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The Water Supply Constraint :  
An Evaluation of Irrigation Projects and  
Their Role in the Development of  
Afghanistan

by

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AND THEIR ROLE IN THE DEVELOPMENT OF  
AFGHANISTAN

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CHAPTER I

INTRODUCTION TO IRRIGATION DEVELOPMENT IN THE THIRD WORLD

Irrigation Infrastructure in Economic Literature

Afghanistan has had a very poor development record in the post-war period. A relatively large volume of aid had sustained high levels of investment with apparently little effect on the standard of living of the vast majority of the population. The general failure of the past investment has been to overlook the linkages between technology and institutions. Mere technical feasibility has been regarded as a sufficient condition for project implementation, whether or not the project was economically justified; or, given the matrix of traditional social and political institutions, whether it was even capable of yielding the projected returns.

What follows is a brief analysis which attempts to explicate the effect of capital intensive projects on the macro economic parameters of employment, balance of payments, migration, income redistribution, domestic savings generation and

administrative and institutional reorganization. The infrastructure as a "pre-condition to development" has not only been proven to be an insufficient condition for development, but has had a net negative impact upon the present potential rate of growth. Whereas this unbalanced approach to development has removed certain barriers to growth, the gross misallocation of scarce resources has, at the same time, delayed the removal of certain key constraints, ossified some other existing constraints, and introduced a whole new set of constraints making present development more difficult.



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Impact of Capital Intensive Investments on National  
Development Potential - Afghanistan

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## ABSTRACT

Within Afghanistan the critical constraint to agricultural surplus generation has not been the physical insufficiency of traditional irrigation systems, but an institutional constraint: on-farm water distribution operates according to feudal tradition and is both inefficient and inequitable. An ex post evaluation of these two major irrigation projects measures the extent of social loss because of inefficient concentration of scarce resources. The Russian and American development agencies applied two distinctly different approaches to remove the water supply constraint, neither succeeded. An ex ante feasibility analysis of incremental investments to complete and improve the largest irrigation project demonstrates that until institutional constraints are removed, technical assurance of increased irrigation water is neither necessary nor sufficient for increased agricultural production. An evaluation of the post-War national development experience identifies the consequences of an unbalanced development plan. Not only has the country failed to achieve its potential growth rate, but misallocation of past development efforts within the agricultural sector has introduced a whole new matrix of constraints that restricts present development potential.

## ABSTRACT

Within Afghanistan the critical constraint to agricultural surplus generation has not been the physical insufficiency of traditional irrigation systems, but an institutional constraint: on-farm water distribution operates according to feudal tradition and is both inefficient and inequitable. The Russian and American development agencies applied two distinctly different approaches to remove the water supply constraint; neither succeeded. An ex post evaluation of these two major irrigation projects measures the extent of social loss because of inefficient concentration of scarce resources. Although the largest irrigation project has not yet been completed, an ex ante feasibility analysis of incremental investments demonstrates that until institutional constraints are removed, technical assurance of increased irrigation water is neither necessary nor sufficient for increased agricultural production. An evaluation of the post-War national development experience identifies the consequences of an unbalanced development plan. Not only has the country failed to achieve its potential growth rate, but misallocation of past development efforts within the agricultural sector has introduced a whole new matrix of constraints to impede present development.

## ARGUMENT

En Afghanistan, la production d'un surplus agricole se trouve bloquée de façon critique. L'obstacle, toutefois, ne consiste pas en une insuffisance physique du réseau d'irrigation traditionnel; il s'agit au contraire d'un obstacle d'ordre institutionnel, social. En effet, la distribution d'eau dans les champs s'opère sous les contraintes d'un régime féodal aussi inefficace qu'il est inéquitable. Sans doute, les agences de développement internationales, tant soviétiques qu'américaines, se sont appliquées à libérer l'agriculture afghane de cette entrave que constitue le manque d'eau. Mais on avancera ici que ces entreprises sont vouées en grande partie à l'échec, à cause d'un système social local qui cause la concentration inefficace de ressources pourtant maigres. On analysera l'exemple d'un grand projet d'irrigation américain, point achevé encore, mais dont l'insuccès final est déjà prévisible, puisque tant qu'il demeurera des obstacles d'ordre social, l'agrandissement du réseau irrigué ne se trouvera être ni nécessaire, ni suffisant pour accroître la production agricole.

On évaluera, enfin, les conséquences depuis la seconde guerre mondiale d'un plan de développement national déséquilibré. L'Afghanistan, en somme, est loin d'avoir accru sa production au rythme qu'on eût pu lui espérer; au contraire, l'injection de projets agricoles maladroits a greffé sur le pays une véritable matrice de nouvelles restrictions, lesquelles bouchent un développement potentiel.

## CHAPTER 1

### INTRODUCTION TO IRRIGATION DEVELOPMENT IN THE THIRD WORLD

#### Irrigation Infrastructure in Economic Literature

Afghanistan, a mountainous, arid, land-locked country in central Asia, has had a very poor development record in the post-war period. A relatively large volume of aid has sustained high levels of investment with apparently little effect on the standard of living of the vast majority of the population. The sluggish growth of the economy in the past has largely been due to the slow progress in the agricultural sector, which is the mainstay of the economy.

Neither foreign nor domestic development investment allocated to the agricultural sector has resulted in an appreciable increase of productivity or output. Over the past decade the agricultural sector has been virtually stagnant, growing at or below the average rate of population increase. Only through an acceleration in agricultural growth can Afghanistan raise itself above subsistence equilibrium. After 16 years of concerted development effort, Afghanistan still approximates the most underdeveloped model in the Third World.

The basic economic characteristic of underdevelopment, which has been the normal state of the world everywhere and in all ages until now, is a low level of food output per head of population (low in comparison with present potential), so that the proportion of the population which can live from the agricultural surplus is very small.

The essence of development is the utilization of this surplus to invest in mechanical power and new techniques to increase agricultural and non-agricultural production by raising output per man-hour of labour above what human muscle and animal muscle alone can achieve.

Within Afghanistan, the development that comes from increased agricultural surplus generation has not evolved. It is not that development investments have been deficient, but that their concentration has been misdirected. In particular, development expenditures, as they have been directed to the agricultural sector, have not been balanced. The largest proportion of projects has been concerned with one resource -- water. A development myopia has persisted in concentrating projects within the agricultural sector of Afghanistan designating water as a unique scarce resource. Its scarcity was judged the critical constraint to agricultural surplus generation and thus the logical priority for the allocation of scarce development investment funds. It has been implicitly assumed that without more water, agricultural production could be increased neither at the intensive nor at the extensive margins. Since the actual annual run-off far exceeds the annual domestic utilization<sup>1</sup> the problem appeared simply technical. In order to store the seasonal run-offs, assure an adequate supply, and increase on-farm irrigation efficiency, capital intensive irrigation delivery systems would be necessary to replace the inadequate traditional structures. Thus, it seemed, underutilization of water was a direct function of inadequate capital formation.

Misplaced emphasis on water as a unique resource is not limited to Afghanistan. It has been the preoccupation of most arid countries,



not only in the Islamic-Mediterranean Basin, but in most of the world. Similarly, Afghanistan is not atypical in concentrating investment in large scale infrastructure investments in order to increase and regulate the supply of this scarce resource. Many such projects have achieved notoriety. The Gezira scheme in the Sudan, the Aswan High Dam in Egypt, the Indus River Plain Project in Pakistan, as well as the Sarada Canal, Chambal Valley, Hirakid Dam and Damodar canal projects in India are but a few of the more notable large scale projects<sup>2</sup> undertaken to remove the water constraint in arid lands.

In the contemporary literature of development, capital-intensive projects are regarded as one of the most satisfactory means to increase agricultural productivity. These projects have their antecedents in early classical economic theories. The English classical economists, Malthus and Ricardo observed the diminishing returns to labour and capital in agricultural production. With a given stock of land and an increasing population, resource scarcity and population pressure lower the real wage, affect the levels of living, and impair economic growth. Marx considered growth of agricultural productivity to be a precondition to the emergence of industrial capitalism.<sup>3</sup> He was impressed with the efficiency gained by large-scale farm production in England, and believed structural changes leading to the elimination of peasant farming were an essential step in agricultural development.

Sixty years later in the post-War period, Rostow presented his famous "leading sectors growth stage" approach.<sup>4</sup> Rostow's system, like that of Marx, clearly specified a dynamic role for the agricultural sector in the transition process. In an open economy, primary

sector industries may act as leading sectors and, at a particular time, carry the burden of accelerating growth. In addition, agriculture must provide food for a rapidly increasing population, provide a mass market for the products of the emerging industrial sectors, and generate capital investment and labour force for new leading sectors outside of agriculture.

In an attempt to grasp the dynamics of the interaction and transition between a stagnating traditional sector and the growing modern sector of post-war Third World countries, "dual economy" theories<sup>5</sup> emerged. These dynamic dual economy models identify agriculture as the traditional sector and industry as the modern sector, and attempt to trace the increasing interaction between the two sectors in the process of development. In the Jorgensen dual economy model, an economy's ability to generate an agricultural surplus depends upon three parameters:

- (a) the rate of technical progress in agriculture;
- (b) the rate of population growth; and
- (c) the elasticity of output in the agricultural sector with respect to changes in the agricultural labour force.

For an economy caught in a low-level equilibrium trap, an escape is only possible through an acceleration in the rate of introduction of new agricultural technology and an alteration of cultural habits which will lower birth rates more rapidly than death rates.

Post-War development efforts have acknowledged that agricultural growth is critical for industrialization and general economic growth of Third World countries, and these efforts have focussed primarily on

- (a) institutional reforms in the fields of land tenure, marketing and credit organizations;
- (b) development of extension and production education systems; and
- (c) investment in physical infrastructure, especially large-scale land and water resource development.

The major category of public investment expenditures in most Third World countries has been physical infrastructure development. In arid areas, particularly, irrigation and land development systems have absorbed a very high proportion of development funds. The argument went like this: The capacity of agricultural producers to respond to the technical and economic opportunities available to them depends significantly on the level of infrastructure development in rural areas. Infrastructure in this particular sense is defined as those inputs and services which are organized and controlled by the community rather than by individual producers. Implicit is the concept of externality and group control. The control group, as in the case of irrigation systems, may be the community or an agency of the government. Usually infrastructure investments are broken into two categories: physical infrastructure such as roads, irrigation networks, and rural electrification grids; and organizational or institutional infrastructures such as extension education systems, disease and pest control organizations, quality control and/or certification activities.

Much of the investment in infrastructure was rationalized as being a necessary precondition to more rapid growth. A view was widely supported that without the construction of a "critical minimum", the

level of payoff to private economic activity would be inadequate to induce the private investment necessary for sustained growth.

The fundamental economic rationale for massive public investment in social overhead capital in agriculture is based on the fact that the marginal social benefit so greatly exceeds private benefit that only the public sector can afford to undertake such projects. Secondary and spillover effects which are not captured in the form of price and user charges for the services provided yield social returns far in excess of private-sector returns. Returns to physical infrastructure investment are considered very high, because of the noticeable shortage of social overhead capital in most Third World countries. Most infrastructure investments are characterized by lumpiness and a relatively long gestation period, so central governments of these countries were encouraged to initiate investment projects not only because they were necessary, but also because the private sector could never be expected to find these ventures attractive.<sup>6</sup>

Irrigation systems, a subset of general agricultural infrastructures, affect the basic economic functions of production marketing and consumption in a variety of ways. In a subsistence agricultural environment, where each farm firm is totally self-sufficient and where the farm family consumes all it produces and buys nothing, an agricultural infrastructure cannot be said to be functioning. The transition from subsistence to commercial farming is inevitably linked to the development of an agricultural infrastructure because, once the farmer injects himself into the market, whether for purchase or sale, he immediately requires, and is dependent upon, external agencies. In its

earliest phases the development of infrastructures accompanies the development of a market, and the development of marketing accompanies the movement toward specialization, division of labour, monetization of production, and purchase of inputs; all of which are characteristics of advanced agricultural economic systems.

Unfortunately, a definite causal relationship has not been determined. Much of our knowledge regarding the role of agricultural infrastructures is inferential at best.

Without adequate roads, clearly, it is difficult to transport a perishable agricultural surplus to feed urban industrial workers; yet there are instances where building a road into a region capable of producing an agricultural surplus has not resulted in any significant increase in the marketed surplus. In other words, we know that some level of infrastructure is a necessary condition to the development of agriculture, but we do not know what the necessary level is. We know that without some minimum level of agricultural infrastructure, efforts to stimulate more rapid increases in agricultural output will be frustrated, but we do not know what that minimum level is. We likewise know that under certain conditions and situations the development of a particular level of agricultural infrastructure has stimulated more rapid agricultural development; yet we do not know in general what those conditions are and what the required level is.<sup>7</sup>

Of the many infrastructure investments that are preconditions to the transition of a traditional agriculture, the construction of irrigation systems has received relatively too much attention. On a global scale, it is generally concluded that there has been over-

investment in water supply systems. Investments have typically been undertaken prematurely and on an over-ambitious scale. Over-investment for any particular area is indicated when facilities stand idle or are put to makeshift uses -- either to avoid the appearance of idleness or to minimize the losses due to past mistakes. Or, over-investment may be indicated by relatively low return earned on capital invested in water supply. All these conditions exist in varying degrees in many Third World countries.

The reasons for over-investment in modern water supply systems in the Third World countries are complex. If responsibility is placed upon faulty and inadequate planning, economists invariably counter with the refutation that most of the large irrigation development structures were initiated without any objective economic feasibility analyses. Engineers could bear some of the responsibility because of their inherent bias for building as a universal remedy for all supply deficiencies. But the technocrats provided only the tools. The major impetus for these projects has too often derived from political and blatantly non-economic reasoning.

On one level there has always been the appeal of the monumental infrastructure investment, a highly visible structure indelibly marking a step forward. Water supply decisions are largely made in the political arena rather than in the market place. Special interest groups may obscure the economic issues involved in government-subsidized water projects. They are able to exploit public romanticism for "making the desert bloom even as the rose", and thus obtain public support for their own financial gain.<sup>8</sup>



The bilateral and multilateral aid agencies, for their part, have favoured capital intensive infrastructure investments in agriculture<sup>9</sup> for a wide assortment of reasons. These projects can easily be planned and developed in a format amenable to the algebra of the whole family of benefit-cost, financial, and investment efficiency analyses. This measurability figures prominently in the bias of project planners who want to see tangible and quantifiable results. This criterion of measurability, on the other hand, cannot easily be met in capital-extensive projects such as research, extension education, plant and animal protection, disease and pest control; all of which lend themselves marginally, at best, to conventional benefit-cost calculations.

The central governments of the Third World countries have been attracted to infrastructure investments in agriculture not only because they were convinced of the "critical minimum" criterion, but also because capital-intensive agricultural projects have certain favourable political externalities. Experience in development planning has taught these countries that the large infrastructural projects are the easiest to delineate and implement. These projects do not presuppose any co-ordinated decisions or action by other agencies. Project planning can be adequately handled by engineers, agronomists and economists. At the same time, the large infrastructure projects are the easiest to manipulate. During implementation the budget may fairly easily be expanded or contracted and the termination date prolonged. Finally most projects do not require social change in the target population. The agrarian (in many cases, tribal and feudal) relationships therefore need not be

disturbed. Leaders in the Third World countries have learned that it is much easier to build bridges and canals than it is to change deeply entrenched social institutions and customs.

### Hypothesis

In the chapters that follow, the problem of inadequate water supply as a constraint to increased agricultural production in arid lands will be studied. The basic hypothesis is that within Afghanistan the critical water constraint to agricultural surplus generation has not been the physical insufficiency of traditional irrigation delivery systems, but the institutional constraint of a deep-rooted Islamic feudal tradition of on-farm water distribution that is both inefficient and inequitable.

Massive capital investments directed at removing the water constraint cannot yield a positive social rate of return until the total matrix of technological, social and political institutions as they relate to this scarce factor of production are understood and altered. Past investment in capital intensive irrigation systems has failed in the analysis of the linkages between technology and institutions. The ability of a country to achieve rapid growth in agricultural productivity and output, hinges on its ability to make an efficient choice among alternate paths. Failure to choose a path which will effectively ease the constraints imposed by resource endowments will depress the whole process of agricultural and economic development. By concentrating resources in inefficient capital intensive irrigation development, Afghanistan has

not only failed to achieve its potential growth rate, but has introduced a whole new matrix of constraints that restricts the present development potential. The general development impediments introduced as a result of a misplaced emphasis upon one physical constraint will be discussed in the final chapters of this study.

### Methodology

The study proposes to analyze the problem of increasing the supply of water at a project, a sectoral and a national economic level. It is divided into two sections.

The first section of the study takes the two major irrigation projects in Afghanistan and evaluates the economic rate of return for these investments. Specifically, an "internal rate of return" framework is applied to an "efficiency" objective function (i.e., increased net regional farm production) to estimate the social rate of return of these major irrigation investments.

The writer will explore in detail the usefulness and critical limitations of the standard ex ante benefit-cost methodology as an effective policy tool for investment decision-making in Third World economies. Specifically, Chapter 2 reviews the literature on benefit-cost analysis as it pertains to Third World project evaluation and offers a defense of the particular benefit-cost methodology employed. There are many possible evaluation techniques and objective functions. Here, an internal rate of return format is used, incorporating a minimum of shadow prices and using only the efficiency criterion as a measure of net social gain. For both theoretical and practical reasons, this approach

is assumed superior to other available methods.

Chapter 3 completes the exercise of calculating a single-valued internal rate of return for the major irrigation project in the country. The American and Afghan planners of the Helmand-Arghandab Valley Project proposed in 1971 a development plan that would add incremental improvements to an already extensive modern irrigation grid. Using only the input and output projections supplied by the project planners, and adjusting market prices where necessary to reflect social valuation, an internal rate of return for the project is calculated.

Chapter 4 explores the limitations of this single-valued social rate of return as a policy guideline. The relevant literature is reviewed for the purpose of supporting the conclusion that the single-valued social rate of return is insufficient to determine investment decisions. Technical feasibility parameters alone cannot determine the potential limits of economic viability. Risk and uncertainty are important considerations and must be incorporated into the analysis. Assuming that the original data overestimate net benefit and underestimate investment costs, critical factors are incrementally adjusted and combined to create a complete new matrix of internal rates of return adjusted for uncertainty. Forty-eight such combinations are presented in the form of a sensitivity analysis. This sensitivity analysis not only adds more precision to policy making, it provides the project analyst with a tool to identify those factors that can substantially alter the internal rate of return if marginally adjusted. From a high of 12 per cent with no uncertainty factor adjustments, the internal rate of return drops to below zero (i.e., negative), depending on factor combinations.

It is in the choosing of those key variables to alter that precision is added to an ex ante benefit-cost analysis. Unless the most probable direction of the input contingency adjustment can be defended, it is impossible to choose between higher range of rates of return (assuming the original benefits were understated and the original costs were overstated) and a lower range of rates of return (assuming the original benefits were overstated and the original costs were understated).

This is the critical limitation of an ex ante project evaluation, whatever the benefit-cost evaluation procedure (internal rate of return or net present value) and whatever the objective function (efficiency or non-efficiency criteria).

With reference to capital intensive irrigation projects, it has not yet been proven that policy recommendations would vary if one procedure were substituted for another. It is explained in Chapter 4 that a great deal of attention has been paid to refinement of the discussion on the choice of technique; but as is clear from the discussion, efforts have largely neglected the need to improve the evaluation procedures in calculating the primary benefits and costs. The fundamental presumption of this study is that real improvements in ex ante benefit cost studies can result when ex post evaluations of like projects are incorporated into the analysis. In order to more precisely determine the most probable limits of future benefits and costs, ongoing and completed projects within the same sector must be studied.

It is not the intent of the writer to develop the full set of criteria that should be applied to all project analyses. Rather, what follows is an attempt to provide an operational tool to be incorporated

into the benefit-cost framework. Some attempt is made to bridge the wide gap between the two wholly distinct activities generally accepted as parts of decision making on projects. The first step is to ascertain the rate of return with a relative degree of analytic precision. The next is to relate this analysis to the general economic and social environment by some not-so-defined process and arrive at a recommendation for policy.<sup>10</sup>

Ex post analysis can help to provide the key to identify the constraints that are critical to the attainment of project objectives. With the aid of ex post evaluations of past investments in capital intensive irrigation projects, the critical input and output factors may be pinpointed. From the matrix of 48 possible internal rates of return a most probable sub-set of net social returns may be selected.

Chapter 5 provides the necessary information for a conclusive policy recommendation for the Helmand-Arghandab Valley Project. As a result of an extensive, detailed narrative of the project history, an ex post evaluation of past investments and net benefits, and an analysis of recent survey data, the critical constraints are identified: the most probable direction for the contingency adjustments specified, and as a result, the original proposed project is rejected as most probably resulting in a negative social rate of return.

The history of the project clearly illustrates the complexity of introducing Western technology into a traditional agrarian society. The 26-year history has proven that a removal of water constraints by means of irrigation dams, canals, laterals and drains is costly and incurs many complex and difficult problems solely of a physical and technical nature.



The project development exemplified a classic backward approach to irrigation development. The dams were built first, then attention was turned to the preparation of the land to be irrigated, then to testing the soils, and finally to teaching the settlers how to irrigate.

The disparity between the project plan and actual implementation in this large scale capital intensive irrigation project is enormous. Projected costs have been greatly exceeded and implementation schedules grossly delayed.

The general failure of the past investment has been to overlook the linkages between technology and institutions. Mere technical feasibility has been regarded as a sufficient condition for project implementation, whether or not the project was economically justified; or, given the matrix of traditional social and political institutions, whether it was even capable of yielding the projected returns. Development planners have often failed to realize that when an increased and assured supply of water is furnished to a traditional soil-crop complex, the relative effectiveness of every other factor in the system changes, and consequently they have failed to see that a new system of management and new social relationships are required.

Specifically, the project in the past has failed to remove the critical institutional constraints to on-farm water distribution. Future development expenditures are again directed to removing the physical constraints to water supply. The ex post evaluation shows clearly that the removal of the technical constraint has been neither a necessary nor a sufficient condition to increased regional agricultural production. The primary problem has been, and still is, a question of the traditional

on-farm water distribution constraint. The quasi-completed modern irrigation delivery system should be taken as given and attention should be turned to the removal of the wide range of other constraints to increased agricultural production. For until the institutional constraint is removed, incremental physical improvements will, in all probability, result in further misallocations of scarce development resources.

Chapter 6 applies the same methodology to the Nangrahar Valley Development Project, the second major irrigation and land development project in Afghanistan. The Russian project tried to circumvent the on-farm water distribution by substituting a collective state farm model for traditional independent farm production. The analysis shows that while the project was technically feasible, the model was culturally and politically unacceptable to the Afghans. Here, too, the investment in irrigation structures has resulted in a gross misallocation of scarce development resources.

The second section of this study expands upon the project analysis presented in the first section. It assesses the direct impact of these two projects upon agricultural development and the direct impact upon the total national development programme.

Chapter 7 analyzes the effect of capital intensive irrigation projects on the macro-economic parameters of employment, balance of payments, migration, income redistribution, domestic savings generation and administrative and institutional reorganization. The infrastructure as a "pre-condition to development" has not only been proven to be an insufficient condition for development, but has had a net negative impact upon the present potential rate of growth. Whereas this unbalanced

approach to development has removed certain barriers to growth, the gross misallocation of scarce resources has, at the same time, delayed the removal of certain key constraints, ossified some other existing constraints, and introduced a whole new set of constraints making present development more difficult.

Chapter 8 assesses the impact of irrigation projects at the sector level. An analysis of the agricultural environment delineates the potential of the country for development. The extent of misdirected and inefficient government investment programmes within the agricultural sector is explained. In evaluating the government's role, it is clear that planners were operating on assumptions that were not supportable. Past analyses of the agricultural sector have all been consistent in their criticism of the agricultural development programme. However, little attempt has been made to understand the total socio-political institutions of the traditional agricultural sector.

The study concludes with a preliminary analysis of the economics of feudal water distribution. The analysis illustrates how traditional feudal institutions force changes in the neo-classical economic assumptions of distribution. In particular, the failure to achieve positive social returns to capital intensive irrigation investment has been the result of:

- (a) the concentration of water rights within the traditional agricultural sector;
- (b) the non-productive demands for water;
- (c) a weak central authority that refuses to impose required water use taxation;

- (d) the lack of administrative infrastructure; and
- (e) the high incidence of poor cultivation resulting in a misuse of a previously scarce factor of production.

Production has not increased within the agricultural sector, because of the failure to accompany infrastructure investments with well-conceived and well-financed, realistic farm programmes.

References to Chapter 1

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8. J.C. DeHaven, quoted in Colin Clark, The Economics of Irrigation (London: Pergamon Press, 1964), p. vii.
9. The International Bank for Reconstruction alone had by 1971 financed approximately seventy irrigation projects in various Third World countries.
10. For an elaboration of this topic, see Albert O. Hirschman, Development Projects Observed (Washington, D.C.: The Brookings Institution, 1967).

PART ONE



## CHAPTER 2

### A REVIEW OF THE LITERATURE OF BENEFIT-COST ANALYSIS FOR PROJECT EVALUATIONS IN THE THIRD WORLD

#### Introduction

Benefit-cost analysis (alternatively called "investment planning" or "project appraisal") is a partial equilibrium technique for estimating the net contribution of a project to some set of objectives. It is a method which attempts to maximize the decision maker's utility, subject to various economic and political constraints imposed upon him. The set of objectives will differ depending on the particular decision maker. For example, an individual consumer or family might wish to maximize the total utility of their consumption of goods and services and their leisure time, while a private entrepreneur might measure his "utility" as the amount of profits his firm earns. In turn, the government, through its investment program, attempts to maximize its concept of social welfare.

Despite these differing objectives (or ways of defining "utility"), the methodology dictated by benefit-cost analysis is basically the same for each decision maker. Namely, add up all relevant costs incurred in using scarce resources (i.e., resources which can be used to contribute to the desired objectives) and the benefits from producing similarly scarce goods and services. The differences between the benefits and the costs is the net benefit of the project, in terms of the relevant objectives for that decision maker. A basic problem of benefit-cost

analysis is to convert these yearly flows of resources into a single aggregate representing the net benefit of the project. This aggregate must reflect different physical quantities, different objectives, and different points of time. To date, the literature on benefit-cost analysis has been replete with discussions of various methods of determining a social discount rate and shadow prices. In this chapter, the major controversies will be presented. A case for the application of an "internal rate of return" framework, incorporating a minimum of shadow prices, will be defended. This approach to the economic appraisal of a project, given the present state of theoretical inconclusiveness, is considered the best possible analytical format for projects in the subsistence agricultural sector of the Third World in general, and for the Afghan economy in particular.

#### In Defense of the Internal Rate of Return Methodology

In agricultural projects, as in all projects, investment activity generally expands capital resources to create a producing asset from which benefits are expected to be realized over an extended period of time. In order to make outputs at different times commensurable with each other, some rate had to be incorporated that would discount the future stream to some equivalent present value. The choice of an appropriate social discount rate for project analysis has consumed the energies of many economists since 1950; and after two decades of controversy, the issue still remains unresolved.

Theorists divide themselves into four groups. As a proxy measure of a social discount factor one group would use a social time preference function (STP); another, the social opportunity cost of

capital (SOC); a third recent innovation has been an attempt for a synthesis of the STP and SOC function; while a fourth group has skirted the controversy completely by not incorporating any social discount factor into the analysis. This latter group has used the internal rate of return methodology which, for theoretical and practical reasons, has been chosen as the appropriate framework for the analysis of the major irrigation projects within Afghanistan. Reasons for rejecting the methodologies 1 through 3 for determining the social discount factor must be explained. What follows is a brief review of the controversy.

#### The Social Time Preference Function

A social time preference function assigns current values to future consumptions: it is a normative function reflecting society's evaluation of the relative desirability of consumption at different points in time.<sup>1</sup>

Neoclassical economics seems to suggest that the equilibrium market rate of interest could be interpreted as the social rate of time preference. Irving Fisher's seminal work, The Theory of Interest (1930)<sup>2</sup> presents a theory of individual decision-making in which each consumer chooses a division of income between savings and consumption which equates his own marginal time reference with the market rate of interest in much the same way that the consumer allocates income between different current consumption goods. Indeed, some sort of market rate of discount is conventionally used as the social discount rate in some benefit-cost analyses.<sup>3</sup>

There are many reasons for arguing that this perfect competition neoclassical model does not justify the use of a market rate of interest as

a proxy measure of a social discount factor.

In the first place, there is no perfect capital market which can be counted on to generate efficient (Paretian) prices. There may be a whole range of imperfections: tariff and other taxes; quotas; increasing returns to scale; monopoly and monopsony power by various buyers and sellers; and a lack of necessary market institutions. All of these factors can be characterized as leading to an inefficient allocation of resources with the corresponding price system no longer equating marginal costs and benefits as it should in a system without imperfections.

Secondly, market prices (even corrected for imperfections) correspond to an efficient allocation of resources for the given distribution of wealth and income and cannot be considered optimal if this distribution is itself sub-optimal. In general, each Pareto optimality situation corresponds to a particular set(s) of wealth and income distribution. In choosing between two different points on the Pareto-optimal frontier, the social welfare function is implicit. Therefore, nothing can be said about the optimality as opposed to the efficiency of a Pareto optimal situation. Market prices reflect the marginal weights society puts on one important social objective -- economic efficiency or, equivalently, aggregate consumption over time. Market prices give little or no indication of the marginal values of resources to other objectives or to the relative weights which society would like to attach to possibly conflicting objectives.

Recently Marglin,<sup>4</sup> Feldstein,<sup>5</sup> and others have elaborated upon the critical weaknesses of the principle of consumer sovereignty as it applies to the consumption-savings decision. In particular, individuals

may not express all their preferences concerning the future within the market place. It is conceivable that individuals may behave in a "schizophrenic" fashion. Their preferences expressed as individuals may not be the same as their preferences expressed when they see themselves as part of a community. Related to this, there may be externalities in individuals' savings behaviour regarding their willingness to transfer resources to future generations. Thus the choice of an appropriate function intimately involves time, and time flows in only one direction. "Economic man" cannot change his overall consumption-investment choice as easily, or as often, as he does for current consumption decisions such as between meat and potatoes. This forces a constraint upon the Fisherian model because consistency requires that the savings-consumption choice must be made with some view of lifetime income.<sup>6</sup>

Finally, if a classical, instead of a neo-classical savings function is employed, then the market rate of interest does not have the same normative implications for public decisions. Proponents of the classical theory of saving (Ricardo, Marx, Keynes, Robinson, Sraffa) contend that individuals consume a fixed proportion of their income (either average or marginal), with the proportions varying between income classes. Workers invariably consume all their income, while capitalists save almost all of their profits. Given a classical savings function and a government that is unable directly to increase investment to the desired level, the rate of investment will be at least partially determined through project selection. Since the rate of savings is determined by the functional distribution of income between various

classes of wage and profit earners and the government, projects that differ in their distribution of net benefit, other factors being the same, will affect the rate of savings.

If these arguments are accepted, then, even if there were perfect capital markets or approximations thereof, the equilibrium of interest might not represent the social time preference of aggregate consumption.

The Social Opportunity Cost of Capital Function (SOC)

Alternatively, it is possible to pose the following question: Not knowing the actual value of the social discount rate, is there any other factor (which is econometrically determined) that can serve as a useful substitute in discounting for project appraisal? The marginal productivity of capital in the private sector has frequently been suggested as just such an appropriate discount rate for public investment projects.<sup>7</sup>

Harberger contends that if the marginal investment can earn  $x$  per cent in the private sector, no public investment project should be allowed to earn less, and vice-versa. All prospective public projects should be discounted at a rate that just equals the marginal efficiency of capital on an incremental investment in the private sector. But an SOC function pinioned on an unquantifiable marginal efficiency of capital function does not help a project analyst. The marginal efficiency of capital is indeterminate primarily because capital is not a homogenous good. Rather, it is composed of physical units with differing marginal products. The marginal efficiency of capital can be used only in a very restricted sense. If it is possible to find the marginal productivity

of some bundle of capital goods whose price relative to aggregate consumption remains constant, then the marginal productivity of this "bundle", when used in project discounting, would approximate a social discount rate by use of a marginal resource cost. But even this limited case is only correct if the rate of investment prevailing in the economy is socially optimal.

In summary, unless the rate of investment is optimal, the social discount factor is not revealed either in free market interest rates or in the marginal productivity of capital. Its determination, therefore, implicitly involves political judgments. The economist may be faced with the only possible alternative of involving politically-determined social weights as substitutes for imperfect market forces which cannot express the collective demand for investment to benefit the future. The choice of discount rate, therefore, is the responsibility of those vested with political responsibility, rather than the economists.<sup>8</sup>

#### The Synthetic Rate of Discount

The conclusion from the above cursory review of the literature is that there is no clear way of directly determining the social rate of discount. The project analyst who does not receive a single rate set by a political authority, must take the rate of discount as an unknown for the project, and the benefit-cost discounting must then be done with a number of alternative discount rates. For some economists, this state of affairs was unsatisfactory. On the one hand, they felt that it might be possible to determine the upper and lower bounds for the social discount rate from some knowledge of a country's national economic plan. On the other hand, they contended that the major flaw of both the STP

and SOC approaches is that they neglect the impact upon changes in the level of private investment induced by the project, through wage payments and the use of scarce capital expenditure funds. The problem of determining a social discount factor must be rephrased.

In a partial equilibrium, "second best", world, some way must be devised to help the economist choose the best set of investments from inferior combinations of public and private investments.

Assuming that the STP is known and that public investments will of necessity displace private investments, what the planner must determine is a rate of discount that will implement those public projects that will not displace "better" opportunities in the private sector. To make this model determinant, both a measure of the opportunity cost of public project investment plus an estimation of the incidence of private sector financing of this project are needed.

Thus in planning of public investment, the present values of the social benefits of private investment that public investment displaces, evaluated at the marginal social rate of discount, supersedes the money cost of the public investment as the measure of its true social cost. In other words, we plan public projects to maximize their net present value at the marginal social rate of discount, but in evaluating the social cost of public investment, an opportunity cost reflecting the social value of utilizing resources in the private investment replaces the money cost of the portion<sup>9</sup> of resources that comes from the private investment sector.

The measurement of these factors poses the dual problem:

(1) What proportion of the resources in the public investment come from the private sector?; and

(2) What is the present value of the stream of this private investment?

If the rate of investment in the economy is not optimal, the



project must be compared with the alternative uses of investment funds. This implies valuing the project's impact on investment funds at the price of capital. Both the Little-Mirrlees manual<sup>10</sup>, and the UNIDO guidelines<sup>11</sup>, suggest similar formulas for calculating this shadow price as a function of the social discount rate and econometric data (such as the marginal savings rate and the incremental capital output ratio). Others<sup>12</sup> have attempted to reduce their social discount rate cum opportunity cost criterion to a single rate which is, in effect, some weighted average of the STP and SOC -- a synthetic rate of discount.

Baumol<sup>13</sup> criticizes the synthetic approach in that it is anchored on the assumption that a savings constraint will diminish with time. But institutional factors may deny the possibility of equilibrating the  $S = I$  even in the long run.

On a more general level, Feldstein<sup>14</sup> criticizes any attempt to synthesize a discount factor. Feldstein points out that the weakness of the synthetic discount rate is that it is only one price.

All of these methods are unsatisfactory because they try to use a single "price" -- the rate of discount -- when two quite different prices are needed; the relative value of future consumption, in terms of current consumption, and the relative value of current private investment in terms of current consumption. The first price corresponds to the rate of time preference. The second price, the opportunity cost of private investment, exceeds one in a second best economy in which the marginal rate of transformation between future and present consumption exceeds the marginal rate of substitution.<sup>15</sup>

He concludes that what is really needed are two types of price in project evaluation: a price of funds transferred from the private sector (which in turn implies a price of foregone investment) and a price of future consumption, both prices being stated in terms of

current consumption.

An Alternative: The Internal Rate of Return Approach

The controversy that centres on the determination of a social discount factor for project analysis is still unresolved. In Third World countries much of the theoretical argumentation remains highly abstract. Arguments are based on feasibility studies of actual projects which were attempted for reasons often having little to do with the findings of the studies. On a practical level, most of the resources in project planning are invariably expended on physical and organizational planning; economic feasibility studies are often regarded as appendages. Rarely are adequate resources and time available for the project analyst to attempt even an approximation of a synthetic discount rate. As a short-hand method, if project economists must determine a social rate of discount, they may evaluate projects at several rates falling between the national economic growth rate and the estimated marginal product of capital. In those cases where adequate resources for a project feasibility study are made available, the national statistical base may be so poor as to yield unreliable marginal savings rates and incremental capital-output ratios. In an attempt to avoid using theoretical caveats to select a suitable social discount factor, the internal rate of return methodology was introduced.

An internal rate of return solution to project appraisal would avoid, in its formulation, the need (a) to estimate any discount factors, and (b) to specify the sources of funding. Its proponents contend that it is at once operationally easier, and at the same time, theoretically more supportable in many Third World countries where institutional

rigidities hinder the determination of the market rate of interest.

The World Bank, as well as most other international financing agencies, has employed the internal rate of return in practically all of its economic and financial analyses of projects.<sup>16</sup>

The internal rate of return is one particular way of discounting cash flows for measuring the worth of a project. It is that rate of interest which just makes the net present value of the cash flow equal to zero, i.e.;

$$\sum_{t=1}^n \frac{B_n - C_n}{(1 + i)^n} = 0$$

where  $B_n$  = benefits in each year,

$C_n$  = costs in each year,

$n$  = number of project years,

$i$  = interest (discount) rate.

Proponents would argue that the internal rate of return formulation requires a minimum of assumptions. Its main advantage is that it does not require an arbitrarily assumed interest rate. The formulation makes inter-project comparisons easy, and shifts the burden to policy-makers for determining whether the project's rate of return is greater or less than the opportunity cost of capital.

The literature for a period of years has argued the relative merits of the internal rate of return and an alternate, more straightforward method that required an estimate of interest rates: the net present value. The net present value is simply the present value (worth)

of the cash flow stream, i.e.,

$$\text{Net Present Value} = \sum_{i=1}^n \frac{B_n - C_n}{(1+i)^n}$$

At first it was thought that these two rules were equivalent.

The subsequent discovery of a basic flaw in the internal rate of return formula resulted in doubts among some economists whether the internal rate of return calculation should be entirely scrapped for project feasibility studies. Doubts pivoted on the possibility that the internal rate of return could result in more than one possible solution, and thus was inadmissible as a discounted measure of a project's worth. The argument was most clearly stated by Hirschleifer<sup>17</sup>, who, in elaborating upon Fisher's dual approach to the investment decision, draws a "main positive conclusion" that the present value rule is universally correct "in a limited sense", given a perfect capital market, and a "main negative conclusion" that the internal rate of return for the multi-period case (under usual definition) is not generally correct.

J. Lorie and L.J. Savage<sup>18</sup> use a simple example to show how the present value of an investment stream varies from negative to positive to negative again as the rate of interest increases, thus providing two positive internal rates of return. Because of this ambiguity in the internal rate of return method, they propose the present value method.

The criticism was carried forward by O. Eckstein<sup>19</sup> who argued that the general use of the internal rate of return method does not give optimal results, and that normative significance in ranking is obtained only by discounting future receipts by a subjective time preference.

Some recent papers like those of S. Marglin<sup>20</sup> and M. Feldstein<sup>21</sup> have gone so far as to take the present discounted value method for granted and have concentrated principally on the elaboration of the present value of a social opportunity cost. The controversy was not all one-sided, though. Proponents of the internal rate of return methodology sought both theoretical and practical grounds for defence.

In an early piece, Soper<sup>22</sup> and Karmel<sup>23</sup> proved the theorem that if it is possible and feasible to truncate investment projects at any moment of time, and if the investor chooses a truncation period which maximizes the internal rate of return, then the truncated investment project possesses a unique internal rate of return. However, choosing a truncation period so as to maximize the internal rate of return is not using the proper criterion for the selection of a project period.<sup>24</sup>

Arrow and Levhari<sup>25</sup> go one step further and prove that if, with a given constant rate of discount, a truncation period is chosen so as to maximize the present value of the project, then the internal rate of return of the truncated project is unique.

In a later article, Flemming and Wright<sup>26</sup> extend the analysis to show that unique results may be derived for a much wider class of discount functions.<sup>27</sup>

On the practical side, McKean<sup>28</sup> and Merrett and Sykes<sup>29</sup> chose the internal rate of return in spite of the analytical weaknesses. In a very recent contribution to the field, Gittinger concludes that "from the standpoint of agricultural project analyses [the non-uniqueness anomaly] is a curiosity of internal rate of return theory of virtually no practical importance."<sup>30</sup>

More than one solution can exist only when, following a period of positive cash flows sizeable enough that the cumulative present worth up to that point is positive, there then occur negative cash flows such that the present worth at  $t_0$  of the cash flow from a given year onward (discounted in the normal way) is negative. Under such circumstances there may be more than one discount rate which will bring the present worth of the cash flow down to zero, although this will not necessarily be the case.<sup>31</sup>

Certain conditions in an agricultural project may create negative cash flows for particular years; for instance, when pumps must be replaced or a canal re-dug in an irrigation scheme, or during a period of crop substitution (orchards replacing subsistence grain crops). But the very nature of agricultural development projects in the Third World generally precludes the possibility that these negative flows will either be very large or last for long periods. Satisfying both these conditions would be tantamount to gross regional deprivation, starvation and forced out-migration. An occasional negative cash flow is not generally sufficient to generate multiple solutions.<sup>32</sup>

Although economists have offered other caveats,<sup>33</sup> the vast majority of economic analysts actually involved in agricultural project appraisal consider both methods equally valid. They concede that the possibility is remote that there will be differences in policy recommendations due to the substitution of one method for the other.<sup>34</sup>

We may conclude that in principle most of the suggested methods (the net present value and the internal rate of return being the most widely used) are equivalent, given the same basic assumptions about the

economic environment. Differences in policy conclusions will not be substantial if either one is used for any given project. In that sense, the controversy is rather moot. The internal rate of return is favoured in the Third World countries because of its ease of calculation and its limited number of required assumptions about the economic environment. Ultimately the theoretical justifications for the use of the internal rate of return are not yet so persuasive as to outweigh the reservations most project analysts have in using an approximation(s) of a social discount rate as a datum.

#### The Use of Shadow Prices

Having resolved how to measure the net benefit stream at different points in time, there still remains the problem of placing a monetary valuation upon the inputs of a project. Sole reliance upon market prices as measures of relative value in project evaluation is considered inadequate, and economists have turned to the estimation of shadow prices to get a closer approximation of true value of various physical quantities involved in a particular project.

Shadow prices, or "accounting prices", are a very tricky, controversial and still-unresolved aspect of the economic analysis of projects.<sup>35</sup> It is argued that market prices in the Third World are very biased and are thus unacceptable as a basis for project evaluation. Markets may be imperfect for a whole list of reasons; there may be institutional rigidities, price, export and import controls, dual-exchange rates, imperfect information about prices offered by competing sellers or buyers, monopoly and monopsony elements, as well as a proportionally large amount of commerce in the traditional and barter sectors. Because these imperfections exist, the use of market prices may introduce a significant error into the economic analysis

of a project. The prices of foreign exchange may be too low, for example, tending to favour projects with a high import content, or, wages paid to labour may be too high, tending to favour capital-intensive projects over labour-intensive projects. To avoid these biases in analysis of projects, it is necessary to seek substitute prices to improve on actual imperfect market prices.

Jan Tinbergen<sup>36</sup> defines these substitute prices, or accounting prices, as those prices that correspond to "intrinsic values". "Intrinsic value" is in turn defined as the price that would equate the supply and demand for a particular factor or good, if full "equilibrium" prevailed. Equilibrium presupposes a perfect national market for that factor or good. Indeed, though Tinbergen does not say so, it is clear from the context of his remarks that he must assume equilibrium in perfect national markets for all factors and goods; otherwise it is difficult to see how the price of one factor or good could come to correspond to its "intrinsic value". In other words, since an equilibrium price in one sector depends on equilibrium prices in other sectors, the determination of the "intrinsic value" of a factor or good implies knowledge of the full equilibrium matrix for the entire national economy. This knowledge has to be acquired in countries which, according to Tinbergen, are characterized by "fundamental disequilibria."

Stated in general equilibrium terms, shadow prices are an all or nothing proposition. Since no Third World country (nor in fact any western industrialized or communist country) is in fact organized and operated in accordance with such a planning model, little can be said of efficient resource allocation in a proposed project, based on social costs and benefits that reflect an "optimally efficient" but fictional use of projects and factors.



The proposal to employ shadow prices in place of market prices is therefore limited to project and programme evaluation; shadow prices are not intended to be used generally as substitutes for all market prices. It is, then, a proposal to apply selectively prices derived from a general equilibrium model. Partial application of shadow prices would not lead to an optimal allocation of resources; although it would not be obvious in advance what biases might be introduced. When a price rule is to be applied partially, the objective would be to find prices that signal an optimal accommodation to a given nonoptimal structure of prices and allocations -- i.e., a "second best" criterion.<sup>37</sup>

In the post-war period, economists involved in project evaluations have argued the merits of including (or excluding) certain domestic product and/or factor prices in benefit-cost studies. For the most part, adjustments were made on the basis of ad hoc judgments of the acceptability of particular market prices as valid measures of social cost or benefit. No systematic, all-inclusive methodology was attempted until the Little-Mirrlees model<sup>38</sup> was introduced in 1969. The major innovation of this model was its approach to shadow-price calculation. They wished to supplant the partial use made of international values (e.g., applying them to major inputs and outputs that are, or easily could be, traded) with a comprehensive application of world prices for all inputs and outputs. Essentially, they argue in favour of valuing all inputs at world prices, even the so-called non-traded inputs that normally cannot possibly be imported (i.e., electricity, construction, local transport, and labour).

The reason Little and Mirrlees want to go "all the way" in using world prices for every input and output is to avoid the distortions which

they feel creep into the calculations if only partial use is made of world prices. A benefit-cost calculation based partly on world prices and partly on domestic prices has to be put into a single currency through the use of an exchange rate. Little and Mirrlees don't like exchange rates, not even "shadow" exchange rates based on "correcting" unrealistic official rates. In their view, no exchange rate, no matter how good, can overcome the distortion in relative values which arises whenever you combine values taken from different sets of prices (such as world prices and domestic prices). The use of one set of prices-- world prices -- bypasses this problem and, by taking all prices from one common pool, achieves a more valid ordering of the relative values in constructing costs and benefits.

For goods actually traded internationally, either imported or exported, there is little difficulty in identifying the relevant world prices, for they are either received or paid by the country (tariffs and most export taxes disregarded). Nontraded goods and resources are partitioned into traded and nontraded components. The world value of all traded parts are summed and the value of any residual nontraded parts is ascertained from its contribution to some traded good. An exception is made for the value of labour.<sup>39</sup>

Little and Mirrlees advance both pragmatic and theoretical reasons for wanting to anchor all benefit-cost values on world prices. They assume that world prices represent actual trading opportunities, which heavily influence domestic investment decisions. The development process, in their model, involves a steady expansion of the demand for imports, and the only way to pay for them, in the long run, is to produce

for export only those things a country can produce best. Resources and goods are valued so that the opportunity cost of a resource in any use whatever, at the margin, is the contribution it makes or might have made to the balance of payments via foreign trade. In this method of finding shadow prices, the foreign sector's influence is not limited to the establishment of some particular rate of exchange. Foreign trade is the window through which all internal values are equated to world values.<sup>40</sup>

The methodology embodied an implicit attempt by Little and Mirrlees to seek a set of optimal prices; and for the same general reasons given above, these optimal prices are irrelevant to an economy that does not, in fact, achieve an optimal allocation of resources. While not really attempting to resolve this contradiction, Little and Mirrlees argue that their method is superior to all other methods now utilized:

The methods suggested do not depend upon the prior analysis of reliable and sophisticated planning models. They are practicable, and are likely to be accurate enough to exclude all definitely bad projects, and allow all definitely good ones. Small mistakes on marginal projects are less important.<sup>41</sup>

The major contribution of the Little-Mirrlees system is, unfortunately, its weakest element. The comprehensive use of world prices would, in effect, they argue, avoid using some good prices (world prices of traded items) and some not-so-good prices (the domestic prices of nontraded inputs) which must then be merged by use of a (frequently bad) exchange rate. Critics disagree.<sup>42</sup> The cure might be worse than the disease. What advantage would be gained in substituting the distortion of bad input/output data or the approximations of conversion

factors for those arising from overvalued exchange rates? It is not even true that Little and Mirrlees get rid of exchange rates entirely, since some world prices will be in U.S. dollars, some in Deutsche marks, and some in yen, etc., and these can be merged only by using exchange rates.<sup>43</sup>

Mishan<sup>44</sup> argued in a recent article that the specific rules for benefit-cost analysis in the Third World are neither explicitly stated nor convincingly defended. Instead of valuing all goods at world market prices, there may be a stronger case for valuing traded goods at domestic prices. By using the Little-Mirrlees rules for calculating the accounting prices of traded goods and the shadow prices of unskilled labour, there are direct allocative implications upon benefit-cost calculations that may result in the disqualification of economically feasible projects. Referring to world prices to determine the value of good imported or exported in a project neglects to account for:

- (a) the less than infinitely elastic demand for a country's exports;
- (b) the existence of domestic excise taxes; and
- (c) the inelastic supply of world commodities.

These three factors have an effect upon the country's domestic evaluation of both the required project imports and exports, and this evaluation is not reflected in world market prices.

In sum, the accounting prices of both additional imports and exports involved in any investment project, or the social opportunity costs of imports and the social benefits of exports, are to be calculated by reference, respectively, to the subtraction from, and addition to, the country's

domestic value; and not by reference to world prices of traded goods.<sup>45</sup>

Similarly, the use of the shadow price of unskilled labour is based upon arbitrary and indeterminate assumptions that may result in a social loss in project selection. In particular, raising the price of labour to industry by some conversion factor (determined as a portion of the additional wages in industry that are wholly consumed and not invested) discriminates, without any allocative justification, against labour-using projects.

Mishan concludes that there is a strong presumption against ad hoc departures from the Pareto principle:

If such departures are thought necessary, they must be explicitly recognized and convincingly defended. In respect to the [Little-Mirrlees] rule for the pricing of traded goods and labour, the authors have failed to do either.<sup>46</sup>

To date, there does not seem to be a widespread acceptance of the Little-Mirrlees methodology.<sup>47</sup> Generally it is conceded that although the model affords many interesting insights into the problems of project evaluation, it is far too complex in comparison to alternative methods of shadow pricing to justify the additional improvement in the quality of investment decisions it might bring. Few tests have been made to determine whether the Little-Mirrlees methodology would actually result in a significantly different investment pattern than the shadow pricing methods generally applied.<sup>48</sup>

The evaluation procedures that are the most salient and widely used today are generally variants of an ad hoc approach.<sup>49</sup> All the procedures relate to ways of adjusting or correcting market prices by

removing important distortions that exist in the economy. The main aspects analyzed are: (1) distortions in foreign trade; (2) distortions in factor markets, namely for labour and capital; (3) problems caused by a nonoptimal income distribution, which includes a discussion of the problem of "employment"; (4) the problem, if any, posed by inflows and outflows of foreign capital associated with particular investment projects, including the "debt servicing" problem; and (5) the general problem of project evaluation in a second-best world, particularly one in which there are distortions caused by nonoptimal taxes and subsidies.

It is beyond the scope of this work to explore the differences of views on these particular aspects of shadow-price determination. Suffice to say that the theoreticians are not in general agreement. There exists at present more accord in a rejection of the Little-Mirrlees model than in proposing any systematic alternative. At one extreme are the critics who oppose on both logical and practical grounds almost any use of shadow price, where an actual domestic market price exists.

The critics of shadow price<sup>50</sup> state that the general equilibrium contradictions cannot be summarily removed by concentrating on a regional or sectoral analysis. Shadow prices generated from any macro model would be inapplicable to project evaluation, for they would be scarcity measures of resources and activity aggregates, where projects must be evaluated in terms of specific resources and good values.

The use of shadow prices causes an additional problem when prices generated differ from actual market prices. Private entrepreneurs will behave on the basis of actual market prices, not hypothetical prices. Private investors, however, can and will behave as the shadow price would

require them only if certain subsidies and taxes are introduced tending to stimulate the use of the abundant resources and discourage the use of the scarce resources.

Where shadow prices have been used in the choice of the project, a problem of some interest then arises for the subsequent evaluation. Since projects which are socially profitable when evaluated with shadow prices may be unprofitable against the standard of ordinary market prices, subsidies are required for private firms and deficits must be tolerated in the case of public projects. If the subsidies are paid in relation to the deficit or according to some bargain between enterprises and government not directly related to the shadow price / market price discrepancy, then the profit-loss incentive to efficient performance is destroyed. Profit-maximizing firms will not correctly economize in the use of scarce resources. There is, therefore, a good deal of importance in the way subsidies are arranged if projects are to be made responsive to changing conditions and if errors are to be discovered and rectified.<sup>51</sup> This is only half the problem, for whatever way the subsidies are paid, there is another problem raised by the need for a subsidy -- namely, the equity with which it is to be financed.

Further, because no one procedure is universally accepted to determine shadow prices, there exists a very large possibility that a wide variety of prices for a single resource will result not only because different agencies are charged with project evaluations, but also possibly because one agency values a resource differently in different projects. This possibility leads to a subsequent criticism; that is, too often the use of casual shadow pricing affords opportunities for self-

serving decisions to those who control funds. In conclusion, it is clear that, to date, the defence of the use of shadow prices remains undecided and vague.

The abstract and metaphysical concept of accounting cannot help to solve the theoretical and practical problems facing South Asian planners. It stands out as a typical example of the pseudo-knowledge, given a learned and occasionally mathematical form, that unfortunately has formed a major part of the contribution of Western economics to the important tasks of ascertaining the facts in underdeveloped countries and creating a framework for policies designed to engender and direct development.<sup>52</sup>

In Third World countries, project analysts would be well advised to use shadow prices very conservatively and only in response to adequate local knowledge of true scarcity values and obviously bogus natural prices.



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24. More exactly, if the life of the project is optimally chosen, then the maximized present value of the project is a monotonic decreasing function of the rate of interest. In a subsequent article, Norstrøm tries to demonstrate that the rate of return that Arrow and Levhari find in reality is no more than Soper's maximal internal rate of return; i.e., the one that is obtained when the truncation period is chosen to maximize the internal rate of return. Carl J. Norstrøm, "Uniqueness of the Internal Rate of Return With Variable Life of Investment: A Comment," Economic Journal 80 (1970): 293-94.

25. Kenneth J. Arrow and David Levhari, "Uniqueness of the Internal Rate of Return with Variable Life of Investment," Economic Journal 79 (1969): 560-64.

26. J. S. Flemming and J. F. Wright, "Uniqueness of the Internal Rate of Return with Variable Life of Investment," Economic Journal 81 (1971): 256-62.

27. David Heebink ("A Critique of Compound Interest Models Used in Decision-making for Capital Budgets", Ph.D. dissertation, Stanford University, 1960, Appendix B, pp. 87-94) has shown that the internal rate of return method gives consistent answers even when dual solutions exist if it is possible to rank alternative projects in order of increasing costs.

28. R. N. McKean, Efficiency of Government through Systems Analysis (New York: Wiley and Son, 1958).

29. A. J. Merrett and A. Sykes, The Finance and Analysis of Capital Projects (London: Longmans, 1963).

30. Gittinger, op.cit., p. 84.

31. Ibid.

32. The kinds of situation where there are large negative cash flows late in the life of the project, although rare in agriculture, can be found in natural resource projects. In mining, for example, if a bauxite firm were required, as part of its concession, to restore the landscape after digging out the ore deposit, such a situation would occur. See Eugene L. Grant and W. Grant Ireson, Principles of Engineering Economy, 4th ed. (New York: Roland Press, 1970), pp. 509-10.

33. In the case of mutually exclusive projects, direct comparison of internal rates of return can lead to erroneous investment choice. This is usually not the choice that faces a central development agency.

Feldstein and Flemming have countered the notion that when projects with different economic lives are being compared, the IRR approach will possibly inflate the desirability of a short-life project. They argue that both the net present value and the IRR bias the choice in favour of small projects with high yields. M. S. Feldstein and J. S. Flemming, "The Problem of Line Stream Evaluation," Bulletin of Oxford University Institute of Economics 26 (1964): 79-85.

Ezra Solomon points out that the usual present value method implies reinvestment of future receipts at the discount rate adopted, while the internal rate of return method implies reinvestment at the resulting internal rate. This ambiguity has never been resolved in the literature. E. Solomon, "The Arithmetic of Capital Budgeting Decisions," Journal of Business (April 1965).

34. See E. J. Mishan, "A Proposed Normalization Procedure for Public Investment Criteria," Economic Journal 77 (1967): 777-96. He proposes a method to ensure identical rankings of alternative investments irrespective of the criterion used.

35. Not to be confused with the use of the term "shadow prices" in linear programming; see, for instance, Robert Dorfman, Paul A. Samuelson and Robert M. Solow, Linear Programming and Economic Analysis, Rand Series (New York: McGraw-Hill, 1958).

36. Jan Tinbergen, op.cit., pp. 39ff et passim.

37. A second-best shadow price is that price associated with continuing divergences between marginal social value and marginal social cost of all goods and factors.

38. Little and Mirrlees, op.cit.

39. The key value of labour is brought into this system of world prices at its proper relative value by first giving its hypothetical or shadow price in terms of its domestic scarcity, and then translating this into its world-price equivalent.

40. R. S. Weckstein, "Shadow Prices and Project Evaluation in Less-developed Countries," Economic Development and Cultural Change 20 (April 1972): 479.

41. Little and Mirrlees, op.cit., p. 188.

42. See "Symposium on the Little-Mirrlees Manual of Industrial Project Analysis in Developing Countries," Bulletin of the Oxford University Institute of Economics and Statistics 34 (February 1972): 1-168; and George B. Baldwin, "A Layman's Guide to Little-Mirrlees," Finance and Development 9 (March 1972): 16-21.

43. Not even broached here is the failure of the Little-Mirrlees model to eliminate distortions in the use of foreign prices caused by a less-than-perfect world free trade. See Deepak Lal, Alternative Project Selection Procedures for Developing Countries: A Critical Survey Without Tears, International Development Association Staff Working Paper no. 158 (Washington, D.C.: International Bank for Reconstruction and Development, July 1973); and Bela Balassa, Project Appraisal in Developing Countries, International Development Association Staff Working Paper no. 119 (Washington, D.C.: International Bank for Reconstruction and Development, 22 October 1971).

44. Mishan, op.cit.

45. Ibid., p. 94.

46. Ibid., p. 98.

47. Few planning agencies are attempting to introduce the method. The United Kingdom Overseas Development Administration has announced it will adopt a modified Little-Mirrlees valuation methodology in assessing prospective project candidates for aid financing. United Kingdom, Overseas Development Administration, "Manual of Project Appraisal" (London: Ministry of Overseas Development, 1971). The German Bilateral Assistance Agency has also announced its intention to adopt a modified version of the Little-Mirrlees model. Werner Hammel and Hans-Rimbert Hamener, Grundlagen der Cost-Benefit Analyse bei Projekten in Entwicklungsländern [Basic Principles of Cost-Benefit Analysis of Projects in Developing Countries], (Frankfurt: Kreditanstalt für Wiederaufbau, 1971). The World Bank and the UNDP and USAID are still reluctant to adopt, waiting rather for results of actual field experience in implementation of the model.

48. The World Bank, as a result of some preliminary tests, seems to conclude that only marginal adjustments result from using the Little-Mirrlees methodology. In a majority of industrial projects distortions in the values of nontraded inputs simply will not be important. Electricity rarely comprises more than 4-5 per cent of manufacturing costs, so a 20 per cent distortion of its value will affect total costs by only one per cent. Distortions in internal transport costs, for capital and operating costs are unlikely to run more than the same order of magnitude. The construction element in plant capital costs is larger and may run 15-30 per cent; at least half of this will consist of labour costs, which, as with operating labour costs, can be adjusted to an "economic" value through the use of shadow wage. The distortion arising from using domestic currency to price labour's shadow wage is likely to be less than the margin of error inherent in deciding what shadow wage to use. Thus, when one looks at the relative unimportance of all the nontraded inputs except labour, in a majority of industrial projects refinements in these values begin to look relatively unimportant. Cost-benefit analysis simply does not work to the order of precision to which Little and Mirrlees want to take us.

49. Well-described in UNIDO, Guidelines for Project Evaluation, op.cit.; in Harberger, "Survey of Literature", op.cit.; in A. C. Harberger, "The Social Opportunity Cost of Labour," International Labour Review (1971); in A. C. Harberger, "Three Basic Postulates of Applied Welfare Economics," Journal of Economic Literature (September 1971); in Lal, op.cit.; and Balassa, op.cit.

50. See "A Note on 'Accounting Prices' and the Role of the Price Mechanism in Planning for Development," Appendix 5 of Gunnar Myrdal, Asian Drama, An Inquiry into the Poverty of Nations, 3 vols. (New York: The Twentieth Century Fund, 1968), pp. 2031-39; and Weckstein, op.cit.

51. Weckstein, op.cit., p. 493.

52. Myrdal, op.cit., p. 2039.

## CHAPTER 3

### A PRELIMINARY INTERNAL RATE OF RETURN ANALYSIS OF THE HELMAND-ARGHANDAB VALLEY PROJECT

#### Introduction

The largest single investment project undertaken by the former Royal Government of Afghanistan was the irrigation and land development scheme in the south-central Helmand-Arghandab Valley. What began as far back as the 1930's as a modest proposal to extend a traditional canal, had, by the 1970's, grown into a massive capital-intensive project to improve the irrigation infrastructure and extend the gross irrigated farm land of the major valley in the country.

Although some development in the region was begun by the Japanese in the 1930's, the Helmand-Arghandab project was actually begun in earnest in the post-war world of bilateral assistance programmes. The project design and funding since World War II has been a joint American and Royal Government of Afghanistan endeavour. During the period 1946-1971, both governments pumped over six billion afghanis into the region (in 1971, US \$ = 80 Afs.) constructing reservoirs, laterals, drains, roads and an administrative centre. The goal was to transform the traditional irrigation delivery system. The various project constructions were designed to assure an adequate supply of water for farmers, and also to allow for an extension of the cropland to accommodate new settlers.

The focus of the initial planning approach (and continuing develop-

ment) has consistently been modern irrigation systems and land development to the virtual exclusion of those less tangible constraints on agriculture-- on-farm water management, credit, high value crop promotion, on-farm investments, surface water exploitation, co-operative promotion, livestock and poultry development, crop protection, labour-intensive river bed and desert reclamation, land reform, etc. This approach to agricultural surplus generation implicitly assumed that the capital-intensive construction activities were a necessary precondition to providing a technically assured supply of water, and that the latter was a necessary condition for increased farm production.

The sheer massiveness of the project, encompassing approximately 100,000 hectares (See Figure 1), mitigated against early completion. By 1971 an incomplete modern irrigation system had been put in place, and within the different areas of gross irrigated farm land "under water command" in the Helmand-Arghandab Valley, the capital infrastructure had varying effects. All areas benefitted directly or indirectly from the dams and reservoirs. But of the estimated irrigated cropland within the Helmand-Arghandab Valley, fully 55 per cent of the cropland was still irrigated from traditional, privately-constructed river diversion structures, juies (hand-dug canals) and drains. An additional 36 per cent of the cropland was irrigated by traditional juie systems hooked into the project's newly-constructed canals combined with some outlet drain networks. Seven per cent of the cropland was serviced by the project laterals, and was partially drained and leveled. Finally, less than three per cent of the total irrigated cropland was benefitting from fully modern capital structures -- canals, drains, laterals and roads.

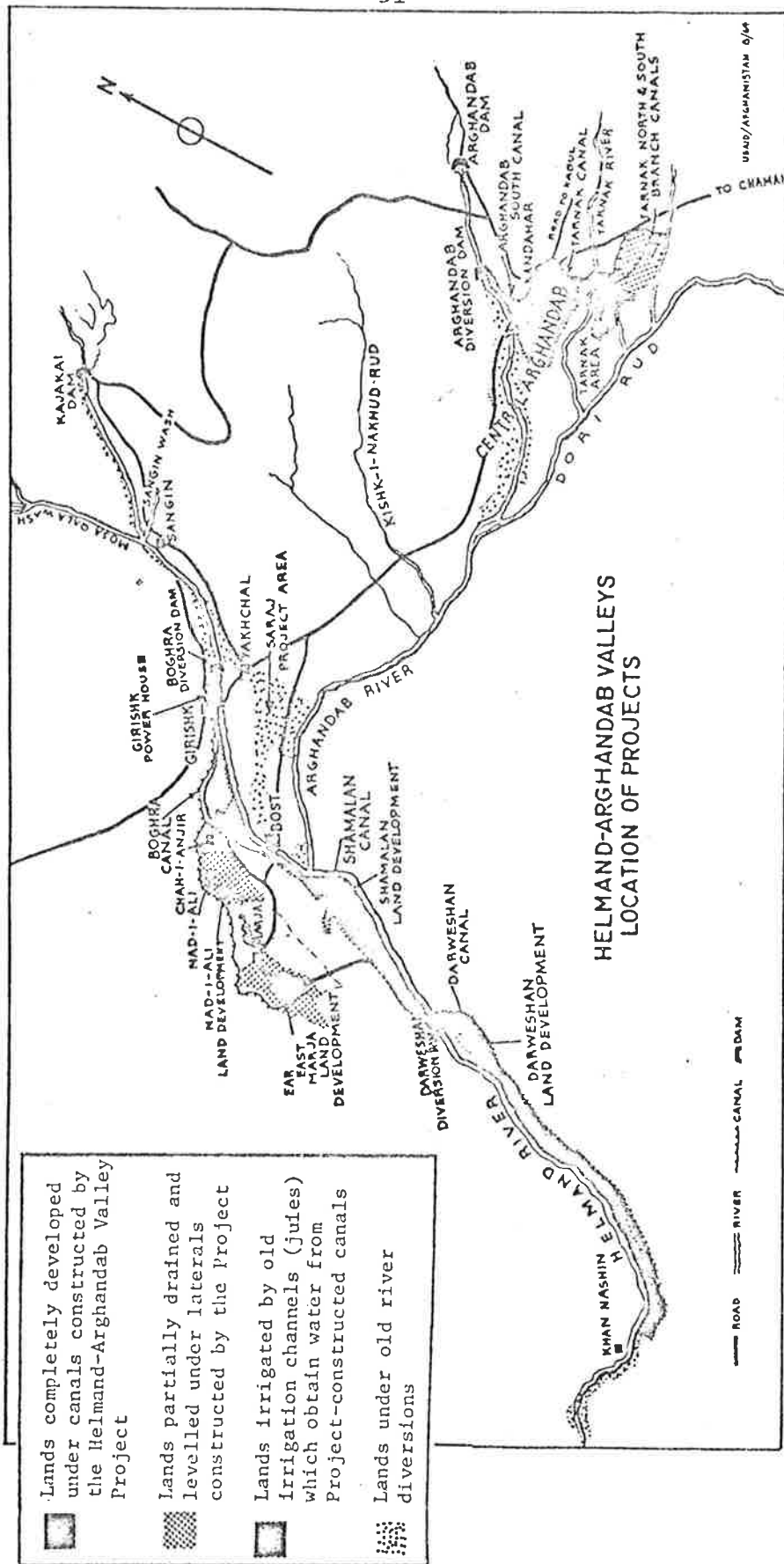


Fig. 1. Helmand-Arghandab Valleys: Location of Irrigation Projects



Most of the construction was completed by the mid-sixties, and it was only the accelerated growth in regional farm production after 1967 that reactivated interest in continuing the expansion of infrastructure. (See Chapter 6 for detailed history). Buoyed by the gains of the "green revolution", the project planners saw in the increases in yield a sufficient justification of past infrastructural investments. By extending the infrastructure, they argued, the region that could benefit from biological and chemical innovations would be expanded. This was the logic that inspired the Helmand-Arghandab Valley Authority and their American advisers the Helmand-Arghandab Valley Regional Advisers to propose a new investment project that would build upon the already extensive infrastructure by extending the modern irrigation grid. The project proposal was not so ambitious as to propose the modernization of the total infrastructure. Rather, it proposed certain incremental capital-intensive investments to remove blatant snags in the water delivery system.

Project planners saw that

in all probability the additional expenditure will show a higher return than investment to date since much of the expensive basic infrastructure is now in place, and in many cases, relatively small amounts of investment are needed to realize on-farm benefits made possible by this infrastructure.<sup>1</sup>

The project proposed primarily to:

- (1) improve the drainage in areas where water-logging seriously limits potential yields;
- (2) straighten, line and improve a few laterals that do not deliver an adequate supply of water;

- (3) modernize the maintenance and operations of equipment and increase the efficiency of the organization charged with maintaining the infrastructure with more training and an enlarged staff;
- (4) construct a pilot project to demonstrate the increased potential of a completely modern irrigation delivery system when combined with leveled, uniform sized farms modeled after the Imperial Valley in California; and
- (5) continue project plans to explore new potential areas for infrastructural investments (if and when additional investment resources could be made available). The remainder of the budget would support a modest on-going agricultural extension and research service, and general regional administration.

These investments, the projects planners felt, would increase the incidence of high yield varieties of wheat and greater fertilizer application; it would also enable farmers to augment the proportion of their land which is double-cropped. A combination of these two conditions would increase the number of farmers above the subsistence level and gradually result in an appreciable increase in the farmland devoted to high value cash crops.

#### A Single Estimation of the Internal Rate of Return

The preliminary feasibility analysis of the Helmand-Arghandab Valley Project used investment and projected farm production series provided by the Helmand-Arghandab Valley Authority and the Helmand-Arghandab Valley Regional Advisers (American) as the primary inputs. In

order to organize these inputs into a format that could be amenable to a standard internal rate of return benefit-cost analysis, certain assumptions had to be made. The methods of incorporating these assumptions into the analysis are discussed below.

The delineation of the project period is a first consideration. Normally, capital-intensive, large-scale irrigation projects are given a 50 year productive life. By a strict accounting, the project was by 1971 one-half way through its productive life. The major reservoirs were completed in 1953 with a normal life of 50 years: i.e. until 2003. Therefore, by assuming 1971 to be  $t_0$ , 2003 would equal  $t_{33}$  and mark the end of the project period for purposes of the analysis. The net benefit and costs streams were discounted over 33 years.

The use of shadow prices is limited in the analysis. As argued in the previous chapter, the application of shadow prices to project analyses in Third World economies should be applied in those situations where the actual market prices manifest wide departures from measures of true value. In the situation of project appraisal within Afghanistan, the noticeable lack of reliable statistics makes the application of shadow prices that much more difficult. Even if the observed prices are not accurate, there remains the problem of determining what figures should be used as shadow prices. It could be argued that all resources and goods should be valued so that the opportunity cost of a resource in any use is, at the margin, equivalent to the contribution it makes or might have made to the balance of payments via foreign trade; however, this formula is difficult to apply in a project directed at a subsistence sector economy where a fair proportion of the output is not even marketed. In the analysis

that follows, the knotty problem of shadow prices is attacked in three particular instances: foreign exchange, some exported commodities and labour.

Perhaps the easiest shadow price to dispose of is that for foreign exchange. The optimum exchange rate would be that which the central planning unit is using. In this way, any project's import content would correctly and uniformly be accounted for. If some projects use one shadow price for foreign exchange, and others use another, the whole basis for comparing projects with foreign inputs is lost. At the same time, using the central planning unit's shadow price for foreign exchange places the responsibility of price justification in another agency.<sup>2</sup>

Unfortunately, in Afghanistan, there is no effective central planning unit. (The Ministry of Planning does not do feasibility studies). As an alternative for the present study, the U.S. dollar inputs are converted to afghanis at the free market exchange rate taken as the average bazaar rate for 1971. The use of free market prices effectively translated the foreign investment component of the project into a market-determined opportunity cost of capital.

Normally in the analysis of agricultural projects it has been customary to use world market prices for all marketed produce in place of domestic prices in protected markets. The reasoning here, is that in a partial equilibrium "second best" model, world market prices are closer approximations of "value" than an artificial domestic fixed price. Afghanistan, although it officially bans interprovincial and international trade of wheat (the major crop of the country), does not have the administrative capability to either effectively restrict the export or the

import of grains. Wheat moves freely among the provinces of the country, and between Afghanistan and both Iran and Pakistan. In recent normal crop years the price of wheat has closely approximated world market prices. In the Helmand-Arghandab Valley in 1970, the average market price was 6.34 afghanis/kilo<sup>3</sup>, while at the same time the world market price plus rail transport from Karachi to Kabul was 6.8 afghanis/kilo.<sup>4</sup> Clearly the market prices for grains approximates true value and can be incorporated into the analysis.

In the subsequent computations the free market rate in the major bazaar (Lashkar Gah) of the Helmand-Arghandab Valley is used not only for wheat but for all the agricultural products. It could be argued that the world market price for the high value crops (principally grapes, pomegranates and apricots) are appreciably higher than the domestic market price and are a closer approximation of the true value. The counter-argument would be that Afghanistan does have a free market and that these market prices reflect true regional value if not world value. If world market prices were to be used, two important qualifications would restrict the validity of their application. First, what would be the "true" valuation of a commodity which has no effective world market price? Second, as the economy develops, the production of cash crops increases, and transportation systems improve, the price of pomegranates, apricots and grapes will rise. But to incorporate these higher prices into the analysis credits the project with externalities generated from national development and not direct project investments. Recall that the project investments are applied primarily to the removal of a specific physical constraint upon increased production. The marketing of that increase

in production is beyond the scope of the project as specified. To use any inflated prices would be to reward the project "costless" net benefits. Afghanistan does not presently have the complete organizational and physical infrastructure for an effective network to export high value crops world-wide. For the additional production to compete in the world market, an additional project would be necessary. Possibly that subsequent project could use the difference between domestic and world market prices as a basis for evaluating its net benefit stream. But to incorporate these net benefits within the present analysis would in effect result in a double counting of the same net benefits. (What we have here is the dilemma of analyzing a specific project within the context of a complete sectoral study.) It is quite conceivable to justify specific projects within the total sector even while the total sector itself, which is the sum of all the projects, is economically unjustifiable. (It is impossible to eat a cake more than once).

An alternate approach would be to estimate the total agricultural sector investment requirements of export crop development to determine the proportion that irrigation development is in the total package. This proposition could then be used to factor out the net benefits from higher product prices that are attributable to this one project among many. Given that no such national plan exists, to determine (independently) the total investment requirements would be beyond the limits of this project analysis.

Inputting a value for labour involved the greatest problem. The whole question of the marginal value product of agricultural labour in Third World economies has received a great deal of attention in the literature of development.<sup>5</sup> Determining the "true" marginal product of

agricultural labour in an economy remains extremely difficult. A whole spectrum of possible shadow prices may be incorporated into an analysis.

At one extreme is a crowded traditional community wherein the marginal product of agricultural labour may be so close to zero as to make zero a good approximation of the real value of the incremental labour used. This would be the case where widespread disguised unemployment and underemployment are evident. At the other extreme, an agricultural project may require technical and highly skilled workers who may be in short supply. In this case, their wage may understate their true marginal value product. Along this continuum, there exist a wide range of possible prices that are above zero but less than or equal to the command price of agricultural labour. To assume labour is valued at the wage it commands implies a marginal value product approximately equal to the wage, and thus negates the need for any shadow prices.

The degree of shadow price imputations in irrigation projects is principally a function of seasonal supply and demand of farm labour for project construction, and the amount of additional on-farm labour involved in capitalization (for example, workers building their own houses, digging their own irrigation canals [juies] and drains and clearing their land). To get a good approximation of the marginal value product of additional labour requires some information about the production function of the traditional environment. Yet, even if this information were readily available, could it be assumed constant over time? Although agricultural labour in a project may be unemployed when the project begins, this may not be the case ten years hence when development has had a chance to progress. A possible alternative is to have the labour price change over

the project life. Possibly from  $t_0 - t_{10}$  the price should equal zero; from  $t_{11} - t_{20}$  the shadow price should equal one-half the annual wage bill; and from  $t_{20} - t_{50}$  the shadow price should be eliminated.

In the Helmand-Arghandab Valley Project, labour demand can be divided between project construction and on-farm labour. In the project construction, the wage bill is calculated without a shadow price; i.e., at its market price. Of the two major categories, skilled and unskilled, the major portion of the wage bill goes to the latter at a pay scale that is set at approximately the family consumption level. There is a slight downward bias in investment costs, not only because there is an acute shortage of trained labour in the country, but because a small proportion of the labour force is not actually hired, but is comprised of a regiment of conscripted soldiers paid only in the provision of daily meals.<sup>6</sup> Farm labour is not employed in the major construction, only in on-farm capitalization necessary to benefit from infrastructure improvements.

On-farm labour is executed by hired hands, contracted labourers, share-croppers and farmer-owner labour. A shadow price for on-farm labour is incorporated into the analysis only after 1976. It is assumed that after that date additional labour will be needed both to extend the on-farm irrigation infrastructure and to introduce the labour-using innovations (biological and chemical). Since total farm costs are calculated by use of a fixed proportion of total gross farm revenue, an upward adjustment of this cost factor is incorporated into net benefit calculations to account for incremental labour requirements. This adjustment factor is arbitrarily set at a ten per cent addition to total farm costs.



Calculation of Net Benefit Series (1971-2003)

Having determined the project period and the required shadow prices, a definition of how to measure the benefit stream as well as a delineation of whom the project is to benefit is necessary.

The objective function in the calculation of net social benefits is based solely upon the efficiency criterion of increased regional production value. In this irrigation project, the objective is to permit better water delivery so that farmers can extend their cultivated cropland, obtain higher yields on existing cropland, increase the proportion of land double-cropped, and allow for the gradual substitution of high value cash crops for subsistence grain production. All these factors will determine the size of the net benefit stream; i.e., the increase in net farm production value as a result of project construction.

In order to estimate the net benefit stream, an approximation of net farm production value (npv) in  $t_0$  as well as an estimate of npv from  $t_1$  to  $t_{33}$  is needed. By subtracting each project year's npv from base  $npv_{t_0}$  we derive the series of incremental net production value ( $\Delta NPV$ ), or

$$\Delta NPV = \sum_{i=1972}^{2003} (npv_i - npv_{71})$$

As a first step in estimating the net benefit to the region from the investments, some idea of the region's initial production is necessary. The basis for determining what the region was producing in 1971 was to use results of the Farm Economic Survey (See Table 1). The writer assumes that this survey, notwithstanding its many shortcomings, is the most accurate source of base data. Whereas base data give estimates

TABLE 1  
HELMAND-ARGHANDAB VALLEY PROJECT:  
ESTIMATION OF NET FARM PRODUCTION VALUE, 1970

Areas	Total Cropland (hectares)	Number of Farms (final adjustment)	Returns per Farm (in Afs.)			Gross Income per Farm (Afs.)
			Crops	Fruits and vege- tables	Live- stock	
<b>Helmand Valley:</b>						
Nad-i-ali	9,190	1,947	40,638	6,103	2,451	49,192
Marja	6,300	1,169	38,195	5,699	2,500	46,394
Shamalen	14,900	3,363	45,389	7,276	4,922	57,587
Darveshan	11,500	1,525	45,851	7,764	3,610	57,225
Seraj	9,350	1,540	24,128	2,419	3,469	30,016
Girishk	9,200	1,726	52,123	10,654	4,531	67,308
Sanguin-Kajakal	6,100	3,228	22,052	3,480	2,950	28,482
Musa Qula - Zamin Dawar	6,200	2,123	20,871	8,024	3,719	32,614
<b>Subtotal: Helmand</b>	<b>72,740</b>	<b>16,621</b>				
<b>Arghandab Valley:</b>						
North Arghandab	12,000	2,000	39,444	34,683	2,916	77,043
Central Arghandab	28,000	2,952	34,968	65,056	3,228	103,252
Tarnak	7,000	651	45,330	49,575	3,421	98,326
<b>Subtotal: Arghandab</b>	<b>47,000</b>	<b>5,603</b>				
<b>Total</b>	<b>119,740</b>	<b>22,224</b>	--	--	--	--

SOURCE: G. Owens, 1970 Farm Economic Survey: Helmand-Arghandab Valley of Afghanistan. (Kabul: U.S. Agency for International Development, December 1971), Table 38, p. 78, and Table 23, p. 50.

TABLE 1--Continued

Areas	Gross Income per Region (Afs.)	Total Costs per Farm (Afs.)	Total Costs per Region (Afs.)	Net Returns per Region (Afs.)
Helmand Valley:				
Nad-i-ali	95,776,824	18,429	35,881,263	59,895,561
Marja	54,234,586	15,374	17,972,206	36,262,380
Shamalan	193,665,081	20,417	68,662,371	125,002,710
Darweshan	87,268,125	27,514	41,958,850	45,309,275
Seraj	46,224,640	19,382	29,848,280	16,376,360
Girishk	116,173,608	31,752	54,807,404	61,366,204
Sanguin-Kajakai	91,939,896	9,250	29,859,000	62,080,896
Musa Qala - Zamin Dawar	69,239,522	12,517	26,573,591	42,665,931
Subtotal: Helmand	754,522,282		305,562,965	448,959,317
Arghandab Valley:				
North Arghandab	154,086,000	24,387	48,774,000	105,312,000
Central Arghandab	304,799,904	39,934	117,885,168	186,914,736
Tarnak	64,010,226	42,083	27,396,033	36,614,193
Subtotal: Arghandab	522,896,130		194,055,201	328,840,929
Total	1,277,418,412	--	499,618,166	777,800,246

of npv by area, the projected values for npv are grouped into two sub-areas; the Helmand and the Kandahar (see Figure 1, p. 51). Roughly divided, the Helmand area is the grain region with only a small proportion of high value cropland, while the Kandahar area (Arghandab) has most of the region's high value crop production. Gross regional production value was divided between livestock and crops. Key factor inputs were projected for specific future dates, i.e., 1976, 1982 and 1992. Using these points in time, point estimates of npv were made using the supplied factor inputs of projected cropland, yield, incidence of double-cropping and proportion of land in high value production. The npv 1976, 1982, and 1992 was calculated using the following equation:

$$\text{npv}_i = (\text{gpv}_i) \cdot \frac{1}{K}$$

where  $\text{gpv}_i = g_c \text{pv}_i + g_L \text{pv}_i$

and  $i = 1976, 1982, 1992$

$\text{gpv} =$  gross farm production value

$\text{npv} =$  net farm production value

$g_c \text{pv} =$  gross crop production value

$g_L \text{pv} =$  gross livestock production value

$K =$  proportion of farm cost to gross farm production value

Gross crop production value was by far the largest proportion of regional farm value and was in turn calculated with the following equation. The  $g_c \text{pv}$  for any year is the summed product of cropland (wheat, high value crop, double-cropped) times respective yields, times respective product prices, or more exactly:

$$G_{c,pv} = (h_w \cdot y_{wi} \cdot P_w) \\ + (h_{hvc_i} \cdot y_{hvc_i} \cdot P_{hvc}) \\ + (h_{dc_i} \cdot y_{dc_i} \cdot P_w)$$

where:

$h_w$  = hectares in wheat

$h_{hvc}$  = hectares in high value crops

$h_{dc}$  = hectares double-cropped

$y_w$  = wheat yield (kg/ha)

$y_{hvc}$  = high value crop yield (kg/ha)

$P_w$  = price per unit wheat (afs/kg)

$P_{hvc}$  = price per unit high value crop (afs/kg)

Two simplifying assumptions are here introduced into the calculations:

(i) The high-value crops within the valley are predominantly grapes, pomegranates and apricots. In the subsequent analysis, all the high value cropland is represented by the proxy, grapes.

(ii) Present cropping patterns alternate corn or mung beans with wheat. Cotton lags behind in importance.<sup>7</sup> Since corn on the average has a higher yield but lower price than wheat, while mung beans have a lower yield but higher average price, to use wheat yields and prices as an approximate measure for all double-cropped areas is at once easier and would result in only minor deviations from the actual gross area return from double-cropping. Farmers customarily use units of wheat production as a base in the calculation of gross land value even if land is double-

cropped, which indicates that the gross returns per hectare for wheat, corn and mung beans are relatively close.<sup>8</sup>

Gross livestock production value ( $g_{Lpv}$ ), or increases in livestock production, although not included in the scope of project development, will undoubtedly increase as an externality of increased cropland and yield. A major difficulty was posed in trying to determine the functional relationship between livestock production value and the gross farm production function.

From economic surveys<sup>9</sup>, the growth in livestock value manifested no obvious trends. The only consistent functional relationship for all areas in the project was between gross livestock value and cultivated cropland per farm.<sup>10</sup> In projecting the growth of net farm production value, the increase in livestock value is treated as an externality. Since the project investments do not account for any planned involvement of livestock promotion, the small increases in livestock value as a result of increased cropland are assumed a sufficient approximation of increased farm income resulting from development investment. Increase in livestock value is therefore assumed to remain constant with increased crop production value per hectare rising only with increased cropland utilization.

Net farm production value from gross farm production value is derived by dividing a farm cost of production factor into the summed  $g_{c}pv$  to  $g_{L}pv$ . Included in this cost calculation were wheat seed, other seed, livestock feed, fertilizer and chemicals, interest on borrowed capital, and labour. A factor ( $K$ ) is used to discount  $g_{pv}$  for all areas. From the two surveys of the area<sup>11</sup> most farm cost/gross farm revenue per hectare (by area) appeared to be only slightly below 40 per cent in

1963 and evenly distributed about 40 per cent in 1970. The increase is assumed to be a function of increased inputed labour cost as a result of the green revolution.

The factor K is assumed constant to 1976, and then equal to 50 per cent to the end of the project life to reflect the higher shadow price of labour. Tables 2, 3, and 4 yield the calculations of npv for 1976, 1982 and 1992.

To determine the series of net farm production value for 1971 to 2003, the point estimates for 1971, 1976, 1982, 1992 were expanded into a continuous series by straight-line interpolation between 1971 and 1992 and extrapolation onward to the end of the project life at the 1992 level.

The investment series is broken down by functions in Table 5, and is summed in Table 6. All data were supplied by the Helmand-Arghandab Valley Authority and the Helmand-Arghandab Valley Regional Advisers (American).

From the above generated series of npv and investment costs, a project internal rate of return of 12.44 per cent is calculated; i.e., the return to the economy on the investment for the Helmand-Arghandab Valley Project over the years 1974 to 2003, with the above assumptions, is estimated at 12.44 per cent.<sup>12</sup>

How is this rate of return translated into a policy recommendation? Short of having any clearly defined opportunity cost of capital, lacking in Afghanistan, projects must be ranked in order of the value of estimated internal rates of return. If enough of these feasibility analyses are attempted then all projects are implemented in descending order until the development budget is exhausted, so the simplest of policy

TABLE 2  
 HELMAND-ARGHANDAB VALLEY PROJECT  
 PROJECTED NET CROP PRODUCTION VALUE FOR 1976, 1982, 1992

Area	Cropland Utilization (%)	Land in Crops			% in wheat	% in High Value Crops	Gross Crop Production Value	Net Crop Production Value <sup>a</sup>
		Cropland (Ha)	Double-Cropped (Ha)	Total (Ha)				
Helmand	138	82,000	30,860	112,860	90	10	1,091,405	654,843
Arghandab	105	50,000	2,500	52,000	64	36	644,097	322,049
Total	-	132,000	33,360	165,360	-	-	1,735,502	976,892

1 9 7 6

NOTE: This table is based upon the assumptions of the Helmand-Arghandab Valley Regional Advisors (American). The prices used are 6.34 and 3.00 Afs./kg. for wheat and high-value crops, respectively. The following yields are assumed (kg./ha.):

	1976	1982	1992
Wheat	1400	1600	2000
High Value Crops	6625	6775	7000

<sup>a</sup>Net Crop Production value equals the Gross Crop Production value multiplied by a factor of .60 for 1976, .50 for 1982, and .50 for 1992.



TABLE 2--continued

Area	Cropland Utilization (%)	Land in Crops				Gross Crop Production Value	Net Crop Production Value <sup>a</sup>	
		Cropland (Ha)	Double-Cropped (Ha)	Total (Ha)	% in wheat			% in High Value Crops
1 9 8 2								
Helmand	148	92,700	44,590	137,290	82	13	1,515,361	757,680
Arghandab	115	63,200	9,500	72,700	46	54	1,084,926	542,463
Total	-	155,900	54,090	209,990	-	-	2,600,287	1,300,143
1 9 9 2								
Helmand	160	105,300	62,725	168,025	79	21	2,314,537	1,157,268
Arghandab	115	63,200	9,500	72,700	46	54	1,205,781	602,890
Total	-	168,500	72,225	240,725	-	-	3,520,318	1,760,158

TABLE 3

HELMAND-ARGHANDAB VALLEY PROJECT  
PROJECTED NET LIVESTOCK PRODUCTION VALUE FOR 1976,1982,1992

Area	Cropland (hectares)	Gross Livestock Value (000Afs.)	Net Livestock Value (000Afs.)
1 9 7 6			
Helmand	82,000	41,000	24,600
Arghandab	50,000	25,000	15,000
Total	132,000	66,000	39,600
1 9 8 2			
Helmand	92,700	46,350	27,810
Arghandab	63,200	31,600	18,960
Total	155,900	77,950	46,770
1 9 9 2			
Helmand	105,300	52,650	31,590
Arghandab	63,200	31,600	18,960
Total	168,500	82,250	50,550

NOTE: Based upon assumptions of the Helmand-Arghandab Valley Region .  
Advisors (American) of additional livestock value attributable  
to the improved irrigation system.

TABLE 4  
HELMAND-ARGHANDAB VALLEY PROJECT  
PROJECTED NET FARM PRODUCTION VALUE FOR 1976,1982,1992

Area	Net Farm Production Value (000Afs.)		
	1976	1982	1992
Helmand	620,044	785,490	1,188,848
Arghandab	393,697	561,423	621,850
Total	1,013,741	1,346,913	1,810,698

NOTE: Based upon assumptions of the Helmand-Arghandab Valley Region Advisors (American) of additional farm production value attributable to the improved irrigation system.

TABLE 5  
HELMAND-ARGHANDAB VALLEY PROJECT  
PROJECTED DEVELOPMENT EXPENDITURES, 1972-92

Expenditures	1972-73		1973-74	
	(000 Afs.)	(\$000)	(000Afs.)	(\$000)
Area Developments:				
Drainage	...	...	...	...
Shamal an	38,000	...	80,000	2,300
Garmab	...	...	...	...
Arghandab	...	...	...	...
Seraj	...	...	...	...
Other a	8,000	600	34,000	...
Subtotal	46,000	600	114,000	2,300
Agriculture Services	16,000	...	18,000	380
Project Studies	8,000	...	14,000	316
Operations and Maintenance	20,000	...	22,000	414
General Administration and Regional Development <sup>b</sup>	38,000	...	38,000	...
Total	128,000	600	206,000	3,410
Total in afghanis <sup>c</sup>	178,700		494,145	

SOURCE: A.R. Baron, Deputy Director, Helmand-Arghandab Valley Regional Advisors, U.S. Agency for International Development.

<sup>a</sup>Includes Asian Development Bank loan for Kajakai Gates in dollar expenditure, and all other drainage improvements and construction. Garmab and Arghandab not broken out for RGA expenditures until 1978.

<sup>b</sup>Includes "green force" employees, livestock, settlement, education, public health and general administration.

<sup>c</sup> \$1 = 84.5 afghanis

TABLE 5 -- Continued

Expenditures	1974-75		1975-76	
	(000) afs.	(000)\$	(000) afs.	(000)\$
Area Developments:				
Drainage	...	...	...	...
Shamalan	80,000	2,300	80,000	...
Garmab	...	...	...	...
Arghandab	...	...	...	...
Seraj	...	...	...	...
Other	80,000	1,000	80,000	1,000
Subtotal	160,000	3,300	160,000	1,000
Agriculture Services	20,000	380	22,000	380
Project Studies	18,000	517	20,000	540
Operations and Maintenance	24,000	443	26,000	800
General Administration and Regional Development	38,000	...	40,000	...
Total	260,000	4,640	268,000	2,720
Total in afghanis	652,080		497,840	

TABLE 5 -- Continued

Expenditures	1976-77		1977-78	
	(000 Afs.)	(\$000)	(000 Afs.)	(\$000)
<b>Area Developments:</b>				
Drainage	...	...	...	...
Shamalan	80,000	...	80,000	...
Garmab	...	...	...	240
Arghandab	...	...	...	200
Seraj	...	...	...	...
Other	90,000	1,000	80,000	...
Subtotal				440
Agriculture Services	170,000	1,000	160,000	380
Project Studies	24,000	380	25,000	436
Operations and	20,000	424	20,000	374
Maintenance	28,000	466	30,000	...
General Administration and Regional Development	40,000	...	40,000	...
<b>Total</b>	<b>282,000</b>	<b>2,270</b>	<b>275,000</b>	<b>1,630</b>
<b>Total in afghanis</b>	<b>473,815</b>		<b>412,735</b>	

TABLE 5 -- Continued

Expenditures	1978-79		1979-80	
	(000Afs.)	(\$000)	(000Afs.)	(\$000)
<b>Area Developments:</b>				
Drainage	40,000	...	40,000	...
Shamalan	90,000	...	90,000	...
Garmab	22,000	240	25,000	240
Arghandab	30,000	1,000	50,000	800
Seraj	42,500	500	42,500	500
Other	...	...	...	...
Subtotal	224,500	1,740	247,500	1,540
Agriculture Services	25,000	...	25,000	...
Project Studies	20,000	...	20,000	...
Operations and Maintenance	65,000	...	65,000	...
General Administration and Regional Development	40,000	...	40,000	...
<b>Total</b>	<b>374,500</b>	<b>1,740</b>	<b>397,500</b>	<b>1,540</b>
<b>Total in afghanis</b>	<b>521,530</b>		<b>527,630</b>	

TABLE 5 -- Continued

Expenditures	1980-81		1981-82	
	(000 Afs.)	(\$000)	(000Afs.)	(\$000)
Area Developments:				
Drainage	40,000	...	40,000	....
Shamalōn	90,000	...	90,000	....
Garmab	28,000	240	31,000	240
Arghandab	60,000	800	70,000	800
Seraj	42,500	500	42,500	500
Other	...	...	...	...
Subtotal	260,500	1,540	273,500	1,540
Agriculture Services	25,000	...	25,000	...
Project Studies	20,000	...	20,000	...
Operations and Maintenance	65,000	...	65,000	...
General Administration and Regional Development	40,000	...	40,000	...
Total	410,500	1,540	423,500	1,540
Total in afghanis	540,630		553,630	



TABLE 5 --- Continued

Expenditures	1982-83		1983-84	
	(000 Afs.)	(\$000)	(000 Afs.)	(\$000)
Area Developments:				
Drainage	40,000	...	40,000	...
Shamalon	...	...	...	...
Garmab	31,000	240	...	...
Arghandab	70,000	800	60,000	800
Seraj	40,000	500	...	...
Other	...	...	...	...
Subtotal		1,540		800
Agriculture Services	181,000	...	100,000	...
Project Studies	25,000	...	25,000	...
Operations and	20,000	...	20,000	...
Maintenance	65,000	...	65,000	...
General Administration	40,000	...	40,000	...
and Regional				
Development				
Total	331,000	1,540	250,000	800
Total in afghanis	461,130		317,600	

TABLE 5 -- Continued

Expenditures	1984-85		1985-6 and following <sup>d</sup>	
	(000 Afs.)	(000\$)	(000 Afs.)	(\$000)
Area Developments:				
Drainage	40,000	...	...	...
Shamalan	...	...	...	...
Garmab	...	...	...	...
Arghandab	60,000	...	...	...
Seraj	...	...	...	...
Other	...	...	...	...
Subtotal	100,000	...	...	...
Agriculture Services	25,000	...	25,000	...
Project Studies	...	...	...	...
Operations and	65,000	...	65,000	...
Maintenance	40,000	...	40,000	...
General Administration and Regional Development		...		...
Total	230,000	...	130,000	...
Total in afghanis	230,000		130,000	

<sup>d</sup> Assume expenditures constant to end of project life.

TABLE 6  
 HELMAND-ARGHANDAB VALLEY PROJECT :  
 ACTUAL AND PROJECTED DEVELOPMENT EXPENDITURES,  
 1971-1992

Year	U.S. Expenditures Dollars (000)\$	U.S. Expenditures <sup>a</sup> In Afghanis (000)afs	R.G.A. Expenditures (000)afs	Total Expenditures	Total Expenditures Plus 15% Contingency
1971-72	600	50,700	90,000	140,700	...
1972-73	600	50,700	128,000	178,700	205,505
1973-74	3,410	288,145	206,000	494,145	568,267
1974-75	4,640	392,080	260,000	652,080	718,842
1975-76	2,720	229,840	268,000	497,840	572,216
1976-77	2,270	191,815	282,000	473,815	544,887
1977-78	1,630	137,735	275,000	412,735	474,645
1978-79	1,740	147,030	374,500	521,530	599,760
1979-80	1,540	130,130	397,500	527,630	606,775
1980-81	1,540	130,130	410,500	540,630	621,725
1981-82	1,540	130,130	423,500	553,630	636,675
1982-83	1,540	130,130	331,000	461,130	530,300
1983-84	800	67,600	250,000	317,600	365,240
1984-85	0	0	230,000	230,000	264,400
1985-86 <sup>b</sup>	0	0	130,000	130,000	149,500

SOURCE: A.R. Baron, Deputy Director, Helmand-Arghandab Valley Regional Advisors,  
 U.S. Agency for International Development.

<sup>a</sup>At an exchange rate of 84.5: \$1.

<sup>b</sup>Remains constant to end of project life (1992).

governs the outcome.<sup>13</sup> The project with the lowest acceptable internal rate of return, given the government's budget constraints, sets the cut-off point, whose internal rate of return would then approximate a hypothetical opportunity cost of public investment.

Within Afghanistan, very few projects have been subjected to formal benefit-cost analysis. The Helmand-Arghandab Valley Project's internal rate of return can then only be compared with the one other agricultural project,<sup>14</sup> on which a similar benefit-cost study was attempted. The Khanabad project produced an internal rate of return of 18.50 per cent. Clearly, the Helmand-Arghandab Valley Project contributes a lower return to public investment, but is that sufficient information for a definite policy recommendation?

Most policymakers have used rule of thumb cut-off criteria. The rate of 12 per cent is a popular low limit. Most countries seem to think that their social rate of discount lies somewhere between eight and 15 per cent. A project, without any further information, will be implemented if its internal rate of return is greater than 12 per cent. This rather crude approach to project selection helps project analysts avoid getting bogged down in an argument concerning the "true" opportunity cost in an economy.

Alternatively a more rigorous approach has been suggested. What is required is an ordering of decision rules for comparing alternatives by use of the internal rate of return. Three such rules have been proffered.

Rule 1. Compare all alternatives over the same period of analysis. Rates of return over different economic lives cannot be meaningfully compared because investment opportunity for the returns from the shorter-lived alternatives must be considered in determining whether capital should remain committed to the longer-lived alternative.

Rule 2. Calculate the rate of return for each alternative. Choose all alternatives having a rate of return exceeding the minimum acceptable value. Reject the rest. If sets of mutually-exclusive alternatives are involved, proceed to Rule 3.

Rule 3. Rank the alternatives in the set of mutually-exclusive alternatives in order of increasing cost. Calculate the rate of return on the incremental cost and incremental benefits of the next alternative above the least costly alternative. Choose the more costly alternative if the incremental rate of return exceeds the minimum acceptable discount rate. Otherwise choose the less costly alternative. Continue the analysis by considering the alternatives in order of increased costliness, the alternative on the less costly side of each increment being the most costly project chosen thus far.<sup>15</sup>

In the chapters that follow, the limitations of this narrowly defined method of project selection will be analyzed.

References to Chapter 3

1. A.R. Baron, "Helmand-Arghandab Valley Region," First draft (Kabul: U.S. Agency for International Development, Helmand-Arghandab Valley Regional Advisors American, 27 February 1971), p.1.
2. Gittinger, op. cit., p. 39
3. G. Owens, 1970 Farm Economic Survey: Helmand-Arghandab Valley of Afghanistan (Kabul: U.S. Agency for International Development, December 1971), p. 60. This survey was carried out by a team from the University of Wyoming under contract to the U.S. Agency for International Development.
4. K. Myint et al., Khanabad Irrigation Project for Afghanistan (Kabul: International Bank for Reconstruction and Development, 1971), p. 18. The minor differences might be accounted for by a different conversion factor between dollars and afghanis used in calculations.
5. For a good survey, see: Charles H.C. Kao and Kurt R. Anschel, "Disguised Unemployment in Agriculture: A Survey," in Agriculture in Economic Development, ed. Lawrence Witt and Carl Eicker (New York: McGraw Hill, 1964), pp. 129-44.
6. These soldiers usually receive subsidies from their families in order to help them survive the two years of service. In this sense, the conscription imposes an extra tax through a degree of forced savings and should be imputed into national revenue calculations, not project costs.
7. Owens, op. cit., Chap. IV, pp. 49-64.
8. Although returns per hectare for cotton are significantly greater than corn or mung beans, they are excluded in the determination of the "proxy" crop to represent double-cropping because (a) cotton is presently still a weak third, (b) there are constraints faced by the United States Agency for International Development in promoting cotton production (southern legislative lobby), and finally (c) it is still uncertain what will be the national policy concerning cotton promotion and how this policy will affect the Valley. Presently (1972) cotton prices are fixed by the Royal Government of Afghanistan at an uncompetitive level, vis-à-vis wheat.
9. Only two farm surveys exist which include livestock valuations. Owens, op. cit., is relatively reliable; not so reliable is I.M. Stevens and K. Tarzi, Economics of Agricultural Production in the Helmand Valley (Kabul: U.S. Department of Interior, Bureau of Reclamation, 1965).
10. Owens, op. cit., p. 53; and Stevens and Tarzi, op. cit., p. 48.

11. See: Stevens and Tarzi, op. cit., p. 48; and Owens, op. cit., p. 53.

12. The computer model used for the calculation of the internal rate of return was written in FORTRAN IV and uses an algorithm in logarithms to the base E after the method developed by Lawrence Fisher of the University of Chicago. See R. Phillips, Feasibility Analysis for Agricultural Projects (Seoul: Ministry of Agriculture and Forestry, Republic of Korea; United States Agency for International Development, Agricultural Division; Dunlop and Associates, Inc., 1970), pp. 519-530. All subsequent internal rates of return calculations employ the same programme (See Appendix for a printout of the programme). The programmes were run at Karachi (United Bank Limited) and New Delhi (University of New Delhi) on IBM 360/30 computers.

13. This approach is based solely on efficiency criteria and fails to satisfy all the social objectives of a society. This point is expanded later.

14. K. Myint et al., op. cit., p. 18.

15. L. Douglas James and Robert R. Lee, Economics of Water Resources Planning (New York: McGraw Hill, 1970).

## CHAPTER 4

### RISK AND UNCERTAINTY AND THE DEVELOPMENT OF THE HELMAND-ARGHANDAB VALLEY PROJECT - A SENSITIVITY ANALYSIS

#### An Introduction to Risk and Uncertainty in the Literature

The internal rate of return analysis of the Helmand-Arghandab Valley Project attempted in the previous chapter has some very clear limitations. The decision to appropriate funds for the development of the Helmand-Arghandab Valley Project cannot rest solely upon one estimate of an internal rate of return, for we live in a world all too obviously dominated by risk and uncertainty. Because of the lack of perfect foreknowledge such a decision to invest must depend upon an evaluation of uncertain anticipated returns attributed to the investment and a comparison of these anticipations with uncertain estimated costs. In the enormous literature on benefit-cost analysis for public investment decisions, the problem of risk and uncertainty has received only sparse coverage. To date, because of the conceptual difficulties of the problem of quantifying degrees of risk and uncertainty, a clear statement in economics does not exist. Consequently project analysts are left with the only viable alternative of constructing the artificial model of a world of certainty altered by some ad hoc adjustments.

Frank Knight has laid the groundwork for a study of risk and uncertainty in his book, Risk, Uncertainty and Profit.<sup>1</sup> In this seminal work, Knight exposes the dichotomy between different varieties of uncertainty. That type of uncertainty associated with an isomorphic



mechanism which is capable of turning out mutually exclusive sets of alternatives, each with an objective probability measurement, he named risk. Its conceptual opposite is that type of uncertainty in which "there is no valid basis of any kind for classifying instances" or for which "there is no possibility of forming in any way groups of instances of sufficient homogeneity to make possible a quantitative determination of true probability".<sup>2</sup> This he called uncertainty.

Subsequent to Knight's book, several economists<sup>3</sup> attempted to close the gap. A lucid clarification was that of Nicholas Georgescu-Roegan<sup>4</sup> who pointed out that the Knightian dichotomy transformed the concept of expectations into two completely separate and extreme categories which are not consistent with the real world. Reality is composed of decisions based upon anticipations which form an infinite continuum between these two extremes. More significantly, Georgescu-Roegan proceeded to demonstrate that neither ordinal nor cardinal numerical values can be applied to any point on this range of expectations, except the rare occasion of true risk.

It is at this point that the theorists are still stymied. Decision-making is viewed as dependent upon expectations which lie along this continuum from pure risk to pure uncertainty with expectations that by their very nature are neither cardinally nor ordinally measurable.<sup>5</sup> These expectations form the basis for the common practice of incorporating a risk premium in project analysis so often called the "expected value adjustment".<sup>6</sup> Although neither cardinally nor ordinally measurable, expectations have comparable elements that allow for estimation of expected value adjustments. Georgescu-Roegan observed that the existence

of common elements in the evidence makes it possible for the decision-maker to establish various hierarchies among expectations upon which to base a rational decision. Among the common elements which form the basis for such comparability are: (1) the importance of past observations; (2) the credibility of each piece of information; and (3) the logical relation between each piece of evidence and its corresponding prediction.

The hierarchy in each direction can be established by any rational individual according to that theory of probability connected with the particular facet of expectation: past observations, credibility, logical relation.<sup>7</sup>

After each expectation is ranked according to these criteria, the decision is made. But if, as is usually true, these ranked hierarchies are contradictory, making a choice will involve the assigning of weights to the various and opposing hierarchies in a largely subjective and arbitrary manner.

Decisions regarding expectations of this type involve mainly intuition and good judgment in weighing the evidence,<sup>8</sup> and scarcely any numerical operations.

Where this evidence is available and explicit, economists unanimously agree that risk in the sense of optimistic bias of proposed government investment is a social cost and must be allowed for by substitution of expected values of costs and returns for "if-all-goes-well" estimates. In general<sup>9</sup> four different approaches to the treatment of risk and uncertainty in expectations can be distinguished: (1) the application of a correction factor to each of the future expected values of revenues and costs; (2) the inclusion of a risk premium into the rate of interest used to discount future benefits (costs); (3) a reduction

of the expected length of economic life of a project and (4) a flat reduction in the final benefit-cost ratio.<sup>10</sup> More elaborate models have also been attempted which introduce risk aversion considerations. Because the uncertainty present in the concepts of both future benefits and costs is not independent of time, the more distant expected values must receive a greater correction factor than those expected in the near future.

Haverin<sup>11</sup> has advocated an interesting variant of the discounting procedures. He would add a premium to the riskless rate when discounting benefits, but would use a lower rate than the pure rate in discounting costs. The basic idea is that risk aversion dictates writing down the present value estimate of future benefits but writing up the present value estimate of future costs. Moreover in view of the greater uncertainty of benefits, the former adjustment should be larger than the latter. How these discount rates are to be determined is left unresolved. Attempts to date to determine this discount factor(s) have not been too successful. McKean<sup>12</sup> notes that risk is an intangible that had best be left to the realm of judgment.

Although no consistent method of handling risk and uncertainty has been found, it remains indisputable that the single valued criterion for estimating the internal rate of return is insufficient. Since the internal rate of return is a decision-making tool, the more complete the inputs, the more useful the decision-making tool. It follows that since certain forms of risk and uncertainty appear to warrant inclusion in the analysis, the internal rate of return analysis must be able to indicate, in some way, the differences in the degree of credibility which surrounds expectations of project costs and benefits. As a minimum, inputs into

the analysis must account for the proclivity of project planners for viewing the future through rose-coloured glasses. Policy makers within any given agency tend, as a rule, to be enthusiastic about aid committed to their own particular goals. The potential for distortions is quite obvious.

#### Criteria for Expected Value Adjustments

Project planners for the Helmand-Arghandab Valley Project used estimates in projecting key benefit and cost variables to incorporate into the internal rate of return. This is generally the case in project evaluation. Admittedly, these estimates, although founded upon technical expertise, are a significant factor in the formation of an investment decision. However, just as the arithmetic mean is but a single moment out of an infinity of moments needed to completely describe a frequency distribution, so are these projected variables an incomplete, and possibly misleading, description of the distribution of most likely combinations of benefits and costs. Because of the varying degree of uncertainty involved in these estimates, specific allowances must be introduced into the decision-making process.

In a recent study of water resource development in the United States, Haveman<sup>13</sup> shows that the ex post estimates of benefits bear little resemblance to their ex ante counterparts. On the basis of a simple analysis, he concludes that there exists a serious bias incorporated into agency ex ante evaluation procedures, resulting in persistent overstatement of expected benefits. In the same study, estimated project construction costs are found to deviate widely from realized costs.

Although no persistent bias in estimation procedures was apparent, nearly 50 per cent of the projects displayed realized costs that deviated by more than plus or minus 20 per cent from ex ante projects costs (See Table 7).

Just how benefit-cost analysis, by its nature, has built-in uncertainty factors is complex. There is a significant difference between the degree of uncertainty in the estimation techniques for benefits and that for costs. Both because of the estimation techniques used, and because of the concept of benefits itself, estimates of project benefits must generally be viewed as less credible than estimates of project costs.<sup>14</sup> Firstly, because of the ease of ex post measurement in the case of project costs, it is possible and relatively easy to continually reappraise the magnitude of the margin of error between the actual and estimated values. With the concept of benefits, however, attempts to secure such ex post measurement are markedly more difficult. Secondly, since benefits streams are deferred and investment streams immediate, these deferred magnitudes incorporate a greater degree of uncertainty than do the immediate cost schedules.<sup>15</sup> Thirdly, real benefits depend primarily upon variables of an evolutionary and unpredictable nature, while real costs depend upon the semi-static principles of engineering. Fourthly, it seems plausible to claim that to some extent the variables upon which future cost estimates are based are somewhat more susceptible to accurate price projection than the variables underlying benefit estimates. And finally, the presence of a repeatable process permits the determination of some measurement of objective probability.<sup>16</sup> These five factors create a situation wherein the variance of the distribution of costs is less than the variance of the distribution of benefits.

TABLE 7

FREQUENCY DISTRIBUTION OF PERCENTAGE DEVIATION OF REALIZED COST FROM ESTIMATED COST FOR WATER RESOURCE PROJECTS IN THE UNITED STATES

Percentage deviation of realized from estimated cost	Current dollars			Constant (1955 dollars)		
	Number of Projects	Total realized cost (\$mil.)	% of total realized cost	Number of Projects	Total Realized Cost (\$mil.)	% of Total Realized Cost
Less than -70	0	0.0	0.0	0	0.0	0.0
-70 - -60	1	0.1	0.0	2	0.1	0.0
-60 - -50	3	1.1	0.1	4	8.1	1.4
-50 - -40	4	8.7	1.2	7	35.1	6.3
-40 - -30	11	46.7	6.5	11	19.3	3.4
-30 - -20	9	18.6	2.6	12	214.9	38.6
-20 - -10	11	22.7	3.1	15	86.7	15.5
-10 - 0	18	352.6	49.5	16	58.0	10.4
.....						
0 - +10	9	6.1	0.8	7	14.4	2.5
+10 - +20	5	8.4	1.1	4	83.8	15.0
+20 - +30	6	85.3	11.9	1	0.2	0.0
+30 - +40	3	63.2	8.8	1	30.8	5.5
+40 - +50	2	55.0	7.7	}	3	5.8
+50 - +60	0	0.0	0.0			
+60 - +70	1	37.0	5.2			
Greater than +70	3	5.9	0.8			
Total	86	711.4	100.0*	83	556.4*	100.0*

SOURCE: Robert H. Haveman, The Economic Performance of Public Investments: An Ex Post Evaluation of Water Resource Investments (Baltimore: Johns Hopkins University Press, 1972), p. 107, table 21.

\* Discrepancy due to rounding.

Compounding the uncertainties inherent in the construction of cost and benefit schedules in all project analyses, there are uncertainties peculiar to capital intensive irrigation projects in Third World economies. In general, different types of projects possess different degrees of risk and uncertainty which in the process of project evaluation should be neither ignored nor neglected. Irrigation projects invariably have a relatively large initial capital outlay and a small but relatively constant operating expense throughout the project life; at the same time the net benefit schedule can usually be presented by a polynomial function whose properties are  $dy/dt$  and also  $d^2y/dt^2$  until some point where the curve smoothes out and remains constant to the end of project life. The  $d^2y/dt^2$  is strongly influenced, among other factors, by investment termination dates, adaption to a new delivery system, and substitution of high-value crops for subsistence cultivation. In a recent International Bank for Reconstruction and Development study of eight World Bank financed irrigation projects,<sup>17</sup> the authors find that construction costs are usually higher than anticipated and execution of construction falls behind schedule. In six of the eight cases examined, even though cost contingency allowances were included in the feasibility analyses, ex post evaluations of actual costs reduced the original anticipated net benefit and concomitantly the internal rate of return in the order of 10 to 20 per cent (See Table 8).

"Until the appraisal of cost estimates is improved, the contingency allowance must be regarded, therefore, as a means, however imperfect, for adjusting appraisal biases, and is not as sometimes viewed, a mere device for avoiding the risk of an occasional underestimate of costs."<sup>18</sup>

TABLE 8

CHANGES IN ANTICIPATED RATE OF RETURN FOR EIGHT IRRIGATION PROJECTS,  
RESULTING FROM DIFFERENCES BETWEEN PROJECTED AND REALIZED  
COST AND TIMING OF PROJECT EXECUTION

Project	Rate of Return		"Error" Relative to Initial Rate of Return (%)
	Initial Rate	Revised Rate	
Purna	13.2	11.2	- 15.2
Shetrunji	16.7	17.4	+ 4.2
Salandhi	18.6	17.3	- 6.5
Brahmaputra	49.6	37.2	- 25.0
Taiwan*	77.6	72.7	- 6.3
Seyhan, Stage I	10.7	8.7	- 18.7
Rio Bravo	18.7	18.0	- 3.7
Yaqui	14.4	17.6	+ 22.2

SOURCE: A. Otten and S. Reutlinger, Performance Evaluation of Eight On-Going Irrigation Projects, International Development Association Economic Working Paper no. 40 (Washington, D.C.: International Bank for Reconstruction and Development, 28 March 1969), p. 6, table 1.

\* Revised rate of return based primarily on change in scope of project.



At the same time, while the study did not attempt a systematic appraisal of anticipated benefits, a casual review of the projects showed that many changes in factors associated with project benefits had been recorded for practically all the projects reviewed. The information, though scanty, indicates clearly that cropping patterns, crop yields, amount of land brought under cultivation, quantity and cost of inputs used by farmers, and commodity prices frequently differ from original expectations.

#### A Sensitivity Analysis

Sensitivity analysis is really a straightforward, but often quite sufficient means to deal with the question of risk and uncertainty in project analysis. Although some attempt has been made to build sensitivity analyses upon elaborate risk analysis techniques using probability theory and computer models,<sup>19</sup> trained manpower and data constraints have invariably limited benefit-cost studies of agricultural projects in Third World economies to simple most probable outcome analysis. In general, the real advantage of sensitivity analysis is its ability to test what happens to the project's earning capacity if something goes wrong. How sensitive is the project's internal economic return (1) to increased construction costs? (2) to a dampened growth in yields? (3) to a change in double cropping and cropland area? (4) to a shortened project life? or (5) to delay in implementation? By applying incremental factor changes to key input and output variables, the new matrix of internal rates of return can give a closer approximation of reality by recognizing that projections are subject to varying degrees of uncertainty and risk.

Recall that the first approximation of the internal rate of return for the Helmand-Arghandab Valley Project yielded an internal economic return of 12.44 per cent. For sake of the subsequent sensitivity analysis we assume that

$$\text{IRR} = f(I, L, \Delta \text{NPV}, \overline{\text{NPV}})$$

where I =investment cost schedule (from base year to end of project life)

L =length of project life

NPV =net production value stream from base year to end of project life as a result of project investment

$\overline{\text{NPV}}$  =net production value stream from base year to end of project life that would have existed had the project not been undertaken

In the first approximation of the internal rate of return, it was assumed that the investment and NPV streams were the ones set out in Table form in Chapter 3 (see Tables 2,3,4 and 5). The project life was assumed to be 33 years and regional growth in net production value, had the project not been implemented, was equal to zero, i.e., a static no-growth condition. What are the uncertain and risky conditions that could reasonably alter the preliminary factors and subsequent internal rate of return?

(a) Investment Contingency Allowance

Cost estimates for the investment period of a project are prepared on the assumption that there will be no modifications in design which will lead to changes in the physical work required; that there will be no exceptional conditions such as unexpected rock bed formations;

that there will be no adverse natural phenomena; and that political decisions will not adversely affect the implementation schedules and thus increase investment costs. Normally, too, project cost estimates assume there will be no relative changes in domestic or international prices during the investment period; and that the general price level will not rise. Clearly, it would be unrealistic to rest project cost estimates simply on these assumptions of perfect foresight and complete price stability.

In a previous section it was shown that even with contingency allowances of from 10 to 20 per cent, project investment schedules were understated. In the subsequent analysis investment contingency factors of plus 15 and 30 per cent are added to the original investment stream. The 15 per cent factor, given the evidence from other similar projects, might be considered the lower limit of the most probable outcome, while 30 per cent would represent a possible result of various unplanned contingencies not uncommon in large infrastructure projects attempted in a Third World environment.

Clearly, a knowledge of the particular technical coefficients (engineering and agronomic) within the Helmand-Arghandab Valley Project should provide the analyst a more precise notion of the direction of the investment contingency adjustment. Why not a lower investment cost contingency adjustment? The justification lies in the assumption that in the projects reviewed by the International Bank for Reconstruction and Development, the ex ante cost studies were done with just that particular knowledge of the technical coefficients, yet understatement, not overstatement, was the norm.

(b) Project Life

The effective life of an irrigation project is directly dependent upon the productive life of the infrastructure. The infrastructure of a modern irrigation system is in turn dependent upon the rate of siltation in the reservoir which cuts the irrigation capacity as well as the effectiveness of the operations and maintenance of the irrigation network. The former factor is purely technical while the latter is both technically and institutionally determined. For the sensitivity analysis it will be assumed that the risk factor for both technical and institutional reasons will cut 10 years off the project life. Assuming a productive life only to 1993 instead of 2003 is not meant to infer that after 1993 the project's infrastructure will be useless. Rather, shortening the project life by an incremental factor assumes that because of unforeseen factors the infrastructure will need additional investment after 1993 to keep production levels up.

(c) The Incremental Net Production Value ( $\Delta$ NPV)

The net economic benefit as a result of project investment is a function of growth of cropland, yields, cash crop substitution, double cropping, livestock production and farm costs. All these projected factors could vary. For the sensitivity analysis only two factors are changed incrementally, i.e., the percentage distribution between wheat and high value crops and the growth of double cropping. These two factors are considered the most uncertain given the realities of a traditional agricultural environment.

In the original net production value estimate the per cent distribution between wheat and high value crops (HVC) is assumed to

change rather dramatically, especially in the Kandahar area. Wheat, which accounted for 75 per cent of the production in the Kandahar area in 1970, will account for 64 per cent by 1976 and 46 per cent by 1982, remaining constant at this level through 1992. In the Helmand area wheat, which accounted for 95 per cent of production in 1970, would account for 90 per cent by 1976, 82 per cent by 1982, and 79 per cent by 1992. In an adjusted  $\Delta$ NPV series, the per cent distribution between wheat and HVC by area changes at a lower rate particularly in the Kandahar area. To assume that by 1982 HVC would account for over 50 per cent of cropland, envisages a rate of change in the next ten years to a cash crop agricultural society that the distribution of investment expenditure does not account for. The rapid change and resulting large cash crop of pomegranates, grapes and apricots will require an accelerated and integrated marketing project. Such investments and the concomitant reorganization of the government bureaucracy to accommodate large cash crops is not provided within the context of the next ten year development plan. Instead, HVC is adjusted downward to account for 33 per cent in 1976, 40 per cent in 1982, and 45 per cent in 1992.

In the Helmand area, wheat area would decline gradually, accounting for 95 per cent of cropland in 1976, 93 per cent in 1982, and 90 per cent in 1992. Given population growth and comparative advantage of the Helmand in wheat production, grain production must remain a major crop or else the area may face a wheat deficit.

Similarly, in the original  $\Delta$ NPV series it is assumed that double cropping would increase at a very fast pace particularly in the Helmand area. Starting from a base level in 1971 of 109 per cent, cropland

utilization would rise to 138 per cent in 1976, 148 per cent in 1982, and 160 per cent by 1992. In the Kandahar area the shortage of water would diminish the cropland utilization potential. By 1976, cropland utilization would rise from the 1971 level of 104 per cent to 105 per cent; then by 1982, it would reach 115 per cent and remain constant through 1992.

In the adjusted  $\Delta$ NPV series double-cropping is assumed to increase at a slower rate and reach a lower absolute level by 1992. To assume a cropland utilization of 160 per cent envisions an agrarian revolution, and this may not happen; on technical grounds for instance, it underestimates the effects of summer winds' burning the second crop in the fields. As an approximation of uncertainty it is assumed that in the Helmand area, cropland utilization would reach 115 per cent, 120 per cent, and 130 per cent in the years 1976, 1982, and 1992 respectively. In the Kandahar area, it is assumed that the water shortage would have a greater impact and so cropland utilization would rise to only 110 per cent by 1992.<sup>20</sup>

(d) Net Production Values Without Project (NPV)

Implicitly assumed in the original calculation of the internal rate of return, is that the region would not change were it not for the project. This approach is typical of the before and after test and is found wanting. Instead a realistic approach is to introduce a "with and without" test into the analysis. The basic economic efficiency criterion requires that the observed values of relevant output variables be compared with the values that would have existed if the project had not been undertaken. Exactly how to incorporate a "with and without" test into an internal rate of return analysis poses some very difficult problems of

measurement. For analytical expediency, two simplifying assumptions are made to account for uncertainty.

1. The "green revolution" begun in 1967 will continue on its own momentum through 1976, with more and more farmers using high yield varieties of wheat and larger quantities of fertilizer. In 1976 it is assumed that 80 per cent of the farmers would be using the new inputs and the spread effect would have reached its saturation point (a phenomenon witnessed in most countries which introduced the new high yield varieties and fertilizers). After 1976 it is assumed that because of the water constraint at that time, the region would remain at the 1976 production level.

2. Another possibility is that regional production value will grow at the national average of 1.5 per cent per year; or at a slightly higher rate of 2 per cent. The latter rate approximates more closely the rate of population growth and is a necessary growth rate if the region is not to experience out-migration and wheat deficits.<sup>21</sup> These two assumptions imply that the region is not farming at the limits of its intensive margin even with the water constraint. To date the contention that Afghanistan in general and the Helmand-Arghandab Valley in particular are not suffering from a high population/irrigated land ratio has not been disproved.

#### Summary of Methodology

By altering factor inputs and outputs to account for risk and uncertainty, the internal rate of return for any project will change. A project's internal rate of return which accounts for factor uncertainty will reflect the number of factors changed: the direction of factor

change and the size (percentage or absolute) of change in each factor. The original internal rate of return equation for an analysis of the Helmand-Arghandab Valley Project expands to account for uncertainty into

$$IRR = f(I_i : L_j : \Delta NPV_b : \overline{NPV}_{\bar{w}})$$

- where I = investment schedule
- i = 1 original estimate; 1.15 investment contingency;  
1.30 investment contingency
- L = project life
- j = project terminates in 2003; project terminates in  
1993
- $\Delta NPV$  = change in net farm production value as a result  
of project investment
- b = original (o); adjusted (a)
- $\overline{NPV}$  = change in net farm production without project  
investment
- $\bar{w}$  =  $\bar{w}_0$ , zero change;  $\bar{w}_s$  spread effect;  $\bar{w}_{.015}$ ;  $\bar{w}_{.02}$

Aside from the original internal rate of return of 12.44 per cent, there are 47 possible permutations of uncertainty adjusted factors which yield 47 different internal rates of return. Table 9 gives the 48 permutations in a format usually referred to as a sensitivity analysis.

Table 9 clearly shows the ramifications of introducing uncertainty into an internal rate of return analysis. Specifically,

- (1) Depending upon how many factor adjustments are made to account for uncertainty, the internal rate of return can drop to anywhere from 10.40 per cent to less than zero. By introducing only a single uncertainty



TABLE 9  
 HELMAND-ARGHANDAB VALLEY PROJECT:  
 INTERNAL RATE OF RETURN SENSITIVITY ANALYSIS

L	Uncertainty Factor Adjustments	b <sub>o</sub>			b <sub>a</sub>		
		W <sub>0</sub>	W <sub>s</sub>	W <sub>.015</sub>	W <sub>0</sub>	W <sub>s</sub>	W <sub>.015</sub>
L <sub>2003</sub>	I <sub>1</sub>	12.44	8.52	7.52	7.00	2.74	0*
	I <sub>1.15</sub>	10.41	6.87	5.84	5.38	0*	0*
	I <sub>1.3</sub>	8.27	4.20	3.41	3.01	0*	0*
L <sub>1993</sub>	I <sub>1</sub>	9.24	4.15	2.96	1.88	0*	0*
	I <sub>1.15</sub>	6.65	1.92	0*	0*	0*	0*
	I <sub>1.3</sub>	2.41	0*	0*	0*	0*	0*

NOTES: L = Project life  
 I = Investment costs  
 W = Net production value without project

\* Equal to or less than zero.  
 b = Net production value as a result of project investment.

factor adjustment the upper limit is 10.41 per cent, yielded if only an investment contingency of 15 per cent is introduced; while the lower limit is 5.38 per cent, yielded only if it is assumed the region without the project would still grow at a compounded rate of two per cent (resulting from population growth and increasing production at the intensive margin to feed larger families on more fragmented and smaller farms) instead of remaining constant. By introducing dual uncertainty factor adjustments, the highest possible internal rate of return is equal to 6.87 per cent and results when investment (increased by a contingency allowance of 15 per cent) is combined with an assumption that the region will, without project investment, continue to increase production for a few years as the "green revolution" continues its spread effect and then levels off and remains constant at a higher level. Many of the other internal rates of return which have accounted for two uncertainty factor adjustments are just marginally above, or well below, zero; while no internal rate of return is greater than zero if three or more uncertainty factor adjustments are made.

(2) It is interesting to note that the least sensitive uncertainty factor adjustment is for investment cost contingency. This is particularly clear when comparing any single uncertainty factor adjustment (observe column 1). Adding a contingency of 30 per cent to investment costs only drops the internal rate of return to 8.27 per cent.

(3) The second least sensitive assumption is the length of project life. Although considerably more sensitive than the contingency allowance, it still results in a positive rate of return if the region is assumed not to grow substantially without the project and the original

net benefit schedule is used (see southwest quadrant of Table 9).

(4) The two most sensitive assumptions are the rate of growth of the region with and without project investments. By merely substituting one uncertainty factor, adjustment (b), the internal rate of return drops to seven per cent; while by substituting  $\bar{w}_{.02}$  for  $\bar{w}_0$  it drops to 5.38 per cent. Combining assumptions  $b_a$  and  $\bar{w}$  into a dual uncertainty factor adjustment yields the highest incidence of a negative rate of return. (See frontier line in Table 9 between a positive and a zero internal rate of return).

#### Summary of Results

Clearly from the above sensitivity analysis, the uncertainty adjustments of factors have a very marked effect upon the internal rate of return of the project. It would appear from the predominance of low or negative rates that the project as designed should not be attempted. But such a policy directive, based solely on the analysis just presented, would not be sufficient.

In a definitive study of several development projects,<sup>23</sup> Hirschman contends that by the principle of the "Hiding Hand", these uncertainties and the concomitant low rate of return should not be instrumental in rejecting a project in a Third World environment. Explicitly,

Since we necessarily underestimate our creativity, it is desirable that we underestimate to a roughly similar extent the difficulties of the tasks we face so as to be tricked by these two off-setting underestimates into undertaking tasks that we can, but otherwise would not dare tackle.<sup>24</sup>

The "Hiding Hand" is essentially a "mechanism that makes the risk

averter take risks and in the process turns him into less of a risk averter".<sup>25</sup> Therefore, the contribution any project makes to development depends not only on the discounted economic return as it has been defined in the preceding analysis, but also upon important side effects and upon the time frame of returns.<sup>26</sup> Specifically, a project that goes through considerable problem solving and the learning experience associated with these problem resolutions, deserves a higher ranking than one with a similar return but with no such learning experience.

As development proceeds, Hirschman argues, recourse to the "Hiding Hand" becomes less necessary. The "Hiding Hand" is a transition mechanism which is discarded as problems are successfully tackled and project difficulties and uncertainties are faced more willingly.

To assess the direction of factor uncertainty it is essential to clearly identify those constraints to increased agricultural production, decreased investment costs, construction time, and effective life which will affect a given project.

Upon inspection, each project turns out to represent a unique constellation of experiences and consequences, of direct and indirect effects. This uniqueness in turn results from the varied interplay between the structural characteristics of projects, on the one hand, and the social and political environment, on the other.<sup>27</sup>

The Helmand-Arghandab Valley development is essentially a capital intensive irrigation project in a Third World country grafted upon a traditional agricultural sector. Although it would be inappropriate to apply a western derived production function to the project as more water is added to a water deficit area, the degree to which the new production function approaches a production function for a western model, (e.g. the

Imperial Valley project in California) can only be assessed with more information and understanding of the traditional agricultural relationships in the area. An analysis of these relationships is attempted in Chapter 5. By detailing the structural characteristics of the project, the problems of large-scale irrigation development in Afghanistan are specified. Similarly, a qualitative and quantitative ex post evaluation of the first twenty-five years of the Helmand-Arghandab Valley Project provides the background for the ex ante feasibility study of the next phase of development with more exact guidelines concerning the probable direction of the uncertainty factor adjustments.

In the area of water resource development both in the western and Third World economies, ex ante planning has reached an advanced stage; but at the same time, efforts to revise and improve evaluation procedures in the water resource area have been unbalanced. Not only has the literature been replete with controversies centered on the selection of appropriate discount rates and shadow prices (discussed in Chapter 2), but recent attention has largely neglected the need to improve the evaluation of primary benefits, and financial resources have been concentrated on revealing non-efficiency impacts such as income distribution, regional growth, demographic patterns, and secondary income effects in the basic evaluation model.

Surely, knowledge of these non-efficiency effects is relevant to project appraisal and choice and information on them should be developed and presented to decision-makers. However, given the serious short falls in the performance of ex ante benefit and cost estimation -- an area where production functions are fairly well understood -- the first order of business would seem to be

improvement of these estimates before more esoteric impacts generated by linkages that are little understood are pushed full-blown into the basic ex ante evaluation model.<sup>28</sup>

If benefit-cost analyses are to retain much credibility as effective aids in decision-making, what is not needed, is more complex procedures for building ex ante estimates from elusive and complex non-efficiency effects. Instead, what is needed, is a development of the criteria for ex post evaluation as well as an exploration of approaches for measuring economic results of completed or partially completed projects. The development of consistent techniques for evaluating the effectiveness of public investment, on an ex post basis, should be a high priority for development economists as well as other scientists concerned with public policy. It is not unreasonable to assume that unless project planners are better informed of the results of ongoing and completed projects, performance will not improve.

In many cases... our prior knowledge of production functions is quite limited. Uncertainty of this type puts a great premium on careful post-program evaluation. Feedback of operating results to program planning is essential.<sup>29</sup>

We must remember that benefit-cost analysis is only an approach or a technique. It provides a rational framework for project choice using national objectives and values. The Helmand-Arghandab Valley Project is judged by use of an internal rate of return measuring its impact upon the economy. The impact in this analysis is evaluated simply as the increase in net farm production value as a result of project investment. Parameters are not introduced to directly reflect other national goals, social objectives and global facts. The internal rate

of return is intended solely to confront policy makers with the consequences of their choices; i.e., choosing a project based solely on the efficiency criterion of increased farm production value.

Is this a sufficient condition upon which to base a policy decision? Is there a complex of non-efficiency criteria that must be taken into account and do these non-efficiency criteria (redistribution of income between income groups and regions; increased savings; favourable balance of payments and greater self-reliance; increased rural employment and decreased urban migration; increased farm settlement; and augmented government revenues) when incorporated into the analysis, then justify such a low rate of return based solely on the efficiency criterion of increased farm income?

Arthur Maass has questioned the idea

that the professional planners should design projects and programs for economic efficiency, for which benefit-cost analysis can provide the necessary ranking function; and that thereafter these project designs can be doctored and modified by a political process to account for any 'uneconomic' objectives.<sup>30</sup>

Maas objects to this practice for the excellent reason that:

where government programs are intended for complex objectives they should be designed, where this is possible, for such objectives, not designed for one objective, which may not be the most important, and subsequently modified to take account of others.<sup>31</sup>

But such an expanded objective function opens a whole Pandora's box of problems. The parameters of the production function implicit in the economic efficiency model are relatively well known. While there are still some unsettled conceptual and empirical issues, there is wide agreement on the definitions and measurement of inputs and outputs of

benefits and costs within the efficiency model. The same cannot be claimed for other non-efficiency models: for example, models with multi-dimensional functions, including income redistribution, regional development, or measures of social well-being. In the case of a country like Afghanistan, the weakness of the data base alone mitigates strongly against an expanded objective function.

In the analysis that follows, an alternative method of combining the narrowly defined objective function of the feasibility analysis and the broader economic and non-economic conditions will be attempted. The Helmand-Arghandab Valley Project, a capital intensive irrigation and land development project, must be looked at as it fits into a global development scheme of Afghanistan.

No project, no matter how small, is implemented in a social, political, or economic vacuum. The Helmand-Arghandab Valley Project proposed in 1971-1972 is part of a national development plan, the 4th Five Year Plan. This irrigation project will affect many national development parameters, and its effectiveness will similarly be affected by developments in other sectors and projects. To understand how the project might contribute to the satisfaction of non-efficiency goals of the national economy, a wider perspective is needed; something more than just a scheduling of various inputs and outputs. What is needed is a study of the recent development past of the country. In particular, an in-depth study of the role of previous capital intensive irrigation projects in the development scheme would help to set realistic limits to the possible contribution of a similar future investment scheme. An appraisal of past development experiences could anchor such a new project



proposal so project evaluation under uncertainty would expand in its application. No more would it be merely a matter of setting probability limits to technological inputs and outputs. An appreciation, in qualitative as well as quantitative terms, could be attempted of how realistic the project plan is as outlined, given national, political, social and economic constraints.

Chapters 7 and 8 deal with this question in depth. By putting the project in the context of the national economy it becomes clear that not only will the project contribute marginally to the non-efficiency considerations, but that those factors not included within the narrowly defined objective function will most probably inhibit effective project implementation.

References to Chapter 4

1. Frank H. Knight, Risk, Uncertainty and Profit (London: London School of Economics, 1948; reissue, New York: A. M. Kelley, 1964).
2. Ibid., pp. 225 and 230.
3. For a more complete discussion see A. Maass et al., Design of Water Resource Systems: New Techniques for Relating Economic Objectives, Engineering Analysis and Government Planning (Cambridge: Harvard University Press, 1962).
4. Nicholas Georgescu-Roegen, "The Nature of Expectations and Uncertainty," in Expectations, Uncertainty and Business Behavior, ed. M. Bowman (New York: Social Science Research Council, 1958), p. 25.
5. See R. H. Haveman, Water Resource Investment and the Public Interest (Nashville: Vanderbilt University Press, 1965), Appendix B.
6. J. Hirshleifer, J. C. DeHaven, and J. W. Milliman, Water Supply, Economics, Technology and Policy (Chicago: University of Chicago Press, 1969), p. 140. An aspect of risk not covered by the writer is the controversy that evolves about "risk aversion." The question asked is whether risk compensation sought by individuals in the form of a "risk premium" yield, over and above the riskless rate of interest, represents a social as well as a private cost. See J. Hirshleifer and D. L. Shapiro, "The Treatment of Risk and Uncertainty," in Public Expenditure and Policy Analysis, ed. R.H. Haveman and J. Margolis (Chicago: Markham, 1970), pp. 291-313.
7. Georgescu-Roegen, op.cit., p. 27.
8. Ibid.
9. See P. A. Samuelson, "Principles of Efficiency: Discussion," American Economic Review 54 (May 1964): 96. Whereas most would account for expected value adjustments by substitution of benefit and cost estimates, some would prefer to make adjustment via the discount rate: see J. S. Bain, R. E. Caves, and J. Margolis, Northern California's Water Industry (Baltimore: Johns Hopkins University Press, 1966), p. 272.
10. Friedrich A. Lutz and Vera Lutz, The Theory of Investment of the Firm, quoted in Haveman, Water Resource Investment, op. cit.
11. Haveman, Water Resource Investment, op.cit., p. 172.

12. McKean, op.cit., p. 64.
13. Robert H. Haveman, The Economic Performance of Public Investments: An Ex Post Evaluation of Water Resources Investments. (Baltimore: Johns Hopkins University Press, 1972).
14. Ibid., p. 159; see also Robert Dorfman as quoted in Maass et al., op.cit., p. 104.
15. O. Eckstein, Water Resource Development: The Economics of Project Evaluation (Cambridge: Harvard University Press, 1958), pp. 58 and 85. He attempted to measure the importance of time related uncertainty involved in the concept of costs, and determined it by using the ratio of annual deferred costs to immediate costs with an effective range of .01 to .1.
16. In Knight's terminology, benefits are more uncertain, and less predictable and insurable than are costs; in Georgescu-Roegen's terminology, predictions of benefits rank lower in the subjective hierarchy of credibility, as judged by all three criteria, than similar predictions concerning project costs. Haveman, Water Resource Investment, op.cit., p. 65.
17. A. Otten and S. Reutlinger, Performance Evaluation of Eight Ongoing Irrigation Projects, International Development Association Economics Working Paper No. 40 (Washington, D.C.: International Bank for Reconstruction and Development, 28 March 1969).
18. Ibid., p. 1.
19. See Shlomo Reutlinger, Techniques for Project Appraisal Under Uncertainty, Staff Occasional Paper No. 10 (Baltimore: Johns Hopkins University Press, for the International Bank for Reconstruction and Development, 1970); and Potential Opportunities for Profitable Land Utilization for Centennial Park (Columbus, Ohio: Battelle Columbus Laboratories, 1972).
20. Projecting a large increase in cropland utilization and substitution of orchards for field crops, entails another degree of uncertainty. Essentially, there exists an upper limit to concurrent growth streams of these two variables because in the limit they are mutually exclusive, i.e., if all land were in orchard there would be ipso facto no double-cropping of field crops, and vice versa.
21. The possibility of  $\overline{NPV}$  being negative is dismissed because, even without project investment, the present infrastructure will be retained by ordinary government budgetary expenditures not counted in the project investment schedules.

22. Calculations for the internal rate of return sensitivity analysis are described on p. 82, note 12, and in the Appendix.
23. Hirschman, op. cit.
24. Ibid., p. 13.
25. Ibid., p. 26.
26. "The rate of return (or, if that is preferred, the present value of the project) results itself from a heroic compression of all the financial data--prospective costs and benefits--into a single figure, and as always with such statistical expressions, some valuable and important aspects of reality are lost in the process. Take, for example, two projects with the same rate, but where one experiences slowly increasing benefits while the other shows at first high returns which then drop off rapidly in the later years. While rate of return calculations imply uniform reinvestment behavior (all returns are presumed to be reinvested at the same internal rate of return), different time shapes of profits are in fact likely to have an important differential influence on reinvestment behavior and on other policies of the project managers, such as expenditures for research and development, for training, etc. This is not an argument against computing the rate of return, but for looking at the time shape of returns as a source of important indirect effects that need to be recorded alongside the rate of return." (Ibid., p. 179.)
27. Ibid., p. 186.
28. Haveman, Economic Performance, op.cit., p. 110.
29. Charles Schultze, The Politics and Economics of Public Spending (Washington, D.C.: Brookings Institution, 1968), p. 3.
30. Arthur Maass, "Benefit-Cost Analysis: Its Relevance to Public Investment Decisions," Quarterly Journal of Economics 80 (May 1966): 214. According to Maass, the planners should spell out the possible trade-offs between the efficiency and other objectives; he cites some examples from United States programs in highways and housing to show that some necessary choices can be made rationally through political processes.
31. Ibid.

## CHAPTER 5

### THE HELMAND-ARGHANDAB VALLEY PROJECT - A HISTORY AND EX POST EVALUATION

#### Introduction

Past glories in the valley of the Helmand and Arghandab rivers have, for centuries, held the imagination of the Afghan people. In the twentieth century, modern irrigation technology has riveted national attention on the ancient dream of a rich and powerful river region, able to provide food for all of central Asia.

This was the dream that, after World War II, led the Royal Government of Afghanistan (RGA) to begin importing men and material to construct a modern irrigation network.

What follows is a detailed history of the Helmand-Arghandab Valley Project 1946-1971. The narrative offers insight into the technical, social and political complexities of large-scale irrigation development in a Third World country. The ex post evaluation that follows will provide a rough approximation of the loss of social benefits as a result of misallocated investment; more importantly, it will attempt to identify the critical constraints to augmented farm production as a result of an increased water supply to the traditional agriculture of an arid country.

#### The Physical Geography

The Helmand-Arghandab river system covers the largest watershed area in Afghanistan (see Figure 2). The watershed, originating in the Hindu Kush



mountain range 40 kilometers west of Kabul, is estimated to cover 361,305 square kilometers or about 40 per cent of the country's total run-off. Most of the river system's stream flow accumulates in the headwater areas, either from rainfall at the intermediate elevations in the winter and spring, or from melting snow at the higher elevations during late spring and early summer. The lower sections of the basin are desert areas with little or no water flow, except for flash floods which result from intense but usually localized rain storms.

Precipitation in the central section of the basin, at or near Lashkar Gah, averages 135 millimeters with a minimum recorded precipitation of 94.8 millimeters and a maximum of 195 millimeters. Precipitation near Kandahar, the principal city of the Valley, is slightly higher at 180-200 millimeters annually. Almost all of the rain occurs from November to April. This fall and spring rain supplies a marginal part of the moisture required for spring crop production, while all the water supply for summer and fall crops must come from irrigation.

The Helmand River is the largest river in Afghanistan. Although its water flow varies from season to season and year to year, it is one of the few perennial rivers in Afghanistan accounting for five-sixths of the system's total water flow (see Figure 1, p.51). From its source in the Pagman range, it flows in a south-westwardly direction for 536 kilometers into the desert plain where it joins the Arghandab River below the city of Lashkar Gah. The Arghandab River, the other major stream of the system, originates 250 kilometers northeast of its junction with the Helmand River in the mountains south of Ghazni. From the point where

the Helmand and Arghandab Rivers join, the river continues its south-westerly course never to reach exterior drainage but to be absorbed in the marshes and sinks of the Chakhansur basin.

The general climate in the Helmand Valley region is hot and very arid, particularly at the lower elevations. Summers are hot and very dry, especially during June, July and August. In the lower section of the basin temperatures of about 52° centigrade have been reported. The winters are mild with average temperatures above freezing. However, minimum temperatures reach levels that make citrus and other subtropical crop production impractical.

The physical potential exists for agricultural production, and the area is in many respects ideal for irrigated farming. A regular flow of water suitable for irrigation is available from March to June; the slope of the land and the lay of the river terraces lend themselves ideally to land leveling and irrigation; the growing season is ten months long; and since the area is high, dry and far inland, water vapor in the atmosphere is low. Consequently, the daily period of ideal light intensity and climate for maximum plant growth is nearly twice as long as is found in other parts of Afghanistan. Whereas the physical environment is conducive to enormous production potential some adverse conditions exist, i.e., high water tables in some areas, a generally poor soil structure, poor soil aeration, high winds, and in large areas poor drainage of clay soils.<sup>1</sup> These conditions all play an important role in defining the production limits of the area.

#### Pre-Project History

Archaeological research to date has touched only a fraction of



the area.<sup>2</sup> Extensive ruins cover stretches of the vast lower watershed, called the Chakhansur-Seistan basin, suggesting the existence of a prosperous and extensive agricultural society.

There is also evidence that many parts of the Helmand-Arghandab Valley were extensively cultivated centuries ago, but with the exception of the area around Kandahar, much of the area in the Valley remained sparsely populated with a few farms scattered along the river valleys.

Many theories are given to explain the disappearance of this vast civilization but most historians agree that successive hordes of invaders from the north and the west destroyed the large cities and major irrigation canals. It is widely believed that the depredation first by Genghis Khan followed by Tamerlane resulted in such a loss of life and out-migration of the population from the area that the remaining inhabitants were unable to mobilize the manpower required to keep the irrigation system in operation. Other historians add that excessive forest utilization for fuel and brick firing resulted in the deterioration of the top soil. This, combined with a possible long period of drought, summarily wiped out the population or forced migration.

Whatever the reason, what was once supposedly the "bread basket" of Central Asia was by the 20th century a vast, barren or sparsely vegetated land affected to varying degrees by salts, alkaline, groundwater and erosion.

Work on restoring and rehabilitating the Helmand-Arghandab Valley prior to the 20th century, although certainly attempted, is nowhere recorded. It is with the dawn of the 20th century that the earliest

attempts at restoring the irrigation systems is recorded.<sup>3</sup> Between 1910 and 1914, the Afghans began to develop parts of an old canal system in the Helmand Valley around the Seraj. During this period, Governor Osman of Kandahar, inspired perhaps by the tales of the ancient "Sughra Canal" in the Seraj, began a canal just below the mouth of Musa Kala. The canal extended southwards and eventually some of its branches reached the Arghandab above Qala Bist (See Figure 3).

In the 1930's the Germans and later the Japanese, under contract with the Royal Government of Afghanistan, gave technical assistance and actually helped in the construction of new canals. In 1930 German engineers repaired the Seraj canal and installed a siphon near the intake. Mohammad Zahir Shah, the former King, had three jetties built in 1941 to protect the Seraj intake. Late in the 1930's an attempt was made to extend the canal development. The Royal Government of Afghanistan called in a team of Japanese engineers to improve the old Deh Adam Khan canal<sup>4</sup> which had been functioning for some 200 years. The canal began above Girishk and irrigated the lands on the eastern bank of the Helmand as far as the water could reach. The Japanese planned to enlarge the canal and change its alignment in order to increase the area which it could irrigate. World War II interrupted this programme after only some 15 kilometers of new canal had been dug by hand.

In 1942, a joint British-Russian ultimatum forced the Japanese and the Germans, along with other Axis personnel, to cease work and leave the country. After their departure the Afghans continued the work under the direction of Mr. S.W. Shah (a Cornell-trained engineer) who completed 25.7 kilometers by 1946. Mr. Shah not only continued the work,

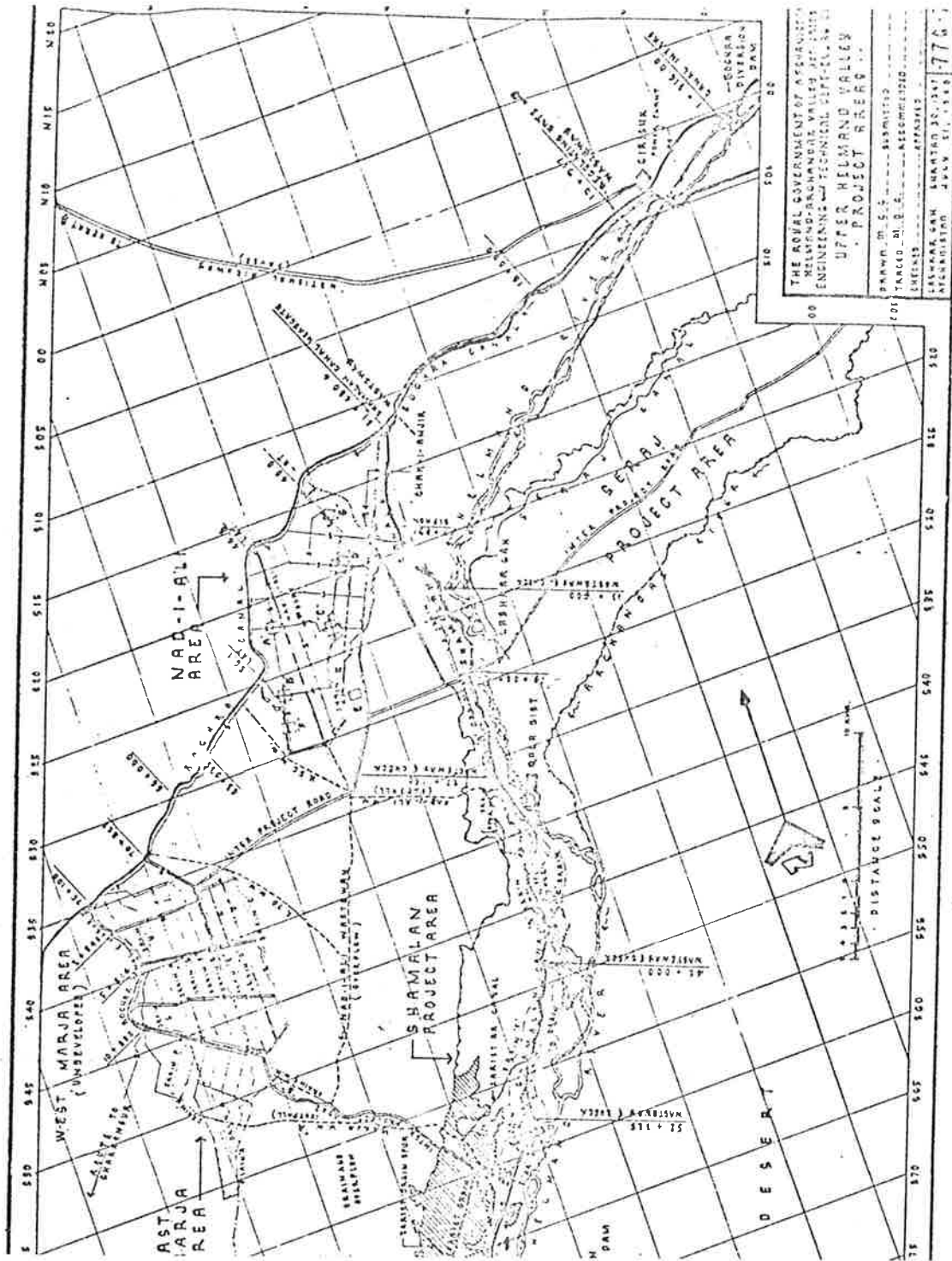


Fig. 3. Upper Helmand Valley: Irrigation Project Areas

but changed the plans. He relocated the proposed intake structure to its present position above Girishk and rerouted the canal onto higher land, preferring to cut and blast through the hard conglomerate of the terrace rather than to fill the flood plain as the Japanese had done. The problems which arose from having to fill in soils containing highly permeable gypsum phases not only changed the course of the canal but initiated the need for heavy equipment unavailable in Afghanistan.

By 1946 the scope of the proposed irrigation works had also enlarged substantially. The Royal Government of Afghanistan intended not only to irrigate the flood plain below Girishk but the Nad-i-Ali and Marja tracts on the terraces or benches to the southwest. This involved enlarging, partially rerouting and bifurcating what is now called the Boghra canal, running separate branches to the flood plain and terrace areas. This plan also necessitated the construction of a much larger diversion dam intake along with many reinforced concrete outlets and drop structures. All this work would require the use of modern equipment and engineering techniques far beyond what the Afghans themselves could supply.

As ambitious as the proposed irrigation scheme seemed, it was but one of many the Royal Government of Afghanistan felt confident that it could implement and complete using its own resources. By the end of the Second World War, the Royal Government of Afghanistan had accumulated substantial reserves of hard currency by selling foodstuffs to the Allied armies in India and karakul on the London and New York fur markets. This hard currency reserve made the Afghans feel confident that they could not only finance several large infrastructural investments, but could effect

a development takeoff independently. All that was lacking was the technical expertise and the equipment. The defeat of Germany and Japan ruled out approaches to either nation which had hitherto provided most of Afghanistan's engineering services. Of the victorious allies both Russia and Britain had long been considered foes of Afghanistan. The Americans appeared sufficiently remote, disinterested and well equipped to meet the need, so the Royal Government of Afghanistan turned to the Idaho firm of Morrison-Knudsen to make proposals for the construction of major roads, electrification and irrigation projects throughout the country, including the Helmand-Arghandab Valley.

The Morrison-Knudsen engineers arrived in 1946, and carried out many surveys in Kabul and in various parts of the country. Most cost estimates for electrification and road construction were considered high by the Royal Government of Afghanistan and were either postponed or awarded to other contract teams.<sup>5</sup> Only in the Helmand-Arghandab Valley were the cost estimates considered reasonable, and consequently a contract was signed and work begun on the Helmand-Arghandab Valley Project.

Phase One of the Project (1946-1949).

In 1946 the Morrison-Knudsen Company, confident of major construction contracts in the Helmand-Arghandab Valley with the Royal Government of Afghanistan, established an affiliate, Morrison-Knudsen Afghanistan in San Francisco to handle its work in Afghanistan. The Royal Government of Afghanistan turned over to this affiliate the old palace of Manzel Bagh, east of Kandahar, for use as a base camp and administrative headquarters. The first contract between the Royal

Government of Afghanistan and Morrison-Knudsen Afghanistan in 1946 was for major transportation and canal system works exclusively in the Helmand-Arghandab Valley.

In order to facilitate the movement of heavy equipment arriving from the United States via Pakistan, the American engineering firm aligned, widened and reconstructed with loose gravel the Chaman to Kandahar road prior to work on canal irrigation. They also improved the Kandahar-Girishk road to render it suitable for rapid movement of men, material and equipment to the forward operations camp which they established on the eastern bank of the Helmand a few miles above Girishk. They deemed these constructions necessary preconditions to efficient irrigation construction.

The first contract work in the Helmand-Arghandab Valley was to build two diversion dams and enlarge and extend the Boghra canal so as to provide water both for the Nad-i-Ali and Marja terrace tracts and the Helmand flood plain (henceforth called Shamalan area, designating all the flood plain watered by the Boghra canal). By 1948 construction of the diversion dams and the first 30 kilometers of the Boghra canal were well underway.

From the outset, the project was plagued by basic cross-cultural misunderstandings and technical miscalculations. Neither the Afghans nor the Americans initially anticipated the problems which would develop in having to ship all the necessary equipment halfway around the world, and then move it by rail and road through Pakistan. The closure of the Afghan-Pakistan border because of the unsolved "Pushtunistan" problem

brought construction to a virtual standstill several times.

Major human problems were ignored by both sides: who, for example, would settle the reclaimed land, and how would those old villagers living in the areas to be affected be informed of the project in order to prepare themselves for the additional amounts of water which would flood the landscape; who would control water distribution; how would the water be distributed; who would pay for the water? Afghans accused Americans of cheating (Americans accused Afghans) and what little good will that had existed at the beginning began to disappear.<sup>6</sup>

It was at this point that the project was to take a dramatic shift -

By the fall of 1948, the Government had mixed feelings about further Helmand development. . . the diversion of water to the tablelands during the low-water season would take water away from bottom lands downstream unless an upsteam reservoir stored flood water. While prestige considerations suggested completion of the limited Boghra project, economic wisdom seemed to advise an enlargement of its scope before continuation. The growing shortage of exchange (FX) forced a decision.

Morrison-Knudsen Afghanistan advocated an integrated valley development, including a major reservoir dam upstream at Kajakai; and completed field surveys for the dam by September 1948. For a comprehensive project Morrison-Knudsen was reluctant to count on more than 400,000 acres for irrigation and settlement until a thorough survey of the entire Valley had been made. But the Afghans saw no need for such a survey. Morrison-Knudsen and "the mission" (Afghan economic mission to Washington) concluded that even an 80 per cent margin of error in estimating the acreage or water supply could not detract from the project's intrinsic value.

A comprehensive project, based on intelligent guesses by Morrison-Knudsen and "the mission" was estimated to cost \$63.7 million, with \$53.7 million of it in foreign exchange.<sup>7</sup>

While this proposal was being considered, work on the Boghra canal continued. With all the misgivings, it is uncertain to what extent loss of face by both the Royal Government of Afghanistan and Morrison-Knudsen was critical in not calling to a halt the half-completed Boghra works, especially in view of the soil and drainage problems which were

becoming manifestly apparent. Nor is it certain to what extent financial considerations forced the firm to continue work on the Boghra.

Delaying work might have meant operating at a level that was uneconomical for Morrison-Knudsen Afghanistan and thus ultimately for the Royal Government of Afghanistan, given the facilities, equipment, material and manpower that had already been brought into the Valley. It appeared that a level of spending of \$4 million per year was necessary to keep Morrison-Knudsen operating at a break-even point.<sup>8</sup>

As of September 1, 1949, the Afghans had paid Morrison-Knudsen Afghanistan \$11.1 million for machinery from the United States and Pakistan and \$8.9 million for services and purchases in Afghanistan (inclusive of \$1.3 million contractor's fees). About \$4.8 million of this was the value of locally purchased machinery, equipment, and costs of construction of camps and shops.

By the end of the first Royal Government of Afghanistan-Morrison-Knudsen contract 57 kilometers of the canal had been dug and the concrete siphons passing under streams or washes were completed. But it was becoming painfully clear that the major construction work that was being proposed by Morrison-Knudsen to accomplish the Royal Government of Afghanistan's objectives for the next phase could no longer be financed by domestic funds alone.

At the national level Afghans at this point were experiencing foreign exchange shortages, rising costs, and growing criticisms of expenditures on the Morrison-Knudsen projects. The Government, still convinced of the viability of the scheme, submitted a request to the Export-Import Bank for a loan of \$55 million to finance various capital projects planned throughout the country. The Bank position was that it



would give priority to agriculture schemes so as to help eliminate the reported food shortages in Afghanistan. In November 1949 the Bank approved a \$21 million loan to cover only the major investment proposals of the Helmand-Arghandab project, but critical groundwater and soil surveys proposed both by Morrison-Knudsen Afghanistan and the Royal Government of Afghanistan were deleted from the loan.

Phase Two of the Project (1949-1953)

The first efforts of Morrison-Knudsen Afghanistan in its second contract were to tackle technical problems arising from earlier canal work. Leakages from the Boghra canal and its laterals combined with poor irrigation practices in the newly developed areas soon brought the water table in the Nad-i-Ali area up from a depth of 5.3 meters to within 10 centimeters of the surface. Although no groundwater survey had been made, the increasing surface salt accumulations afforded visual evidence of the poor drainage characteristics of the tract and particularly, evidence of the seriousness of the problems of impermeable substrata which had previously been underestimated. Lining canals and laterals, installing drains, and particularly training settlers in better water usage practices had now become critically important.

Aside from canal construction and rehabilitation, a major portion of the financial commitment of the first Export-Import Bank Loan was expended on the construction of two major storage facilities (the first step toward an integrated regional approach):

1. The Arghandab Reservoir, a combination storage and power dam, situated 45 kilometers north of Kandahar, was begun in June 1950 and

completed by January 1952 at a total cost of \$7,049,114,<sup>9</sup> with an estimated saving of \$2.5 million over the original contract estimate. Storage capacity is given at 481 million cubic meters - 390,000 acre feet; gross irrigable area under command of the reservoir 191,058 hectares or 475,000 acres.

2. The Kajakai Reservoir, situated 90 kilometers north of Lashkar Gah, required major road construction from Girishk. The reservoir was begun in May 1950 and completed by June 1952 at a total cost of \$13,431,164. Storage capacity is given at 1.8 billion cubic meters or 1,495,000 acre feet. Gross irrigable area under command of this reservoir is stated as 325,000 hectares or 500,000 acres.

During the period of the first Export-Import Bank Loan, the division of tasks between the Royal Government of Afghanistan and Morrison-Knudsen Afghanistan began to go askew. Morrison-Knudsen's task, from the first, had been to construct dams and intakes, main canals, waterways, laterals and sublaterals.<sup>10</sup> From these constructions, the Royal Government of Afghanistan and the settlers were to construct feeders and farm ditches to bring water to land which had previously been demarcated, leveled and prepared for crops. But the Afghans fell so far behind with their part of the task that in 1951, they asked Morrison-Knudsen to assume the responsibility of completing the job for 6,500 hectares in the Nad-i-Ali tract.

Within a year, the contractor had completed drop structures and lateral outlets on the Boghra canal to the end of the Nad-i-Ali tract and had also completed the land preparation as requested by the Royal Government of Afghanistan. The Afghans, over the same period were to

begin moving settlers into three areas: Nad-i-Ali, Marja, and Shamalan.<sup>11</sup> But while 4,250 hectares of new land were under cultivation, only ten per cent was being worked by settlers. Large landowners were farming 57 per cent, the Royal Government of Afghanistan had incorporated 19 per cent into an experimental farm while Morrison-Knudsen Afghanistan was farming the remainder.

Delays in settlement were caused by bureaucratic procedures. The process by which a farmer could obtain land appeared simple on paper, but normal bureaucratic delays often expanded the application-acceptance time to months and even years. Settlers desiring land would apply to the Ministry of Interior or directly to the Prime Minister's office.<sup>12</sup> The Prime Minister would decide whether the applicants would go north (to parts of Qatangan Province and to other areas that were also being developed) or south to the Helmand Valley.

Meanwhile, 15,000 settler applications had piled up due to the lack of administrative machinery to process them. Finally, under pressure from the Export-Import Bank, the Royal Government of Afghanistan established an autonomous Helmand Valley Authority to process settler applications, determine plot sizes, and farm and village locations. The Authority was also designated to help the settlers construct their homes and prepare their land and to teach improved cropping and water use practices. This agency decided each family should receive 30 jirib (5.8 hectares of land)<sup>13</sup>, a ready-built house, agricultural implements (plows, shovels, hoes, etc.), one pair of oxen per two families, a grant of 2,000 afghanis and enough seed for the first year, valued at an additional 1,000 afghanis. All the above was considered a loan payable

without interest in 17 equal payments over a 20 year period, with a three year period of grace to permit the settlers to become adjusted. With the total debt of about 17,000 afghanis per family, annual payments would be about 1,000 afghanis. In addition, a new villager was exempt from military service for his first six years of residence in the Valley. The Government also constructed a central bazaar and mosque for the use of the seven villages, plus an administrative center. In spite of attempts by the Helmand Valley Authority to prevent absentee ownership, large landholders were in some instances able to pass off tenants as genuine applicants for land.

Originally about 1,300 families moved into the area, 90 per cent of whom were impoverished kochis (nomads), welcoming the opportunity to become independent landowners. But within a few years 300 kochi families had departed. Reasons given were that the land was of very poor quality and plagued by a high water table which, after plowing, resulted in salts quickly percolating to the surface. The kochis were not trained irrigation farmers, and bad farm practices on marginal lands only worsened the salt problem. The Government further aggravated the situation by forcing different tribal groups to share the villages.

By April 1953, the funds of the first Export-Import loan were nearly exhausted. After seven sporadically-interrupted years of work with the expenditure over 1.6 billion afghanis, the Royal Government of Afghanistan had storage dams on the Arghandab and Helmand Rivers, a diversion dam and two long feeder canals on the Helmand River and some 7,500 hectares of partially developed, sparsely settled land in the

Nad-i-Ali terrace area. It had become obvious that a system of deep drains would have to be incorporated into the Nad-i-Ali project and the East Marja tract, as well as further lining of the Boghra to prevent leakages into the Nad-i-Ali water table. The proposed West Marja project had been completely abandoned, saving \$844,000, but this in turn created technical complications. The Boghra canal had been designed to serve both the East and West Marja tracts. By not developing one part of the land area, the flow of water through the canal decreased in this case from 762 cubic meters/second to 488 cubic meters/second. This in turn increased the silting rate of the canal. Thus, in the case of the Boghra canal not only were investments misallocated on over-specifications of the canal construction, but additional expenditures would be required to operate and maintain the canal.

#### Phase Three of the Project (1953-1960)

Whereas 1948, with the decision to construct two storage reservoirs, marked the point where the project took a dramatic swing toward a regionally extensive, capital intensive project, 1953 was the date from which the project was inextricably labeled an American endeavour. In that year under the United States Point IV Assistance Program two agricultural extension advisers were sent to the Helmand-Arghandab Valley. From that point on, the fate of the Helmand Valley and the prestige of the American aid programme became, rightly or wrongly, tightly intertwined. Previously Morrison-Knudsen Afghanistan had maintained agronomists, hydrologists and soil technicians on its own staff. With the assignment of International Cooperation Administration agronomists,

hydrologists, extension supervisors, community development specialists, public health advisers and administrative specialists to assist the Helmand Valley Authority, the Afghans could hardly fail to interpret this as a tacit endorsement by the United States Government of the Royal Government of Afghanistan-Morrison-Knudsen contracts over and above that which had been implied by the Export-Import Bank Loan.

The project was nowhere near completion. An extension of the Morrison-Knudsen Afghanistan contract would be necessary. But with the first loan almost exhausted and with few tangible benefits to show for the amount of money invested, some document was needed to justify added commitment to the Valley. Consequently, an optimistic 87 page prospectus was prepared including economic justifications for continued investment with the projection of income from the Helmand and Arghandab areas to the year 2050. "The Helmand Valley Development Program"<sup>14</sup> projected enormous increases in the production of the area upon completion of the project, but substantive analysis was conspicuously lacking.

Armed with the report, a proposal for a second loan of \$38 million was submitted by the Royal Government of Afghanistan to the Export-Import Bank. The plan called for drainage systems in East Marja and the Shamalan, and land development of the East Marja tract. It similarly proposed to build a new intake structure on the Helmand, midway between Kajakai and Girishk, complete with canals, laterals and trunk drains to serve the Seraj area. The proposal also called for installation of generators on the Boghra drop structure near Girishk, and for the construction of a complete power plant at the Arghandab

dam. A diversion dam was to be built downstream on the Arghandab to serve canals extending on both sides of the stream. One of these proposed canals, the South Arghandab canal, was to extend as far as the Tarnak region south of Kandahar and between the Arghestan and Tarnak Rivers (See Figure 4). The plan further called for development of the Darweshan flood plain area downstream from the Shamalan and the opposite bank of the Helmand and of part of the Chakhansur Basin at the end of the river to utilize excess water stored in the Kajakai Reservoir. All these investments were deemed necessary to reap the potential benefits of increased irrigated land.<sup>15</sup> In July 1953, the Export-Import Bank granted a loan of \$18.5 million, roughly half the sum requested. The Bank specifically excluded Arghandab power, the right bank "North Arghandab Canal", Tarnak drainage and the entire Seraj and Chakhansur proposals.<sup>16</sup>

Between 1955 and 1958 work continued on improving the water delivery systems in the areas of first loan constructions. The Marja irrigation and drainage outlet systems, the drainage outlet system for part of the Shamalan area, and a portion of the drainage outlet system of the Nad-i-Ali area were completed. But work within the second Export-Import Bank loan also expanded to new areas. Construction was begun for the area below the Shamalan (the Darweshan area), wherein a diversion dam and drainage were installed. In the Arghandab River Valley, a diversion dam was constructed to divert water into the South Arghandab Canal. A new canal, which was to be almost 17 kilometers long upon completion, would bring water to feed five of the largest traditional canals in the central Arghandab area as well as to the new proposed

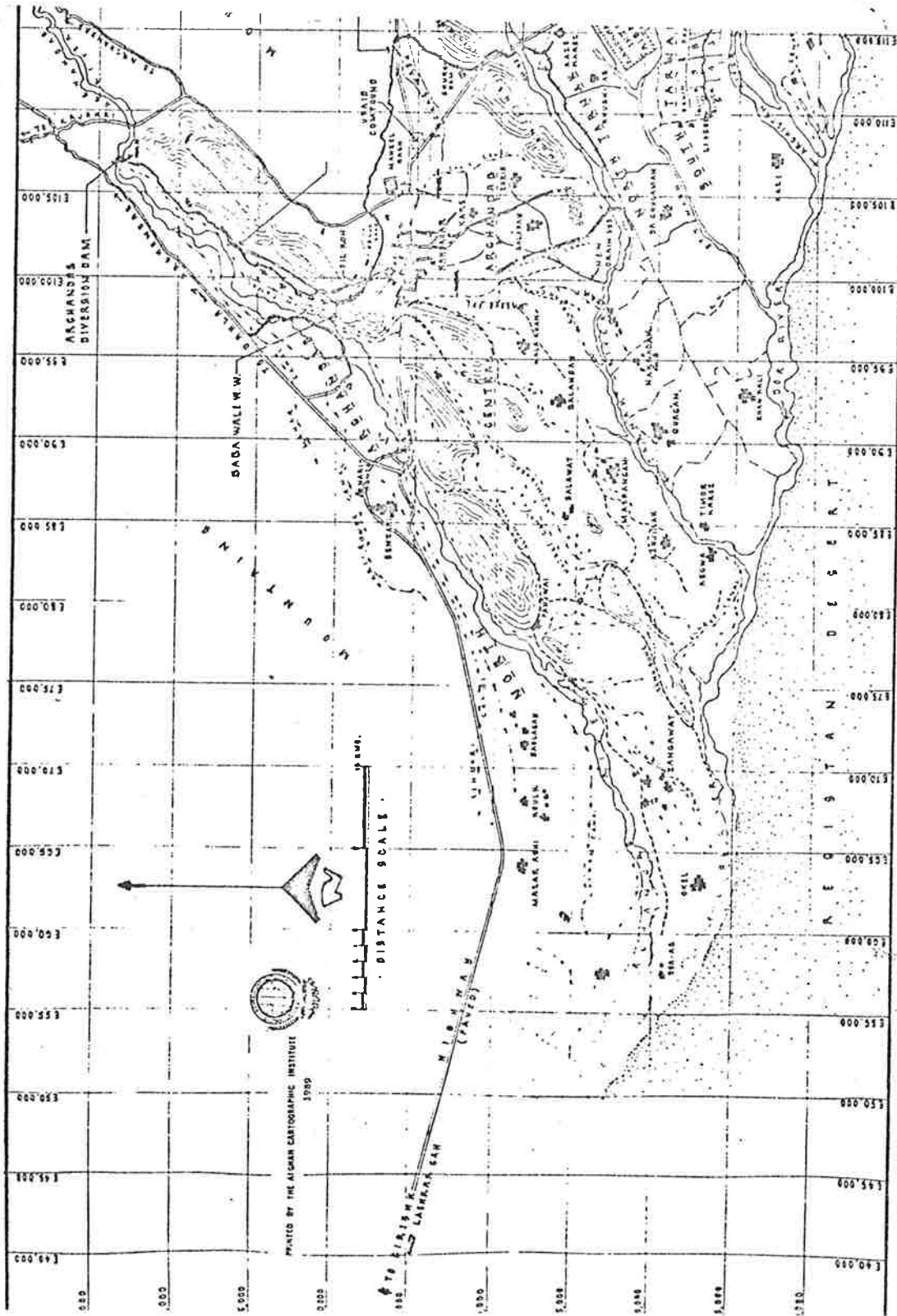


Fig. 4. Argh.



Tarnak canal. The Tarnak canal would transport water for 26 kilometers from the bifurcation to a point across the Tarnak River in the northeast corner of the Tarnak area (See Figure 4). During this period of the second loan the first unit of the north branch Tarnak irrigation canal was constructed.<sup>17</sup>

During the same period extensive project and interproject road construction was carried out; two of the three generating units of the Girishk hydroelectric power plant were installed and transmission lines to Girishk and Ghan-i-Angirs, Nad-i-Ali, Marja, and Lashkar Gah were completed as well.

The Afghan Construction Unit was instituted under the 1954 loan agreement to satisfy the Royal Government of Afghanistan's desire to create an Afghan organization that would eventually replace the American firm, Morrison-Knudsen Afghanistan. The new organization was planned as a construction unit wherein Afghans would be trained in the various fields of engineering construction, equipment maintenance and administration. The work planned for Afghan Construction during this period was primarily land development, the development of the government-owned lands and the tracts brought under new irrigation systems constructed by Morrison-Knudsen. The work consisted of clearing, leveling and the installation of sublaterals; and the farm irrigation and surface drainage systems in the Marja and Shamalan areas. The new unit was also given the responsibility for the operations maintenance of all canals and interproject roads.

By October 1957 the two Export-Import Bank loans had been exhausted with the projects only 68 per cent complete. It became

progressively evident that earlier costs were grossly underestimated and returns overestimated. Foreseeing the need to salvage the Helmand-Arghandab Valley Project, which had become identified as an American project and which had absorbed an average of 19 per cent of the total Afghan development expenditures for several years, the International Cooperation Administration decided to undertake the first independent engineering study made of the Helmand Valley Project. The Tudor Engineering Company, under the leadership of the former Governor of Idaho, Leonard B. Jordan, was called upon to make an "unbiased"<sup>18</sup> survey of the accomplishments and the problems which had arisen to date. The field team arrived in Afghanistan for a six weeks' observation and study tour; with the subsequent report, the "Tudor report", submitted to the International Cooperation Administration in November.

The relatively short period spent in the field, combined with the complexity of the project, compelled the team to rely mainly on secondary source materials. They were in a position to do only limited independent or original study, and were heavily dependent upon drafts of "Soil and Water Resources of Southwest Afghanistan"<sup>20</sup> for most of their data. The Tudor report brought together into workable and debatable form most of the relevant information available to that date. It presented its recommendations in the form of a two-phase programme. Phase one discussed the constructions that were nearing completion, while phase two considered the work that could be deferred for a number of years. The report thus formed the basis for the relative priorities to be assigned to the various portions of the project and the resulting financing necessary over the next five years.

The Tudor report observed that under the third Royal Government of Afghanistan-Morrison-Knudsen contract the primary irrigation and construction work was proceeding at a much faster pace than the corresponding land development work for which the Afghan Construction Unit was responsible. In order to narrow this gap, it proposed postponing certain development until the second phase and concentrating primary efforts of both Morrison-Knudsen and the Afghan Construction Unit on a much smaller area. Specifically, it was recommended that:

Phase I include construction and land development in Marja, Shamalan, and the upper two-thirds of the Darweshan areas, with limited provisions for improving the supply of water to a portion of the Tarnak area. Phase II would cover development of the Seraj area and the lower third of the Darweshan area, and might also include the Tarnak area, if and when the water supply to the area has been proven adequate by better conservation or more storage, or by a combination of both.<sup>21</sup>

Whereas consolidation of construction activities was justified on technical grounds, the analytic base was weak. The study's assessment of the actual and potential benefits of consolidation upon traditional agricultural production was not explained. At first the report was candid in its observation that the past estimates of irrigable land and the potential increases in the value of crop production, were "in the light of present knowledge . . . very optimistic."<sup>22</sup> Likewise -

. . . estimates of production which are presently being used to determine the economic feasibility of projects take for granted a high degree of farmer skill and efficiency which Afghan farmers do not now possess and are not likely to attain in the foreseeable future.<sup>23</sup>

Yet, in a following paragraph it stated that since its conception, the project land, irrigated annually, has increased by about 42,089 hectares,

adding 205 million afghanis per year to the gross regional production.<sup>24</sup> The only way the Tudor report could justify such enormous gains would be to arbitrarily assume there was no production in the Helmand-Arghandab Valley prior to 1946. At the same time the Tudor report attempted to demonstrate the great potential of the project:

. . . upon completion of the development program now authorized and underway, 81,805 hectares of land are scheduled to receive irrigation water through newly constructed distribution systems, and an additional 136,661 hectares will receive an augmented and regulated water supply for use through existing privately owned canals.<sup>25</sup>

Just how the project development would accomplish such ambitious results is not elaborated.

The Tudor report, aware that the achievement of its projected gains depended upon considerations other than land development, suggested a large package of investments to remove various constraints to increased production. Included were an expanded extension programme, rural development, education, public health, a farm credit programme, public administration assistance, and the encouragement of handicraft and industrial expansion. In all, the Tudor report recommended 14 positions for U.S. specialists (included were a social economist, rural development adviser, handicraft specialists, an organization and management specialist, a public health team, an irrigation engineer, an agriculturalist, and a plant pathologist-entomologist to assist the Helmand Valley Authority.<sup>26</sup> No development methodology was included aside from the list of advisers required.)

Capital intensive development of a relatively large area, requires a large package of heavy machinery, and puts considerable strain on the

transportation system. The Tudor report recommended the creation of an integrated transportation system linking the Helmand Valley with Pakistan and the port of Karachi.

In view of the importance of transportation facilities in the development of the Helmand Valley, it is recommended that efforts be made to work out an in-transit trade agreement with Pakistan which might include a bonded warehouse in Karachi and a railway spur over the border at Spin Baldak with necessary storage and handling facilities.<sup>27</sup>

Subsequent to this recommendation, Koebig and Koebig of Los Angeles were contracted to make a survey of the problem of transits through Pakistan.<sup>28</sup> Their analysis confirmed the Tudor view, outlining a specific programme of road, rail and harbour improvement and recommended in the strongest terms that a transit and trade agreement be signed with Pakistan as soon as possible to implement the project. With the submission of the report in January 1958, the International Cooperation Administration promised that if a bilateral agreement could be negotiated successfully, it would provide a grant for funding all of Phase I of the project,<sup>29</sup> as outlined by the Tudor report.

The Royal Government of Afghanistan preferred to have a national railway (even though the Koebig and Koebig estimates were that a break-even operation would require a 70-fold increase in volume of traffic); or at least a rail spur at Torkham with the road paved to Kabul instead of between Quetta and Kandahar. In any case, in June 1958 an agreement was ratified that would give Afghanistan \$19 million for a two-lane asphalt surface on the 104 kilometer Spin Baldak/Kandahar road, including rebuilding of roadbed and structures, and a one-lane asphalt surface on the 445 kilometer Kandahar/Kabul road (to be expanded to a two-lane highway at a

later date).<sup>30</sup>

It was admitted that local currency for both roads (nearly 80 million afghanis), would be a strain on the country's budget but -

Afghanistan will now have free access to the sea, no transit tax for goods, vastly lower costs for exports and imports, and a great saving of time over the present 2-4 months transit time required to get the goods from Karachi to Kabul.<sup>31</sup>

The Morrison-Knudsen Afghanistan era ended with the termination of their third contract in 1959.<sup>32</sup> When the contractual arrangement between the Royal Government of Afghanistan and Morrison-Knudsen terminated, the project could be considered only partially complete. Most areas of the Helmand-Arghandab Valley Project, particularly the Shamalan, Darweshan, Central Arghandab, and Tarnak, were only in construction. Efficient, irrigated agriculture was not possible over much of the areas for which supply canals had been provided. Although the Marja and Nad-i-Ali areas had been given fairly elaborate distribution systems, and considerable drainage work to overcome very bad waterlogging and salinization problems, much work still had to be done.

Criticism of the Morrison-Knudsen work in the Helmand-Arghandab Valley had been varied. The company did satisfy its contractual agreements. Two technically first class dams, a series of main and lateral canals and drains, a system of roads linking the various projects, and a small electrification programme had been accomplished in the fifteen years of contract construction. But Morrison-Knudsen was more than an engineering team contracted to build specific structures; it had general development responsibilities.

The fault lay in the lack of understanding of the responsibilities of a foreign company which introduces a major development project on the landscape of a developing country. Since the Helmand Valley project affected 40% of Afghanistan, I suggest that the company involved had some responsibility for what happened to its beautiful dams, canals and roads after it departed.<sup>33</sup>

The Morrison-Knudsen Afghanistan period is a classic example of the backward approach to irrigation development. The dams built first, attention then turned to preparation of lands to be irrigated, then to testing of soils, then to teaching the settlers how to irrigate, then to teaching the teachers. By the time Morrison-Knudsen left it was still not certain who owned what.<sup>34</sup> An important lesson can be learned. As long as the river flow can be used to expand the irrigated area, surface water development should be in this area.

It is true that Morrison-Knudsen were not the sole decision makers; they were contractors trying to satisfy contractees' demands which were at times technically and economically inexpedient. But the decision to build Kajakai Dam and to continue work on land development before adequate soil surveys were complete, the underestimation of gypsum deposits and the resulting dumps which occurred at various places underneath and beside the canals, among other decisions, were Morrison-Knudsen's responsibility.

Over the 15-year period, the area under cultivation had increased, but production had not increased appreciably (see benefit-cost analysis). In some areas, Nad-i-Ali, Marja, and Arghandab, waterlogging and salinity were having a negative effect on yields. The provision of an assured supply of water might have caused increased yields in years of

major droughts (estimated at one year in seven), but that surely is a marginal benefit. Similarly, the damages of floods that occurred in 1957 and 1959 were partially alleviated because of the existent reservoir systems, even though water did flow over the dam spillways (primarily because of a lack of coordination between the Helmand Valley Authority and the Central Government in Kabul). But this is not too significant, since the production saved must be compared with the added repair costs to large capital structures.

A generation of auto mechanics, machinists, truck drivers, bulldozer and crane operators, electricians, cooks and other specialists were another legacy of Morrison-Knudsen Afghanistan<sup>35</sup>, at an exorbitant cost for a technical assistance programme! Finally, to defend their major capital investments to 1960 on the grounds that it would have been more expensive to build the dams and canals in 1960 than in 1953 is a specious argument at best. What is true is that by 1960 two major capital investments (the Kajakai and Arghandab Dams) stood majestically in the desert, their stored waters used to no significant extent for either irrigation or electric power.

#### Increased U.S. Involvement

Before Morrison-Knudsen actually left the Valley it was anticipated that further land development work would be carried forward by the Afghan Construction Unit<sup>36</sup>, the recently organized construction division of the Helmand Valley Authority. It was contemplated that the construction of laterals, secondary and farm drains, and land leveling, with the possible exception of some development of farms to be done by



landowners, could be done by this unit. With its own financial resources and with some grant-in-aid funds advanced by the International Cooperation Administration, the Afghan organization carried work forward to a limited extent. However, major problems affected its operations. Not enough trained Afghans existed to supervise the extensive irrigation system already installed, equipment was poorly maintained, and as equipment wore out it was not replaced. The Afghan Construction Unit became less and less able to carry out construction activities. The Royal Government of Afghanistan requested further assistance for the unit, but the International Cooperation Administration declined to provide further funds until, first, an adequate study could be made to determine a better strategy for project development, and second, the development of an adequate organization and management programme.

In 1959, a new commitment for American involvement in the Helmand-Arghandab Valley was signed with the Royal Government of Afghanistan. In 1960, the U.S. Bureau of Reclamation was contracted under a participating Agency Service Agreement to give the Helmand Valley Authority assistance on critical problems of drainage and maintenance and on the design and construction of irrigation systems. By the end of 1961 there were 13 Bureau of Reclamation technicians in Afghanistan.

The Bureau of Reclamation immediately involved itself with improving maintenance techniques. An example was the innovation in canal and lateral cleaning introduced to the Afghan Construction Unit by the Bureau of Reclamation - to drag a chain between two bulldozers driven on either side of a canal, dredging the ubiquitous flora which grows

rapidly and clogs the system.<sup>37</sup>

While the Afghan Construction Unit and the Bureau of Reclamation personnel tackled operations and maintenance problems, the Helmand Valley Authority continued settling new villagers in Marja, the second area on the terrace of the Boghra canal. The new settlers received from four to six hectares, two oxen per two families, agricultural implements, and 15 maund (one Kandahar maund equals 4.4 kilos) of seed for the first year, all on the usual 20 year, no interest loan agreement, payments beginning after a four year period of grace.<sup>38</sup> The new village plans placed the huts adjacent to the fields, thus eliminating the distance to work - a problem of the Nad-i-Ali. Each village was to have 30 to 40 families and 11 new rural schools were planned to serve the whole Marja area.

Initially the new settlers at Marja gained excellent crop yields, particularly when compared to Nad-i-Ali, but the yields progressively decreased as a result of misuse of the irrigation water, lack of adequate drainage and other bad agricultural practices.

Settlement was also attempted in the Shamalan area. By 1961, 30 new families had been settled, but settlement problems were aggravated by confrontations with an already settled traditional agricultural community. Similar problems arose in the Darweshan area below the Shamalan. The difficulties of moving new settlers into already settled areas had not been anticipated.<sup>39</sup>

Not only was the Bureau of Reclamation involved in maintenance and operation assistance to the Helmand Valley Authority, but it began to play an instrumental role in planning. As a preliminary to further

project development, the Bureau of Reclamation recommended an economic analysis of the area. (After 16 years there was still very little farm data pertaining to the Helmand Valley). In 1963 the Helmand Valley Authority requested the Bureau of Reclamation's agricultural economist to develop an economic analysis of the Marja district for the purpose of determining the optimum size of an economic farm unit for new settlers.

This "Economic Analysis of Marja Farms"<sup>40</sup> recommended the farm sizes given to new settlers be increased to allow for agricultural surplus creation. The land then being distributed yielded only subsistence livings which would not keep settlers on new lands.<sup>41</sup> The study similarly suggested that land of lower quality (Morrison-Knudsen Afghanistan Classifications IV and V) should not be used for regular crop farming. It suggested land classified as IV might be suitable for pasture-livestock or a forestry programme; while land classified as V should, for the most part, be abandoned. The report was unique in providing the first farmer cost-income profile in the Helmand-Arghandab Valley, a methodology later employed and expanded to estimate the cost-income profile of all the farmers in the Helmand Valley region.

A second report by two of the same authors, known as the Tarzi-Stevens study<sup>42</sup>

. . . was undertaken to secure badly needed information on crop yields in the Helmand Valley . . . and factors affecting them; also to compare production now and before the dams and irrigation works were built. The data (sic) was obtained from interviews with 495 families and village chiefs, and from observation of farming practices throughout the Helmand Valley.<sup>43</sup>

The study was rather extensive in its qualitative analysis of problems encountered by farmers, but most observations were not sub-

stantiated by any quantitative analysis.

The obvious and known factors cited for low yields were:

1) Capital. Farmers who had insufficient capital received considerably lower yields than those with adequate capital supply.

2) Experience. Settlers without previous farming experience received substantially lower yields than settlers who had previous farming experience.

3) Domicile. Farmers living on their land were receiving substantially higher yields than farmers living in the villages.

Water or lack of water as a major constraint to increased production was not mentioned. What was said about water supply seemed contradictory; it was judged by farmers as both excessive and insufficient in the same regions. In the Kandahar and Shamalan areas, some farmers said that they had more water now, and were therefore more "happy and prosperous", while others in the Kandahar and Shamalan areas had less water now and were therefore "less happy and prosperous".<sup>44</sup> This was the first published hint that a problem of water distribution existed. Although hinted at in the qualitative analysis, nowhere was the water distribution system mentioned as a constraint to increased production.

Those farmers who indicated production had improved since the dams were built cited, as the most important reason, that more water was available now, and, in some areas, that water was now also available late in the season, while those farmers who said that their yields were lower since the dams had been built gave various reasons depending on the area.

Just below Arghandab, farmers complained that silt which had formerly enriched their lands during the flood season each year was now being trapped above the dam. In other sections, farmers said the cotton that they were now required to grow <sup>(45)</sup> was taking fertility out of the soil. In some places the increased water supply was accentuating the salt, water table, drainage, and weed problem.<sup>46</sup>

Other problems that were mentioned were the extremely difficult credit situation and need for credit reform; the lack of management know-how; and lack of education and basic knowledge. "All of these can be solved with careful planning" and "hard work."<sup>47</sup> What kind of careful planning and hard work was necessary, was not elaborated.

As a major finding, the survey purportedly showed that larger farms yielded greater production and therefore larger farms with increased mechanization should be encouraged. Thus:

The problems of low production can be overcome to some extent by larger acreages. Although the gross farm revenue in Darweshan is lower than in any other district, the large acreage per farm makes the total gross revenue per farm higher than in any other district - \$423. The opposite is true of Arghandab where gross farm revenue per acre is highest - \$87. The small acreage makes the total gross revenue per farm only a little over half as much as that found in Darweshan.<sup>48</sup>

It is not quite clear what the statement proves; obviously, other things being equal, the larger the farm, the greater the gross revenue per farm. The critical policy criterion, however, is the relationship between farm size and return per hectare; this is not provided by the study. Using the same partial data,<sup>49</sup> it can be argued based on the prima facie evidence that since the average gross return per jerib in Darweshan is 348 afghanis and in Arghandab it is 804 afghanis with the former having larger farms, smaller farms should

be a policy goal.

The Tarzi-Stevens study tried to explain the externalities of large farms:

Farms need to be of sufficient size and productivity to accomplish two goals - providing surpluses for urban development and improving of living standards on the farm. Increasing the size of the present subsistence farms and increasing their productivity are necessary to accomplish these goals.

Whereas the objective of providing surpluses for urban development is a debatable point, depending on national objectives, that farms should be increased in size to achieve this end is not proved by the survey.

A Shift in Emphasis Toward Social and Institutional Problems

In the early 1960's project movement was continually constrained by the need to solve salinity in Nad-i-Ali and Marja which was absorbing a great portion of development funds and energy. The digging of drains in the Marja area had been hampered by contractors' failing to fulfill their contracts. According to government regulations, small construction jobs had to be put out for bids to private contractors. The Helmand-Arghandab Valley Authority<sup>50</sup> had been following this procedure and had let contracts for several drains. But as the contractors overshot their estimates, they stopped work and reneged on their contracts. The Authority's engineers knew at the time the contracts were signed that the work could not be done for the price bid by the contractors, but still allowed the contracts to be negotiated. The Authority's Technical Department would have liked to hire labourers and do the job themselves, but was prohibited by government regulations from doing this. As a result, the work on the Marja project was progressing at a snail's pace, with slim prospects of ameliorating

the situation.<sup>51</sup>

To drop the Nad-i-Ali and Marja project was from a policy point of view impossible; both the Afghans and the U.S. Agency for International Development (successor to the International Cooperation Administration) were "determined to succeed". Large sums had already been invested, and settlers had been brought from various parts of Afghanistan -- these were unstated reasons for sinking more money into drainage, even though economic justification for further expenditures was doubtful.<sup>52</sup> Further out-migration, particularly from Nad-i-Ali where large numbers had settled, would have been an embarrassment for both the Royal Government of Afghanistan and the U.S. Agency for International Development.

The excessive involvement with the technical problems of the Nad-i-Ali and Marja areas (which did not comprise more than 12.5 per cent of the total cropland) caused myopia as regards other development problems in the region. A critic<sup>53</sup> in 1961 found that although drainage was a major problem in the Helmand-Argbandab Valley, it was by no means the only problem, nor even the principal problem. He regarded retarded agriculture and lack of proper operation and maintenance of the irrigation system to be primary problems in the area.

Unnoticed by the developers was the gradual shift in the scope and direction of the project and the emergence of new social and institutional problems. When the project was first begun, there was a strong desire in the Royal Government of Afghanistan to develop the publicly-owned desert lands to provide opportunities for settling nomads and landless farmers. The project had provided water to lands in private ownership and already under irrigation, but that was incidental. The emphasis on development

of public lands had been clearly expressed in the "Rules of Procedure" adopted for the Helmand Valley Authority. The purposes of the organization were stated to be:

Maintaining and operating the properties now owned by the Government of Afghanistan in and near the Helmand River drainage basin in the interest of national welfare and for the conservation and development and use of the nation's land and water resources, and for land reclamation and settlement and agricultural development . . .<sup>54</sup>

By the mid-1960's, the situation had completely changed. Apart from a few minor areas of public lands, most of the land that could be successfully developed was in private ownership. New policies had to be established for this new situation. Planning development for privately-held land would entail finding solutions to the problems of existing land titles and water rights and the related problems of payment for water supplied.

With the changing nature of the project, and an increased involvement with improving water supplies to already settled landlords using traditional irrigation practices and structures, new legal and social problems arose. While the technical problems of irrigating flood plains are less complex than irrigating terrace lands, the social and legal implications of providing private landlords with an assured and greater supply of water demanded extensive study. (These social and legal problems, which were becoming apparent in the 1960's, were by the early 1970's still a delicate subject for the Helmand-Arghandab development, as will be explained in later sections).

With time, the bureaucracy grew, with the general administrative machinery becoming more cumbersome and less able to handle the expanding project. Nervik and Noory<sup>55</sup> summarized the situation succinctly. In the



early stages of the Helmand Valley Project, they observed, the emphasis was on construction activities. Later, as serious salinity conditions developed in Nad-i-Ali and Marja, a major effort was devoted to solving these. Under these conditions it is understandable that little time was left for considering either the removal of other constraints or the changing nature of the project and its problems. The Helmand-Arghandab Valley Authority, which had begun as an agency to expedite the settlement program, had become by the mid-1960's an agency that coordinated utilities, education, agricultural research and extension, housing, health and industrial enterprises.<sup>56</sup>

As the responsibilities of the Authority grew, administrative problems were further aggravated by the involvement of three major decision-making bodies in the project, the foreign sponsor represented by the U.S. Agency for International Development, the Royal Government of Afghanistan<sup>57</sup> and the regional Afghan development authority, the Helmand-Arghandab Valley Authority. The lines of communication and authority between the three often became blurred, and the project goals never quite became definite, with the result that

. . . . a number of programs and projects in the Helmand-Arghandab Valley Authority program still do not adequately reflect well defined objectives and goals. There is no agreed overall plan defining exactly the concrete results it is intended to gain, and how they are to be gotten. Needs may not be foreseen in sufficient time to plan and organize required programs effectively. Furthermore, administrators and technicians come and go, each new arrival, whether Afghan or American, having his own views as to what should be done. Lacking clear overall guidelines, past programs have suffered from lack of continuity.<sup>58</sup>

Throughout the 1960's some observers became more vociferous in their warning that the project should not expand the area of land development, but rather should concentrate on area intensive improvements. In

1962 Benz and Holmgren<sup>59</sup> recommended concentration on the area under water command and avoidance of extending irrigation to new areas. R.H. Allen<sup>60</sup> in 1963 similarly suggested a concentration of effort.

It should not be assumed that once the water distribution and drainage systems are installed and the land leveled a highly productive agriculture will develop without further effort on the part of the Helmand Valley Authority. Many other elements are essential for such an intensive agricultural economy to develop.<sup>61</sup>

By 1965, critics saw little change or improvement in the Helmand-Arghandab Valley approach. "About half of the area is still not adequately served because of lack of laterals and farm ditches and lack of control of turn-outs from the laterals. Only a few thousand jeribs are fully developed."<sup>62</sup>

As the controversy raged over the efficacy of extending the area to be introduced to modern irrigation structures versus concentrating and resolving the problems of areas already developed, capital intensive development work was continuing in the Tarnak (in the Kandahar area) without any economic study or justification. Not only was some of the land of doubtful quality but two factors further complicated the matter:

- 1) In the Arghandab River basin the flow of the water in some years is not sufficient for irrigation of all the projected land development in North Arghandab, Central Arghandab and Tarnak areas. Detailed knowledge was necessary to pick the areas which showed the most potential since all could not be developed. By 1965 it had not been proven that Tarnak was the most promising candidate; rather, evidence hinted the opposite.

- 2) The provision of water to "new" water users in Tarnak, given a limited supply for "old" water users, would obviously result in conflict. Project planners had not considered this eventuality.

Similarly, land betterment work in Darweshan was in progress on a pilot basis. Since Darweshan is downstream of Shamalan, logic would have dictated (given location closer to Lashkar Gah) that the latter should have been developed first, other things equal.

It was this "helter-skelter" irrigation development approach of the Helmand-Arghandab Construction Unit in the early 60's that prompted the Bureau of Reclamation to add a feasibility planning team in 1964, and to select an area for immediate study and subsequent development. Selection was to be made on the principle that areas with potential for producing the greatest economic returns in the shortest period of time should be given first priority. After careful consideration of such salient factors as soils, remaining engineering and land development work, qualification of farm population, and economic returns that might be anticipated after land development, the Shamalan area was selected as the first unit of the Helmand-Arghandab Valley Project for the Bureau of Reclamation's feasibility studies.

Shortly after the Shamalan area was selected, a demand arose for completed studies on a portion of it as soon as possible, so land could become available for development by the Helmand-Arghandab Construction Unit when a proposed equipment loan became available. The necessary loan was anticipated at an early date, and so the western portion of the Shamalan area was the one selected for concentrated effort. Even before the draft report<sup>63</sup> was completed, and with only aerial photographs available, work was started on the West Shamalan. It was not until September 1968, with the final publication of the Bureau of Reclamation's feasibility report<sup>64</sup> that

the overall plan for development of the Shamalan area finally became clear. It was proposed that a completely modern water distribution system be constructed in the area, to provide ample water at peak demands to all portions of the project. This was to include not only lands classified as irrigable (Morrison-Knudsen Classification I-IV), but also lands classified as "6W" which are eliminated from the irrigable land class, but which have a history of irrigation and probably had prior water rights. The work entailed changes in the distribution and drainage systems as well as a major land preparation program, and constituted a substantial extension of the capital-intensive approach. Engineers in the Bureau of Reclamation claimed that the failings of previous irrigation construction in the Helmand-Arghandab Valley were that these were only partially complete. The Shamalan project proposed to give a complete package of a modern irrigation system.

The new distribution system would include an additional supply of water to the area from the Boghra canal via the use of Nad-i-Ali wasteway and through the rehabilitation of the Shamalan canal: construction of a new lateral diverting from the Shamalan canal to supply the "water short" West Shamalan; and the redesign and realignment of the remaining juie lateral and sublateral systems presently supplying water to the major land segments of the Shamalan area.

The drainage system would also have to be improved. Main outlet drains and subsequent lateral and field drains would be added to the present main drainage system to lower the high water tables in localized areas, and to ensure proper future drainage of the project area when adequate irrigation water is supplied.

The major innovation would be in the land preparation scheme. The

existing juie system would be completely eliminated; land would be cleared, leveled and organized and redistributed in large, uniform, smooth land plots. The water distribution system which existed in Shamalan, as in most of Afghanistan<sup>65</sup>, consisted of a convoluted network of juies which cut the lands into small irregularly-shaped tracts.

With project development accompanied by the adoption of mechanical farming and modern irrigation methods, establishment of a suitable irrigation system is necessary. This will require broad-scale leveling and grading to obtain fields of proper size, shape and gradient necessary to achieve a high degree of irrigation efficiency. The existing jui system would be removed by leveling and replaced with a modern, controlled distribution system.

The sequence of land preparation measures would be: clearing trees from the jui banks<sup>66</sup>, leveling the jui system, and overall leveling or grading of the farm units to coincide with the construction of the new project irrigation system. Lands would be deep plowed or ripped as required.<sup>67</sup>

Also involved with the development programme is the would-be development in Shamalan of a new source of potable domestic water supply,<sup>68</sup> the construction of access roads to provide better transportation to market, and the provision of assured flood and erosion control in localized areas.

The decision to concentrate land development work in one area, coupled with a detailed time schedule and work programme, went part way in satisfying critics' demand for an organized area specific plan. But for all their elaborate planning and economic feasibility study, the Bureau of Reclamation did not

- 1) prove that the method employed was the most efficient means of increasing the agricultural surplus; or
- 2) consider adequately the social implication of such a total alteration of the farmers' physical environment.

The Shamalan study lists as constraints to increased production

- non-availability of farm credit;
- continued use of oxen;
- a feudal sharecropper system;
- fragmented holdings which conform to an oxen-sharecropper, labour intensive farming system;
- rudimentary development of the marketing infrastructure, which results in low prices for farm products and high prices for farm inputs;
- low levels of education, sanitation and health; and
- a shortage of practical extension, demonstration training personnel and programs.

The reasons why these conditions persist, according to the Bureau of Reclamation, are because of the "traditional attitude of farmers, lack of incentives, and a scanty understanding of scientific principles of farming." To change these attitudes a "revolution in mental concepts" is needed. But just how this revolution could happen was not elaborated. The Shamalan project, as outlined in the report, would only eliminate the continued use of oxen and the fragmented holdings and improve sanitation; the project as planned would result in large consolidated farms, increased mechanization, feeder roads and a potable water system.

The feasibility report on the Shamalan project, exhaustive as it is in technical details, is sparse in its analysis of the social implications of such a drastic and abrupt alteration of the farmers' environment. As early as 1967 a lack of concern for social problems was noticed.

There remain a number of unresolved questions of a policy nature that will need to be dealt with before the project [Shamalan] can be implemented successfully. Yet to be worked out is the problem of how to handle the people in the Shamalan area who will have to be moved off their land while the land betterment work is being done; how to redistribute the land to the people after the job is completed, and whether or not to charge land-owners for the improvements. Also, there will be the problem of providing farmers with the necessary production inputs including short-and-medium-term credit if the benefits assumed in the Shamalan feasibility report are to be attained.<sup>69</sup>

Once the Bureau of Reclamation had completed its analysis of the Shamalan area, attention turned immediately to removing the physical constraints to improved agricultural production in the Kandahar area (the area irrigated by the Arghandab River). As early as 1965, problems in the Kandahar area were being reported.

In some of the very rich orchard lands near Kandahar, North and Central Arghandab, serious water-logging problems have arisen along the canals from the Arghandab River below the Arghandab diversion dam. On these canals, intakes and canal banks have to be improved and water control should be installed. Unless steps are taken soon to remedy this situation, valuable orchard land may go out of production.<sup>70</sup>

With the completion of the Arghandab Dam and the South Canal<sup>71</sup> the water supply to the Kandahar area was altered; whereas irrigation water had been seasonal, it was now made available almost continually. This in turn made good on-farm irrigation and agricultural practices more critical, and increased the amount of maintenance time required to keep the juies in fair operating condition. In some instances, irrigation practices did not change so as to use the increased water supply efficiently, and maintenance was neglected at times to the point of hindering the water supply. Gradually these conditions, coupled with inadequate drainage, began to raise the

water table and have a net negative effect on area production.

In 1967 feasibility investigations were initiated by the Bureau of Reclamation on the Central Arghandab Unit, and these were completed by 1970. The Bureau's final report on the Central Arghandab unit<sup>72</sup> underlines the unfavourable conditions which had resulted from an increased availability of irrigation water superimposed on inadequate and inequitable water control and distribution system, inefficient irrigation practices and inadequate drainage.

At the present time, considerable portions of the Central Arghandab area are badly in need of drainage relief. Dating as far back as 1953, when some of the initial investigations were in progress, a few isolated areas were delineated as being marshy. Since completion of the Arghandab Dam in 1952, and the South Canal in 1955, these areas have become increasingly larger due to the increase in the divertible irrigation water supply. Interviews with various landowners in the area during the 1967-1969 period indicated that the visible effects of waterlogged land had accelerated over the past 5 years. During a 1964 interview, representatives of the Zakir village (situated in the southeastern part of the area) indicated that they had not particular (sic) damaging water table problems. However, a subsequent interview in October 1967 revealed the existence of numerous damaging water table problems both with respect to agricultural land as well as deteriorating effects on the buildings and homes in the village area itself. Today many other areas are similarly affected by high ground-water levels. Numerous vineyards were destroyed; dead vines were removed and trenches filled in, in an attempt to grow grains when the production of grapes failed due to high water levels and increasing salinity and alkalinity.<sup>73</sup>

This deterioration in productivity of thousands of hectares of land has resulted in a 1970 cropland utilization only slightly in excess of the level that was prevalent prior to the completion of the Arghandab Reservoir and the South Canal.

The development plan for the Central Arghandab proposes to improve and modernize the water distribution system, provide adequate drainage and



develop a road network. The proposed plan provides for construction of main canals and principle laterals. The plan also proposes to combine several small laterals into a larger lateral to serve the area more efficiently.

The proposed plan provides for main canals and principal laterals, but leaves the smaller laterals and farm distribution system as they exist, with such alterations as are necessary to join the old system with the new. The existing distribution systems in the vineyards and orchards are not to be changed, as excessive costs and administrative problems would be involved and the benefits to be gained would be very minor.<sup>74</sup>

Similarly, a river diversion is planned to replace five major and two minor existing diversions in the Panjwai area of the Central Arghandab. To solve the problem of a rising water table, the Bureau of Reclamation proposed 33 kilometers of drains to complete the drainage system work already begun by the Helmand-Arghandab Construction Unit in the 1960's. Finally, a road network was proposed to link the project with the existing system of roads.

Most of the above activities, the Bureau of Reclamation concedes, are needed merely to restore agricultural production to what was attained during the first five years after completion of the Arghandab Reservoir and South Canal. Whereas the study arrives at a positive benefit/cost, it merely mentions certain constraints that have to be overcome if the project is to achieve the proposed increase in net regional production value. Critical to the project's success in increasing production is the modernization and improvement of the water distribution system. The study admits that this is essential to realize the proposed benefits but assumes that the small farmers will incur the extra costs of reorganizing and combining their small laterals. What method they propose to induce farmers to make this added on-farm

investment is not explained. Similarly there is little explanation of the method by which water rights are to be resolved once the new canals and laterals are completed.

Given that little is known about the present water distribution rights and methods along juies that have been in operation for hundreds of years,<sup>75</sup> there is no reason to assume that the increased supply of water will be used voluntarily by farmers to effect an increase in net area production. An example will suffice to prove this point. If we assume the distribution along a juie is by turn, with each farm being served in order of location along the juie so that when the water reaches a farmer he takes all that he wants for a specified unit of time before the next farmer is served, then all the added water supply may be absorbed by each farmer in turn, with no extra water to expand cropland. Possibly the man at the end of the lateral, who complained about water prior to project construction, will still face the same constraint after project completion.

The Central Arghandab report excludes consideration of the externalities of increasing water supply to one area upon the two other areas (North Arghandab and Tarnak) served by the same reservoir. There remain to date too many unknowns to achieve maximum efficiency: the size of the reservoir in relation to maximum cropland potentially irrigable; the role of sedimentation and the resulting decreasing storage capacity of the reservoir<sup>76</sup>; and the present water needs by canal and lateral. That the Arghandab Dam Reservoir dried up in 1971 was unexpected, confirming the opinions of those who have claimed that the dam is too small.<sup>77</sup> The dam's drying up gave the Bureau of Reclamation a chance to observe the rate of

sedimentation, which was observed to be 0.8 per cent per year with 15 per cent capacity lost by 1971.

Prior to this:

Sedimentation samples of reservoir inflows were taken in 1950 indicating an annual siltation rate of approximately 0.36 per cent. A survey for the measurement of siltation in Arghandab Reservoir was conducted in 1962. The results of this survey, which were inconclusive, indicated that the storage had been reduced on the order of 7 per cent as the result of siltation, or at a rate of approximately 0.7 per cent annually.<sup>78</sup>

The direct impact of sedimentation on the life of the reservoir is still a matter for speculation, as is the relationship between decreasing reservoir capacity and net irrigable area. To date there is still no accurate estimate of water needs, given the inefficient water utilization within the Kandahar region, and so the decreasing reservoir capacity may or may not have a negative effect upon either the continued ability to irrigate the lands presently cultivated and/or the ability to irrigate the projected increase in area.

Sensitive to the need to estimate the future life of the reservoirs, the U.S. Geological Survey in 1967 made a reconnaissance survey of the Kajakai reservoir to observe the extent of silting and determine the optimum method to be used for later detailed sediment studies which would be conducted at each reservoir. Results of the study<sup>79</sup> show that the "decrease in capacity at spillway elevation for the period 1953-1968 due to sediment deposition was 7.8 per cent or 117,700 acre feet."<sup>80</sup> But, as with the Arghandab Dam, the total impact of this decrease in capacity is just not known.

The Central Arghandab report can be criticized on the same grounds

as the Shamalan Unit report and other reports issued since the beginning of the project. The social and institutional constraints to effective project implementation are casually argued away.

It appears that the best approach to the solution of the water right problem is to establish water rights for the land in the entire area, so that it may be resolved prior to, or in conjunction with, the implementation of the proposals included in this report. 81

For instance, the exact implications of non-establishment of water rights on the project's initiation are not discussed. Crisis periods can be expected to result directly from lack of consideration of the social and political constraints.

Aside from the major work in the Marja and Nad-i-Ali area, and some work in the Tarnak and Darweshan, it was not until the Shamalan project began that the major land development programme became revitalized. Compared with the 1950's, the 1960's witnessed relatively lower expenditures on land improvements and a greater proportion of expenditure on urban development.

#### An Ex Post Evaluation of 25 Years of Investment

Until the "green revolution" the little gain in regional production could in no way begin to justify the massive investment in the infrastructure. Primarily, the regional gains prior to 1966 could be attributed to the added cropland, principally in the Marja and Nad-i-Ali areas, and to a lesser extent in the Shamalan and Darweshan areas. Until the "green revolution" there were only marginal increases from intensive farming, with real gross income per hectare remaining relatively constant. Over the five years beginning in 1967, agricultural production in the Valley has increased dramatically because farmers have steadily increased their use of fertilizer

and the new high-yield varieties of wheat (Mexi-Pak) and corn (Shur-cropper).

The 1970 Farm Economic Survey,<sup>82</sup> a regional farm survey of 800 farms, clearly shows the impact of the new inputs on increased yields and net farm-production value. In 1970 more than 15 per cent of the farms reported using some new improved wheat seed, while 21.1 per cent of the farms reported the use of some fertilizer.<sup>83</sup> (The use of fertilizer more widely than the use of new high-yield variety wheat seed is attributed to the application of fertilizer to crops other than field crops by some farmers in the Kandahar area).

As is the experience in almost all places in the world, the combination of new seed varieties and fertilizers resulted in a dramatic increase in average yields (See Table 10).

Evaluating a project mid-way through its productive life affords an analyst a unique opportunity to gain added insights which are critical both in

- 1) Assessing the net social gain (loss) of this form of investment;  
and
- 2) Identifying those constraints to increased regional production value as a result of past investments in water delivery systems.

More specifically it would be helpful to have answers to the following questions:

- 1) Are the recent gains in net farm production sufficiently large to justify the past investments?
- 2) If the present trend of increasing yields, cropland utilization, and high value crop substitution are to continue, could the project when evaluated over its total 50 year life yield a net social benefit?

TABLE 10

HELMAND-ARGHANDAB VALLEY PROJECT:  
AVERAGE YIELDS FOR MAJOR FIELD CROPS AND AREA DOUBLE-CROPPED  
AS PER CENT OF LAND IN CROPS

AREA	Wheat Yields		Corn Yields		Total Area Double- Cropped as Percent of Cropland
	Local kg./ha.	Improved kg./ha.	Local kg./ha.	Improved kg./ha.	
Helmand Valley:					
Nad-i-Ali	996.8	2721.1	1799.6	3679.1	14.4
Marja	766.4	2445.1	901.0	2173.7	11.2
Shamalan	1491.7	2046.0	1852.1	2084.7	15.1
Darweshan	912.4	1749.5	1088.0	-	5.0
Khanishin	374.1	-	3049.6	-	1.0
Seraj	595.3	-	812.0	-	3.9
Girishk	946.6	2036.8	1498.6	2659.5	29.2
Sanguin-Kajakai	1379.9	2940.1	1991.2	-	33.9
Musa Qala-Zamin	989.9	2470.2	1621.7	-	4.7
Nowzad Dawar	634.1	-	1208.9	-	-
Average: Helmand	755.0	2324.2	1557.9	2342.5	9.28
Arghandab Valley:					
Maiwand	1092.6	-	362.7	-	5.1
Dund-Daman	757.3	1733.5	1145.0	-	8.0
Arghandab	1265.9	1943.3	1505.4	-	18.7
Panjwai	666.0	-	1384.5	-	0.1
Average: Arghandab	830.2	1954.7	1268.2	2636.7	9.17
Average: Helmand- Arghandab Valley	789.2	2246.7	1462.1	2367.6	9.23

SOURCE: G. Owens, 1970 Farm Economic Survey: Helmand-Arghandab Valley of Afghanistan. Kabul: U.S. Agency for International Development, 1971, Table 11a, p.26. Yields are not reported when the number of farms reporting is less than three. However, area and production for these farms are considered in subtotal calculations. Yields for Helmand, Arghandab, and the Helmand-Arghandab Valley are properly weighted on the basis of area and production per area.

If the ex ante benefit-cost analysis is to provide a useful policy recommendation, answers to these questions would be helpful.

In the following section, two analytical devices are used to evaluate past development performance and to identify the major obstacle to realizing the potential gains from the removal of the physical constraints to water supply.

First, a simple ex post evaluation of benefit and costs is attempted to give a rough approximation of the net contribution of the project to the Afghan economy after 25 years of life. Essentially, an undiscounted and unadjusted net benefit series is summed and subtracted from an undiscounted and summed investment series. From this simple summary of undiscounted and unadjusted series (1946-1971) of investment and net benefits, one thing is immediately clear. After 25 years, the summed incremental net farm production series is still at best only 50 per cent of the summed investment series (See Tables 11 and 12).

For every dollar invested, only 30 to 50 cents has been returned in increased farm production, a rough indication of the minimum loss of social welfare as a result of 25 years of misdirected national investment. The word minimum is very important. Entering the adjusted values into the cost stream to account for inflation and technical change would not change the contribution, if discounting were simultaneously incorporated into the ex post evaluation. Given that the investment stream is heavily skewed toward the early years and the benefit stream is heavily skewed toward the later years, a discounting of the two streams would accentuate the measure of social loss far beyond any possible adjustments made possible by inflation and technical change adjustments. Assume, for the moment, that this was

TABLE 11  
 HELMAND-ARGHANDAB VALLEY PROJECT  
 NET BENEFIT STREAM, 1946-1971  
 (In thousands of Afghanis)

Year	Low	High
1946-1947	0	0
1947-1948	0	0
1948-1949	0	0
1949-1950	0	0
1950-1951	0	0
1951-1952	0	0
1952-1953	23,424	43,910
1953-1954	46,848	87,819
1954-1955	70,273	131,729
1955-1956	93,697	175,638
1956-1957	92,926	174,867
1957-1958	92,155	174,096
1958-1959	91,384	173,325
1959-1960	90,612	172,554
1960-1961	89,841	171,782
1961-1962	89,070	171,011
1962-1963	88,299	170,240
1963-1964	87,528	169,469
1964-1965	87,528	169,469
1965-1966	87,528	169,469
1966-1967	87,528	169,469
1967-1968	87,528	169,469
1968-1969	151,605	235,761
1969-1970	215,681	302,053
1970-1971	279,758	368,345
<b>Total</b>	<b>1,955,213</b>	<b>3,400,474</b>

NOTES: The construction of a net benefit stream for the period 1946-1971 posed major problems. Among them were:

(a) Selection of a base (1946) cropland. The earliest estimate of cropland by region prior to 1946 is from "Helmand Valley Development Program" (Kabul, 1953), table 4.1; this 1953 report is supposedly the result of Claude Fly's research. The estimates represent a summary of aerial and reconnaissance survey work done between 1952 and 1953, and the report warns of limitations in the estimates obtained because wide variations exist in the reliability of data for various areas. The second



Table 11--Continued

source of cropland estimates prior to project development, and the one most often quoted, is the Tudor report (Tudor Engineering Company, Report on the Development of the Helmand Valley, Afghanistan, Washington, D.C.: Tudor Engineering Company, 1958), Table 1, p. 18. The estimates of land cultivation used in the Tudor study are drawn from International Engineering Company ("Soil and Water Resources of Southwest Afghanistan," Draft report submitted to Morrison-Knudsen, Afghanistan, Kabul, 1957), table 68, p. 177. This estimate is similarly attributed to Claude Fly. Since no a priori logical reason is furnished to give one estimate greater validity than the other, both are used as a base for cropland estimates. These two cropland estimates comprise the basis for the high and low net benefit series.

(b) Estimation of base (1946) yields. No accurate estimates of crop yields for 1946 in the Helmand-Arghandab Valley exist. The earliest recorded estimates found in the Tudor report are rife with contradictions. For a weighted mean of all cropland, the wheat yield was estimated at 6.8 bushels per acre (356.6 kg./ha.) in 1946, which is a good estimate for dryland farming, but surely poor for irrigated land, even traditionally-irrigated land. For with an average annual precipitation at Girishk of 100 mm., and 180 mm. at Kandahar, the possibility of dryland farming on any regular basis in most of the area must be discounted. The method of estimating yields prevailing in the base year has been to use several national estimates of yields from cropland using traditional inputs and dependent upon an irregular water supply, as an approximation of yields in the Helmand-Arghandab Valley in 1946-47. Yield estimates found in Asian Development Bank, Sectoral Planning Study of Agriculture in Afghanistan (Kabul: Robert R. Nathan Associates and Asian Development Bank, 1971), Table 36, pp. 3-55, were compared with estimates made by experts in the field--Dr. Richard Saunders, agricultural economist with the R.R. Nathan Associates team assigned to the Ministry of Planning; Dr. Raymond Hooker, Programme Economist, U. S. Agency for International Development, Afghanistan; and M. A. Ghafour, Vice President for Ministry of Agriculture--and the final assumption was obtained of 1,000 kg./ha. for the average wheat yield for the traditionally-irrigated farmland in 1946.

Yields in 1946 for high value crops, vineyards and orchards (assumed to be a composite of pomegranates and apricots) were estimated by the same method used for wheat. They were assumed to be 6,000 kg./ha. for vineyards and 7,000 kg./ha. for orchards.

(c) Per cent distribution of cropland between wheat and high value crops. The estimate of high value crop production in 1946 was derived from F. O. Youngs, Report on Three Years of Agriculture Survey and Experimental Work (Kabul: Morrison-Knudsen Associates, 1949), Table 1. For the Helmand, 95 per cent of cropland was estimated to be in wheat, 3 per cent in orchard, and 2 per cent in vineyard. For the Arghandab, 75 per cent was estimated to be in wheat, 18 per cent in orchard, and 7 per cent in vineyard.

Table 11--Continued

Once an estimate of base cropland, yields and per cent distribution among the major crops was made, the methodology for calculating the net benefit series was very similar to that described in Chapter 3. Prices used were 1971 market prices; i.e., 6.34 Afs./kg. for wheat, 2.72 Afs./kg. for orchards and 3.18 Afs./kg. for vineyards. Similarly, livestock values were calculated on a gross cropland basis. Double-cropping was assumed to be 5 per cent, and net farm production value was assumed to be 60 per cent of gross farm product. Using the formula on page 63, Chapter 3, the net farm production value for 1946 was calculated.

The net benefit series 1952-1971 is generated from a straight line interpolation of point estimates. Three such points were taken: 1955-56 (Tudor report, Table 1, p. 3), 1962-63 (I.M. Stevens and K. Tarzi, Economics of Agricultural Production in the Helmand Valley, Denver: Bureau of Reclamation, U.S. Department of the Interior, 1965, Table VII, p. 46), and 1970-71 (G. Owens, 1970 Farm Economic Survey: Helmand-Arghandab Valley of Afghanistan, Kabul: U.S. Agency for International Development, 1971, table 23, p.50).

The series begins in 1952, marking the completion of the first reservoir, and from that date until 1968, the only variable that changed was cropland. Notice that between 1955 and 1968, the amount of cropland remained relatively constant, decreasing slightly due to salinization problems in the Arghandab.

From 1967 to 1971 the yields, and the incidence of double-cropping as well as the cropland are increased gradually until they reach the levels of the 1971 survey data (Owens, Farm Economic Survey) Table 38, p. 78 and Table 23, p. 50.

TABLE 12  
 HELMAND-ARGHANDAB VALLEY PROJECT:  
 HISTORICAL INVESTMENT SERIES 1946-1971

Year	U.S. Expenditures <sup>a</sup>			R.G.A. <sup>d</sup>	
	\$000	000Rs. <sup>b</sup>	Total <sup>c</sup> in Afs.000	Expenditure Afs.000	Total Afs.000
1946-47	4,195	3,242	85,904	37,825	123,729
1947-48	4,195	3,242	89,679	37,825	127,504
1948-49	4,195	3,242	95,972	37,825	133,797
1949-50	4,195	3,242	132,469	37,825	170,294
1950-51	6,324	319	220,879	83,749	304,628
1951-52	7,800	3,476	290,202	113,027	403,229
1952-53	4,564	4,039	186,588	192,600	379,188
1953-54	3,510	962	134,550	162,200	296,750
1954-55	3,681	3,568	170,658	201,100	371,758
1955-56	4,328	5,447	219,705	207,400	427,105
1956-57	2,400	--	129,120	80,000	209,120
1957-58	2,400	--	129,840	80,000	209,840
1958-59	2,400	--	131,280	80,000	211,280
1959-60	2,400	--	111,840	80,000	191,840
1960-61	2,400	--	97,920	80,000	177,920
1961-62	2,223	--	96,478	123,502	219,980
1962-63	1,780	--	93,984	151,977	245,961
1963-64	2,177	--	111,680	231,325	343,005
1964-65	2,166	--	137,758	188,385	326,143
1965-66	1,920	--	184,530	190,205	374,735
1966-67	1,786	--	178,202	217,962	396,164
1967-68	2,305	--	307,284	37,090	344,374
1968-69	1,388	--	103,267	194,741	298,008
1969-70	1,752	--	131,751	96,406	228,157
1970-71	1,252	--	105,919	87,241	193,168
Total					6,707,317

NOTES: (a) The series of U.S. expenditures is derived from several sources. These include contracts between the Royal Government of Afghanistan and Morrison-Knudsen, the Export-Import Bank, the International Cooperation Agency, and the U.S. Agency for International Development. Data for the period 1946-1955 is from the Tudor report (Tudor Engineering Company, Report on the Development of the Helmand Valley, Afghanistan, Washington, D.C.: Tudor Engineering Company, 1958), p. 176, table 25, with the total of \$16,778,000 for the period 1946-50 divided into four equal parts. For the period 1956-61, data was obtained in the U.S. Department of Interior, Bureau of Reclamation, Shamalan Unit Feasibility Report (1968), p. 14, table 2. The investments in the period

TABLE 12--Continued

1961-1971 are derived from U.S. Agency for International Development, Operations and Status Reports. Expenditures of \$9.2 million for the Kandahar airport have not been included. Similarly, over the period 1965-1971 a £ 650,000 British loan for a cotton gin and allied technical assistance is included (converted at a rate of 1£ = \$2.80).

(b) Indian Rupee expenditures were documented in the Tudor report (cited above), p. 176, table 25.

(c) U.S. dollars are converted to afghanis by the yearly average free market (bazaar) exchange rate (source, D.A. Afghanistan Bank). The rate rises constantly from 17:1 in 1946 to 84.6:1 in 1971 with the exception of the period 1959-1961 when it declined slightly. The Indian Rupee expenditure is converted to afghanis at a constant rate of 4.5:1.

(d) The RGA development expenditure data are gleaned from various sources. From 1946 to 1949 the estimates of expenditure are taken from Peter G. Franck, Obtaining Financial Aid for a Development Plan: The Export-Import Bank of Washington Loan to Afghanistan, U.S. Congress, 83rd Session, Committee on Banking and Currency (Washington, D.C.: Committee Print, September 1953; U.S. Government Printing Office, 1954), p. 34, note 64. From 1950 to 1956 the source used was the Tudor report (p. 176, table 25), and data for 1957-1960 were taken from the Royal Government of Afghanistan, Ministry of Planning, Survey of Progress 1959, 1960, and 1961-62. The data for 1961 to 1971 were taken from the General Accounts Department, Helmand-Arghandab Valley Authority, Lashkar Gah.

not so, and that the relative skewed-ness of the two undiscounted and unadjusted series was not so obvious. Would it then be necessary to introduce technical change and inflation factor adjustments? An obviously affirmative response would have to be qualified with the particular caveats associated with ex post data adjustments.<sup>84</sup>

Aside from the difficulty of locating the historical data, the actual generation of these two ex post series of investment costs and incremental net farm production values poses a plethora of analytical problems. In the first place, the reliability of any historical series in a Third World country where systematic data gathering is generally a recent phenomenon, is open to a very wide range of justified skepticism. National statistics which go back for more than five years are of dubious validity. Within Afghanistan many of the national statistics for present day values are questionable (See Chapter 7), and historical series do not exist. Fortunately, while it may be unrealistic to generate national historical series, a regional series is more defensible, particularly when there has been heavy foreign involvement. Such is the case with the Helmand-Arghandab Valley, where there has been a relatively comprehensive accounting of past investment as well as several attempts at estimating gross regional farm production as early as 1949.

With an historical investment series in current dollars, afghanis and rupees, and point estimates of key agricultural factors of production (cropland, yields, crop combinations, and double cropping) the next step in developing consistent historical series amenable to convention benefit-cost analysis requires somewhat questionable assumptions and data adjustments.

Looking first at the historical investment series, adjustments have to be made for foreign exchange, inflation and technical change. The

foreign exchange component is by far the easiest to handle. Dollar and rupee inputs are converted at the average annual free market exchange rate when the expenditure is recorded. Inflation is more difficult. In 1949 a man's daily wage was one or two afghanis per day; by 1971, the daily minimum wage (set by custom) had risen to 20 to 30 afghanis. In 1949 a tractor might have cost \$3,000; in 1971 that tractor might cost \$5,000 to \$6,000. If an adequate price index (comparable to those in Western countries) were available, the costs could be roughly separated and inflated by the appropriate index number. In Afghanistan such an index series does not exist. At the national level only the price of wheat can be traced (with some gaps) back to 1949; obviously an inadequate basis on which to inflate tractors, cement and foreign technicians. An alternative would be to take the record of physical units developed, cubic meters of earth moved, tons of concrete poured, kilometers of canal laid and roads built annually and cost them out in 1971 prices. This is an interesting but not wholly feasible proposition. Technical change enters into the problem, because that 1949 tractor was not as efficient as its 1971 counterpart. Thus if an accurate historical series were to be generated, quality differences would similarly have to be incorporated into the undeflated and unadjusted series.

To generate a reliable series of net benefits from point estimates of agricultural factors of production is less difficult. The calculation of a net farm production value series in constant 1971 prices from 1949 to 1971 is rather straightforward. The methodology used in the historical series can be directly compared with the methodology used for projecting net farm production value 1971-1992. (See Chapter 3).

Fortunately, many of these problems need not be breached in order

to arrive at a conclusion from the ex post evaluation of the Helmand-Arghandab Valley Project. The ex post analysis, just attempted, although providing some interesting insights, may, in fact, be irrelevant as a guideline for an ex ante evaluation. The proposition would be forwarded that what was sunk into the project area has no bearing upon future investment decisions. The past failures in construction design, delayed implementation, and inflated costs do not detract from the fact that in 1967 the "green revolution" came to the valley, and since that date production has been rising. Without the infrastructure, these gains would have been impossible, and if the trend continues, there may be some point where the undiscounted net production gains will not only equal, but greatly surpass aggregate past investments.

Looked at in this light, the concept of capital intensive irrigation is not a fault; rather, the project was plagued with unusual situations which, in all probability, will not be replicated, given the more advanced state of the present Afghan economy. Any ex ante analysis should disregard the past social costs as sunk. The infrastructure is now in place, and the recent gains as a result of the "green revolution" provide the necessary proof of the efficacy of the present system.

Unfortunately, the evidence does not support this hypothesis. Upon closer inspection, the impact of the irrigation infrastructure upon the gains from the "green revolution" appear quite chimerical. Analyzing a recent survey, it is clear that the problems experienced in the past are very relevant to an ex ante evaluation. The Farm Economic Survey<sup>85</sup> shows that the modern irrigation infrastructure has proven necessary neither to increased yields nor to the elimination of complaints of water shortages

and salinity problems. The survey was done in using farmers selected at random from various regions of the project. The regions varied in the extent to which they benefitted from the infrastructure.

Of the total land estimated to be under water command of the two reservoirs, it is estimated <sup>86</sup> that as of 1972:

- Land receiving full benefits from the capital structures totalled only 2.6 per cent.
- Land under laterals constructed by the Helmand-Arghandab Valley Authority, partially drained and leveled, totalled only 7.1 per cent.
- Land irrigated by old irrigation canals with water from canals constructed by the Authority, rather than from old river diversions with some drains built, totals 35.5 per cent.
- Land still irrigated from old privately constructed river diversion systems totalled 54.8 per cent.

When comparing areas which have extensive capital investments in place with areas benefiting only from the dams, there seems to be little correlation among area-specific investments and yields, farm incomes, cropping patterns, incidence of double-cropping, and complaints of water shortages (See Tables 10 and 13).

By referring to these tables several interesting relationships may be observed:

- 1) Whereas farmers in the Marja and Nad-i-Ali areas, areas with the heaviest capital-intensive investments, complain the least about water deficiency, they are the most frequent complainers about salt problems. That 67 per cent of those farmers in Marja and Nad-i-Ali who complain about water



TABLE 13

HELMAND-ARGHANDAB VALLEY PROJECT: PER CENT OF FARMS REPORTING INSUFFICIENT WATER, REASONS FOR SHORTAGE, AND PER CENT OF FARMS REPORTING SALINIZATION PROBLEMS, BY AREA

Area	% of Farms Reporting Insufficient Water	Reasons for Shortage						% of Farms with Salinization Problems
		Lateral Too Small	End of Jule	Dry Kariz <sup>a</sup>	Poor Dam	Shortage in Summer	Economic Problems <sup>b</sup>	
Helmand Valley:								
Nad-i-Ali	14.3	16.0	67.0	--	-	-	-	71.0
Marja	15.0	-	67.0	--	-	-	-	68.0
Shamalan	32.2	-	25.0	--	10.0	20.0	-	36.0
Darweshan	37.5	7.0	-	7.0	7.0	60.0	-	55.0
Khanishin	100.0	8.0	-	8.0	90.0	38.0	8.0	82.0
Seraj	95.7	18.0	-	-	53.0	47.0	-	53.0
Girishk	40.0	10.0	-	-	50.0	25.0	10.0	58.0
Sanguin-Kajakai	59.3	-	-	-	67.0	-	-	54.0
Musa Qala-Zamin Dawar	93.5	-	12.0	33.0	52.0	92.0	3.0	11.0
Nowzad	100.0	10.0	-	63.0	5.0	97.0	-	10.0
Average: Helmand	49.9	8.0	8.0	19.9	41.8	62.0	3.0	48.6
Arghandab Valley:								
Maiwand	97.3	25.0	14.0	33.0	6.0	64.0	8.0	30.0
Dund-Daman	77.5	7.0	-	1.0	14.0	58.0	34.0	73.0
Arghandab	29.1	23.0	-	-	30.0	10.0	37.0	16.0
Panjwai	76.0	20.0	9.0	2.0	21.0	46.0	2.0	75.0
Average: Arghandab	64.5	9.9	3.9	4.1	10.8	32.0	33.1	51.5
Average: Helmand-Arghandab Valley	56.0	11.5	6.3	13.0	29.6	56.0	26.4	49.8

SOURCE: G. Owens, 1970 Farm Economic Survey, Helmand-Arghandab Valley of Afghanistan (Kabul: U.S. Agency for International Development, 1971). Percentages by area may add to more than 100 per cent because some farmers mentioned more than one reason for the water shortage. Question was unstructured and replies were categorized in editing.

(a) Kariz irrigation is practiced to a significant extent only in Musa Qala-Zamin Dawar, Nowzad and Maiwand, where there were significant reports of "dry karizes".

(b) Economic problems refers primarily to lack of funds for purchasing water pumps or paying labor to maintain irrigation ditches.

insufficiency are at the end of juies strongly suggests a water distribution problem.

2) Farmers in Shamalan, which is upstream from Darweshan and profits from a relatively larger irrigation infrastructure, complain almost as much as farmers in Darweshan about water insufficiency.

3) Whereas farmers in Sanguin and Kajakai report a relatively high incidence of water shortage, the average amount of double-cropping is more than 300 per cent greater than the average amount in the entire region (See Table 10). That this area is high on the flood plain with a long history of traditional farming partially explains the high proportion of double-cropping, but why the complaint of water inadequacy?

There is only one possible explanation. The incidence of water shortage, salinity, double cropping, and high yields, is not determined primarily by access to a modern irrigation infrastructure, but by the control of water. Farmers who cannot get guaranteed access to traditionally supplied water will not necessarily benefit from a removal of the physical constraints. This will be discussed in detail in Chapter 8. Whereas the modern infrastructure will technically assure an adequate supply, culturally determined on-farm distribution systems set the real distribution patterns of a constant and augmented supply of irrigation water.

Returning to our conclusion of Chapter 4, it is now possible to give a definite policy recommendation for the most probable direction of the contingency adjustments. Unless the institutional constraint of on-farm distribution can be removed, the project is definitely not feasible. The results of investment will most probably be a net social loss. If the

institutional constraints can be removed, then the probability of achieving a positive social rate of return increases.

Although the removal of the institutional constraint might be a necessary condition for a positive social rate of return, it is not a sufficient condition. The introduction of chemical and biological innovations has shifted the comparative advantage toward land intensive agriculture and labour using technical change. The responsibility of project planners, given that an effective method to assure equitable and efficient water distribution can be introduced, must still be to prove that the water supply is so critically short that it limits the increase in production potential from alternate, less expensive forms of technical change.

References to Chapter 5

1. H. Pillsbury, Afghanistan: The Greenhouse Nation (Kabul: University of Wyoming and Kabul University, 1968).
2. Traces of civilization have been found as early as the Bronze Age. Qala Bist, situated seven kilometers from the present day Lashkar Gah, is mentioned in ancient history along with the earliest city of Nineveh. French archaeologists, exploring near Kandahar, have found ruins which they have dated at 2500 to 3000 B.C. W. Kerr Fraser-Tytler traces the history of the area from 500 B.C. in his book, Afghanistan (London: Oxford University Press, 1935).
3. Information prior to 1946 from A.A. Michel, The Kabul, Kunduz, and Helmand Valleys and the National Economy of Afghanistan: A Study of Regional Resources and the Comparative Advantage of Development (Washington, D.C.: National Academy of Sciences, National Research Council, 1959), p.48; and Louis Dupree, "Afghanistan: Draft" (Princeton, N.J., 1971), Chap.4, p.76.
4. In the vicinity of the present Boghra Canal (see figure 3).
5. Morrison-Knudsen was slated to build the Sarobi Dam in the Kabul River Gorge, but its contract bid was too high and the RGA awarded the contract to Siemens-Schuckert of West Germany. From Peter G. Franck, Obtaining Financial Aid for a Development Plan: The Export-Import Bank of Washington Loan to Afghanistan, U.S. Congress, 83rd Congress, 2nd Session, Committee on Banking and Currency (Washington, D.C.: Committee Print, September 1953; U.S. Government Printing Office, 1954), p.14 note 25. Cited by Michel, op.cit., p.150.
6. Dupree, op.cit., p.78.
7. Franck, op.cit., p.17 note 28.
8. Michel, op.cit., p.154.
9. No breakdown of local and foreign currency costs is available.
10. The first contract between the Royal Government of Afghanistan and Morrison-Knudsen provided bonuses for early completion dates. This expensive clause was removed from the second contract between them (1951).
11. The Shamalan already contained several old villages; and the farmland, along with that of Darweshan farther down the Helmand, was owned primarily by large landowners. Dupree, op.cit., p.81.

12. "Rarely did an individual apply other than as a member of a group. Generally, local leaders would lead their people, Moses-like, to the promised land. The Helmand Valley Authority, however, always informed the new settlers they could choose new village leaders, to be called wakil, if they so desired."None did. Dupree, op.cit., p.81.

13. Experts from the Export-Import Bank had advised an increase in the farm size from 4 to 5.8 hectares per settler and the adoption of irrigated pasture for sheep and cattle with wheat sown only on one-fourth of the acreage in any given year. The Helmand Valley Authority agreed to increase the plot size as recommended, but the task of converting grain-growing traditional farmers to animal husbandry proved impossible.

14. "The Helmand Valley Development Program", (Kabul, July 1953). This report was written by a committee chaired by Mr. Tolbert, Chief of the International Cooperation Administration for Helmand Valley operations. The committee was composed of International Cooperation Administration, Helmand Valley Authority, Export-Import Bank and Morrison-Knudsen Afghanistan representatives with some participation by the Food and Agriculture Organization of the United Nations and the U.S. Embassy in Kabul. Some analysis by Claude L. Fly is incorporated, but Fly states explicitly that the conclusions are a result of the committee's work. Subsequent to the 1953 publication, a similar publication appeared in September 1955, to be revised again in December 1955. Considerable doubt remains in the mind of the author as to the authorship of these publications and the subsequent veracity of the analysis.

15. Included also in the Royal Government of Afghanistan's proposal was a request for assistance in paving the streets of Kabul. This was excluded from the second loan, only to be immediately accepted by the Russians and to serve as one of the Russians' first successful public relations aid programs in Afghanistan.

16. Development of the Lower Helmand posed a delicate political problem. The Royal Government of Afghanistan insisted that the Lower Helmand development was the only way to reap full benefit of the investment in the reservoir, while the American policy-makers feared the political repercussions of cutting a major portion of the flow into Iran.

17. It must be mentioned that this work in the Arghandab River Valley was similarly begun before adequate soil and engineering surveys were completed; and the ramifications of this insufficient planning were to arise only by the mid-1960's.

18. It may be merely coincidental, but both Tudor Engineering Company and Morrison-Knudsen were Idaho firms.

19. Tudor Engineering Company, Report on the Development of Helmand Valley, Afghanistan (Washington, D.C.: Tudor Engineering Company, for the International Cooperation Administration, November 1958).

20. International Engineering Company, "Soil and Water Resources of Southwest Afghanistan," Draft Report (Kabul: Morrison-Knudsen Afghanistan, September 1957). This publication represents the most complete survey of the area. Unfortunately, most of the original data has been lost; all that remains are several copies of the final draft.

21. Tudor Engineering Company, op.cit., p.6. The soils specialist for the Tudor appraisal was Milton Foreman, now the senior soils specialist of the World Bank. He confronted Fly with clear proof that in terms of soil productivity ratings, every series and type of soil was classified higher than the employment of scientific criteria would permit. Fly acknowledged this and stated, "We wanted to have a project."

22. Ibid., p.1.

23. Ibid., p.2.

24. New income from the project was estimated by Tudor at \$10 million. International Engineering's report, op.cit., had estimated \$5 million, while the Afghan Director of the Helmand Valley Authority at the time of the Tudor report estimated only \$1 million, which he stated was a result mostly of backed up waters from the Arghandab Dam enabling double-cropping around Kandahar. From G.K. Fitch, "Report," U.S. State Department Program Course (Baltimore: Johns Hopkins University, October 1958), p.331. The new income estimates are not directly comparable to data used in the internal rate of return analysis that follows and are taken to be less reliable.

25. Tudor Engineering Company, op.cit., p.1.

26. Subsequently the International Cooperation Administration had great difficulty in recruiting men to fill these positions; some were unwilling to live in the Helmand-Arghandab Valley. Suggestions were made to hire younger professionals more willing to endure the hardships (Fitch, op.cit., p.43), but instead, the project chose to change the physical environment and make the desert comfortable by Western standards.

27. Tudor Engineering Company, op.cit., p.8., Recommendation 11.

28. Koebig and Koebig Company, Transportation Facilities of Afghanistan (Los Angeles: Koebig and Koebig, October 1957). This report was contracted by the U.S. Agency for International Development.

29. Fitch, op.cit.

30. Only the portion of the Spin Baldak-Kandahar road is included in the investment schedule of the benefit-cost analysis. Although subsequent studies of the Helmand-Arghandab project costs have excluded the Spin Baldak road as a project expenditure, it can be argued that the road construction is an integral part of the project. The recommendation was born originally from the Tudor report, op.cit., p.167, which stated "future prosperity of the Valley would depend in very considerable part upon the smooth and rapid transit of goods through Pakistan, and it is essential that such transit be made as easy as possible. Existing difficulties and delays, particularly in shipping goods to and from Karachi, constitute a serious burden upon trade, increase the cost of development, and may well retard the Valley's economic growth."

31. Fitch, op.cit., p.25.

32. The small hydroelectric plant of about 3,000 KVA constructed on the Boghra canal about midway between the diversion dam and Girishk was one of Morrison-Knudsen Afghanistan's last jobs in the Helmand-Arghandab Valley.

33. Dupree, op.cit., p.85.

34. Cadastral survey was really only begun in the late 1960's.

35. A by-product of 15 years of American presence was the spread of the English language. Today many people, particularly in the Kandahar area, still remember the "Morrison-Knudsen Company." It was, in fact, the first major English language program in Afghanistan.

36. In 1964 the Afghan Construction Unit was renamed Helmand-Arghandab Construction Unit.

37. In the United States, chemicals are used to keep the canals free of these impediments--an impossible procedure in Afghanistan, where the water serves as drinking water for man and livestock, as well as for irrigation.

38. As at Nad-i-Ali, nothing has been paid back on these loans to date. Dupree, op.cit., pp. 88-89.

39. "These areas [Shamalan] had about 50% of the agricultural land owned by absentee landlords. The local power elites regard the influx of new independent land owners as a threat, and although they hope to benefit from the additional water furnished by the dams, they resist the Government's attempt to collect land and water revenues." Dupree, op.cit., p. 92.

40. I.M. Stevens, K. Tarzi, and K. Mohammed, "Economic Analysis of Marja Farms" (Kabul: Helmand Valley Regional Development Project, U.S. Department of Interior, Bureau of Reclamation, November 1964).

41. "Some cynics believe some in the Government do not want the farmers in the Helmand Valley to develop into independent, commercial farmers, in order to maintain tighter economic and political control of the region. However, the articulated goals of the Helmand-Arghandab Valley Authority remain: to create a region of independent, landowning commercial farmers." Dupree, op.cit., pp. 96-7.

42. Stevens and Tarzi, Economics of Agricultural Production, op.cit.

43. Ibid., p.ix.

44. Ibid., pp. 37-8.

45. A national programme of the Royal Government of Afghanistan that required farmers to devote 25 per cent of land under irrigation to cotton was abandoned in 1967.

46. Stevens and Tarzi, Economics of Agricultural Production, op.cit., p.x.

47. Ibid.

48. Ibid., pp. x-xi.

49. Ibid., refer to Table I, p.6, and Table X, p.49.

50. Under a new charter with the Royal Government of Afghanistan in 1965, the Helmand Valley Authority was extended to cover the Kandahar area, becoming the Helmand-Arghandab Valley Authority.

51. Richard F. Saunders and Ahmad Zia Morshidi, "Development Project Evaluation Report: Helmand-Arghandab Valley Authority" (Kabul: Royal Government of Afghanistan, Ministry of Planning, November 1967).

52. Twice, in 1955 by Tudor Engineering (op.cit.) and again in 1965 by Stevens and Tarzi (Economics of Agricultural Production, op.cit.), it was recommended that Nad-i-Ali be converted to pasture land. "Our study confirmed that the Nad-i-Ali lands and conditions are so poor that people cannot hope to make a living from cropping this land. In lieu of large expenditures for drainage and development of Nad-i-Ali, it should be used for a pasture-livestock program," Tudor report, p.xi. Although economically a sound proposition, the political and social realities of relocating the new settlers made the proposal unworkable.

53. C.R. Maierhofer, Drainage and Related Problems of Irrigation Development in the Helmand Valley (Denver, Colo.: U.S. Department of Interior, Bureau of Reclamation, April 1961), cited in Shamalan Unit Feasibility Report, Helmand-Arghandab Valley Project (Lashkar Gah: U.S. Department of Interior, Bureau of Reclamation, December 1968), p.19.



54. Tudor Engineering Company, op.cit., p.59.
55. Vakil A. Noory and Ottar Nervik, Report on Field Trip to Helmand Valley (Kabul: Robert R. Nathan Associates, January 1961).
56. Under a new charter (1964) between the Helmand-Arghandab Valley Authority and the Royal Government of Afghanistan, the Authority was given responsibility for industrial development.
57. Involved were not only the Central Government's policy planners, but various ministries: e.g., Ministry of the Interior and Ministry of Planning.
58. Raymond T. Moyer, "Basic Assumptions, Objectives, Immediate Goals and Required Action for an Agricultural Development Program in the Helmand-Arghandab Valley: A Draft Proposal for Review and Comment," (Kabul: U.S. Agency for International Development, January 6, 1968), pp. 2-3. The lack of coordination between the Royal Government of Afghanistan and the Helmand-Arghandab Valley Authority may have been aggravated by some high government officials who believed that the project was a failure and that development funds would be better used if funneled to other areas, particularly the more heavily populated, more fertile Turkestani Plain in northern Afghanistan. But whether this was the reason, or because the administrative procedure imposed by the Royal Government of Afghanistan on all agencies was at fault, is beyond the purview of this paper. For more detail on general administrative problems encountered in agricultural development see R. Hughes, et al., Sectoral Planning Study of Agriculture in Afghanistan (Kabul: Asian Development Bank, July 1971).
59. John S. Benz and F.S. Holmgreen, "The Helmand Valley - An Overall Review" (Kabul: U.S. Agency for International Development, November 1962).
60. R.H. Allen, "Helmand Valley Development" (Kabul: Robert R. Nathan Associates, November 1963).
61. Ibid., p.4.
62. Noory and Nervik, op.cit.
63. United States, Department of the Interior, Bureau of Reclamation, "Draft Feasibility Report, West Shamalan Division, Shamalan Unit" (Kabul: Bureau of Reclamation, December 1966). Later this report was updated by the Bureau of Reclamation's Shamalan Unit: Feasibility Report, op.cit.
64. Bureau of Reclamation, Shamalan Unit: Feasibility Report, op.cit., p.10. Prior to the completion of the report, the Helmand-Arghandab Construction Unit had not only begun work in the West Shamalan but had done some land development work at Zarest (the lower end of the Shamalan area). Some of the work has been ineffective as the areas have since proven to be unsuited for irrigated agriculture.

65. Other Islamic countries farming by traditional irrigation methods had the same characteristics.

66. Faced with strong farmer resistance, the Bureau of Reclamation planners later were content that the trees could remain.

67. Bureau of Reclamation, Shamalan Unit: Feasibility Report, op.cit., pp. 127-128. The total cost of land leveling was estimated as being relatively low since a good proportion of the land leveling had already been accomplished by individual farmers using their oxen, in order to achieve a relatively high degree of efficiency of water use.

68. The potable water system would be accomplished by sinking wells. This new drinking water system would not only cut the incidence of dysentery and other disease, but would increase maintenance efficiency, because flora that line the canal walls could then be killed by chemicals. What had not been considered by the Bureau of Reclamation is the Afghan preference for running water over well water, a view that stems from the Koran.

69. Saunders and Morshidi, op.cit., p.4.

70. Ottar Nervik, "Irrigation Development, Afghanistan" (Kabul: Robert R. Nathan Associates, Inc., August 1965), p.27.

71. It will be recalled that the Helmand-Arghandab Construction Unit between 1961-1965 constructed approximately 50 kilometers of laterals and 53 kilometers of drains, and leveled 300 hectares of land in the Tarnak area. But aside from the construction of the reservoir, the South and Tarnak canals and the minor land development in Tarnak, little else in the way of development took place in the Arghandab River Valley.

72. U.S. Department of Interior, Bureau of Reclamation, Central Arghandab Valley Unit Feasibility Report (Kabul: December 1970).

73. Ibid., pp. 138-139.

74. Ibid., p.162.

75. Many of the juies in the North Arghandab were built in 1777 as part of a public works program during the reign of Ahmad Shah.

76. A new phenomenon recently disclosed is the pumping of water from the reservoir to irrigate lands above the project area. What impact this will have on the area's potential cropland below the reservoir is still unknown.

77. It was never envisioned that the reservoir would dry up. A feasibility study, R.W. Beck "Electrical Power Survey Report: Helmand-Arghandab Valley, Afghanistan" (Kabul: R.W. Beck and Associates, 1964), concluded that the construction of a proposed electrification facility at Arghandab would be infeasible, even though the dam's construction specification had included an eventual hydroelectric facility.

78. Ibid., vol.2, Part 3, p.1-a, quoted by Bureau of Reclamation, Central Arghandab Valley Unit Feasibility Report, op.cit., p.54.

79. Don Perkins and K. Culbertson, Hydrographic and Sedimentation Survey of Kajakai Reservoir (Kabul: U.S. Geological Survey, 1968).

80. Ibid., p.1.

81. Bureau of Reclamation, Central Arghandab Valley Unit Feasibility Report, op.cit., p.8.

82. Owens, op.cit.

83. Ibid., Tables 15 and 16.

84. In attempting a project evaluation, either ex ante or ex post within a Third World environment, the analytical problems associated with the handling of technical change, inflation, and the basic unreliability of the data base are ubiquitous: they are only more exaggerated within the context of an ex post analysis.

85. Owens, op.cit., Chaps. 3-5, pp. 34-73.

## CHAPTER 6

### THE NANGRAHAR IRRIGATION AND LAND DEVELOPMENT PROJECT

In the Helmand-Arghandab Valley Project, the American planners attempted to solve the water supply and distribution problem in one particular way: they changed the physical parameters of the water supply system and combined the new infrastructure with a generally laissez-faire attitude to on-farm water distribution. They were content to let farmers' individual incentives maximize the efficient use of an increased supply of this scarce factor of production. In the Nangrahar Irrigation and Land Development Project, the Russian development experts, on the other hand, tried to circumvent the water distribution problem by substituting a collective state farm mode for traditional independent farm production. By uprooting and replacing the whole traditional system, they assumed the inefficient use of this costly resource would disappear. This solution turned out to be technically feasible, but culturally and politically untenable. The model proposed by the Russians for Afghanistan was never fully tested in the field. Instead of organizing 75 per cent of the developed land into mechanized and semi-mechanized collectives producing cash crops for exportation, the Afghans deliberately altered the project, once the major infrastructure was in place, by distributing the newly reclaimed land primarily in small parcels to landless farmers who could be expected to grow little more than grain crops for subsistence.

The Nangrahar Irrigation and Land Development Project in many ways resembles the Helmand-Arghandab Valley Project. It is an attempt to increase agricultural production in a region of the country by means of

capital-intensive irrigation and land development. The basic assumption is that the "construction of the Jallalabad (Nangrahar) irrigation system will introduce radical changes into the agriculture of the Valley and will play a leading role in the expansion of the economy of this area."<sup>1</sup>

Although founded with a degree of economic rationality (the irrigated cropland could be extended by the construction of a dam and new laterals), the impetus for the Russians to commit such a proportionately large amount of resources to this area was clearly political. Until the Nangrahar Project, Russian investments had been concentrated north of the Hindu Kush (Kabul being the exception). The Russians saw in this project an opportunity to extend their influence among the ruling ethnic group; the Pushtuns who are concentrated along the Pakistan frontier. Also, the Russian presence in Nangrahar province would put the Soviets closer to Pakistan and conceivably provide eventual access to the sea for South Central Russia.

Project investment in Nangrahar began in 1960 and is not complete to date. Technical, economic, social and political problems have plagued the project, with similar effects upon it as upon the Helmand-Arghandab Valley Project. The Russians have, after 14 years of investment, laid in place a very impressive infrastructure at an enormous expense. Like the Americans they have proved that it is technically feasible to construct modern irrigation facilities in a land-locked Third World Country. What they have not been able to prove is that the incurred investments in capital intensive irrigation and land development can yield a positive rate of social return.

As with the Helmand-Arghandab Valley Project, the Nangrahar project

was beset by many technical problems merely in putting the infrastructure in place. Briefly summarized, the technical problems were due primarily to poor planning. In the first place, the dam site at Darunta selected by the Russians had unstable strata and had to be grouted. Secondly, development of a major tract of land had to be abandoned since soil surveys showed the land of marginal potential productivity. Thirdly, in many areas top soil is still being trucked in before new irrigation water can be applied effectively to the land. A fourth major problem, that of a rising water table and salinity is both technical and cultural in nature. It is a problem that plagues many irrigation projects even under the best cultivation practices. The problem is aggravated when a modern irrigation delivery system is utilized by inexperienced traditional farmers on small independent holdings.

What exists now in Nangrahar province is only a rough approximation of what the Russian planning team intended. Essentially they wanted to prove the efficacy of large mechanized collective farms producing primarily cash crops (citrus and olives), using a modern irrigation grid both on newly reclaimed land and on land that had previously been traditionally farmed and irrigated.

In this chapter, the writer attempts to present through a brief history the developments from pre-project days until today within the target region, a task complicated by several factors. Collecting and analyzing information on the Nangrahar Irrigation and Land Development Project was very difficult. Much of the existing data is inaccessible, and that which is available is replete with historical gaps and serious contradictions. To the writer's knowledge, this is the first non-Russian

attempt at a comprehensive historical and quantitative analysis of the region since the irrigation project began. The information presented here is based upon numerous field trips, upon lengthy conversations with farmers and officials, and upon such scant documentation as was available.

Unfortunately, many gaps in the information base still exist and consequently, the underpinnings of any conclusions drawn are much less sound than those associated with the Helmand-Arghandab Valley Project. The history is followed by an evaluation of the benefits and costs of the project as presently formulated.

#### Project History

The same American engineering company which began construction of the Helmand-Arghandab Valley Project did the first surveying in the region. The survey was done to explore the possibility of an irrigation and land development project. As early as May 1947, the Morrison-Knudsen Engineering Company initiated a semi-detailed soil survey, and a land classification was made of an area of 5,000 hectares in the Jallalabad Valley, extending from Jallalabad City (see Figure 5) southeastward for about 15 kms. In February 1948, the reconnaissance soil survey and land classifications were extended to an adjacent area of about 12,500 hectares on the Batikot Flat. (This area lay to the southeast of the Jallalabad Valley toward the Torkham Pass border in Pakistan, and was separated from the former survey area by a belt of stony mountains a few kilometers wide). Both areas, although separate, were irrigated by the Kabul River. As a result of these two surveys and from rough estimates of additional areas traditionally farmed, it was estimated that approximately 20,250 hectares are, or can be,

reducing the possibility of loan repayment to the Russians.

(3) The Russian plan did not satisfy one basic political requirement of the Royal Government of Afghanistan. The proposed settlement programme would involve only 868 families, merely enough to resettle those farmers displaced above the Darunta Dam as a result of the reservoir's flooding their land. The Royal Government of Afghanistan wanted more farmers settled in the Nangrahar region; it saw the Russian proposal as merely a vehicle to increase employment, not to increase the number of small landholders in the area. Distributing the land in small parcels to the landless of the region would increase the permanent settlement within the area, without requiring any land tenure reform. On the other hand, the organization of the large state farms would increase wage employment but might also increase political activism in the area. A large cadre of landless workers (even if employed by the government) are much more likely to organize and foment political change than are small subsistence landholders. Enough Afghan government officials had been educated in Russia to explain to their compatriots the Russian theory of social dynamics. Only through the landless proletariat can revolution be initiated.

This is not how the arguments were stated in the public forum.

The Royal Government of Afghanistan argued that the Russians had underestimated the cost of the project and thus had reneged on their part of the agreement. By 1965, the realized costs had far exceeded the planned investment costs as envisioned in 1960 and 1961. This was primarily due to poor planning on the part of the Soviet Union. In the pre-planning stage, adequate soil surveys were not completed, and so when the work began to reclaim land, the initial soil surveys reported that in many areas top-



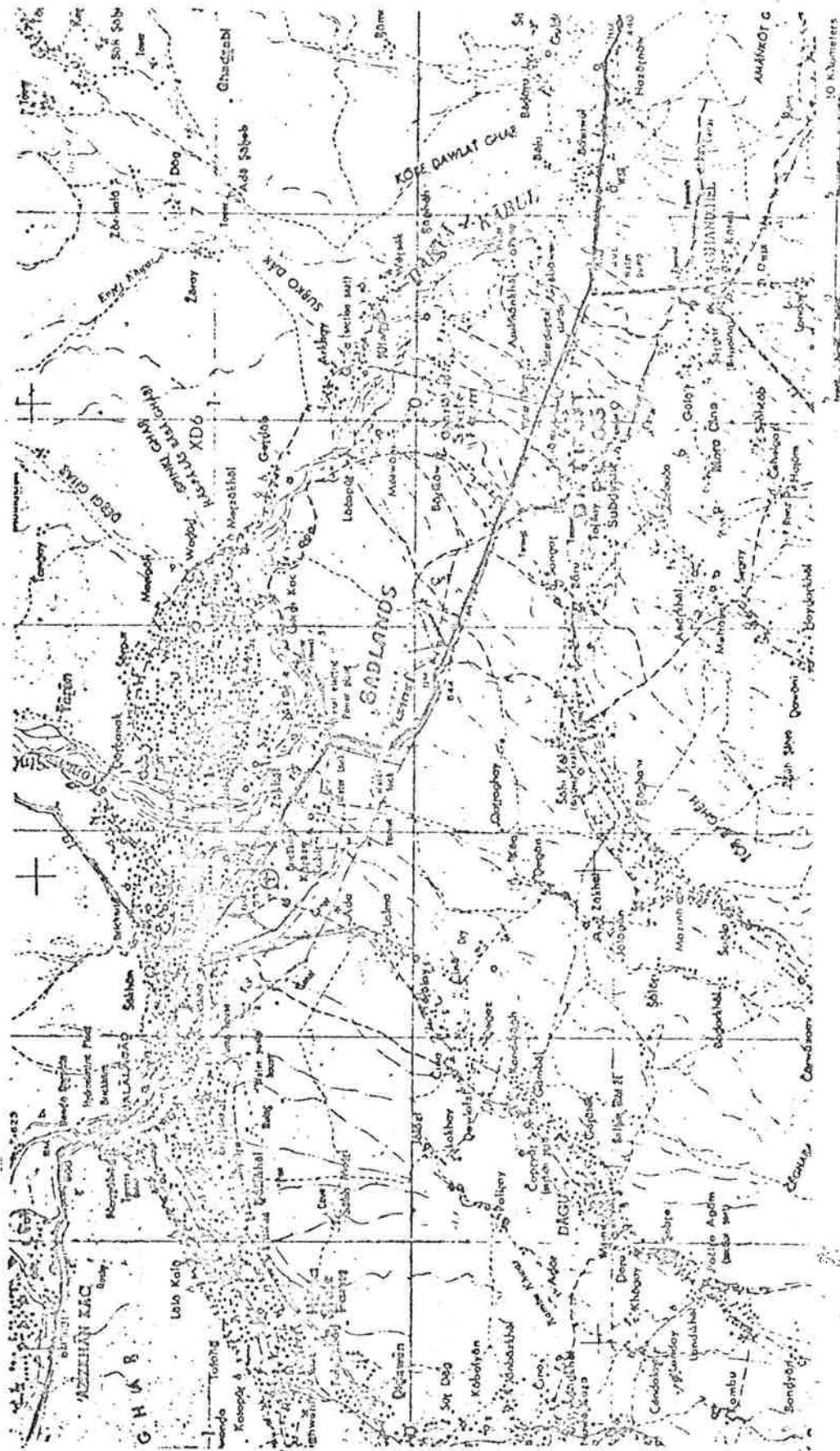


Fig. 5. Nangrahar Irrigation and Land Development Project: Principal Canal System

cultivable in the Jallalabad oasis and Batikot flat. The engineers were however, not optimistic about the region's developmental potential. In the first place, at least 5,750 hectares were inferior land and needed top-soil; in the second place, an area of 10,000 hectares on the Batikot Flat could not be irrigated by the same diversion structure at the Darunta Gorge. To get water across the nine kilometers of bad lands (See Figure 5) and up to the Batikot Flat, a separate diversion structure would be necessary. Consequently, the net irrigated potential was judged too small to warrant the heavy capital investment required. "The small area of the irrigatable valley lands is the chief factor limiting development in this area, as water is plentiful and the soils and climate favour high production of crops."<sup>2</sup>

F.O. Youngs, at the time, was favourably impressed with the traditional farming methods in the region and recommended only marginal changes. Thus:

No radical change in the irrigation practices, cropping methods, or the introduction of labour saving machinery should be recommended at this time. There is a need for a few minor changes in practices and introduction of new tools; however, these may be effected gradually.<sup>3</sup>

The Afghans did not want to accept the engineers' conclusions. The Royal Government of Afghanistan was convinced that the only way to increase agricultural production was to augment the water supply from the Kabul River by means of a large storage dam and a modern distribution system. Undaunted, the government made a petition to the United Nations for an \$8 million irrigation development grant to complete the proposed five year project. In light of later experiences, this estimate was to prove grossly unrealistic. The United Nations refused to consider the proposal.

The Royal Government of Afghanistan persisted.

The Afghans were anxious, for very salient political reasons, to develop Nangrahar province. It was a Pushtun area which had been losing population through temporary and permanent out-migration since Partition in 1947. The Pushtuns on the Pakistan side of the Durrand line were enjoying the benefit of a modestly successful development effort. Afghanistan wanted to find a way to keep as many Pushtuns as possible on the Afghan side of the border. Any obvious depletion of the Pushtun settlements could possibly disturb their hegemony over the other ethnic minorities within the country. A large irrigation project seemed the most likely means. All they needed was a sponsor.

The Russians were the first foreign donors to seriously examine the area as a possible region of involvement. For political reasons, the Nangrahar province was ideal. The Americans by the 1950's had already earmarked their territory: the Helmand-Arghandab Valley. The Jallalabad Oasis was not only situated in the heart of another major Pushtun area, but straddled the main transportation link to Pakistan, which could put the Russians more than 500 kilometers closer to an access to the Indian Ocean. All the Russians needed was a project.

In 1957, the first Russian project in the region was initiated. It was in that year that Soviet engineers laid out a drain through the marshes which lay between a newly constructed sugar factory and the Kabul River. The drain was to be a pilot project proving the efficiency of reclaiming land for sugar cane production, and was also a means to keep the Government's failing sugar cane factory in operation. But the swampy soils were heavy with clay. If the drains were to operate efficiently they

would require expert maintenance. Obviously, the expert water management capability was lacking: drains clogged, sugar cane production did not increase, and the sugar cane factory ceased operation.<sup>4</sup>

The ill-conceived project plan and its rapid implementation were based more upon a public relations drive than on any social or economic reasoning. By moving Russian technicians into the area, it was hoped that inbred hostilities<sup>5</sup> would be overcome.

The Russians at the same time were preparing for a major project in the region: one that would satisfy the needs of the Royal Government of Afghanistan. As early as 1957, Soviet engineers conducted an initial survey for a dam at the Darunta Gorge and signed a preliminary agreement with the Royal Government of Afghanistan to construct a 70 kilometer irrigation canal, a joint power/irrigation diversion dam, and a hydro-electric power station with an output capacity of 11 thousand kilowatts. The project agreement estimated the total cost at 2,588 million afghanis and proposed to terminate construction in five years.

Only after the first formal Soviet/Afghan contract was signed did the Russians begin to address the possible technical construction problems of extending the irrigation system and the methods of reclamation of new lands. While these inquiries were going on, defining the limits of the project, the Russians began in 1959 to physically move into the area. At first, secondary structures, including official and residential buildings were constructed to house the arrival of many new Russian technicians. The canal construction and the laying of the foundation for the power site were begun by 1960.

From the first, the Royal Government of Afghanistan began to have second thoughts. They wanted a dam and a canal constructed: then the Russians would leave. But the Russians were talking about land preparation and regional development to find ways for the Afghans to repay the loans for construction. What was first outlined as a single diversion dam-canal bifurcation project was slowly growing into a proposal for general irrigation, land reclamation, and land amelioration, i.e. a regional development project embodying a fundamental agrarian revolution.

From the estimate of 2,558.8 million afghanis the first revision in 1962 raised the project total to 3,005.8 million afghanis<sup>6</sup> of which, it was estimated, 687 million afghanis had already been expended.

In that same year, a group of Russian specialists arrived "to acquaint themselves with the natural and economic conditions of the Jallalabad Valley and to discuss with the Afghanistan representatives the problems of the land reclamation".<sup>7</sup> It was their objective to extend the project beyond 1965; the termination date for the initial project constructions. By 1965, over 3.5 billion afghanis would have been spent to merely construct a dam, canal and electrification plant. No provision had been made for the delivery of water to the farmers, the drainage of additional water off the land, the preparation of soils, and the delivery of the electricity to the consumer. The Russians were sensitive to the need for additional investment, particularly in land reclamation and development. They knew that the bare minimum infrastructure the Afghans wanted was insufficient to realize an increase in agricultural production. The critical element in the planning of the Nangrahar Irrigation and Land Development Project for the Russians was the creation of large-scale

mechanized (state) farms as a means of effectively using the modern irrigation network and the newly reclaimed land.

Given the high cost of land reclamation, the Russian advisers saw the possibility of creating a surplus and repaying the capital investments only by means of large-scale state farms. In a very detailed analysis, the Russian experts attempted to show the relative merits of state farms, state-type farms (different only from state farms in the degree of proposed mechanization), peasant farms, and peasant farms organized into co-operatives, with reference to:

- The size of capital investments necessary for implementation;
- The years required for repayment of capital investments to begin; and
- The total number of years until capital investment repayment would be completed.

The organization of the reclaimed land into state mechanized farms would obviously cost more per hectare, but the planners tried, with their analysis, to show that the state farms and state type farms would result in greater net gain to the national economy than investment in peasant, or small independent farms. Not only would these larger farms be able to generate a surplus to meet variable costs of operations and maintenance of the infrastructure at an early date, but they would be able to repay completely the investment loan in an appreciably shorter period. Table 14 summarizes their findings. From the table, it is clear that the peasant farms would take one-half the project life to begin repayment of the capital investments. For the first 28 years, the Royal Government of Afghanistan would have to sink additional investment within the region

TABLE 14

NANGRAHAR IRRIGATION AND LAND DEVELOPMENT PROJECT:

BREAK-EVEN AND INVESTMENT REPAYMENT

PERIODS (YEARS) BY FARM ORGANIZATION

Period	Farm Organization			
	State Farms	State-type Farms	Peasant Farms Organized in Place of State-type Farms	
			Without Cooperatives	With Cooperatives
<u>Break-even period:</u> From beginning of operation to year surplus generated can begin repayment of investment in infrastructure.	11	17	21	19
<u>Repayment period:</u> Years to repay investment in infrastructure.	7	8	28	22
<u>Total:</u> Years from beginning of operations to termination of debt obligations	18	25	49	41

SOURCE: U.S.S.R., Ministry of Agriculture, The Organization of the Territory Irrigated by the Jallalabad Canal in Afghanistan, 5 vols. (Tashkent: Uzgipozess, 1965), vol. 1, p. 45.

merely to meet the operating costs. And the agricultural surplus generated would, for the total effective life of the project (49 years), be drained off to debt repayment. The introduction of co-operatives among the peasant farms to speed the break-even date and recoupment period would help only marginally. On the other hand, the state farms and state-type farms would begin generating adequate surplus to cover operating costs by the seventh or eighth year and would take no more than one half the effective project life for debt repayment.

The analysis so presented leaves no room for doubt; large-scale state farms are the only possible way for Afghanistan to generate adequate surplus to both repay the debt to the Russians and have at least 25 years of claim-free cash crop surplus production to be used for other possible development investments. Also, the greater the degree to which Afghanistan could afford to mechanize the state farms, the shorter the recoupment period. Since the critical difference between the state farms and state-type farms is the degree of mechanization, total mechanization of the farms would cut 28 per cent of the repayment period; i.e. from 25 to 18 years.

Unfortunately, the methods used to calculate the years to a break-even operation under various organizational forms are not provided in the Russian plan. The conclusions, however, coincidentally and conveniently complement the accepted Russian notion of agricultural development as practised in their own country. The most effective agricultural organization is the large mechanized farm which liberates the working force for industrial development. Unfortunately, this model has not succeeded too well within the Russian experience; it is of even more questionable validity in a Third World country with a small population base and a low industrial potential.



The organization of the region would be predominantly in state collectives. Table 15 presents the proposed distribution of the lands in the Nangrahar Irrigation and Land Development Project. Of the total net cropland, only 25 per cent would be distributed as small individual holdings, "peasant" farms as the Russians so aptly called them.

The total investment costs would equal 9 billion<sup>8</sup> afghanis (See Table 16) for the development of 31,181 hectares of cropland, a cost of 289 thousand afghanis per hectare. The construction of the Jallalabad irrigation canal and distribution network would amount to 18 per cent of the costs<sup>9</sup>, the preparation of the lands would consume 30 per cent of the expenditures, the organization of the state and state-type farms (construction, equipment, cropland and orchard planting and preparation) would absorb 45 per cent of the total regional development budget, while the remainder of the budget would be spent on communication, processing plants, training schools, and greenery for ornamental and conservation purposes. From Table 16 it is clear that the expenditures on land preparation and state farm organization would place the greatest strain on the Royal Government of Afghanistan budget between 1965 and 1970. The six year period would require 66 per cent of the total Afghan commitment.

Whether or not the Royal Government of Afghanistan had originally accepted the plan is not known. However, by 1963, it was already quite concerned about the cost over-runs in the initial construction phase and was dubious about the reliability of these new cost estimates as proposed by the Russian experts.

In particular, the Royal Government of Afghanistan wished to postpone the reclamation of 6,601 hectares of rocky land at least beyond

TABLE 15  
 NANGRAHAR IRRIGATION AND LAND DEVELOPMENT PROJECT  
 PROPOSED DISTRIBUTION OF LAND  
 (hectares)

Farm Type	Land Distribution			Condition of Cropland	
	Gross Area <sup>a</sup>	Net Area	Distribution (percentage)	Pre-project Irrigated and Farmed	Newly Irrigated
State Farms	10,861	9,748	31.2	460	9,288
State-type farms	15,049	13,592	43.6	1,654	11,938
Peasant farms	8,590	7,841	25.2	5,522	2,319
Total	34,500	31,181 <sup>b</sup>	100.0	7,536	22,545

SOURCE: U.S.S.R., Ministry of Agriculture, The Organization of the Territory Irrigated by the Jallalabad Canal in Afghanistan, 5 vols. (Tashkent: Uzgipozess, 1965), vol. 1, p. 78, table 17.

<sup>a</sup>Includes all lands, some which will be occupied by structures and roads or otherwise be inaccessible to farming.

<sup>b</sup>Of this total, 9,635 ha. was in the western tract and 21,546, in the eastern tract.

TABLE 16

NANGRAHAR IRRIGATION AND LAND DEVELOPMENT PROJECT

PROPOSED INVESTMENT SERIES 1961-1981

YEAR	R.G.A. Investment (million afs.)	USSR Investment			Total Investment (million afs.)
		Roubles (000)	Afghanis (million)	Total* (million afs.)	
1961	68.8	2054.8	51.3	133.5	202.3
1962	137.5	4109.6	102.6	267.0	404.5
1963	225.0	8219.1	205.1	533.9	758.9
1964	343.8	10273.9	256.4	667.4	1011.2
1965	705.0	3402.7	84.9	221.0	926.0
1966	680.3	3279.4	81.8	213.0	893.3
1967	696.0	3353.4	83.7	217.8	913.8
1968	529.9	2564.4	64.0	166.6	696.5
1969	662.8	3205.4	80.0	208.2	871.0
1970	605.5	2934.2	73.2	190.6	796.1
1971	337.1	1627.4	40.6	105.7	442.8
1972	243.8	1183.6	29.5	76.8	320.6
1973	120.7	591.8	14.8	38.5	159.2
1974	55.1	271.2	6.8	17.6	72.7
1975	60.9	295.9	7.4	19.2	80.1
1976	87.4	419.2	10.5	27.3	114.7
1977	89.9	443.8	11.1	28.8	118.7
1978	57.6	271.2	6.8	17.6	75.2
1979	57.6	271.2	6.8	17.6	75.2
1980	78.7	369.9	9.2	24.0	102.7
1981**	29.5	147.9	3.7	9.6	39.1

SOURCE: The series of investments was taken from U.S.S.R., Ministry of Agriculture, The Organization of the Territory Irrigated by the Jallalabad Canal in Afghanistan, 5 Vols. (Tashkent: Uzgipozess, 1965), Vol. 3, p.27. Modifications in this series were made to provide internal consistencies. The years 1961 to 1964 were adjusted using data from Royal Government of Afghanistan, Ministry of Planning, Survey of Progress 1961-62 (Kabul: Government Printing House, 1963), and Survey of Progress 1962-64 (Kabul: Education Press, 1964).

\* Russian rubles to afghanis conversion equals 1:40.

\*\* constant to the end of project life.

1970, the proposed termination date of project construction. The revision that the Royal Government of Afghanistan suggested would eliminate the proposed construction of the second (eastern) pumping station and would reduce by 342 million afghanis the total development expenditures required. For their part, the Russians wanted this tract developed to realize a favourable benefit-cost ratio for their project, but they were sensitive to the Royal Government of Afghanistan budget constraints and were willing to be flexible, if only because they wanted their general concept of mechanized and partially mechanized state farms tested as an effective method to develop new lands and generate agricultural surplus in Afghanistan.

The Russians argued that aside from strict accounting considerations, the proposed model of large state farms was superior to small peasant farms for the following reasons:

- (1) The large state farms would hasten the process of reclamations by creating highly efficient fruit groves (olives and citrus). The specialized production of these commercial products would both expand domestic and export markets as well as concentrate all profits in the hands of the state.
- (2) The large state farms could effectively exploit the geographic and topographic comparative advantage of each crop.
- (3) The large state farms could direct earned surplus to reclamation of more difficult cropland and thus avoid excessive budgetary strains.
- (4) The large state farms would extend the division of labour and introduce new technology more rapidly; and finally;

- (5) The large state farms would create the basis for new state enterprises for processing the agricultural products (oil, canned goods, juices, jams, etc.) thus developing local industry, and by this, increasing regional employment, improving living standards, and contributing significantly to the growth of the national economy.

All these advantages did not impress the Afghans.

The planned organization of the Nangrahar Project as proposed by the Russians was never to be realized. In 1965 the Royal Government of Afghanistan and the Soviet Union agreed to dramatically alter the nature of the Nangrahar Irrigation and Land Development Project. Instead of four state mechanized farms, the Royal Government of Afghanistan wanted only two such state farms organized by 1970 on a combined area of not more than 5,000 hectares, instead of the 23,340 hectares of the first plan. Similarly, the Royal Government of Afghanistan proposed extending the time for reclamation and preparation of all other lands to thus relieve the annual investment burden. This alteration in plans by the Royal Government of Afghanistan would be the first, but surely not the last, major change in a long line of changes that would eventually satisfy the needs of the Royal Government of Afghanistan and completely nullify the proposed development plans of the Soviet Union.

The Royal Government of Afghanistan had several very salient reasons to precipitate such drastic changes in planning.

- (1) The Royal Government of Afghanistan, by 1965, was already feeling the burden of heavy capital investments, both within the Jallalabad Oasis, and as a result of other project invest-

ments, principally in the Helmand-Arghandab Valley (See Chapter 4). As the development progressed, the Royal Government of Afghanistan's annual commitment grew progressively. By 1964 it was greater than 343 million afghanis (See Table 16). The Russian plan would have doubled that amount for the next five years. The Royal Government of Afghanistan saw no way to support such a level of development expenditure. What they wanted was to find a way to reduce their annual expenditures while keeping the Russian involvement as near to the original plan as possible. Consequently, the Royal Government of Afghanistan proposed a plan that would effectively cut their commitments by 57 per cent while the Russians would cut back investment commitments by 12 per cent. This could be accomplished simply by reducing the size and number of collective farms. By substituting "peasant" farms for the state and state-type farms most of the Royal Government of Afghanistan's investment requirements would be eliminated.

(2) As part of the preliminary agreements between the Soviet Union and the Royal Government of Afghanistan, the whole agricultural surplus that would result principally from the large citrus and olive plantations would be sold to the Soviet Union in repayment of the debts. This agreement, once it became generally known throughout the country, drew great criticism, especially within Parliament. The Afghans were very concerned about "giving" their produce to the Russians. Although to some financial analysts this seems a logical way to repay an investment loan, to the Afghans the agreement was clearly exploitative. The Russians would "take" from Afghanistan, for at least 25 years most of the cash crop from the Nangrahar area. The most direct way out of this problem would be to avoid organizing the state farms, thus both saving the required increased investment and

soil would have to be trucked in before the new irrigation water could be applied to the land. This would require an increase both in investment costs and in construction time before the project could be handed over to the Royal Government of Afghanistan. The Afghans capitalized on this oversight, and used this technical problem as a sufficient condition to completely rewrite the project plan.

The Russian planners warned that the cut in capital investments in the reclamation of the land would seriously jeopardize future productivity. If such measures as improving soil fertility, planting fruit seedlings and field-protective trees, proper irrigation practices, and the maintenance of canals and drains were all to be handled primarily by "peasant" farmers, many of whom were nomads and inexperienced in farming practices, there would be no way of guaranteeing the newly reclaimed land would not fall back into disuse. The problem, the Russians warned, would be aggravated by winds that would accelerate soil deterioration.

But aside from verbal criticism, the Russians did little more than try to reorganize their planned involvement in the area. Their goal after 1965 was to hand over as much of the operation as quickly as possible to the Royal Government of Afghanistan. To a certain extent, they were able to effect a partial transfer, and a wholly Afghan Nangrahar Development Authority was created to manage the project. But at the same time, the Russians were locked in, and their prestige was inextricably involved with the success of the project. By 1974, land settlement programmes were still being implemented, and some of the land was not as yet levelled or prepared. Russians experts still lived in the Valley, and an additional number has been proposed to handle new drainage problems that have started to appear

as a result of poor irrigation practices among the new settlers.

An Ex Post Analysis

Lack of data prevented more than a cursory ex post analysis of the Nangrahar Valley Project, but it clearly shows that the project as presently organized will never be able to yield a positive social rate of return if judged merely on efficiency criteria.

By 1974, after 14 years of construction, the project had yet to be completed. Although exact statistics of annual budgeted expenditures by both the Afghans and Russians are unavailable, the writer estimates that over six billion afghanis have already been spent on the irrigation grid and on the development of a maximum of approximately 23,000 hectares. By 1973, at least 25 per cent of the potential cropland had not been distributed to farmers. Work is still continuing to level and prepare (by trucking in tons of topsoil) this land for eventual distribution to landless farmers. Only 5,700 hectares had been organized into two state farms which had begun operation in 1969 and 1970.

The major cash crop of the two state farms is projected to be citrus, but the latest published statistics show that by 1971 citrus production<sup>10</sup> had reached a level of only 164 metric tons. The production of the other major crops for that year is shown in Table 17.

Using world market prices (F.O.B. Karachi plus transport by rail to Kabul) for citrus, and domestic prices for all other commodities, gross state farm production in 1971 totaled no more than 25 million afghanis. Assuming as an upper limit that 15,000 hectares, divided into small "peasant" farms, were in full production, 1971 produced a wheat crop with an average yield of 1,500 kilos/hectare. This would add just over 81 million afghanis to gross regional production. Subtracting out costs of production (a



TABLE 17  
NANGRAHAR IRRIGATION AND LAND DEVELOPMENT PROJECT:  
AGRICULTURAL AND LIVESTOCK PRODUCTION, 1971  
(metric tons)

Crop	Production
Wheat	3,844
Barley	153
Peas	120
Beans	13
Clover	1,138
Hay	1,226
Citrus	164
Milk	294

SOURCE: Royal Government of Afghanistan,  
Ministry of Planning, Survey of Progress 1971-72  
(Kabul: Government Printing House, 1972), p. 119.

conservative 50 per cent) would leave a net regional production (state farms plus private holdings) in 1971 of 53 million afghanis. According to the present plan, ultimate project development envisions all the remaining reclaimed cropland as being divided and distributed among small landholders. Assuming both state farms at some date are in full citrus production and that all the individual small landholders' cropland is in high yield variety wheat, the maximum net regional production is estimated at approximately one half billion afghanis. Given the relatively slow rate of land leveling, preparation and distribution to the landless farmers, as well as the lag period required for citrus groves to reach maturity, it would be unreasonable to project full production before 1981; twenty years after the initiation of project investments. There is no conceivable way that the Nangrahar Irrigation and Land Development Project as presently conceived will ever yield a positive rate of return.

As in the case of the ex post evaluation of the Helmand-Arghandab Valley Project (Chapter 5) after one half of the project life, the summed undiscounted and unadjusted net benefit series does not equal the summed undiscounted and unadjusted investment stream. In this case the summed net benefit series (assuming straight line interpolation between 1971 and 1981 net benefit levels, and an extrapolation to 1985 of the 1981 levels) will after one-half of the project life equal approximately five billion, or only 83 per cent of the summed investment series to 1973.

Alternatively stated, by 1971 the net production value was approximately equal to the pre-project net production value. Table 18 calculates the pre-project crop production value in 1970-1971 prices. In that year the target area produced a net value of Afs. 60.9 million of agri-

TABLE 18  
NANGRAHAR IRRIGATION AND LAND DEVELOPMENT PROJECT:  
PRE-PROJECT NET CROP PRODUCTION VALUE, 1960-1961

Use of Cropland (7280 hectares)		Yields <sup>b</sup> (kg/ha)	Prices <sup>c</sup> (Afs/kg)	Production Value <sup>d</sup> (million afs.)	
CROP	HECTARES <sup>a</sup>			GROSS	NET
Wheat (40%)	2912	1200	6.4	22.4	13.4
Corn (20%)	1456	1700	6.0	14.8	8.9
Sugar Cane (28%)	2038	26500	0.75	40.5	24.3
Rice (10%)	728	1650	9.2	11.0	6.6
Citrus (2%)	146	1800	6.6	1.7	1.0
Double Cropping <sup>e</sup> (20%)	1456	-	-	11.2	6.7
Total	8736	-	-	101.6	60.9

<sup>a</sup>The percentage distribution among the principal crops is given in U.S.S.R. Ministry of Agriculture, The Organization of the Territory Irrigated by the Jallalabad Canal in Afghanistan, 5 vols. (Tashkent: Uzgipozess, 1965), Vol. 1, pp. 32-33. The same source (p.78) includes submerged lands above the Darunta Dam totalling 580 ha., of which 380 were private and 200 government-owned. Other estimates exist (for example, K. Dawlaty, "Nangrahar Irrigation Project and Haghlo Hydroelectric Plant" (Kabul: Kabul University, Faculty of Agriculture, November, 1967), pp. 3-4, but since differences were not extreme, and the area of 7280 hectares is the most quoted figure, it is used as a base.

<sup>b</sup>Yields are from The Organization of the Territory...(cited above). Vol. 1, pp. 32-34. Citrus is assumed to have relatively low yields because of poor cultivation practices and disease. See A. Kochmal, "A Report of a Trip to Jallalabad" (Kabul: United States Agency for International Development and University of Wyoming, July 12-13, 1957).

<sup>c</sup>Prices are world market prices plus shipping costs to Kabul. Sources: Asian Development Bank, Agricultural Sector Study (Kabul: Asian Development Bank, 1971), Table A-1; and United States, Department of Agriculture, Agriculture Statistics, 1970, Government Printing Office, (Washington, D.C., 1970), pp. 77, 81, 221 and 237.

<sup>d</sup>Net production value = 60% gross production value.

<sup>e</sup>This area is assumed to be intensively farmed. Cropping patterns are rice-wheat-corn, or, sugar beet-wheat-corn - a three crop, two year rotation. For computation, wheat is assumed to be the double crop.

cultural goods. Although 40 per cent of the land was in wheat, under 22 per cent of net production value could be attributed to its cultivation. At the same time sugar cane, which occupied approximately 28 per cent of the cropland, produced almost 40 per cent of the area's net production value. (In 1971 it is assumed the "peasant" farms had a higher proportion of wheat production than in 1961. To the extent that they double-cropped and substituted rice and sugar cane for wheat, the estimate of 50 million afghanis is an under-statement.)

Can one key factor be identified to account for the poor performance of the net benefit series? Most of the newly reclaimed land will be distributed in small individual holdings. Consequently farmers will not rise much above subsistence unless highly capitalized in the early years. Since the likelihood of this is slight, the probability of a large proportion of the cropland to be devoted to grain production is high and therefore, the net regional production value cannot be projected to not rise dramatically. One question remains, what if the newly reclaimed lands had been put into high value crops? Would the investment have achieved an acceptable rate of return? Alternatively, Did the Russians propose a viable model for irrigation and land development in the area? What if the original Russian development model had been executed successfully? Would the project have passed the efficiency criterion test?

Within the five volumes of The Russian Plan, a plethora of data is presented. Unfortunately the information provided does not lend itself easily to the calculus of benefit cost analysis. An internal rate of return analysis, like that presented in Chapter 3, is impossible because of the internal inconsistencies of the data presented in The Russian Plan. At various points there are conflicting series of projected yields

and cropland distribution among the various farm organizations and among the various crops.

In summary, the project developments, as presently organized, can never yield a return in net farm production that could justify the investment on efficiency criteria alone. It could be argued, however, that non-efficiency benefits (employment effect, settlement of landless peasants, regional income effect and balance of payment effect) are large enough to compensate for the loss in potential increased farm production. The following chapter will argue quite the contrary, that the misallocation of productive investment in both the Helmand-Arghandab Valley and the Nangrahar Irrigation and Land Development Projects has had a net negative effect on non-efficiency criteria and development potential.

References to Chapter 6

1. U.S.S.R., Ministry of Agriculture, The Organization of the Territory Irrigated by the Jallalabad Canal in Afghanistan, 5 vols. (Tashkent: Uzgipozess, 1965), vol. 1, p. 52. (Hereafter referred to as The Russian Plan).
2. Morrison-Knudsen Company, "Report on Jallalabad", (Kabul: U.S. Morrison-Knudsen Co., 1949), p. ii.
3. F.O. Youngs, "Report on Field Trip to Jallalabad" (Kabul: Overseas Mission, 1949), p. 6.
4. The failure of the plant is attributable to many factors. The equipment was obsolete, having been bought from Germany in 1928. There is an unresolved controversy as to whether climatic conditions favoured proper ripening of any varieties of cane on a sufficient scale to support a local extractive industry. The cane planted in March is generally not fully ripened by November when it is customarily harvested. This early harvesting is precipitated because frost, which can arrive in mid-November, drastically lowers the sugar content of uncut cane. In addition, competition from Pakistani sugar made a break-even operation without trade barriers difficult.
5. Prejudice towards the Russians, aside from being political, is also deeply rooted in religious values. The Russians are "bai-qatab" (without the Book). Their atheism is not accepted in a traditional Muslim society.
6. Royal Government of Afghanistan, Ministry of Planning, Survey of Progress 1961-62 (Kabul: Government Printing House, 1963), p. 30.
7. The Russian Plan, op. cit., Vol. 1, introduction.
8. The investment series is slightly overstated because it includes the total cost of the hydroelectric facility at Darunta. Its inclusion is necessary because without the extra power (one half of the total capacity of the present facility is used for pumping stations), the irrigation of the Batikot Flats would be impossible.
9. The Russian Plan, op. cit., Vol. 1, p. 61.
10. Olives are the second major cash crop.

PART TWO

## CHAPTER 7

### IMPACT OF CAPITAL INTENSIVE INVESTMENTS ON NATIONAL DEVELOPMENT POTENTIAL

#### Introduction

The benefit cost analyses attempted in the previous chapters have been restricted to an ex ante feasibility test based on efficiency criteria. They were found limited in their reliability as a policy making tool. The ex post evaluations of the projects identified constraints that were not reflected in the ex ante analysis. Moreover, a preliminary analysis of on-farm production methods within Afghanistan seems to indicate that there is not a strong positive correlation between increased production yields and incremental investments in a modern irrigation infrastructure. Technical factors in water delivery systems do not adequately define the water supply constraint. The projects, if judged solely on efficiency criteria, would most probably yield a negative internal rate of return.

Yet the question remains: could there exist a possible ranking of non-efficiency criteria that would counter-balance the efficiency criteria? The project may not appreciably increase farm income (and, as has been shown, may not even account for a major portion of it), but may have positive employment, balance of payment, migration, income redistribution and domestic savings impacts, as well as other non-quantifiable effects, which still might justify investment.

The difficulties encountered in trying to expand the parameters



by which a project's feasibility may be tested are discussed by

A.O. Hirschman:

The generally accepted notion appears to be that decision making on projects involves two, and only two, wholly distinct activities: ascertaining the rate of return and, then, applying feel, instinct, "seat-of-the-pants" judgment, and the like. In actual fact, these latter categories have been left to control a very large portion of the decision-making process.<sup>1</sup>

Accurate guidelines for policy makers can only be achieved through an attempt to reclaim part of the vast domain of the intuitive discretion for objective and methodical scrutiny.

In the case of the Helmand-Arghandab Valley and Nangrahar Valley projects it could be argued that the narrow definition of increased farm production is inadequate to evaluate major infrastructural investments. Their size and required time for completion mitigates against effective assessment of national impact based exclusively on the results of a benefit cost analysis. Projects must be placed within the context of the national economy.

What follows is first a description of the social and political milieu in Afghanistan. Next there is a brief history of the national development experience and how it relates to the two irrigation projects. Finally an analysis is offered of the impact of capital intensive infrastructure investments on domestic savings generation, the foreign exchange deficit, administrative efficiency, income distribution, urban migration, and employment generation.

The conclusions derived in this chapter are at variance with Hirschman's proposals. Hirschman attacks the problem of a wider more

analytical approach to project analysis through the principle of the "Hiding Hand".<sup>2</sup>

Some of the most successful projects which Hirschman has encountered are those which have experienced substantial uncertainties and difficulties. The non-efficiency criteria become important because each project comprises a set of direct and indirect effects which:

act essentially as crutches for the decision maker, permitting him to go forward at a stage when he has not yet acquired enough confidence in his problem-solving ability to make a more candid appraisal of a project's prospective difficulties and of the risks he is assuming. The experience of meeting with these difficulties and risks and of being able to deal with them should then enable him to discard these crutches and to achieve a more mature appraisal of new projects.<sup>3</sup>

In Nietzschean terms, what doesn't destroy the risk taker, makes him stronger.

In the Chapter which follows, an attempt is made to demonstrate the ramifications of pursuing projects which do not satisfy the efficiency criterion. The constellation of direct and indirect effects associated with the two major irrigation projects have had a negative impact upon the economic development potential of Afghanistan. Large infrastructure projects are risky. Problems of a technical and social nature are endemic. The hypothesis that the risks involved would increase the country's development ability has not been substantiated by the Afghan case.

The controversy over the "critical minimum" of infrastructure is still unresolved, but Afghanistan seems to qualify as a classic example of overinvestment in infrastructure, to the virtual neglect of other national economic requirements. Not only has this misallocation of resources

## The Social and Political Fabric of Afghanistan

Afghanistan, a small, isolated, mountainous country in central Asia, ranks among the poorest and least developed nations in the world. Despite a massive infusion of foreign capital and technical assistance since World War II, the country remains a static, predominantly low-subsistence agrarian society. While its neighbours: Iran, Russia, and Pakistan, have been able to accomplish a certain degree of success in improving the well-being of the vast majority of their indigenous population, most of the rural inhabitants of Afghanistan are no better off today than they were before national efforts at modernization began. To understand why the traditional subsistence equilibrium has not been effectively disturbed after 16 years of development planning, it is essential to appreciate the nature of the threads in the social and political fabric of the country.

The present social and political structures in Afghanistan are tightly bound by traditional values which mitigate against modernization. Religious conservatism, ethnic and tribal rivalries as well as geographical factors have determined the present nature of society. Afghanistan today is a society wherein the forces to maintain and strengthen the traditional feudal institutions are far stronger than any forces for change.

The social structure of Afghanistan reflects the values of Islam. This structure is predominantly patriarchal, patrilineal, and patrilocal.

A man's action is dedicated to seeking that which will increase his honour and shunning that which will increase his shame. His honour is enhanced commensurate to the degree to which he can organize his environment so as to free himself for leisurely social intercourse with his peers.

Although wealth and status in this society clearly are tied to the ownership of land, the traditional agrarian society of Islam apparently differs from that of most peasant societies which manifest several closely related attitudes concerning the land, i.e., an intimate and reverent attitude toward the land, the idea that agricultural work is good and commerce not so good, and an emphasis on productive endeavour as a prime virtue.<sup>4</sup>

Although a Muslim peasant maintains a reverence for the land and finds it shameful for a man to relinquish his title to ownership, he attaches no particular sanctity to agricultural labour. Given the possibility, he would prefer to pass the labour to someone else, thus increasing his personal honour, and then if possible, move off his land entirely and open a shop or teahouse in a nearby town.<sup>5</sup>

An anthropologist living among the Pushtuns in Afghanistan has summed up the traditional tribal attitude toward work. First the Afghan will in all things try to gain honour and avoid shame, largely by increasing his social self through the diminishment of others. In occupational contexts this becomes a search for prestige or power. Second, he will seek independence, at least a pro-forma independence, such that he appears to be his own man un beholden to any superior. Third, he will seek overwhelming wealth so long as it does not come as a reward for effort; honour requires that the wealth accrued be out of proportion to

effort expended.<sup>6</sup>

It is not within the scope of this study to investigate the manner in which these societal characteristics may have affected the development efforts. Rather, they are brought up here to emphasize that assumptions which are based on Western experience and which underline development programmes must be carefully scrutinized in terms of the indigenous culture.

Afghanistan's political development has been characterized by the gradual accretion of power within the central government by a dominant tribal group. Historically, the modern state-making process began in 1880<sup>7</sup> when Abdur Rahman Khan became Amir of Kabul. Since that time the Pushtun tribes have dominated the political life of the country. They have achieved this dominance by the skillful balancing and manipulation of conflicting tribal interests.

Afghanistan's geographic boundaries were never determined by the Afghans. While Abdur Rahman extended the influence of the Pushtuns internally, the British, Russians, and Persians collaborated in drawing the external boundaries of the country. Consequently, Afghanistan today is comprised of a rather large heterogeneous ethnic mixture. The major ethnic groups aside from the Pushtoons include the Tajiks, Qizilbash, Uzbeks, Turkomen, Aimok, and Hazara. The Pushtuns are the largest

single ethnic group<sup>8</sup>, although their present political dominance far surpasses their proportional representation.

Discrimination among ethnic groups exists with the Pushtuns clearly the dominant group. The recognized status hierarchy is: Pushtun, Tajik, Qizilbash, Uzbek, Turkoman, Aimak and Hazara. Lowest ranking on the socio-political ladder are the Hazaras, a Mongoloid Dari-speaking group from central Afghanistan who are discriminated against not only on ethnic grounds, but also on the basis of religion, the Hazaras being Shi'ahs while the other tribes are Sunni Muslims. In the past 20 years the power base has expanded somewhat to incorporate some non-Pushtoons, primarily in middle government and provincial posts. But even in the last cabinet before the coup of 1973, only two cabinet ministers were from another ethnic group. Not surprisingly, major project development, particularly in agriculture, has been concentrated in Pushtun areas.

This tension between a ruling group and the other ethnic groups is normalized by a concerted effort to minimize direct confrontations. Thus the different regions, which are still the strongholds of ethnic concentrations, are allowed a fair degree of autonomy at the expense of national cohesion. The general ban on political parties has been another overt act to short-circuit any potential forum based on ethnic lines that might threaten the status quo.

The resistance of the Pushtun tribes to foreign incursions is legendary. In the Nineteenth Century the Russians in the north and the British in the south pressed hard to extract loyalty from the Afghans in order to contain the expansion of their rivals. Intermittent foreign intrusion and attempts to impose foreign will upon the Afghans were met

with constant resistance and militance - the impregnable will of the tribesmen to remain independent. Thus:

When imperialism came to India, after some years it chose to cross our historical boundaries at the Indus River openly in the name of making the Afghans submit to their will, that is to be their military and political allies. Since that date the Afghans were compelled to fight a war of more than one hundred and twenty-four years to prove to the invaders that it was their inherent right, as a nation . . . to remain what we were and what we are, Afghans, independent and in possession of our destiny.<sup>9</sup>

The present power elite contends that this principle of independence which is embodied in the culture and the "psychological attitudes carved in [their] souls"<sup>10</sup> and apparent in the constant and resolute refusal of foreign domination, has worked against the modernization of Afghanistan.

At various times the failure to implement early designs for road planning, town planning, forest preservation, major irrigation schemes, communication networks, and modernization of the educational system and public administration has been blamed on the constant interference by foreign powers in the domestic affairs of nation building. This one-to-one relationship between external pressure and internal chaos is far too simplistic to explain both the social-political structure and the history of the area for the past hundred years. Yet, these incursions have left a mark on the country and on its present potential for modernization.

The sporadic incursions of the Russians and the British in the past, combined with weak authority within and among the tribes produced shifting loyalties and uncertain dynastic alliances. This period of

imperialistic expansion intensified tribal quarrels among the Pushtoons. The period left a heritage of internal mistrust and a general suspicion (cavendo tutus) of any foreign designs on the country.

As Afghanistan was never colonized, it never received the more tangible "benefits" of extended colonial occupation! A trained group of administrators, a rock around which nationalism could rally, an economic infrastructure of roads, railroads and telecommunications, and possibly a higher level of functional literacy<sup>11</sup> might have been helpful for future development potential, as evidenced in Pakistan, India, and Ceylon.

Along with its ancient tradition of farming and herding, the area has had a long history of trade. Historically, Afghanistan straddled the major east-west trade routes, which bequeathed a tradition of commerce. The men involved were variously referred to as traders, smugglers, commission men, black marketeers, money changers and bandits, depending on the epoch and political bias of historians. As the modern nation states were organized in Pakistan and India, trade barriers and currency controls were instituted to accelerate their domestic development. These national economic policies increased Kabul's involvement with the sub-continent as a free port for the illegal exportation of foreign-manufactured consumer goods and a financial clearing house, and as foreign exchange banker for black market hard currencies. The recent popularity of hashish and opium in the West has opened a whole new avenue of lucrative commerce in cash crop by-products. Whereas commerce in the traditional products of karakul, meat and dried fruit accounted for the accumulation of hard currencies after World War II, and facilitated the beginnings of developmental investments, the presence of a strong commercial



sector has been a detriment to the introduction of necessary economic legislation.

The established commercial groups have inhibited the formation of local industry by effectively blocking the introduction of a protective tariff system. Thus:

The traders' position is that poor people need low prices and consequently low duties on their essential goods . . . . The surprising feature of this argument is its inconsistency . . . . The essential personal goods for which there are no local producers are found to carry the highest average duty rate of any goods category. Protecting the poor people from high prices apparently stops as soon as there are no local producers.<sup>12</sup>

The study has also found that essential goods carry an average tariff rate that is much higher than less essential goods. That Afghanistan has not introduced effective trade barriers, effectively organized an export and import tax system, nor introduced necessary legislation to reorganize and modernize banking operations is due partially to the fact that these development policies run contrary to the interests of the established commercial group.

#### Foreign Aid and the End of Isolationism

The reign of Mohammed Zahir Shah (1933-1973) was to witness the end of isolationism. Afghanistan opened its doors gradually to foreign competition in material endowments.

As early as 1927, Afghanistan invited Russian aid, and accepted a radio-telegraph system and a cotton gin. In the 1930's German and Japanese engineers began work on irrigation construction in the Helmand Valley. But it was not until the 1950's that Afghanistan sought foreign aid for economic development and military purposes on a massive,

coordinated scale. The stated purpose in seeking economic assistance was to give its people a greater share of the world's growing wealth; and the reason for the request of military aid was to consolidate a young national government that had to deal with several hostile ethnic groups and other various tribal affiliations. A modern military would be pivotal in the balance between the central government and regional autonomy: no more would regional chieftans be able to contest Kabul's hegemony.

The RGA took its first important step into the international community of developed countries by sending missions to the United States<sup>13</sup> between 1952 and 1954 to discuss assistance, both for strengthening its military forces and for developing the national economy. Although the United States Export-Import Bank was already financing the Helmand Valley irrigation project, a proposed quantum jump in American involvement was at first summarily rejected. The request for military assistance was considered ill-advised and unnecessary by post-war global strategists; and on the question of development assistance, the United States Government advised the RGA to formulate a national development plan as a pre-condition for receiving economic assistance.

The RGA formed a Planning Ministry, and in 1956 drafted the first Five-Year Plan for the period 1956-57 through 1961-62,<sup>14</sup> and requested a commitment of \$100 million from the U.S. Government to help finance its implementation. The RGA was informed that United States law did not permit a blanket program commitment, but rather that each specific project and function would have to be considered separately. Spurned by the Americans in their attempt to find complete support for their development plans, the Afghans turned to their northern neighbour, the Russians.<sup>15</sup>

It was in Afghanistan that the Russians began their foreign aid to the non-communist world. An opening to closer Afghan-Russian relations was precipitated in 1950, when Pakistan, angered by Afghanistan's claims over a disputed border area (Pushtunistan), imposed a three-month blockade. Cut off from its traditional trade routes, Afghanistan signed a trade agreement with the Russians, granting them among other things exclusive rights to oil exploration north of the Hindu Kush. After the death of Stalin, the Russians slowly extended loans. First, in 1953, was a \$3.5 million loan for a flour mill and a grain elevator with an interest rate of three per cent; in 1954, a \$2.1 million loan was granted to build an asphalt factory and to pave the streets of Kabul.<sup>16</sup> Immediately subsequent to the U.S. Government's refusal to finance the First Five Year Plan, and timed with the arrival of Bulganin and Khrushchev in Kabul in December, 1955, the Russians proposed to loan the RGA \$100 million at two per cent for 30 years. Thus the First Five Year Plan was launched.

The First Five Year Plan reflected the major interest of the RGA at the time: the ending of Afghanistan's isolation. It emphasized large-scale irrigation and power projects, along with road building and the creation of Ariana Airlines, linking Afghanistan with its neighbours. The writing and implementation of the First Plan was to set a precedent.

Thus:

national economic and social development planning was initiated in Afghanistan to create an instrument for the mobilization, allocation, and utilization of domestic resources. It was also initiated as a useful device for securing development assistance from foreign donors. The apparently increasing emphasis on the second purpose over time gave rise to a commonly expressed contention that Afghanistan's five year plans were largely 'shopping lists' of projects formulated principally to solicit financial assistance.<sup>17</sup>

The original planned investment program for the First Five Year Plan had heavy emphasis on agriculture and industry. However, in implementation the emphasis shifted to one of building an economic infrastructure of roads, hydro-electric power generation, major water storage dams and irrigation systems, communications, and mineral exploration (See Table 19). Some regionalization of development was attempted through emphasis on such programs as the Helmand Valley Project which had been started prior to the Plan.

The apparent gains of the First Plan were partially a result of the low base from which Afghanistan began in 1956. Prior to the First Plan Afghanistan had no paved roads, very few permanent bridges, and practically no air links with the outside world. Industry consisted of a few cotton-ginning companies, textile mills, a vegetable oil extracting company, a sugar factory, a match factory and a few machine repair shops. Total annual electricity produced in the country in 1955 was only 47.2 million kilowatt hours. After five years, the production value of electric power plants and manufacturing plants rose from Afs. 340. million to a little less than Afs. 1,000 million, with employment rising from 5,500 to 11,000.<sup>18</sup>

The Second Five Year Plan followed the approach and emphasis of the First Plan. The investments were to be used to continue the construction of a more adequate infrastructure in the transportation and agricultural sectors, to establish some basic industries, and to develop a few light consumer industries, mainly in agricultural processing. The implementation record of the Second Plan compared unfavourably with that of the First Plan partially because the more successful turnkey projects were completed in the First Plan. Uncompleted and difficult projects were carried over,

TABLE 19  
 NATIONAL DEVELOPMENT, AFGHANISTAN: INVESTMENTS DURING  
 THE FIRST, SECOND, AND THIRD FIVE-YEAR PLANS  
 (billions of afghanis)

Investments	First Plan		Second Plan		Third Plan		Plan Performance (Percentage Accomplished)			
	Planned	Actual	Planned	Actual	Original Plan	Revised Plan	Actual	First	Second	Third <sup>a</sup>
Total Public Investment	8.50	9.35	31.08	24.65	31.10	25.7	19.02	110	79	74
Mining and Industry	2.85	2.60	10.23	8.40	9.64	7.7	6.63	91	82	86
Agriculture and Irrigation	2.65	1.20	7.36	4.40	8.73	9.0	5.85	45	60	65
Transportation and Communication	2.10	5.04	8.01	9.60	4.10	2.9	3.38	240	120	117
Social Services	0.60	0.40	3.51	11.82	5.51	3.8	2.27	67	52	60
Other	0.30	0.11	1.97	0.43	--	1.1	0.89	37	22	81
Reserve	--	--	--	--	3.00	1.2	--	--	--	--
Total Private Investment	n.a.	1.00	0.27	0.36	2.00	3.0	1.70	n.a.	133	57
Total Investment	n.a.	10.35	31.35	25.01	33.00	28.7	20.72	n.a.	80	72

SOURCE: Robert R. Nathan Associates, Inc., Final Report: Economic Advisory Services Provided to the Ministry of Planning, Royal Government of Afghanistan, Sept. 1961-June 1972 (Kabul: U.S.A.I.D., July 1972).  
 NOTES: (a) Percent actual over revised. n.a. - not available.

determining the actual composition of the Second Plan's investments. Moreover, the projected increase in planned investment was too ambitious. In fact, although total investments actually rose by almost two and one-half times, inflation accounted for a good portion of it.

After ten years of experience in development planning, it became apparent that the approach had not been effective in mobilizing the necessary resources. Especially unfortunate was the failure to increase the agricultural production to any appreciable extent. The total value of agricultural production rose over the five years by only about seven per cent. This rise was mostly accounted for by increases in vegetable and fruit production, while all other products showed no increase or actually declined.<sup>19</sup> So the major irrigation works that were to reclaim the land and the major roads systems that were to accelerate resource mobility had no impact in terms of the increased commercial output in the agricultural sector.

The Third Plan (1967-1971) proclaimed a basic change in development strategy. The priorities were radically changed and generally favoured investments with a short recoupment period. There was a move away from investments in the transportation and communications sectors toward the agricultural and industrial sectors. This shift was undertaken in the hope of achieving a substantial rise in gross domestic product originating in the commodity sectors. The plan envisaged an expansion of private sector investment in agriculture, livestock, and industry, a greater generation of domestic saving, an increased level of employment, and a general improvement in living standards. Expenditures on social services were planned to increase substantially, both in absolute and

relative terms. The balance of payments was to be strengthened by providing increased incentives for major agricultural exports while encouraging investments in import substitution and in export-oriented industries.

Poor performance of the economy persisted. Although the Plan was comprehensive and specific in its articulation of the implementation measures required, its performance was inferior to the previous two Plans. As in the previous Plans, scheduled project completions were only partially realized. Once again investments in transportation and communication exceeded Plan targets, but investments in every other sector fell far short of target. In financial terms, the implementation of the Third Plan achieved only about 63 per cent of the original planned investments and about 72 per cent of the revised planned investments. As indicated in Table 19 investment in total was about 17 per cent less than the actual investment outlays in the Second Plan.

By early 1972, drafts of the Fourth Five Year Plan were submitted for review. They contained many of the defects of the previous plans and seemed to be oblivious to the constraints that faced developmental efforts in present-day Afghanistan. The financial basis of the plan is unsound. The contribution of domestic revenues to development is, for the years 1971-1976, projected at Afs. 6.8 billion. (See Table 20). In order to obtain this amount, Afs. 5.3 billion in additional net revenues must be found. This projection implicitly assumes both that the ordinary (non-developmental) budget expenditures will increase relatively slowly, and that new revenue sources will be found. But from the Second to Third Plans, ordinary expenditures rose from Afs. 13.1 billion to Afs. 23.2

TABLE 20

NATIONAL DEVELOPMENT IN AFGHANISTAN:  
ORIGINAL AND REVISED FOURTH FIVE-YEAR PLAN

(Billion Afs.)

Item	Fourth Plan	Revision
Project Aid	11.7	9.0
Surplus of domestic revenues	6.8	.4
Commodity Assistance	6.0	5.0
Private Investment	3.2	2.0
Deficit Financing	1.1	2.0
Total	28.8	18.4

SOURCE: German Economic Advisory Group (Dr. K. H. Hendrickson), "Comments on the Draft of the Fourth Five Year Plan (1351-1355) which the Ministry Submitted in May 1972 to the Higher Economic Council," (Kabul, June 1972).