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Economic analysis of the Nazareth sector colonization prospective project

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**ECONOMIC ANALYSIS OF THE HAZARETH
SECTOR COLONIZATION PROSPECTIVE PROJECT**

by

159

Jorge Cossio L.

**A Thesis Submitted to the
Graduate Faculty in Partial Fulfillment
of the Requirements for the Degree of
MASTER OF SCIENCE**

Major Subject: Agricultural Economics

Signatures have been redacted for privacy

**Iowa State University
of Science and Technology
Ames, Iowa**

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I. INTRODUCTION

During the last years the Peruvian government has paid considerable attention to the development of (1) irrigation programs in the Coast, (2) water control programs in the Sierra, and (3) colonization projects in the Jungle regions of the country for improving and increasing the production of the agricultural sector.

Important reasons for which colonization programs in the Jungle deserve special consideration include (1) the existence of fertile lands in the eastern slope of the Andes; (2) the possibility of growing a wide variety of crops in various sub-climates; (3) the possibility of redistributing labor resources from overpopulated areas (mainly in the Coast and Sierra regions) to Jungle underpopulated areas, thus reducing the prevailing disguised unemployment; (4) the convenient development of potential agricultural resources in accordance to the high dependence the Peruvian economy has with respect to the agricultural sector; (5) the alternative of avoiding political conflicts with action aimed at unused new land instead of coping with going concerns (latifundia); and (6) the need for integrating remote Jungle areas into the national economy. In addition, it should be noted that the important marginal Jungle road project implies the need for an urgent complementary action oriented at the colonization of all fertile areas located within the influence of this road.

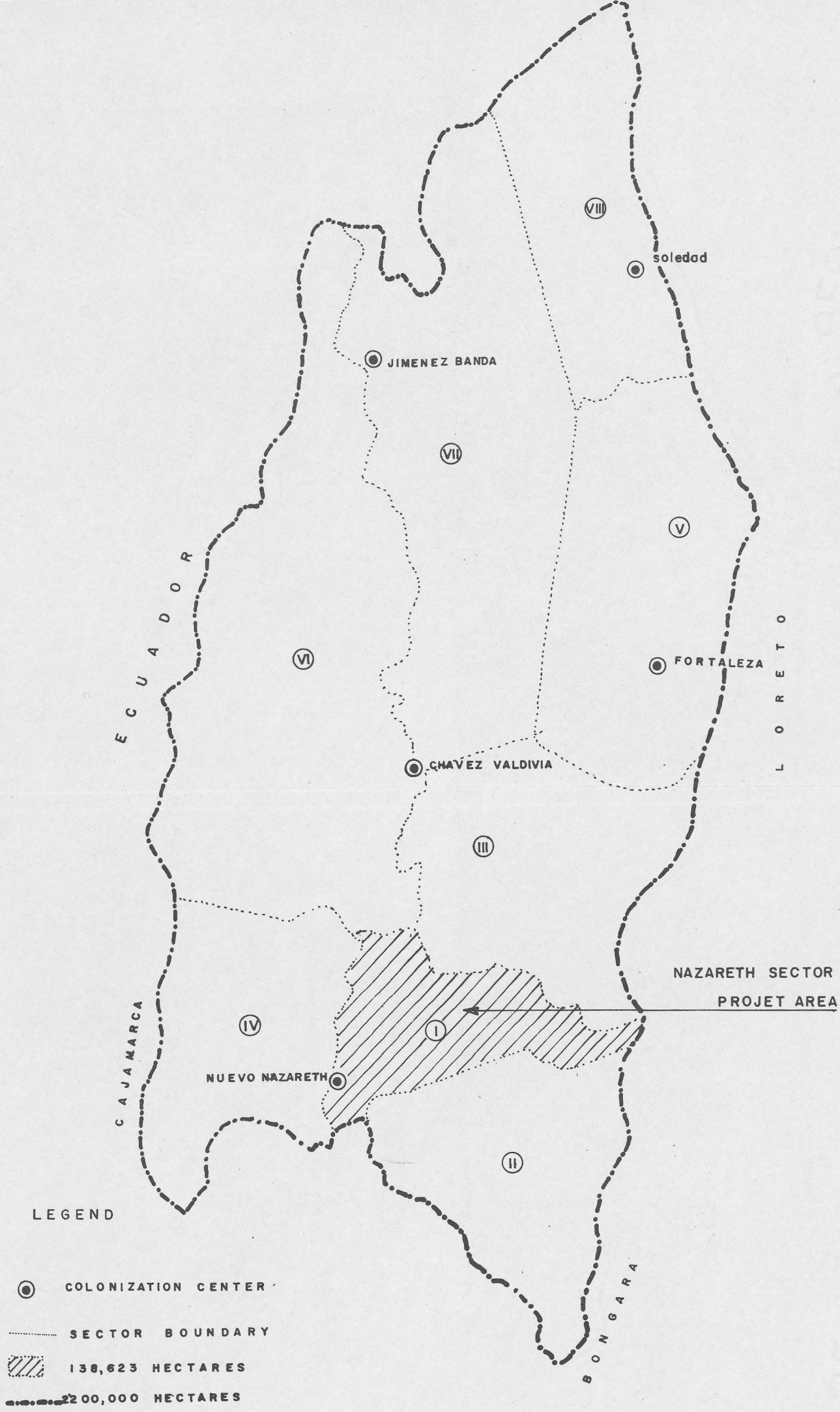
The Peruvian government has completed four major colonization studies (8, 9, 10, 11) for four different regions in the Jungle. One more effort in this direction is the actual processing of a study for the fifth colonization project for a vast Jungle area in the North.

This project, which is the focus of this thesis, aims to incorporate an area of 2.2 million hectares for agricultural purposes. It is the largest Jungle colonization project among those programmed by the government.

The planning strategy adopted by the project agency responsible for the Jungle colonization program divides the area into eight planning sectors limited by geographical physical boundaries (see Figure one). Their respective names and total land areas are as follows:

	<u>Planning Sector</u>	<u>Total Area (Hectares)</u>	
I	Nazareth	138,623	(Nazareth Project)
II	Chitiyacu	203,104	
III	Nieva	247,115	
IV	San Rafael	189,659	
V	Santiago	299,340	
VI	Cenepa	508,866	
VII	Chavez Valdivia	417,565	
VIII	Cahuide	195,728	
	Total Area	2,200,000	(Complete Project)

Each planning sector will be studied separate and independently with regard to specific environmental characteristics. The first stage in the planning of each sector is the development of a Pilot sample or reduced-scale project in a limited within-sector area defined as the "colonization center". The reduced scale project is designed for accomplishing basically two objectives, namely, (1) model guidelines for the establishment of community centers within the sector area (with the community centers providing basic services such as water, power, hospitals, schools, church, stadiums and parks); and (2) farm planning guidelines which will be subsequently followed in the progressive colonization of the planning sector.



LEGEND

- COLONIZATION CENTER
- SECTOR BOUNDARY
- ▨ 138,623 HECTARES
- .-.-.- 2,200,000 HECTARES

Figure 1. Map of the Alto Marsnon colonization project area

The Nazareth sector is the first one to be studied. The project agency has given priority to this sector for mainly three reasons. First, it is with respect to its location a bridge-head to the 2.2 million hectares total project area. Second, it has quick access to the Olmos-Maranon penetration road thereby rendering available its output in less time than would any other planning sector. Third, it is the sector nearest to the Coast region and to important Jungle towns such as Begua Grande, Begua Chica, Jaen and others.

The total area for the Nazareth sector is of approximately 138,623 hectares. Only 28,000 hectares or 20 percent of this area is estimated as suitable for agricultural uses. Approximately 14,000 hectares will be allocated for agricultural production and 14,000 hectares for livestock production.

The project agency began working on this program in May 1965. To the present, it has produced only the final report for the Nazareth Pilot project (12) covering an area of approximately 2,300 hectares. Its next step is the study of the complete Nazareth sector project. The investigation of the economic characteristics of this project constitutes the main subject of this thesis. For this purpose, and as a prior necessary step, the Nazareth project has been simulated, taking as basic elements of synthesis the model structure of the Nazareth Pilot project (12) and other supporting data derived from oral interviews with project agency officials and from the Tingo Maria-Tocache Project (11). The Nazareth project thus constructed is of a prospective nature. Its definite detailed version will be realized by the project agency in the near future. This investigation thus will bring forth a first impression on the economical

characteristics of the Nazareth project and, possibly, of the over-all colonization program. In addition, this study may suggest the application of existing methodology for analysis of projects of this type and in charge of military analysts¹ not regularly engaged in these duties.

There are various limitations to be regarded in this work. First, the Nazareth Pilot project design is assumed to be correct at least for that part which has been availed for the construction of the Nazareth project. Second, additional information was needed by the author for project simulation. Third, the analysis does not deal with a comparison of alternatives; instead, it generates the characteristics of the project prior to such a comparison. Fourth, social and political matters have not been included so that economic aspects can be emphasized. Fifth, the marked absence of sufficient project input data has made necessary use of a considerable number of supporting assumptions. Sixth, benefits are over-estimated. This study utilizes the yield estimates considered in the Pilot project. It complies but does not necessarily agree with these estimates. The Pilot project's source for its yields are estimates from other jungle colonization projects having similar characteristics to those prevailing in the Nazareth area. A comparison has been made in this study for checking these yields against those obtained by the Convenio de Cooperacion

¹ The institutions engaged in the performance of the referred colonization program are the Institute for Agrarian Reform and Promotion and the Army. Both institutions have equivalent equal responsibilities. But, the Army (engineering branch) does not appear to have the necessary and sufficient knowledge for adequately analyzing the economics of projects of this type.

Tecnica² for bananas, pineapples, soybeans, cassavas, corn, beans and vegetables grown in the Department of Amazonas which includes the Nazareth project area. This comparison shows a significant over-estimate of the Pilot project yields. Consequently, benefits derived from the sale of outputs from the Nazareth project are also over-estimated thus implying an inflation of the benefit-cost result of this analysis.

Finally, it is adverted that by the time this study was completed the Peruvian economy was affected by an approximately 50 percent devaluation of its local currency. As this devaluation affects colonization projects a brief summary of its probable effects upon the economics of the Nazareth project is added as necessary for the introduction of this work.

It is considered that the recent devaluation of the Sol affects both the supply and demand for outputs from the Nazareth project. Quantities of food products demanded as a function of higher prices should decline while their supply is expected to increase following higher prices.

An estimate, at the national level, of the probable changes implied by the devaluation³ indicates a 28 percent decrease in the consumption of beef and a 23 percent decrease in the consumption of milk. These reductions result in a 93 percent decrease in imports of beef and an 85 percent decrease in imports of milk. Also, it is estimated that the quantity purchased of

² The "Convenio de Cooperacion Tecnica; Estadistica y Cartografia" (CONESTCAR) is a public agency whose basic mission is the periodical recapitulation and processing of agricultural production data. It is one of the most efficient and reliable sources of agricultural data in Peru.

³ Considering a rate of exchange of 1 Dollar for 40 Soles and assuming that products are bought and sold on a free market.

fruits and tubers, and beans will decrease by 3.6 percent and 7 percent respectively.

On the supply side a rough estimate indicates a prospective increasing trend in the production of agricultural outputs. A quantitative measure of supply increments for each product is yet undetermined in the absence of sound evidence on the supply response to price changes. Nevertheless, it is expected that production will increase to the extent that price controls, derived demands and production technological limitations will allow it to occur.

Furthermore, the devaluation affects the foreign exchange balance in colonization agricultural projects. These cover foreign exchange costs for purchasing fertilizers, insecticides, farm machinery and livestock. Such items need to be fixed in the quantities required by a pre-determined technological level. Thus, the devaluation effect is a direct increase in sales cost to the project. In addition, the little substitutability between capital and labor inputs in colonization projects (given the labor shortage in jungle areas) does not facilitate the betterment of an increased cost situation of a project.

On the benefit side the devaluation affects colonization projects more severely than other types of projects, viz., irrigation projects, given that these are akin to a subsistence agriculture -- at least in their first stage of development. Nevertheless, an optimistic attitude may be adopted for allowing colonization projects to exert a long run import substitution effect for ameliorating the foreign exchange balance, e.g., through increased meat and milk production.

After the above considerations it can be concluded that the Nazareth project is seriously affected by the recent devaluation of the Sol turning it less favorable.

For the development of this work the author has frequently resorted to Shaners' (16) study for reference materials and analytical framework to be adopted in the analysis of Peruvian jungle colonization projects. Also, the Tingo Maria-Tocache project (11) has been frequently used as a valuable reference study.

The present study is divided into three major chapters. Chapter II deals with the theoretical considerations on the benefit-cost and sensitivity analysis. Chapter III refers to the analysis of the prospective Nazareth sector colonization project and includes, in three sections, the general description of the Nazareth project, its economic evaluation in terms of the discounted cost-benefit balance, and the supplementary sensitivity analysis of four major variables of the project, viz., rate of interest, rate of colonization, study period or time horizon and type of prices considered. And, Chapter IV includes the summary and conclusions of the study.

II. THEORETICAL CONSIDERATIONS

A. Benefit-Cost Analysis

There are a considerable number of criteria, any of which can be applied in evaluating the economic soundness of a project. The criterion selected as convenient for the present case is identified with the comparison of project costs and benefits. This is portrayed within the context of a project evaluation method called benefit-cost analysis. A summary description of this technique can be initiated by quoting the following:

Cost-benefit analysis is a way of setting out the factors which need to be taken into account in making certain economic choices. Most of the choices to which it has been applied involve investment projects and decisions whether or not a particular project is worthwhile, which is the best of several alternative projects or when to undertake a particular project (14).

The evaluation criterion of the benefit-cost approach is the ratio of the present value of its benefits to the present value of its costs which, if exceeding unity, indicates a favorable ratio.⁴ The mathematical expression or decision algorithm for this criterion is as follows:

$$\frac{\frac{b_1}{(1+i)} + \frac{b_2}{(1+i)^2} + \dots + \frac{b_n + s}{(1+i)^n}}{\frac{c_1}{(1+i)} + \frac{c_2}{(1+i)^2} + \dots + \frac{c_n}{(1+i)^n}} \quad 1$$

⁴ An equivalent meaning for this definition is the selection of a project, when its present value of benefits exceeds its present value of costs, i.e., when the net present value is positive. This equivalent meaning is ahead availed for the sensitivity analysis (14).

Where,

b_1, \dots, n = Prospective benefit values for years 1 through n .

c_1, \dots, n = Prospective cost values for years 1 through n .

i = Interest rate⁵ used for discounting.

s = Scrap or salvage value.

There are basically four relevant aspects in this analytical device which deserve special consideration. These refer to the procedures followed for identifying and evaluating costs and benefits, to the selection of an appropriate rate of discount and to the relevant constraints affecting the final outcome of a project.

1. Identification of benefits and costs

The effects of a project may be divided differently according to the criteria adopted for such purpose. This study follows Tinbergen's (17) criterion. He divides consequences of a project into three types, viz., direct, indirect and secondary.

1. Direct consequences Within this category are included those items which the analyst can determine in a straightforward manner. These items are associated with project investment and operating costs and receipts. Costs cover construction and maintenance of roads and community facilities, on-farm installments, and other activities such as technical assistance. Receipts or gross benefits refer to the income derived from the sale of outputs in local markets. Net benefits refer to gross benefits less farm production costs.

⁵ The interest rate (i) which is also the shadow price of capital, may not be constant over time. If this is the case, the term $(1 + i)$ would be altered. But this is a refinement which is frequently omitted.

ii. Indirect consequences Indirect consequences refer to changes in the organization of production in industries whose final outputs enter as inputs to the project; such industries are vertically integrated to the project enterprise. Their inclusion in the analysis requires, of course, clear knowledge of interindustry relations. By means of a well defined input-output matrix it is possible to trace the project's indirect effects on related industries as well as to induced effects on household consumption patterns and levels by the project to its related industries.

iii. Secondary consequences Secondary consequences of a project stem from the income growth resulting from the project. An increase in farmers' incomes, for example, may induce a derived increased demand for domestically produced consumer goods and on imports. These effects depend upon the size of the project involved. Their inclusion into the benefit-cost analysis may be regarded as relevant only for projects with substantial income increasing effects.

2. Valuation of benefits and costs

As it is extremely difficult to forecast with accuracy the future development of relative prices for large planning horizons,⁶ a general practice is to value costs and benefits of a project at constant prices adopting the price levels existing at the departure point of the project. For a more rigorous analysis, a hypothesis may be adopted for the Peruvian case for allowing a degradation of the purchasing power of money of, for

⁶ This is especially true for countries showing an almost chronic tendency for devaluation of its local currency.

example, 10 percent per year, and consequently an equivalent rise in the general price level. Then, the evolution of relative prices would presumably be different for certain categories of goods and services (15). The inclusion of this inflationary variable in the analysis could place the project in a more profitable basis, except for repaying the loans.

On the other hand, proper consideration needs to be given to the various circumstances affecting the true value of the items involved in a project. As an example, the valuation of costs and benefits may be associated with the actual deviations from perfect competition. Departures from Pareto optimum conditions, e.g., monopolistic elements in product or factor markets, pervert relative outputs away from their perfectly competitive equivalent terms. Market prices used in the valuation of benefits and costs would no longer serve in making decisions on investments. Thus, project funds would be misallocated between different industries. The difficulty could be corrected by adjusting the actual level of costs and benefits. A second example may be related to the unemployment of labor. The excess supply or national misallocation of labor resources, referring to a regional concentration of labor greater than the existing labor absorption capacity, implies overstated prices for labor resources. For this reason, the application of labor market prices in the valuation of direct benefits and costs overstates the social cost and under-estimates the total benefits of a project (14). In addition, large projects may alter price levels of inputs and outputs.

The inappropriateness of market prices for reflecting the true value of costs and benefits under the above circumstances may be, at least partially, corrected with the use of real (shadow or accounting)

prices. Accounting prices, according to Tinbergen (17), are those at which supply is just sufficient to satisfy demand. These prices represent the opportunity cost or the value of the marginal product of a production factor. Use of accounting prices is being recommended in the analysis of at least labor, capital and foreign exchange production factors (16).

Since a generally satisfactory technique for accurately determining the accounting values of the above mentioned production factors has not yet been developed, it becomes opportune to apply to alternative techniques for obtaining at least approximate results. Analysts may thus apply to the sensitivity analysis alternative as an adequate mean for determining the influence of various accounting adjusted values on the outcomes of a project.

3. Rate of interest

Benefit-cost analysis needs to be implemented with an adequate interest rate selected according to the capital supply-demand conditions of the economy. This task constitutes one of the most delicate problems which have to be solved in this process.⁷ It has to be taken into account that most projects have long lives⁸ and require significant investment expenditures, and that the selection of low interest rates may yield a type of program substantially different from that obtained by using a high interest rate.

⁷ Only in certain cases as, for example, when a fixed budget is to be spent there is no need for an opportunity cost rate of interest because the problem of selection does not involve an opportunity cost of capital. Furthermore, some authors, e.g., McKean (7), argue there is neither need for a social discount rate of interest. This is valid only when not considering the present value of benefits less costs, for if so, some rate of discount has to be chosen.

⁸ But, it is adverted that the inability to foresee the future and the elements of uncertainty affecting the project outcome tend to reduce the planning horizon at the same time that they imply higher internal discount rates.

If maximum welfare conditions were assumed to exist, thus implying an optimal allocation of resources, the marginal social rate of time preference and the marginal social rate of return from investment would be equivalent terms. But, this does not occur in the real world economy where the market determined interest rate does not necessarily coincide with the social rate. This problem is further complicated by the existence of different interest rates utilized by the public and private sectors of the economy. In addition, market determined interest rates in under-developed countries tend to be below the real or competitive rate, i.e., they are undervalued estimates which do not reflect the full price-increasing effect of a demand for capital larger than its supply.

The interest rate controversy is an endless discussion which is disposed by Prest and Turvey (14) as follows:

Discussion about social rates of time preference, social opportunity costs, etc., do not cut very much ice in most empirical work, and we have not been able to discover any convincingly complete application of such notions.

Eckstein (1) also concludes that "The choice of interest rates must remain a value judgement."

Under this state of things the usual practice is to select an interest rate on the basis of prevailing rates. The range of selection, as proposed by Shaner (16), can be determined by (1) the interest rate utilized by the Central Bank, which may be regarded as the lower bound, and (2) the interest rate prevailing in unorganized money markets, as the upper bound. A point of reference within this rate selection range might be the government borrowing rate, even though it may be argued that the government is not a competitive borrower.

Shaner estimates that a realistic selection range for most of the less developed countries, including Peru may have an 8 percent interest rate at the lower bound and a 14 percent interest rate at the upper bound. This range estimate leads to the recommendable application of a sensitivity analysis for covering all possible outcome alternatives. Of course, in correlation with other relevant variables.

4. Relevant constraints

Finally, it is worthwhile mentioning the various types of constraints which may obstruct directly and/or indirectly the straightforward development of benefit-cost analysis. And, which, to a certain extent, may impede the relevant technique for obtaining optimum final results in what concerns the accuracy of the quantitative elements involved in the project.

Eckstein (1) classifies constraints as follows: (1) physical constraints, the most general of which is the project production function; (2) legal constraints, which reduce action to the framework of the laws affecting the project domain, e.g., agrarian reform laws; (3) administrative constraints, which affect the operativeness of project agencies conformed as part of an integrated planning organism; (4) distributional constraints, referring to the real world non-attainment of welfare equilibrium conditions, i.e., the income distribution problem; and finally (5) budgetary constraints.

B. Sensitivity Analysis

It is not always possible to rely on the value estimates of all the relevant variables entering the economic analysis of a specific project. In fact, a considerable degree of uncertainty affecting the final outcome is generally expected. This is especially true for project studies performed in less developed countries, including Peru. In these areas factors such as (1) insufficient and/or inconsistent statistical data scheme, and (2) inadequate analytical procedures, among other elemental deficiencies, reduce the validity of the results of the studies. The most important implication of these uncertainty elements, when not properly managed in the analysis, is the increased probability for accepting (or rejecting) a project erroneously, i.e., the evaluation result may be misled by the uncertain behavior of variables under different circumstances. To this respect, Shoner (16) states the following:

Estimates used in the analysis were treated as if they were certain to occur. Yet many of them are subject to considerable uncertainty. Clearly, this possibility can influence the economic attractiveness of a project.

One way of enhancing the validity of a project investigation is to undertake a sensitivity analysis. This analytical tool starts with the best available estimate⁹ of each relevant variable and then proceeds with

⁹ The best estimate, as used here, represents the expected value defined as the sum of all $p_i x_i$, where x_i is the value of the i -th outcome and p_i is the probability that it will occur. Other possible interpretations of the "best estimate" are the mode (the most likely outcome) and the median (the outcome which has a 50 percent chance of being exceeded). In the present case, however, such statistical calculations have not been made and the "best estimate" is based on judgment about what the expected value might be.

a systematic modification of the value of one of them to calculate the sensitivity of the outcome with respect to changes in decision variables.

Grant and Ireson (2) refer to sensitivity analysis (which is the approach adopted in this study) as follows:

Sensitivity refers to the relative magnitude of the change in one or more elements of an engineering economy problem that will reverse a decision among alternatives. Thus, if one particular element can be varied over a wide range of values without affecting the decision, the decision under consideration is said not to be sensitive to uncertainties regarding that particular element. On the other hand, if a small change in the estimate of one element will alter the decision, the decision is said to be very sensitive to changes in the estimates of that element.

Also, Hirshleifer (5) refers to sensitivity analysis as follows:

As a practicable alternative (to more sophisticated procedures) and it is vital to make at least this much allowance for uncertainty the calculations should be repeated under a number of different assumptions about the unknown values of the most crucial elements of the problem. This is called "sensitivity testing", and a wise procedure would be to check sensitivity of the calculations to construction-cost changes, weather variation, discount rate, etc.

Other alternative techniques which could be used for dealing with uncertainty elements in the outcome of a project are those proposed by Hertz (3) and Hillier (4). Hertz proposes computer analysis together with estimates of the frequency distribution of significant variables, to generate a frequency distribution for the overall investment proposal. Hillier suggests an analysis of estimates of the mean and variance of projects annual net returns to accomplish the same type of result.

III. ANALYSIS OF THE PROSPECTIVE NAZARETH SECTOR COLONIZATION PROJECT

The first step taken by a project agency is the development of a project study, e.g., concerning the colonization of the Nazareth sector. This part of the thesis is devoted to the economic analysis of the prospective Nazareth colonization project.

An advanced formulation of the Nazareth project has been prepared, utilizing as elements of synthesis (1) model guidelines developed in the Nazareth Pilot project report, (2) additional references derived directly from the project agency, and (3) references from other similar studies. The basic data are incorporated in the material contained in Appendix A of this study.

The analysis of the project will be accomplished within a benefit-cost framework.¹⁰ Also, a sensitivity analysis will be made of some of its relevant variables, viz., rate of colonization, type of prices, project life and interest rate. Only discrete changes in the net present worth of the project due to discrete changes in the four mentioned variables will be investigated inasmuch as the principal focus of the preliminary analysis is to find some indications of the direction of change.

This chapter is divided into three sections. The first contains a brief general description of the project. The second section deals with

¹⁰ Without considering it as part of the integral 2.2 million hectares project.

the economic evaluation of its direct costs and benefits and finally the third section refers to the various sensitivity tests proposed as relevant.

A. General Description

The Nazareth project¹¹ covers a total area of 138,623 hectares, of which only 20 percent or 28,000 hectares are available for agricultural uses. Approximately one half (14,000 hectares) of the latter area is exclusively for cattle raising; the other half is retained for mixed enterprise production. The project will establish approximately 1410 agricultural familiar units or lots¹² of which 448 are cattle raising units and the remaining 962 units are of the mixed enterprise type. The estimated investment cost for on-farm facilities amount to an undiscounted total of 161.373 million Soles.

The project estimates that approximately 7050 colonists will be settled during its developing period. This colonial population is equivalent to 1410 families. Each family composed, as an average, of five members corresponds to one farm unit.

The project considers the establishment of four urban or community centers which will be constructed according to the model specifications contained in the Pilot project. Their estimated total investment cost is 38,556 million Soles.

¹¹ Of which, it is recalled, the Pilot Project is an integral part.

¹² Of the types defined in the Pilot Project report (see Part 1 of Appendix A).

The road system measures approximately 300 kilometers including a 20 kilometer road segment corresponding to the Olmos-Maranon penetration road. This system will make the project output¹³ available to markets in the North Coast and neighboring Jungle regions. Its investment cost amounts to approximately 90,208 million Soles.

The weather, soil and forestry factors for the Nazareth project are assumed to be similar to those described for the Pilot project (refer to Part I of Appendix A).

The objectives of the Nazareth project are (1) to settle army discharged personnel and peasants of the area in agricultural communities according to agrarian reform procedures; (2) to regulate the actual land tenure system among precarious land owners and modern Indian farmers and grant land property certificates according to legal specifications; (3) to consolidate the establishment of human centers in the area; (4) to incorporate 28,000 hectares for agricultural production; (5) to grant technical, financial and economic aid to project beneficiaries; and, (6) to increase agricultural output in the project area and in the country.

B. Economic Evaluation

The economic evaluation of the project will be made in terms of the present worth of its direct costs and benefits. Costs and benefits will be conditioned by the subsequent base assumptions.

¹³ The ultimate gross output value of the project is estimated in at least 270 million Soles per year.

1. Base assumptions

The setting of the Nazareth project, according to the mentioned model references has taken into consideration the necessary conditions for making the result compatible with reality. Reality includes limited financial resources, administrative bottlenecks, lack of planning unity and untimely action affecting project planning and execution. These circumstances coincide with the more pessimistic assumptions related to the rate of colonization, rate of interest, project life and prices considered.

1. Rate of colonization It is assumed that the project will incorporate into agricultural production 1,000 hectares per year based on a straightline trend. This is a low (pessimistic or conservative) rate of colonization based on references obtained from other four colonization studies (8, 9, 10, 11) that show a higher average constant rate of 3,000 hectares per year.

The low estimate for this study is justified because of capital and financial limitations and a short supply of colonists. Moreover, the use of a straightline trend in colonization is preferred because of the absence of sound evidence for shifting to a non-linear trend.

At the estimated rate of settlement, the project area of 28,000 hectares would be incorporated into agricultural production in approximately 30 years. If ten to fourteen years of farm unit production development is added to the settlement period, a total project production-development period of from forty to forty-four years would then be applicable, i.e., regular or full-scale annual production would begin in the forty-fifth year.

ii. Time horizon It is assumed that an analysis period of fifty years, including forty-four years for the project's full output development and six years of regular annual production, is an appropriate estimate for this study. The beginning year corresponds to the first of the Pilot project's corrected time horizon.¹⁴ This life period estimate is based on an evaluation of the four mentioned colonization studies, the Shauer report and interviews with local authorities on the subject. All evidence derived from these sources indicates that colonization projects are normally long lived and that fifty years is a reasonable estimate for analysis purposes.

iii. Rate of interest It is assumed that an applicable rate of discount for carrying project costs and benefits to a comparable present worth basis is 15 percent, which is supported by McGaughey (6) in his statement that, "most frequently accepted interest rates range anywhere from 10 to 15 percent or larger," and by Shauer (16): this range of values (interest rates of 8, 10, 12, and 14 percent) should span the majority of possible riskless interest rates in a number of development countries, including Peru.

The relevant matter in this case, no matter what the interest rate is as long as it is realistically high, is the marked preference of present benefits over benefits received at a later time.

¹⁴ The original Pilot project report considers erroneously as the first year of the project, that in which land incorporation begins. In this study the Pilot project has been corrected to start really two years earlier with the year in which the first investment for infra-structure works is made.

iv. Prices This study will substitute shadow or accounting prices for farm (unskilled) labor market prices. However, only labor, accounting prices have been used, given the absence of sufficient data for other project inputs.

It is assumed that farm labor accounting prices are 50 percent of the respective market wage. This estimate, based on Shaner (16), takes into account the prevailing relative labor surplus, the low farm labor productivity, the fact that some of the costs of settling the colonists have been included elsewhere in this analysis under the heading of farm investment, community center investment and ancillary costs, and the possibility that additional costs would be incurred in employing the above, e.g., transport costs for transferring labor from surplus areas to the project.

2. Direct costs

Total project costs start in the first year with 2.754 million Soles and grow steadily until the thirtieth year, after which they fluctuate within the range of 93 and 102 million Soles. Project investment costs amount to a total undiscounted value of over 290 million Soles.

Costs have been grouped for analysis into four major categories, viz., farm, road, community center and ancillary costs. The annual flow of this expenditure is listed in Columns (1) through (9) of Table 1.

i. Farm costs Total farm costs start in the third year with 2.949 million Soles and increase irregularly to the thirty-ninth year, after which they fluctuate within the range of 74 and 81 million Soles.

Table 1. Direct costs and benefits for the Nazareth project subject to a rate of colonization of 1000 hectares per year, a study period of 50 years and at accounting farm labor prices (thousands of soles)

Year	Costs			Road		Total
	Investment	Farm Operating ^a	Total	Investment	Maintenance	
1	-	-	-	192	-	192
2	-	-	-	192	-	192
3	1,401	1,548	2,949	635	31	666
4	1,309	1,972	3,881	3,432	82	3,514
5	2,197	4,716	6,913	18,325	356	18,681
6	2,902	6,291	9,193	17,138	1,822	18,960
7	3,161	7,835	10,996	2,138	3,193	5,331
8	3,647	5,400	9,047	2,138	3,364	5,502
9	3,884	11,175	15,059	2,138	3,535	5,673
10	4,483	12,996	17,479	2,138	3,706	5,844
11	4,656	14,164	18,820	2,138	3,877	6,015
12	5,083	15,968	21,051	2,138	4,048	6,186
13	5,670	17,810	23,480	2,138	4,219	6,357
14	6,331	19,104	25,435	2,138	4,390	6,528
15	7,097	21,344	28,441	2,138	4,561	6,699
16	7,894	24,129	32,023	2,138	4,732	6,870
17	8,484	26,399	34,883	2,138	4,903	7,041
18	8,935	28,816	37,751	2,138	5,074	7,212
19	9,169	31,019	40,188	2,138	5,245	7,383
20	9,677	34,129	43,806	2,138	5,416	7,554
21	9,817	36,332	46,149	2,138	5,587	7,725
22	10,174	39,439	49,613	2,138	5,758	7,896
23	11,882	41,645	53,527	2,138	5,929	8,067
24	12,149	43,848	55,997	2,138	6,100	8,238
25	13,388	46,051	54,439	2,138	6,270	8,408
26	14,246	48,254	62,500	2,138	6,440	8,578
27	14,767	50,457	65,224	2,138	6,610	8,748
28	15,270	52,660	67,930	2,138	6,781	8,919
29	13,774	54,863	68,637	2,138	6,952	9,090
30	13,705	57,066	70,771	1,120	7,123	8,243
31	13,544	57,778	71,322	-	7,217	7,217
32	13,518	59,028	72,456	-	7,217	7,217
33	13,842	60,262	74,104	-	7,217	7,217
34	13,740	61,302	75,042	-	7,217	7,217
35	14,429	62,306	76,735	-	7,217	7,217

^a Includes labor at accounting prices.

Table 1. (Continued)

Year	Costs		Investment	Road Maintenance	Total
	Investment	Farm Operating			
36	14,808	63,268	78,076	7,217	7,217
37	14,921	64,182	79,103	7,217	7,217
38	14,725	65,150	79,875	7,217	7,217
39	17,302	66,090	83,392	7,217	7,217
40	13,698	66,997	80,695	7,217	7,217
41	13,224	67,904	81,128	7,217	7,217
42	12,867	68,811	81,678	7,217	7,217
43	14,412	60,576	74,988	7,217	7,217
44	14,351	60,576	74,927	7,217	7,217
45	15,467	60,576	76,043	7,217	7,217
46	16,018	60,576	76,594	7,217	7,217
47	16,164	60,576	76,740	7,217	7,217
48	16,176	60,576	76,752	7,217	7,217
49	14,229	60,576	74,805	7,217	7,217
50	14,046	60,576	74,622	7,217	7,217

Table 1. (Continued)

Year	Community Investment	Costs Ancillary	Total	Gross Benefits ^b
1	412	2,150	2,754	-
2	412	2,658	3,262	-
3	1,896	12,133	17,644	900
4	4,054	12,157	24,606	3,105
5	2,865	12,202	40,661	7,133
6	-	12,202	40,355	11,988
7	-	12,202	28,529	13,395
8	-	12,202	26,751	21,554
9	3,213	12,202	36,147	26,779
10	3,213	12,202	38,738	32,101
11	3,213	12,202	40,250	38,406
12	-	12,202	39,439	42,523
13	-	12,202	42,039	51,552
14	-	12,202	44,165	58,276
15	-	12,202	47,342	69,027
16	-	12,202	51,095	77,383
17	-	12,202	54,126	86,755
18	-	12,202	57,165	96,738
19	3,213	12,202	62,986	106,738
20	3,213	12,202	66,775	116,732
21	3,213	12,202	69,289	126,718
22	-	12,202	69,711	136,708
23	-	12,202	73,796	146,698
24	-	12,202	76,437	156,688
25	-	12,202	75,049	166,678
26	-	12,202	83,280	176,668
27	-	12,202	86,173	186,658
28	-	12,202	89,051	196,329
29	3,213	12,202	93,142	209,429
30	3,213	12,202	94,429	219,932
31	3,213	11,705	93,457	229,032
32	-	11,705	91,468	236,855
33	-	11,705	93,026	242,782
34	-	11,705	93,964	247,771
35	-	11,705	95,657	252,995

^b Sale of farm outputs value.

Table 1. (Continued)

Year	Community Investment	Costs Ancillary	Total	Gross Benefits
36		11,705	96,998	256,480
37		11,705	98,025	260,382
38		11,705	98,797	264,036
39		11,705	102,314	267,074
40		11,705	99,617	269,395
41		11,705	100,050	271,298
42		11,705	100,600	271,951
43		11,705	93,910	272,103
44		11,705	93,849	272,103
45		11,705	94,965	272,103
46		11,705	95,516	272,103
47		11,705	95,662	272,103
48		11,705	95,674	272,103
49		11,705	93,727	272,103
50		11,705	93,544	272,103

Total farm costs have been disaggregated into investment and operating categories (Columns (1) and (2) of Table 1). Investment costs are incurred for land clearing, housing facilities, fences, equipment and tools, pastures, livestock, barns and pigpens. Also, within this category are included replacement costs for (1) farm housing facilities every 20 years, (2) barns and pigpens every 10 years, (3) pastures and fences every 10 years, and (4) land clearing every 20 years.

The total undiscounted value of these costs amount to 516.633 million Soles (or 80 percent of total project investment costs) distributed over a fifty year period starting in the third year of the project life.

Operating costs are for payments to labor and material purchases, e.g., seed, fertilizers, pesticides. These start in the third year with 1.548 million Soles and continue increasingly until the forty-second year, after which they reach the stable figure of 60.576 million Soles.

Annual operating costs are maintained constant after the forty-second year due to the lack of evidence of declining costs after the development period of each of the three types (A, C and D) of lots considered for the project. It is recognized, however, that costs would tend to drop with specialization in farm activities.¹⁵ Still there is a question regarding the time required for farmers to become sufficiently trained in their tasks so as to result in significant reductions in farm production costs.

¹⁵ Conditions for the possible occurrence of economies of scale implying an increase in farm size is disregarded because one of the objectives of this type of project is precisely the promotion of family size farm units.

ii. Road costs The Nazareth project includes a total 300 kilometer road system demanding an investment cost of 90.208 million Soles (or 14 percent of total project investment costs) distributed over the first 30 years of the project. This cost is listed in columns (4), (5) and (6) of Table 1.

The road sub-system corresponding to the Pilot project area is comprised of a 2 kilometer main road connecting the community center with the Olmos-Maranon penetration road and of 13.5 kilometers of second class roads for intercommunication between lots and the community center. This sub-system, having an investment cost of 3.5 million Soles, has a construction schedule of five years, starting with the first year of the project.

The secondary road sub-system for the rest of the sector project area measures 265.3 kilometers. Its estimated investment cost is 56.708 million Soles distributed over a twenty-seven year period starting in the third year of the program. The outlays occur at an annual rate of 2.138 million Soles, which correlates with the annual road facilities need of the project (see Part 2 of Appendix B). In addition, an investment of 30 million Soles, distributed evenly over the 5th and 6th years of the project, for the construction of the Olmos-Maranon penetration road segment corresponding to the Nazareth project area, is imputed as a cost to the project (inasmuch as the road will improve access of project outputs to markets beyond the immediate project area).

Project costs for road maintenance start in the third year and continue increasingly (as more roads are constructed) until the thirty-first year, after which they continue with an annual constant value of 7.217 million Soles until the fiftieth year of the project. Maintenance costs

have been calculated as an average eight percent value of annual road investments.

iii. Community center costs The project considers the establishment of four urban centers for providing colonists with services and facilities such as water, electric power, schools, medical posts, city hall, public markets, public agencies, churches, recreational centers and parks. The investment required for establishing these four community centers amount to an undiscounted total value of 38.556 million Soles, or 5.47 percent of total project investments. Each center demands an investment cost of 9.639 million Soles (see Column (7) of Table 1). The first center corresponding to the Pilot project, is to be built during the first five years of the project; the second, during ninth, tenth and eleventh years; the third, during the 19th, 20th, and 21st years and the last during the 29th, 30th and 31st years of the project. The spacing between construction of each community center has been determined according to the rate of settlement of colonists and their demand for this type of services and facilities (refer to Appendix B).

A commentary can be made with respect to the investment volume for community services and facilities. It may be argued that the proposed volume is excessive and that colonists may not actually demand this level of social services, to which Patch (13) reacts as follows:

But more impressive than the organized colonies which can be multiplied as many times as there is money to finance them is the spontaneous colonization which reaches where ever a road or trail permits.....The Bolivian Development Corporation, instead of encouraging new settlers to come into the area, is trying to slow the pace because it has not even the most rudimentary resources with which to help the newcomers. There is no doctor, there are no medicines, no tools, and provisions must be secured

from Santa Cruz. Yet, it is certain that within the next year 500 families will be settled on parcels which have been laid out along the road.

iv. Ancillary costs This category includes investment and operating costs for economy studies, agricultural experimentation and promotion, and farm planning (see Table 20). These costs are included inasmuch as they are associated with agricultural development costs imputable to the project that affect the forthcoming project outputs.

Ancillary costs have not been yet determined by the project agency. Neither is there any reference in the Pilot project as to what their probable value might be. The values applied in the present study for these costs have been determined on the basis of the costs for the Tingo Maria-Tocache project (refer to Part 2 of Appendix A).

Expenditures for economy studies are made for guiding the annual project output through economically efficient channels. These studies include basically investigations related to the marketing of the various products produced. Within this context, analysis is made of mainly the storage, processing and transportation costs affecting production. These research costs amount to 750 thousand Soles per year and occur throughout the life time of the project. Although the Nazareth and the Tingo Maria-Tocache projects differ in size, it is assumed that both have the same economic study cost.

With respect to agricultural experimentation, it is considered that the project will have at least one station for this purpose. Costs for agricultural experimentation are composed of (1) investment costs for buildings, installations, and equipment and (2) operating costs for wages,

salaries, maintenance, etc. Total investment costs amount to 1.6 million Soles distributed over the first two years. Annual operating costs amount to 9.36 million Soles and occur throughout the 50 year life time of the project beginning in the third year.

Too, it is considered that the project will require the establishment of four agricultural promotion offices. The investment costs for these four offices amounts to 1.5 million Soles. The main agency would cost 600 thousand Soles and the other three sub-agencies would cost 300 thousand Soles each. The main agency would be established in the first year with two sub-agencies established in the second year and the last in the third year of the project. Total annual operating costs are 1.595 million Soles throughout the life time of the project. The main agency has an annual operating cost of 507 thousand Soles while each sub-agency has annual expenditures of 362 thousand Soles.

Farm planning involves expenditures for the design and distribution of lot units, design of crop rotations, financial programs and other planning aspects at the farm unit level. The unit cost of this project input is estimated in 100 Soles per hectare. The annual expenditure for farm planning has been directly related to the annual rate of colonization yielding the annual cost flow appearing in the corresponding column of Table 20 in Appendix C.

Total project ancillary costs for the above items begin in the first year with 2.150 million Soles and continue throughout the project life time with an average yearly figure of approximately 12 million Soles (see Column (8) of Table 1).

3. Direct benefits

The project output value¹⁶ has been estimated by considering the hectare unit yield of each crop. Crops grown on an annual basis, e.g., corn and beans, were assumed to yield the same volume per hectare year after year. Perennial crops would increase each year until maturity and then hold constant at that rate. All perennial crops, except bananas, were assumed to last at least 20 years; bananas would have to be replanted every 8 years.¹⁷ The annual output value of each crop was then evaluated at local prevailing market prices which have been assumed to remain constant throughout the 50 years study period of the project. Also, output consumed at the farm, viz., vegetables, beans, beef, pork and fruits, have been valued at current market prices.

Constant market prices over a 50-year study period is a simplifying assumption, justified only by the absence of detailed studies of local markets that would be required for valid predictions of future relative prices. Current market prices are considered merely as convenient benchmarks.

Project gross benefits are listed in column (10) of Table 1. These begin in the third year with 900 thousand Soles and continue increasingly until the forty-third year after which they attain a constant full production level of 272.103 million Soles per annum.

¹⁶ Defined as the gross benefit or total receipts derived from the Nazareth project.

¹⁷ Assumed banana production is based on data for the Tingo Maria-Tocache project.

4. Benefits versus costs

In this sub-division, the economic soundness of the prospective Nazareth project is investigated through the comparison of its direct benefits and costs. For this purpose, benefits and cost flows must be discounted to the first year of the project to put them on a comparable basis. Afterwards, a ratio is constructed between the sum of the discounted present worth of benefits and the sum of the discounted present worth of costs. This benefit over cost ratio identifies the economic indicator upon which final judgment on the project's economic characteristics is based. Cost and benefit flows discounted at an interest rate of 15 percent are listed in columns (3) and (4) of Table 2 together with their respective sum of discounted annual values. The aggregate benefit cost ratio obtained for the project is 0.95. This outcome rejects the Nazareth project as an economically feasible enterprise.

The analytical results would otherwise be less discouraging if certain circumstances implicit in its development are taken into proper consideration. For example, reductions in project costs associated with economies of scale are likely to occur (1) at later periods of the project, and/or (2) once the Nazareth project is integrated with the overall 2.2 million hectares project. In addition, high community center unit establishment costs are charged against the project (11). Furthermore, the highly conservative market and technological assumptions contribute to a low benefit-cost ratio. Conversely, inclusion of indirect economic and social benefits could increase the project benefit-cost ratio.

Table 2. Discounted present worth of the Nazareth project direct cost and benefits
(thousands of soles)

Year	Undiscounted		Discounted at 15 percent	
	Total Costs ^a	Net Benefits ^b	Total Costs	Net Benefits
1	2,754	-	2,395	-
2	3,262	-	2,466	-
3	14,695	(2,049)	9,661	(1,347)
4	19,725	224	11,278	128
5	33,748	220	16,780	109
6	31,162	2,795	13,471	1,208
7	17,533	2,399	6,591	902
8	17,704	12,507	5,787	4,088
9	21,088	11,720	5,995	3,332
10	21,259	14,622	5,255	3,615
11	21,430	19,586	4,605	4,209
12	18,388	21,472	3,437	4,013
13	18,559	28,072	3,016	4,562
14	18,730	32,841	2,647	4,640
15	18,901	40,586	2,323	4,988
16	19,072	45,360	2,039	4,849
17	19,243	51,872	1,788	4,819
18	19,414	58,987	1,569	4,766
19	22,798	66,350	1,603	4,678
20	22,969	72,926	1,403	4,456
21	23,140	80,569	1,229	4,278
22	20,098	87,095	929	4,024
23	20,269	93,171	815	3,745
24	20,440	100,691	713	3,514
25	20,610	112,239	627	3,412
26	20,780	114,168	549	3,014
27	20,949	121,434	482	2,793
28	21,121	128,399	422	2,568
29	24,505	140,492	416	2,445
30	23,658	149,161	351	2,252
31	22,135	157,710	290	2,066
32	18,922	164,307	216	1,873
33	18,922	168,678	216	1,670

() Indicates negative values.

a Excluding farm investment and operating costs.

b Net benefits defined as the sale of outputs value (or gross benefits) less farm investment and operating costs.

Table 2. (Continued)

Year	Undiscounted		Discounted at 15 percent	
	Total Costs	Net Benefits	Total Costs	Net Benefits
34	18,922	172,729	216	1,486
35	18,922	176,260	216	1,322
36	18,922	178,404	216	1,202
37	18,922	181,279	216	1,084
38	18,922	184,161	216	961
39	18,922	183,682	216	819
40	18,922	188,700	1,322 ^c	698
41	18,922	190,173	1,322	635
42	18,922	190,273	1,322	567
43	18,922	197,115	1,322	516
44	18,922	197,176	1,322	446
45	18,922	196,060	1,322	373
46	18,922	195,509	1,322	332
47	18,922	195,363	1,322	293
48	18,922	195,351	1,322	254
49	18,922	197,298	1,322	217
50	18,922	197,481	1,322	178
Present worth ^d			112,486	107,052

^c These values were calculated using uniform series present worth factors.

^d The net present worth of direct costs and benefits yields a benefit-cost ratio equal to 0.95.

It is also observed that the project is also subject to cost-increasing considerations, viz., additional urban services and facilities.

C. Sensitivity Analysis

This section includes a brief and simple analysis of the sensitivity of the net present worth¹⁸ of the project to discrete changes in the value of four major variables, viz., rate of interest, rate of colonization, time horizon and type of prices considered. These variables correspond to the base assumptions fixed at conservative values for the analysis of the preceding section B. Here, as each variable is changed (thereby affecting the project costs and benefits), the values of the other three are held constant. The discrete variation range selected for each variable is, 1,000 and 3,000 hectares per year for the rate of colonization variables; 8, 10, 12, and 15 percent for the rate of interest variable; 30, 40, 50 and 60 years for the time horizon variable; and market prices and accounting prices at 50 percent of market prices.

¹⁸ The net present worth (NPW) is defined here as the discounted difference between net benefits (or gross benefits less farm costs) and total project costs. The corresponding mathematical expression is the following one:

$$NPW = \sum_{j=0}^t (B_j - C_j) + (1 + i)^j$$

Where,

- j = The year in which benefits and costs occur.
- t = The time horizon considered for the project.
- B_j = The value of the benefits in the j -th year.
- C_j = The value of the costs in the j -th year.
- i = The interest rate used for discounting.

In this analysis, a negative NPW corresponds to a benefit-cost ratio less than unity; a positive NPW to a benefit-cost ratio greater than unity; and, a NPW equal to zero to a unity benefit-cost ratio.

The higher rate of colonization of 3,000 hectares per year is an average value for the Tingo Maria-Tocacha project (11). It has been used in this study as the most probable rate for the Nazareth project. The lower rate of 1,000 hectares per year is a conservative alternative estimate for the same project. The interest rate considered for this analysis corresponds to estimates made by Shaner (16) and McGaughey (6). For four time horizon estimates have been selected arbitrarily by the author, while the accounting prices estimated as 50 percent of market prices are based on Shaner. Market prices have been included in this analysis only to illustrate the errors its use might imply for the project.

The various net present worth outcomes of this sensitivity analysis appear in Table 3 and Figures 2, 3 and 4. These results are subsequently treated in three sensitivity tests, the latter of which, referring to the project evaluation at market prices, is included only for illustrative purposes.

1. First test

For the first sensitivity test related to changes in the time horizon, accounting prices are used and a rate of colonization of 3,000 hectares per year.

The results of columns (3), (4), (5) and (6) of Table 3, which are drawn in Figure 2, show an increasing sensitivity of the project to changes in the time horizon, the lower the interest rate considered. At the higher interest rate of 15 percent, the variation relation is an absolute increase in the net present worth of 18.24 million Soles to an increase of 30 years in the time horizon or, alternatively, an increase of 42.3 percent in the

Table 3. Net present worth of the Mazarath project under varying rates of interest, rates of colonisation, time horizons and price types
(thousands of soles)

Price type	Market		Accounting				
	1,000	1,000	3,000	50	50	40	30
Rate of colonisation (hectares per year)	(1)	(2)	(3)	(4)	(5)	(6)	(6)
15	(20,804)	(4,880) ^a	61,415	60,605	57,031	43,172	
12	(6,349)	48,296	170,761	167,237	155,512	121,081	
10	42,421	120,442	280,307	271,000	246,298	182,519	
8	140,357	256,728	550,193 ^b	524,722	468,542	347,764	
Rate of interest (percent)							

() Indicates negative values.

^a The corresponding minimum benefit-cost ratio is 0.95.

^b The corresponding maximum benefit-cost ratio is 3.07.

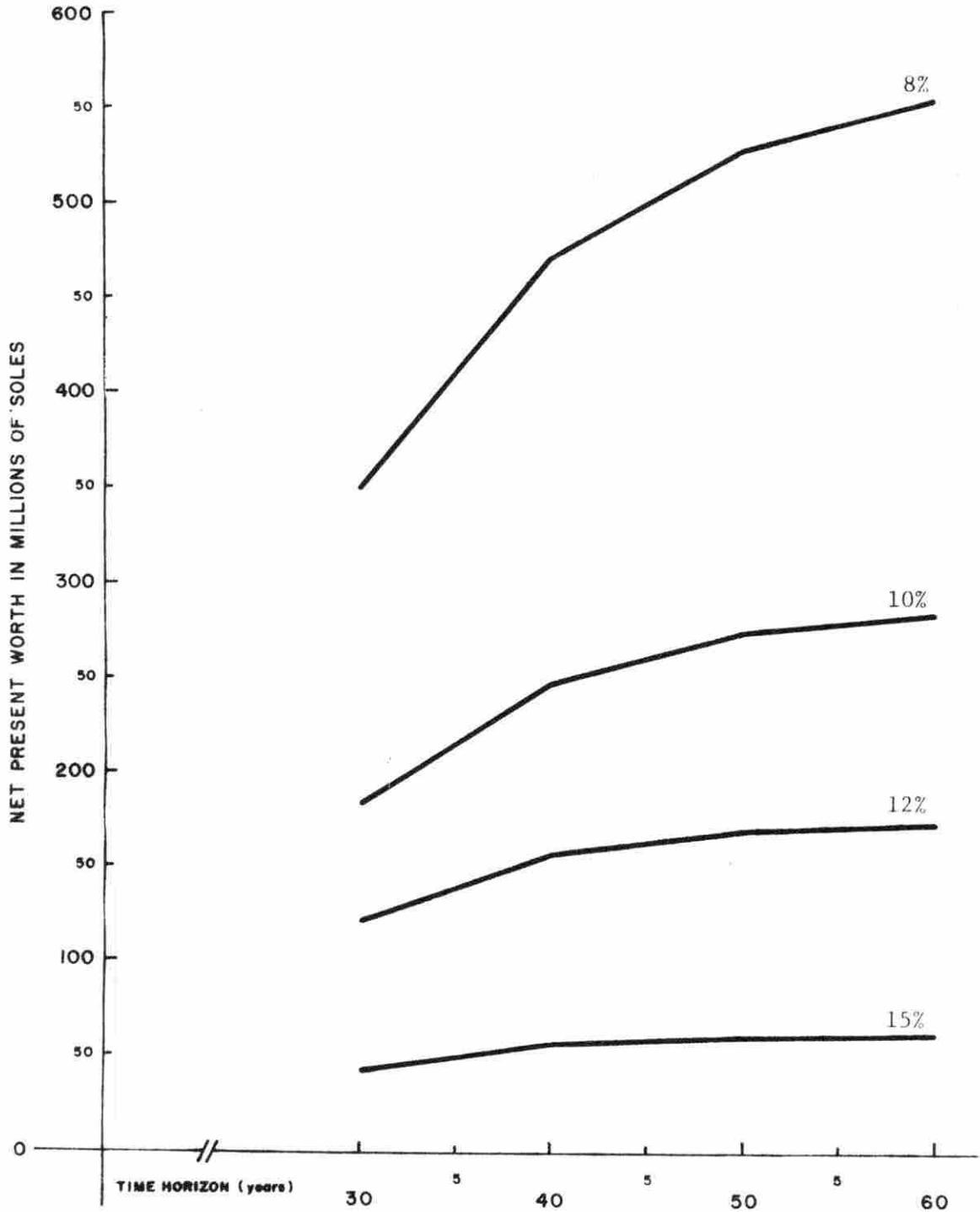


Figure 2. Sensitivity of decision to changes in the time horizon (for alternate discount rates, for a rate of colonization of 3,000 hectares per year and for farm labor accounting prices at 50 percent of market prices).

net present worth. On the other hand, at the lower interest rate of 8 percent, the project becomes (in a progressive manner) significantly sensitive to the time variable. At this rate, an increase of 30 years implies an absolute increase in the project's net present worth of 202.429 million Soles or, alternatively, an increase of approximately 58.2 percent in the net present worth.

Also, it may be observed that shifts in the four curves in Figure 2 towards larger time horizons tends to bring these relationships to a zero slope at substantially different net present worth levels. This tendency is quite evident at a 60 year time horizon, implying that this time period may be preferred for allowing the project to bring forth a stable high net present worth (particularly with the project discounted at high rates of interest). On the other hand, the extension of the four curves towards lower time horizon tends to bring these relationships to a common net present worth level. The evidence thus indicates that the effect of the interest rate is greater the larger the time horizon considered.

2. Second test

This test refers to the sensitivity of the project to changes in the constant rate of colonization. Here, farm labor costs are valued at accounting prices and a 50 year time horizon is assumed for the project.

With respect to the rate of colonization, the results of columns (2) and (4) of Table 3 and which are drawn on Figure 3 show a marked sensitivity of the analysis to changes in the rate of colonization the lower the interest rate considered. At an interest rate of 8 percent an

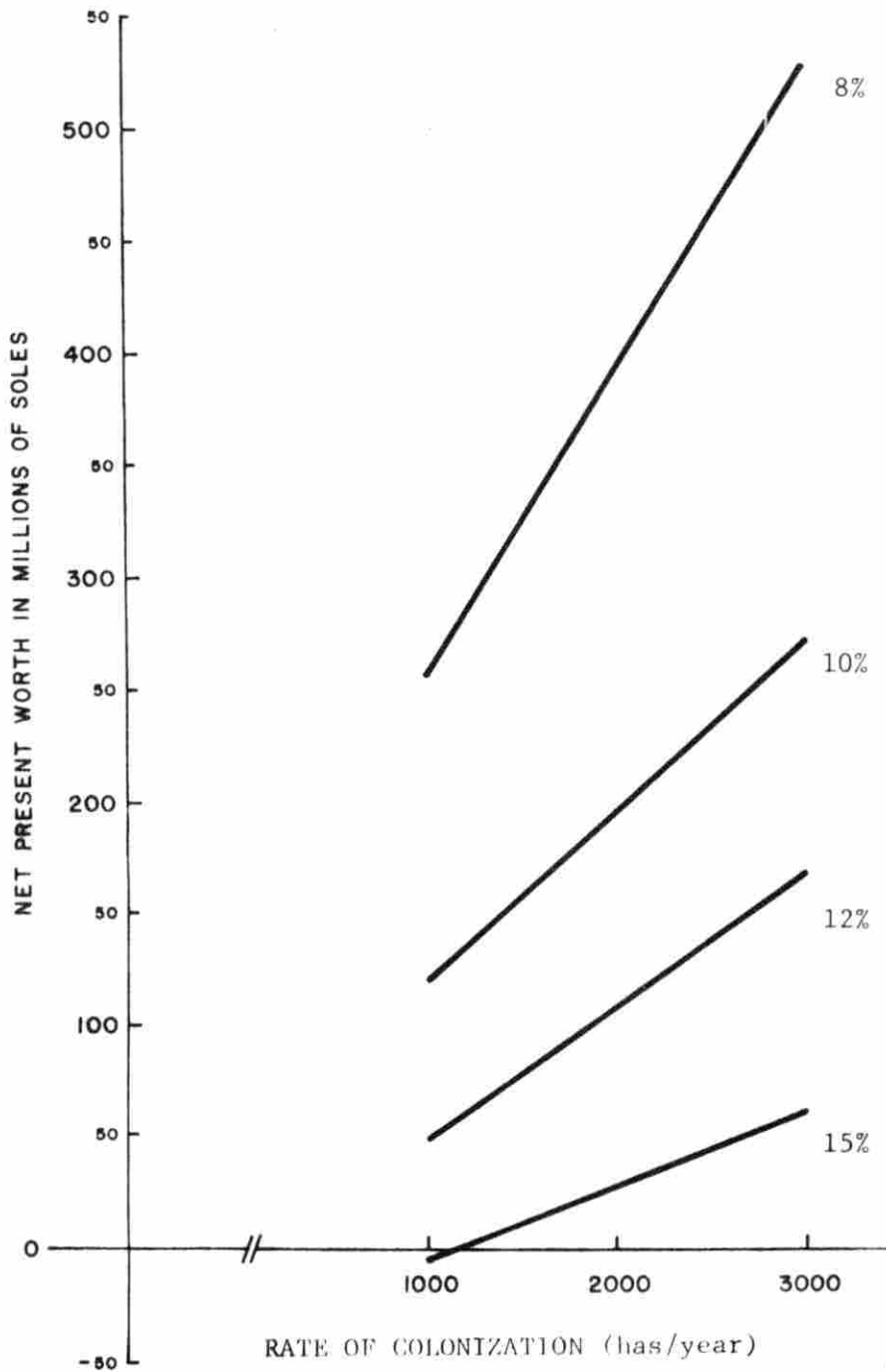


Figure 3. Sensitivity of decision to changes in the rate of colonization (for alternate discount rates, for 2 time horizon of 50 years and for farm labor accounting prices as 50 percent of market prices).

increase of 2,000 hectares per year in the constant rate of colonization effects an absolute increase of 267.994 million Soles in the net present worth. Alternatively, at an interest rate of 15 percent, the same increase affects the project by turning it from a negative to a positive 60.605 million Soles net present worth level. Also, it is observed in Figure 3 that, at this higher interest rate, the net present worth is zero at a rate of colonization larger than 1,000 hectares per year.

Furthermore, the straight line projection towards lower net present worth levels of the four curve segments¹⁹ in Figure 3 seem to indicate a convergence of these at a common net present worth level. This tendency implies a lessening in the importance of the rate of interest when lower rates of colonization are considered. Or alternatively, if attention is paid to higher rates of colonization, then the interest rate selection becomes a crucial matter in the analysis of the project.

3. Third test²⁰

This test includes a brief comparative analysis between the results, at different interest rates, of the project at market and accounting prices for labor. This comparison may illustrate the kind of error which can arise when prices not representing the opportunity cost of only labor in this case are utilized in the economic evaluation of a project.

¹⁹ It is assumed that the discounted net present worth is a curvilinear function of the rate of colonization. This assumption is based on Shaners' (16) analysis on the same subject for the Tingo Maria-Tocache project (11).

²⁰ This test is aimed at illustrating the importance that should be attached to the use of accounting prices in project evaluation and in terms of the different outcome their use might imply.

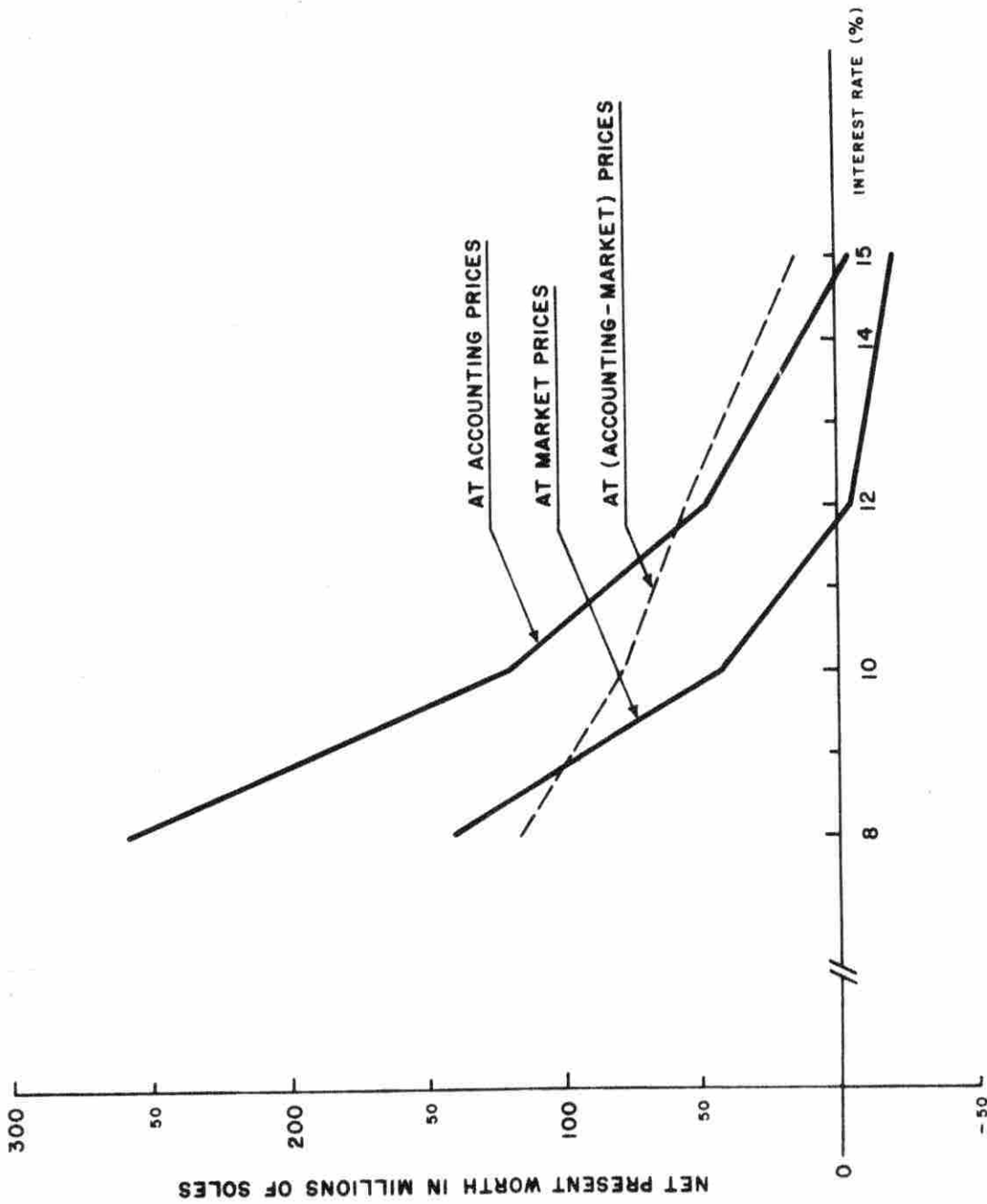


Figure 4. Sensitivity of decision to changes in the type of prices considered (for alternate discount rates, for 2 time horizon of 50 years and for a rate of colonization of 1,000 hectares per year).

It is considered that unskilled labor, being in relative surplus supply in the national economy, is overpriced in the market place. Consequently, the use of market prices for evaluating the economics of a project with respect to its impact at the national level will yield less favorable results relative to those derived with the use of accounting prices. This situation may be illustrated with the results of this analysis appearing in columns (1) and (2) of Table 3 (and graphically illustrated in Figure 4). It can be observed, in the first place, the marked preference the use of accounting prices have with respect to market prices for rendering this project more favorable. This is especially true for the project discounted at low interest rates. The broken curve in Figure 4 represents the difference between the net present worth of the project at accounting prices and the net present worth of the project at market prices, at four different interest rate values. This curve slopes downward towards lower interest rates. Its shape implies that the effect of accounting prices is more noticeable whenever low interest rates are critical to the analysis.

The significance of the use of accounting prices is evident whenever the project is placed within the margin of its acceptance or rejection. It is imperative to give proper consideration to accounting prices for they provide the most valid base for accepting or rejecting a project on economic grounds. In this study the decision uncertainty margin may be placed within two boundaries, viz., (1) the project discounted, alternatively, at accounting prices and at market prices at an interest rate greater than 11 percent but less than 12 percent and, (2) the project discounted,

alternatively, at accounting prices and at market prices at an interest rate greater than 14 percent but less than 15 percent. At this margin it may be assumed that the project is accepted only at accounting prices for the presumable result at market prices would be a negative net present worth figure.

4. Relative sensitivity of the analysis

Table 4 contains figures representing the relative sensitivity of the analysis to individual changes in each of the three variables formerly tested.

Results in Table 4 indicate that of the three variables considered, the time horizon is the most sensitive. A 1 percent change in this variable effects the largest percent change in the net present worth of the project discounted at any of the considered interest rates. The second most sensitive variable is the price type. And, the relatively less sensitive variable is the rate of colonization.

It can also be noticed that the three variables have a declining relative sensitivity the higher the rate of interest considered. The declining rate of change is larger for the time horizon variable meanwhile the lower declining rate of change corresponds to the rate of colonization variable.

Table 4. Relative sensitivity of the analysis at various discount rates to individual changes in each of the time horizons, rate of colonization and price type variables

Parameter	Variable	Percent change in the net present worth per 1 percent change in the variable discounted at			
		8% (1)	10% (2)	12% (3)	15% (4)
A ^a	Time horizon (from 30 to 60 years)	6.76	3.27	1.66	0.60
B ^b	Rate of colonization (from 1,000 to 3,000 hectares per year)	0.13	0.07	0.06	0.03
C ^c	Price type (market prices, and accounting prices at 50 percent of market prices)	2.32	1.56	1.10	0.32

^a A rate of colonization of 3,000 hectares per year and farm labor costs at accounting prices at 50 percent of market prices.

^b A time horizon of 50 years and farm labor costs at accounting prices at 50 percent of market prices.

^c A rate of colonization of 1,000 hectares per year and a time horizon of 50 years.

IV. SUMMARY AND CONCLUSIONS

A. Summary

The Peruvian Government is developing through two of its agencies (the Institute for Agrarian Reform and Promotion in joint venture with the Army Engineering Branch) a project study for the colonization of an area of approximately 2.2 million hectares located in the Alto Marañon jungle region in the northwest part of the country. The total jungle project is one of the largest among those undertaken by the government.

The project planning strategy which has been adopted by the project agency involves a dividing of the 2.2 million hectares area into eight planning sectors. Each of these are to be studied first as independent sub-projects and, later, after having been studied separately, each of the eight sectors are to be brought together as integral or systematic parts of a unique total project comprising the 2.2 million hectares area.

The first and only sector which is being studied at the moment is that corresponding to the Nazareth area of 138,623 hectares. A Pilot project concerning an area of approximately 2,300 hectares has so far been developed for defining the model planning guidelines to be subsequently followed in the progressive colonization of the Nazareth sector area.

After considering the above background circumstances, the Nazareth project was selected as a prototype project for analysis on three points. First, the Nazareth project is the first of a series of projects to be developed under its image. Thus, the analytical approach applied in the

Nazareth project becomes critical in affecting the development of subsequent projects. Second, the Nazareth project is part of one of the largest projects in the country. Third, a well defined criterion for properly differentiating the financial from the economic analysis of a project is now lacking in the project planning.²¹ The lack of a conceptual criterion for project evaluation, added to others related to the proper planning of a project, points to a need for an analysis of the sort undertaken in this study.

The purposes of this thesis is to provide an example of the application of a preliminary data methodology for the economic evaluation of the Nazareth project. The results of this analysis may be useful by providing project analysts a first impression of the economic dimensions of the Nazareth and comparable projects. They may also induce analysts to further consider the planning of the complete program since other sectors will be treated similarly. Thus, planners may give thought to new directions in their original system planning strategy to achieve preferred changes. To this respect, refinements still are needed to clarify the position of the overall program versus the partial sector project approach.

For the economic evaluation of the Nazareth project, two analytical tools have been employed in this work, viz., benefit-cost analysis and sensitivity analysis. These are first treated under their theoretical context and afterwards applied to the project.

²¹ The author arrived to this knowledge after a critical lecture of the Pilot project report and other similar studies, mainly, the Tingo Maria-Tocache project.

The analysis of the direct costs and benefits of the project is performed under the following set of conservative assumptions: (1) a rate of colonization of 1,000 hectares per year; (2) a rate of interest of 15 percent; (3) a project analysis period of fifty years; and (4) farm labor accounting prices at 50 percent of market prices. The total present value of benefits and costs of the project are 107.052 and 112.486 million Soles respectively. The resulting benefit-cost ratio is 0.95, which is derived on the basis of highly conservative assumptions without including indirect economic and social effects.

For the sensitivity analysis, the base assumptions of the benefit-cost analysis are permitted to vary discretely, yielding different net present worth results for the project. The sensitivity test with the conservative assumptions gives a negative net present worth of 4.88 million Soles or a benefit-cost ratio of 0.95 for the project at accounting prices, at a discount rate of 15 percent, with a time horizon of 50 years and with a rate of colonization of 1,000 hectares per year. The sensitivity test with the more optimistic assumptions gives a net present worth of 550.193 million Soles or a benefit-cost ratio of 3.07 for the project at accounting prices, at a discount rate of 8 percent, with a time horizon of 60 years and with a rate of colonization of 3,000 hectares per year. The sensitivity analysis thus provides a range in the benefit-cost ratio of 0.95 to 3.07. The final project ratio may be associated with any value within the limits of the range according to the values assumed for the four variables tested. The values to be given to these variables are ultimately subject to the analysts' judgment regarding

real world factors, viz., economic, social, political and financial, which may affect the project results within an environment of uncertainty.

B. Conclusions

This work draws the following conclusions for the Nazareth prospective project:

1. The Nazareth project is not economically feasible when subject to a set of conservative assumptions regarding the rate of interest, rate of colonization, time horizon and accounting prices.

2. The benefit-cost ratio of 0.95 resulting from the economic evaluation of the Nazareth project based on the conservative assumptions may not be excessively low to be economically feasible if (1) proper consideration is given to the very adverse environment in which the project performance is placed when subject to the conservative base assumptions, and (2) an optimistic attitude is adopted in considering the net effect of indirect economic consequences and social consequences as being favorable to the project.

3. With respect to the sensitivity of decisions to changes in the rate of colonization, it is concluded that the Nazareth project increases its probability of becoming economically feasible as the rate of colonization increases *ceteris paribus*.

4. With respect to the sensitivity of decisions to changes in the time horizon, it is concluded that the Nazareth project increases its probability of becoming economically feasible as the time horizon increases, *ceteris paribus*. A time horizon of 60 years is sufficient for allowing

the project to approximate its maximum net present worth discounted at higher interest rates. Larger time periods are necessary if lower discount rates are considered.

5. With respect to the sensitivity of decision to changes in the rate of discount, it is concluded that the Nazareth project increases its probability of becoming economically feasible the lower the rate of discount considered, *ceteris paribus*. Thus, the decision for selecting a time horizon and/or rate of colonization for the project becomes an increasingly important matter the larger the discount rate considered.

6. A net present worth of 550.193 million Soles, or alternatively, a benefit-cost ratio of 3.07, is the maximum feasible result applicable to the Nazareth project subject to the conditions of this analysis.

7. The use of accounting prices yields a net present worth result greater than that arrived at through the use of market prices in the economic analysis, *ceteris paribus*.

8. The decision to use accounting prices in the economic analysis becomes an increasingly important matter the lower the rate of discount considered, *ceteris paribus*. At higher rates of discount the difference between the net present worth of the project at accounting prices and the net present worth of the project at market prices becomes less important.

C. Recommendations

Prior to any recommendation on the use of results of this analysis it is necessary to include the subsequent considerations:

First, the prospective nature of this analysis of the Nazareth project should be properly considered. This condition of the analysis sub-

jects its results to modifications of a quantitative nature according to the complete data scheme which will be obtained a posteriori (presumably in the near future) by means of a conventional complete project research work including on-field surveys. Incidentally, the analytical procedure of going, on a proportional basis, from the Pilot project to the Nazareth project (or larger projects) implies the probable disproportionate reproduction of certain categories of data inherent in the Nazareth project characteristics. Possible changes in going from the Pilot project to larger projects may include, for example, adjustments in the net farm income data after definition of the marketing channels for the entire sector area production. Also, the consideration of cooperatives working within the spheres of mainly production and marketing of project outputs may favorably alter the results of the analysis. Equally, the necessary industrialization of marketable surplus production conveys possibilities for modifying the economic characteristics of the project.

Second, attention needs to be given to the economic nature of this analysis. Financial aspects should not be expected to enter the analytical framework designed for the economic analysis of the Nazareth project. As such, this study is concerned only with project effects on the economy. Thus, it indicates the economic gains to the society subject to the Nazareth project investment. Project costs and benefits are defined with relation to the economy rather than to the government. Prices put on production factors should indicate, at least approximately, the value of production foregone. And, as market prices are seldom permissive to this condition accounting prices are used accordingly.

This study yields two types of results. The first type, which may be defined as a point estimate, is related to the benefit-cost analysis result. And, the second type, which may be defined as a range estimate, refers to the sensitivity analysis set of outcomes. The latter result is based on variations of the conceptual limitary frame set a priori for the former benefit-cost analysis.

For decision-making purposes it is recommended to put emphasis on the results of the sensitivity analysis. These should be looked upon as the most probable range of values within which the fully developed Nazareth project result will fall. In this respect, analysts may compute an adjusted estimate of the outcome after their selection of the rate of colonization, study period, rate of interest and accounting prices considered.

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APPENDIX A

Basic Information for the Analysis of the Nazareth
Sector Prospective Project

This appendix contains tables, calculations, and notes which were taken into consideration and/or used in the analysis of the Nazareth project. It is composed of two parts. Part 1 is a brief general description of the Pilot project. Part 2 presents the model references extracted from the Pilot project and complementary sources which served for elaborating the prospective Nazareth project.

Part 1: Description of the Pilot Project

In October 1967 the Peruvian War Ministry in joint venture with the Peruvian Institute for Agrarian Reform and Promotion issued the results of the first Pilot Project Study (12) for the Nazareth planning sector. The description of this Pilot Project may be accomplished through the consideration of the subsequent relevant selected aspects.

1. Objectives

The objectives considered in the report are the following: (1) Settle army discharged personnel and peasants of the area in agricultural communities according to the agrarian reform procedures; (2) regulate the actual land tenure system among precarious land owners and nomad Indian farmers and grant land property certificates according to legal specifications; (3) consolidate the establishment of human centers in the area; (4) incorporate 2,300 hectares for agricultural purposes; (5) establish a point of departure for the 2.2 million hectares complete project; (6) grant

technical, social and economic aid to project beneficiaries; and (7) increase agricultural output in the Pilot project area and in the country.

2. General aspects

The Pilot project covers an area of approximately 2,300 hectares located at the right riverside of Meranon River and at both riversides of Inacite River (see Figure 5).

Total population in the area is of approximately 253 inhabitants. There are potential immigration flows from high population pressure towns in the North Coast region and important neighboring jungle towns. These migration flows are restrained by the control exercised there by the Army.

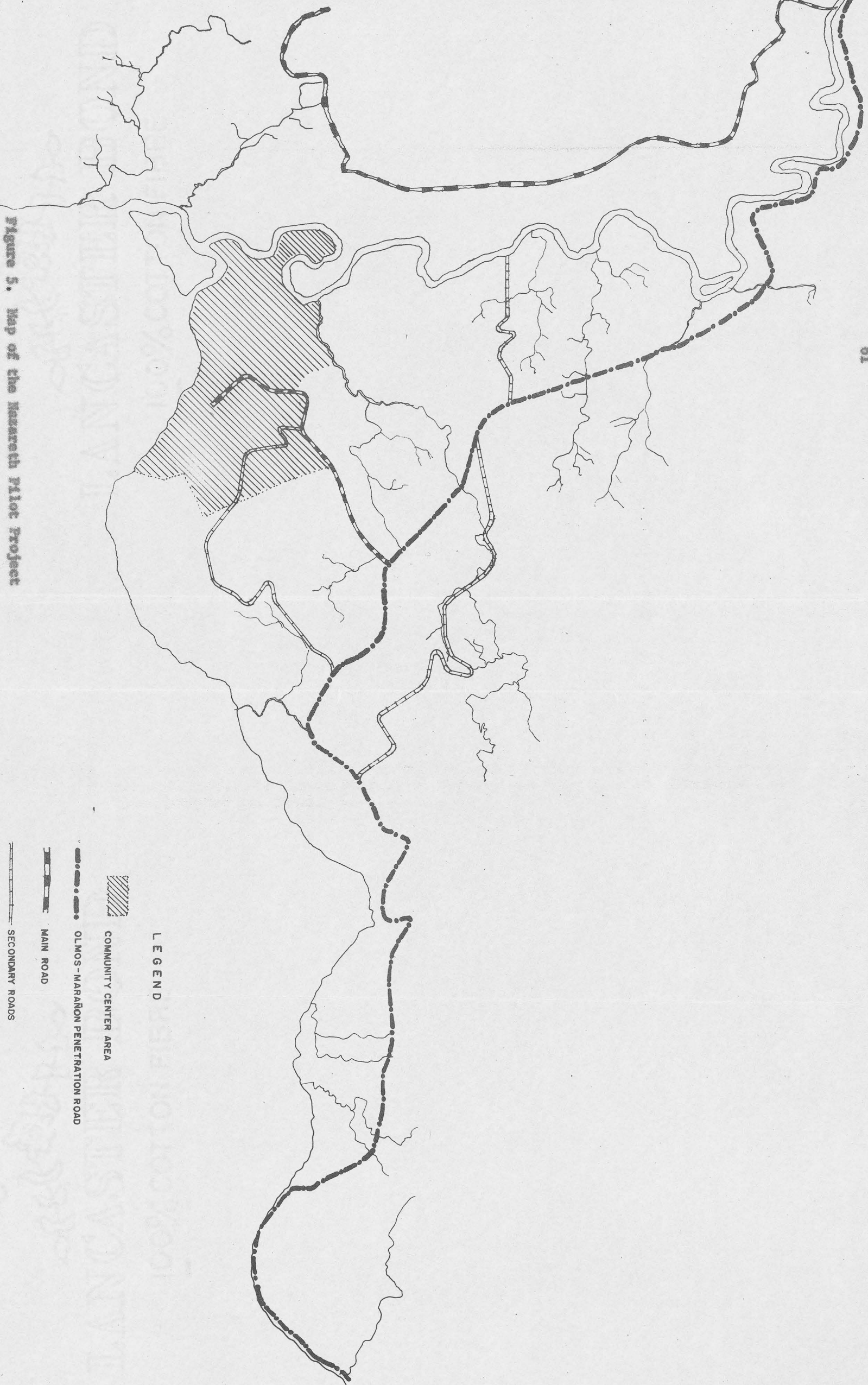
The study area is of the tropical dry forest type. The mean temperature is 75°F. It has a mean annual rainfall of 118 inches uniformly distributed throughout the year.

Soil classes according to USDA standards are distributed as appear in Table 5 below.

Table 5. Pilot project area distribution per soil class

	USDA Soil Classes	Area per soil class Hectares	Percent of total
Soils suited for cultivation	II	26.25	1.2
	III	783.60	34.2
	IV	1,347.33	58.9
Soils not suited for cultivation	V	22.73	1.0
	VII, VIII	108.43	4.7
Total		2,288.34	100.0

Figure 5. Map of the Nazareth Pilot Project



LEGEND



COMMUNITY CENTER AREA



OLMOS-MARAÑON PENETRATION ROAD



MAIN ROAD



SECONDARY ROADS

Land suited for cultivation (soil classes II, III and IV) has an area of 2,157.15 hectares or 94.3 percent of the total area. Class IV soils which represent more than 62 percent of the total land suited for cultivation are suited preferably for grazing purposes. The remaining area (soil classes II and III) is considered for growing crops and cattle raising.

Forestry economic possibilities are not significant. The limited resources of this type are restricted to the construction of rural housing facilities.

The existing road system connects the Pilot project area with the jungle towns of Jaen, Bagua Grande, and Bagua Chica. It also gives access to the North Coast region by means of the Olmos-Maranon penetration road (see Figures 6 and 7). Alternative communication means are the Maranon, Chiriyacu, Imacita and other minor navigable rivers.

3. Investment program

Total investment costs for the Pilot project amount to approximately 20.446 million Soles. This cost covers the construction of infrastructure (3.755 million Soles), urban (9.639 million Soles) and on-farm (7.053 million Soles) facilities.

Infrastructure facilities for the Pilot project comprehend (1) the completion of a main road connecting the agricultural community center with the Olmos-Maranon penetration road, (2) construction of a secondary road system within the Pilot project area, and (3) the establishment of a bordering system for defining individual parcel limits.

TO NAZARETH PILOT PROJCT

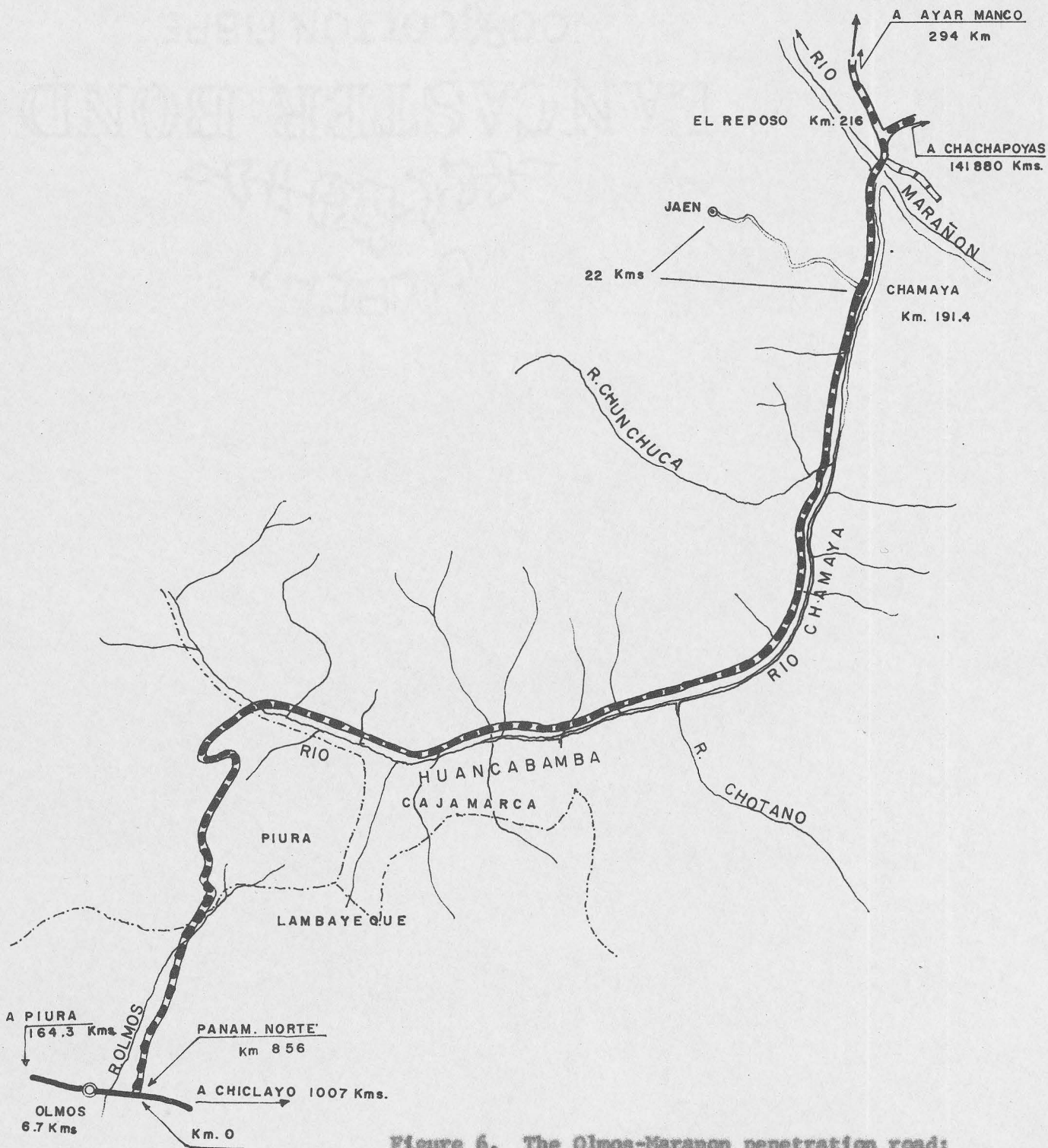


Figure 6. The Olmos-Marañon penetration road: Olmos-River Marañon segment

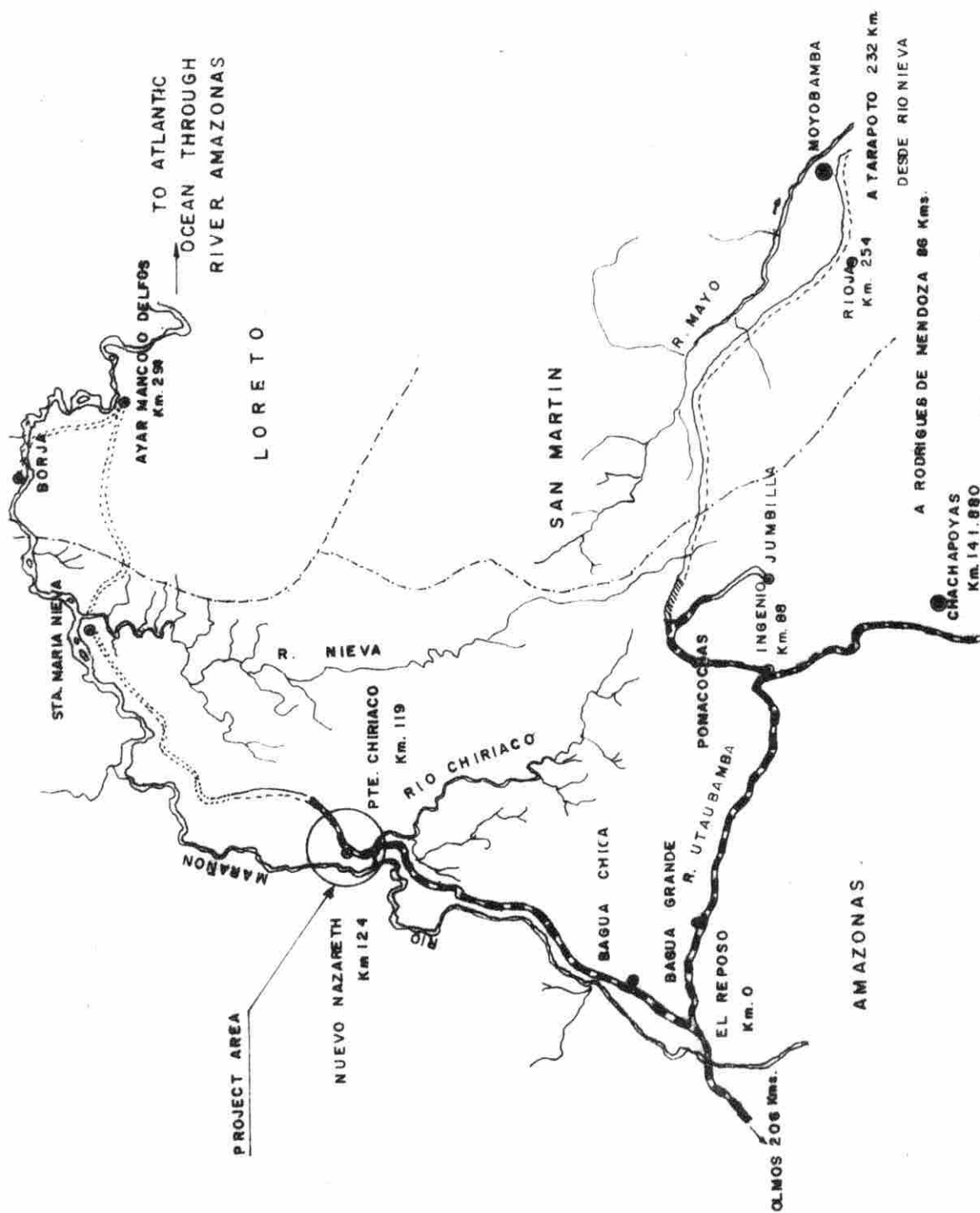


Figure 7. The Olmos-Maranon penetration road: River Marañon-Delfros segment

Investments in community facilities will provide for medical posts, schools, local government offices, parks, water, electric power, public markets, public agencies, housing, and other community center social and economic requirements.

On-farm investments are for housing and minor farm structures, land clearing, corrals, fencing, tools and equipment, semi-permanent crop plantations, pastures and livestock. Agriculture and cattle raising related activities represent approximately 29 percent and 41 percent respectively of total expenditures for on-farm facilities.

Investment costs for community and infrastructure facilities are distributed over the first three year period of the program. On-farm investments are allocated throughout a 15-year development period beginning in 1967. More than 43 percent of these outlays occur in years 1967 and 1968.

4. Farming program

The farming program aspects selected here as relevant refer to the size and type of farm units, the programmed farming activities and the farm unit production costs and receipts.

i. Parcel size The Pilot project complies to the Agrarian Reform Law regulations in determining the size of farms.

The Peruvian Agrarian Reform Law in one of its articles defines the farm unit as the agricultural area which being labored by the farmer and his family, under reasonable efficiency terms, fulfills the following requirements: (1) absorb all the peasant family labor force without requiring non-family labor assistance except in seasonal periods when

crops demand transitorily more labor attention; and even then, this excess labor demand should not be greater than 25 percent of the annual family labor capacity. And, (2) render the farmer a net income sufficient for adequately supporting his family and allowing for savings.

Considering the above, the Pilot project has determined two types of farm units according to their size. The first type measures 15 hectares and is designed for growing crops and swine production, i.e., this farm unit undertakes a mixed enterprise. Ten of the 15 hectares would be constantly under production meanwhile the remaining five hectares would be allocated among rotation and land reserve activities.

The second farm unit type measures 50 hectares and is designed for only cattle raising. Forty-five hectares in pasture equivalent terms supplies feed for 91 animal units. The remaining area of 5 hectares is for growing food crops for the farm and for rotation and land reserve activities.

ii. Parcel type The colonization program includes three types of parcels, viz., types A, C and D²² organized according to their land capabilities. Types A and C parcels measure 15 hectares each and are designed for growing pineapples or bananas, and cassavas, as main crops, and for swine production. There are 44 type A parcels and 34 type C parcels to be distributed among 78 settlers. Type D parcels measure approximately 50 hectares each. These are exclusively for cattle raising.

²² Type B lots were found to be economically unfeasible by the project agency.

There are 6 parcels of this type which will be allocated among 6 settlers.

Land distribution among parcel types and total land used appear in the report as in Table 6 below.

Table 6. Pilot project area distribution among parcel types A, C, and D

Parcel type	Number of parcels	Parcel unit size (hectares)	Total area per type of parcel (hectares)
A	44	15	660
C	34	15	510
D	6	50	300
Total land used			1,470
Total study area			2,288

Distribution of these three types of parcels among colonists is performed according to the Agrarian Reform Law specifications. These imply, for example, that type D parcels will be distributed among colonists having large families, previous experience in farm production, managerial skills and other determinants.

iii. Farming activities Farmers in type A, C and D parcels will be engaged in growing various crops and pastures in varying land area distributions as appears in Table 7.

Crops have been selected according to their suitability with respect to agrological and weather factors and to their marketing and processing possibilities. Emphasis is put on primary processing as a necessary condition for the successful performance of individual farm enterprises.

Table 7. Pilot project area distribution among farm activities and per types A, C and D parcels (hectares)

Farm activity	Type A parcel	Type C parcel	Type D parcel	Pilot project total area
Pineapple	4	--	--	176
Bananas	1	4	--	180
Cassava	1	1	6.25	79
Corn	3	3	--	234
Soybeans	4	4	--	380
Beans	--	--	0.25	1.5
Vegetables	0.25	0.25	--	19.5
Pastures	0.50	0.50	45.0	309
Land for rotation	3	3	0.75	238.5
Reserve land	2	2	3	174
Land for non-farming activities ^a	0.25	0.25	1	25.5
Parcel size ^b	15	15	50	1,470
Total farmed area				1,817.5

^a Non-farming activities are associated to mainly construction of housing facilities.

^b Adding column figures does not yield totals as appearing in the parcel size row due to crop association practices.

Crop selection has also taken into consideration factors such as short cropping cycles, high rentability, low loss probabilities and significant financial opportunities.

Farming activities are expected to gradually develop throughout a 15 year period. Mixed enterprises would reach their maximum output at the tenth year and cattle raising enterprises at the fourteenth year of the mentioned period.

iv. Farm unit production costs and receipts Type A parcels have an estimated development period of 10 years. Annual costs and receipts for this period are listed in Table 8. The expected annual net family income is arrived at in the tenth year. Then, annual total costs amount to 68.358 thousand Soles, gross receipts to 95.250 thousand Soles, and net income to 26.892 thousand Soles. Farm production costs include payments for labor and materials. Consumption at the farm level, depreciation and interests are also considered as farm costs. Gross receipts are derived from sale of farm products at prevailing market prices.

Type C parcels have also an estimated development period of ten years. Annual costs and receipts for this period are listed in Table 9. In this year, total annual costs amount to 64.812 thousand Soles, gross receipts to 79.550 thousand Soles, and net income to 14.738 thousand Soles. As in the above case, farm production costs include payments for labor and materials, consumption at the farm level, depreciation and interest. Gross receipts are derived from sale of farm products at prevailing market prices.

Table 8. Pilot project type A parcel unit investment, expenses and receipts (soles)^a

Years of development	Expenses						Total Costs
	Materials	Payments for labor	On-farm consumption	Sub-total	Depreciation	Interests	
1	34,532	2,690	6,600	43,822	14,263	600	58,685
2	16,124	2,656	6,600	27,380	14,263	2,897	44,540
3	16,110	12,970	7,600	36,680	14,263	4,825	55,768
4	17,606	15,738	8,600	41,944	14,263	6,432	62,639
5	18,991	15,144	9,600	43,735	14,263	3,829	61,827
6	18,732	15,431	10,600	44,736	14,263	2,141	61,167
7	20,794	16,089	11,600	48,483	14,263	1,162	63,908
8	18,841	13,013	12,600	44,454	14,263	1,162	59,479
9	19,882	15,431	14,600	49,313	14,263	1,162	64,738
10	20,244	16,089	16,600	52,933	14,263	1,162	68,358

^a The material contained in tables 7, 8 and 9 is an exact translation to the English of the terms and figures contained in the original corresponding tables of the Pilot project report. Their inclusion here serves for illustrating the criterion followed by the authors of the Pilot project for deriving parcel unit net incomes.

Table 8. (continued)

Years of development	Receipts ^b		Total	Net income
	Agriculture production	Livestock production		
1	11,560	-	11,560	(47,125)
2	26,200	6,800	35,000	(9,540)
3	48,000	17,600	65,600	9,832
4	73,150	17,600	90,750	28,111
5	77,650	17,600	95,250	33,423
6	78,450	17,600	96,050	34,883
7	77,650	17,600	95,250	31,342
8	77,650	17,600	95,250	35,761
9	78,450	17,600	96,050	31,312
10	77,650	17,600	95,250	26,892

^b Receipts (or gross benefits) are defined as the sale of agriculture and livestock product value.

Table 9. Pilot project type C parcel unit investment, expenses and receipts (soles)

Years of development	Expenses						Total Costs
	Materials	Payments for labor	On-farm consumption	Sub-total	Depreciation	Interests	
1	30,005	2,644	6,600	39,249	8,050	929	48,228
2	11,826	1,845	6,600	20,271	8,050	2,087	30,408
3	11,390	10,904	7,600	29,894	8,050	3,967	41,911
4	13,769	21,369	8,600	43,738	8,050	6,825	58,613
5	14,500	23,555	9,600	47,655	8,050	4,585	60,290
6	15,088	19,339	10,600	45,027	8,050	1,947	55,024
7	15,638	19,339	11,600	46,577	8,050	1,162	55,789
8	15,269	23,731	12,600	51,600	8,050	1,162	60,812
9	15,638	19,339	14,600	49,577	8,050	1,162	58,789
10	15,269	23,731	16,600	55,600	8,050	1,162	64,812

Table 9. (continued)

Years of development	Receipts			Total	Net income
	Agriculture production	Livestock production			
1	13,560	-		13,560	34,668
2	12,550	8,800		21,350	9,058
3	29,650	17,600		47,250	5,339
4	56,650	17,600		74,250	15,637
5	57,450	17,600		75,050	14,760
6	59,750	17,600		77,350	22,326
7	59,750	17,600		77,350	21,561
8	61,950	17,600		79,550	18,738
9	61,950	17,600		79,550	20,761
10	61,950	17,600		79,550	14,738

Type D parcels develop during a 14-year time period before production at full capacity is attained. Annual costs and receipts for this period are listed in Table 10. The expected annual net family income is arrived at the fourteenth year. Then, annual total costs amount to 130,219 thousand Soles, gross receipts to 327,750 thousand Soles and net income to 197,531 thousand Soles. Farm production costs include the same items as for the other two types of parcels. Equalwise, gross receipts apply to market prices.

5. Settlement plan

The project considers that 84 colonists will be settled in the Pilot project area in a two-year period starting in 1967. Fifty colonists will begin producing in 1967 and thirty-four in 1968.

Part 2: Model References

This part of the Appendix comprises (1) references from the Pilot project, (2) references from the project agency, and (3) additional references.

1. References from the Pilot project

The farm unit cost data contained in Tables 11, 12 and 13 were extracted from the Pilot project and served for the synthesis of the cost and benefit structure of the Nazareth project. These data are a corrected, rearranged and condensed version of the material contained in Tables 17, 19 and 20 and Appendices 6, 8 and 9 of the Pilot project.

Table 10. Pilot project type D parcel unit investment, expenses and receipts (soles)

Years of development	Expenses						Total costs
	Materials	Payments for labor	On-farm consumption	Sub-total	Depreciation	Interests	
1	116,009	4,723	6,600	127,332	35,215	177	162,724
2	26,929	1,773	6,600	35,302	38,695	336	74,333
3	16,984	-	7,600	24,584	38,695	220	63,499
4	20,832	-	8,600	29,432	39,735	13,243	82,410
5	27,353	8,341	9,600	45,294	40,515	15,098	100,907
6	28,320	10,805	10,600	49,725	41,295	18,468	109,488
7	13,037	-	11,600	24,637	40,515	18,468	83,620
8	22,674	1,913	12,600	37,187	41,815	18,468	97,470
9	33,078	16,483	14,600	64,161	43,115	18,468	125,744
10	44,587	36,502	16,600	97,689	44,775	18,468	160,932
11	41,418	31,610	16,600	89,628	46,075	18,468	154,171
12	37,413	45,286	16,600	99,299	47,635	18,468	165,402
13	57,773	51,058	16,600	125,431	49,195	18,468	193,094
14	31,003	14,953	16,600	62,566	49,195	18,468	130,219

Table 10. (continued)

Years of development	Receipts			Net income
	Agriculture production	Livestock production	Total	
1	9,800	-	9,800	152,924
2	9,800	9,450	19,250	55,083
3	4,800	12,900	17,700	45,779
4	4,800	31,000	35,800	46,610
5	8,550	34,175	42,725	58,182
6	8,550	57,625	66,175	43,313
7	-	103,225	103,225	19,605
8	4,800	98,900	103,700	6,230
9	8,550	129,500	138,050	12,306
10	13,550	143,250	156,800	3,333
11	9,800	191,250	201,050	46,879
12	13,550	215,850	229,400	63,998
13	13,550	289,350	302,900	109,806
14	-	327,750	327,750	197,531

Table 11. Farm unit production costs and benefits for the Nazareth project type A lots (soles)

Year	Investment				Costs			Operating			Total (9)=(5)+(8)
	Land clearing (1)	Construc- tion (2)	Live- stock (3)	Equipment and tools (4)	Total (5)	Labor ^a (6)	Materials (7)	Total (8)			
1	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-
3	4,950	18,500	-	2,000	25,450	11,575	14,057	25,632	51,082		
4	3,300	-	3,000	-	6,300	11,568	13,124	24,692	30,992		
5	3,300	-	-	500	3,800	15,725	15,660	31,385	35,185		
6	3,300	-	3,000	-	6,300	17,109	17,606	34,715	41,015		
7	1,650	-	-	500	2,150	16,137	18,491	34,628	36,778		
8	-	-	3,000	2,000	5,000	18,605	18,732	37,337	42,337		
9	-	-	-	500	500	18,934	20,294	39,228	39,728		
10	-	-	3,000	500	3,500	17,396	18,441	35,837	39,337		
11	-	-	-	500	500	18,605	18,782	37,387	37,887		
12	-	-	3,000	500	3,500	18,934	19,744	38,678	42,178		
13	-	-	-	2,000	2,000	18,934	19,744	38,678	40,678		
14	-	-	3,000	500	3,500	18,934	19,744	38,678	42,178		
15	-	-	-	500	500	18,934	19,744	38,678	39,178		
16	-	-	3,000	500	3,500	18,934	19,744	38,678	42,178		
17	-	-	-	500	500	18,934	19,744	38,678	39,178		
18	-	-	3,000	2,000	5,000	18,934	19,744	38,678	43,678		
19	-	-	-	500	500	18,934	19,744	38,678	39,178		
20	-	-	3,000	500	3,500	18,934	19,744	38,678	42,178		
21	-	-	-	500	500	18,934	19,744	38,678	39,178		
22	-	-	3,000	500	3,500	18,934	19,744	38,678	39,178		
23	4,950	18,500	-	2,000	25,450	18,934	19,744	38,678	64,128		
24	3,300	-	3,000	500	6,800	18,934	19,744	38,678	42,178		
25	3,300	-	-	500	3,800	18,934	19,744	38,678	45,478		
						18,934	19,744	38,678	42,478		

^a Labor costs at accounting prices at 50 percent of market prices.

Table 11. (Continued)

Year	Costs				Labor ^a (6)	Operating		Total (9) = (5)+(8)
	Land clearing (1)	Investment Construc- tion (2)	Live- stock (3)	Equipment and tools (4)		Total (5)	Materials (7)	
26	3,300	-	3,000	500	6,800	18,934	19,744	38,678
27	1,650	-	-	500	2,150	18,934	19,744	38,678
28	-	-	3,000	2,000	5,000	18,934	19,744	38,678
29	-	-	-	500	500	18,934	19,744	38,678
30	-	-	3,000	500	3,500	18,934	19,744	38,678
31	-	-	-	500	500	18,934	19,744	38,678
32	-	-	3,000	500	3,500	18,934	19,744	38,678
33	-	-	-	2,000	2,000	18,934	19,744	38,678
34	-	-	3,000	500	3,500	18,934	19,744	38,678
35	-	-	-	500	500	18,934	19,744	38,678
36	-	-	3,000	500	3,500	18,934	19,744	38,678
37	-	-	-	500	500	18,934	19,744	38,678
38	-	-	3,000	2,000	5,000	18,934	19,744	38,678
39	-	-	-	500	500	18,934	19,744	38,678
40	-	-	3,000	500	3,500	18,934	19,744	38,678
41	-	-	-	500	500	18,934	19,744	38,678
42	-	-	3,000	500	3,500	18,934	19,744	38,678
43	4,950	18,500	-	2,000	25,450	18,934	19,744	64,128
44	3,300	-	3,000	500	6,800	18,934	19,744	45,478
45	3,300	-	-	500	3,800	18,934	19,744	42,478
46	3,300	-	3,000	500	6,800	18,934	19,744	45,478
47	1,650	-	-	500	2,150	18,934	19,744	40,828
48	-	-	3,000	2,000	5,000	18,934	19,744	43,678
49	-	-	-	500	500	18,934	19,744	39,178
50	-	-	3,000	500	3,500	18,934	19,744	42,178

Table 11. (Continued)

Year	Benefits		Costs	
	Gross ^b (10)	Net (11)-(10)-(9)	Labor ^c (6)	Operating Total (8)-(6)+(7)
1	-	-	-	-
2	-	-	-	-
3	18,750	(32,332)	23,150	37,207
4	65,150	34,158	23,136	36,260
5	115,200	80,015	31,450	47,110
6	136,200	95,185	34,218	51,824
7	133,200	97,422	35,274	53,765
8	146,700	104,363	37,211	55,943
9	140,700	100,972	37,869	58,163
10	133,200	93,863	34,793	53,234
11	146,700	108,613	37,211	55,993
12	140,700	98,522	37,869	57,613
13	140,700	100,022	37,869	57,613
14	140,700	98,522	37,869	57,613
15	140,700	101,522	37,869	57,613
16	140,700	98,522	37,869	57,613
17	140,700	101,522	37,869	57,613
18	140,700	97,022	37,869	57,613
19	140,700	101,522	37,869	57,613
20	140,700	96,522	37,869	57,613
21	140,700	101,522	37,869	57,613
22	140,700	98,522	37,869	57,613
23	140,700	76,572	37,869	57,613
24	140,700	95,222	37,869	57,613
25	140,700	98,222	37,869	57,613

^b Gross benefits are defined as the sale of farm outputs value.

^c Labor costs are at market prices.

Table 11. (Continued)

Year	Benefits		Costs	
	Gross (10)	Net (11)-(10)-(9)	Labor (6)	Operating Total (8)-(6)+(7)
26	140,700	95,222	37,869	57,613
27	140,700	99,872	37,869	57,613
28	140,700	97,022	37,869	57,613
29	140,700	101,522	37,869	57,613
30	140,700	98,522	37,869	57,613
31	140,700	101,522	37,869	57,613
32	140,700	98,522	37,869	57,613
33	140,700	100,022	37,869	57,613
34	140,700	98,522	37,869	57,613
35	140,700	101,522	37,869	57,613
36	140,700	98,522	37,869	57,613
37	140,700	101,522	37,869	57,613
38	140,700	97,022	37,869	57,613
39	140,700	101,522	37,869	57,613
40	140,700	98,522	37,869	57,613
41	140,700	101,522	37,869	57,613
42	140,700	98,522	37,869	57,613
43	140,700	76,572	37,869	57,613
44	140,700	95,222	37,869	57,613
45	140,700	98,222	37,869	57,613
46	140,700	95,222	37,869	57,613
47	140,700	99,872	37,869	57,613
48	140,700	97,022	37,869	57,613
49	140,700	101,522	37,869	57,613
50	140,700	98,522	37,869	57,613

Table 12. Farm unit production costs and benefits for the Nazareth project type C lots (soles)

Year	Costs					Labor ^a	Operating Materials	Total
	Land clearing (1)	Construction (2)	Investment Live-stock (3)	Equipment and tools (4)	Total (5)			
1	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-
3	4,950	18,500	-	2,000	25,450	11,552	9,530	21,082
4	3,300	-	3,000	-	6,300	10,162	8,626	18,988
5	3,300	-	-	500	3,800	14,692	10,850	25,582
6	3,300	-	3,000	-	6,300	19,924	13,769	33,693
7	1,650	-	-	500	2,150	21,892	14,000	35,892
8	-	-	3,000	2,000	5,000	20,559	15,088	35,647
9	-	-	-	500	500	21,459	15,138	36,597
10	-	-	3,000	500	3,500	22,755	15,269	38,024
11	-	-	-	500	500	20,559	15,138	35,697
12	-	-	3,000	500	3,500	22,755	16,769	37,524
13	-	-	-	2,000	2,000	22,755	14,769	37,524
14	-	-	3,000	500	3,500	22,755	16,769	37,524
15	-	-	-	500	500	22,755	16,769	37,524
16	-	-	3,000	500	3,500	22,755	16,769	37,524
17	-	-	-	500	500	22,755	14,769	37,524
18	-	-	3,000	2,000	5,000	22,755	14,769	37,524
19	-	-	-	500	500	22,755	14,769	37,524
20	-	-	3,000	500	3,500	22,755	14,769	37,524
21	-	-	-	500	500	22,755	14,769	37,524
22	-	-	3,000	500	3,500	22,755	14,769	37,524
23	4,950	18,500	-	2,000	25,450	22,755	14,769	37,524
24	3,300	-	3,000	500	6,800	22,744	14,769	37,524
25	3,300	-	-	500	3,800	22,755	14,769	37,524

^a Labor costs at accounting prices at 50 percent of market prices.

Table 12. (Continued)

Year	Costs					Operating			Total (9)=(5)+(8)
	Land clearing (1)	Investment Construc- tion (2)	Live- stock (3)	Equipment and tools (4)	Total (5)	Labor (6)	Materials (7)	Total (8)	
26	3,300	-	3,000	500	6,800	22,755	14,769	37,524	44,325
27	1,650	-	-	500	2,150	22,755	14,769	37,524	39,674
28	-	-	3,000	2,000	5,000	22,755	14,769	37,524	42,524
29	-	-	-	500	500	22,755	14,769	37,524	38,024
30	-	-	3,000	500	3,500	22,755	14,769	37,524	41,024
31	-	-	-	500	500	22,755	14,769	37,524	38,024
32	-	-	3,000	500	3,500	22,755	14,769	37,524	41,024
33	-	-	-	2,000	2,000	22,755	14,769	37,524	39,524
34	-	-	3,000	500	3,500	22,755	14,769	37,524	41,024
35	-	-	-	500	500	22,755	14,769	37,524	38,024
36	-	-	3,000	500	3,500	22,755	14,769	37,524	41,024
37	-	-	-	500	500	22,755	14,769	37,524	38,024
38	-	-	3,000	2,000	5,000	22,755	14,769	37,524	42,524
39	-	-	-	500	500	22,755	14,769	37,524	38,024
40	-	-	3,000	500	3,500	22,755	14,769	37,524	41,024
41	-	-	-	500	500	22,755	14,769	37,524	38,024
42	-	-	3,000	500	3,500	22,755	14,769	37,524	41,024
43	4,950	18,500	-	2,000	25,450	22,755	14,769	37,524	62,974
44	3,300	-	3,000	500	6,800	22,755	14,769	37,524	44,324
45	3,300	-	-	500	3,800	22,755	14,769	37,524	41,324
46	3,300	-	3,000	500	6,800	22,755	14,769	37,524	44,324
47	1,650	-	-	500	2,150	22,755	14,769	37,524	39,674
48	-	-	3,000	2,000	5,000	22,755	14,769	37,524	42,524
49	-	-	-	500	500	22,755	14,769	37,524	38,024
50	-	-	3,000	500	3,500	22,755	14,769	37,524	41,024

Table 12. (Continued)

Year	Benefits		Costs	
	Gross ^b	Net	Labor ^c	Operating Total
	(10)	(11)=(10)-(9)	(6)	(8)=(6)+(7)
1	-	-	-	-
2	-	-	-	-
3	20,750	(25,782)	23,104	32,634
4	47,100	21,812	20,325	29,151
5	85,200	55,818	29,384	40,274
6	112,200	72,297	39,849	53,618
7	114,700	76,658	43,785	57,685
8	119,200	78,553	41,119	56,207
9	115,200	78,103	42,919	58,057
10	119,200	77,676	45,511	60,780
11	119,200	83,003	41,119	56,257
12	119,200	78,176	45,511	60,280
13	119,200	78,676	45,511	60,280
14	119,200	78,176	45,511	60,280
15	119,200	81,176	45,511	60,280
16	119,200	78,176	45,511	60,280
17	119,200	81,176	45,511	60,280
18	119,200	76,676	45,511	60,280
19	119,200	81,176	45,511	60,280
20	119,200	78,176	45,511	60,280
21	119,200	81,176	45,511	60,280
22	119,200	78,176	45,511	60,280
23	119,200	56,226	45,511	60,280
24	119,200	74,876	45,511	60,280
25	119,200	77,876	45,511	60,280

^b Gross benefits are defined as the sale of farm outputs value.

^c Labor costs at market prices.

Table 12. (Continued)

Year	Benefits		Costs	
	Gross (10)	Net (11)-(10)-(9)	Labor (6)	Total (8)-(6)+(7)
26	119,200	74,876	45,511	60,280
27	119,200	79,526	45,511	60,280
28	119,200	76,676	45,511	60,280
29	119,200	81,176	45,511	60,280
30	119,200	78,176	45,511	60,280
31	119,200	81,176	45,511	60,280
32	119,200	78,176	45,511	60,280
33	119,200	79,676	45,511	60,280
34	119,200	78,176	45,511	60,280
35	119,200	81,176	45,511	60,280
36	119,200	78,176	45,511	60,280
37	119,200	81,176	45,511	60,280
38	119,200	76,676	45,511	60,280
39	119,200	81,176	45,511	60,280
40	119,200	78,176	45,511	60,280
41	119,200	81,176	45,511	60,280
42	119,200	78,176	45,511	60,280
43	119,200	56,226	45,511	60,280
44	119,200	74,876	45,511	60,280
45	119,200	77,876	45,511	60,280
46	119,200	74,876	45,511	60,280
47	119,200	79,526	45,511	60,280
48	119,200	76,676	45,511	60,280
49	119,200	81,176	45,511	60,280
50	119,200	78,176	45,511	60,280

Table 13. Farm unit costs and benefits for the Nazareth project type D lots (soles)

Year	Costs					Operating				Total	
	Land clearing (1)	Fences (2)	Construction (3)	Live-stock (4)	Equipment and tools (5)	Pastures (6)	Total (7)	Labor ^a (8)	Materials (9)		Total (10)
1	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	-	-	-	-	-	-
3	7,425	12,000	18,500	6,500	2,000	5,000	51,425	15,314	89,109	104,423	155,848
4	6,600	12,000	-	-	3,000	5,000	26,600	12,436	6,929	19,365	45,965
5	3,300	6,000	-	-	500	2,500	12,300	11,474	7,984	19,458	31,758
6	3,300	6,000	-	3,500	-	2,500	15,300	10,626	8,832	19,458	34,758
7	5,785	10,500	-	-	500	4,375	21,160	16,128	11,978	28,106	49,266
8	5,785	10,500	-	6,500	2,000	-	24,785	17,360	13,445	30,805	55,590
9	825	-	-	-	3,500	2,500	6,825	11,064	12,487	23,551	30,376
10	3,300	6,000	-	-	500	4,375	14,175	14,156	14,174	28,330	42,505
11	5,785	10,500	-	3,500	500	6,875	27,160	20,199	17,203	37,402	64,562
12	9,075	16,500	-	-	500	5,000	31,075	28,563	21,212	49,775	80,850
13	6,600	24,000	-	6,500	2,500	11,875	51,475	27,355	23,918	51,273	102,748
14	9,075	16,500	-	-	3,500	11,875	40,950	32,955	26,038	58,993	99,943
15	9,075	22,500	-	-	1,000	2,500	35,075	35,891	30,898	66,789	101,864
16	-	6,000	-	3,500	500	2,500	12,500	22,326	31,003	53,329	65,829
17	-	10,500	-	-	500	4,375	19,500	22,326	31,003	53,329	72,829
18	-	10,500	-	6,500	2,500	-	19,500	22,326	31,003	53,329	72,829
19	-	-	-	-	3,500	2,500	6,000	22,326	31,003	53,329	59,329
20	-	6,000	-	-	1,000	4,375	11,375	22,326	31,003	53,329	59,329
21	-	10,500	-	3,500	500	6,875	21,375	22,326	31,003	53,329	74,704
22	-	16,500	-	-	500	5,000	22,000	22,326	31,003	53,329	75,329
23	7,425	24,000	18,500	6,500	2,500	11,875	70,800	22,326	31,003	53,329	124,129
24	6,600	16,500	-	-	3,500	11,875	38,475	22,326	31,003	53,329	91,804
25	3,300	22,500	-	-	1,000	2,500	29,300	22,326	31,003	53,329	82,629

^a Labor costs at accounting prices at 50 percent of market prices.

Table 13. Farm unit costs and benefits for the Nazareth project type D lots (soles)

Year	Costs					Pastures Total (7)	Labor (8)	Operating Materials Total (9)	Total (10)(11)-(7)+(10)		
	Land clearing (1)	Fences (2)	Construction (3)	Investment Live-stock and tools (4)	Equipment (5)						
26	3,300	6,000	-	3,500	500	2,500	15,800	22,326	31,003	53,329	69,129
27	5,785	10,500	-	-	500	4,375	21,160	22,326	31,003	53,329	74,489
28	5,785	10,500	-	6,500	2,500	-	25,285	22,326	31,003	53,329	78,614
29	825	-	-	-	3,500	2,500	6,825	22,326	31,003	53,329	60,154
30	3,300	6,000	-	-	1,000	4,375	14,675	22,326	31,003	53,329	68,004
31	5,785	10,500	-	3,500	500	6,875	27,160	22,326	31,003	53,329	80,489
32	9,075	16,500	-	-	500	5,000	31,075	22,326	31,003	53,329	84,404
33	6,600	24,000	-	6,500	2,500	11,875	51,475	22,326	31,003	53,329	104,804
34	9,075	16,500	-	-	3,500	11,875	40,950	22,326	31,003	53,329	94,279
35	9,075	22,500	-	-	1,000	2,500	35,075	22,326	31,003	53,329	88,404
36	-	6,000	-	3,500	500	2,500	12,500	22,326	31,003	53,329	53,329
37	-	10,500	-	-	500	4,375	19,500	22,326	31,003	53,329	72,829
38	-	10,500	-	6,500	2,500	-	19,500	22,326	31,003	53,329	72,829
39	-	-	-	-	3,500	2,500	6,000	22,326	31,003	53,329	59,329
40	-	6,000	-	-	1,000	4,375	11,375	22,326	31,003	53,329	64,704
41	-	10,500	-	3,500	500	6,875	21,375	22,326	31,003	53,329	74,704
42	-	16,500	-	-	500	5,000	22,000	22,326	31,003	53,329	75,329
43	7,425	24,000	18,500	6,500	2,500	11,875	70,800	22,326	31,003	53,329	124,129
44	6,600	16,500	-	-	3,500	11,875	38,475	22,326	31,003	53,329	91,804
45	3,300	22,500	-	-	1,000	2,500	29,300	22,326	31,003	53,329	82,629
46	3,300	6,000	-	3,500	500	2,500	15,800	22,326	31,003	53,329	69,129
47	5,785	10,500	-	-	500	4,375	21,160	22,326	31,003	53,329	74,489
48	5,785	10,500	-	6,500	2,500	-	25,285	22,326	31,003	53,329	78,614
49	825	-	-	-	3,500	2,500	6,825	22,326	31,003	53,329	60,154
50	3,300	6,000	-	-	1,000	4,375	14,675	22,326	31,003	53,329	68,004

Table 13. (Continued)

Year	Benefits		Costs	
	Gross ^b (12)	Net (13)-(12)-(11)	Labor ^c (8)	Operating Total (10)-(8)+(9)
1	-	-	-	-
2	-	-	-	-
3	-	(155,848)	30,628	119,737
4	9,450	(136,515)	24,873	31,802
5	12,900	(18,858)	22,949	30,933
6	31,000	(3,758)	21,252	30,084
7	34,175	(15,091)	32,256	44,234
8	57,625	2,035	34,720	48,165
9	103,225	72,849	22,128	34,615
10	98,900	56,395	18,313	42,487
11	129,500	64,938	40,398	57,601
12	143,250	62,400	57,127	78,339
13	191,250	88,502	54,710	78,628
14	215,850	115,907	65,911	91,949
15	289,350	187,486	71,683	102,581
16	327,750	261,921	44,653	75,656
17	327,750	254,921	44,653	75,656
18	327,750	254,921	44,653	75,656
19	327,750	268,421	44,653	75,656
20	327,750	263,046	44,653	75,656
21	327,750	253,046	44,653	75,656
22	327,750	252,421	44,653	75,656
23	327,750	203,621	44,653	75,656
24	327,750	235,946	44,653	75,656
25	327,750	245,121	44,653	75,656

^b Gross benefits are defined as the sale of farm outputs value.

^c Labor costs at market prices.

() Indicates negative values.

Table 13. (Continued)

Year	Benefits		Costs	
	Gross (12)	Net (13)-(12)-(11)	Labor (8)	Operating Total (10)-(8)+(9)
26	327,750	258,621	44,653	75,656
27	327,750	253,261	44,653	75,656
28	327,750	249,136	44,653	75,656
29	327,750	267,596	44,653	75,656
30	327,750	259,746	44,653	75,656
31	327,750	247,261	44,653	75,656
32	327,750	243,346	44,653	75,656
33	327,750	222,946	44,653	75,656
34	327,750	233,471	44,653	75,656
35	327,750	239,346	44,653	75,656
36	327,750	274,421	44,653	75,656
37	327,750	254,921	44,653	75,656
38	327,750	254,921	44,653	75,656
39	327,750	268,421	44,653	75,656
40	327,750	362,046	44,653	75,656
41	327,750	253,046	44,653	75,656
42	327,750	252,421	44,653	75,656
43	327,750	203,621	44,653	75,656
44	327,750	235,946	44,653	75,656
45	327,750	245,121	44,653	75,656
46	327,750	258,621	44,653	75,656
47	327,750	253,261	44,653	75,656
48	327,750	249,136	44,653	75,656
49	327,750	267,596	44,653	75,656
50	327,750	259,746	44,653	75,656

2. References from the Project Agency

The unreported references utilized in the synthesis of the Nazareth project are related to (1) the construction of road facilities and (2) the establishment of urban centers.

The project agency considers that, for approximately every 100 hectares incorporated to agricultural production in the Nazareth project, 1 kilometer of second class road facilities will be required for inter-communicating production centers with assembling, storage, processing and consumption centers. The unit investment cost of this second class road is estimated at 213.75 thousand Soles per kilometer. And, its annual maintenance cost at 7 percent of the latter figure, i.e., 14.94 thousand Soles per kilometer.

Also, the project agency estimates that for the Nazareth project a community center will need to be established for tentatively every 500 colonial families (or 2,500 colonists) entering the project. The estimated investment costs for the establishment of one community center is 9,639 million Soles.

3. Additional references

These refer to the base material for determining the ancillary and the relevant Olmos-Marshon penetration road segment costs. For determining the ancillary costs appearing in Tables 20 and 21 of Appendix C, the following references included in paragraph headings i through iv were extracted from the Tingo Maria-Tocache project (11).

1. Annual costs for economy studies The cost data contained in Table 14 below have been extracted from Appendix 27 of the Tingo Maria-Tocache project report (11).

Table 14. Tingo Maria-Tocache project annual cost for economy studies (thousands of Soles)

Cost item	Soles
Salaries and wages	480
Traveling expenses	114
Office expenses	36
Miscellaneous costs	90
Total annual cost	750

The total labor estimated as necessary for the performance of these economy studies includes one economist for international market affairs, one economist for domestic market affairs, one agricultural economist, secretaries and office assistants.

The annual cost of 750 thousand Soles has been applied to the present study as a high estimate. The three specialized economists proposed above represent an excess supply of skilled labor for the Nazareth project. It may be assumed for the present study that only one agricultural economist would suffice for performing the necessary economy studies. Thus the applied annual cost becomes a conservative estimate.

ii. Agricultural experimentation costs The cost data contained in Table 15 below have been extracted from Appendix 28 of the Tingo Maria-Tocache project report (11).

Table 15. Tingo Maria-Tocache project agricultural experimentation costs (thousands of Soles)

	Soles
Investment cost	2,360
Office and housing facilities	1,860
Improvement of existing facilities	1,000
Equipment	500
Annual maintenance and operating costs	9,360

The investment cost for the Nazareth project was assumed to be 1.6 million Soles instead of 2.36 million Soles for two reasons. First, as there are no before-project facilities and services of this type, the improvement of existing facilities cost is not applicable, thus reducing the total investment cost to 1.36 million Soles. Second, an arbitrary safety margin of 240 thousand Soles was considered for raising the reduced investment cost to 1.6 million Soles. On the other hand, maintenance and operating costs were valued with the same value for the Nazareth project. To this respect, it is considered that the station for the Nazareth project will have the same operative mechanism as that implied in the Tingo Maria-Tocache project agricultural experimentation station.

iii. Agricultural promotion costs The cost data contained in Table 16 below were extracted from Appendix 30 of the Tingo Maria-Tocache project report (11).

Table 16. Tingo Maria-Tocache project agricultural promotion costs (thousands of Soles)

	Soles
A. For one agency	
Investment cost (buildings, housing facilities, cars, trucks, and office equipment)	600
Annual maintenance and operating costs	507.6
B. For one sub-agency	
Investment cost (buildings, housing facilities, cars, trucks, and office equipment)	300
Annual maintenance and operating costs	362.4

These costs were assumed to be applicable to the Nazareth project.

iv. Farm planning costs From Appendix 29 of the Tingo Maria-Tocache project (11) a farm planning unit cost of 100 Soles per hectare was used for the Nazareth project. This cost is incurred for the performance of activities such as (1) the design of lots including the forms and location of all on-farm installations, viz., houses, barns, and pigpens, (2) the elaboration of financial and investment programs, (3) preparation of initial economic rotation programs, (4) general organization of lot units and (5) final reporting and instructions.

v. Road costs With respect to the additional road cost information, the Army engineering branch estimates that the Olmos-Maranon penetration road segment corresponding to the Nazareth project area has an investment cost of one million Soles per kilometer. And, an annual maintenance cost of 8 percent of the latter unit investment cost, i.e., 80 thousand Soles per kilometer.

APPENDIX B

Estimates of the Need for Community Center and Road Facilities

1. Need for community center facilities

The project agency determined a priori the establishment of three community centers for the Nazareth project in addition to that of the Pilot project. One community center would be established for tentatively every 500 family or farm units entering the project. Thus, the establishment of the three additional urban centers is related to the rate of settlement of the project. With these considerations it was estimated in this study that the first additional center would be constructed and available to the project after the eleventh year when the cumulative number of family units (or family size lots) entering the project amounts to 435 (see Table 18); the second additional center after the twenty-first year when the cumulative number of family units amounts to 945, and the third additional center after the thirty-first year when the cumulative number of family units amounts to 1,410.

One observation needs to be made concerning the above matter. The project agency made the demand estimate for these facilities with respect to a static population, disregarding its natural rate of growth of approximately 3 percent per annum. Were this time related factor included in these estimates the resulting population²³ would reach 2,216 family

²³ Without considering migration in the project area which is assumed to become significant upon completion of the programmed road facilities.

units (or 11,080 colonists) by the end of the thirtieth year and 4,002 family units (or 20,010 colonists) by the end of the fiftieth year of the project. Thus, the estimated total supply of community center facilities, i.e., four community centers, would be just sufficient only until the thirtieth year. Afterwards, demand for this type of urban services and facilities will have been duplicated by the fiftieth year implying a proportional and progressive enlargement of the four programmed community centers. This urban expansion signifies additional investment costs which have not been properly regarded in the project. This omission might be worth according to the authors judgment at least one half of the actual investment cost programmed for these facilities, i.e., approximately 19 million Soles.

2. Need for road facilities

The road investment program for the Nazareth project is as appears in Table 17.

The annual investment outlays included in column (1) of Table 17 have been thus defined in the Pilot project study. Similarly, the annual investment outlays included in column (3) of Table 17 have been thus defined by the pertinent Army engineering branch. The annual investment outlays included in column (3) of Table 17 have been defined and distributed by the author after considering the following. First, the estimate made by the project agency for supplying one kilometer of road facilities for approximately every 100 hectares incorporated into agricultural production. And, second, the rate of colonization of 1,000 hectares per year as assumed in this study for the Nazareth project. These considerations

Table 17. Projected road investment costs for the Nazareth project
(thousands of Soles)

Years	Pilot project area road sub- system cost	Nazareth project area road sub- system cost ^a	Olmos-Maranon penetration road cost ^b	Total invest- ment cost (4)
	(1)	(2)	(3)	
1	192	-	-	192
2	192	-	-	192
3	635	-	-	635
4	1,294	2,138	-	3,432
5	1,187	2,138	15,000	18,325
6	-	2,138	15,000	17,138
7		2,138	-	2,138
.		2,138		2,138
.		2,138		2,138
.		2,138		2,138
.		2,138		2,138
.		2,138		2,138
29		2,138		2,138
30		1,120		1,120

^a Excluding the road sub-system corresponding to the Pilot project area.

^b Road segment corresponding to the Nazareth project area.

imply the necessary construction of ten kilometers of road facilities per year, or alternatively, an annual investment of 2.138 million Soles per year given a unit investment cost of 2,138 thousand Soles per kilometer of second class roads. These annual investments are made to occur ahead of next years' coming demand for these facilities.²⁴ From Table 19 it is

²⁴ The actual rate of road construction in the project area is estimated in 15 kilometers per year. Thus, the required construction rate of 10 kilometers per year becomes a conservative estimate.

Table 18. Projected annual increment of farm units and their implicit population for the Nazareth project, subject to a rate of colonization of 1,000 hectares per year^a

Year	Farm units		Population cumulative total ^b
	Annual increment	Cumulative total	
1	-	-	-
2	-	-	-
3	50	50	250
4	34	84	420
5	51	135	675
6	51	180	900
7	51	231	1,155
8	51	282	1,410
9	51	333	1,665
10	51	384	1,920
11	51	435	2,175
12	51	486	2,430
13	51	537	2,685
14	51	588	2,940
15	51	639	3,195
16	51	690	3,450
17	51	741	3,705
18	51	792	3,960
19	51	843	4,215
20	51	894	4,470
21	51	945	4,725
22	51	996	4,980
23	51	1,047	5,235
24	51	1,098	5,490
25	51	1,149	5,745
26	51	1,200	6,000
27	51	1,251	6,255
28	51	1,302	6,510
29	51	1,353	6,765
30	51	1,410	7,020
.	51	1,410	7,020
.	51	1,410	7,020
50	51	1,410	7,020

^a One final goal of the project is the establishment of approximately 1,410 agricultural lots. Of these, 962 lots would be engaged in mixed enterprises meanwhile only 448 would be for exclusively cattle raising. The gradual establishment of 1,410 lots implies a gradual incorporation of approximately 27,000 hectares into agricultural production. In this study, a conservative assumption estimates for the project a constant rate of land incorporation of 1,000 hectares per year. Or alternatively, a constant rate of settlement of 51 farm lots per year. At this pace, the project requires 30 years for finally establishing 1,410 lots in the area.

^b The rate of natural growth and migration flows have not been taken into consideration.

Table 19. Projected land area annual expansion for the Nazareth project subject to a rate of colonization of 1,000 hectares per year

Year	Annual increment	Cumulative total
1	-	-
2	-	-
3	925	925
4	545	1,470
5	1,000	2,470
6	1,000	3,470
7	1,000	4,470
8	1,000	5,470
9	1,000	6,570
10	1,000	7,470
11	1,000	8,470
12	1,000	9,470
13	1,000	10,470
14	1,000	11,470
15	1,000	12,470
16	1,000	13,470
17	1,000	14,470
18	1,000	15,470
19	1,000	16,470
20	1,000	17,470
21	1,000	18,470
22	1,000	19,470
23	1,000	20,470
24	1,000	21,470
25	1,000	22,470
26	1,000	23,470
27	1,000	24,470
28	1,000	25,470
29	1,000	26,470
30	1,000	27,470
.	-	27,470
.		27,470
.		27,470
50		27,470

observed that the land incorporation rate of 1,000 hectares per year begins in the fifth year following immediately after the last annual land incorporation corresponding to the Pilot project. Thus, the first annual investment of 2.138 million Soles occurs in the fourth year. At this rate of investment, 265.3 kilometers of second class roads, costing 56.708 million Soles, will have been built in a 27-year period for an area of approximately 26,000 hectares.

APPENDIX C

Supplementary Data for the Benefit Cost
and the Sensitivity Analysis

Table 20. Ancillary costs for the Nazareth project subject to a rate of colonization of 1,000 hectares per year
(thousands of Soles)

Year	Economy studies	Agricultural Investment	Operating	Investment	Agricultural promotion	Agricultural Investment	Operating	Farm planning	Total
1	750	800	-	600	-	-	-	-	2,150
2	750	800	-	600	508	-	-	-	2,658
3	750	-	9,360	300	1,233	490	490	490	12,133
4	750	-	9,360	-	1,595	452	452	452	12,157
5	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	12,202
30	750	-	9,360	-	1,595	497	497	497	12,202
31	750	-	9,360	-	1,595	497	497	497	12,202
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
.	750	-	9,360	-	1,595	497	497	497	11,705
50	750	-	9,360	-	1,595	497	497	497	11,705

Table 21. Ancillary costs for the Hazareth project subject to a rate of colonization of 3,000 hectares per year

(thousands of Soles)

Year	Economy studies	Agricultural investment	Operating	Investment	Agricultural promotion	Operating	Farm planning	Total
1	750	800	-	600	-	-	-	2,150
2	750	800	-	600	-	508	-	2,658
3	750	-	9,360	300	1,233	490	490	12,133
4	750	-	9,360	-	1,595	452	452	12,157
5	750	-	9,360	-	1,595	1,436	1,436	13,141
6	750	-	9,360	-	1,595	1,436	1,436	13,141
7	750	-	9,360	-	1,595	1,436	1,436	13,141
8	750	-	9,360	-	1,595	1,436	1,436	13,141
9	750	-	9,360	-	1,595	1,436	1,436	13,141
10	750	-	9,360	-	1,595	1,436	1,436	13,141
11	750	-	9,360	-	1,595	1,436	1,436	13,141
12	750	-	9,360	-	1,595	1,436	1,436	13,141
13	750	-	9,360	-	1,595	1,436	1,436	13,141
14	750	-	9,360	-	1,595	1,436	1,436	13,141
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
.	750	-	9,360	-	1,595	-	-	11,705
50	750	-	9,360	-	1,595	-	-	11,705

Table 22. Direct costs and benefits for the Nazareth project subject to a rate of colonization of 1,000 hectares per year, a study period of 50 years and at market farm labor prices

Year	Investment			Costs			Benefits Gross
	Farm Operating	Total	Investment	Maintenance	Road	Community Investment	
1	-	-	192	-	-	412	2,754
2	-	-	192	-	-	412	3,262
3	1,401	3,547	635	31	31	1,896	18,242
4	1,309	4,221	3,432	82	82	4,054	23,946
5	2,197	6,691	18,325	356	356	2,865	42,439
6	2,902	11,556	17,138	1,822	1,822	-	42,718
7	3,161	14,551	2,138	3,193	3,193	-	32,084
8	3,647	17,448	2,138	3,364	3,364	-	35,152
9	3,884	20,407	2,138	3,535	3,535	3,213	41,495
10	4,483	23,821	2,138	3,706	3,706	3,213	45,080
11	4,656	26,146	2,138	3,877	3,877	3,213	47,576
12	5,083	29,839	2,138	4,048	4,048	-	48,227
13	5,670	32,099	2,138	4,219	4,219	-	50,658
14	6,331	36,834	2,138	4,390	4,390	-	55,564
15	7,097	41,007	2,138	4,561	4,561	-	59,908
16	7,894	45,247	2,138	4,732	4,732	-	64,319
17	8,484	49,558	2,138	4,903	4,903	-	68,801
18	8,935	53,299	2,138	5,074	5,074	-	72,713
19	9,196	56,823	2,138	5,245	5,245	3,213	79,621
20	9,677	60,621	2,138	5,416	5,416	3,213	83,590
21	9,817	64,051	2,138	5,587	5,587	3,213	87,191
22	10,174	67,698	2,138	5,758	5,758	-	87,796
23	11,882	72,696	2,138	5,929	5,929	-	91,965
24	12,149	76,153	2,138	6,100	6,100	-	96,593
25	13,388	80,785	2,138	6,270	6,270	-	101,395

Table 22. (Continued)

Year	Costs				Ancillary Total	Benefits Gross			
	Invest- ment	Farm operating	Total	Invest- ment			Community invest- ment		
26	14,246	70,684	84,930	2,138	6,440	8,578	12,202	105,710	176,668
27	14,767	73,974	88,741	2,138	6,610	8,748	12,202	109,691	186,658
28	15,270	77,264	92,534	2,138	6,781	8,919	12,202	113,655	196,329
29	13,774	80,554	94,328	2,138	6,952	9,090	12,202	118,833	209,429
30	13,705	83,844	97,549	1,120	7,123	8,243	12,202	121,207	219,932
31	13,544	83,910	97,454	-	7,217	7,217	11,705	119,589	229,032
32	13,518	85,543	99,061	-	7,217	7,217	11,705	119,983	236,855
33	13,842	86,825	100,667	-	7,217	7,217	11,705	119,589	242,782
34	13,740	88,322	102,062	-	7,217	7,217	11,705	120,984	247,771
35	14,429	89,206	103,635	-	7,217	7,217	11,705	122,557	252,995
36	14,808	90,409	105,217	-	7,217	7,217	11,705	124,139	256,480
37	14,921	90,964	105,885	-	7,217	7,217	11,705	124,807	260,382
38	14,725	91,728	106,453	-	7,217	7,217	11,705	125,375	264,036
39	17,302	92,388	109,690	-	7,217	7,217	11,705	128,612	267,074
40	13,698	92,695	106,393	-	7,217	7,217	11,705	125,315	269,395
41	13,224	92,650	105,874	-	7,217	7,217	11,705	124,796	271,298
42	12,867	92,599	105,466	-	7,217	7,217	11,705	124,368	271,951
43	14,412	92,322	106,734	-	7,217	7,217	11,705	125,656	272,103
44	14,351	92,322	106,673	-	7,217	7,217	11,705	125,595	272,103
45	15,467	92,322	107,789	-	7,217	7,217	11,705	126,711	272,103
46	16,018	92,322	108,340	-	7,217	7,217	11,705	127,262	272,103
47	16,164	92,322	108,486	-	7,217	7,217	11,705	127,408	272,103
48	16,176	92,322	108,498	-	7,217	7,217	11,705	127,420	272,103
49	14,229	92,322	106,551	-	7,217	7,217	11,705	125,473	272,103
50	14,046	92,322	106,368	-	7,217	7,217	11,705	125,290	272,103

Table 23. Net of direct costs and benefits for the Nazareth project subject to a rate of colonization of 1,000 hectares per year, a study period of 50 years, various discount rates and at market and accounting prices
(thousands of Soles)

Year	At market prices		Discounted at:	
	Undiscounted	8%	10%	12%
1	(2,754)	(2,550)	(2,504)	(2,459)
2	(3,262)	(2,797)	(2,696)	(2,600)
3	(17,342)	(13,766)	(13,029)	(12,344)
4	(20,841)	(15,318)	(14,234)	(13,244)
5	(35,306)	(24,029)	(21,921)	(20,032)
6	(30,730)	(19,366)	(19,347)	(15,567)
7	(18,689)	(10,905)	(9,591)	(8,453)
8	(13,598)	(7,347)	(6,343)	(5,492)
9	(14,716)	(7,361)	(6,281)	(5,306)
10	(12,979)	(6,012)	(5,003)	(4,179)
11	(9,170)	(3,933)	(3,214)	(2,636)
12	(5,704)	(2,265)	(1,817)	(1,464)
13	8,94	328	259	205
14	2,712	923	714	555
15	9,119	2,874	2,183	1,666
16	13,064	3,813	2,843	2,131
17	17,954	4,853	3,551	2,614
18	24,025	6,011	4,322	3,123
19	27,117	6,283	4,433	3,148
20	33,142	7,109	4,925	3,437
21	39,527	7,854	5,340	3,660
22	48,912	8,995	6,006	4,040
23	54,733	9,821	6,113	4,039
24	60,095	9,477	6,099	3,960
25	65,283	9,531	6,025	3,839
				145
				383
				1,121
				1,397
				1,658
				1,941
				1,906
				2,025
				2,099
				2,260
				2,200
				2,097
				1,985

() Negative values.

Table 23. (Continued)

Year	At market prices			Discounted at:	
	Undiscounted	8%	10%		12%
26	70,958	9,594	5,953	3,725	1,873
27	76,967	9,636	5,872	3,610	1,770
28	82,674	9,582	5,729	3,464	1,653
29	90,596	9,721	5,707	3,388	1,576
30	98,725	9,813	5,657	3,297	1,491
31	109,443	10,068	5,701	3,261	1,434
32	116,872	10,128	5,634	3,161	1,355
33	123,193	9,720	5,309	2,932	1,220
34	126,787	9,255	4,957	2,688	1,090
35	130,438	8,818	4,643	2,465	978
36	132,341	8,284	4,287	2,284	892
37	135,575	7,863	3,986	2,118	811
38	138,661	7,446	3,702	1,938	724
39	138,462	6,881	3,364	1,709	618
40	144,080	6,627	3,184	1,542	533
41	146,502	6,241	2,945	1,433	489
42	147,563	5,829	2,700	1,307	439
43	146,447	5,345	2,431	1,163	384
44	146,508	4,952	2,212	1,028	331
45	145,392	4,551	1,991	887	276
46	147,841	4,287	1,848	899	251
47	144,695	3,892	1,635	803	217
48	144,683	3,602	1,490	729	188
49	146,630	3,372	1,363	663	161
50	146,813	3,127	1,248	514	132
Net present worth:		140,357	42,421	(6,349)	(20,804)

Table 23. (Continued)

Year	Undiscounted	At accounting prices ^a			Discounted at:
		8%	10%	12%	
1	(2,754)	(2,550)	(2,504)	(2,459)	(2,395)
2	(3,262)	(2,797)	(2,696)	(2,600)	(2,466)
3	(16,744)	(13,291)	(12,579)	(11,918)	(11,009)
4	(21,501)	(15,803)	(14,685)	(13,664)	(12,294)
5	(33,528)	(22,819)	(20,817)	(19,024)	(16,670)
6	(28,367)	(17,877)	(16,013)	(14,371)	(12,263)
7	(15,134)	(8,831)	(7,767)	(6,845)	(5,689)
8	(5,197)	(2,808)	(2,424)	(2,099)	(1,659)
9	(9,368)	(4,686)	(3,973)	(3,376)	(2,663)
10	(6,637)	(3,074)	(2,559)	(2,137)	(1,641)
11	(1,844)	(791)	(646)	(530)	(396)
12	3,084	1,225	983	792	576
13	9,513	3,498	2,756	2,180	1,546
14	14,111	4,805	3,715	2,887	1,994
15	21,685	6,835	5,191	3,962	2,665
16	26,288	7,673	5,720	4,288	2,810
17	32,629	8,820	6,454	4,751	3,031
18	39,573	9,901	7,119	5,144	3,197
19	43,752	10,137	7,153	5,080	3,076
20	49,957	10,715	7,424	5,181	3,052
21	87,429	17,372	11,815	8,096	4,642
22	69,997	12,872	8,596	5,782	3,233
23	72,902	12,415	8,143	5,380	2,931
24	80,251	12,655	8,145	5,288	2,800
25	91,629	13,378	8,457	5,388	2,785

^a Accounting prices at 50 percent of market prices.

Table 23. (Continued)

Year	Undiscounted	At accounting prices		
		8%	10%	12%
26	93,388	12,626	7,835	4,903
27	100,485	12,581	7,667	4,713
28	107,278	12,433	7,434	4,695
29	116,287	12,477	7,326	4,349
30	125,503	12,475	7,191	4,192
31	135,575	12,473	7,063	4,040
32	145,387	12,387	6,891	3,867
33	149,756	11,816	6,454	3,564
34	153,807	11,228	6,014	3,261
35	157,538	10,625	5,601	2,974
36	159,482	9,984	5,167	2,753
37	162,357	9,417	4,773	2,536
38	165,239	8,873	4,412	2,310
39	164,760	8,188	4,004	2,033
40	169,778	7,810	3,752	1,817
41	171,248	7,293	3,442	1,675
42	171,351	6,768	3,136	1,518
43	178,193	6,504	2,958	1,415
44	178,257	6,023	2,692	1,251
45	177,138	5,544	2,427	1,081
46	176,587	5,121	2,207	1,074
47	176,441	4,748	1,994	981
48	176,429	4,393	1,817	889
49	176,376	4,102	1,659	806
50	176,559	3,803	1,518	625
Net present worth:		256,728	120,442	48,296
				(4,880)

Table 26. Direct costs and benefits for the Nazareth project subject to a rate of colonization of 3,000 hectares per year, a study period of 50 years and at accounting prices (thousands of Soles)

Year	Costs				Community Investment	Ancillary Total	Benefits Gross
	Investment	Farm Operating Total	Investment	Road Maintenance			
1	-	-	192	-	412	2,150	2,754
2	-	-	192	-	412	2,658	3,262
3	1,601	1,548	635	31	1,896	12,133	17,644
4	1,309	1,972	7,707	82	4,054	12,157	27,281
5	5,580	9,704	22,700	698	2,865	13,161	54,688
6	7,573	16,359	21,413	2,514	3,213	13,161	64,213
7	8,697	17,626	6,413	4,227	3,213	13,161	52,918
8	9,909	21,889	6,413	4,740	3,213	13,161	59,305
9	10,989	26,891	6,415	5,253	3,213	13,161	65,900
10	12,732	32,163	6,413	5,766	3,213	13,161	73,663
11	13,139	36,730	6,413	6,279	3,213	13,161	78,915
12	14,277	42,341	5,404	6,792	3,213	13,161	85,168
13	14,996	46,719	-	7,225	3,213	13,161	85,194
14	12,273	46,208	-	7,225	3,213	13,161	80,624
15	13,116	44,602	-	7,225	3,213	11,705	76,648
16	14,395	52,155	-	7,225	3,213	11,705	85,480
17	14,882	54,814	-	7,225	3,213	11,705	88,626
18	14,526	56,316	-	7,225	3,213	11,705	88,772
19	13,904	57,636	-	7,225	3,213	11,705	90,470
20	14,878	59,118	-	7,225	3,213	11,705	92,896
21	13,733	60,416	-	7,225	3,213	11,705	93,079
22	13,625	51,242	-	7,225	3,213	11,705	83,797
23	16,034	61,604	-	7,225	3,213	11,705	94,568
24	12,543	61,643	-	7,225	3,213	11,705	92,916
25	15,412	61,095	-	7,225	3,213	11,705	95,437

Table 24. (Continued)

Year	Costs					Community Invest- ment	Ancillary	Total	Benefits Gross
	Invest- ment	Farm Operating	Total	Invest- ment	Road Maintenance				
26	15,250	63,194	78,444	-	7,225	7,225	11,705	97,374	278,982
27	17,152	63,194	80,346	-	7,225	7,225	11,705	99,276	278,982
28	17,524	63,194	80,718	-	7,225	7,225	11,705	99,648	278,982
29	17,309	63,194	80,503	-	7,225	7,225	11,705	99,433	278,982
30	18,641	63,194	81,835	-	7,225	7,225	11,705	100,765	278,982
31	18,113	63,194	81,307	-	7,225	7,225	11,705	100,237	278,982
32	18,093	63,194	81,287	-	7,225	7,225	11,705	100,217	278,982
33	17,449	63,194	80,643	-	7,225	7,225	11,705	99,573	278,982
34	13,809	63,194	77,003	-	7,225	7,225	11,705	95,933	278,982
35	14,508	63,194	77,169	-	7,225	7,225	11,705	96,099	278,982
36	14,508	63,194	77,702	-	7,225	7,225	11,705	96,632	278,982
37	14,848	63,194	78,042	-	7,225	7,225	11,705	96,972	278,982
38	14,582	63,194	77,776	-	7,225	7,225	11,705	96,706	278,982
39	13,939	63,194	77,133	-	7,225	7,225	11,705	96,063	278,982
40	14,909	63,194	78,103	-	7,225	7,225	11,705	97,033	278,982
41	14,143	63,194	77,337	-	7,225	7,225	11,705	96,264	278,982
42	13,622	63,194	76,816	-	7,225	7,225	11,705	92,746	278,982
43	16,034	63,194	77,228	-	7,225	7,225	11,705	96,158	278,982
44	12,843	63,194	75,677	-	7,225	7,225	11,705	94,607	278,982
45	15,492	63,194	78,686	-	7,225	7,225	11,705	97,616	278,982
46	16,388	63,194	79,582	-	7,225	7,225	11,705	98,572	278,982
47	17,152	63,194	80,346	-	7,225	7,225	11,705	99,276	278,982
48	17,524	63,194	80,718	-	7,225	7,225	11,705	99,648	278,982
49	17,309	63,194	80,503	-	7,225	7,225	11,705	99,433	278,982
50	18,641	63,194	81,835	-	7,225	7,225	11,705	100,765	278,982

Table 25. Net direct costs and benefits for the Nazareth project subject to a rate of colonization of 3,000 hectares per year, a study periods of 30, 40, 50 and 60 years, discount rates of 8, 10, 12 and 15 percent and at accounting prices (thousands of Soles)

Year	Undiscounted	Discounted at:			
		8%	10%	12%	15%
1	(2,754)	(2,550)	(2,504)	(2,459)	(2,395)
2	(3,262)	(2,797)	(2,696)	(2,600)	(2,466)
3	(16,744)	(13,291)	(12,579)	(11,918)	(11,009)
4	(24,176)	(17,769)	(16,512)	(15,364)	(13,824)
5	(46,252)	(31,479)	(28,718)	(26,243)	(22,996)
6	(46,908)	(29,561)	(26,479)	(23,764)	(20,278)
7	(24,166)	(14,100)	(11,273)	(10,930)	(9,084)
8	(16,173)	(8,738)	(6,859)	(6,532)	(5,287)
9	(8,235)	(4,119)	(3,175)	(2,970)	(2,341)
10	235	109	82	76	58
11	12,904	5,535	4,111	3,710	2,773
12	24,578	9,760	7,120	6,309	4,594
13	43,066	15,835	11,339	9,871	6,998
14	66,362	22,596	15,887	13,378	9,377
15	86,470	27,255	18,816	15,798	10,627
16	90,498	26,416	17,900	14,760	9,674
17	100,861	27,262	18,144	14,675	9,370
18	114,662	28,688	18,747	14,906	9,265
19	127,785	29,607	18,988	14,836	8,983
20	135,947	29,160	18,366	14,098	8,306
21	147,229	29,254	18,079	13,633	7,818
22	173,096	31,832	19,334	14,298	7,997
23	171,366	29,184	17,394	12,647	6,889
24	179,446	28,298	16,562	11,825	6,263
25	181,932	26,562	15,264	10,698	5,531
26	181,608	24,553	13,856	9,534	4,794
27	179,706	22,499	12,454	8,428	4,133
28	179,334	20,784	11,298	7,514	3,587
29	179,549	19,265	10,288	6,715	3,124
30 Net present worth when time horizon is 30 yrs.	178,217	17,714	9,285	5,932	2,691
31	178,745	16,445	9,313	5,327	2,342
32	178,765	15,231	8,473	4,755	2,038
33	179,409	14,155	7,733	4,270	1,776
34	183,049	13,363	7,157	3,381	1,574
35	182,883	12,363	6,511	3,456	1,372

() Indicates negative values.

Table 25. (Continued)

Year	Undiscounted	Discounted at:			
		8%	10%	12%	15%
36	182,350	11,415	5,908	3,147	1,229
37	182,010	10,557	5,351	2,843	1,088
38	182,276	9,788	4,867	2,548	951
39	182,919	9,091	4,445	2,257	816
40 Net present worth when time horizon is 40 yrs.	181,949	8,370	4,021	1,947	673
		468,542	246,298	155,312	57,031
41	182,718	7,784	3,673	1,787	610
42	186,236	7,356	3,408	1,650	553
43	182,824	6,673	3,035	1,452	479
44	184,375	6,232	2,784	1,294	417
45	181,366	5,677	2,485	1,106	345
46	180,470	5,233	2,255	1,097	307
47	179,706	4,834	2,031	999	270
48	179,334	4,465	1,847	904	233
49	179,549	4,130	1,670	812	198
50 Net present worth when time horizon is 50 yrs.	178,217	3,796	1,514	624	160
		524,722	271,000	167,237	60,605
51	178,217	524,722	271,000	167,237	60,605
52	178,217	524,722	271,000	167,237	60,605
53	178,217	524,722	271,000	167,237	60,605
54	178,217	524,722	271,000	167,237	60,605
55	178,217	25,471 ^a	9,307 ^a	3,524 ^a	810 ^a
56	178,217	25,471	9,307	3,524	810
57	178,217	25,471	9,307	3,524	810
58	178,217	25,471	9,307	3,524	810
59	178,217	25,471	9,307	3,524	810
60 Net present worth when time horizon is 60 yrs.		550,193	280,307	170,761	61,415

^a These values were calculated using uniform series present worth factors.

Table 26. Discounted present worth of direct costs and benefits for the Nazareth project subject to a rate of colonisation of 3,000 hectares per year, a study period of 60 years, a rate of discount of 8 percent and at accounting prices
(thousands of Soles)

Year	Undiscounted		Discounted at 8%	
	Total costs	Net benefits	Total costs	Net benefits
1	2,754	-	2,550	-
2	3,262	-	2,757	-
3	14,695	(2,049)	11,665	(1,626)
4	24,000	(176)	17,640	(129)
5	39,404	(6,848)	26,818	(4,661)
6	40,281	(6,627)	25,385	(4,176)
7	26,994	2,831	15,751	1,652
8	27,507	11,334	14,322	6,124
9	28,020	19,785	14,324	9,896
10	28,533	28,768	13,216	13,325
11	29,046	41,950	12,458	17,992
12	28,550	53,128	11,337	21,097
13	23,479	66,345	8,670	24,469
14	22,143	88,505	7,540	30,136
15	18,930	105,400	5,967	33,222
16	18,930	109,428	5,967	31,942
17	18,930	119,791	5,967	32,379
18	18,930	133,592	5,967	33,465
19	18,930	146,715	5,967	33,993
20	18,930	154,677	5,967	33,221
21	18,930	166,159	5,967	33,016
22	18,930	192,026	5,967	35,313
23	18,930	190,296	5,967	32,407
24	18,930	198,376	5,967	31,284
25	18,930	200,862	5,967	29,326
26	18,930	200,538	5,967	27,112
27	18,930	198,636	5,967	24,869
28	18,930	198,264	5,967	22,979
29	18,930	198,479	5,967	21,296
30	18,930	197,147	5,967	19,596
31	18,930	197,675	5,967	18,186
32	18,930	197,695	5,967	16,844
33	18,930	198,339	5,967	15,649
34	18,930	201,979	5,967	14,744
35	18,930	201,813	72,245 ^a	13,642
36	18,930	201,280	72,245	12,600
37	18,930	200,940	72,245	11,654
38	18,930	201,206	72,245	10,805
39	18,930	201,849	72,245	10,031
40	18,930	200,879	72,245	9,240

Table 26. (Continued)

Year	Undiscounted		Discounted at 8%	
	Total costs	Net benefits	Total costs	Net benefits
41	18,930	201,645	72,245	8,590
42	18,930	202,166	72,245	7,986
43	18,930	201,794	72,245	7,364
44	18,930	203,305	72,245	6,871
45	18,930	200,296	72,245	6,269
46	18,930	199,400	72,245	5,783
47	18,930	198,636	72,245	5,343
48	18,930	198,264	72,245	4,937
49	18,930	198,479	72,245	4,565
50	18,930	197,150	72,245	4,565
51	18,930	197,150	72,245	4,565
52	18,930	197,150	72,245	4,565
53	18,930	197,150	72,245	4,565
54	18,930	197,150	72,245	4,565
55	18,930	197,150	72,245	28,177 ^a
56	18,930	197,150	72,245	28,177
57	18,930	197,150	72,245	28,177
58	18,930	197,150	72,245	28,177
59	18,930	197,150	72,245	28,177
60	18,930	197,150	72,245	28,177
Present worth ^b			262,645	808,696

() Indicates negative values.

^a These values were calculated using uniform series present worth factors.

^b The net present worth of costs and benefits yields a benefit-cost ratio of 3.07.

Table 27. Annual increment of land and farm units and their implicit population for the Nazareth project, subject to a rate of colonisation of 3,000 hectares per year

Year	Area		Farm units		Population Cumulative total ^a
	Annual Increment	Cumulative Total	Annual Increment	Cumulative Total	
1	-	-	-	-	-
2	-	-	-	-	-
3	925	925	126	50	250
4	545	1,470	34	84	420
5	3,000	4,470	150	234	1,170
6	3,000	7,470	150	384	1,920
7	3,000	10,470	150	534	2,670
8	3,000	13,470	150	684	3,420
9	3,000	16,470	150	834	4,170
10	3,000	19,470	150	984	4,950
11	3,000	22,470	150	1,134	5,670
12	3,000	25,470	150	1,284	6,420
13	2,320	27,990	126	1,410	7,020

^a The rate of natural growth and migration flows have not been considered.

Table 28. Alto Maranon project planning sectors estimated total and available land areas and its farm uses

Sector	Total area		Total available area		Area for agricultural production		Area for livestock production	
	Hectares	%	Hectares	%	Hectares	%	Hectares	%
I ^a	138,623	20	28,000	50	14,000	50	14,000	50
II	203,104	10	20,000	50	10,000	50	10,000	50
III	247,115	60	150,000	30	45,000	70	105,000	70
IV	189,654	10	18,964	50	9,482	50	9,482	50
V	299,340	35	105,000	20	21,000	80	84,000	80
VI	508,866	15	76,000	10	7,600	90	68,400	90
VII	417,565	15	65,000	10	6,500	90	58,500	90
VIII	195,728	25	5,000	10	5,000	90	45,000	90
Total	2,200,000	23	512,964	23	118,582	77	394,382	77

^a Sector I of the Alto Maranon project corresponds to the Nazareth project subject of this study.

Table 28. (Continued)

Sector	Agricultural production units ^b	Livestock production units ^c	Total farm units
I	933	467	1,350
II	666	333	999
III	3,000	3,500	6,500
IV	632	316	948
V	1,400	2,800	4,200
VI	506	2,280	2,786
VII	433	1,950	2,383
VIII	333	1,500	1,833
Total	7,403	13,096	20,999

^b Agricultural production units measure 15 hectares each.

^c Livestock production units measure 30 hectares each.