EVALUATION OF SMALL IRRIGATION PROJECTS

IN THE PHILIPPINES

THE CASE OF SMALL WATER IMPOUNDING PROJECTS

By

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ABSTRACT

An economic evaluation of the proposed Camagsingalan Small Water Impounding Project was conducted using the benefit-cost analysis framework to determine its economic desirability to the society. The project will be located in Sual Pangasinan and envisioned to provide irrigation water to about 55 hectares which will give the upland farmers an oportunity to shift from dryland to irrigated farming systems. The recommended cropping pattern for the project area is a crop of rice followed by a crop of mungbean or garlic. Moreover, about 20 hectares each of mango and cashew will be planted in the surrounding portion of the watershed area.

Based on the twenty period economic analyis, the Camagsingalan Small Water Impouding Project would generate a substantial gain to the province and to the nation in general. At discount rate of 15 per cent,the project will result in a Net Presnt Value of P 536,194.00 using the Cropping Pattern 1 and an Internal Rate of Return (IRR) of 39 percent. On the other hand Cropping Pattern 2 will result in a Net Present Value of P 5,911,844.00 and an Internal Rate of Return of 41 per cent. In summary, the project based on quantifiable costs and benefits is economically desirable and worthwhile undertaking.

However, a number of enviromental problems have not been dealt with in the economic analysis. This include the possible environmental and socio-economic problems that will result due to the construction of the SWIM project. Though the scale of the project is small, the extent of effect is however not yet established. Water pricing is not also dealt with in the analyis.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

In the last ten years the role of agriculture in economic growth in developing countries has gone through a period of reconsideration with rural enterprise emerging into greater prominence as the basic area of activity for the provision of welfare, livelihood and new capital resources that will stimulate economic growth. There is now a wide recognition that an increase in agricultural productivity is a necessary and crucial development to improve national income and personal welfare. In the Philippines agriculture remains an important sector of the economy. Together with fisheries and forestry, it provides livelihood for about two-thirds of the rural population. The agriculture sector contributes one-third of the country's total Gross National Product (GNP). It also employs half of the country's workers and earns 36 percent of the country's total export income.

From ancient times irrigation has been a powerful lever for intensifying production. Irrigation development has generally been considered a key factor in helping agricultural production meet the growing demand for food. Today irrigation projects are undertaken primarily as a means of increasing the productive capacity of agricultural lands by assuring a steady supply of water during the dry months of the year. Improved water control and availability are recognized to be important for the achievement of the full potential of modern rice varieties.

In the Philippines, irrigation development is by no means a recent undertaking. Traditionally, irrigation has been practised by rice farmers for 1,000 years. In Northern Luzon, about 25,000 hectares of paddy field terraces have been cultivated on steep-sloped mountains, where levees built of earth and stone hold and collect the water. Such construction is widely praised and regarded as one of the wonders of the world. Irrigation systems were built during the Spanish colonial period and many of the masonry dams built then still remain in use today. Though irrigation practices started long ago, the pace of development has been slow, with today only 40 percent of the total crop area in the country under irrigation. It was only during the last two decades, that the Philippines made impressive progress towards irrigation development. Tremendous expansion in irrigated areas occurred from 1950 to the early 1980's. This can be attributed to the creation of government agencies like the National Irrigation Administration (NIA) which have systematically hastened the construction of both large-scale communal and pump irrigation systems. From about 0.7 million hectares in 1968, the area provided with irrigation facilities increased to about 1.47 million hectares in 1990. Public investment in irrigation infrastructure averaged over 2.0 billion pesos annually during the same period.

There are three types of irrigation systems in the Philippines to which irrigation investments are directed. The first is the national irrigation system (NIS) which are gravity or run-of-the-river type. Areas under this type of irrigation system range from 1,000 to 100,000 hectares in size. In general these systems are constructed by the government, with operations placed under the NIA supervision.

The NIS service areas are, in most cases, larger than communal irrigation systems. They are also most intensive in terms of infrastructure per unit service area with structures consisting of an appropriately-sized concrete dam, service roads, intricate irrigation and drainage canal networks, as well as other structures for controlling water distribution. Examples of this type are the Upper Pampanga River Integrated Irrigation Systems (UPRISS) with service area of 103 thousand hectares, the Bicol River Basin Integrated Systems and Magat Multipurpose Dam, to name a few.

The second type is the communal irrigation system (CIS). These are small gravity systems, mostly run-of-the-river type which are constructed under NIA or Bureau of Soils and Water Management (BSWM) supervision. The basic structure of this system is an appropriately-sized concrete or earth fill dam and a simple network of irrigation canals for water distribution. After completion, these systems are turned over to the farmers through their respective farmer associations. This type of irrigation system is popularly called Small Water Impounding Projects which are mostly built in areas which are not benefited by national irrigation systems. The service area can range from 25 up to 1000 hectares. This study is focused mainly on this type of irrigation system.

The pump irrigation systems (PIS) is the third type and is classified according to water source. Surface pumps draw water from rivers, creeks, canals or any surface water reservoir. Deepwell and shallow pumps, on the other hand, draw water from an underground water source. Pump irrigation systems are usually privately owned and are small with a majority of them serving fewer than 20 hectares.

Like most developing countries, self-sufficiency in food, particularly rice, has been the foremost objective of irrigation development in the country. Irrigation development together with the green revolution (adoption of high yielding varieties and other improved farming technologies), fertilizer subsidy and investments in farm mechanization, such as postharvest technologies, increased total paddy production from 4.1 million tons in 1967 to 9.2 million tons in 1986 . The rapid rise in rice production (about 4 percent annually) during the late 1960s and 1970s enabled the country to attain self-sufficiency in 1977. This was sustained until 1983. However, succeeding years showed a slow increase in rice yield of about 2.0 per cent per year, way below the annual growth rate in population. In the 1984-1990 period rice production fall short of consumption. The re-emergence of rice import is becoming a major socio-economic. technical and political issue (David,1990).

With rapid population growth, about 2.7 percent to 2.8 percent for the past decade, there is a crisis in terms of land and resources to produce food which will greatly increase in the coming years. Opportunities for expanding cultivated areas are diminishing while the need to increase crop productivity becomes more compelling. Increased production therefore will have to come from the utilization of less favourable rainfed and upland areas. Population pressure also causes farmers migrate to and cultivate upland areas. At present, upland population is estimated to be 17.8 million or 3.18 million households. It is projected that there will be an additional 2.5 million persons per year who will occupy the uplands. At the present population growth rate, it is projected that by the year 2025, an additional 5.24 million hectare of forest lands will be cleared to accommodate the increasing population (Sajise and Ganapin,1990).

In the face of declining availability of frontier land for agricultural purposes and the increasing population level, the Philippine government is placing greater emphasis on the development of upland area which, if managed properly may augment current production. Properly developed, these lands are a key to sustainable development and socioeconomic progress . The policy is seen as a major government strategy to attain greater social stability .

A major component of the upland development undertaken by the Department of Agriculture is the provision of irrigation water through the construction of Small Water Impounding Projects (SWIPs). The experience gained in the Rainfed Resources Development Project (RRDP) funded by USAID which was locally known as the KABSAKA project has made Small Water Impounding Projects popular. This infrastructure along with the right technology and effective extension strategies will give upland farmers greater opportunity of developing and sustaining their farming system.

The emphasis on SWIPs is reflected in the recently enacted House Bill No. 1064 by the Philippine Congress which approved an accelerated ten (10) year development program with an annual budget of P 3.0 billion. Development will focus on small irrigation projects such as small water impounding projects, shallow tube wells and similar projects. With this development, along with other support services, it is hope that the government can attain its goal of increasing rice production to achieve self-sufficiency and reduce poverty in the countryside.

1.2 STATEMENT OF THE PROBLEM

The compelling issue of increasing population and the provision of food given the limited area for expansion, coupled with the emerging issue of poor performance and increasing construction costs and operating and maintenance cost of existing large irrigation systems, have led policy makers to direct investment funds into small irrigations systems which are potentially more productive and more cost effective than large irrigation systems . In addition, emerging concerns about large irrigation systems, are the environment effects which are becoming evident today.

A recent World Bank (1989) study showed that even the Upper Pampanga River Integrated Irrigation System (UPRIIS), which is the flagship of the National Irrigation Administration (NIA), is performing well below expectation. Designed to irrigate 103 thousand hectares, the system can only serve about 85 and 64 percent of the service area during the wet and dry season, respectively. On average, actual yields are still much lower than those projected during the design and project appraisal stages.

The National Irrigation Administration (NIA) estimated that the present cost of irrigation development is about P 60 thousand per hectare for gravity irrigation systems. In many small water impounding projects and large gravity irrigation systems, the cost of development exceeds P 100 thousand per hectare. For projects intended solely for irrigation the cost ranges from P 96,153.00 to P 212,226 per hectare .

Small scale irrigation project such as the Small Water Impounding Projects are gaining greater attention today because of quick yielding effects with relatively low capital investment needed for the construction of small reservoirs compared to the much larger national projects and their potential multi-oriented uses. Projects of this type are generally constructed in areas not benefited by large national irrigation systems, and where a potential exist for the development of upland watersheds by using small water impoundments as an economic source of water for irrigating small farm systems planted to both upland and lowland crops.

Small-scale projects (such as SWIPs) are attractive because they are conceived with the participation of local community and as such tend to be easier to manage and therefore to sustain. Their costs are on the whole lower and the time of completion (3 to 6 months) shorter. A small group of farmers organized as an irrigator association has better control over the timing of operation of the irrigation systems.

The Small Water Impounding Projects are generally defined as those small scale-water impounding dams which have a structural heights of not more than 30 meters and/or a volume storage of not exceeding 50 million cubic meters (JICA,1989).

In Master Plan Study of Small Water Impounding Projects (JICA,1989), a total of 550 SWIM projects were identified throughout the country, of which 32 projects were already constructed and 17 projects were under construction (as of March 1989). The remaining 501 projects were to be investigated.

Based on the JICA evaluation, 230 out of 501 are qualified projects for implementation within a 10 year period. One hundred eighteen (118) projects, including 39 candidate projects for Overseas Economic Cooperation Fund (OECF-SWIM) have been prioritized for implementation during the first five years. The estimated total funds required for implementation of the 10 Year Action Program is P 6.1 billion, comprising for the first five years (118 projects) and P 3.8 billion for the second five years (112 projects).

As government initiated projects, irrigation projects such as these, derive financial support from public funds and from foreign aid and grants. Considering the huge amount involved and the prevailing economic condition of the country, is it worthwhile to undertake such projects? To answer this question, it is imperative that a critical evaluation of the proposed projects be performed to help the decision maker make more rational decisions regarding the use and allocation of limited resources.

1.3 OBJECTIVES OF THE STUDY

This study generally aims to contribute to the general knowledge of the place of small irrigation projects in the Philippines and to evaluate their contribution to the society.

Specifically the project aims the following objectives:

1. To describe the Small Water Impounding Project Scheme and discuss its desirability.
2. To conduct an economic evaluation of a case study project to demonstrate its economic value to the nation.
3. To identify possible constraints (economic or social) to the implementation of SWIP that need to be addressed by the government and other institutions.
4. To draw conclusions and make final recommendations re-SWIM projects.

1.4 OUTLINE OF PRESENTATION

Chapter 1 is the introductory part of this thesis. Section 1.1 discusses the role of agriculture in Philippine economy and the state of irrigation development. Section 1.2 deals with the statement of the problem while Section 1.3 presents the objectives of the study.

A review of literature (Chapter 2) follows the introductory part and discusses the impact of irrigation on various areas of concern such as agricultural production and productivity, level and distribution of income and employment, and environment.

The methodology part (Chapter 3) outlines the framework of Benefit-Cost Analysis in the ex-ante evaluation of irrigation projects from the national point of view. Likewise the different parameters used in the economic analysis are explained.

The Small Water Impounding Project Case Study is presented in Chapter 4 with a general description of the project and its proposed development. It is then evaluated using the Benefit-Cost Analysis framework discussed in the previous chapter.

Chapter 5 discusses how the economic analyis was conducted as well as the results obtained in the analyis. A discussion of the wider impacts of the project is given in last section (Section 5.5) of this chapter.

A sensitivity analysis is conducted to show which variables most affect the result of the project appraisal. Decision criteria are subjected to variations in the value of parameters.

The closing chapter summarises the results of evaluation done and addresses the feasibility of the project. A set of recommendation to the overall implementation of the project and related issues are also presented.

CHAPTER 2

REVIEW OF LITERATURE

This section reviews some of the existing literature on the impact of irrigation. Although there is a large number of studies on the impact of irrigation,this review concentrates on those that deal with areas of concern namely, agricultural production and productivity, level and distribution of income and employment, and impact on the environment.

2.1 IMPACT ON AGRICULTURAL PRODUCTION AND PRODUCTIVITY

Perhaps the most significant impact of irrigation projects is on agricultural production and productivity. There are several reasons why irrigation allows for increased agricultural production and productivity. First, irrigation makes it possible to grow rice and other crops several times a year. In the case of rice, the observation has been that where previously rice could only be grown once a year during the wet season, irrigation makes it possible for farmers to plant an average of 2.5 crops per year (Wickham and Barker, 1976). With the advent of the new high yielding varieties of rice which are early maturing (about 95 days compared to 150 days for traditional varieties) it is possible to plant up to three crops per year with good irrigation facilities.

Second, with better water control made possible, the yield per hectare for each crop tends to increase. Wickham and Barker (1976) have summarized some findings of studies on yield response to nitrogen (N) under different water conditions in the Philippines. On the basis of the various nitrogen (N) response functions, they calculated the yield benefits associated with irrigation (assuming efficient levels of nitrogen for each function). In estimating the benefits of irrigation, they computed the yield difference between irrigated and rainfed crops in the wet season and took the full yield in the dry season. They reported that the yield benefit due to irrigation of modern varieties is 0.96 tons per hectare and 2.76 t/ha for the wet and dry season respectively. On the other hand, for traditional varieties the yield benefits due to irrigation are 0.75 and 1.90 t/ha in the two seasons.

Although the incremental yield discussed above are quite substantial, they would even be greater, if the supply of irrigation water was fully adequate or ideal throughout both seasons. Wickham and Barker (1976) estimated that for traditional varieties in the dry seasons, improving the adequacy of irrigation from actual to ideal irrigation would result in yields increases from 1.90 to 2.67 tons per hectare assuming efficient nitrogen use. For modern varieties the yields increases from 2.84 to 4.10 tons/ha.

Third, irrigation not only contributes to increased crop production but may also reduce variability in production through improved control of the crop environment. However, the dependence of modern seed-fertilizer technology on irrigation and fertilizer, which are subject to unreliable supply, may contribute to increased variability in production. Rosegrant (1992) examined this issue using an irrigation system simulation model to analyze the impact of irrigation on the variability in area, yield, production and farm income in diversion systems in the Philippines. The results show that irrigation more than doubles crop-year rice production and income. However, because of the dependence of diversion irrigation systems on highly variable dry-season streamflow, irrigated dry-season production and income are highly variable compared with those of wet season rainfed production. On a crop year basis, production and income variability under irrigated conditions are slightly higher than under rainfed conditions. Although improved management of irrigation systems can reduce income and production disparities among farmers within the systems, it has little impact on system wide variability.

Rosegrant (1992) also attempted to estimate the yield benefits of new irrigation and improved existing irrigation systems. He estimated that improving existing irrigation systems from low quality to medium quality resulted in a 0.55 t/ha yield benefit while an improvement from medium quality to high quality irrigation systems (at medium seepage and percolation and with the application of 40 k.ha of N) resulted in about 0.50 t/ha yield increase. The expected yield benefit from a shift from rainfed to irrigated condition is about 0.35 t/ha.

Moya et al (1983) studied the impact of the introduction of irrigation in the Libmanan-Cabusao area, Camarines Sur, Philippines. The result of the study showed that irrigation has produced significant changes in terms of yield, cropping intensity, employment and profitability of rice production. Analysis of data shows that the introduction of irrigation increased the output per hectare per year by 1.1 ton (from 3.9 to 5.0 tons per hectare). Area planted rose from 22 percent to 83 percent in the dry season and from 64 to 81 percent in the wet season.

The Agency for International Development (1980) in their assessment of the benefits of the ISA small scale irrigation project in the Philippines, took into account the relationship of water to farm productivity. AID reported that rice yields increased as did the opportunity for double cropping. Approximately half of the farmers involved were able to plant two crops per year and harvested more from each crop. The expectation was that with improved water control, all of the farmers would be able to double crop. Overall rice production would increase by as much as two to three times over rainfed production conditions. These increases in yield and the achievement of the production potential, however, require improvements in water supply, fertilizer applications and insect controls, and greater skill in off-farm water management.

The report also added that although gross farm income, as expected, doubled and in some cases tripled with the installation of the irrigation systems and improved water distribution, costs tended to increase even more rapidly. This was in part because the price of palay tended to remain stable-- farmers were receiving between P 0.80 and P 1.00 per kilogram of palay-- while the costs of electricity, fuel, fertilizer, credit and the drying and processing of rice increased over the 1975-1979 period. Consequently, many farmers with less than one hectare of land were not able to cover production costs.

The above studies emphasize the complementary effects of irrigation and new rice technology. It is well-known that modern varieties require adequate water control and are not suitable to non-irrigated areas. Obedoza (1976) examined the impact of water adequacy on nitrogen use and rice yield in 5,700 hectare area commanded by lateral canal of the Penaranda River Irrigation Systems. It was found that water adequacy and nitrogen are positively related to yields. Further, the joint effect of water adequacy and nitrogen on yields is greater than their independent effects.

Another possible impact of irrigation on agricultural productivity is the increase in physical area cultivated. With irrigation, marginal lands could be made productive and may be planted to rice and other crops. It remains to be investigated however, the extent to which physical land area is increased due to irrigation (Paris, 1979).

2.2 IMPACT ON LEVEL AND DISTRIBUTION OF INCOME

Although evidence indicates a clear relationship between irrigation, modern variety utilization and optimal fertilizer application, to rice yield improvement and maximization of farm income, the impact of irrigation and modern rice technology on income distribution remains still an unclear issue. The significance of the equity issue lies in the concern that productivity and equity may be conflicting objectives. (If the provision of irrigation facilities tends to worsen income distribution, its beneficial effects on productivity could be neutralized or negated, Sison, 1987).

Since the advent of the new seed-fertilizer technology, popularly known as the "Green Revolution", there has been much concern that the technological advance might have contributed to a deterioration in the income distribution (Grabowski, 1984). The arguments cited are faster rates of adoption by high income farmers or by owners compared to tenant farmers, a tendency toward " labour saving" bias in the technology that reduces labour's share; non adaptability of technological innovations to all geographic areas; incentives for landlords or wealthy farmers to consolidated smallholdings into larger units thereby promoting a polarization of rural population and a tendency for public service to be available to big farmers.

To the extent that the new seed-fertilizer technology is complementary with irrigation, the latter may affect the distribution of income in a number of different ways. First, the increase in output which irrigation makes possible may cause the real price of rice to decline. Consumers would benefit at the expense of producers, other things being equal. The distribution of income would also be altered since low income consumers spend a large share of their budget on food relative to the upper income consumers. Similarly, particular groups among producers may be worse off as a result of the decline in product price.

Irrigation projects can also affect the personal distribution of income within the agricultural sector. Here, the effect will be determined largely by institutional arrangements. If the water or the access to water is distributed as a free good, those who receive these benefits will receive an increase in their resources endowment. They will benefit relative to those who do not receive access.

IFPRI (1985) studied the performance of irrigation system in the Philippines. They developed a simulation model which links the operation of the irrigation system, together with agroclimatic variables such as streamflow, rainfall, and soil type, to the water adequacy of farms within the system. Water adequacy in turn determines, along with input levels and prices, yields and incomes within the system. The model has been used to simulate the operation of three irrigation systems using rainfall and streamflow data for the years 1955-77. The results for continuous flow irrigation confirm the large disparity in benefits among farms due to differences in their access to water. Farms near the sources of the system, have annual per hectare incomes from 25 to 50 percent higher than farms downstream. Roughly a third of the difference in incomes can be attributed to the smaller dry season area harvested downstream, and about two thirds of higher moisture stress, which reduces fertilizer use and rice yield downstream.

The same study showed that rotational irrigation is quite effective in equalizing benefits among farms in the system, increasing income downstream by 15-25 percent and reducing disparity in income between farmers at the source and at the end of the systems to 4-6 percent. However, the income gains to farmers downstream are partly at the expense of losses at the source, where annual incomes decline by 5-10 percent. Thus the systemwide income benefits from rotational irrigation are only 3-6 percent.

Dozina, et. al (1976) in their study of the rehabilitation of the Cavite Communal Irrigation System estimated how the average gross value added per farm in the system was divided among landlords, farm operators, and hired workers and compared the distribution before and after the rehabilitation. They found that the income shares of landlords, farm operators, and hired labourers all increased in absolute terms by over 100 per cent. However the rate of change was the largest for hired labourers, followed by farm operators. As a result, the relative share of income for hired labour increased by 18 per cent but those for farm operators and landlords decline by 3 per cent and 6 per cent respectively.

Infanger and Butcher (1974) examined the performance of publicly provided irrigation as a means of income distribution by applying fiscal incidence analysis to a representative area int the Columbia River Basin Project. The fiscal incidence or redistributional effects was ascertained by a comparison of the amount of benefits and burdens attributable to members of each income class. The lowest income group was found to bear more in burden than it receives in benefits. The authors conclude that income distributional impact of publicly provided irrigation is clearly not in favour of the poor-- the lowest income group consistently experiences negative net benefits.

Paris and Pascual (1987) on the distributional impact of irrigation on production factors and among earners using earner-share, factor share and Gini ratio-Lorenz approach, concluded that (1) irrigation in the Philippines has a positive impact on increasing the level of income of all factors of production, but the increase in the returns to fixed capital is relatively larger than the increase in earnings of labour and management. They point out that, although investment in irrigation development is justified for its productivity effect, the irrigation systems is more advantageous to owners of capital than to owners of labour; (2) Irrigation has also the effect of increasing the household income of all earners, with the benefits being almost equally distributed among the various kinds of earners on the farm or village. This suggests that the irrigation project is desirable not only to the farm operators but also to other classes of earners in the area; (3) the study of inequality in income distribution among farmer-households is lower in the "after" than in the "before" irrigation situation. This means that irrigation leads to an improvement in the distribution of income across farmer households; and (4) The index of inequality of income distribution across all types of households in the village "after" the installation of irrigation is lower than that in the "before" situation. This implies that the irrigation project causes a more equal distribution of income across households.

These studies therefore concluded that irrigation has a positive effect on both the average levels of income and on the redistribution of income among factors of production, earners of income as well as across the different types of households in the study area.

These findings are supported by research findings in other countries such as Indonesia and Thailand. Furthermore, these studies show that aside from the fact that "irrigation substantially increases the income to all factors of production, much of the gains to land accrue directly to small owner operators" (IFPRI, 1986).

A number of studies have looked into the effects of modern rice technology on the distribution of income. A review of these studies may be helpful in drawing further conclusions on the distributional impact of irrigation since the adoption of the new technology is greatly facilitated by irrigation development. The results of these studies do not appear to be conclusive with respect on income distribution.

Herdt and Ranade (1978) evaluated the changes to distribution of earnings from rice production for a sample of small farmers in Laguna and Central Luzon from 1960 to 1976. Their basic approach was to calculate the real income share of output accruing to the three main classes involved in agricultural production - landlords, hired workers, and operators and the share of output and real income transferred outside the agricultural sector to purchase inputs. They found that in both areas the share of output used for purchasing current input increased substantially between 1966 and 1970 and it continued to increase through 1974 in Central Luzon. The share of landlords was modestly reduced in both areas while hired labour's share was maintained at about 20 per cent of the total value of output across samples. They concluded that there is no evidence that labour has suffered either an absolute or relative decline in earnings since the introduction of new varieties. instead there seems to be evidence of increasing labour use and increasing proportion of hired labour.

There may also be some impact of technological change on income distribution through market price effects. Essentially, the argument is that technical progress implies a downward shift in cost function and hence a rightward shift in supply function, which, with a downward sloping demand curve results in increased welfare through the consumption of a larger quantity at a lower cost. The distribution of the gains in economic welfare between consumers and producers depends on the price elasticities of demand and supply for the community.

Hayami and Herdt (1977) developed a model to analyze the distributional impact of market price effects due to technological change. The model incorporated attributes of semi-subsistence production and applied this to data for the rice economy of the Philippines. They conclude that differences in adoption of technological change between large and small farmers resulted in differential benefits-- but small farmers gain more than large farmers when supply shifts faster than demand. Technological change within agriculture had the effect of promoting more equal income distribution through downward pressure on prices and hence on the income of those farmers with a large proportion of marketable surplus. It tends to transfer income from large commercial farmers and landlords to the urban poor and the rural landless classes.

Scobie and Posada (1984) studied the distributional impact of high-yielding rice varieties in Colombia. Their conclusion was that the positive benefits of the technological change all accrued to consumers, with the lowest income households receiving the largest benefits, both absolutely and relatively. While 25 per cent of the households received 4 per cent of the income, the same group captured 28 per cent of the net benefits. On the other hand, for the producers, the foregone income through lower rice prices affected mostly the low-income upland (not irrigated) producers. The foregone income to producers with irrigated fields varied with the farm sizes, with the 200-1000 hectare farms bearing the heaviest burden. However, while the equity consequences may not be desirable, the internal rates of return to the nation ranged from 77 to 94 per cent.

The main empirically unresolved issue concerns regional distributional effects. Agricultural technologies are highly location specific, and thus the scope for direct technology transfer across regions is inherently limited. In particular, adoption of modern varieties has been constrained by environmental conditions, especially the degree of water control, which has limited the diffusion of modern varieties to irrigated and favourable rainfed areas (Barker and Herdt 1985). IRRI (1991) reported that nearly 40 percent of rice areas in South and Southeast Asia i.e. unfavourable rainfed lowland, upland, deepwater and tidal wetland areas, were still planted to traditional varieties by the late 1980s. Concerns have, therefore, been increasingly expressed that the widening productivity gap between favourable and unfavourable rice production environments not only accentuated relative income disparities but also exacerberated the absolute poverty of the farmers and landless households in the unfavourable environments (Falcon, 1970).

Evenson and David (1993) examined the impact of differential technology adoption (modern varieties) across production environments on income distribution based on a recently completed collaborative research study in seven major rice growing countries - Philippines, Indonesia, Thailand, Bangladesh, Nepal, India and China. The study examined not only the direct effects of technology on productivity factor use, and income, but equally important, examined the indirect effects through factor and product market adjustments on the incomes of various rice production groups. These country studies confirmed that neither farm size nor tenure significantly affected modern varieties adoption. Modern varieties adoption was found to be limited to irrigated and favourable rainfed areas. The studies also showed that when direct and indirect effects are taken into account, differential adoption of modern varieties across production environments did not significantly worsen income distribution. The adoption of modern varieties increased labour demand in the favourable areas due to greater labour requirements per crop, higher cropping intensity and growth linkage effects on non-farm employment. This greater labour demand induced interregional migration from unfavourable to favourable areas which helped to equalise wages across production environments. As far as the income of landless labourers are concerned, the study showed that there was no strong evidence that differential modern varieties adoption have made them worse off.

2.3 IMPACT OF IRRIGATION ON EMPLOYMENT

Conceptually, irrigation projects can have several employment effects. The construction of the irrigation system itself generates employment to a number of persons. In addition, there are backward linkages of irrigation projects, that is employment generated in the manufacture of irrigation equipment such as pumps. The most important employment effects, however, are to be found within farms served by the irrigation project and those activities which are related to farm production such as marketing, transport, milling, etc.

At the farm level there are two possible reasons why the availability of irrigation tends to increase labour utilization. First, additional cropping made possible by irrigation correspondingly increases labour requirements. Secondly, labour requirements are higher for irrigated crops than non-irrigated crops. To the extent that irrigation increases crop yield, increased labour use stems from the higher labour requirements for harvesting, threshing and other post-harvest operations due to the higher physical output handled. Labour is also required in the care of canals, dikes and to other maintenance of the irrigation facility.

Irrigation projects also have indirect employment effects on farm-related activities through increased agricultural production. Because of the increased volume of output, there will be increased non-farm activities such as milling, transporting, marketing, etc. hence generating more employment.

Potentially therefore there are reasons why it can be expected that an increase in irrigated cropping will lead to an increase in employment. The empirical question therefore is whether irrigated farms require more labour to non-irrigated farms . One approach to investigate this is to simply compare cross-sectionally the labour utilization per hectare between irrigated vs. non-irrigated farms. In practice, this is not easy since several factors can not be held constant such as the degree of mechanization, the degree of input use, etc. For example, survey data on 76 farms in Central Luzon and Laguna in 1966/67 and 1970/71 show that in 1971, rainfed farms had a labour input of 65.2 man-days/ha, irrigated farms in the wet season had only 61.2 man-days/ha of labour input and in the dry season only 58.8 man-days per hectare (Mangahas et al, 1972). However, the proportion of farms using tractors are 7 per cent, 30 per cent and 61 per cent for rainfed, irrigated wet and irrigated-dry farms, respectively. Hence, it is difficult to infer how much of the change in labour utilization is attributable to irrigation.

Nevertheless, the evidence seems to show that labour requirements per hectare are higher for irrigated farms than non-irrigated farms. A nationwide survey by the Bureau of Agricultural Extension in the Philippines in 1982 revealed that lowland irrigated rice crop utilized 76 man-days/ha, lowland non-irrigated crop utilized 70 man-days/ha and upland rice crop utilized 65 man-days/ha. The differences may be explained by the fact that additional labour is required for the maintenance of irrigation canals, dikes and operation of the irrigation facility (BAExt,1983).

Crisostomo, et al (1978) approximated the effects of new irrigation on employment based on both the change in relative level of irrigated, rainfed and upland areas and the expansion in crop principally through double cropping of rice. They estimated the labour absorption rate due to new irrigation was 1.9 per cent per annum from 1956 to 1963/65 and 0.9 per cent per annum from 1963/65 to 1968/70. Based on survey results, they also concluded that if mechanization levels were constant the introduction of the new technology would imply substantial increases in per hectare labour inputs, mainly for land preparation, weeding, and harvesting-threshing operations. The survey results also show that a large portion of the total increase in per-hectare labour inputs would be supplied by hired labour, which in turn would imply a wide distribution of the increased farm income.

In the case of small scale irrigation systems where local resources, especially labour, are important, the construction of the system itself may provide employment for a number of people. Kikuchi et al (1976) reported that a total of 1,008.9 man-days were contributed by the farmers in the rehabilitation of Cavite Communal Irrigation System or an average of about 10 man-days per farmer.

With respect to employment effects in the non-farm sector Gibb (1985) traced the impact of 25 per cent increase in farm income (derived from increase rice production) on non-farm labour employment in farm rural towns in Nueva Ecija, Philippines. His main finding was that non-farm employment responded positively and substantially to increases in agricultural output and income, much more so than agro-related employment. Employment in stores and shops increased by 65 percent, an increase of 40 percent for sari-sari store employment. The differential growth rates are considered significant since the three categories mentioned account for 95 percent of non-farm employment.

In a related study in West Bengal, India Gosh (1984) made a comparison of an irrigated village and a largely unirrigated one which the impact of irrigation on landless labourer. He noted that in the irrigated area there was virtually no dead season and also that a large number of migrant labourer came in for the peak periods.

The implied difference in livelihood for labour in these two villages are stark and the value of irrigation can be surmised as not just work and income, but the relative assurance and continuity of work to provide regular income without gaps. This contrasts with the condition in the largely unirrigated village where the negligible agricultural employment over three-month periods in the year must have meant either seeking other low paid local work, or migration, or serious deprivation, or some combination of these. Put differently, the value to labourers of filling in the dead seasons exceeds the value of extra work at the peaks.

In a review made by Chambers (1991), empirical studies conducted in India confirm that reliable and adequate irrigation directly raises employment: for example, increases in days worked per hectare with irrigation compared with rainfed conditions are reported to be 61 percent in Dantiwala Canal Irrigation Project, more than 100 percent in Kakatiya Canal Irrigation of Sriramasaga Project in Andhra Pradesh, 135 percent in a village under the Damodar Canal in West Bengal. He concluded that cropping intensity had the greatest employment impact.

2.4 IMPACT OF IRRIGATION ON THE ENVIRONMENT

Irrigation presents an increasingly large variety of environmental costs and hazards to current and future generation. These environmental concerns can be grouped into two broad categories - water pollution and conservation of land and water ecosystems.

The most discussed and analyzed pollutants resulting from irrigation have been the total dissolved solids, suspended solids (sediments) and to a lesser degree nutrients, organic and pesticides. Willey (1980) viewed suspended solids as a cost to irrigation because they represent a loss of topsoil estimated in replacement value to be worth tens of billion of dollar per year and therefore a detriment to long-term productivity. The large particles in suspended solids acts a vehicle transporting pesticides and nutrients into aquifers and surface waters by way of the "clinging ' effect of these molecules to the sediment particles, thereby creating toxic and/ or hazardous to fish, wildlife and human population using those waters. Also, sediments tend to settle in river channels and reservoirs, thereby requiring expensive dredging operation to maintain the river and reservoir.

In most Asian countries, where the green revolution was achieved through the use of high yielding varieties and increased application of chemical fertilizers, pesticides and water, the environmental impacts have becoming evident . Over application of chemical fertilizers, leads to chemicals being washed and carried by runoff and leached into the environment. These runoff nutrients provide food for aquatic plants, the growth and subsequent decomposition of which creates carbon dioxide levels sufficient to support growth of blue-green algae. Algal blooms , eutrophication of nearby surface water systems and some accumulation of phosphates and heavy metals in the soils are correlated with nutrient runoff brought about by irrigation water (World Bank,1993).

According to Huang and Geaun (1993) overuse of pesticides for rice production in Taiwan is quite pervasive. The quantity applied to every hectare is about 40 percent higher than the efficient level. Scant evidence also indicates that underground water and irrigation water in some areas are polluted by nitrate, which largely comes from fertilizer runoff, pig slurry and other industrial pollution sources. The annual marginal damage of nitrate on rice varies from region to region and ranges from 171,500 to 2,386 kilograms.

In the Philippines, Fertilizer and Pesticides Authority (1990) reported that total imports of fertilizer increased dramatically from 426,891 metric tons in 1981 to 1,066,112 metric tons in 1988 of which 204,204 metric tons and 725,295 metric tons respectively are urea fertilizers. Other fertilizer materials include ammonium sulphate, diammonium phosphate and muriate of potash (Fig. 1 . Pesticides used in the past ten years indicated a three fold increase from 4,725 metric tons in 1980 to 15,901 metric tons in 1987. Unfortunately, fertilizer and pesticide residues are insufficiently monitored.

A more subtle type of loss of productive land associated with irrigation projects has been the raising of water tables and resulting waterlogging and salt buildup in the root zone as capillary pressure pushes water to the soil surface where it evaporates. This may occur in badly designed and managed irrigation systems. The consequences can be severe. Unlined canals and other water channels contribute to ground water recharge. When water is used for irrigation in excess of water requirements, it also leads to water logging and groundwater recharge. The rising

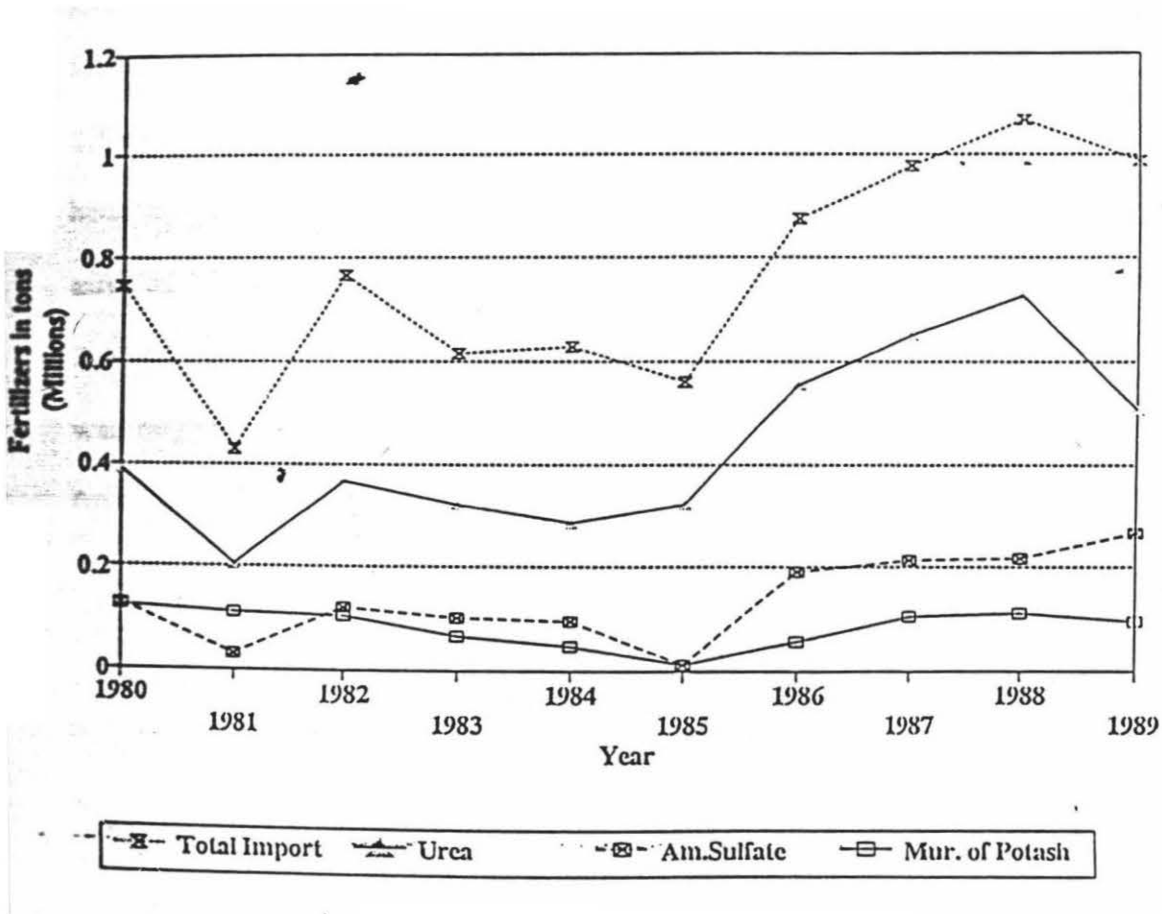

Fig. 1. Fertilizer Imports by year, 1980-89 (tons)

Source: FPA, Fertilizer Statistics (1990)

groundwater tables then draws up the salts found in the soil when the water evaporates or transpires through plants. Also, irrigation with poor quality ground water can lead to salinity soils. In time, the top soil accumulates a high salt content and become less fit for cultivation.

The World Bank (1992) reported that in Asia, most of the waterlogging and salinity occurs in China, India and Pakistan. India has the highest area of land affected by waterlogging and salinity - by 1988 the productivity of nearly 20 million hectares of cropland (30 percent of the irrigated cropland) had been seriously affected and farmers had to abandon 10 million hectares of productive cropland. In Pakistan, about 3 million hectares (20 percent of irrigated land) is affected by waterlogging and salinity. In China about 7 million hectares is feared to be suffering from waterlogging.

Other potential harmful effects of irrigation arise from habitats served by stagnant water in canals and drainage areas leading to public health problems like bilharzia, malaria, yellow fever and other diseases. People living and working near canal water supplied through irrigation stand an increased risk of contracting such diseases associated with water development.

The most serious threat is bilharzia, also known as Schistosomiasis, since the carrier vector is released from an aquatic snail and penetrates human skin that comes in contact with disease-infected water. Bilharzia, which is widespread in the savannah and semi-arid regions of Africa, the Middle East and South America. It has also appeared in Southeast Asia, China, the Philippines , and Sulawesi. Significant increases in the incidence of bilharzia have been documented in Sub-Saharan Africa as a result of irrigation development in Ethiopia, Kenya and Sudan.

In most of these countries, bilharzia infestations have increased among the population at risk at rates from less than 5 percent to 10 percent after the introduction of irrigation schemes. But the incidence of occurrence rose over 80 percent of the population at risk after irrigation in some extreme cases, such as Gezira in Sudan. Recent study by the World Health Organization concluded that the spread of bilharzia in an island nations, such as the Philippines was facilitated by the removal of natural barriers to the snail's migration, because of irrigation project development and construction of roads through rain forests (Barghouti and Le Moigne, 1991).

Availability of large quantities of water in reservoirs and canals is also associated with a variety of other diseases such as liverfluke infections, malaria, Bancroftian filariasis and yellow fever. Water project operations that increased dissolved oxygen levels (such as spillway releases from reservoirs) can adversely affect health by improving breeding conditions for the carrier of onchocerciasis (Cox, 1987).

2.5 IMPACT OF IRRIGATION ON OTHER AREAS OF CONCERN

Small-scale irrigation projects have very little direct impact on energy use. Communal gravity systems do not require oil and pump irrigation would only require modest amounts of petroleum and electricity. There may be, however, some indirect impact on energy if irrigation development brings about increased fertilizer use and other energy-based inputs.

The experience has been that communal irrigation systems enhances greater the participation of farm household in the construction, rehabilitation and maintenance of irrigation systems. The small farmer systems such as the irrigators association involve greater participation of farmers, including women in community and farm level decision making.

2.6 CONCLUSION

Based on the above review, it appears that irrigation results in increased agricultural productivity through increased yield in both wet and dry seasons due to better water control, increased number of croppings per year (that is with the use of early maturing varieties in the case of rice), reduced variability in production through improved control in production environments and to a lesser extent increased physical land area cultivated.

The review also show that the increase in output made possible by irrigation cause the price of rice to decline thereby benefiting the consumers (at the expense of producers) particularly the low income group who spend a large proportion of their budget on food. At the farm level, those who have access to water distribution would received an increase in their resource endowment relative to those who do not receive access. Although irrigation is justified for its productivity, it has been shown that irrigation systems are more advantageous to owners of capital than to owners of labour.

With regards to employment effects, the construction of the irrigation facilities itself provides employment. Studies also show that the additional cropping made possible by irrigation will require more labour, hence employment opportunity is possible.

Though most of the above review deals on the impact of large irrigation systems, the impact of constructing SWIM projects will likely be similar particularly on the possible increase in current productivity and reducing the risk of losing the crop by ensuring the availability of water during the cropping period. As to the environmental effects, the project will lead to increased use of fertilizers and chemicals. However, due to the scale of the project, it is assumed that the impact would be rather small.

CHAPTER 3

METHODOLOGY

3.1. RATIONALE OF ECONOMIC EVALUATION

No country has unlimited supplies of land, labour and capital. Although resources can be combined in many different ways to produce goods and services of various kinds, production possibilities over any given period of time will always be restricted. Every society is thus forced in making decisions about the best use of its resources.

Until quite recently, economic arguments about the advisability of irrigation projects seemed almost superfluous. The obvious richness of irrigated land alone seemed to justify any investment needed. At the same time engineers and politicians tended to regard irrigation engineering works such as large dams and pumping stations as monuments of progress justified by the prestige they conferred on those who built them.

This situation is now changing. While there are often admittedly social and political factors involved in taking decisions about irrigation project there are also very important economic criteria involved. The most readily feasible, hence most profitable irrigation projects, have already been carried out. Moreover, the greenness of irrigated area does not necessarily ensure that the farmers established there will obtain a higher income. Irrigation is no longer necessarily profitable, and in the case of relatively costly projects, the question must always be asked whether the resources devoted to it might not be better employed elsewhere.

Examples of failed public government irrigation projects particularly in developing countries are too numerous to be explained away by mistakes in project planning and selection (Carruthers and Clark, 1981). We have seen the construction of massive irrigation scheme in India and elsewhere that covered too large an area with insufficient water, excessively lengthy canals with inadequate control structures, poorly engineered watercourses with water discharges too large for farmers to cope with, badly levelled fields, with no drainage or public health measures and obviously harmful environmental deterioration and a failure to maintain the capital investment in good order. In the Philippines, a number of the major irrigation projects are performing way below the expectations as in the case of Upper Pampanga River Integrated Irrigation System (UPRIIS).

Gigantism, haste and incompleteness have been triple problems that have stayed with us (Carruthers, 1982).

Many of these irrigation projects built, in the past 25 years, appeared to be economically attractive only because they did not include expensive subcomponents such as proper drainage. It did not take too long before such neglect produced costly results.

In several cases, flaws in the design of the system have had serious negative consequences on its operation due to failure to take into account the important location - specific conditions affecting the system. These location specific conditions must serve as the basis for the technical assumptions used and the design criteria for a particular system. The assessment of current and future site-specific conditions must be realistic to avoid overdesign of the system with respect to its benefitted area as well as to prevent the construction of irrigation facilities which may be non-functional or unutilized resulting from overdesign. Furthermore, operational problems generally arise due to erroneous design criteria or assumptions which are incompatible with actual on-site conditions.

As failure of large-scale irrigation schemes came into light particularly with regards to the negative environmental effects, there was a growing scepticism that irrigation and drainage projects could be justified solely on the basis that they provided significantly increased opportunities for food production, trade, flood control, electricity, and for sustaining water supplies to growing populations in both urban and rural communities. Those benefits could be offset by damage to the environment and social disorientation caused by resettlement of people in the affected areas.

Because of emerging concerns, the cost of supplying water - the key input in the production of major cereals - became greater than the value of the crops and services it provided. This is the basis of the emerging "water problem crisis". To forestall such problems, it is essential to put into place water management plans that view human intervention in the hydrological cycle not as isolated act, but rather view them in terms of the systemwide consequences. A well articulated water investment strategy should provide a framework for analyzing the environmental and other implications of human intervention in the hydrological cycle over the long term.

As we saw in the previous chapter, one of the consequences of the concern about large irrigation projects and the need to help upland farmers increase productivity, has been the development of Small Water Impounding Projects.

In light of the above, it is necessarily desirous, that a more comprehensive economic evaluation be done for any proposed irrigation projects such as the Small Water Impounding Projects, to determine whether they are the appropriate vehicle improve the lives of the rural people and to weigh up the likely consequences of building or foregoing the project. It is believed that benefit-cost analysis, including its application to environmental quality valuation, is a technique that can be used to help the decision makers make more rational decisions about the allocation of scarce resources. This is particularly true in a country like the Philippines where capital resources are scarce .

3.2 THE BENEFIT-COST ANALYSIS FRAMEWORK

Benefit-cost analysis is the principal analytical framework used to evaluate public expenditure decisions. It is an ex-ante approach that attempts to evaluate a project before it is undertaken to decide in what form and at what scale it should be undertaken and indeed whether it should be undertaken at all (Stokey and Zechauser, 1978).

Benefit- cost analysis organises information to reveal the implications of a proposed action for economic efficiency. The basic methodology for the economic evaluation of benefits and costs can be summed up as follows:

* Identify and evaluate the social cost and social benefits of the change in comparable units (where possible).
* Adjust all benefits and costs for the time value of money by discounting.
* Compare discounted benefits and costs using the net present value criterion (NPV) or internal rate of return (IRR) to decide about the economic desirability of the change in one for which the NPV is positive or for which the IRR is greater than the chosen rate of discount.

An economic appraisal provides the decision maker with a systematic and disciplined process to evaluate the desirability of irrigation projects to society. The process however, is based on several assumptions:

1). that benefits and costs are the same to whomever accrue (i.e.the distribution of income is ignored and the current distribution is taken as desirable).

2). that consumers are the best judges of their well being.

3). that market prices reflect social opportunity cost (if this is not so prices need to be adjusted i.e "shadow prices").

How realistic or unrealistic are these assumptions for application of Cost-Benefit Analysis in the Philippines? Taken each assumption in turn:

1). Although it is well known that the income distribution in the Philippines is very uneven and surely cannot be taken as desirable, the application of CBA to small water impoundment schemes may not be to unreasonable. The beneficiaries of the scheme will on the whole by a rather homogenous group of population belonging to the lower or middle income stratum in the country. The people that will pay for the scheme are the general taxpayer. The schemes therefore will to some extent cause a redistribution of income from the general taxpayer to small groups of low income farmers. This direction of redistribution is in line with government policy (which to some extent also reflects society's wishes). Therefore, it is felt that it is not unreasonable to ignore the income redistribution impact.

2) This is hard to dispute. Not accepting this would imply that consumer preferences are based on poor information or formed by irrational people. Although current preferences may be based on very short-term objectives and may be formed in ignorance of the wider consequences

of them (such as environmental impacts of consumption patterns), it is hard to accept that this invalidate them as guide to resource allocation. Where clearly wider consequences are ignored, prices as the result of preferences, can be adjusted to account for that (shadow prices).

3) For several reasons market prices may not truly reflect social cost. One was mentioned already in 2, the presence of environmental costs (externalities). However another reason may be macro policy which can lead (especially in developing country) to an overvalued exchange rate. In this case the true opportunity costs faced by the country are border prices if much of the country's production is exported and inputs imported. These border prices should be expressed in local currency using a shadow exchange rate.

In this particular study, it was felt that the Philippine peso is overvalued by 20 % at the time the project was conceived, hence the currency was shadow priced by 1.2. The country does rely heavily on trade and hence border prices were used for outputs (mainly rice) and inputs (fertilizers). No further price adjustments were made.

3.2.1 Viewpoint of the Analysis

An irrigation project proposal can be viewed critically from several standpoints: (1) that of the central planning organization whose aim is to optimize the allocation of scarce resources within the economy and to achieve a certain set of planning targets; (2) that of the government or regional socio-political organs who in the broadest sense wish to improve the conditions of the people and of the environment; (3) that of the farmers who form the basic operational unit of many projects in the public sector; (4) that of a managing authority in public sector projects who needs a secure flow of appropriate resources (notably financial) to meet the day-to-day needs of the project; and (5) that of the entrepreneur, if he/she is being encouraged to invest his/her capital in the project (Rydzewski,1984).

The choice of viewpoint in project appraisal is significant in determining which cost and benefits are included in the analysis and the appropriate prices at which these costs and benefits should be valued. From the national point of view, only net direct (or primary) costs and return to the scheme are included. Transfer payments such as fertilizer subsidies and charges for water are not included. For the latter, water should be costed at its true opportunity cost. When pricing the additional output expected to be produced from the project area with the scheme, export prices are used when the country is a net exporter of the major commodity or commodities produced. When the country is net importer of a commodity under consideration, an import parity price would be used rather than an equalized or pool price.

In contrast, the economic appraisal of a project from the regional point of view takes into consideration two main areas of impact. These are the total changes in social welfare of the region, and the distribution of the change in welfare between various groups in the region. Many of the factors involved in these two concepts are extremely complex and difficult to analyze. With such constraints, the analysis can be confined to identifying the likely magnitude of increased expenditures of farm materials and services, additional labour requirement during the construction and operational phases of projects, and where appropriate additional income earned by local processing industries.

In the case of this SWIM project, where the evaluation takes the national viewpoint, contingencies, contractor's profit and value-added taxes are ignored in the economic analysis because they are transfer payments.

3.2.2 The With and Without Situation

In order to carry out an analysis two courses of action have to be defined and compared. These are referred to as the "with and without" situation. Small Water Impounding Project when eventually implemented will generate a predictable stream of benefits associated with an equally predictable flow of recurrent costs. The situation which can be predicted to exist if and when the project is carried out is referred to as the " with-project " which will be different from the one expected to exist if this is not carried, the " without-project " situation. The economic assessment of a project consists of comparing the one with the other to determine whether the with-project situation is significantly better than the without project one, and whether the difference between the two is large enough to pay for the cost of the initial investment plus the benefits that the resources required for the investment would have generated elsewhere if the project was not carried out. The critical word here is additionally : what gets compared is the additional benefits the project is expected to generate (i.e. the with-project situation minus the without project one) with the additional costs it implies .

The definition of the without-project situation is usually easy, but may be one of the trickiest part in evaluation of projects involving activities such soil conservation and irrigation. It is usually easier to forecast what will happen if a certain investment activity is carried out than what would if it is not. Accurate forecasting is a prerequisite for quantification of both physical quantities and prices. Typically, problems of prediction will tend to be more difficult on the output side of the project, though the nature of such problems will differ according to the type of project in question. In the case of this project where new technologies (new crops and inland fishery) are being introduced into existing farming systems, the rate of increase in output depends both on the rate at which farmers take up new cropping opportunities and on the yields achieved. These in turn will depends on non-engineering aspects of project design, such as the provision of adequate credit facilities, extension services and timely availability of farm inputs.

3.2.3 Identification of Costs and Benefits

To assess a project's worthiness, it is necessary to identify all costs and all benefits associated with the proposed projects. This must be carried out systematically, going through the network of project activities in order not to overlook any significant items. Both direct and indirect costs and benefits must be included, both on-site and elsewhere, particularly downstream, and those likely to occur in the future. Provision for physical contingencies must always be included, as well as contingencies for price variations whenever appropriate. Costs imposed on and benefits accruing to persons and activities other than those directly linked to the project must be explicitly identified and included. Financial cost and benefits, as well as taxes, subsidies and transfer payments must be included in the analysis at market prices (financial evaluation) but excluded in the analysis at social prices (economic evaluation). Production foregone because of the implementation or operation activities such as the suspension of annual cropping activities while land is levelled must always be included as project costs or as a reduction in project benefits.

Since the SWIM project physically will take place on an area of land, it is important to take note of what use this land is being put into currently and what potential it has for development without the project. It is very rare indeed to find instances where the land to be occupied by the project has absolutely no productive value. The project is viewed as an investment proposal superimposed on the existing condition in the hope of increased benefits accruing as a result of particular investment. The value of the area to be inundated should be considered.

In constructing the cost and benefits streams of cost-benefit analysis, it is convenient in the case of irrigation projects to consider the on-farm cost of agricultural production as a negative benefit.

The gross benefits which are the direct output of the project are not difficult to identify and quantify. But the presence of irrigation will undoubtedly have a more far-reaching effects on the area . These are called externalities which are commonly subdivided into linkage and multiplier effects.

Linkages, which can be forward or backward concern, respectively, the industries that have to be created to process the output and to produce the inputs for the project. In irrigation projects there is no strong evidence of backward linkages, except possibly in the provision of services connected with mechanized agriculture. Forward linkages of this project are the additional milling plants that will handle the expected increased in harvest and perhaps processing industry for mango and cashew nuts.

Multiplier effects relate to the economic activity outside the project generated by the increased spending power of those within the project. The difficulty in handling these effects is in defining the boundaries of the " project" area in both physical and economic terms. The physical boundaries of a project are not conceptually difficult to define but in practice data limitations and computational convenience may lead to a smaller project area being defined than might be theoretically correct. Of a more fundamental nature is the dilemma concerning which external costs and benefits to include in the economic evaluation. Frequently external costs and benefits are no more than transfers of internal costs and benefits and although indeed consequences of the project (and important in regional analysis), to include them in the economic evaluation of the project would be to double-count them. The rule concerning which multiplier effects should be included is that they should be included only in so far as they alter the physical production possibilities of those outside the project area. They should not be taken into account if their sole effect is via prices of products or factors.

3.2.4 Valuation of Costs and Benefits

In the full economic evaluation of a project (i.e from the national viewpoint) certain cost and benefits are correctly valued by market prices but there are a number of instances where the full economic and social values of costs and benefits are not truly reflected by market prices. Firstly, many market prices for commodities included transfer payment elements. Secondly, market prices at best only reflect the economic scarcity (or resource cost) of a commodity and not the social and economic objectives which the government may pursue through project evaluation and selection. Thirdly, because of market imperfection, the market price and resource costs for some commodities may diverge. Fourthly, some costs and benefits are of such a nature that no market price exist for them. If the correct cost-benefit procedure for public sector projects are to be followed "shadow prices" must be determine to value approximately those costs and benefits whose resource cost are not given by their market prices (Copeland, 1979).

To arrive at a more consistent and realistic valuation of benefits and costs, inputs and outputs are valued in terms of international or border prices. Where imports are not expected to affect the foreign supply price or export demand price, the appropriate border prices to use are the projected c.i.f import and f.o.b. export prices. The output of this project, which is mainly rice will be priced comparable to imported goods measured as f.o.b. (free on board including ocean freight and insurance to Philippine port, domestic transport from the point of entry to the point of use). The same calculations will be performed for the imported fertilizers to reflect the true opportunity cost.

3.2.5 Discounting

The investment costs of this project are incurred in the first year of its life; its recurrent cost as well as its benefits show up later. This leads to a cash flow with large negative entries in the first few years which then become more progressively smaller and eventually positive and increase up to the project's " full development" years. But the value of money now is larger than that of money sometime in the future (society's time preference). Because the utility of any quantity of any good is not the same when this quantity is available immediately or in a more or less remote future, a time decreasing weight is applied to quantities obtained at different dates. The discount rate is utilized to make them comparable. The net present value and internal rate of return criteria will be used to judge the overall economic viability of the project.

The choice of social discount rate is not easy. In general, the choice of discount rate is normally governed by opportunity costs of capital, donor or lending agency agreement, cost of money to the government and the national view of the private sector consumption-investment mix in relation to future generations. The actual rate to be used in economic analysis will be country specific and is often established as a matter of government policy. In the case study to be described in Chapter 4 and 5, a government dictated discount rate of 15 per cent is used. However, the sensitivity of the overall result is tested against various discount rate.

CHAPTER 4

THE CASE STUDY

THE CAMAGSINGALAN SMALL WATER IMPOUNDING PROJECT

4.1 THE PROJECT AREA

4.1.1. Location and accessibility

The selected site for the Small Water Impounding Project is located in the province of Pangasinan, which politically belongs to Region I. The province of Pangasinan is located in the southern part of the region. Its boundaries are the province of La Union and Lingayen Gulf which opens to the Luzon Sea in the North, the province of Nueva Viscaya in northeast; Nueva Ecija in the east (Fig 2 and 3 . The province is easily accessible from Manila via Bulacan, Pampanga or Tarlac route. It is approximately 212 kilometres north of Manila and 80 kilometres of Baguio city.

The project site is located in the Municipality of Sual on the western side of Pangasinan. The Agno River, the most prominent among the drainage-ways, stretches to about 97.5 kilometres from San Manuel to Labrador. The Bued River, which is also a major tributary bows out of San Fabian.

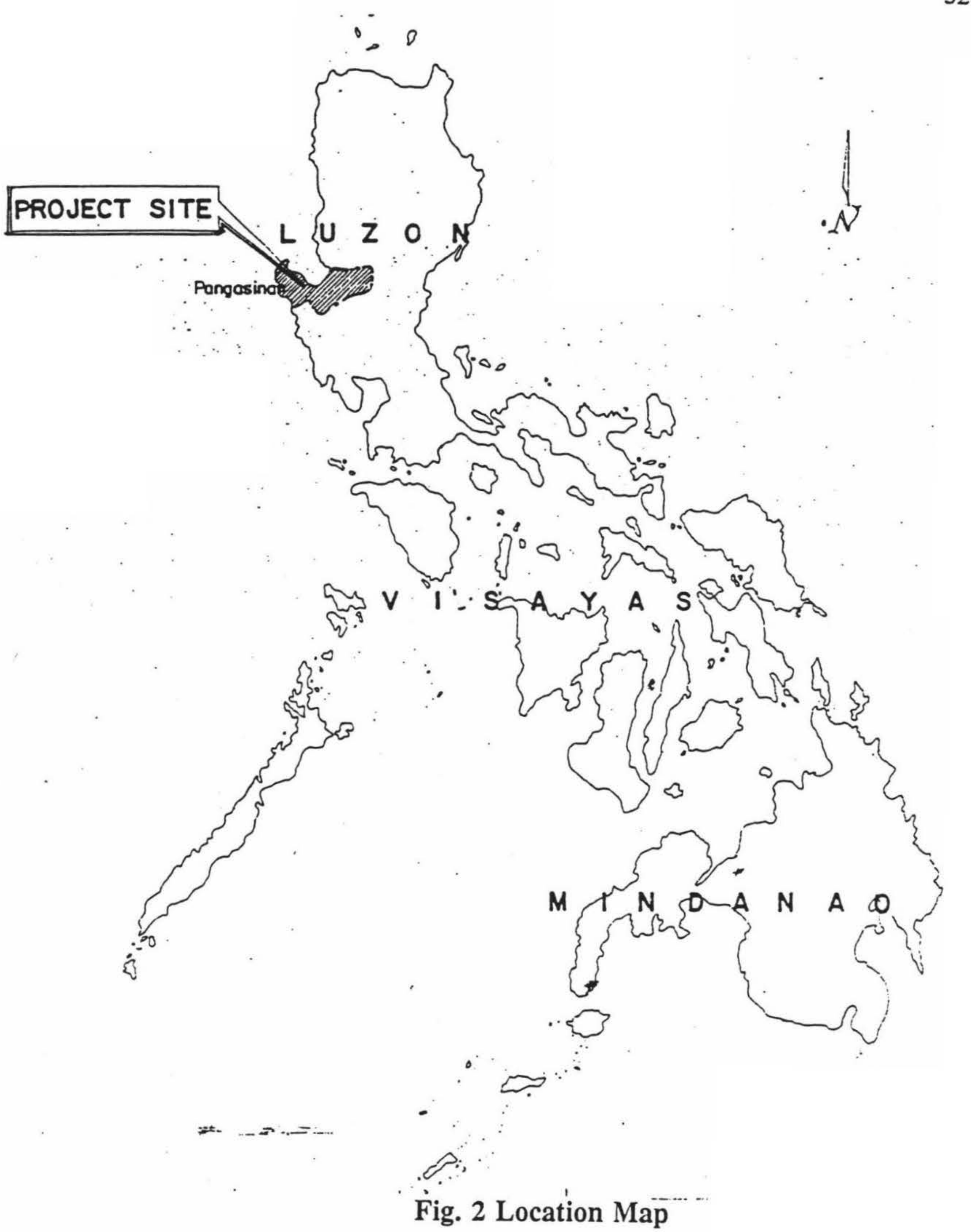

Fig. 2 Location Map

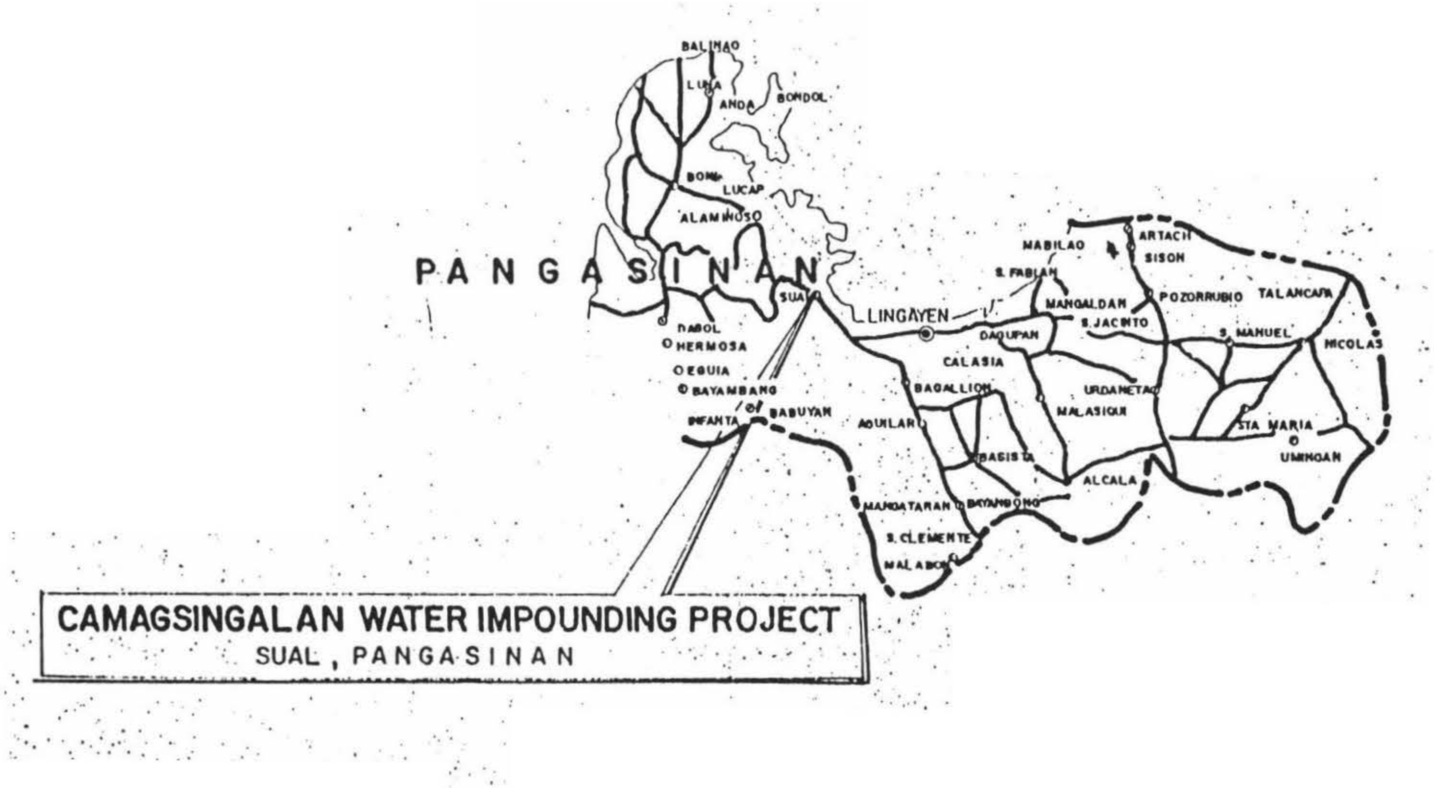

Fig. 3 Vicinity Map

4.1.2. Climate and Water Resources

The province has a Type I climate (Coronas classification) characterized by two pronounced seasons, wet from May to October and dry from November to April. The area is shielded from the northern winds and to some extent from the Pacific tradewinds by the Cordillera and Sierra Madre Mountains, respectively. It is vulnerable to the northwest monsoon and occasionally visited by tropical cyclones or typhoons.

Temperature readings show that on the average, January is the coolest month (24-26°C) while April or May is the warmest month (28°C). The mean annual relative humidity for the province is about 79 percent.

The province generally experiences intense rains during the months of June to September. The distribution of precipitation varies from place to place depending upon the local topographic conditions. Minimum rainfall is found nearest the coastline, while higher rainfall occurs inland at higher altitudes.

The surface run-offs in the Agno River show their peaks in the months of July to September in synchrony with the high monthly rainfalls. Lowest monthly run-offs occur in the dry months of March and April. The surface water resources of the province has been exploited for irrigation, hydropower and to some extent water transport. Flooding hazard is perennially present during the peak rainfall months especially in the floodplain of the major river of the province. Supply for domestic municipal and industrial use is mainly derived from groundwater sources.

Potential exists for the development of upland watersheds into water impounding projects as an economic source of water for irrigating small farm systems planted to both upland and lowland crops, and for operating mini-hydropower for electrification of nearby small rural barangays or sitios. For the benefits of these projects to be realized over a long term, it is important that soil conservation and forest management practices be undertaken in the watershed of these projects.

4.1.3. Physiography and Soil Resources

The project site is located in the slight to moderately dissected undulating to rolling low sedimentary hills with smooth sideslopes and rounded hills and ridges with occasional narrow alluvial valley. Terraced rainfed paddy rice is a common sight on the areas designated as the irrigable area of the project. The service areas are located on the nearly level to gently sloping terrain (0-8 % slope) below the damsites whereas the watershed areas are in the rolling and steeper portions (15-40%) of the low sedimentary hills.

There are five dominant soil series in the project area. These soils are derived from colluvial alluvial materials sedimentary rocks (shale, siltstone and sandstone) and peridotite-gabbro complex. They are therefore generally similar in their physical and chemical characteristics and consequently also in their management requirements.

The general soil texture of the project site ranges from clay loam to clay, and are somewhat poorly drained on the service area and moderately to well drained on the watershed areas. The soil factor, however, makes the site highly suitable for paddy rice production during the periods of continuous rain and for upland crops like corn and mungbean during the dry months. Suitability is also high for orchard crops like mango, cashew, citrus and other fruit trees including cover crops that minimize soil erosion.

The salient feature of the project area and the soil characteristics are summarized below:

	SERVICE AREA	WATERSHED AREA
Hectares	55	86.5
Dominant slope	1-5 %	8-25 %
Soil Series	Bungun clay	Alaminos clay loam
Texture	clay	clay loam
Parent Material	Collu-alluvial materials	sedimentary shale/ sandstone
Drainage	somewhat poorly drained	moderately well drained
Fertility	moderate	moderate

Rainfed rice is the only crop grown in the cultivated areas during the months from July to October with a low yield from 1.4 to 1.6 tons per hectare. This is due primarily to an inadequate and uncertain water supply and the moderate fertility level of the soil. Corn ranks second to rice in terms of area planted followed by mungbean. The yields of these crops are likewise relatively low because of inadequate soil moisture and fertilization.

4.1.4 Watershed Condition

A watershed is a land area drained by streams or fixed bodies of water and their tributaries having a common outlet for surface run-off. Watershed sizes ranges from less than a hectare to several thousand hectares. About 50 per cent of the total land area of the country may be considered watershed. Most of these watershed areas were at one time or another covered with dense vegetation. A few years back these areas were ecologically stable serving as natural water storage complexes. However, present conditions show a continuing degradation of watersheds manifested by accelerated soil erosion, slippage or massive landslides, decreasing land productivity, denuded/open unproductive watershed, frequent flash flooding and drought and massive stream or reservoir sedimentation.

The above conditions are true to most if not all of the watersheds chosen for the various water impounding projects. For this project, about 25.7 hectares is open grass land, 20.05 hectares is planted to paddy rice and vegetables, 19.25 hectares is planted with mango and cashew trees. In general, the watershed condition of the project area is hydrologically unstable, unproductive and denuded.

4.1.5. The Economy of the Project Area

Pangasinan is composed of 40 municipalities and two cities. The 1980 census for the province has a population of 1,636,000 and an average density of 123.15 persons per square kilometres. The population of the town where the small water impounding project will be located is approximately 17,000. The project area is consider an out migration area losing an average of 14.37 persons per 100 population.

The province has basically an agro-based economy. It produces a varied number of agro-based products part of which are consumed within the province and the surplus being sold to other provinces with some being sold to other regions. The provincial products are rice, corn, peanuts, beans, cassava and mungo. In terms of livestock, the province has also cattle, poultry and piggery farms. Present cropping intensity for rice averaged 104 percent with present yield of 0.2 metric tons to 3.1 metric tons per hectare with an average of 2.0 metric tons per hectare.

The average farm size in the project is about 2 hectares as compared to the 3.6 hectares national average. Regarding the land tenure status in the municipality, out of 1,102 farmers in the lease-hold operations 567 are leases and 535 are lessors. In Operation Land Transfer (OLT), there are four (4) landowners under this program involving 23 tenants cultivating a total of 32.94 hectares. However, in the project area, farmer beneficiaries are owner operators.

The commercial activities in the province are primarily centered in Dagupan city, San Carlos city, Urdaneta, Alaminos and Lingayen towns. The service sector activity within the province is primarily centered around trading activities involving the province's agricultural products.

As to the physical infrastructure, the municipalities of western Pangasinan are relatively well covered by a road network. A large portion of this road network is however gravel and dirt roads.

The project area has a relatively young population with an average of 41.88 percent of the population being in the age group of 14 years old. About 43.4 percent of the population are in the labour force with 69.99 percent being employed in productive activities.

With respect to education, there is a high level of literacy among the project beneficiaries which can contribute to the success of the project. The high literacy will make possible the faster assimilation of the whatever introduced technology by the project.

As to market access, the distance of the project site to the major trading centers ranges from 2 to 30 kilometres with an average distance of 10.5 kilometres mostly over a concrete and asphalt roads. Most of the farmers in the project area are exposed to a market economy with many of them cultivating cash crops like peanut, mungbean and beans.

With regard to credit facilities, the project site is located in a municipality which has one rural bank capable of providing credit to the farmer beneficiaries. Farmers have also access to extension facilities through the extension workers from the Department of Agriculture in the municipality or province.

4.2 THE PROJECT

4.2.1. Structural Component

a). DAM - the principal structural component of the project is an earthfill dam built across the main stream where distance between the abutments is narrowed. The main purpose of this structure is to create a reservoir for impounding water upstream. The impounded water will be utilized for the various functions of the small water impounding projects such as irrigation of rice and upland crops, mitigation flood damage downstream by flood-peak attenuation, and fish production or duck raising.

b. SPILLWAY - a safety valve for the dam, which will be constructed to conduct the safe passage of the design flood. The spillway adopted for this study is an ungated chute type. It consist of a flat, open-cut, earth approach channel, a rectangular concrete chute discharge channel and a terminal section provided with a hydraulic jump-type energy dissipator. Horizontal alignment of the spillway is typically on either the left or right abutment alongside the dam embankment. The spillway length is usually shortest along this direction. The spillway discharges immediately downstream of the dam to an existing waterway.

c. OUTLET WORKS - The outlet works is designed to deliver the required amount of water for irrigation. The system consists of flared concrete structure provided with fish screen to prevent the escape of fish from the reservoir. An improvised gate will be provided to allow a shut-off in case of gate valve malfunction. The main line consists of spirally welded steel pipes embedded under the dam embankment to an outlet structure consisting of the following: gate valve, impact type energy dissipator, wasteway and calibrating and measurement section.

d. IRRIGATION SYSTEM - The irrigation system consists of a network of canals and canal structure designed to maintain efficient distribution of water. Due the to small size of the service area, farm ditches take off directly from the canals instead of the conventional main-canal-to-lateral-to-farm ditch scheme in large irrigation system. Farm ditches will be provided with division boxes at their take-off points and will be strategically located to provide efficient water distribution to both lowland and upland irrigation. Division boxes are typically spaced to serve approximately 10 hectares each of the service area.

e. ACCESS ROAD - The construction of the dam and appurtenances will require an access road for the mobilization and transport of heavy equipment and delivery of construction materials to the sites. The access road to be constructed will be provided with ditches at the sides for drainage purposes. This road could later be also be used for transport of farm produce and would have to be maintained by the farmer beneficiaries.

The summary of the structural component of the Small Water Impounding Project is presented below.

Project Particulars

1.	DAM	
	a). Type	modified homogenous backfill
	b). Height(m)	8.52
	c). Crest width (m)	5.0
	d). Crest length (m)	100
	e). Upstream slope	2.75:100
	f). Downstream slope	2.50:100
2.	SPILLWAY	
	a).DISCHARGE CHANNEL	
	Length (m)	46
	Width (m)	7
	Slope (%)	30%
	b). STILLING BASIN	
	Type	II
	Length (m)	4.6
	Width (m)	2.5
3.	OUTLET WORKS	
	a). Type	Flared inlet structure with spirally welded steel pipeline
	b). Pipe diameter (m)	0.20
	c). Pipe length (m)	50
4.	IRRIGATION WORKS	
	a). Canal length (kms)	3
	b). Structure	
	Diversion Box	3
	Drops	2 concrete
5.	ACCESS ROAD	
	a) Type	Gravel surface road

4.2.2. Watershed Development Component

Watershed development is an integral component of the small water impounding projects. It includes all measures involving the manipulation of land, water and other resources in the watershed. Among others, these measures include reforestation, agro-forestation, forest fire protection, dam construction, water impounding, bench terracing and contour farming.

Watershed development measures are necessary to maintain, if not enhance, the productive quality and stable nature of the watersheds. As watershed resources are conserved and developed, soil, water, wildlife and range are also conserve. Soil erosion would be checked or controlled and destructive stream or reservoir sedimentation will be minimized. In addition, sustained flow of quality water from the watershed is assured. As a result, the desired quality and quantity of water needed for storage in the reservoir becomes available. The stored water will ensure sustained supply of water for irrigation and other purposes.

Without the watershed development measures, obstructive soil erosion would be accelerated. Rivers, and the water reservoirs would be silted, reducing their storage capacity and serviceable life. As a result the whole watershed ecosystem would be affected in terms of having a degraded and unproductive watershed, silted reservoirs, undependable water yield and unirrigated farm lands. Consequently, efforts for socio-economic development within the project area or even in the whole country would be thwarted.

To prevent water loss, the project calls for the extension of the effective capacity and life of the reservoir by reducing the rate of sedimentation through the improvement of the watershed. The following are recommended to attain this objective:

1. Establish protection forest on the most critical areas where no other activity should take place because of slope or critical nature of soil protection. Effective watershed cover will insure steady flow of good quality water into the reservoir.
2. Establish production forest or tree farms that need permanent protection but which are less critical so that some forest utilization can take place on a controlled basis.
3. Manage and maintain pasture lands on rotation, based on their carrying capacity and ability to regenerate.
4. Practice contouring, crop rotation, buffer strip planting and multiple cropping in the cultivated areas that form part of the watershed to counter soil erosion.

The development measures to be undertaken in the watershed are primarily vegetative in nature. Priority areas for rehabilitation and development are areas immediately above the water level surface (25 meters and above), 20 meters on both sides of river/stream banks and active gullies, landslides and unstable areas. For this project, fruit bearing trees will be planted in the about forty hectares of the watershed areas (20 hectares for mango and the other 20 hectares will planted with cashew).

A possible constraint on the implementation of watershed development schemes (i.e. plantation development) deals with watershed occupants. There are illegal as well as legal watershed occupants. These occupants need not be resettled, because resettlement, as experience has shown, is very expensive and creates adverse social impacts. An effective strategy is that the occupants will be allowed to stay on the watershed, but should undertake resource-conserving land activities. These activities such as plantation establishment on contours, buffer strip planting, contouring, enrichment plantings and others. In addition, an intensive extension program should be conducted to make the occupants thoroughly understand that attainment of their goals and aspiration can be harmonized with the proposed development schemes.

4.2.3. Fish Production Component

Fish production is one of the objectives of the project. For this small size project, however, a reservoir space allocation exclusively for fish production is not practical. Hence, the space allocated for fish production will also be the pool/storage for irrigation and sedimentation.

One of the species that promises profitable harvests is the noted "tilapia nilotica". From the time the fingerlings are sown, it takes only 70 to 90 days to develop the marketable size for harvest. The marketable size weighs on average 150 grams per piece.

There are two alternative methods to grow tilapia that can be considered for the project. The first method is free spawning i.e. raising tilapia without any control such as cages and nets or fish pens. The other is by raising tilapia in cages. Both methods have a number of advantages and disadvantages. The free spawning has the lesser production and investment cost and requires only minimal maintenance or none at all. The tilapia are allowed to reach any point of the reservoir. In contrast the cage method requires a very high investment cost and periodic maintenance. The tilapia yield is however significantly higher than that produced using the free spawning method.

Materials used for cages plus the enclosure nets are among the items which make up the high investment cost. The materials include wooden frame, bamboo float, and enclosure net, green knotless square mesh 108" wide. Normally one cage occupies 25 square meters of the reservoir.

Although the tilapia species can be harvested after three months from sowing, for this project it is recommended that only two stockings be made in a cropping year. This is to prevent conflict of interest between the reservoir owner and the farmer-beneficiary in the release of water. Since during the fish cropping period, the water level in the reservoir fluctuates over a certain range due to irrigation, the average surface water area during the period should be used as the basis of the stocking density. The timing of stocking should be attuned to the proposed cropping calendar for irrigation.

The recommended stocking density depends on the method of fish cultures. For free spawning, the recommended stocking density ranges from 10,000 to 20,000 fingerlings per hectare of reservoir surface area. Assuming a mortality rate of 20 percent, each hectare of reservoir area is expected to yield 8,000 to 16,000 marketable tilapia. For caged culture, the average stocking density is 150 per cubic meter of water. Assuming the same mortality, at least 120 tilapia can be harvested per cubic meter of water.

4.2.4 Technical Feasibility

a.) Agronomic suitability - The success of the water impounding project depends on the success of the farmers in increasing their yield and net income. Their income comes from the crops they grow, the fish they harvest and the animals they produce. To increase the probability of success, a cropping pattern based on the FAO system of land evaluation was developed. This system multiplies scores (0-100 percent) given to each climate and land characteristics relative to particular land use, the product of which serves as the land suitability index (0-100 percent). The higher the suitability index is, the more suitable the land is to the crop for which it is evaluated. Using the said system of land evaluation, it was found out that the most suitable crop that can be grown during the rainy season (late May to early October) is paddy rice. This crop can be followed by a choice of the following crops which can grown in moderately suitability : virginia tobacco,eggplant, bittergourd, pepper, cowpea, onion, mungbean, and others. The land suitability evaluation for the service areas of the Small Water Impounding Projects in Western Pangasinan is presented. the below:

SOIL SERIES	PADDY RICE	CORN	MUNGO	GARLIC
Tagulod	92%	88%	83%	86%
Quingua	89%	86%	84%	86%
Alaminos	95%	89%	88%	88%
Bungon	94%	88%	89%	85%

LEGEND:

S1 (75 - 100%) Highly suitable, requires minimum recurring inputs for high suitability.

S2 (50 - 75%) Moderately suitable, requires moderate amount of recurring inputs for high suitability.

S3 (25 - 50%) Marginally suitable, requires maximum amount of recurring inputs to produce moderate productivity.

S4 (1 - 25%) Unsuitable for use, cost of improvement will be too high if use for cropping.

The general cropping for this project is presented below:

CROPPING PATTERN FOR THE SMALL WATER IMPOUNDING PROJECT

Jan.	Feb.	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec

/ Fallow or Mongo / Paddy Rice / Garlic,corn,mongo

b). Fertilizer Requirement - In order that yield and profit be optimized, the following fertilizer requirements are recommended:

Rice - The fertilizer requirement for rice will 60 kgs nitrogen, 30 kilograms phosphorous and 30 kilograms potassium per hectare. The fertilizer that can be used is urea, triple 14, and ammonium sulphate.

For garlic, the requirement is 60 to 90 kgs, nitrogen, 30 to 40 kgs. phosphorus and 0 to 40 kgs. potassium.

For mungbean, the required amount is 0 to 20 kgs. nitrogen, 30 to 40 kgs. phosphorus and 0 to 40 kgs. potassium. For other vegetables such as bitter gourd, eggplant and pepper, 4 to 6 bags of complete fertilizer (14-14-14) is necessary.

c). Expected yield - the expected yield of these crops given sufficient water, appropriate fertilizers and enough protection from pest and diseases are:

1.	Paddy rice -	4 to 6 tons per hectare
2.	Virginia tobacco -	1.8 to 2 tons per hectare
3.	Garlic -	2 to 3 tons per hectare
4.	Mungbean -	0.6 to 1.2 tons per hectare
5.	Vegetables -	8 to 10 tons per hectare

4.2.5. Institutional Component

The construction of small water impounding projects has one of the highest government priorities to deal with the basic needs of the small farmers. The effectiveness of the water impounding projects is measured by its implementation success and by how well it caters for the need of the farmers. In most cases, failure of the projects can often be traced to ill-planned implementation strategies and failure of the planners to consider the farmer's response and attitude, and not to the farmer's indifference or "no -concern" attitudes towards the project .

The most common problem encountered during the implementation of any project, is the institutional aspect. Since the water impounding project are so small, operation and maintenance can be handled by a relatively few individuals hence the projects are planned so that the farmer beneficiaries or farmer associations can handle the actual operation and maintenance. The institutional aspect thus becomes a major consideration. It is for this reason that careful planning for implementation strategies for these projects needs to be conducted.

It is recognized that the most appropriate solution to settle the above mentioned problem is to get farmers involvement in the project. Farmers' participation even at the planning stage plays a vital role in the smooth and efficient operation of the project

The institutional aspect of the project can be handled by the Department of Agriculture through the local offices. Extension workers in the locality will be used in the introduction of small water impounding technology, in organizing farmer beneficiaries into associations, educating farmers on the responsibilities and obligations of the associations and providing continuous training for farmers subject that will help in the successful operation and maintenance of the project.

In addition , training programs on crop production with the water impounding projects should be conducted. In areas where new farming technology will be introduced, adaptive trials will be undertaken. Demonstration farms will put up on the project sites, where land-uses other than those traditionally practised will be conducted. This methodology of approach recognizes the fact that the farmers generally have a "to see is to believe" attitude, and that the new technology need first to be proven feasible to them before they adopt it. Adaptive trials and on-site water management training should be done as soon as the water impounding projects become operational.

4.2.6 The Marketing Aspects of the Project

The primary goal of the proposed package is increased output. A marketing system for turning a farmer's increased output into cash is critical to the entire project. The project's output consists of commercial agro-based products principally mango, cashew, garlic , rice, corn, mongo and fish. These products have good market potentials and can be easily absorbed in the municipal and other nearby market centers.

Garlic and mango have good national market as well as export market potential so that any surplus in Pangasinan can be absorbed either in nearby provinces or to the other regions. The projected total rice output can easily be absorbed within the immediate localities of the project area.

As to market accessibility, the project site is located 32 kilometres from Dagupan city (the principal market center), 6 kilometres from Sual market and about 18 kilometres from Alaminos market. The province has sufficient land transport linkages over good concrete and/or gravel roads.

Trucking costs in the Northern and Central Luzon area averages P 1.45 to P1.50 per ton per kilometre depending on road conditions. Surplus commodities such as mango, cashew and garlic can easily be transported to Manila where it has good market potential.

4.3 SUMMARY OF THE PROJECT

The Camagsingalan Small Water Impounding is envisioned to support the regional agricultural development program, by providing irrigation facilities that will enhance the agricultural activities of the area. Together with other support services and the right technology, the project aims to attain self-sufficiency in food. The main products of the project are paddy rice, mungo, corn or garlic. In the remaining area of the watershed, mango and cashew trees will be grown.

In the next chapter, data for the project will be presented together with the economic analysis.

CHAPTER 5

ECONOMIC ANALYSIS

5.1 BASIC ASSUMPTIONS

This study aims to conduct a full economic analysis of the Camagsingalan Small Water Impounding Project from the national viewpoint using the Feasibility Study Report of SWIM Projects prepared by the Bureau of Soils and Water Management, Philippines in 1989. The costs and benefits identified in that report are in constant mid- 1989 prices. The JICA Master Plan Study of SWIM Projects (JICA,1989) was also used as a source for other costs and prices.[1] For this analysis, the same constant mid-1989 prices are used. The question therefore answered by this study is " Was the project at the time it was proposed, economically desirable?" After this question has been answered, trends in costs and prices will be looked to see if the economic desirability has increased or decreased in light of those time trends.

The benefits attributable to Camagsingalan Small Water Impounding Project consist of the net increment in the production of rice, mungbean/garlic, mango and cashew under "with-project" relative to "without- project" conditions. Additional benefits are also derived from fish production which is made possible with the construction of the impounding dam. For the "with" scheme scenario the Small Water

[1]The official exchange rate used in the document is one US dollar equivalent to P 21.80 which is further adjusted by 1.2 correction factor to correct for an overvalued exchange rate, to arrive at P 26.16.

Impounding Project will provide irrigation water which will transform the farming enterprises in the project area from dryland to irrigated farming. The project will encourage multiple cropping systems instead of the monoculture being presently practised. For the "without" scheme situation , the present farming systems (rainfed, monocropping) are assumed to continue. The economic useful life of the project is estimated to be twenty (20) years, and the construction period is four to six months.

5.2 PROJECT COST

The costs needed to complete the project are P 2,392,468.7 for the construction of the an earthdam including its irrigation and outlet works. Details of the cost are presented in Table 1. Annual maintenance cost is estimated to be P 11,962.00 based on half a percent of the construction cost. Land acquisition cost is P 34,500.00 for the 2.3 hectares reservoir area (this cost is based on JICA figures of P 15,000 per hectare for land acquisition in SWIM projects).

5.3 PROJECT BENEFITS

The economic benefits as calculated are explained below:

1. The irrigation benefits are primarily derived from the increased crop production attributable to a stable water supply. These benefits are estimated as the difference of the annual net crop production values under the with and the without

project conditions. The net crop production value is defined as the difference between the gross production value and crop production cost. The irrigation benefits are calculated based on the following assumptions:

(a) The envisaged irrigation areas is 55 hectares. The cropping pattern will be a crop of paddy rice followed by a crop of mungbean (Cropping Pattern 1) or a crop of paddy rice followed by a crop of garlic (Cropping Pattern 2).

(b) The project assumes that the yield of paddy under the with project condition will be 3.5 tons per hectare[2] increasing at the rate of 15 percent (based on the yield of 3.5 tons) per year until the fourth year at which the final yield will stabilise . The yield without the project is about 2 tons/hectare as observed in the project area.

(c) The economic price of rice based on border prices is P 3,690/ton (JICA, p. 106).

(d) Fertilizers are imported either from Europe or from the neighbouring Asian countries. For traded goods such as fertilizers their economic prices are computed based on their border prices . This analysis used the Indonesian f.o.b price (FPA, Fertilizer Statistics) of imported

[2]PCARRD, Philippine Recommends on Rice Production

fertilizers which was then converted to local currency project prices by adjusting for ocean freight and in costs, port handling charges, transport cost to distribution center and transport/handling cost to farm. The entry port in the Philippines is Manila, the distribution center is Dagupan City while the farm is in Sual, Pangasinan. The computed economic prices are P 4.2, P 5.14, P 3.69 and P 4.04 per kilogram for urea, triple superphosphate, superphosphate and muriate of potash respectively. The derivation of fertilizer price structure is presented in Table 2. Fertilizer and other input requirements per hectare are presented in Table 3.

(e) The expected yield of mungbean in the with project condition is 900 kilograms per hectare and the price is P10.00 per kilogram. The yield in the without project situation is only 500 kilograms per hectare. The area cultivated is 20.05 hectares.

(f) The expected yield of garlic is 3000 kilograms with a price of P 25.00 per kilogram. The area cultivated is 55 hectares in the with situation while 20.05 hectares in the without situation.

(g) Additional benefits are expected from the increased number of mango and cashew trees to be planted in the watershed development. Twenty additional hectares each of mango and cashew will be planted in the watershed areas. At 69 trees per hectare, there will be 1380 (20 hectares) mango trees in the with project situation in addition to the 655 (9.5 hectares) mango trees already existing. There are about 2700 (9.75 hectares) cashew trees in the without project situation and 5540 (20 hectares) in the with project situation. The expected yield of mango in the with project is 100 fruits per tree during the first harvest which is on the sixth year, increasing to 200 fruits in the 7th year and 400 fruits in the 8th year onward. The price of mango fruit is P 1.50 per piece. In the without situation, the average yield of mango is 400 fruits per tree. For cashew trees, the assumed yield is 0.5 kilograms in the first harvest which is in the 4th year, then increases to one (1) kilogram in the 5th year. There will be an increase of one kilogram per tree per year starting in the sixth year until the yield stabilises to four kilograms in year 8-20th year. Yield in the without situation is assumed to be four (4) kilograms per tree and the price is P 15.00 per kilogram.

(h) A summary of input and output price and expected yield is presented in Table 4.

(2) Benefits from the inland fishery are obtained from the 2.3 hectares reservoir area. With stocking rate of 10,000 fingerlings per hectare and at 20 per cent mortality rate, there will be an estimated 8,000 fishes per hectare . At marketable size, a kilo of fish is about 7 pieces which cost P 20.00 per kilo.

(3) It is assumed that the extra output will have no impact on market prices and that these can be taken as constant for duration of the project.

Based on the above assumptions, the project resulted in the following benefits:

1. The net benefits in the with project situation, from the first crop which is rice is about P478,438.65 annualy. Compared with the without project situation this results in an increase in net benefits of P 404,620.88 during the first year. Table 5a to 5d shows the cost and return analysis for the with and without project at 15 percent yield increase annually from the base yield of 3.5 tons per hectare.

2. The second crop which is mungbean gives a net annual benefit of P337,310.85 . Compared with the net benefits in the without project situation, an increase in net benefits of P 291,618.41 annually is realized due to project. Table 6 shows the derivation of the incremental value of production in mungbean.

3. If garlic is the second crop, the annual increase in net benefit is P 379,477.55, much larger than that of the mungbean crop. Garlic as the second crop appears to be attractive from the point of view of the net returns. However, it should be noted that this crop requires a larger investments and stricter cultural requirements relative to mungbean crop. Considering that the target beneficiaries are in general small

farmers, capital and technical resources are limited. Compared to the mungbean crop, the net benefits may not be as large as the garlic crop but the manner of growing the crop is not as tedious as the garlic crop. From the point of view of soil conservation, mungbean which is a legume crop contributes to the maintenance of soil fertility. This is not monetized and hence not accounted for in the economic analysis. The derivation of the increase in net benefits for garlic production is presented in Table 7.

4. For the net return of the extra mango production a negative net income with project is observed during the first year up to the fifth year since harvesting will start on the sixth year. However at full development (year 8), net income with project amounts to P 630,446.36 . Table 8 shows the cost and return analysis for the production of mangoes.

5. With regards to the production of cashew, positive net benefit will start in the sixth year increasing up to full development in year eight. The increase in net benefits at full development (year 8) of the cashew trees is P 234,030.60 per year. Table 9 shows the cost and return analysis for the production of cashew.

6. Benefits of inland fishery production are presented in Table 10. For the two crop of fish per year the net income is P 67,560 starting in the second year of the project.

5.4 THE RESULTS

Based on the costs and benefits discussed above, the project will generate a Net Present Value of P 5,361,904.00 at 15 percent discount rate. The internal rate of return is the discount rate which sets the net present value equal to zero, that is where, the discounted total benefit flow equals the discounted total cost flow. The IRR for the Camagsingalan Small Water Impounding Project is 39 per cent using the Cropping Pattern 1 which is based on a crop of rice followed by mungbean. Table 11 summarises the 20 year analysis made for the proposed project.

However, based on Cropping Pattern 2 which is a crop of rice followed by a crop of garlic, the project generates a Net Present Value of P 5,911,844.00. The Internal Rate of Return for this alternative cropping pattern is 41 per cent. It can be attributed to the high profitability of garlic production. However investment cost is also high, so that only those farmers who have the capital can afford to grow garlic. Table 12 presents the summary of the economic analysis for the twenty year period using the alternative cropping pattern.

Sensitivity analysis was conducted to test the sensitivity of the different variables used in the analysis. Varying the prices of rice, urea, superphosphate, triple 14 and muriate of potash, rate of man-animal-day, rate of man-day, construction cost and service area to a degree of -10%, -20%, +10% and +20% from their base scenario values, all exhibit a positive Net Present Value and Internal Rate of Return greater than the discount rate used. Thus sensitivity analysis showed that

Camagsingalan is a profitable investment. Table 13 shows the sensitivity test conducted on the different parameters.

The economic analysis conducted indicates that the Camagsingalan Small Water Impounding project was economically speaking (using 1989 costs and prices) highly viable at the time it was conceived. Examining the price trends from 1990 to 1995, the average price of rice is two hundred ninety two US dollars and seventeen cents (US $ 292.17) while urea and triple superphosphate average price are US $ 139 and US $ 125.83 respectively. At an average exchange rate of P 25.83 to US $ 1, this means that the border price of rice is P 7,546.75, which is higher than the farm gate price (P 3,690/ton) used in the economic analysis. For the imported fertilizers, the border price of urea is equivalent to P 3,500.37 and P 3,250.02 for TSP in local currency. It appears that the current border price of rice is expensive while the cost of imported fertilizers are relatively cheaper than the 1989 prices . This indicates that in light of the above figures the economics of the Camagsingalan Small Water Impounding Project at current day prices, would look even better than they did in 1989. Table 14 shows the price and exchange rate trends of rice and fertilizers.

5.5 WIDER IMPACTS

While the analysis conducted on the Camagsingalan Small Water Impounding Project showed that the project is economically desirable, a variety of environmental effects are not accounted for in the economic analysis. These are the possible effects of the contruction of the dam on the quantity and quality of water in the upstream and downstream areas. Though the scale of the dam of this project is small, in general, construction of impoundments increases the water level of upstream area and decreases the water level downstream. The extent by which this affects the life of the people in those areas is not yet established. Moreover, it is well known that water impoundments and its irrigation canals provide breeding ground for mosquitoes, hence the possibility of incidence of malaria and other water borne related disease are not remote.

The project permits crop diversification. However, sustaining the yields from diversified crops depends on continuing fertilisation using chemical and organic fertilizers. Any failure to replenish the required soil nutrients can quickly lead to a decline in crop yields. This will result in an increased utilisation of chemicals which if not managed properly will result in other problems (such as algal blooms and problems on acquatic weeds) as experienced in lowland farming. Related to this, high level of chemical residues on fruits and vegetables due to improper and extensive use of fertilizers and pesticides have been cited.[3] On the other hand, repeated cultivation of a particular crop as practised in monocropping often leads to the build up of pests and diseases peculiar to them. That is why, the recommended practise for this project is a rotation of rice and mungbean crops or rice followed by garlic.

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[3] cited in the Book Environmental Constraints to Pacific Rim Agriculture (1993) edited by Rae, A. N. and A. D. Meister p.3.

The planting of fruit crops such as mangoes and cashew instead of forest trees in a portion of the watershed surrounding the dam will ensure that not only additional income could be derived but that also a good cover for the watershed is created to sustain the life of the dam. Though perennial crops such as these are less risky than annual crops, the initial investment is quite high while the expected benefits come in later years. This may not be attractive to the farmer where he is constrained by lack of capital. On the other hand, there are illegal occupants in the watershed area who are dependent on the forest trees as source of income. Forest trees when planted will not last long, because they tend to cut these trees for firewood and charcoal purposes. The cutting of these trees will lead to the degradation of the watershed areas due to increased soil erosion as commonly experienced in most of the watershed areas in the country.

Other benefits which are not dealt with in the economic analysis are the benefits in terms of flood and erosion control. The construction of a dam will provide as catchment basin for rainfall and water run-off during rainy season and prevent the water from flowing directly to the lowland areas. The extent of the benefits from flood damage avoidance and soil erosion control by this project have not been studied.

With regards to socio-economic impacts, the project will encourage land use changes with resulting consequences for income, labour, public health and lifestyle. Land use changes will be rather small due to the small scale of the SWIM project. The major impact will be an increase in farm income due to increased productivity, however, the extent of distribution is not yet known. The increased production would also mean increased labour demand, hence the project could provide employment for a number of people on a seasonal basis. This could help ease the problem of unemployment in the upland areas, where at present it is critically high. With regards to nutritional condition, the project will provide a source of protein as a result of the inland fishery component, thereby improving the nutritional condition of the people in the area. The lifestyle of the people may also change by utilizing reservoir areas as recreational sites for swimming, fishing and picnic. These aspects have not been dealt with in this analysis, for the effects are not certain as yet.

Other social impact will be strenthening the institutional structure of the farmer beneficiaries and greater participation in the decision making particularly the management and operation of the dam. As the project will be turned over to the farmer beneficiaries, a clear understanding of the responsibility of each member is crucial in the success and sustainability of the project. However, conflict may arise due to conflict of interest in water users, i.e. irrigation and inland fishery.

The issue of water pricing is not dealt with in this study. The construction of dam is provided free to the farmers since it is funded by the government. This may lead to overuse of the resources as experienced in most publicly provided irrigation systems. Overuse of the resources as in the case of irrigation water has resulted in salinization in some areas. Therefore, water should be treated as scarce resources, and pricing should reflect its scarcity. Pricing of this input so as to provide the necessary economic stability to small farmers without encouraging overuse from enrvironmental sustainability standpoint is important. Since, the number of farmers involved in this project is small compared to large irrigation systems, devising institutional mechanism to solve this problem does not seem too difficult. It should also be emphasized that a good water management is critically connected with efficient fertilizer usage as discussed in the literature review.

CHAPTER 6

SUMMARY AND RECOMMENDATION

6.1 SUMMARY

The Camagsingalan Small Water Impounding Project is envisioned to give the rural community an opportunity to develop their farming systems and thereby increase their income. The project makes this possible through the provision of irrigation infrastructure which will ensure the availability of water throughout the cropping season. As the project site is dependent on rainfall, the current cropping system is limited to rainfed paddy rice, with uncertainty of yield. With the construction of Small Water Impounding Project, the rice areas will increase from 20 hectares to 55 hectares and rice can be grown with certainty due to the availability of water. Likewise, a second crop of mungbean or garlic is possible, not to mention the inland fishery production made possible in the reservoir.

Based on the economic analysis conducted, the Camagsingalan Small Water Impounding project would generate a substantial gain to the province and to the nation in general. This can be attributed to an increase in the volume of rice , mungbean/garlic, mangoes, and cashew harvest. From the present yield of 2.0 tons per hectare rice yield will increase to 5.075 tons per hectare at full development. This would mean a total increase of 239.025 tons or an annual net revenue of P768,182.00 at project's full development. Likewise benefit will be derived from crops of mungbeans resulting to a net benefit of P 291,618.41. Additional income will likewise be derived form the inland fishery production which is estimated to be P 67,560.09 per year. Mango and cashew which are planted in the watershed areas will give an annual net income of P 630,446.36 and P 234,030.60 respectively at full development of the trees.

Benefit-cost analysis shows that Camagsingalan Small Water Impounding Project resulted in a Net Present Value of P 536,194.00 at 15 percent discount rate using the Cropping Pattern 1. The Internal Rate of Return obtained is 39 per cent which is more than the discount rate. On the other hand, using the alternative Cropping Pattern 2, Net Present Value obtained is P 5,911,844.00 and an Internal Rate of Return of 41 per cent. It would appear that, Cropping Pattern 2 is more profitable than Cropping Pattern 1,due to high profitability of garlic crop. However, additional benefits in terms of maintaining/enhancing soil fertility using legumes as the second crop for Cropping pattern 1 was not monetized and hence not included in the cashflow.

Sensitivity analysis conducted indicates the project's return are relatively stable with respect to crucial parameters. Upper and lower limits on the Net Present Value and Internal Rate of Return were calculated for changes in increased construction cost, yields, price of rice and fertilizer inputs, and discount rate. For changes up and below 20 percent of the base value of these parameters, the Internal Rate of Return remained above 15 percent.

In summary, Camagsingalan Small Water Impounding Project based on quantifiable costs and benefits showed that the project is economically desirable.

6.2 RECOMMENDATION

Based on the Net Present Value of this project, it is worthwhile undertaking and should receive a high priority for funding and implementation. Small projects such as SWIM have a high social impact, that is giving the rural people especially those living in the upland areas (who belong to the poorest 30 percent of Filipino households), the opportunity of improving their lives by provision of the necessary irrigation water. This project will provide a system that will allow them to sustainably earn a living from their cultivation, thus dampening the need to expand or transfer to other areas. By promoting this project, the government will not only create new sources of livelihood but will also minimize the damaged caused by inappropriate farming techniques (kaingin or swidden farming) and forest exploitation currently practised. Moreover, peace and order conditions will improve.

However, the success of the project will greatly depend on a lot of factors such as:

(1) participation of the farmer beneficiaries - farmer involvement in the planning of the dam project will give them a clearer understanding of the SWIM technology and how to operate and maintain the structures. It is also needed in drawing up the responsibilities and accountabilities of individual farmers towards the

project. At the same time it will give farmers a sense of ownership which will give them an attitude of responsibility toward the project.

(2) right technology - this means that the technology to be introduced to the farmers must be simple and easy to adopt because farmers tend to shy away from complicated technologies.

(3) extension services - it is necessary that extension workers must be based in the area and must be always available for consultation by the farmers especially during the cropping season,

(4) availability of credit facilities - as the project requires inputs such as seeds and fertilizers, credit facilities should be made available through a simple transaction. Since the target beneficiaries are small farmers, they could not provide suitable collateral normally required by the bank. Therefore a mechanism should be devised whereby farmers could avail such credit similar to informal credit but at lower interest rate.

(5) timely availability of inputs - the project should provide information on where to avail of planting materials and fertilizer inputs or make an arrangement with the distributors to supply the needed inputs sufficiently and timely.

In light of the above, it is recommended that the institutional organisation should be strengthen. The organisation of the farmer beneficiaries should not be limited to irrigators association but to cooperative systems whereby they could handle not only the operation and maintenance of the project but the marketing of the produce as well.

On the other hand, the responsibility of the government should not end with the construction of the dam but should continue in the form of reliable extension services, credit facilities and reliable information on market prices and prospective buyers. Increased lending in the agricultural sector should be provided by increasing the funds for existing guarantee facilities for rural lending. The government should also consider providing direct financial assistance through special credit programs to cover the high cost of credit delivery in remote areas (such as the upland areas as in the case of this project) or to make government agricultural credit support accessible to the small farmers where there are no existing banks. In remote areas where credit transaction cost is high, the government may extend credit to the cooperative, in case of this project, the cooperative formed by the farmer beneficiaries. Group lending will facilitate the systematic delivery of services and a less cumbersome collection of loan repayment. Formal loans should also address subsistence (e.g consumption) and emergency needs of the small farmers. Credit should also considers the labour expenses aside from expenditures for material inputs. Banking institution should simplify and systematize the loaning process to reduce loan processing costs and motivate the small farmers to borrow from these credit institution instead of informal sources where the interest is high. As mentioned in Chapter 4, there is only one rural bank near the project area, therefore, expanding the reach of the rural banks network should be looked into.

Credit alone, however, will not ensure increase farm income. The project should be viewed in the context of the economy as a whole. The project should be implemented along with infrastructural support such as farm to market roads, market facilities and possibly storage facilities.

It is also recommended that a thorough investigation of the environmental impacts of the project as well as the aspect of water charges be done since it has not been covered by this study.

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APPENDIX A

Table 1 DETAILS OF CONSTRUCTION COST CAMAGSINGALAN SWIP

Item No.	Description	Unit	Quantity	Unit Cost	Total Amount in Peso
1	Construction of Camp, other Temporary Facilities and Movement of Equiptment	L.S.	1.00	45000.00	45000.00
2	Field Office	sq.m	36.00	2777.78	100000.08
3	Concrete Bridge				
	3.1 Excavation	cu.m	54.00	44.33	2393.82
	3.2 Backfill	cu.m	50.00	97.50	4875.00
	3.3 Concrete Class A	cu.m	38.02	3872.00	147213.44
	3.4 Reinforcing Bar	kg.	5032.00	23.15	116490.80
	3.5 100 mm STD Pipe	m	2.00	350.00	700.00
	3.6 Bearing Plates (fabricated)	pcs.	6.00	1100.00	6600.00
4	Relocation of 2 houses	L.S.	1.00	36000.00	36000.00
	4.1 Relocation of jetmatic pump	L.S.	1.00	1500.00	1500.00
5	Reservoir and Borrow Area				
	5.1 Clearing and Grubbing	sq.m.	26511.84	2.20	58326.05
6	Dam				
	6.1 Excavation				
	6.1.1 Stripping	cu.m	2180.85	16.32	35591.47
	6.1.2 Core Trench	cu.m	564.00	26.07	14703.48
	6.2 Embankment Fill				
	6.2.1 Slide Borrow	cu.m	10765.53	40.50	436003.97
	6.2.2 Slide Borrow from Core Trench and Spillway	cu.m	2424.00	35.62	86342.88
	6.3 Gravel Blanket	cu.m	223.00	220.20	49104.60
	6.4 Handlaid Riprap for u/s 0.3 m dia.	cu.m	445.00	656.50	292142.50
	6.5 Blanket Sodding on downstream	sq.m	2240.00	15.10	33824.00
	6.6 Gravel Surfacing	cu.m	70.00	203.20	14224.00
	6.7 Toe Drain				
	6.7.1 Rock Toe (Boulders)	cu.m	120.00	321.10	38532.00
	6.7.2 Gravel and Sand Transition Filter	cu.m	161.00	205.90	33149.90
	6.7.3 Fine Sand Transition Filter	cu.m	68.00	205.90	14001.20
7	Spillway				
	7.1 Excavation	cu.m	1860.00	26.07	48490.20
	7.2 Structural Backfill	cu.m	46.00	97.50	4485.00
	7.3 Contrete Class "A"	cu.m	102.70	3872.00	397654.40
	7.4 Reinforcing Steel Bars	kgs	4416.10	23.15	102232.72
	7.5 Levelling Course(Gravel Bedding)	cu.m	18.90	220.19	4161.59
	7.6 Riprap (Grouted)	cu.m	33.43	1196.50	39999.00
8	Outlet Works				
	8.1 Excavation	cu.m	8.55	43.33	8.00
	8.2 Structural Backfill	cu.m	4.27	97.50	416.32
	8.3 Concrete Class "A"	cu.m	1.25	3872.00	4840.00
	8.4 Reinforcing Steel	kgs.	53.75	23.15	1244.31
	8.5 Levelling Course	cu.m	1.62	220.19	356.71
	8.6 Steel Pipe 10"(0.15) x 20' (schedule 40)	pc.	9.00	18166.53	163498.77
	8.7 Gate Valve 10" (0.15) @	assm.	1.00	25755.95	25755.95
	8.8 Trashrack,Fishscreen & Flashboard	L.S.	1.00	1074.94	1074.94
9	Irrigation Works				
	9.1 Excavation	cu.m	270.00	43.33	11699.10
	9.2 Concrete Class "A"	cu.m	3.00	3872.00	11616.00
	9.3 Reinforcing Steel	kg.	36.12	23.15	836.18
	9.4 RCP (0.46 m. @)	m	8.00	799.90	6399.20
	9.5 Grouted Riprap	cu.m	0.82	1196.50	981.13
	TOTAL				2392468.70

Source: Agency Estimates, Bureau of Soils and Water Management

Table 2. FERTILIZER PRICE STRUCTURES, 1989

	UREA	TRIPLE 1	SUPERPH	MUR.POTASH.
Import price,f.o. b. in US$/ton, bagged (1)	138	177	123	135
Ocean freight & ins. to Phil. port (Peso)	360	280	240	280
Port handling charges in Peso	85	85	85	85
Transport cost to distrbn. center(3) in Peso	135	135	135	135
Transport cost distrib. to farm (Peso)	10	10	10	10
Farm gate price (Peso)	4200.08	5140.32	3687.68	4041.6
Economic price/kg (P)	4.20	5.14	3.69	4.04
Economic price/bag(P)	210.00	257.02	184.38	202.08

Source: Fertilizer and Pesticides Authority

1. Official exchange rate,US $ 1.00 = P 21.8
   Adjusted by 1.2 equivalent to P 26.16
2. All the fertilizers are bagged from Indonesia equivalent to 50 kg/bag
   Port of entry is Manila.
3. Dagupan city is the distribution center
   Prices quoted above are in Peso except the f.o.b. price which is in US $

Table 3. FERTILIZER AND OTHER INPUT REQUIREMENT PER HECTARE

CROP		UREA (KGS.)	TRIPLE 14 (KGS.)	POTASH (KGS.)	SUPER P	INSECT.	FUNGICID	FLOWER HORMO	SEEDS/ SEEDLINGS	LUMBER	FEEDS
RICE N	60	65.22				1			50		
P	30		214.29								
K	30										
GARLIC N	90	108.70							1000		
P	40		285.71			2	2				
K	40										
MUNGBEAN	20		142.86			1	1		25		
P	30				50						
K	30			16.67							
MANGO			34.5			1	1	1	69	69	
CASHEW		160	100	100	200	1	1		277		
FISH		100							10000		12

Source : Feasibility Studies oF SWIM Projects

For mango, fertilizer is applied per tree (69 trees/ha)
and the amount of fertilizer increases as the tree get older.
For cashew, the number of trees per hectare is 277.
Urea fertilizer has 46% N, Triple 14 has 14 % N, 14% P & 14% K.,
Superphosphate has 20% P.

Table 4. SUMMARY OF INPUT PRICE, OUTPUT PRICE AND EXPECTED YIELD

INPUT	PRICE	CROP	YIELD	PRICE	HECTAR
UREA	4.20	RICE W/P		3.69	55.00
		1st yr.	3500		
TRIPLE 14	5.14	2nd yr.	4025		
		3rd yr.	4550		
POTASH	4.04	4-20 yr	5075		
SUPER		RICE W/	2000		20.05
PHOSPHATE	3.69				
		GARLIC	2000	25	55.00
INSECT.	145.00	WO			20.05
	78.00	MUNGBEAN		10	
FUNGICIDE	95.00	W/P	900		55.00
(for mango)	1433.00	WO/P	500		20.05
FLOWER					
HORMONE	75.00	MANGO		1.5	20.00
		6th yr.	100		
RICE SEEDS	3.00	7th yr.	200		
		8-20th	400		
GARLIC	35.00	WO/P			9.50
		CASHEW		15	
MUNGBEAN	12.00	W/P			20.00
		4th yr.	0.5		
MANGO	7.00	5th yr.	1		
		6th yr.	2		
CASHEW	2.00	7th yr.	3		
		8-20th	4		
FISH	0.05				
FEEDS	48.00				
LUMBER	35.00	WO/P	4		9.75
RATE/M-A-D	35.00	FISH 1st	1142.86	20	2.30
		2nd			1.30
RATE/M-D	15.00				

Source : Feasibility Studies of SWIM Projects

Table 5 a. COST AND RETURN FOR RICE PRODUCTION (1st yr.)

	WITH PROJ. (55 HAS)			W/O PROJ. (20.05 HAS.)		
	M-A-D	M-D	VALUE	M-A-D	M-D	VALUE
1 LABOUR COST						
Seedbed prep.	55		1925.00	20.05		701.75
Sowing/seedling care	55		1925.00	20.05		701.75
Plowing	495		17325.00	180.45		6315.75
Harrowing	385		13475.00	140.35		4912.25
Prep.planting mat.		440	6600.00		160.4	2406.00
Hauling	27.5		962.50	10.025		350.88
Planting/transp.		825	12375.00		300.75	4511.25
Weeding		110	1650.00		40.1	601.50
Fert.Apllication		110	1650.00		40.1	601.50
Pest.Appl.		110	1650.00		40.1	601.50
Weed Control		110	1650.00		40.1	601.50
Harvesting		825	12375.00		300.75	4511.25
Treshing			35516.25			7398.45
Drying/bagging			21309.75			4439.07
Hauling	137.5		9625.00	50.125		2005.00
Sub-Total	1155	2530	140013.50	421.05	922.3	40659.40
2 INPUT COST	QTY.					
Seeds	2750.00		8250.00	1002.50		3007.50
Urea	3586.96		15065.50	1307.61		5492.06
Triple 14	11785.71		60582.34	4296.43		22085.02
Insecticides	55.00		7975.00	20.05		2907.25
Sub-total			91872.85			33491.83
TOTAL COST			231886.35			74151.22
GROSS INCOME	192500		710325	40100		147969
NET INCOME			478438.65			73817.78
NET BEN.TO PROJ.			404620.88			

Source : Feasibility Studies of SWIM Projects

1. M-A-D means Man-animal-day at the rate of P 35.00 per day
2. M-D means Man-day at the rate of P 15.00 per day
3. Yield per hectare Without project = 2.0 tons
4. Yield per hectare With Project = 3.5 tons with 15 % increase per year up to the 4th year.

Table 5b. COST AND RETURN FOR RICE PRODUCTION (2nd yr.)

		WITH PROJ. (55 HAS)			W/O PROJ. (20.05 HAS.)		
		M-A-D	M-D	VALUE	M-A-D	M-D	VALUE
1	LABOUR COST						
	Seedbed prep.	55		1925.00	20.05		701.75
	Sowing/seedling care	55		1925.00	20.05		701.75
	Plowing	495		17325.00	180.45		6315.75
	Harrowing	385		13475.00	140.35		4912.25
	Prep.planting mat.		440	6600.00		160.4	2406.00
	Hauling	27.5		962.50	10.025		350.88
	Planting/transp.		825	12375.00		300.75	4511.25
	Weeding		110	1650.00		40.1	601.50
	Fert.Apllication		110	1650.00		40.1	601.50
	Pest.Appl.		110	1650.00		40.1	601.50
	Weed Control		110	1650.00		40.1	601.50
	Harvesting		825	12375.00		300.75	4511.25
	Treshing			40843.69			7398.45
	Drying/bagging			24506.21			4439.07
	Hauling	137.5		11068.75	50.125		2005.00
	Sub-Total	1155	2530	149981.15	421.05	922.3	40659.40
2	INPUT COST	QTY.		2.00			
	Seeds	2750.00		8250.00	1002.50		3007.50
	Urea	3586.96		15065.50	1307.61		5492.06
	Triple 14	11785.71		60582.34	4296.43		22085.02
	Insecticides	55.00		7975.00	20.05		2907.25
	Sub-total			91872.85			33491.83
				8.00			
	TOTAL COST			241854.00			74151.22
	GROSS INCOME	221375		816873.75	40100		147969
	NET INCOME			575019.75			73817.78
	NET BEN.TO PROJ.			501201.98			

Source : Feasibility Studies of SWIM Projects

1. M-A-D means Man-animal-day at the rate of P 35.00 per day
2. M-D means Man-day at the rate of P 15.00 per day
3. Yield per hectare Without project = 2.0 tons
4. Yield per hectare With Project = 4.025 tons

Table 5c. COST AND RETURN FOR RICE PRODUCTION (3rd yr.)

		WITH PROJ. (55 HAS)			W/O PROJ. (20.05 HAS.)		
		M-A-D	M-D	VALUE	M-A-D	M-D	VALUE
1	LABOUR COST						
	Seedbed prep.	55		1925.00	20.05		701.75
	Sowing/seedling care	55		1925.00	20.05		701.75
	Plowing	495		17325.00	180.45		6315.75
	Harrowing	385		13475.00	140.35		4912.25
	Prep.planting mat.		440	6600.00		160.4	2406.00
	Hauling	27.5		962.50	10.025		350.88
	Planting/transp.		825	12375.00		300.75	4511.25
	Weeding		110	1650.00		40.1	601.50
	Fert.Apllication		110	1650.00		40.1	601.50
	Pest.Appl.		110	1650.00		40.1	601.50
	Weed Control		110	1650.00		40.1	601.50
	Harvesting		825	12375.00		300.75	4511.25
	Treshing			46171.12			7398.45
	Drying/bagging			27702.67			4439.07
	Hauling	137.5		12512.50	50.125		2005.00
	Sub-Total	1155	2530	159948.80	421.05	922.3	40659.40
2	INPUT COST	QTY.					
	Seeds	2750.00		8250.00	1002.50		3007.50
	Urea	3586.96		15065.50	1307.61		5492.06
	Triple 14	11785.71		60582.34	4296.43		22085.02
	Insecticides	55.00		7975.00	20.05		2907.25
	Sub-total			91872.85			33491.83
	TOTAL COST			251821.65			74151.22
	GROSS INCOME	250250		923422.5	40100		147969
	NET INCOME			671600.85			73817.78
	NET BEN.TO PROJ.			597783.08			

Source : Feasibility Studies of SWIM Projects
1. M-A-D means Man-animal-day at the rate of P 35.00 per day
2. M-D means Man-day at the rate of P 15.00 per day
3. Yield per hectare Without project = 2.0 tons
4. Yield per hectare With Project = 4.55 tons

Table 5d. COST AND RETURN FOR RICE PRODUCTION (4th yr.)

	WITH PROJ. (55 HAS)			W/O PROJ. (20.05 HAS.)		
	M-A-D	M-D	VALUE	M-A-D	M-D	VALUE
1 LABOUR COST						
Seedbed prep.	55		1925.00	20.05		701.75
Sowing/seedling care	55		1925.00	20.05		701.75
Plowing	495		17325.00	180.45		6315.75
Harrowing	385		13475.00	140.35		4912.25
Prep.planting mat.		440	6600.00		160.4	2406.00
Hauling	27.5		962.50	10.025		350.88
Planting/transp.		825	12375.00		300.75	4511.25
Weeding		110	1650.00		40.1	601.50
Fert.Apllication		110	1650.00		40.1	601.50
Pest.Appl.		110	1650.00		40.1	601.50
Weed Control		110	1650.00		40.1	601.50
Harvesting		825	12375.00		300.75	4511.25
Treshing			51498.56			7398.45
Drying/bagging			30899.14			4439.07
Hauling	137.5		13956.25	50.125		2005.00
Sub-Total	1155	2530	169916.45	421.05	922.3	40659.40
2 INPUT COST	QTY.					
Seeds	2750.00		8250.00	1002.50		3007.50
Urea	3586.96		15065.50	1307.61		5492.06
Triple 14	11785.71		60582.34	4296.43		22085.02
Insecticides	55.00		7975.00	20.05		2907.25
Sub-total			91872.85			33491.83
TOTAL COST			261789.30			74151.22
GROSS INCOME	279125		1029971.2	40100		147969
NET INCOME			768181.95			73817.78
NET BEN.TO PROJ.			694364.18			

Source : Feasibility Studies of SWIM Projects
1. M-A-D means Man-animal-day at the rate of P 35.00 per day
2. M-D means Man-day at the rate of P 15.00 per day
3. Yield per hectare Without project = 2.0 tons
4. Yield per hectare With Project = 5.075 tons

Table 6. COST AND RETURN FOR MUNGO PRODUCTION

		WITH PROJECT (55 HAS.)			W/O PROJ. (20.05 HAS.)		
		M-A-D	M-D	VALUE	M-A-D	M-D	VALUE
1	LABOUR COST						
	Land Prep						
	a. 1st plowing	275		9625	100.25		3508.75
	b. 1st Harrowing	220		7700	80.20		2807.00
	c. 2nd plowing	275		9625	100.25		3508.75
	d. 2nd Harrowing	165		5775	60.15		2105.25
	e. Furrowing	110		3850	60.15		2105.25
	Fertilzer Appl.		110	1650		40.10	601.50
	Seeding		275	4125		100.25	1503.75
	Hilling up	165		5775	60.15		2105.25
	Thinning/replanting		110	1650		40.10	601.50
	Weeding		275	4125		100.25	1503.75
	Spraying		330	4950		120.30	1804.50
	Harvesting/thresh.		1100	16500		401.00	6015.00
	Drying/cleaning		110	1650		40.10	601.50
	Sub-total	1210	2310	77000	461.15	842.10	28771.75
2	MATERIAL INPUTS		QTY.	VALUE		QTY.	VALUE
	Seeds		1375	16500		501.25	6015.00
	Fertilizers						
	a.Inoculant		55.00	440.00			
	b.Triple 14		7857.14	40388.23		2864.29	14723.35
	c. Fert.K		916.67	3704.80		334.17	1350.57
	d. Superphosphate		2750.00	10141.12		1002.50	3696.90
	e. Insecticides		55.00	4290.00			
	f. Fungicide		55.00	5225.00			
	Sub-total			80689.15			25785.81
	TOTAL COST			157689.15			54557.56
	GROSS INCOME			495000.00			100250
	NET INCOME			337310.85			45692.44
	NET BENEFIT TO PROJECT			291618.41			

Source : Feasibility Studies of SWIM Projects

1. M-A-D means Man-Animal-Day at the rate of P 35.00 /day
2. M-D means Man-day at the rate of P 15.00/day
3. Yield of Mungbean without the project = 500 kgs/ ha.
4. Yield of Mungbean With Project = 900 kgs/ha

Table 7. COST AND RETURN FOR GARLIC PRODUCTION

		WITH PROJ. (55 HAS)			W/O PROJ. (20.05 HAS.)		
		M-A-D	M-D	VALUE	M-A-D	M-D	VALUE
1	LABOUR COST						
	Land preparation						
	a. 1st plowing	385		13475	140.35		4912.25
	b. 2nd plowing	275		9625	100.25		3508.75
	c. Harrowing	440		15400	160.40		5614.00
	d. Clove separation		275	4125		100.25	1503.75
	e. Seed/clove treat.		110	1650		40.10	601.50
	f. Fert.Appl.		220	3300		80.20	1203.00
	g. Mulching		1100	16500		401.00	6015.00
	h. Planting		1650	24750		601.50	9022.50
	i. Insect/fungic.appl.		275	4125		100.25	1503.75
	j. Handweeding		440	6600		160.40	2406.00
	k. Harvest.drying		1375	20625		501.25	7518.75
	Sub-total	1100	5445	120175	401.00	1984.95	43809.25
2	MATERIAL INPUT						
	1. Seeds(clove)		55000.00	1925000.00		20050.00	701750.00
	2. Fertilizers						
	a. Urea		5978.26	25109.17		2179.35	9153.44
	b. Triple 14		15714.29	63510.86		5728.57	23152.59
	3. Insecticide		110.00	8580.00		40.10	3127.80
	4. Fungicide		110.00	10450.00		40.10	3809.50
	Sub-total			2032650.03			740993.33
	TOTAL COST			2152825.03			784802.58
	GROSS INCOME			2750000.00			1002500.00
	NET INCOME			597174.97			217697.42
	NET BENEFIT TO PROJECT			379477.55			

Source : Feasiblity Studies of SWIM Projects
1. M-A-D means Man-animal-day at the rate of P 35.00/day
2. M-D means Man-day at the rate of P 15.00/ha.
3. Yield of garlic = 2,000 kgs/ha

Table 8. COST AND RETURN FOR MANGO PRODUCTION (20 hectares)

		YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		YEAR 8-20	
		QTY.	VALUE	QTY.	VALUE	QTY.	VALUE	QTY.	VALUE	QTY.	VALUE	QTY.	VALUE	QTY	VALUE	QTY.	VALUE
1	LABOUR COST																
	1. Staking,digging																
	and planting	10	150														
	Replanting			10	150												
	2.Tree guard fixing	3	45														
	3.Ring weeding and					12	180	12	180	12	180	12	180	12	180	12	180
	fert.application	12	180	12	180	4	60	4	60	4	60	4	60	4	60	4	60
	4.Spraying fungicide	6	90	6	90	6	90	6	90	6	90	29	435	29	435	29	435
	5 Spraying Hormones											6	90	6	90	6	90
	6.Harvesting											15	225	15	225	15	225
	7.Hauling											69	345	207	1035	345	1725
	8.Miscellaneous		200		200		200		200		200		200		200		200
	Sub-total		665		620		530		530		530		1535		2225		2915
2	MATERIAL INPUT																
	Grafted Mango	69	483	10	70												
	Fertilizers	34.50	177.34	34.50	177.34	34.50	177.34	34.50	177.34	34.50	177.34	69.00	354.68	69.00	354.68	69.00	354.68
	Insecticide	1	78	1	78	1	78	1	78	1	78						
	Fungicide											1	1433	1	1433	1	1433
	Flower hormone											69	5175	69	5175	69	5175
	Lumber for tree guard	69	2415														
	Sub-total		3153.34		325.34		255.34		255.34		255.34		6962.68		6962.68		6962.68
	TOTAL COST/HA		3818.34		945.34		785.34		785.34		785.34		8497.68		9187.68		9877.68
	TOTAL COST (20 HAS.)	20	76366.82		18906.82		15706.82		15706.82		15706.82		169953.64		183753.64		197553.64
	YIELD/HA												6900		13800		27600
	TOTAL YIELD (20 HAS)												138000		276000		552000
	GROSS INCOME/HA												10350		20700		41400
	TOTAL GROSS INCOME	1.5											207000		414000		828000
	NET INCOME/HA		-3818.34		-945.34		-785.34		-785.34		-785.34		1852.32		11512.32		31522.32
	TOTAL NET INCOME		-76366.82		-18906.82		-15706.82		-15706.82		-15706.82		37046.36		230246.36		630446.36

Source : Feasibility Studies of SWIM Projects

1. At 69 trees per ha. there will be 1380 trees in 20 hectares

2. Yield of mango is 100 fruits/tree starting the 6th year, 200 in the 7th year, 400 in 8-20th year.

3. Price of mango/ piece = P 1.50

Table 9. COST AND RETURN FOR CASHEW PRODUCTION (20 hectares)

	YEAR 1		YEAR 2		YEAR 3		YEAR 4		YEAR 5		YEAR 6		YEAR 7		YEAR 8- 20 TH	
	OTY.	VALUE	OTY		OTY	VALUE	OTY.	VALUE	OTY.	VALUE	OTY.	VALUE	OTY.	VALUE	OTY.	VALUE
1 LABOUR COST																
Land clearing	20	300														
Staking & digging	277	277														
Planting	4	60														
Ring weeding	18	270	2	30	24	360	24	360	24	360	24	360	24	360	24	360
Spraying	4	60	2	30	8	120	8	120	8	120	8	120	8	120	8	120
Fert.application	4	60	4	60	4	60	8	120	8	120	8	120	8	120	8	120
Replanting	1	15	1	15												
Harvesting & hauling					3	45	4	60	6	90	6	90	6	90	6	90
Miscellaneous		100		100		100		100		100		100		100		100
Sub-total		1142		235		685		760		790		790		790		790
2 MATERIAL INPUT																
Seedlings	277	554.00	15	30.00												
Fertilizer																
Triple 14	100	514.03	100	514.03												
Superphosphate			200	737.54	200	737.54	200	737.54	400	1475.07	400	1475.07	400	1475.07	400	1475.07
Muriate of potash					100	404.16	150	606.24	200	808.32	200	808.32	300	1212.48	300	1212.48
Urea					160	672.01	160	672.01	160	672.01	192	806.42	192	806.42	224	940.82
Insecticides	1	78.00	2	156.00	2	156.00	2	156.00	2	156.00	2	156.00	3	234.00	3	234.00
Fungicides					1	95.00	1	95.00	2	190.00	2	190.00	2	190.00	2	190.00
Kaing (basket)					3	10.20	8	27.20	10	34.00	15	51.00	15	51.00	20	68.00
Sacks					1	1.35	3	4.05	5	6.75	5	6.75	5	6.75	6	8.10
		8.00														
Sub-total		1146.03		1437.57		2076.26		2298.04		3342.15		3493.56		3975.72		4128.47
TOTAL/HA		2288.03		1672.57		2761.26		3058.04		4132.15		4283.56		4765.72		4918.47
TOTAL COST (20 HA)		45760.64		33451.36		55225.18		61160.78		82643.10		85671.15		95314.35		98369.40
YIELD PER HECTARE								138.50		277.00		554.00		831.00		1108.00
TOTAL YIELD								2770.00		5540.00		11080.00		16620.00		22160.00
GROSS INCOME/HA								2077.50		4155.00		8310.00		12465.00		16620.00
GROSS INCOME								41550.00		83100.00		166200.00		249300.00		332400.00
NET INCOME/HA		-2288.03		-1672.57		-2761.26		-980.54		22.85		4026.44		7699.28		11701.53
NET INCOME		-45760.64		-33451.36		-55225.18		-19610.78		456.90		80528.85		153985.65		234030.60

Source : Feasbility Studies of SWIM Projects

1. At 277 cashew trees per hectare there will be 5540 trees in 20 hectares

2. Yield of Cashew is 0.5/tree starting the 4th year, 1 kg in 5th yr.,2 kg in 6th yr., 3 kg in 7th yr, 4kg in 8th yr.

3. Yield in the without project is 5 kg./tree

4. Price of Cashew nuts = P 15.00/kg

Table 10. COST AND RETURN FOR FISH PRODUCTION

		CROP I			CROP2		
		QTY	COST	VALUE	QTY	COST	VALUE
1	POND AREA	2.3			1.3		
2	LABOUR COST						
	Care & Maintenance	2	500	3500	2	500	3500
	Harvesting	4	15	60	4	15	60
	Hauling	4	15	60	4	15	60
	Sub-Total			3620			3620
3	MATERIAL INPUT						
	Stocks	23000	0.1	2300.00	13000	0.1	1300.00
	Fert.	230		966.02	130		546.01
	Feeds	27.6	48	1324.80	15.6	48	748.80
	Fishing net			300.00			
	Sub-total			4890.82			2594.81
	TOTAL			8510.82			6214.81
	PRODUCTION (kgs.)			2628.57			1485.71
	VALUE OF PRODUCE/CROP			52571.43			29714.29
	NET RETURN			44060.61			23499.48
	TOTAL NET RETURN/YR.			67560.09			

Source : Feasibility Studies of SWIM Projects

1. Pond area is 2.3 hectares for the 1st crop and 1.3 ha for the 2nd crop
2. Stocking rate is 10,000/ha and mortality rate is 20 %
3. No. of fish per kg is 7 pieces and the price/kg = P 20.00

Table 11 BENEFIT COST ANALYSIS OF CROPPING PATTERN 1*

YEAR	Capital Cost	Land Acq. Cost	O & M Cost	NET REVENUE WITH PROJECT Rice	Mungbea	Mango	Cashew	Fish	TOTAL	NET REV. W/O PR Rice	Mungbea	TOTAL	MARGIN BENEFIT	NET CAS FLOW	P.V 0.15
0	2392469	34500												-2426969	-2426969
1			11962	478439	337311	-76367	-45761		693622	73818	45692	119510	574112	562149	488826
2			11962	575020	337311	-18907	-33451	67560	927533	73818	45692	119510	808022	796060	601936
3			11962	671601	337311	-15707	-55225	67560	1005540	73818	45692	119510	886030	874067	574713
4			11962	768182	337311	-15707	-19611	67560	1137735	73818	45692	119510	1018225	1006263	575334
5			11962	768182	337311	-15707	457	67560	1157803	73818	45692	119510	1038293	1026330	510268
6			11962	768182	337311	37046	80529	67560	1290628	73818	45692	119510	1171118	1159156	501135
7			11962	768182	337311	230246	153986	67560	1557285	73818	45692	119510	1437775	1425812	536016
8			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	623094
9			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	541820
10			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	471148
11			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	409694
12			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	356256
13			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	309788
14			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	269381
15			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	234244
16			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	203690
17			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	177122
18			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	154019
19			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	133930
20			11962	768182	337311	630446	234031	67560	2037530	73818	45692	119510	1918020	1906057	116461

NPV = 5361904

IRR = 0.39

* Cropping Pattern 1 is based on crop of Rice - Mungbean with Mango, Cashew and Fish.

Table 12 BENEFIT COST ANALYSIS FOR CROPPING PATTERN 2**

YEAR	Construc. Cost	Land Acq. Cost	O & M Cost	NET REVENUE WITH PROJECT Rice	Garlic	Mango	Cashew	Fish	TOTAL	NET REV. W/O PR Rice	Garlic	TOTAL	MARGIN BENEFIT	NET CAS FLOW	P.V. 0.15
0	2392469	34500												-2426969	-2426969
1			11962	478439	597175	-76367	-45761		953486	73818	217697	291515	661971	650009	565225
2			11962	575020	597175	-18907	-33451	67560	1187397	73818	217697	291515	895881	883919	668370
3			11962	671601	597175	-15707	-55225	67560	1265404	73818	217697	291515	973889	961926	632482
4			11962	768182	597175	-15707	-19611	67560	1397599	73818	217697	291515	1106084	1094122	625568
5			11962	768182	597175	-15707	457	67560	1417667	73818	217697	291515	1126152	1114190	553949
6			11962	768182	597175	37046	80529	67560	1550492	73818	217697	291515	1258977	1247015	539119
7			11962	768182	597175	230246	153986	67560	1817149	73818	217697	291515	1525634	1513671	569045
8			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	651815
9			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	566795
10			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	492866
11			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	428579
12			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	372677
13			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	324067
14			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	281798
15			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	245041
16			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	213079
17			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	185286
18			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	161119
19			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	140103
20			11962	768182	597175	630446	234031	67560	2297394	73818	217697	291515	2005879	1993916	121829

**Cropping Pattern 2 is based on Crop of Rice - Garlic with Mango, Cashew and Fish.

NPV = 5911844

IRR = 0.41

Table 13. SENSITIVITY TEST

Comparative Table of NPV (in Pesos) and IRR (in percent)

OBJECT OF THE TEST (Parameters)	WITH A VARIATION OF									
	+10%		+20%		-10%		-20%			
	NPV	IRR	NPV	IRR	NPV	IRR	NPV	IRR	NPV	IRR
1. Construction Cost	5115169	0.3589	4868435	0.3359	5608639	0.4179	5855373	0.4570		
2. Price of Rice	5822972	0.4070	6284039	0.4283	4900837	0.3648	4439770	0.3439		
3. Labour cost										
M-A-D	5363222	0.3859	5364540	0.3860	5360587	0.3858	5359269	0.3857		
M-D	5361160	0.3858	5360416	0.3858	5362649	0.3859	5363393	0.3859		
4. Fertilizer price (f.o.b.)										
Urea	5349544	0.3853	5337183	0.3848	5374265	0.3863	5386625	0.3863		
Triple 14	5321293	0.3838	5280683	0.3817	5402515	0.3879	5443126	0.3900		
Superphosphate	5347066	0.3853	5332228	0.3847	5376742	0.3864	5391581	0.3870		
Muriate of Potash	5352989	0.3856	5344074	0.3853	5370819	0.3861	5379734	0.3864		
6. Service area	6007718	0.4164	6653531	0.4474	4716091	0.3557	4070278	0.3260		
7. Discount rate	4594090	0.3858	3935406	0.3858	6262185	0.3858	7324209	0.3858		
8. Base Data (Cropping Pattern 1)									5361904	0.3858

Table 14. Price and Exchange rate Trends, 1990-1995

Year	Exch.rate (Peso)	Rice (US$)	Urea (US$)	TSP (US$)
1990	24.39	287	137	132
1991	27.77	314	172	133
1992	25.64	287	140	121
1993	27.02	280	118	115
1994	25.61	285	127	122
1995*	24.57	300	140	132
Average	25.83	292.17	139.00	125.83

Sources:

1. FAO Yearbook, Vol. 47 for the exchange rate

2. The World Bank, Price Prospects for Major Primary Commodities 1990-2005.

3. 1995 is World Bank projected value