pulses				25

Source:IFAD, Philippines, Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report, Working Paper 6, p.22.

TABLE 5
CROPPING AND IRRIGATION INTENSITY FOR FARMS IN THE REHABILITATED IRRIGATION SYSTEMS

	Percentage of Area Planted			
	Without Project		*with Project*	
	Wet Season	**Dry Season**	**Wet Season**	**Dry Season**
Climate Regime 1				
Rain fed paddy	75			
Irrigated paddy	25		100	50
Corn				25
Pulses				25
Climate Regime 2				
Rain fed paddy	75	25		
Irrigated paddy	25	25	100	50
Corn				25
Pules				25
Climate Regime 3				
Rain fed paddy	75			
Irrigated paddy	25	25	100	50
Corn				25
Pulses				25
Climate Regime 4				
Rain fed paddy				
Irrigated paddy	25	25	100	50
Corn	75	75		25
Pulses				25

Source:IFAD, Philippines, Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report, Working Paper 6, p.22.

Paddy yields in the three Visayas regions are generally below the national average reflecting the low level of technology and reliance upon rained crop production. Average paddy yields are 2.81 tons per hectare with average cropping intensity of one crop a year. Future paddy yields with the project have been projected to increase to about 3.75 tons per hectare based on increased inputs, especially fertilizer usage, improved seeds, technology and most of all through irrigation. Cropping intensities in the "with" project situation are estimated at two crops a year resulting into a total production of 5.75 to 6.00 tons per hectare. These yields are still below the potential yields of available early maturing, semi-dwarf varieties which have considerable resistance to diseases and which respond well to fertilizer applications. The lower yield estimate makes allowance for the occurrence of typhoons and the possibility that not all farmers will make the optimum use of inputs and the full range of farm management expertise.

The average incremental yields brought about by the project are shown in Table 6. It is assumed that the paddy incremental yield will only reach its maximum on the fourth crop year.

TABLE 6
AVERAGE INCREMENTAL YIELDS (TONS/HECTARE)

	2	**3**	**4**	**5-20**
New Irrigation Systems				
Paddy	3.40	3.58	3.74	3.88
Corn	-.19	-.19	-.19	-.19
Pulses	.20	.20	.20	.20
Paddy byproducts	.34	.36	.37	.39
Rehabilitated Irrigation Systems				
Paddy	2.48	2.66	2.82	2.95
Corn	-.19	-.19	-.19	-.19
Pulses	.20	.20	.20	.20
Paddy byproducts	.25	.27	.28	.30

Source of basic data: IFAD, Philippines, Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report, Working Paper 14, pp.1-5.

The projected yields can only be achieved through increased inputs and use of better technology. The projected average incremental inputs for the farms in the new and rehabilitated irrigation systems are shown in Tables 7 and 8 respectively.

TABLE 7
AVERAGE INCREMENTAL OPERATING INPUTS, NEW SYSTEMS
(Per Hectare)

	Year			
	2	**3**	**4**	**5-20**
Paddy Seed (kg)				
Own	-81.80	-81.80	-81.80	-81.81
Selected	60.74	60.74	60.74	60.74
Corn Seed (kg)	-2.52	-2.52	-2.52	-2.52
Pulse Seed (kg)	4.94	4.94	4.94	4.94
Urea (pesos)	98.47	98.47	98.47	98.47
NPK (pesos	320.11	320.11	320.11	320.11
Pesticides (pesos)	458.77	458.77	458.77	458.77
Herbicides (pesos)	301.51	301.51	301.51	301.51
Sacks (pc)	6.96	7.47	8.22	8.22
Contract/animals (pesos)	416.00	416.00	416.00	416.00
Contract/small equipmt (pesos)	29.48	29.48	29.48	29.48
Family labor (man-days)	99.05	99.05	99.05	99.05
Irrigations fee (canvas)	3.50	3.50	3.50	3.50

Source of basic data: IFAD, Philippines, Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report, Working Paper 14, pp. 6-9.

TABLE 8
AVERAGE INCREMENTAL OPERATING INPUTS, REHABILITATED SYSTEMS
(Per Hectare)

	Year			
	2	**3**	**4**	**5-20**
Paddy Seed (kg)				
Own	-87.00	-87.00	-87.00	-87.00
Selected	60.74	60.74	60.74	60.74
Corn Seed (kg)	-2.52	-2.52	-2.52	-2.52
Pulse Seed (kg)	4.94	4.94	4.94	4.94
Urea (pesos)	92.28	92.28	92.28	92.28
NPK (pesos)	270.16	270.16	270.16	270.16
Pesticides (pesos)	442.99	442.99	442.99	442.99
Herbicides (pesos)	301.51	301.51	301.51	301.51
Sacks (pc)	6.39	6.39	6.39	6.39
Contract/animals (pesos)	416.00	416.00		
Contract/small equipmt (pesos)	29.48	29.48	29.48	29.48
Family labor (man-days)	92.23	92.23	92.23	92.23
Irrigations fee (canvas)	2.00	2.00	2.00	2.00

Source of basic data: IFAD, Philippines, Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report, Working Paper 14, pp. 10-13.

VI. FINANCIAL EVALUATION

A. Assumptions

For the financial analysis, the incremental benefits and costs of the project from the investment and equity points of view are evaluated. The assumptions used in the calculation are shown in Annex 1, the Table of Parameters. The bases for some of these assumptions are the following:

1. *Palay prices*

Nominal palay prices have been increasing since 1972, with sharp increments from 1983 to 1985 (Annex 2). However, real palay prices declined from 1973 to 1983. The downtrend was arrested and real prices increased at an annual average rate of 1.6% from 1984 to 1990. The increase in the latter years was brought about by changes in government policy to remove the bias against the agricultural sector.

Future palay prices are expected to move with world prices as the agricultural sector is being liberalized. In this case, World Bank projections on rice prices are used as indicators of the future movements of palay prices. The World Bank projects an annual 4.5 percent decline over the next five years followed by a 2.05 percent annual increase for the subsequent five years or an average decrease of 1.2% in the next ten years. The average decrease of 1.2% was used in the forecast of the base case because it may not be realistic to assume that the Philippine government would allow real palay prices to fluctuate greatly given its policy to improve the lot of the farmers. The price forecasts are further considered in the sensitivity and risk analysis that follows.

2. *Fertilizer prices*

World Bank projections were used for the world price of fertilizer, which show an annual 1.6 percent increase for the next five years, followed by a 1.2 percent decline over the subsequent five years or an average increase of .4% in the next 10 years. Again, the fertilizer price forecasts the subject of further study in the risk analysis section of the report.

3. *Supply of family labor*

All the work in the farm will be supplied by family labor. Surveys in the project areas revealed that each family has available labor for 26 days a month or 1,872 man-days a year given an average family size of 6 in the Visayas. The prevailing agricultural wage rate in the area, 30 Pesos/day is taken as the opportunity cost of family labor since it is assumed that the family members will be working in the area if they are not working on their own farm.

4. ***Rural wages***

Rural wages are projected to increase at an annual real rate of 1.42 percent based on the trend over the last 10 years.

5. ***Land taxes***

Land taxes are expected to increase because with the project the participating farms will now be classified as irrigated land and not rain fed. The assessed value of rain fed land is 6,000 Pesos and irrigated land 10,000 Pesos. The land tax is 2 percent of the assessed land value.

6. ***Crop loans***

It is assumed that the farmers will be able to secure financing that will cover 40% of production costs. The Land Bank of the Philippines offer loans to farmers cooperatives at a 21% effective nominal interest rate per year.

B. Investment and Equity Points of View

The pro-forma financial cash flow statements were computed from the total investment and equity points of view, first in nominal terms in order to capture the effects of inflation. Then, the nominal cash flows were deflated to arrive at the constant price level cash flows.

For the equity point of view the cost of the project charged to the farmers represent their investment on the project. The difference between the total project cost and the farmers' investment is treated as a government grant to the farmer beneficiaries. Also, since the government shoulders all the initial cost, the equity portion of the farmers can be treated as an advance from the government which is amortized through the payment of irrigation fees.

The cash flows used in calculating the financial NPVs are shown in Tables 9 and 10 while a summary of the results is in Table 11.

TABLE 11
FINANCIAL NPVs

Point of View	in Thousand Pesos
Investment	52,993
Equity	237,430

The large positive NPV from the equity point of view is the result of the huge government subsidy on the project. The amount chargeable to the farmers beneficiaries account for only 64% of the total project cost.[5]

C. Budget Point of View

The financial impact of the project on the government's budget was also analyzed. A cash flow statement is constructed showing the different sources of cash inflows and outflows. The cash inflows come from the: proceeds from the IFAD loan, repayment of crop loans by the farmers, irrigation fees collected from the project beneficiaries, and the increase in land taxes brought about by the higher values of irrigated land. On the other hand, the cash outflows cover the: investments made on the project, crop loans to farmers, and repayment of the IFAD loan.

[5]As stipulated in the project documents, the IAs will only be charged 40,000 pesos per hectare for new irrigation systems, and 20,000 pesos per hectare on rehabilitated irrigation systems.

The results show that the project would be a big drain on government coffers in the first five years when the investments are being made (Table 12). The net cash flow starts to become positive only on the sixth year of the project.

VII. ECONOMIC EVALUATION

In order to obtain the pro-forma cash flow statements from the economic perspective the financial cash flows were adjusted by using conversion factors. The calculations of most of the conversion factors are shown in Annex 2. The conversion factors for the major inputs and outputs were calculated using the methodology described in the Jenkins and Harberger manual. [6] A brief explanation on some of the items used in the calculations is given below:

a) Rice Prices (palay): since rice or palay is an import substituting well, the economic value of rice was calculated based on the economic value of foreign exchange saved for not importing the good. The CIF price for rice was adjusted for handling and transport charges as well as the trade margin. One ton of palay or unmilled rice is equivalent to .65 ton of milled rice.

b) Paddy seeds: paddy seeds are produced domestically at the International Rice Research Institute (IIRI) in Manila and are considered exportable goods. The economic value of paddy seeds is equal to the economic value of foreign exchange foregone for not selling the goods abroad, adjusted for the economic cost for freight, handling and trade margins.

c) Urea, herbicides, pesticides and NPK fertilizer are imported goods. The tariff rate is equal to 5 percent. The economic costs take into account the cost of spending foreign exchange on these goods as well as tariffs, freight, handling and transport costs and dealer margins.

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[6] Arnold Harberger and Glenn Jenkins, "Manual for Cost Benefit Analysis of Investment Decisions", Harvard Institute for International Development, 1991.

e) Labor: labor used in the project is basically family labor. The economic cost for family labor was calculated from the rural agricultural wages. It is equal to the financial wage rates since there are no distortions.

f) Foreign exchange and capital: the economic cost of foreign exchange and capital were obtained FROM an Asian Development Bank study by Jenkins and El-Hifnawi.[7]

In the economic analysis, the IFAD loan is not considered as an incremental economic inflow of benefits because it could be utilized in other projects if it is not used for this project.

The economic cash flows shown in Table 13 reveal that the project has an economic NPV of about 328 million pesos. The large positive NPV vis-a-vis the financial NPVs can be attributed to the fact that the economic price of palay is much higher than its financial price.

VII. SENSITIVITY AND RISK ANALYSIS

A. Sensitivity Analysis

Sensitivity analysis is used to determine the relative changes in the project's outcome given variations in selected crucial variables. A sensitivity analysis was conducted and the results reveal that the key variables which most affect the project's outcome are the real growth in palay and fertilizer prices and the incremental production of palay (Table 14).

[7]Glenn P. Jenkins and Mostafa Baher El-Hifnawi, "Economic Parameters for the Appraisal of Investment Projects: Bangladesh, Indonesia, and the Philippines", (Harvard Institute for International Development, November 1993).

TABLE 14
SENSITIVITY OF FINANCIAL NPV FROM INVESTMENT POINT OF VIEW TO CHANGE IN PALAY AND FERTILIZER PRICES AND INCREMENTAL PALAY PRODUCTION

Real Growth In Palay Prices, %	Financial NPV ('000 pesos)	Incremental Palay Prod. (tons/ha)[8]	Financial NPV ('000 pesos)
-1.0	60,456	2.20	-54,547
-1.5	41,903	2.50	-35,294
-2.0	23,699	2.80	-16,040
-2.5	5,840	3.10	3,213
-3.0	-11,679	3.40	22,467
-3.5	-28,863	3.70	41,720
-4.0	-45,718	4.00	60,973
-4.5	-62,248	4.30	80,227

Real Growth In Fertilizer Prices, %	Financial NPV ('000 pesos)
-2.0	70,155
-1.5	66,707
-1.0	63,193
-0.5	59,612
0.0	55,962
0.5	52,243
1.0	48,454
1.5	44,593

B.Risk Analysis

The variables that were identified in the sensitivity analysis as having the biggest impact on NPV, real growth of palay and fertilizer prices and incremental palay yields were used to conduct a risk

[8]This applies only to the incremental production of palay in the new systems from Years 5 to 21.

analysis. The assigned probability distributions and the range limits of the change in the values of the selected risk variables are shown in Table 15.

In conducting the risk analysis, an autoregressive model was used to describe the movements of palay prices overtime. This model was derived from an analysis of historical data. This means that the price of palay in a given year depends on the price of the previous year. On the other hand, the annual fertilizer price was modeled as an independent risk variable for each year of the project after an analysis of historical data revealed that the price for one year is independent of its price for the previous year.

The incremental increase in palay production was correlated (correlation coefficient = -.90) with the fertilizer price since it is well known that farmers use smaller amounts of fertilizer when prices are high leading to lower yields.

In modeling the annual incremental palay production, the expected value of the probability distribution was made 2.5% lower than the base value used in the financial and economic analysis because studies show that the actual yields of irrigation projects are often lower than expected because of certain constraints like inadequate expenditure for operating and maintenance.[9] Among the constraints identified for this project are: ineffective technology transfer; limited training of farmers, inadequate supply of high yielding variety seeds, limited applied research, high postharvest losses, lack of formal linkages among government institutions involved in irrigation and agriculture.[10] The project has components to address these constraints but given the difficulty of hurdling these of constraints and the assumption that the farmers will be able to raise the required

[9]For example, Robert C.G. Varley in "Irrigation Issues and Policy In Indonesia: 1968-88", Harvard Institute for International Development Paper No. 322 (December 1989) cites that returns on irrigation systems with sophisticated designs have been well below their potential because of inadequate operations and maintenance performance.

[10]IFAD, "Philippine Visayas Communal Irrigation and Participatory Project Appraisal Report", Working Paper 4, pp. 16-18.

financing for the incremental inputs it is prudent to assume that the yields will be lower than the expected.

TABLE 15
RISK VARIABLES AND PROBABILITY DISTRIBUTIONS

Risk Variable	**Base Value**	**Prob. Distri-bution**	**Min. Value**	**Max. Value**
Change in Real palay price, Yrs. 1-20	0	Normal	-.45	.45
% change in Fertilizer prices, Yrs. 1-20	Deterministic Forecast	Normal	-20%	20%

			Range Value	**Probability**
Incremental palay prod. New system, Yr 1, Tons/hectare	3.40	step	2.55-3.40	.60
			3.58-4.48	.40
Incremental palay prod. New system, Yr 3, Tons/hectare	3.74	step	2.80-3.74	.60
			3.74-4.68	.40
Incremental palay prod. New system, Yrs 4-20, Tons/hectare	3.88	step	2.91-3.88	.60
			3.88-4.85	.40

Incremental palay prod. reh. System, Yr 1, Tons/hectare	2.48	step	1.86-2.48	.60
			2.40-3.10	.40
Incremental palay prod. reh. System, Yr 2, Tons/hectare	2.66	step	2.00-2.66	.60
			2.66-3.32	.40
Incremental palay prod. reh. System, Yr 3 Tons/hectare	2.82	step	2.12-2.82	.60
			2.82-3.52	.40
Incremental palay prod. reh. System Yrs 4-20 Tons/hectare	2.95	step	2.21-2.82	.60
			2.82-3.69	.40

The results of the risk analysis shows that the financial NPV from the investment point of view has a 15% chance of being negative while that from equity point of view has no chance of becoming negative (Figure 2). The economic NPV has also no chance of having values lower than zero (Table 16).

TABLE 16
RISK ANALYSIS RESULTS

	Fin NPV (Investment)	**Fin NPV (Equity)**	**Economic NPV**
Expected value	42,145	227,333	306,326
Standard deviation	40,296	40,416	64,108
Coeff. of variation	0.96	0.18	0.21
Minimum value	-69,740	115,136	127,987
Maximum value	160,815	346,045	497,559
Prob. of neg. return	15.0%	0.0%	0.0%

VIII. DISTRIBUTIVE ANALYSIS

In order to assess the costs or benefits resulting from this project, a distributive analysis was carried out. Projects have externalities when the financial inflows and outflows vary with the economic values. The computation of the externalities is shown in Table 17 while the summary of the results are shown in Table 18.

TABLE 18
DISTRIBUTIVE ANALYSIS RESULTS

Present Value of Externalities (in '000 Pesos)	***Distribution of Externalities*** Farmer-Landowners	Lessor-Landowners	Government
95,503	139,698.5	139,698.5	(183,894)

The analysis shows that the main beneficiaries of the externalities are the farmers who own their farms and the landowners who lease their farms. The latter receive 25% of the gross value of production as lease payment. It is estimated that about half of the project's beneficiary families own their farms.

The government gets a positive externality of about 243 million pesos from the foreign exchange savings of not importing rice. However, this is offset by the subsidies and advances it gives to the farmers resulting to a net negative externality of about 184 million pesos.

IX. CONCLUSIONS

The major conclusions that can be derived from the financial, economic, risk and distributive analyses are:

1. The project yields a positive financial NPV from the total investment and equity points of view. It also generates a favorable economic NPV.

2. The project yields a large positive financial NPV from the equity (farmer's beneficiaries) point of view. This is due to the subsidy from the government that accounts for about 36% of total project cost. Also, the farmers repay their share of the project cost under very liberal terms i.e., with no interest charges.

3. The large positive economic NPV is the result of the higher economic value of palay vis-a-vis its financial value because of the foreign exchange premium saved by not importing rice.

4. From the budget point of view implementing this project results in a financial subsidy from the government. This stems from government's policy of subsidizing irrigation.

5. The main variables that affect the project's outcome are palay and fertilizer prices and the incremental production of palay. The risk analysis showed that the financial NPV from the investment point of view has a 15 chance of being negative while those from the equity and economic points of view would remain positive even with scenarios of lower prices for output, higher prices of inputs and lower incremental outputs.

6. Aside from the farmers, the other beneficiaries of the project are the lessor-landowners. The lease payments on their farms will be significantly increased by the project.

The financial and economic analyses show that the project should be implemented. Although the project would lead to a government subsidy it is justifiable since irrigation projects are usually subsidized. The sensitivity and the risk analysis show that the NPV from the investment point of view is very sensitive to the incremental production of palay. These points to the importance of the project components such as farmers' training, extension services, decreasing post-harvest losses, increasing the availability of high yielding variety seeds which seeks to address the constraints to higher productivity. The analysis shows that the potential benefits to the farmers are large and the irrigation fees collected to amortize the infrastructure expense of the project is only a small portion of the incremental benefits to the farmer beneficiaries. These points to the possibility of increasing the irrigation fees to lessen the government subsidy, if the availability of the subsidy is a constraint to undertaking such economically productive irrigation projects.

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ANNEX 2

PHILIPPINE PALAY PRICES

Farm gate Price

Year	Nominal	Real
1973	.77	1.42
1974	.94	1.30
1975	.98	1.26
1976	.98	1.16
1977	1.00	1.07
1978	.98	.98
1979	1.04	.89
1980	1.15	.83
1981	1.30	.83
1982	1.36	.79
1983	1.52	.80
1984	2.47	.86
1985	3.24	.92
1986	2.82	.79
1987	2.92	.79
1988	3.17	.79
1989	4.13	.93
1990	4.77	.95

Source: Department of Agriculture, Rice Development Plan. 1992-1995