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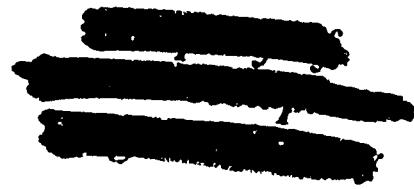
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of
Agricultural Projects

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University of Arizona/U.S. Agency for
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1974

**Manual
for
Preparation and Analysis
of
Agricultural Projects**

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General Directorate Planning,
Research and Coordination.**

**The United States Agency for International
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MANUAL FOR
PREPARATION AND ANALYSIS
OF
AGRICULTURAL PROJECTS

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PREFACE

Within the Ministry of Food, Agriculture, and Livestock the General Directorate of Planning, Research, and Coordination (PRC) has been charged with the responsibility of reviewing all project proposals originating with the line agencies of the Ministry, as well as with in-house preparation of projects, agricultural economics research, and coordination of all project related activities. A major function of PRC therefore, involves the formulation of developmental projects.

In order to improve the quality of the project formulation and evaluation process carried out in PRC and the Ministry, PRC is seeking to formalize a general methodology for project design. The purpose of this Manual is to identify the data, and the step by step, computational procedures needed to prepare sound project alternatives.

This report reflects the cooperative efforts of the General Directorate of Planning, Research, and Coordination, the U.S. Agency for International Development/Turkey, and the Arizona contract team. There are far too many who contributed to the preparation of the report to list them all. Several individuals made significant contributions and should be mentioned.

First, the input of Dr. John L. Fischer, Chief of Party was important and greatly helpful.

Special recognition should also be given to Mehmet İhtiyaroglu, Chief of the Planning Department within PRC who served so well as host country counterpart to the author. Without Mehmet's able assistance this phase of the contracts' objectives would not have been met. The help of Zishan Ögüt, Nurettin Aydan, Sabri Öge, and Hüseyin Cinemre, of the, PRC staff who read, and commented upon portions of the report in various stages of development is gratefully acknowledged. Responsibility for any errors and omissions to be found in the report of course accrues only to the author.

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CHAPTER I

INTRODUCTION

A. Purpose of Manual

The planning process may be characterized as a series of logical steps and analytical operations leading to a decision. Fundamental to good development planning is the preparation and implementation of projects which are effective means for reaching specified targets or goals. In order to be certain that projects represent desirable allocations of scarce national resources it is important to prepare each alternative investment proposal carefully and examine each on the basis of consistent analytical methods and choice criteria. When projects are formulated and evaluated in this way it should be possible to determine how effective each proposal is in meeting planning objectives. The purpose of this manual is to improve the process of project planning by formalizing a set of procedures for systematic preparation and evaluation of alternatives.

We might ask ourselves at this point "Is there a need for special evaluation of public projects?"

The general question that project evaluation attempts to answer is whether alternative investment proposals, say A, B, C, and D should be undertaken. In situations where the investment budget is limited the evaluation should indicate which among the proposals is most desirable, and therefore should be carried out first, second, third, and so on until the budget is exhausted. Also, an evaluative analysis carried out through the project formulation stage should result in proper scale and/or scope, product output choices and technological design.

The need for special analysis of agricultural development projects stems from the fact that since projects of this type are by and large carried out entirely by the public sector analysis must verify that investment alternatives represent a desirable way to utilize scarce public resources. These evaluations call for assessment of the gains and costs of projects from the perspective of society at large; hence there is need for procedures making use of data and investment criteria which differ from those that an investor in the private sector would follow when evaluating his options. The private individual is primarily concerned only with those costs and benefits he himself would receive from an investment possibility. The agricultural project planner, on the other hand, must examine the various options in terms of a much broader set of impacts ranging from profitability to the economy at large to social welfare considerations such as improvements in the distribution of national wealth

and income, employment, education, health, and sanitary conditions among rural inhabitants.

The variety and diverse nature of social objectives, the inadequacy of market prices as measures of social gains and losses, and the special characteristics of the agricultural sector (seasonal fluctuations in production, large numbers of farmers having little market power and who operate under a variety of motivational factors, structural disabilities, institutional and infrastructural problems) thus call for public projects and a specialized process for designing, evaluating, and implementing them. The steps outlined in this manual are designed to facilitate this process.

There are several basic elements implicit in the manual procedures contained herein. First, the focus is upon the micro aspects of project preparation and not upon sector or national planning. This means that the integration which should exist between agricultural project planning and more aggregate plans is implicit. The procedures outlined assume that national or macro planning has been based upon a sound assessment of the role of agricultural projects in bringing about growth and development and that general priority areas (regions, commodities, developmental potentials, etc.) have been assessed and realistic guidelines set forth for preliminary project planning. However, the important function of feedback to macro planning as more information is learned through detail project formulation activities is stressed.

A second point is that the manual includes material relevant for project design as well as project evaluation. Project design requires the input of professionals from many disciplines, e.g., engineers, agronomists, livestock specialists, veterinarians, economists, and other specialists. The manual materials are intended to be a general guide for all for general project possibilities and, hence, do not outline the specific data input needed for any particular application. The materials therefore are designed to utilize the knowledge and data which the various technicians must provide, but do not focus upon the problems of how physical and biological data is to be assembled. The exception to this is economic and financial analysis where the procedures do make explicit what data is needed and how it is to be used.

Third, the procedures are based upon the philosophy that many criteria should be employed in determining the desirability of carrying out a proposed project. Economic efficiency and the "value added" by a project is but one important factor. Equity considerations, social welfare goals, financial impacts upon project participants, as well as the relative utilization of scarce resources should also be brought to light in the evaluation phase of project planning. For that reason, the manual outlines a number of financial, economic, and socio-political indices which may be used to judge the effectiveness of project alternatives in meeting developmental goals.

Fourth, the manual procedures seek to integrate project formulation and implementation within the project planning process. The rationale is that every project related activity which is required must also be accompanied by a specific program to carry it out -- otherwise the project plan becomes only a statement of what would be nice to have happen but what may not happen at all! For this reason project planning should include provisions for implementation. The manual, therefore, contains a section outlining organization and management needs during project set-up and operation.

Fifth, the manual takes cognisance of the fact that administrative inefficiency, lack of political commitment, and an inadequate "will" to do what is necessary for development to occur are often the main bottlenecks to growth and change. One feature of the manual, therefore, is the importance given to setting forth the rationale which underlies the project proposal and the detailed implementation and management plan. Thus, project feasibility analysis involves a determination of the likelihood that the "system" can achieve project expectations by examining not only the physical and economic potential of the project but also the assumptions which have been made and the operational planning described in the project report.

B. Discussion of Issues

1. The Role of Agriculture in Economic Development

Agriculture's role in the process of economic growth and development is relevant to the problem of determining the desirable "balance" between agriculture and other sectors vis-a-vis direct government investment or assistance to investment, budget allocations for publicly funded research and education-extension programs, and the taxation policies formulated for different sectors. The importance of a "developed" agricultural sector to overall economic development must be taken into consideration when formulating basic developmental policies and programs. Increased productivity in agriculture can complement the efforts devoted to other sectors and further stimulate overall growth.

There are five important ways in which increased agricultural output and productivity contribute to general economic growth, viz.^{1/}

- (1) Economic development is characterized by a substantial increase in the demand for agricultural products, and failure to expand food supplies in pace with the growth of demand can seriously impede economic growth.
- (2) Expansion of exports of agricultural products may be one of the most promising means of increasing income and foreign exchange earnings, particularly in the earlier stages of development.
- (3) The labor force for manufacturing and other expanding sectors of the economy must be drawn mainly from agriculture.

^{1/} Johnston and Mallor, 1961, p.571.

- (4) Agriculture, as the dominant sector of an under-developed economy, can and should make a net contribution to the capital required for overhead investment and expansion of secondary industry.
- (5) Rising net cash incomes of the farm population may be important as a stimulus to industrial expansion.

Let us consider each of these points in more detail.

The growth of the demand for food is of major importance in a developing economy for several reasons. In Turkey the annual rate of population growth is approximately 2.7 per cent.^{2/} Coupled with the growth in population is the annual change in personal income estimated to be on the order of 5.2 per cent for the period 1972-77.^{3/} As income levels increase there will be a corresponding gain in the ability of individuals to increase their consumption. The combined effect of population growth, and growth in incomes as the development process proceeds will have a compounding effect upon the domestic demand for food. If food supplies fail to keep pace with the growth of demand there is likely to be a substantial increase in food prices leading to political discontent and pressure upon wage rates with adverse consequences for industrial profits, investment and economic growth. Since the price elasticity for basic food commodities is generally very low, rising price levels will do very little to dampen demand. Moreover, the inflationary impact of sharp rises in food prices is very great in LDC's where a high proportion of income goes for the pur-

^{2/} Third Five Year Plan for Turkey, State Planning Office, Publication No. DPT 1272, 1972, p.V.

^{3/} Ibid, p. 72.

chase of food. With little opportunity to shift consumption away from other goods as food prices rise there is only one recourse -- increase in wages, which has repercussions in other sectors. To the extent foreign exchange is in abundant supply importation of food commodities may be increased, but foreign exchange may not always be available especially given the demands of the expanding industrial sector for foreign technology and equipment.

In addition to a means of earning foreign exchange, a healthy and productive export sector provides a good means of increasing incomes because, except for a few specialty markets, the world wide demand of a commodity may be very large relative to the productive capacity of the agricultural sector. To the extent this is true, exporters face a fairly elastic demand schedule.

Increasing per capita productivity in the agricultural sector can free up labor as needed in the expanding industrial sectors. Also, balanced development within the agricultural sector can put to productive work the rural unemployed until such a time as they can be absorbed by the other sectors of the economy.

Since the potential exists for raising productivity in agriculture through measures that require moderate capital outlays, and since the agricultural sector is the largest sector in the economy, it is possible for the agricultural sector to make a contribution to the formation of capital for infrastructure and for industrial expansion.

The flow of capital out of agriculture can be achieved by better utilization of the resources already committed to agriculture and by minimizing the use of scarce resources with higher productivity elsewhere.

Where the rural population of a country is a high proportion of the total population as it is in Turkey, and when that population is among the poorest in the land (the 1969 census shows that in Turkey 69 per cent of the farm families produced only 25 per cent of the total farm products and hence had access to only 25 per cent of the production for income)^{4/}, the extent of a viable market for the products of an industrial economy are liable to be virtually non-existent. Therefore, if there is to be a demand for these products in sufficient volume to make their production profitable and hence provide the stimulus for industrial growth, an economically affluent rural (agricultural) sector is required.

On a number of grounds one can therefore argue that an efficient and productive agricultural sector is a necessary component in a general strategy for Turkish economic development. How a traditional agricultural sector can be transformed into an entity capable of fulfilling its potential role in overall development goes beyond the scope of this manual; however, it is recognized that agricultural development projects play a decisive role in achieving the kind of

^{4/} Ibid, Table 11., J.L. Fisher, End of Tour Report, University of Arizona/USAID Contract nesa 594. 1974.

changes which are require both within and without the agro-rural sector. Sound project design and evaluation is a necessary step in achieving the potential of this sector.

2. The Role of Agricultural Projects in Development

Since the term "project" does not have a universally agreed upon definition different people tend to have different notions about just what is an agricultural development project. Before we can understand what part projects can play in helping to bring about growth and development in the agricultural sector we should at this point establish what the project concept means here in this manual.

Gittinger (1972, p.1) says that a project is "The whole complex of activities involved in using resources to gain benefits". The kinds of agricultural activities which can be included in the project concept are many. As examples Gittinger mentions irrigation, livestock, agricultural credit, land settlement, tree crops, agricultural machinery, and agricultural education. He goes on to say (p.2) that a project can be looked at as "...a specific activity with a specific starting point and a specific ending point intended to accomplish a specific objective." A project is generally thought of, therefore, as an investment activity which "...lends itself to planning, financing, and implementation as a unit."

While other "hard" definitions of a project may be preferred, the above comments suit our purpose very well, for it is sufficient for us here to be aware that a project can be any agriculturally oriented investment alternate that seeks to reach specific objectives. For example, a project may be a single investment entity such as the development of an irrigation system to service a particular area within a river basin, or it may be the development of an irrigation system for the entire basin. A project may also encompass activities to achieve several objectives within one geographic area such as provision of irrigation, plus additional fertilizer, new seed varieties, improvements in on-farm storage facilities, and the construction of all weather farm to market roads. Thus, the concept of a project as an investment plan to achieve an objective means that the scale, scope and characteristics of the project will depend upon the nature of the problem. Groups of project may be thought of as a program; however the line between a very large project composed of numerous more or less separated parts and a program may not always be a sharp one.

The investment program is the hard core of a developmental plan in that it is through projects that the specific events which the plan calls for come about. Put another way, it is through projects that the specific changes which are needed for the growth and development of the agricultural sector occur. Public investments in the form of project activities are necessary because in traditional agriculture the overall productivity is insufficient to generate the capital

required for these changes to happen naturally and soon enough to do what is needed. Projects therefore are designed to introduce the capital, the improvements in technology, management, and infrastructure which are required if the agricultural sector is to move from its low productivity subsistence base to a modern commercially oriented endeavor capable of achieving its potential. If output is to be increased both for domestic and export purposes, if a gradual movement of the large rural population into urban areas is to take place in response to labor demands of the growing industrial sector, and if agriculture is to make its own way in the total development of the economy as well provide for the general well being of its people, then projects are the driving force during the early stages of growth.

Since investment capital is scarce the projects which are undertaken must be done so with care. Projects should be selected only after thorough examination of alternatives in the economy as a whole as well as in the agricultural sector itself. The material of this manual outlines a procedure for preparing and evaluating specific agricultural project alternatives so that comparisons between them can be made and, using various criteria, the most desirable among them identified.

3. Relationship Between Plans, Programs and Projects

Agricultural projects are not formulated and implemented independently of activities carried on in other sectors of the economy. In order to evaluate their performance and potential impact upon the sector and/or sub-sector in which they fall as well as upon the economy at large, projects must be tied to overall development plans and programs. The relative scarcity of key resources necessary for growth and development calls for a linkage between projects, general programs, and the development plan, and for coordination during the planning and implementation stages among all those concerned.

Although a close relationship between projects, programs, and plans is desirable in most circumstances very worthwhile agricultural projects may be prepared on the basis of rather preliminary investigation of the economy and the various subsectors and in the absence of a fully coordinated planning environment. In the early phases of development when the interrelationship between sectors and the priority investment needs have not been established simple approaches and sound but unilateral planning is likely to be the case. As the development process proceeds, as more information becomes available and investment opportunities become greater, the task of allocating scarce resources among competing ends becomes at once more critical and complex. It then becomes necessary to operate with a more refined framework selecting projects which are consistent with coordinated

The importance of programs and plans in project selection is that they provide the background data and information necessary for project design and formulation. These data and related information will provide insight as to the socio-economic problems which require action. For example, they should point to the future supply and demand relationships of goods and services as well as assess social overhead requirements. Programs and plans can also articulate agricultural sector policies, developmental possibilities, establish priority areas, and formulate criteria for project selection.

While programs and plans lay the groundwork for project preparation, projects, on the other hand, can serve to test the validity of the agricultural policies, assumptions, and growth potentials set forth within a plan. For example, project evaluations can verify the desirability and feasibility of various production targets and can indicate the socio-economic impact of, say, economic efficiency as opposed to social equity criteria in planning. Thus, the results of project feasibility analysis can act as feedback to the program-plan formulation process and, hence, influence the direction of growth policies. Moreover, as more and more projects are prepared and analyzed, additional information regarding the range of agricultural problems and alternative solutions will become available. As a result, policies and priorities in the agricultural sector can be critically examined and if needed be altered.

C. Organization

The logical framework underlying this manual for agricultural project preparation is that within the Ministry of Agriculture there is a need for project planning guidelines which (a) outline the data and organize the calculations needed for project design and evaluation, and (b) include the detailed step by step procedures to be followed. The objective of the manual is therefore to provide the practicing project planner with materials which fill this need. The format followed is to review the project planning process through its basic steps -- problem identification, selection of alternative courses of action, detailed project formulation -- and to include the principal worksheets for pulling together all the needed data.

The Manual is organized as follows: Chapter II deals with identification of developmental needs or problems which lend themselves to projects and with the selection of a tentative list of possible investments which could alleviate those problems; Chapter III surveys the data needed for detailed project formulation and for measuring expected welfare conditions in the project area in the absence of the proposed project -- worksheets are included; Chapter IV focusses upon steps and worksheets necessary for preparing project investment schedules, operating/annual costs, financial returns to participating farmers, and indirect project effects such as secondary costs and benefits and environmental impacts; Chapter V outlines methods for

assessing the logic, rationale, and assumptions underlying the project plan; Chapters VI and VII deal respectively with financial and economic feasibility studies; Chapter VIII reviews additional project feasibility analyses viz., political and social acceptability, cost-minimization and cost-effectiveness, sensitivity analysis, project authority and implementation/operation plans, and comparison of several alternative projects; Appendices outline additional details.

CHAPTER II
IDENTIFICATION OF PROBLEMS
AND
TENTATIVE SELECTION OF PROJECT ALTERNATIVES

The objectives set forth in national development plans generally provide guidelines for the development of the agricultural sector. However, these objectives should be supplemented by more specific objectives applicable to the various agricultural subsectors and regions. In developing economies two fundamental conditions in the agricultural sector, are low productivity and low standards of living, require effective government programs if the sector is to play its proper role in the process of overall development.

A. National Developmental Needs and Plans

One condition within the agricultural sector in Turkey which must be improved has to do with the aggregate performance of the sector in terms of its ability to produce in sufficient quantity to satisfy the growing demands of an expanding and evermore affluent population, and to contribute to the nation's growing needs for food and fiber for export and industrial use. These kinds of issues are articulated in the Five Year Development Plans where various production and marketing targets are specified for Agriculture as necessary

for the desired growth of the economy is a whole.^{1/} Achieving targeted rates of output in Agriculture, hence, becomes one of the problems to be overcome through projects.

Underlying the plan targets is the belief that the achievement of these goals will alleviate certain classes of problems in the economy which are tied to the production and export of agricultural goods. The foundation for the belief rests upon the understanding that the agricultural sector does not exist as an entity separate from the rest of the economy. This relationship in turn means that development in the agricultural sector is heavily dependent upon the overall development strategy for the country at large. Thus, agriculture is subject to policies and programs affecting a host of variables such as:

- . the growth of population, per capita income, and GNP
- . the amount of capital available for investment in agriculture, the demands from other sectors, and export possibilities
- . the development needs of other sectors, e.g., investments for manufacturing, power development, transportation, education and health
- . the extent of international trade and foreign exchange rates both of which bear upon import costs, export potentials, and opportunities for import substitution

^{1/} For example, the Third Five Year Plan (TFYP) lists goals setting forth the desired (expected) annual growth of agricultural output for all the major crop, livestock, fishery and forestry products. The plan calls for average annual output goals as follows: 4.0% increase in crop production, 5.0% increase in livestock production; 9.1% increase in forestry production; and 8.4% increase in fishery production. It also specifies desired annual increases in agricultural export. (SPO, A Summary of the Third Five Year Development Plan 1973-77, Ankara, 1973. Tables IV. 07-08, p. 101-102).

- . taxation and pricing policies
- . credit costs and programs
- . social welfare programs

To the extent that national development planning influences these variables, the problems found within agriculture are also influenced as are the programs which are put forth to solve these problems.

B. Social Welfare Conditions

A second set of conditions with which agricultural planners must contend occurs at the level of individual welfare. Here the concern is with what we may call "people problems" to distinguish them from the broad problems of the economy at large and such issues as volume of total production the size of the export sector, self sufficiency in food production, the balance of payments and national employment. People problems may be taken to be those which impinge directly upon the well being of rural families, e.g., low and unstable annual farm income, poor health and nutrition, lack of goods and services which enhance the quality of rural life, lack of education, inadequate regional growth, and limited opportunities for individual self improvement.

These difficulties may also be alluded to (although probably in very general terms) in national plans. For example, under objectives for the agricultural sector the TFYP contains these words:

"...the agricultural planning is based to attain....
increased living standards of the rural population...."^{2/}

Thus, a second category of difficulty to which projects may be directed are welfare problems and the project planner must look to the national Development Plan for guidance upon the issues to which priority is given.

C. Selection of Priority Problems

Having before him the general problems which need to be solved as outlined in the national Development Plan, the planner must translate these into more specific terms which can form the basis of investment projects. Priority problems can be derived from the current and projected supply considerations for the various agricultural commodities, from identification of the bottlenecks in the growth of productive capacity of sub-sectors and regions^{3/}, and from analysis of the social

^{3/} If the national development Plan for the agricultural sector contains production targets which are based upon specific commodity demand forecasts which in turn are derived from sound estimates of expected consumption under realistic market behavior then these targets may be taken as supply requirements. However, if the Plan output targets are not specific with respect to commodities and the timing of consumption the project analysis must include demand studies. Moreover, it may be that although the target rates of consumption as outlined in the Plan are specific they are not hard estimates of probable demand based upon changes in prices, incomes, consumer tastes and preference, etc., but are more in the nature of optimistically "hoped for" requirements assuming that many other hoped for changes occur in the economy. It is possible that the production targets may be deliberately overestimated to provide a tough goal to meet in the full realization that only half the requirements will actually be utilized, but that by "shooting" high realized output will probably be about right! In these circumstances it is the responsibility of the project analyst to thoroughly understand the rationale for plan output targets and the methods used to calculate them. If disagreements exist over either the rationale or the procedures followed in preparing Plan estimates they should be pointed out and the difference resolved.

and economic characteristics of geographical areas and demographic groups. Identification of specific project relevant problems involves:

- (1) selection of regions where there is high potential for rapid expansion of output and preliminary estimation of the necessary costs and returns;
- (2) identification of areas where the growth in productive capacity is most urgently needed;
- (3) identification of areas and/or sub-sectors where technological improvements and improved managerial practices could have the maximum effect upon output in what length of time;
- (4) stratification of sub-sectors and regions in which production can be increased through the use of additional purchased inputs or through the rational use of existing farm capital and labor;
- (5) identification of sub-sectors and regions where alternative economic measures have potential for improving productivity and enhancement of social conditions, e.g., new pricing programs, direct and indirect subsidies, improvements in the availability of credit and the terms of borrowing;
- (6) identification of areas where improved institutions and infrastructure would improve productivity and enhance social welfare, e.g., land reform, taxation, cooperatives, marketing facilities and improved public services including extension;
- (7) analysis of area and/or regional data pertaining to income, employment, education and training, health and sanitary conditions, migration patterns, demographic characteristics, etc.;
- (8) selection of regions and their agricultural products having high potential for serving export demands;
- (9) identification of areas having high or unique development possibilities due to special resource endowment, e.g., ground water supplies, mineral reserves, archeological sites, etc.

The planner must therefore, begin to think in terms of regions, provinces, even villages, so that he may identify places where projects may be carried out on a priority basis. In order to do that he must learn as much as he can about different locales, which means he must have access to information about individual geographical and political units describing their physical and socio-economic characteristics, and the potential for growth and change in these parameters.

In preparing a preliminary assessment of area conditions numerous published (secondary) statistical data, such as census information, special questionnaires, and survey reports which are referenced to specific locations can be helpful.^{4/} Relative to productivity and the potential for expansion the data needs involve crop areas, yield output levels, livestock numbers and per animal yields, output quality, resource utilization patterns, prices paid and received, export production, animal health data, resource availability problems, labor and managerial requirements, plus household survey data such as food consumption patterns, income and expenditures, as well as other sociological information. (Appendix A contains examples of the kind of data needed to prepare a socio-economic profile).

^{4/} A good example of published work which contains useful information are the provincial statistical reviews prepared in commemoration of the 50th Anniversary of the Republic. In addition, there are the data collected on an annual basis by the provincial staffs and compiled by the State Institute of Statistics, as well as special investigations undertaken by the various directorates within the Ministries. The project planner should be fully informed as to all possible sources of data and should be capable of perseverance in unearthing any and all data which may be useful to him.

With the two basic sources of inspiration available, viz., the general (and perhaps specific) policy guidelines of the National and Agricultural Sector plans, and the area profile, identification of relevant problems which might be alleviated with a project now involves four steps:

- (1) linking the production and marketing targets to the geographical areas where potential exists for meeting those targets through a government project.
- (2) pin pointing the ways in which social welfare in those areas falls short of what is desirable.
- (3) formulating a general statement of needs for each area which synthesizes goals of the national production targets and the relevant social problems, and
- (4) selecting the priority area for project formulation.

Step one should result a list of macroeconomy relevant problems (i.e., a list of what is not being done or accomplished which could be to help meet national production targets) for various areas.

Step two leads to an assessment of the needs of people to improve their standards of living, i.e., a list of welfare relevant problems. A key point here is the necessity of criteria for determining what is or is not a desirable standard of living. Should it be some minimum level of annual income, so many teachers per school age children, so much animal and vegetable protein to be consumed per capita, or what? Some rather specific notions of what is desired will have to be decided upon before one can determine whether or not a locale is above or below the established minimum norm for "enlightened" living. These norms, will of course, change, as growth and development occurs,

but at any time, for problem identification, some level of performance in these and other areas must be set as minimal goals.^{5/}

Completion of the third step provides the planner with a summary of the principal ways in which each region falls short of achieving the productive potential it has and in providing for the welfare of its inhabitants i.e., a composite of shortcomings and difficulties. Particular attention should be given at this point to identification of the extent to which macro target plans and social needs are either compatible or mutually exclusive. It is possible that both goals can not be achieved simultaneously. It is also possible that achievement of one goal precludes entirely reaching the other set of goals. This inconsistency should be pointed out so that decision makers are aware of what must be given up in order to reach certain ends.

Once the planner has outlined the current production capability and the people problems for various areas and prepared an area profile, in step four he then must decide upon which area, or areas, to give priority attention. If planning resources, (time, money and expertise) were unlimited perhaps all areas could be analyzed at once; however, some resources will always be limited, and there is a need

^{5/} Final decision as to what criteria and what "cut off" levels to use lies outside the scope of the individual planner as these relate to very fundamental value questions which ought to be answered by society at large. Whether they are so decided and if so what weight is given by the decision makers responsible for specific programs to the preferences of different segments of the population remains as one of the critical factors in determining the developmental objectives chosen and hence, the type of projects which are undertaken.

to decide where to devote one's attention first. A convenient check list of questions, or criteria, which can be helpful in identifying key problem areas is attached in Annex B. A major source of difficulty will be choosing which problem or problems will be attacked first. For example should projects be carried out yielding high export increases or high increases in domestically demanded goods thereby saving expenditures of foreign exchange instead of earning foreign exchange. The choice in such a case will not generally be made at the project planning level. In any event the project planner should be prepared to demonstrate to the extent that he can what will be given up in terms of foregone objectives by choosing any particular problem as the priority one to be solved.

Let us assume that the project planner has now chosen a particular area where he will concentrate his attention. Finding ways in which to make a contribution to Sector Plans and to the improvement of living conditions of people in the area is the problem to be dealt with. It is a joint goal, or a joint "production" problem in economic parlance, which invariably must be solved. Finding the project, or group of projects, that can do that given limited resources is the next step in project formulation.

D. The Search for Project Possibilities

The process of project identification and formulation begins with a search for an idea and ends with a specific developmental proposal.

Having completed the steps outlined in previous sections the project analyst should now be aware of the problems of an area and have a general idea of its growth and development possibilities. The next task is identification of alternative project proposals which tentatively appear to have potential for improving the conditions found therein.

The task is divided into three basic steps: (1) pre-inventory of area conditions to gain more detailed understanding of problems and potentials, (2) preparation of tentative project proposals, and (3) a "course screen assessment of those proposals."^{6/} There is then a systematic build-up from the germ of an idea to a set of investment project proposals worked out in rough detail. The process involves a series of successive approximations calling for various preparatory and analytical phases requiring the input of experts in many disciplines as well as cooperation between various government agencies. This process is discussed in the remaining portions of this chapter. Once possible project alternatives have been chosen, one by one they must then be designed, or formulated, in full detail and subject to complete feasibility analysis. The final design and feasibility testing phases of project planning is discussed in Chapters III-VIII.

^{6/} If the national plan for the development of the agricultural sector is one of great detail then it is possible that these steps have already been carried out. In most situations, as it is in Turkey, this is not the case and the project planner will have to translate broad developmental goals into specific objectives and design projects to reach those objectives.

1. Pre-Inventory

The pre-inventory stage consists of an examination of available data pertaining to existing resources including investment capital within the region of interest. A key point is that at this time the planner should be using existing information, i.e., secondary data. Under no circumstances should resources now be allocated to collection of primary data. The possible sources of published information include:

- . the national plan to the extent detailed developmental potentials are given,
- . special developmentally oriented studies carried out by consulting firms, government agencies, universities and international aid agencies,
- . technical reports by national and international experts.
- . agricultural sector and area review studies done by agricultural groups.
- . developmental programs and projects undertaken previously both by the public and private sectors.

An additional source of information not to be overlooked is the farming community itself. Through their knowledge of agriculture and the conditions in their own area, farmers and villagers may be able to suggest viable project alternatives. In any event these people are the ones who will be directly influenced by the project and views as to how they see their problems and what developmental approaches will be accepted must be built in to the project selection process. However, large scale socio-economic and attitudinal surveys are still premature at this stage.

The purpose of pre-inventory is thus to secure sufficient information upon which to base generalized project ideas. The focus of data analysis should be to determine what resources exist, physical, institutional, and human, which can form the basis of projects. This thrust differs from previous data review in that prior to this the purpose was to learn what the problems in an area are! Here the planner begins to formulate ideas for various corrective action and he is examining the data in order to put together a preliminary project design i.e., to determine the type, scale, and boundary of a possible plan. In doing so he must consider not only development possibilities but resource scarcities, limitations expected in the future, and potential bottlenecks in the development process vis-a-vis specific project possibilities. Information gaps are brought to light and rough estimates made as to the cost of gaining additional data. The pre-inventory should cover the following points:^{7/}

- (1) the natural resource system comprising water, soils, climate, and agro-potential
- (2) capital resources available for a development program,
- (3) crop production inputs required to sustain the production process at various levels of output,
- (4) human resources
- (5) institutional resources currently existing at the outset of the development process and those which will have to be added as development activity in general, and project implementation in particular continues.

^{7/} Aaron Wiener, The Role of Water Development, McGraw-Hill, 1972. p.256.

This survey should make it possible to formulate an outline of various projects which could help to achieve the developmental objectives specified for the project area. It may also form the basis for more concrete and detailed information gathering which will be necessary later once a final set of project possibilities has been selected.

Since at this stage neither very detailed developmental objectives nor specific projects have been articulated, data analysis is confined to comparisons of the area in question with other similar cases and the judgement of the planner as to the feasibility of various project possibilities which the data suggest. Although data examination is still very general the planner must begin to focus upon the most important information regarding the resources which appear most relevant to the development problem. Such a focus presupposes some reasoned development program or project which provides the rationale for the collection and assembly of data. The preparation of a plan, however, is dependent upon a resources survey -- which brings us back to the starting point.

The way to deal with this vicious circle is through the use of an iterative, sequential approach by which the planner moves back and forth between data, analysis, and project formulation using ever more detailed information as he goes.

2. Preparation of Tentative Project Proposals

Let us assume that the project planner has pulled together all of the existing data pertaining to a project relevant area, has organized it accordingly to topic, and has made a preliminary analysis to bring out the key factors regarding developmental potentials and limitations.

Preliminary project design involves articulation of realistic (but again tentative) objectives for the area and preparation of a list of courses of action which can meet the objectives. Here the importance of clear thinking regarding the problems which exist, both national and regional, and the performance of projects in solving those problems cannot be overemphasized. The imagination of the planner and the thoroughness with which he searches out various means of reaching alternative ends is often the key to the success of developmental programs. This is the aspect of analysis which may call the "art" of project planning.

All too often a critical error is made whereby preliminary project selection leads to restricted set of choices, and/or choices which emphasize a certain kind of project. For example, irrigation projects are often looked at as the cure-all for all manner of problems and the only way to achieve a productive agricultural sector. While a secure water supply is very important in many cases that alone may not be enough to bring about the needed changes. With irrigation project planning the scope of the analysis should be large enough to

include not only the control structures and canals but also watercourses and farm channels, arrangements for land leveling, provision for drainage, farm credit, farm to market roads, regional research stations, agricultural extension services and arrangements for financing. Also it may be possible that another entirely different approach may be even more beneficial, say a fertilizer/improved seed program or a farm credit program. If a broad set of possibilities is not put forth at this stage there is no chance of it reappearing later, except by accident!

At this point the planner should be taking a rough look at the problems and the area potentials and deciding upon the class of projects which might suit the situation. For example, he may decide based upon what he knows about the area whether a livestock improvement project or a feed improvement program, or both is a possibility. He may decide that irrigation is not required but that credit for improved seed and mechanical equipment has much better potential. As he begins to generate ideas for possible projects he will perhaps need to take a closer look at the data to "wring" out from it more knowledge regarding the capability of the area to respond to each alternative. Since the discovery of promising project opportunities is not an exact science much depends upon the project planner's ingenuity as well as his technical competence.

When looking for possible projects the planner should keep in mind the following questions:^{8/}

- (1) What are the unique cultural and physical advantages of the project area?
- (2) What are the market potentials for the product and services of the project?
- (3) What new technology can be applied?
- (4) What sources of supply, e.g., for raw materials, fuel, labor can be utilized?
- (5) What can be done to take advantage of current and planned development in the area?
- (6) Are there any innovations in organization which can be used?

The answers to these questions will point the way toward greater specification of concrete projects. One should bear in mind that not only may there be more than one project which can reach stated objectives within the region, but that any one project type may have several alternate forms. If nothing else there may be different ways of implementing a project. Each of the different possibilities should be explored and for each the planner should set out a "first-cut" at project design.

^{8/} A clear statement of the logical framework underlying project proposals is an important aspect of project design. The preparation of material relating to the basic rationale for projects is discussed in "The Logic of Project Design: Goals, Objectives, Outputs, and Inputs" by J.C. Day, General Directorate of Planning, Research and Coordination, Report No. 57, pp. 17 Ankara, 1974.

In order to prepare preliminary designs the secondary data previously assembled may not be adequate and a certain amount of primary data must be collected. Although field surveys and questionnaires may be in order, their scope should be no larger than absolutely necessary for once again the purpose is not to generate a complete data bank on each project idea, but to assemble only that which is necessary for making rough estimates of physical resource needs and benefits and costs. The latter provide the basis of a tentative evaluation of each project idea in what can be called the "course screen phase".

3. The Course Screen Phase

Once a complete set of project possibilities has been selected, and preliminary design work completed, there remains the task of screening to determine which among the various options are worthy of closer scrutiny. Many of the alternatives suggested will be, for logical or other substantive reasons, easily identifiable as prima facie unattractive or infeasible; others will be considered unattractive from the point of view of program objectives; the rest will be considered as eligible for further evaluation.

The purpose of screening is to separate the last group of alternatives from the first two. The screening criteria should be based upon program objectives with the evaluations largely dependent upon available data, limited use of primary data, and rough approximations of benefits and costs.

Of concern in all project design questions is logical soundness in terms of project performance vis-a-vis stated objectives and technical, economic, financial and socio-political acceptability. The "course-screen" process should be an analysis using these criteria, but with a recognized margin of error accepted in the accuracy of data. All project alternatives which pass the course screen test must then be subject to much more detailed examination (Chapter V-VIII) using the same criteria but with much better data. The latter may be generated either through additional special surveys or more detailed study of existing information.

Screening Data

For each alternate proposal the course screen analysis should display the following information:

- (1) a description of the project, i.e., its principal features and their technical design in sufficient detail to insure that the proposal is technically sound and workable if implemented in the subject area.
- (2) a preliminary estimate of project investment and annual operating and maintenance costs.
- (3) an outline of probable key construction and/or managerial man-power needed with an assessment of their future availability.
- (4) an outline of raw materials and other inputs required and an assessment of their future availability.
- (5) a preliminary assessment of the market potential for project induced output.

- (6) a brief statement outlining the relationship between proposed projects and area, sector, and national developmental problems and a preliminary estimate of benefits to the national economy and to individuals.
- (7) calculation of preliminary internal rates of return plus any other parameter for which it may be desirable to have estimates, e.g., improvements in health and sanitary conditions.

Screening Criteria

Since a number of alternatives for reaching the same objective may be possible, all of which appear to be reasonable, preliminary screening of project proposals should utilize the following feasibility criteria.^{9/}

1. From the technical point of view, which of the alternatives has:
 - (i) the least technical complications
 - (ii) the greatest chance of acceptability by farmers
 - (iii) the greatest adaptability to factor endowment in the (area and) country
2. From the economic point of view, which of the alternatives has:
 - (i) the potential of giving quick results
 - (ii) the shortest capital recovery period
 - (iii) the highest rate of return on capital
 - (iv) the widest impact upon the economy.
3. From the management point of view, which of the alternatives has:
 - (i) the least cumbersome management organization
 - (ii) the smallest demand on skilled staff needed for operation and management
 - (iii) the greatest chance of being accepted and supported by the largest number of producers.

^{9/} Source: General Guidelines to the Analysis of Agricultural Production Projects, FAO, Rome, 1971. p.11.

Since different projects will score higher than others on the basis of different criteria, it may not be possible at this stage to eliminate any of the preliminary proposals. However, to the extent that certain ones emerge as less desirable than others which accomplish the same objective the list of tentative projects can be reduced in size. Moreover certain projects may prove to be undesirable on the basis of specific standards, such as a minimum value of the economic internal rate of return and can be dropped from further consideration,^{10/}

Screening therefore serves to (a) determine the most promising projects for more detailed analysis, and, (b) guide those project plans which look promising but for which information is incomplete. The result of the course screen analysis should be a list of project alternatives which justify more effort and attention to detail in their design and feasibility testing.

E. Summary

In this Chapter the preliminary steps which must be followed in order to prepare sound developmental projects have been outlined. These steps can be placed in a logical sequence which begins with the need to identify problems, then proceeds to selection of a list

^{10/} A degree of caution should be introduced when eliminating project alternatives during the course screen test due to the approximate nature of the data. The analyst should be convinced that either additional new information or more detailed data would not change the feasibility/desirability of any project found to be unacceptable at this stage.

of possible projects (and other actions) which may be effective means of solving those problems and finally moves to preliminary assessment of the list of measures so identified.

While these aspects of project formulation can be easily at and described as a "flow" of activity leading from one step to another, the "feedback" or backward flow between them is less straightforward to portray. Nevertheless, the importance of this movement back and forth cannot be overemphasized. As the planner begins to learn more and more about a region, and as he begins to formulate tentative ideas about viable solutions to its problems, he will be forced to search out more information which in turn may generate additional ideas for developmental alternatives. This iterative process which will, and in fact should, occur will gradually converge upon a set of project measures which will justify the time and effort involved in detailed project design and feasibility analysis. Methods which can facilitate preliminary project formulation and evaluation as well as final project design are outlined in the remaining chapters of this manual.

CHAPTER III

PROJECT AREA BASE LINE STUDIES

A. Discussion

Once project alternatives have been identified which on the basis of a course screen assessment appear to have potential for improving the conditions found within a (priority) area, the tasks which remain are to flesh out the preliminary project design, identify with precision project benefits and costs, and verify project desirability through detailed feasibility analysis. In this Chapter procedures are outlined for generating the background information necessary for detailed project design and for establishing a baseline from which to measure expected project impacts. The chapters that follow focus upon enumeration and evaluation of project benefits and costs.

The baseline study involves an intensive examination of the project area and making forecasts of future conditions in the area as they are expected to be in the absence of each of the tentative projects previously identified. Particular attention should be given in the study to the expected demand and supply of potential project out-

puts, and farm cropping/livestock production patterns without the proposed project. Marketing studies must therefore be carried out to ascertain the saleability of project produced output and farm budgets must be prepared (based upon expected enterprise operations and prices of inputs and outputs) in order to bring to light the trend of economic conditions in the area. Finally, an estimate of general conditions (e.g., income distribution, employment, health and sanitary conditions) as they currently exist and as they are expected to be in the future should be prepared.

B. Survey of the Project Area

The purpose of this detailed survey is to establish current physical and socio-economic conditions in the project area. It serves as the base from which detailed project design proceeds and from which changes brought about by the project can be measured. Using the preliminary investigations previously carried out all necessary surveys, questionnaires, and other investigations must be completed to assemble sufficient information about the area and its problem to adequately describe the following factors:

1. Project Location
2. Natural Resources of the Area
 - i. Climate
 - ii. Topography
 - iii. Geology
 - iv. Soils
 - v. Soil Survey and Land Classifications
 - vi. Hydrology and Water Supplies
 - vii. Vegetation

3. Land Use and Agricultural Patterns

- i. Land Distribution and Tenure**
- ii. Cropping Patterns in Relation to Social Capability**
- iii. Livestock**
- iv. Technology in Use**
- v. Farm Management Practices**
- vi. Markets**

4. Water Resource Development

- i. Structural Works**
- ii. Usage Patterns**
- iii. Water Law**
- iv. Water Rights and Ownership**

5. Human Resources

- i. Population Characteristics**
- ii. Education**
- iii. Employment**
- iv. Income and Income Distribution**
- v. Health and Wellbeing**

6. Area Infrastructure

- i. Marketing and Processing Facilities**
- ii. Transportation and Storage Facilities**
- iii. Cooperatives and Farmers Associations**
- iv. Availability of Farm Inputs**
- v. Availability of Improved Technology**
- vi. Availability and Terms of Farm Credit**
- vii. Prices Received by Farmers**
- viii. Research, Extension, and Training Facilities**
- ix. Government Programs and Policies**
- x. Expatriat Donor Aid Programs**

7. Economic Conditions in Area

- i. Level and Composition of Agricultural Output**
- ii. Level and Patterns of Individual Consumption**
- iii. Surveys and Investment**
- iv. Trade Patterns**
- v. Share of Export Markets**

8. Specification of Project Relevant Problems

- i. Area Problems**
 - ii. Developmental Potentials**
 - iii. Obstacles to Development**
 - iv. Current Developmental Programs**
 - v. Need for Proposed Project**

Analysis of survey data will indicate concrete developmental possibilities by reinforcing, or refuting, directions brought to light in the preliminary stages of project preparation. The data should be sufficiently accurate for the analyst to confine his project design activity to one project at a time. Once a single project proposal has been thoroughly examine (as outlined below) the analyst will return to this point and prepare and evaluate a second, and third alternative, and so or until the list of possibilities is exhausted.

C. Commodity Demand Analysis

Following the area survey which focuses upon general conditions the next step in project planning involves preparation of precise commodity demand projections and marketing studies for each of the products to be produced by the tentative project, or the developmental program whatever it may be, which is under examination. The ultimate purpose of demand, supply, and marketing studies (outlined here and in Section D and E) is to establish the saleability of project outputs. In order to do that it is necessary to first project the future demand for each project product.

Demand projections for both the short-run and long-run must be prepared. This requires that the specific market which exists for project output must be identified. The output from agricultural projects will be sold in one or more of the following types of markets: (1) a national market, (2) a local or regional market, and (3) export markets.

In projecting the quantity of goods which may be sold by project participants two basic calculations are required irrespective of which market(s) (national, local or export) are involved. First, it is necessary to determine the total demand for each good during each year of the planning horizon. Second, the share of total demand which can be serviced by the project must be identified.

The specific procedures for projecting market demand will differ depending upon whether the goods in question are consumer goods or industrial materials.

The total demand over time for consumer goods is a function of changes in economic and social variables such as population, income, prices (of the goods in question as well as of substitute and complementary goods), tastes and preferences of consumers, and urbanization. Since industrial outputs are intermediate goods to be utilized in production, the demand for industrial commodities is a "derived demand" related to the projected output of industrial sectors or firms as well as to input prices. Technological relationships such as input-output

ratios and the specification of the production function (in terms of input substitution) are also important factors in projecting industrial demand for agricultural inputs.

Projecting the potential market share for the project on the other hand requires data about market conditions in addition to commodity consumption data. For products destined for national markets marketing shares are calculated by comparing the projected national demand with projected national production (supply), the supply deficit being the marketing potential of the project. Whenever the commodity in question is imported from foreign sources the expected imports over the planning horizon should be added to projected domestic supply to arrive at total national supply without the project in place.^{1/} Whenever project outputs are limited to a local or regional market, potential market share is based upon the projected demand for the relevant area less the expected production of supplies for that market. In a similar fashion, the export potential of the project is determined by the difference between import demands and the expected supply from exporting countries. Thus for both consumer goods and intermediate goods demand and supply estimates are required for each of the relevant markets.

^{1/} A critical element in projecting imports during the future is the relationship between public policy as it relates to foreign trade and international agreements and how these are likely to evolve over time, as well as the ability to substitute domestic production for foreign imports.

In the following material procedures for calculating the necessary expected demand relationships are outlined. Supply projections are covered in Section D.

1. Market Demand: Consumer Goods

Economic theory tells us that the principal factors which determine the quantity purchased of a consumer good are:

- (1) the price of the good
- (2) the price of substitute and complementary goods
- (3) the size of the consumer population
- (4) the level of consumer income
- (5) tastes and preferences of consumers for the good
- (6) the time period over which consumption is forecast

Let us examine the relationship between these variables and demand more closely.

Prices Variables

In the short run, for example from year to year, changes in the real price of a commodity may have important impacts upon the quantity which will be purchased. The relationship between a given change in the real price level and the resulting change in the quantity demanded may be specified by the price elasticity of demand. Price elasticity of demand is defined as follows:

$$E_{P_a} = \frac{\frac{\Delta Q_a}{Q_a}}{\frac{\Delta P_a}{P_a}} = \Delta Q_a / \Delta P_a \cdot P_a / Q_a$$

where:

- E_{P_a} = price elasticity of demand for commodity (a)
- ΔQ_a = the change in the quantity demanded of commodity (a)
- Q_a = the quantity demanded of commodity (a)
- ΔP_a = the change in the price of commodity (a)
- P_a = the price of commodity (a)

Price elasticity thus measures the percent change in quantity demanded following a given percentage change in price and indicates the responsiveness of demand to changes in the price of the good. For example, if $E_p = -5$, then we can say that 1 percent reduction in price will result in a .5 percent increase in the quantity demanded. A 10 percent price reduction will lead to a 5 percent increase in quantity taken. By knowing the price elasticity of demand we can calculate the expected changes in the quantity taken following a given price change.^{2/}

^{2/} In utilizing this relationship care must be taken to be sure that all other variables which affect consumer demand (i.e. items 2-6 p.4) remain constant. Whenever more than price changes occur, these factors must also be taken into account (See page 55.) Also, different values for price elasticity may result depending up on the size of the percentage change in price as well as the method of calculation. For a good treatment of the concept of elasticity see Ferguson, C.E., Micro Economic Theory. Irwin Press, 1972.

For most commodities (i.e., normal goods) a reduction in price will lead to an increase in quantity taken, and vice-versa for price increases. However, price decreases (increases) do not always lead to decreases (increases) in the total revenue ($P \cdot Q$) received by producers. The latter is true because changes in the price may be offset by the resulting change in the volume of the product purchased. The price elasticity coefficient will also indicate the direction of the change in total revenue following changes in commodity price.

For example, a decrease in price will have the following effect upon total revenue (TR) depending upon the absolute value of E_p :

if $E_p > 1$ then total revenue (TR) increases

if $E_p < 1$ then total revenue (TR) decreases

Given the same values for E_p , an increase in price will have the opposite effect on total revenue. If $E_p = 1$ total revenue is at a maximum and changes in price in either direction will decrease total revenue.

For project evaluation purposes, knowledge of the price elasticity of demand is important for two reasons: (1) whenever the proposed project output is large enough to alter the market price of a commodity, the price change and the change in the revenue must be computed in order to determine the value of the resulting output; (2) whenever the price of project output changes relative to other commodities in the market (generally a long-run phenomena) the new prices must be determined and utilized in

computing long run product value. However, whenever relative prices can be assumed to remain constant and uninfluenced by the project price elasticity of demand will not be important in computing demand projections.^{3/} Under this assumption the change in price (ΔP) is zero, hence price elasticity (E_p) is equal to zero and drops out of the equation for calculating future price and quantity.

If for any reason the reported price level during the base period(s) utilized are not representative of the market prices actually paid by consumers an adjustment to those prices and resulting consumption should be made using price elasticity of the commodities involved. For example, if prices must be increased by 10% and the $E_p = -.5$ then the volume adjustment is found by multiplying the price elasticity coefficient by the adjustment factor, e.g.

$$\text{Volume Advustment Coefficient} = (-.5)(.10) = -.05$$

Estimation of price elasticities fails outside the scope of project preparation and evaluation. Such data should be published by a central

3/ In most circumstances it will be safe to assume that relative prices for goods and services will remain relatively stable over long periods of time. The effects of inflation, for example, are felt throughout an economy and for practical purposes may be assumed to have the same impact on all prices; hence the relative price of any good compared to another will be the same. Cyclical high's and low's on the other hand will tend to cancel each other out so that a mean price trend is adequate. Both inflationary trends and cyclical ups and downs are very difficult to predict with confidence over long planning horizons and the accuracy obtainable rarely justifies the effort required in forecasting these phenoma. To the extent that one can be sure that a significant change in prices of project input and outputs relative to other commodities will take place they of course should be taken into account.

statistical unit within the GOT (SPO) capable of carrying out the detailed econometric analysis for general use by all planning groups. For consistency in such basic data, it is important that the various groups which require price elasticity data do not construct their own, but rely on official estimates as prepared by the responsible experts.

A second price variable of importance is the price of commodities which may be close substitutes for, or complementary goods in consumption to, the specific items to be produced by the project. If substitute commodities exist their prices may effect the quantity demanded of the project output. For example, if the price of margarine becomes high relative to the price of butter, consumers may shift their purchases to butter, and vice versa if butter becomes more expensive relative to margarine. Complementary goods are those such as tea and sugar which are jointly consumed. For these goods a rise in the price of one will not only reduce its consumption but that of the complementary good as well since one is not consumed without the other. This relationship is known as the cross price elasticity of demand and may be expressed as follows:

$$CE_{pa}^b = \Delta Q_b / Q_b / \Delta P_a / P_a = \Delta Q_b / \Delta P_a \cdot P_a / Q_b$$

where:

CE_{pa}^b = the cross price elasticity of demand for commodities (a) and (b)

Q_b = the quantity demanded of commodity (b)

ΔQ_b = the change in the quantity demanded of commodity (b)

ΔP_a = the change in the price of commodity (a)

P_a = the price of commodity (a)

Using the previous example, if $CE_{pa}^b = .5$ then a 1 percent change in the price of commodity (a) (margarine), all other factors remaining unchanged, will result in a .5 percent change in quantity demanded of commodity (b) (butter). With substitutes, cross elasticities will be positive, an increase in the price of margarine, (i.e., ΔP_a is positive) will increase the quantity demanded of commodity (b) (Q_b is also positive) while for complements the relationship is negative since the price/quantity variables change in opposite directions.

As before, cross price elasticities should be made available by a central source having authority to prepare official government estimates.

Once again, as long as relative price ratios do not change, use of the cross elasticity coefficient is unnecessary in forecasting future demand in project outputs.

The Population Variable

The growth of population and changes in its age distribution are two fundamental and very important parameters for estimating the future

demand for food. Population characteristics also influence the labor force and hence hold important implications for economic growth in general and for the demand for industrial agricultural commodities. In computing demand projections, separate estimates must be prepared for urban and rural population growth, and for different age and sex categories depending upon the specific commodity and market in question. For example, children consume different kinds and amounts of food than do adults and therefore separate consumption patterns will need to be developed for each group. Similarly, different consumption patterns may exist for different sex-age distributions of the population.

Population information should be published annually by a central agency responsible for such studies and these should be utilized by the project analyst.

The Income Variable

The quantity of any consumer good which will be purchased during a period of time is directly related to consumer income. For purposes of estimating future consumption of agricultural goods it is necessary to calculate increases in per capita income over the project planning time horizon and the changes in the amount spent on various products (i.e., the change in demand times the price). Estimate of the expected change in average real income are needed for each of the separate population categories whose growth forecasts were prepared as outlined above. Values for the income elasticity of demand for the various in-

come classes for project outputs should be taken from official estimates as prepared by the central reporting agency.

Income elasticity of demand measures the responsiveness of consumer demand for a product to changes in consumer income and can be expressed as follows:

$$E_{Y_a} = \frac{\frac{\Delta Q_a}{Q_a}}{\frac{\Delta Y_a}{Y_a}} = \Delta Q_a / \Delta Y_a \cdot Y_a / Q_a$$

where:

- E_{Y_a} = the income elasticity of commodity (a)
- ΔQ_a = the change in the quantity demanded of commodity (a)
- Q_a = the quantity demanded of commodity (a)
- ΔY_a = the change in average real per capita income
- Y_a = average real per capita income

E_{Y_a} measures the percent change in demand following a given percent change in consumer income. As income increases the demand for (normal) goods will also increase; thus, E_Y for normal goods will be positive. If E_Y for a commodity is known to be 1.5, then we may say that a 1 percent change in income will result in an increase of 1.5 per cent in the volume of commodity demand (providing all other determinants of demand remain unchanged.) A negative income elasticity means that as income increases (decreases) the volume of demand for the period will decrease (increase).

Changes in income are primarily a long-run phenomena and do not materially influence future demand projections for short intervals of the planning horizon. The effect of income change is cumulative, however, and should be calculated from the initial period through the final point in the project planning horizon. Since elasticity coefficients will vary with different income levels, the analysis should utilize values which are applicable to the specific income groups which generate consumer demand.

Consumer Tastes and Preferences

Underlying consumer demand is a set of factors independent of commodity prices, population characteristics, and income which also help to determine consumption patterns. These factors are generally referred to as consumer tastes and preferences. They reflect such things as aesthetic or purely psychological returns from consumption, the desire to compete with the consumption patterns of close associates, and cultural differences among people. Together with price and income variables, tastes and preferences conveniently sum up the principal factors which are thought to give rise to individual consumer demand for a commodity.

In the markets for established consumer goods, tastes and preferences are not likely to change rapidly over the time horizon involved with most agricultural projects. To the extent this is true, the impact of these changes can be ignored in preparing forecasts of consumer

demand. However, when new products are being introduced into the economy, either by foreign imports or through the proposed project, alterations in consumer demand vis-a-vis price/income variables must be taken into account.

Correction factors for changing consumer attitudes may be derived from test market data whereby a comparison can be made between old and new consumption relations (using price, income and population variables as demand determinants). Another approach would be to compare a market where the "new" commodity is an established line with one where it is not. A problem in both situations is the difficulty of insuring that the only difference between the two markets is the existence of a single commodity, or a behavior relevant change, in one case and not in the other. In many instances where changing tastes and preferences can be expected, choice of the correction factor becomes a judgement decision.

Time Period

The period of time for which demand forecasts can be prepared may vary from very short intervals such as individual months to very long range planning horizons of 50 years or longer. For project planning purposes what is required is an estimate of annual consumer demands spanning some appropriate long run period. The length of the planning period will depend upon the specific nature of the project and upon the confidence that can be placed upon forecasts of future events.

While specific rules for planning horizons may not be realistic, as a general rule most development projects will require at least a 20-30 year period of analysis.

Demand Projection Formulae

In preparing consumer demand projection for developmental projects, it is typically assumed that relative prices of goods and services in the economy will not change over the period of analysis. While this assumption may be quite valid in many instances, there still remains the possibility that relative prices will alter; hence, the methods utilized to prepare market demand projections should allow for this fact. Income and price elasticities can be very useful in preparing demand projections; however, econometric studies of consumer demand are necessary in order to produce the elasticity coefficients. Lacking these the analyst will have to fall back upon point estimates of consumption assuming price quantity relations unchanged from the past. While this may not be unrealistic in some cases, in others it is very unlikely particularly in a developing economy wherein development itself depends upon as well as fosters changes in the basic input/output and consumption patterns of the past. Thus, to the fullest extent possible price and income elasticity data should be utilized in making demand projections. This is true even when prices are administered because first of all the effect of alternative pricing policies upon consumption forecasts and project feasibility should be made available,

and secondly, if demand functions are known for project outputs and changes in the pricing policy are expected in the future, the quantity side may still be estimated using the elasticity values. Since econometric studies are becoming more and more recognized for their potential value in planning, methods using elasticity coefficients are described below:

A General Formula:

A convenient formula for computing annual commodity demand is as follows:

$$(1.1) \quad Q_a^1 = Q_a^0 (1+g)(1+E_y^a I) (1+E_p^a P_a)(1+CE_a^b P_b)(1+t_a)$$

where:

- Q_a^1 = estimated quantity of commodity (a) demanded in year (1) following the base year (0)
- Q_a^0 = the quantity of commodity (a) consumed in the base year (0)
- g = the population growth rate per annum
- E_y^a = income elasticity of demand for commodity (a)
- I = expected annual rate of growth in average per capita real income.
- E_p^a = price elasticity of demand for commodity (a)
- P_a = the expected rate of change in the price for commodity (a) during the year
- CE_a^b = cross price elasticity of demand for commodities (a) and (b)
- P_b = the expected rate of change in the price for commodity (b) during the year
- t_a = expected annual rate of change in demand for commodity (a) as a result of changes in consumer tastes for commodity (a).

Formula 1.1 is a general formula which can be utilized for both short-run and long-run demand forecasting. It permits estimation of total consumption of commodity (a) on a year by year basis, given expected changes in population, consumer income, commodity prices, changes in consumer tastes, and the necessary price and income elasticities. Whenever it is safe to assume that there will be no relative price changes, i.e., the project itself or other factors will not change the economic relationship between commodities produced through the project and other goods and services, the two price elasticity terms will drop out. If tastes remain stable from year to year then the last term in the formula also drops out. Thus, when only population and income changes are expected to occur, formula 1.1 simplifies to:

$$(2.1) \quad Q_a^1 = Q_a^0 (1+g)(1+E_y^a I)$$

or

$$(2.2) \quad Q_a^1 = Q_a^0 + Q_a^0 (E_y^a I + g + gE_y^a I)$$

since, the annual change in demand is

$$(2.3) \quad Q_a^1 - Q_a^0 = Q_a^0 + Q_a^0 (E_y^a I + g + gE_y^a I) - Q_a^0$$

then the rate of change in annual demand becomes

$$(2.4) \quad \frac{Q_a^1 - Q_a^0}{Q_a^0} = \frac{Q_a^0 (E_y^a I + g + gE_y^a I)}{Q_a^0} \\ = E_y^a I + g + gE_y^a I$$

Expressions (1.1), (2.1) or (2.4) can be used to compute an annual series of expected total market demand for a commodity by iterative computations substituting the newly estimated value (Q_a^1 for example) for the base year thus deriving a new annual estimate (Q_a^2) for the second year in a series (See Worksheet III.1).

Forecasting probable consumer demand becomes more complicated whenever price changes can be expected to occur. Two situations may be possible in developing economies such as that of Turkey where an active government sector exists which can establish commodity prices by fiat, viz., (1) future pricing policies may call for a change in the relative price of a project output, or (2) the project output may be so large relative to the size of the market that prices are reduced automatically through any market forces which are operating. Both situations require that the price elasticity of demand be taken into account.

In the case where specific prices will go into effect following a governmental policy decision, formula (1.1) is the appropriate one to use.^{4/} The rate of change in prices (either P_a , P_b or both) can be calculated for the year or years over which the change is to occur and the Q_a 's derived directly. Once again, if the price of substitute

^{4/} Caution is required whenever official price elasticities are used to insure that expected price changes (also quantity changes) are percentage-wise very small. If they are not less than, say 2-3 percent, then the elasticity coefficients given by the central planning unit may be inappropriate for such a large change. The planner must then consult with the responsible official to select the proper elasticity coefficient to use under these circumstances.

or complementary goods is not changed and if consumer tastes and preferences remain stable, the relevant price terms drop out.

If a change in price can be expected as a result of project output adding to market supply, rather than because of a pricing policy decision, it is now necessary to compute the resulting price change instead of the quantity change. Formula (1.1) is still appropriate; however, the computation will need to be modified as follows:

Since the expected change in supply over the period is the sum of project output plus any other supplies, total market supply (Q_a^i) is known for the i^{th} year while the rate of change in price (P_a) is not; therefore, the resulting impact upon prices can be found by substituting the expected total supply for Q_a^i in (1.1) and solving the equation for P_a .

Once P_a has been determined there is sufficient information to compute the market value of new project output. The latter of course, is necessary data for determination of project benefits (See Chapters VI, VII, and VIII.).

Formula (1.1) thus provide the basis for computing expected consumption of a project consumer good in the year following the last year for which actual consumption data is available or alternatively the impact of predetermined outputs upon prices. It is necessary, however, to know not only the growth in population for the consumer group in question and their average income, but also current prices, and income/price elasticities for each period for each level of

average income. When using the formulas the income elasticity coefficient must be that of the income level during the base year, while the price elasticity coefficient must be that of the new income level for the year following the base year. Whenever income changes are very small from year to year, income and price elasticities will not change from one income level to another (see Appendix C for current income-price elasticities for Turkey). The formula should be utilized for each market in question. The resulting annual demand projections are then combined with estimates of annual commodity supplies from all existing and planned sources to determine the excess demand which the proposed project may serve to meet.

2. Market Demand: Intermediate Commodities

Forecasting future demand for commodities which are not destined for consumer markets requires procedures that differ from those outlined in the previous section. Intermediate commodities are goods which will enter some productive process as inputs to be combined with other factors in the formation of either another intermediate good or a final good for direct consumer use. Agricultural commodities may be inputs to other production activities such as feed grains, seed, and chemicals, or they may enter industrial production e.g., oil seeds. In either case the demand for agricultural intermediates is closely related to the demand for the product which they help to produce.

It is for this reason that the demand for intermediate inputs is often referred to as a "derived demand". For example, the demand for livestock feed is partially derived from the demand for the livestock itself.

The demand for intermediate commodities may be estimated by two basic methods: (1) utilization of technical coefficients (conversion ratios) for the input/output relation of interest; or (2) projection of a trend of input consumption over time.

Use of the first method requires first of all an estimate of the quantity of the given input needed to produce a unit of the relevant output, plus a realistic estimate of the amount of the output to be produced. By multiplying the conversion factor (the input per unit of output) by the total output level, the total input required will be known. For example, if it takes 200 kilos of barley feed grain to produce 100 kilos of beef (live weight), and the output of beef cattle is 1000 head per year at an average weight of 900 kg., then the annual feed requirement is $200 \times 900 \times 1000 = 180,000$ MT. Similarly, given the input/output ratios and feed availability, output may be computed.

When appropriate technical information and output forecasts are available the above procedure is straight forward. However, the use of constant technical relationships over the long periods of time involved in projecting demands for project analysis should be done with extreme

caution. Moreover, the constant ratio ignores the economic relationship between inputs and any substitution possibilities that may exist. With respect to the latter consideration it should be recognized that the choice and level of an intermediate commodity employed is also dependent upon the relative price of those inputs, and whenever it is technologically possible for alternative inputs to be utilized, intelligent producers will choose an input mix that is most profitable. As input prices change the economically optimal input ratios per unit of output may also change.

In dealing with these difficulties there is no easy approach to take. About all that can be said is that the project analyst should be aware of any impending technological changes and economic factors which will significantly alter his projections of input demands. A thorough knowledge of relevant technical and economic research which bears upon these problems is of paramount importance. Judgement decisions have to be made and the analyst must be prepared to rationalize and document the basis for his actions so that they may be readily understood for very often these decisions will not be made in isolation from various other factors or from the opinions of others.

The second approach to estimating future demand for intermediate products is based upon historical trends of use. Whenever an acceptable technical relationship between inputs and outputs cannot be established,

or whenever a sufficiently accurate demand forecast for the output commodity is not available use of the trend approach can yield useful results.

A trend projection can be made by plotting a scatter of past consumption of the good for individual years and fitting a curve to the data. The scatter diagram should be first examined to determine obvious trends during the most recent periods since these intervals may reflect conditions most applicable to the forecast period of interest. This is not always the case however and the analyst should be aware of any unusual pricing relationship that have occurred in the past which may have resulted in uncharacteristic data points. Also cyclical patterns occurring over a long historical series may repeat themselves one or more times during the project planning horizon. In any event the analyst should determine whether a straight line or some curvilinear trend line will best represent the possible course of future consumption.

The methods of selecting the trend line may be either visual or mathematical. Visual plotting of the trend involves pure judgement regarding the probable course of consumption during each year based upon the past. Mathematical methods i.e., least-square methods employ formulae for minimizing the sum of all data point deviations from a historical trend line and extrapolating that line into the future. The least-squares approach will generate a mathematical equation which facilitates plotting of consumption for the project horizon.

Use of the historical trend of annual consumption of intermediate goods to project future consumption (by either visual or mathematical methods) is computationally straightforward; however, underlying the approach are implicit assumptions which must be understood. Basically, with this method it is assumed that the factors which have influenced the demand for the input in the past will remain unchanged in the future. Thus, technological changes which will affect the trend of input/output relationships are ignored. Similarly, economic factors which determine input ratios as well as demand for the final product are assumed to remain the same as indicated by the trend line of the past. In addition, sociological factors (e.g., tastes and preferences) for final goods are assumed to remain constant. All these are questionable assumptions to make. In effect, the trend projection method is based upon the assumption that any changes that do occur in the factors affecting input demand will move in opposite directions so that the combined effects will cancel each other out. To the extent that changes are not mutually compensating the effect of changes which alter the relationship between time and intermediate good consumption must be taken into account when projecting demand. Despite its theoretical limitations, the trend method is useful.

In the above material, several approaches for estimating consumer and intermediate demands for potential project output have been outlined which employ special techniques. Other approaches which may be followed

are less technique oriented and more related to subjective assessment of past and future relationship. These methods are as follows: International comparisons of consumption patterns realizing that country consumption may follow the same trend but with a time lag; known changes in export demand; analysis of family budget data; sector analysis of consumption; use of official government development targets; and political factors such as foreign trade agreements. Although, useful information may come from a variety of data sources, the basic element no matter where the data comes from is estimation of what demand will be in the future. The best results may come from a comparison of the results obtained by several different methods.

Worksheet III.1. Commodity Demand Forecasts

Worksheet III.1 can be used to prepare forecasts of commodity demand and to record consumer prices for the project output. There should be one such worksheet for each commodity to be produced and each market which the project may serve.

The worksheet is divided into two main parts, one comprised of Column (1), (2) and (3), and the other of Column (4) and (5). Column (2) provide space to record historical data pertaining to population, income per capita, commodity prices, income and price elasticities and consumption, viz., all the parameters listed in Column (1) with

the exception of Forecast Coefficients^{5/} which are entered in Column (5) only. Column (3) permits the analyst to record average annual per cent changes in the variables over the historical period. Percentage changes for shorter periods, e.g., 4 or 5 year intervals may be entered above the relevant annual values in Column (2). Income and price elasticities and the time interval utilized in the statistical study leading to the elasticity values should be given in Column (2).

Columns (4) and (5) are used to record data relevant to the forecast period for project planning. Column (4) is used to record expected percentage changes in population, income, and commodity prices over the entire planning horizon. In Column (5) periodic changes for less than the entire horizon may be noted above the annual estimates. Income and price elasticities to be used in the calculation of annual future demand are also entered in Column (5). Additional sheets may be used.

The procedure to follow in completing Worksheet III.1 is straightforward given estimates of expected consumer prices^{6/} for

^{5/} The Forecast Coefficient is the adjustment factor to be applied to the base year demand to determine probable demand in the following year. The coefficient is computed from demand elasticities and population growth as shown in Formula 1.1 on p. 54 and discussed below p. 67.

^{6/} The ease or difficulty of preparing of appropriate annual commodity price forecasts depends upon the data available. If average annual consumer prices are published then they may be used directly in Column (2). However, if monthly data is recorded then relevant portions of Worksheet III.5 can be helpful and should be used for this purpose.

the project commodity involved and also price and income demand elasticities. The main computations are (1) calculation of the Forecast Coefficients, and (2) computing annual consumer demand (using the Forecast Coefficient) during each year of the project planning horizon.

Completion of the Worksheet is as follows. Historical values for population, income, and consumer prices for urban and/or rural final demand and the average price are first entered on the appropriate lines in Column (2). Any percentage change values of interest are then recorded either in Column (2) above the absolute values being careful to note the time series to which the changes refer, or they may be entered in Column (3) for the entire historical base period. Forecast values for the three variables may then be entered in Column (5). The historical trend plus any other known factors which will affect the expected future trends should form the basis for the estimates.

The next step is to record the historical elasticity coefficients on the appropriate lines in Column (2). The time series to which the elasticity values refer should be noted. Since incomes and tastes and preferences will tend to differ among urban and rural populations separate elasticities for each group may be needed. These values become the basis for determining the elasticities to be utilized in making the demand forecast. While the "forecast" elasticities will normally be the same as those of Column (2), there may

be good reason to adjust these for future periods because of known factors which will change consumption patterns. In any event, the elasticities to be used in calculating the demand forecasts for future periods should be recorded in Column (5).

Using the expected annual percent change in population, per capita income and the expected change in annual price (all taken from either Column 4 if the changes are uniform throughout the forecast period, or from periodic changes noted in Column 5), plus price and income elasticities, the Forecast Coefficient for each segment of demand (urban and rural) is then computed. Formula 1.1 shown on page 55 is used to compute the Coefficient. To illustrate the calculation if we ignore cross-elasticities and changes in consumer tastes Formula 1.1 becomes

$$(2.5) \quad Q_a^1 = Q_a^0 (1+g)(1+E_Y^a I)(1+E_p^a P_a)$$

If

g = annual population growth = 4.5 percent

E_Y^a = income elasticity = .2

I = annual per capita income change = 2 percent

E_p^a = price elasticity = -.5

P_a = annual price increase = 3 percent

then equation (2.5) becomes

(2.6)

$$Q_a^1 = Q_a^0 (1+.045)(1+(-.2)(.02)(1+(-.5)(.03))$$

$$Q_a^1 = Q_a^0 (1+.045)(1+.004)(1-.015)$$

$$Q_a^1 = Q_a^0 (1.0334)$$

Thus the new expected consumption demand in year 1 following the base year 0 is 1.0334 times the base year consumption. The value 1.0334 is the Forecast Coefficient. If, for example, .5 million tons of the commodity were taken in year 0 (the last year of the historical basis) then expected consumption in year 1 of the forecast period following income changes, population changes, and price changes as shown above, would be

$$.5 (1.0334) = .51670 \text{ million tons}$$

The resulting value is then entered as the forecasted demand for the initial year in the project planning horizon. This value in turn becomes the base year for computing the forecasted consumption in the second year of the planning horizon, and so on through the entire forecast period. Whenever price, income and population changes vary in magnitude during the forecast period new Forecast Coefficients will need to be computed for those years.

It should be noted that if relative consumer prices are not expected to change then P_a may considered to be zero, even though the

actual forecast values shown in Column 5 reflect a change from year to year. When this occurs the last terms in equation (2.5) drops out.

The final step in completing Worksheet III.1 is summing the annual consumption forecasts to yield the total demand for the commodity in the particular market analyzed. When several markets exist for one commodity a recap sheet will be needed to combine the individual market forecasts into one estimate of the total commodity demand.

D. Commodity Supply Analysis

In order to determine the economic potential of the proposed project it is necessary to make a comparison between the estimates of commodity demand prepared in Part C, and estimates of the likely supply of those commodities coming from various sources during the life of the project. The difference between projected demand and projected supply represents the quantity which could be sold by project participants under favorable conditions. In this section suggested methods for projecting commodity supply are outlined.

1. Supply: National Markets

The supply of agricultural goods destined for national markets may come from two sources: (1) domestic production and (2) foreign imports. Therefore, projections are required for each source.

(1) Demand Parameters	(2) Historical Period											(3) Historical Changes	(4) Projected Changes Per. Yr.	(5) Forecast Period											
	1	2	3	4	5	6	7	8	9	10	11			1	2	3	4	5	6	7	8	9	10	11	12
Population (1000)																									
Urban																									
Rural																									
Total																									
Income/Capital (\$)																									
Urban																									
Rural																									
Average																									
Price (\$)																									
Urban																									
Rural																									
Average																									
Income Elasticity																									
Urban																									
Rural																									
Price Elasticity																									
Urban																									
Rural																									
Forecast Coefficient																									
Urban																									
Rural																									
Total																									

Worksheet 1.1 Commodity Demand Forecasts (Cont')

Project _____ Commodity _____ Market _____

(1)

(2)

(5)

Budget Item	Forecast Period																																							
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50		
Population (1000)																																								
Urban																																								
Rural																																								
Total																																								
Income/Capital (R)																																								
Urban																																								
Rural																																								
Average																																								
Price (R)																																								
Urban																																								
Rural																																								
Average																																								
Income Elasticity																																								
Urban																																								
Rural																																								
Price Elasticity																																								
Urban																																								
Rural																																								
Forecast Coefficient α																																								
Urban																																								
Rural																																								
Consumption (Tons) β																																								
Urban																																								
Rural																																								
Total																																								

Domestic Production should be estimated on a province (or geographic area) basis and the results totaled for all provinces or areas for each year of the proposed project's life. Estimates of crop production require information as to probable area planted and expected yield. The historical trend is important for both but due regard must be given to possible future changes which will affect the amount of land sown in each crop and the per decare yield. For livestock products, the expected number of producing animals and yield per animal are required. Similarly, for other agricultural commodities output is a function of yield per unit multiplied by the anticipated number of producing units. However, the list of variables for both cases is large and includes socio-economic factors as well as technological considerations. The project analyst must therefore take into consideration changes in land use patterns, the development of new agricultural lands, the potential affect of price policies, adoption of new seed varieties, agronomic practices, and development programs in preparing these estimates.

For agricultural commodities produced through commercial or industrial processes, e.g., fertilizer, feed, and certain other farm supplies, estimates of supply must be tied to forecasts of raw material supplies and expected plant capacity. Once again historical trends provide the basic starting point for preparing these estimates, but expected or potential future changes in relevant variable should be

assessed carefully. New sources of raw materials and opportunities for plant development must be considered.

Estimation of the annual volume of foreign imports can be (partially) based upon the trend of past imports; however, foreign policy with respect to international trade agreements, international economic and political conditions which may affect imports, the affect of balance of payments, and the changes in import requirements as Turkish productive capacity changes will have to be taken into account. As domestic demand for agricultural products grows decisions will have to be made by the planner as to the share of the total demand which will come from imports.

2. Supply: Local Markets

The procedure for estimating supply potentials for local markets is in general the same as for estimating national supplies. An important difference, however, is that the sources of supply for each market must first be identified and then projections established for those specific areas. Three factors must be kept in mind in preparing area projections:

- (1) the productive potential of the area and the cost of production
- (2) area location vis-a-vis the market and transport costs
- (3) the extent of market organization and the share of the market enjoyed by the area.

Supply potentials rest upon size of productive area and yield data. Costs are based upon productive efficiency, capacity, and pricing information for necessary inputs. Comparative advantages in production for areas must be weighed against locational disadvantages and marketing capabilities.

Total area supply is then calculated on the basis of the volume of commodities likely to enter the local market from each area. The cost of production plus transportation must be compared to estimates of probable consumer prices to determine the quantity which can be expected to be available at the local markets. Thus, the competitive position of each local supply source will determine the extent to which that area services the local demand.

3. Supply: Export Markets

Projecting foreign country export potentials rests upon an analysis of foreign domestic production expectations and probable importation from other exporting countries. The difference between domestic demand and domestic production plus competitor exports represents a supply deficit (surplus) which may be met by Turkish exports. As before, economic conditions in world markets and changes in productive capacities and trade policies world wide can strongly influence the foreign supply for any country. Hence, estimation of this supply potential is not always based upon hard data. Neverthe-

less estimates for traditional markets where Turkey enjoys an actual (or as yet undeveloped) comparative advantage can be made which are helpful for planning purposes.

In preparing estimates of foreign supplies the analyst will find it necessary to work on a country by country basis assessing the relative comparative advantage in production and transport for each country supplying the various export markets. Also, the emphasis given to developing foreign markets for potential supplies by each exporting country, including Turkish marketing programs should be evaluated. The results should be a forecast of expected exports (supplies) moving into the various export markets. Worksheet III.2 can facilitate making these forecasts.

Worksheet III.2 Commodity Supply Forecasts

The Worksheet to be used for preparing estimates of commodity supplies entering the various markets prior to completion of the project under consideration is similar to Worksheet III.1 in that two basic sections are provided, one relating to historical production patterns Cols. (2) and (3) and the other pertaining to production forecasts, Cols. (4) and (5). The data recorded in Column 2 for each source of supply listed in Column (1) are to be used as basic information for preparation of the expected future trend of supplies from these areas, plus any new sources of supply expected to enter the market in the future.

Column (3) is to be used to enter notes regarding percentage and/or absolute value changes in historical production from year to year. As with Worksheet III.1, space should be reserved above each line of actual yearly output for recording additional data concerning periodic fluctuations and trends in output. For example, the percentage change in annual output for the 5 year intervals 1965-1969 and 1970-1974 may be shown above the annual changes for those intervals.

Column (4) should provide space to enter notes or other information which will be used to compute the forecasted annual production from each supply source. The historical pattern of production plus any other known factors which will influence future output will determine the forecast values. As an example, the expected rate of average annual change in area supply for the entire planning horizon may be recorded on each line in Col. (4) while periodic trends for intervals of time within the horizon may be written above the relevant line in Col. (4).

Columns (3) and (4) supplemented by appropriate entries in Cols (2) and (5) therefore provide space for recording relevant information for assessing historical output patterns and making explicit the basis for calculating expected output. Once the forecasted values have been obtained and entered on the correct line in Column (5) they

are summed to provide the estimated total supply entering the market in the absence of the proposed project.

E. Marketing Potentials

Marketing potentials should reflect the volume of agricultural goods which the proposed project through its participants could potentially sell, and the probable commodity prices which can be expected to obtain for each year of the project's life.

For each of three basic types of markets the sales potentials of the project are calculated similarly. The first step is to determine which market, or markets, the project will serve. The next step, is to calculate the difference between market demand and the supplies which can be expected to flow to that market from other sources. The balance represents the amount which could be marketed by the proposed project. If demand volume for each year of the project horizon exceeds expected supplies, then the deficit could be provided by the project. If there is a supply surplus then the marketing potential for a new project is nonexistent.

In preparing estimates of marketing potentials considerable stress must be placed upon the effect of commodity prices and costs of production upon annual demand and supply. Just as changes in the factors which affect demand will affect annual volume of demand, cost changes will affect the amount supplied by the various producing enti-

ties. Thus, the marketing potential of a project depends upon relative prices in the markets for outputs and for inputs. Also, if a new project can enjoy a cost of production and/or a transportation advantage over its competitors then it may displace an existing supplier.^{7/}

Worksheet III.3 Commodity Marketing Potentials

Worksheet III.3 provides the necessary format for estimating the total quantity of the commodity which could be sold in all markets on a year by year basis. Total market demand determined in Worksheet III.1 (plus summaries for all markets) and total expected supply from Worksheet III.2 in the absence of the proposed project are entered on lines I and II of Worksheet III.3.

The difference between forecasted demand and forecasted supply represents either a supply or demand deficit. A demand deficit means that potential exists for sale of project output. The precise volume of that potential may be computed by either assuming an annual marketing quota which will be assigned to the project or through the use of an estimated percentage share of the market. The latter may be based upon historical market shares.

^{7/} Whenever commodity prices are regulated in the economy, cost of production transportation advantages of a new project may not be permitted to appear in prices. It should be of interest however, to point out any possible consumer and industry wide advantages of lowering the pegged market price. We are of course referring to the important price elasticity coefficient of demand.

Production Source	Historical Period										Past Changes	Projected Changes	Forecast Period											
	1	2	3	4	5	6	7	8	9	10			1	2	3	4	5	6	7	8	9	10	11	12
Domestic																								
1. Area or Province																								
2.																								
3.																								
4.																								
5.																								
Total																								
Exports																								
1.																								
2.																								
3.																								
4.																								
Total																								
Grand Total																								

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Worksheet III.2 Commodity Supply Forecasts (Cont')

Project _____ Market _____ Supply Area _____ Commodity _____

Production Source	Forecast Period																								
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38
Domestic																									
1. Area or Province																									
2.																									
3.																									
4.																									
5.																									
Total																									
Imports																									
1.																									
2.																									
3.																									
4.																									
Total																									
Grand Total																									

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At this point the analyst will have to determine the approximate commodity output which the project can produce and compare that amount with the supply deficit. If the project output will be sufficient to satisfy the forecasted demand gap then the expected consumer prices as estimated in Worksheet III.1 should remain valid. However, if even after the full output potential of the project is reached a supply deficit can be expected in any period then there will be pressure for the market price to rise and exceed the previous estimates. In this case it will be necessary to go back to Worksheet III.1 and recompute the commodity price estimates using equation (2.5). Since the quantity taken in the initial year (and thereafter) must be equal to the total forecasted supply, both Q_a^0 and Q_a^1 (where Q_a^1 is equal to all supply including project output), population growth, income change, and elasticities are known, the equation can be solved for P_a which is the annual change in price. If P_a is not allowed to change because of government pricing policies, the recomputation should still be carried out in order to show how revenues would change if market forces were free to operate, and also how farmgate prices received (after deduction of marketing costs and margins) might differ.

Worksheet III.3 Commodity Marketing Potential
 Project _____ Commodity _____

Demand / Supply Deficit	Historical Period											Forecast Period														
	1	2	3	4	5	6	7	8	9	10	11	1	2	3	4	5	6	7	8	9	10	11	12	13	14	
I. Total Demand (from III.1)																										
II. Total Supply (from III.2)																										
III. Total Market Deficit (I-II)																										
IV. Project Market Share - %																										
V. Forecast Project Marketing Potential a/																										
VI. Expected Project output																										
VII. Market Deficit with Project (III-VI)																										

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a/ Project market share x market deficit (ie, line III. = line IV.)

Worksheet III.3 Commodity Marketing Potential (cont')
 Project _____ Commodity _____

Demand / Supply Deficit	Forecast Period																									
	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	
I. Total Demand (from III.1)																										
II.																										
III. Total Supply (from III.2)																										
IV. Market Deficit (I-II)																										
V. Project Market Share - %																										
VI. Forecast Project Marketing Potential ^{a/}																										
VII. Expected Project output																										
VIII. Market Deficit with Project (III-VI)																										

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^{a/} Project market share x market deficit (ie, line III.x line IV.)

Worksheet III.4 Monthly Marketing Potentials

Once the forecast of potential annual project sales and output has been prepared (Worksheet III.3) for the entire planning horizon, there remains the task of converting annual sales into a monthly estimate. This is important because we must coordinate production and storage capabilities with the time occurrence of consumer demand. If there is a discrepancy between the periods of production and the periods of consumption, then storage facilities must be made available if possible.

Worksheet III.4 is completed by entering the historical consumption figures by month for the chosen base period in Col. 2. These are then summed horizontally to yield total consumption over the base period for each month (Col. 3). Total consumption is then divided by the number of months in the base period to yield average consumption each month during the base period (Col. 4). Monthly consumption is also summed vertically to give annual total consumption. The average annual consumption (last line, Col. 4) is calculated by totalling the annual values (Col. 3) and dividing by the number of years in the historical period. The monthly values in Column 4 are then divided by the average annual figure for the total base period to yield the average monthly marketing potential as a percent of average annual total market consumption (Col. 5).

The forecasted annual market potentials from Worksheet III.3 are now entered in Column 6 on the bottom line for total annual forecast potential. These values are then multiplied by the monthly percentages of Column 5 to generate expected monthly marketing potential which is then recorded on the appropriate monthly lines under Forecast Period.

There is a Worksheet III.4 for each of the project product lines. The estimates of monthly sales potential as computed above are thus based upon the historical monthly share of total sales. Any known factors, such as future import policies, construction of product storage facilities, etc., which may come into play and alter the future timing of monthly demands should be taken into consideration and adjustment made to the forecast values of Column 6.

In part F. to follow the detailed production plan for the project will be prepared. The monthly production/harvest schedule may then be compared to the annual patterns of demand to determine the need for additional storage improved marketing facilities. If new facilities become part of the project their capital costs and annual operating charges are then computed and included in the analysis (see pp. 138-147).

Worksheet III.5 Project Commodity Prices Received by Producers

Worksheet III.5 is designed to facilitate preparation of prices to be received by producers for the forecasts period. Historical price data may be either farm gate prices (those received by the producer), wholesale prices, or retail prices. The choice will depend largely upon the price series data available and the market in which the commodity is sold by the project participant. Whenever prices other than those received directly by the farm producer are used they must be adjusted downward to reflect the costs of marketing and processing. Methods for preparing estimates of marketing costs are outlined below in material dealing with Worksheets III.6-III.9. If farm prices are utilized here, then the remaining portions of this Section may be skipped.

The worksheet is filled out in the following way. First the price series data with which the analyst must work is identified in the appropriate space at the top of the worksheet. The data, as indicated may be farm gate prices, wholesale, or the retail consumer prices utilized in Worksheet III.1. Then, the historical monthly prices are recorded in Col. (2), and the average annual price calculated for each year. The monthly averages and monthly averages as a percent of the annual average may be recorded in Column (3) if desired. If prices used are farm gate prices there will be entries in Column (2) for only those months during which farm producers sold their product. Those

prices occurring at the peak harvest period (5) are then identified and entered on the line for Harvest Period Price. If there is no storage or other marketing costs reflected in the Harvest Period Prices these prices are the returns accruing only to the farm producer and the factors utilized in actually producing the product and become the basis for computing net revenues received by those producers. If on the other hand the Harvest Period Price is a wholesale or retail price, or includes any marketing costs incurred by the farmer, then all marketing costs (storage, transportation, advertising, make-ups, etc.) are entered on the line labelled Marketing Margins. Margins are then subtracted from the Harvest Period Price to yield the net prices received by producers. The latter values can be recorded on the appropriate line in Col. (2). Annual marketing costs are to be computed using Worksheet II.6.

In Column (3), in the lower section of the Worksheet simple averages and any percentages desired may be entered. Column (4) provides space for recording additional calculations, e.g., percentages such as the average percent difference between harvest period price and the yearly average, the marketing margin as an average percent of harvest price, and the average price received by farmers as an percent of the average annual price.

Analysis of the price relationships of the historical period forms the basis for the forecasted prices for the planning horizon.

If the only price series data available is retail consumer prices then the forecast values entered in Column (5) should be the same as those utilized in Worksheet III.1. Otherwise wholesale, or farm gate prices will be estimated. Since it is unlikely that annual retail or wholesale price as usually reported averages will be the same as harvest period prices an adjustment factor will be needed. This factor can be calculated (as mentioned regarding Column (4) of the Worksheet) as the ratio of historical average yearly price to average historical Harvest Period Price. As before expected marketing margins derived as a percent of harvest price (Col. 4) must be subtracted to yield expected farm gate prices. The whole process is simplified if original historical data are farm gate prices to begin with for then all that is required is to estimate the future prices directly.

It is to be remembered that in preparing price forecasts no attempt should be made to build in either a seasonal fluctuation or a periodic cyclical rise and fall in annual average prices. Seasonal fluctuations reflect by and large variation due to supply and storage inadequacies and high off-season prices do not reflect productivity of the farmer and the value of the goods since the added return is really to storage capabilities and supply restrictions. Cyclical variations in harvest price are very difficult to predict with any accuracy and, hence, will probably not justify the effort required to prepare them. Moreover, cyclical high's and low's will tend to cancell

each other out. An inflationary trend should likewise not be built in since what is important in project analysis is that relative prices change be accounted for and not changes whereby all prices are more or less equally affected as they are with inflation. Thus, the price values utilized should be thought of as 'real prices'.

Worksheet III.6 and III.7 Marketing Costs

The marketing of project output may give rise to costs which need to be taken into account when computing gross returns to producers. Worksheet III.6 is designed to facilitate computation of these project costs.

Space is provided in Column (1) for listing each of the activities involved in moving project output from the farm to the consuming market. Four main activities have been entered -- processing, transportation, storage and merchandizing, but others may be listed as needed. Subcategories of these main functions and individual components of each activity should be listed separately in Column (1).

In columns (2) and (3) basic descriptive information about each marketing activity should be recorded. Column (4) is designed to provide space for additional notes and comments pertaining to each activity. More than one line should be utilized if necessary to adequately describe the marketing activity and any facts relevant for computing the unit cost of handling project output. In Column (5) the cost per unit is

recorded. Each cost estimate should be tied to the series of forecasts years for which it applies and sub-columns within Column (5) may be used if required.

Total unit costs for all activities associated with the particular market under examination are derived by summation of the values entered in Column 5. A separate worksheet must be prepared for each potential market for each project product line. Worksheet III.7 can be used to aggregate all marketing costs into a single annual figure. These costs will then be utilized in Worksheet III.5 to compute net returns per unit in the various markets.

In some situations marketing facilities for certain markets may be nonexistent. Whenever this is true, the entry "none" should be made in Column (2) of Worksheet III.6. A follow up analysis will then be made (Chapter IV.) to determine the cost of constructing new facilities to service that market.

F. Land Use and Production Without the Project

A fundamental principal in project analysis is that project impacts with the project should be computed net of what can be expected without the project. For example, it is the increase in beneficiary net income created only by the project that is a project benefit and not the entire income that participants may receive as a result of

Worksheet III. 6 Marketing Costs for Alternative Markets :

Project _____ Commodity _____ Market _____

(1) Marketing Activity	(2) Facility/ Equipment	(3) Location	(4) Assessment of Facility	(5) Unit Cost				
				19.. - 19..	19.. - 19..	19.. -19..	19.. - 19..	19.. - 19..
Processing								
Transportation								
Storage								
Merchandising								
Other								
Total								

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Worksheet III: Marketing Cost Summary

Project _____

Commodity / Market	Project Planning Period : Year From Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Commodity																										
Market:																										
Commodity																										
Market:																										
Commodity																										
Market:																										
Commodity																										
Market:																										
Total Cost																										

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Worksheet III.7 Marketing Cost Summary (Cont)

Project _____

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Commodity / Market	Project Planning Period : Year From Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Commodity																										
Markets																										
Commodity																										
Markets																										
Commodity																										
Markets																										
Commodity																										
Markets																										
Total Cost.																										

the project, nor is it necessarily the added income which they are earning after the project has been carried out.^{6/}

Project impacts may be many and varied depending upon the type of project, its size, the area in which it is located, and the time horizon considered in the planning period. Many such impacts will be economic ones, while others may represent qualitative changes in standards of living. No matter what impacts is considered, the starting point for analysis is an estimate of the conditions expected without the project. These values must be compared with estimates of the conditions expected to derive from the project. The difference between these estimates becomes the change induced by the project.

In this section estimates are to be made as to the basic farm enterprise combinations, yields, costs of production, and expected revenues for direct project farm participants. These then become the basis for computing changes in net farm income for the project area. Other conditions in the area, e.g., employment levels, income distribution among income classes and use of modern farm technology, etc. are also required and Worksheets which can facilitate the assembly of such information are included.

^{6/} Note the use of the terms "with" and "without" the project as opposed to "before" and "after" the project. The former phraseology makes explicit the need to measure impacts which arise only as a result of the project whereas the latter may include changes that have come about by the time the project is in place but which may not be due to the project itself.

Worksheet III.8 Land Use Without Project

Before commencing Worksheet III.8 there should be completed a detailed forecast of farming activity in the project area without the project. This may be an extrapolation of past cropping/livestock enterprise activity, land use, etc., or a forecast of expected changes due to introduction of new technology, new institutions, and new crops or livestock breeds, etc., not connected with the proposed project. In most cases, the project area is already engaged in agricultural activity; hence, the forecast can be an informed judgment of future conditions based upon past trends and anticipated changes.

Worksheet III.8 is used to summarize land use expectations without the project. The anticipated allocation of land of various classifications to each crop or livestock enterprise during each year of the project's life is recorded. Space is provided for recording the amount of land devoted to each enterprise as well as for a grand total of all enterprises for each year of the forecast period. Land classifications may be based upon drainage slope, fertility, etc., or any other factors which will alter the input/yield relationships between different portions of the project area. The specific classifications which will cause a change in basic input/output ratios may vary from project to project and area to area. The project planner must choose the groupings that fit the particular situation.

The values in Worksheet III.8 are to be utilized in Worksheet III.9 to compute returns and costs to the farm area on a crop/livestock enterprise basis for individual periods (years) within the project time horizon. The latter values are in turn transferred to Worksheet III.10 for determination of net returns in the area without the project.

Worksheet III.9 Farm Capital Investment Required Without Project
by Area

Worksheet III.9 is designed for the preparation of estimates of capital investment outlays which will be required by the farm and related agricultural activity in the project area under conditions expected to prevail in the absence of the proposed project. In Column (1) are listed the various capital expenditure items which are relevant for the agricultural enterprises under considerations. These items are related to the cropping patterns outlined in Worksheet III.8, and the farming practices which form the basis of Worksheet III.11. Various subcategories of items may be listed as necessary.^{7/} Expected outlays in each planning year are listed under the appropriate time period of Column (2).

^{7/} In economic evaluation of projects the data pertaining to investment in land and other capital items may require certain adjustments to avoid erroneous results. These adjustments involve corrections to market values for costs to reflect the social opportunity cost of these resources. The material of Chapter VII covers this problem. Here, all investments are in terms of lira amounts as paid by the individual participants in the project. Later in Chapter VII these data will form the basic starting point for the analysis of project costs from the perspective of the economy at large.

Form No. 1 III-B Land Use Without Project (Revised)

Project _____

Crop/Livestock Activity	Project Planning Period: Year From Present and Date																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	
Crops																														
Wheat																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Barley																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Sugar Beets																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Potatoes																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Other																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Livestock																														
Sheep																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Goats																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Cattle																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Other																														
Land Class																														
1.																														
2.																														
3.																														
Total																														
Grand Total																														

MINNESOTA BUREAU OF LAND MANAGEMENT
 LAND USE WITHOUT PROJECT (acres) (Cont.)

Project _____

Crop/Livestock Activity	Project Planning Period: Year from Present and Date																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Crops																									
Wheat																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Barley																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Sugar Beets																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Potatoes																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Other																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Livestock																									
Sheep																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Goats																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Cattle																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Other																									
Land Class																									
1.																									
2.																									
3.																									
Total																									
Grand Total																									

Since the farming area serviced by the project may be quite large and diversified, calculation of capital investments necessitates separate consideration of small geographic units. These may be individual farms, villages, groups of villages, land types, or any other classification of convenience.

In any event, there is a separate sheet for each unit examined. These are then aggregated in Worksheet III.10 to present the total investment component in the farm area.

Worksheet III.10 Total Farm Capital Investment Required Without Project

Worksheet III.10 is identical to the previous one except that its purpose is to pull together the area estimates of Worksheet III.9 into a single investment component for the whole area affected by the project. Thus, the sub-totals for each capital item listed are transferred from each Worksheet III.9 to the appropriate area line in III.10. Summation of the expenditures for all areas, for all items, gives the total capital expenditure outlay for the whole project area.

Once Worksheet III.10 is completed, detailed budget data for variable farm costs and annual revenues are prepared in Worksheet III.11. The summary investment data from Worksheet III.10 will later be combined with similar data as expected with the project to determine the added capital investment expected when the proposed project is carried out.

Investment Item	Project Planning Period : Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Land																									
Total																									
Building																									
Total																									
Equipment																									
Total																									
Inventories																									
Total																									
Other																									
Total Investment																									

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Investment Item	Project Planning Period : Year from Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Land																										
Total																										
Building																										
Total																										
Equipment																										
Total																										
Inventories																										
Total																										
Other																										
Total Investment																										

of 7p. and 8p.

It should be noted that the salvage value of capital items may be looked upon as a cash receipt at the time of disposal and as such can be entered in Worksheet III.12 as a farm cash income item.

Worksheet III.11 Farm Yields, Revenue, and Production Costs Without Project

Worksheet III.11 is utilized for the preparation of budgets for each crop/livestock activity in the farm management plan anticipated in the absence of the project. It is essentially a form for preparing itemized cost and revenue data on a per decare basis for each activity as they would be without the project, and aggregating them according to the estimates of land use in each activity as prepared in Worksheet III.8.

There should be separate sheets filled out for each crop/livestock activity. Since key variables (prices and costs per unit and the quantity of input and output per decare) may change over time, each sheet should identify at the top the time period to which the estimates refer. The period may be either a single year, or, in the case where values are unchanged over several years, they may be a period of time. In any event, there should be as many sheets filled out as there are periods.

Separate columns for recording input/output quantities; and corresponding costs and returns are to be used whenever factors exist

Worksheet III.10 Total Farm Capital Investment Required Without Project
 Project _____

Investment	Project Planning Period : Year from Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Land a/																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
buildings																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Equipment																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Inventories																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Other																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Total Capital Investment																										

a/ cfs. 7p. and 8p.

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Worksheet III.10 Total Farm Capital Investment Required Without Project (Cont.)
 Project _____

Investment	Project Planning Period : Year from Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Land a/																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Buildings																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Equipment																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Investments																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Other																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Total Capital Investment																										

a/ cfs. 7p. and 8p.

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which will cause a change in these values from one location to another. In the sample sheet, there is space for four different land classes; hence separate budgets are needed for each one.

Column (1) provides space to record the sources of income and expenses involved in production at the farm level. In Column (2) unit prices of inputs and outputs are listed and in Column (3) the output yield and input utilized per decare for each land class is entered. Values for Column (4) are derived by multiplying the entries in Columns (2) and (3) to give the value per decare, entering the total number of decares (from Worksheet III.8), and then multiplying the value per decare by the number of decares to give the total value of outputs or cost of inputs. The remaining columns are identical to Col.s (3) and (4); however, Column (11) is utilized to record the totals for each line (the latter being the total annual cost-revenue summary for each crop and livestock activity for the particular time period covered). These totals will then be transferred to Worksheet III.12 in order to compute revenues/costs/net returns for all crop/livestock activities per project period.

Budget categories include both cash and non-cash items. Total production costs (Item III) has been divided into farm cash expenditures (III.a), farm cash and non-cash costs (III.b), and a separate cost category which excludes taxes and interest (III.c). The latter cost item refers to economic costs as calculated in the national

efficiency account. Corresponding net returns per decaire are shown on lines IV.a, b, and c.

Yearly totals for each crop/livestock activity are then transferred to Worksheet III.12, where costs and revenues for all crop/livestock activities are determined.

Worksheet III.12. Revenue and Costs All Crop/Livestock Activities
Without Project

Worksheet III.12 is used to prepare annual estimates of returns and costs for all crop/livestock activities associated with the project. One such Worksheet should be filled out for each year (period) of the project horizon. Budget items listed in Column (1) are identical to those of Worksheet III.11. Under Column (2) are listed the various activities involved in the anticipated farming pattern. The values entered under each crop/livestock enterprise, are taken from Column (11) of the appropriate year of Worksheet III.11. Column (3) provides space to list the salvage value of any capital items disposed of during the project period. In Column (4) total cost-revenue data for each line is recorded. Care should be taken to insure that yearly data from III.11 is posted to the correct yearly sheet in III.12. The net return values (Item IV.) of Column (3) applicable to each year of the project will eventually be transferred forward for comparison with the corresponding net returns with the project in place.

Worksheet III.11 Yields, Revenue, and Production Costs Without Project
 Project _____ Crop or Livestock Activity _____ Project Period _____

(1) Budget Item	(2) Unit Price	(3) Land Class:			(4) Land class:				(5) Land class:				(6) Land class:				(11) Total
		Yield/ Input/d	Value/d	No/d	Total Value	Yield/ Input/d	Value/d	No/d	Total Value	Yield/ Input/d	Value/d	No/d	Total Value	Yield/ Input/d	Value/d	No/d	
I. Revenue																	
a. Farm cash revenue																	
Crops/Livestock																	
Loans																	
Subsidies																	
b. Farm home consumption																	
c. Total farm (a. plus b.)																	
d. Total farm revenue less subsidies and loans																	
II. Costs																	
a. Cash Costs																	
1. Seed																	
2. N. Fertilizer																	
3. P. Fertilizer																	
4. K. Fertilizer																	
5. Manure																	
6. Pesticides																	
7. Herbicides																	
8. Hired labor																	
9. Animal charge																	
10. Tractor charge																	
11. Tool charge																	
12. Building " "																	
13. Water " "																	
14. Custom services																	
15. Other																	
Energy																	
Working Capital																	
16. Subtotal																	
17. Payments on																	
18. Interest																	
19. Taxes																	
20. Depreciation																	
21. Total cash costs																	
b. Non-cash costs																	
1. Family labor																	
2. Annual land charge																	
3. Annual maint. charge																	
4. Other																	
5. Total non-cash costs																	
III. Total Production Costs																	
a. Supply costs																	
b. Family labor																	
c. Annual land charge																	
d. Annual maint. charge																	
e. Other																	
f. Total non-cash costs																	

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Budget Item	Crop/Livestock Activities									
	Wheat	Barley	Sugar Beets							
I. Revenue - Income										
a. Farm cash revenue										
Crops/Livestock										
Loans										
Subsidies										
b. Farm income consumption										
c. Total farm income (In. plus a)										
d. Total farm revenue less Subsidies and loans										
II. Cost										
a. Cash costs										
1. Seed										
2. N. Fertilizer										
3. P. Fertilizer										
4. K. Fertilizer										
5. Manure										
6. Pesticides										
7. herbicides										
8. hired labor										
9. annual charge										
10. tractor charge										
11. fuel charge										
12. building charge										
13. water charge										
14. custom services										
15. Other Energy										
working capital										
16. Sub-total										
17. Payment or principal										
18. Interest										
19. Taxes										
20. Depreciation										
21. Total cash costs										
b. Non-cash costs										
1. Family labor										
2. Annual land charge										
3. Annual maint. charge										
4. Other										
5. Total non-cash cost										
III. Total Production Costs										
a. Total cash costs (II.a. 21)										
b. Total non-cash costs (II.b. 5)										
c. Total production costs (II.a. 21 plus II.b. 5)										
IV. Net income without Project										
a. Net farm cash income (In. minus II.a.)										
b. Net farm income (In. minus III.c.)										
c. Net economic income (In. minus III.c.)										

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Worksheets III.13-19 Conditions Without Project

Worksheets III.13 through III.19 provide space to assemble various information about the project area and its inhabitants as expected in the absence of the particular project under preparation. The effects of other government programs may be taken into account here providing these other investments are assured. These data provide necessary socio-economic benchmark information against which project net benefits will be measured.

Worksheet III.13 Employment Conditions Without Project
 Project _____

	Project Planning Period : Year from Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Level of Unemployment																										
Without Project %																										
Area																										
Area																										
Area																										
Area																										
Total																										
No of Permanent Jobs																										
Income Class																										
0 - 2499 TL/yr.																										
2500- 7199 TL/yr.																										
7200- 9999 TL/yr.																										
Over 10,000 TL/yr.																										
					</																					

Worksheet III.14 Income Without Project
Project _____

Input Categories	Project Planning Period : Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Change in Annual Income by Income Class(Direct Participants-1/yr.)																									
0- 2499																									
2500-7199																									
7200- 9999																									
Over-10,000																									
Share of National Income by Income Class(Direct Participants- %)																									
Without Project																									
0- 2499																									
2500- 7199																									
7200- 9999																									
Over-10,000																									
Annual Income Variation																									
Without Project																									
0- 2499																									
2500- 7199																									
7200- 9999																									
Over-10,000																									
Land Ownership in Project Area by Income Class(% of total arable)																									
Without Project																									
0- 2499																									
2500- 7199																									
7200- 9999																									
Over- 10,000																									
Expected Bankruptcies in Project Area																									
Without Project																									
Demand for Short-Term Emergency Loans in Project Area																									
Without Project																									
Inflationary Trend in Project Area																									
Without Project																									

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Impact Categories	Project Planning Period : Year From Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Change in Annual Income by Income Class (Direct Participants-Tl/yr.)																										
0- 2499																										
2500-7199																										
7200- 9999																										
Over-10,000																										
Share of National Income by Income Class (Direct Participants - %)																										
Without Project																										
0- 2499																										
2500- 7199																										
7200- 9999																										
Over-10,000																										
Annual Income Variation																										
Without Project																										
0- 2499																										
2500- 7199																										
7200- 9999																										
Over-10,000																										
Land Ownership in Project Area by Income Class (% of total arable)																										
Without Project																										
0- 2499																										
2500- 7199																										
7200- 9999																										
Over- 10,000																										
Expected Bankruptcies in Project Area																										
Without Project																										
Demand for Short-term emergency loans in Project Area																										
Without Project																										
Inflationary Trend in Project Area																										
Without Project																										

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Worksheet III.15 Access to Modern Farm Technology (Cont.)
 Project _____

Impact Categories	Project Planning Period - Year from Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Promotion of Farms Utilizing:																										
Fertilizer																										
Pesticides																										
Herbicides																										
Improved Livestock																										
Breeding Practices																										
Improved Animal Feeding and Health Practices																										
Improved Livestock Buildings (per head)																										
Tractors																										
Other Equipment																										
II. Per hectare Amount or No. of:																										
Fertilizers																										
Pesticides																										
Herbicides																										
Improved Livestock																										
Breeding Practices																										
Improved Animal Feeding and Health Practices																										
Improved Livestock Buildings (per head)																										
Tractors																										
Other Equipment																										
III. Irrigation Works:																										
Amount / Quantity																										
IV. Erosion Control:																										
Amount / Quantity																										
V. Land Leveling:																										
Amount / Quantity																										
VI. Extension workers per farm:																										
Number																										

Year	Project Planning Period : Year from Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
I. Total Farm Loans																										
Live Value																										
II. Average Loan Value By Farm Size (TL.)																										
Under 5 ha.																										
5-15 ha.																										
16-25 ha.																										
26-50 ha.																										
51-100 ha.																										
Over-100 ha.																										
III. Average Loan Value By Income Class (TL/yr.)																										
0-2499																										
2500-7199																										
7200-9999																										
Over-10,000																										

IV. Financial Terms/beneficiary	Source of Loans	Ave. Value of Loan	Required Collateral	Interest Rate	Repayment Terms
a. Farm Size					
1-15 ha.					
16-25 ha.					
26-50 ha.					
51-100 ha.					
over 100 ha.					
b. Type of Terms					
1. Sheep					
2. Cattle					
3. Pigs					
4. Other					
c. Income Class (TL/yr.)					
0-2499					
2500-7199					
7200-9999					
Over 10,000					

Worksheet III. 16 Access to Farm Credit (Cont')
 Project _____

Item	Project Planning Period : Year From Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Total Farm Loans																										
Live Value																										
II. Average Loan Value By Farm Size (TL.)																										
Under 5 ha.																										
5 - 15 ha.																										
16- 25 ha.																										
26- 50 ha.																										
51 - 100 ha.																										
Over- 100 ha.																										
III. Average Loan Value By Income Class (TL/yr.)																										
0- 2,999																										
2500- 7,999																										
7200- 9,999																										
Over- 10,000																										

(2)

Item	Project Planning Period: 1 Year from Present and Date																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
I. Project Area Road Roads (Per. ...)																								
All-Weather/All-Vehicle																								
Total Kilometers																								
Restricted																								
Total Kilometers																								
II. Agricultural Cooperatives																								
Number																								
Participation Rate																								
Farm Size																								
Under 5 ha.																								
15 - 15 ha.																								
16 - 25 ha.																								
26 - 50 ha.																								
51 - 100 ha.																								
Over 100 ha.																								
Income class (fl./yr.)																								
0 - 2499																								
2500 - 7199																								
7200 - 9999																								
Over 10,000																								
III. Shipping and Transport Capacity																								
Per ha.																								
For head of livestock																								
IV. Storage Capacity																								
Per ha.																								
For head of livestock																								
V. Processing Capacity																								
Per ha.																								
For head of livestock																								
VI. Subsistence Farms																								
Number																								
VII. Share of Local Area Output																								
For Home Consumption																								
Amount																								

Worksheet III.17 Improved Capacity of Marketing and Distribution System (Cont.)

Project _____

(1)

(2)

Item	Project Planning Period : Year from Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Project Area Feeder Roads (Per. ha.)																										
All-Weather/All-Vehicle																										
Total Kilometers																										
Restricted																										
Total Kilometers																										
II. Agricultural Cooperatives																										
Number																										
Participation Rate																										
Farm Size																										
Under 5 ha.																										
15 - 15 ha.																										
16 - 25 ha.																										
26 - 50 ha.																										
51 - 100 ha.																										
Over 100 ha.																										
Income class (R./yr.)																										
0 - 2499																										
2500 - 7199																										
7200 - 9999																										
Over 10,000																										
III. Shipping and Transport Capacity																										
Per ha.																										
Per head of livestock																										
IV. Storage Capacity																										
Per ha.																										
Per head of livestock																										
V. Processing Capacity																										
Per ha.																										
Per head of livestock																										
VI. Subsistence farms																										
Number																										
VII. Share of Project Area Output for Home Consumption																										
Amount																										

CHAPTER IV
PROJECT FORMULATION

A. Discussion

Following, the assessment of tentative project possibilities as outlined in Chapter III, the next step is formulation of a specific project plan and estimation of its major financial impacts. In this chapter procedures are outlined which can facilitate project design.

In formulating a project the specific project works, measures, and/or policies must be described in detail and estimates made of the costs of capital investments, annual inputs, and operation-administration activities. The related inputs and their costs, and outputs and revenues must also be computed as they are expected to be at the farm level with the project in place. This means that a fundamental part of project formulation is preparation of farm enterprise plans and corresponding farm management and resources utilization schedules which are compatible with the proposal project.

Since improvements in farm practices are likely to be a component part of the project itself, the materials to be worked up in this section focus also upon these new procedures, the purpose being to calculate the net revenue occurring at the farm level with the proposed project in place and the new practices in effect. These net returns are later compared to the net returns expected in the absence of the project as computed in Worksheets III.10, III.11, and III.12 to derive the added income generated by the project. The latter in turn, will be used in Chapters VI and VII to determine project financial and economic benefits.

Agricultural development projects may vary greatly in type and extent from a small capital investment project such as a river diversion structure providing irrigation water to a village, to large storage reservoir and irrigation systems capable of serving an entire valley. It may be a credit program, or a livestock and feed improvement plan, or package of improved agronomic practices within a village, province or region. A project may seek to improve the capability of an extension activity. It may also involve various combinations of all of these each at different scales of effort. A project planning manual should be suitable for use in any one of these situations.

In order to facilitate the project formulation process general descriptive categories of inputs and outputs are suggested and

worksheet are prepared which can be used to tabulate these items and calculate costs and returns to project participants irrespective of the character of individual proposals. For example, there is a category of inputs and a corresponding worksheet applicable to capital cost items. For irrigation projects the respective engineering works fit this description very well; however, a strictly credit program may not. Similarly a long list of annual variable inputs may be required with one type of project but not with another. On the other hand entirely different types of programs may have items that fit very nicely into the capital cost, annual inputs, operation and administration framework even though the specific items are not at all similar, e.g., annual increments of loan funds vs. seed, fertilizer and labor. In many situations some or all project impacts may defy quantification in monetary terms. When this occurs appropriate Worksheets are designed for descriptive entries which can be utilized in cost minimization and/or cost effective analysis. Thus, to the extent the categorical items listed in the Worksheets apply to a project proposal they should be filled in--if they do not apply, then these categories and perhaps even entire worksheets should be left blank.

The balance of this Chapter is organized as follows: Section B. Project Design and Description; Section C. Technical Feasibility; Section D. Project Investment Schedules; Section E. Annual Operating Costs; Section F. Farm Management Plan with Project; Section G. Indirect Project Effects, and Section H. Summary Data.

B. Project Design and Description

As the planner begins to formalize a final design for a project he should prepare a narrative description of the proposal. The purpose of such a description is to present detailed information necessary for complete understanding of what the proposed project is, what it is designed to do, and what its input requirements are. The description should include the following:

1. A description of the project in terms of its general characteristics.
2. Relevant project site characteristics (slope, drainage, stability, micro-climate).
3. Output and/or service provided by the project.
4. Time schedules for project planning, implementation, start up, and for reaching full output/service capacity.
5. The rationale for project scale and/or scope and the possibilities for reduction or enlargement.
6. The technical and economic length of life of the project.
7. The salvage value of equipment, buildings and works.
8. The goods and services required by the project and associated production input/output relationships utilized.
9. The skilled technical and/or administrative staff required by the project during implementation and operation and their availability. The availability of necessary labor inputs.
10. Offsite impacts including adverse environmental effects and means proposed for their control.

Project formulation is a multi-disciplinary activity and will require input from specialists in many fields. The number of specialists involved and the disciplines to be represented will depend upon the type of proposal being considered. In any event, this aspect of project preparation involves taking the ideas generated earlier and working them out in complete detail. The narrative description based upon the items shown above forces the project planning team to outline their idea in concrete terms.

Once the project has been put together and the description is completed calculation of investment costs, input costs, and operating, maintenance, repair expenditures, and/or administration charges can begin. However, before going on it is necessary to thoroughly examine the project as now planned in order to be certain it is technically feasible.

C. Technical Feasibility

The purpose of technical feasibility analysis is to verify that a project proposal is sound with respect to its physical and biological aspects. The project activity (i.e., the production, service or assistance stemming from the project) as well as the physical characteristics of the location of that activity, input/output relationships utilized, project size, machinery, equipment, buildings, lending capital, seed, feed, livestock inputs, construction and/or

administrative set-up schedules, physical availability of operating inputs, and finally physical and biological side effects would be considered. To the extent that the proposal involves these (and other) purely technical considerations, the project analyst should give the design criteria and the rationale for the design and/or administrative structure of the project.

For example, a technical feasibility analysis should show that the proposed scale of the project is adapted to the resource, area, or product to be developed, that the proposed location is technically and/or economically the best available, that the project layout and design are appropriate, etc. In the case of an irrigation project technical feasibility involves careful examination of the availability and quality of the physical resources to be used especially water and land, viz., the quantity, quality, and reliability of water supply, and the ability of project land to yield projected levels of production. Livestock projects require studies of herd composition and productivity.

Thus, technical feasibility studies are based upon detailed engineering, agronomic and animal husbandry factors. The number of factors to consider are necessarily large and will vary depending upon the particular project under examination. Good project design will depend upon the application of sound technical criteria and good judgement. For purposes of project preparation the services of

skilled technicians is once again a necessity. Since no general parameters exist for judging whether the detailed aspects of project are technically feasible or not, this section of the report will be limited to descriptive material outlining the various considerations involved. For that reason no worksheets for preparing technical feasibility analysis are included in the manual. Skilled personnel from the relevant physical and biological disciplines must be relied upon to judge the feasibility of proposals and their component parts using whatever format is appropriate in their analysis.

D. Project Investment Schedules

A number of worksheets have been prepared which can be used to pull together the necessary capital cost figures for project proposals. These are presented in this section along with instructions for filling them out.

Worksheet IV.1 Description of Project Capital Items

The purpose of Worksheet IV.1 is to provide a convenient means for an inventory of capital investment items required by the project and for recording key specifications necessary for computing their costs. The Worksheet is straightforward -- each individual item is listed in Column (1). If there are several components to the project, e.g., more than one small dam, several separate storage facilities servicing different areas, extension facilities in more than one pre-

vince, etc., the items listed in Column (1) should be organized, or at least identified, as to the project component of which they are a part. Descriptive information for each component item is entered in Column (2). Each item is specified further as to materials utilized (Col. 3), dimensions (Col. 4), and capacity (Col. 5). Space is provided in Column (6) for additional commentary. Column headings listed in IV.1 are intended for general use; hence they may not be applicable in every situation. Whenever this is the case, the Columns which do not apply may be ignored or other parameters for describing project components may be substituted.

Worksheet IV.2 Investment Cost of Project Capital Items

In Worksheet IV.2 the total cost of each capital item calculated on a yearly basis and the total investment during the construction and/or set up periods is computed. Specific items are transferred from Worksheet IV.1 while unit cost information must come from other sources. The rate of exchange utilized for the foreign exchange component of investment costs should be recorded at the top of the table. The basis for the exchange rate chosen should be set forth in a footnote to the Worksheet. As many sheets as needed should be utilized; however, since Column (8) is for summarizing annual investment costs only the last page should have these values filled in.

As indicated Column (1) should correspond to Column (1) of Worksheet IV.2. The number of items is given in Column (2), and unit cost per item in terms of domestic currency and foreign exchange equivalent is recorded in Column (3). The cost of labor for installation and/or set-up of the item is placed in Column (4). Column (5) contains the summary of investment cost for each item, i.e., the cost per unit (purchase price or construction cost per unit multiplied by the number of units) plus any additional labor costs required to render the unit operational. Column (6) provides space for recording the dates initial investment commences, completion (start-up) is achieved, and replacement is needed.

Under Columns (7) and (8) space is utilized to summarize all investments into annual values for each year in which the expenditure takes place. In Column (7) the number of years from the present (beginning with 1 and continuing to the end of the project's life and the corresponding date is listed. Column (8) is completed by summing all the foreign exchange equivalent expenditures for the first year, the second year, the third, and so on, as identified in Column (6). The same is done for the domestic expenditures listed in Column (6). The latter two Columns are then added across for each year to give the total expenditure required in TL. for each year (date) of the project's life. Any capital goods which are to be turned over to

project participants should be so identified and the value of such goods itemized. This may be done by footnotes to the worksheet. These equity shares of public investments will later be brought forward to Worksheet VI.1 to determine remaining financing needs by participants.

(2) Worksheet IV.3 Investment Cost New Marketing Facilities

As indicated, situations may arise where marketing facilities for serving a particular market are inadequate or do not exist, and in order for the project to be successful additional facilities and/or equipment may be required as part of the project. To the extent new investments are necessary they must be evaluated either separately as more or less independent entities, or as component parts of the main agricultural project. In general the latter approach is preferred since the benefits of a project stem from the process of producing goods and making them available to consumers. Thus, whenever new marketing facilities are a part of a project the complete package should be examined not just parts of it. Worksheet IV.3 is to be used in computing the investment costs of needed facilities as identified in Worksheet III.6. These costs will be combined with other cost data regarding project investment (Worksheets IV.4) to generate a complete display of project capital investment.

Worksheet IV.3 is identical IV.2 and is filled out in the same way; however, since marketing facilities required may be specific

Worksheet IV.2 Investment Cost of Project Capital Items
 Project _____ Exchange Rate \$/_____

(1) (2) (3) (4) (5) (6) (7) (8)

Facility/Equipment	No. Unit	Unit Cost		Labor Cost/- Unit	Installed Cost			Date Of			Total Investment Cost By Year			
		Foreign Exchange	Domestic Currency		Foreign Exchange	Domestic Currency	Total	Investment	Completion	Replacement	Fr. Rate	Foreign Exchange	Domestic Currency	Total
											1			
											2			
											3			
											4			
											5			
											6			
											7			
											8			
											9			
											10			
											11			
											12			
											13			
											14			
											15			
											16			
											17			
											18			
											19			
											20			
											21			
											22			
											23			
											24			
											25			
											26			
											27			
											28			
											29			
											30			
											31			
											32			
											33			
											34			
											35			
											36			
											37			
											38			
											39			
											40			

(c)

for different commodities the cost analysis may be broken down on a commodity by commodity basis. Thus, there may be one sheet for each separate project output. If this is the case, then a final annual summary for all commodity facilities may be filled out using only Cols. (7) and (8). As before, any capital goods transferred to participants should be identified and the value of such goods recorded. Footnotes to this worksheet may serve this purpose. As indicated this "equity share" of public investment will be brought forward to Worksheet VI.10 to determine the balance of private financing needed.

Worksheet IV.4 Total Investment Schedule

Worksheet IV.4 is to be used to assemble the investment schedule for the entire project time horizon. In preparing the schedule the annual total investments for all project components are to be transferred from their respective worksheets to here.

As illustrated, six investment components have been listed in Column (1), but in practice, as many items may be listed as required. The listing should, however, distinguish between the main categories, or components of the project so that each of the investment items may easily be reviewed separately if necessary. Only the total annual investment should be brought forward to Worksheet IV.4. Investment is broken out as either domestic or foreign exchange with the exchange rates listed in Column (1) for the various currencies involved.

Once the individual annual totals have been entered they are then added to determine the grand total investment for each year. Care should be taken to insure that items transferred are in the same monetary units and that no Worksheet totals have been omitted.

E. Annual Operating Costs

Worksheets, IV.5, IV.6, IV.7, and IV.8, are designed to facilitate computation of the annual operation costs of the project or developmental program and of any marketing facilities included. These costs, therefore, refer only to those expenses incurred in order to operate and/or administer the project or program itself and do not include annualized capital costs of the project or annual operating costs occurring at the farm level. The investment component has been worked up in Worksheets IV.1-4 above and the farm level costs are covered in Worksheets IV.9-15 below.

When computed the four Worksheets shown in the following pages summarize reoccurring input costs. Worksheet IV.5 is the source for the annual data pertaining to the basic project or program per se, while worksheet IV.6 is the same but pertains to only the new marketing facilities. The worksheets are described in detail below.

Worksheet IV.5 Project Annual Operating Costs:

This worksheet is the source of operating cost information for the project itself. As a beginning the project analyst must prepare

Worksheet IV.4 Total Investment Schedule (Cont.)
 Project _____

(1)

(2)

Investment Type	Project Start Date		Year from Present and Base		Year from Present and Base		Year from Present and Base		Year from Present and Base		Year from Present and Base		Year from Present and Base		Year from Present and Base		Year from Present and Base		
	Year	Month	Year	Month	Year	Month	Year	Month	Year	Month	Year	Month	Year	Month	Year	Month	Year	Month	
Marketing facilities (from IV.3)																			
Domestic currency																			
Foreign exchange																			
Ex. Rate																			
Ex. Rate																			
Ex. Rate																			
Capital Item (from IV.2)																			
Domestic currency																			
Foreign exchange																			
Ex. Rate																			
Ex. Rate																			
Ex. Rate																			
Raw materials																			
Domestic currency																			
Foreign exchange																			
Ex. Rate																			
Ex. Rate																			
Ex. Rate																			
Loan Capital																			
Working Capital																			
Other Investment																			
Total Investment																			
Domestic currency																			
Foreign exchange																			

a list of the basic inputs required by the project and estimates of their average unit costs for each year of operation in the project time horizon. Basic inputs will include (1) raw materials, (2) energy, (3) labor, (4) management, (5) repair and maintenance, (6) operations, (7) research and development, and (8) depreciation, taxes and interest charges; others may also be important depending on the nature of the project and may be added to the list. Once this data is available Worksheet IV.5 can be filled in.

For each year the estimated quantity of each input item listed in Col. (1) to be utilized in the project, the unit price of each input, and the total cost (unit price quantity) is entered in the appropriate columns under each year or price identified at the top of Column 2. Explicit recording of each unit price is very important because these prices may require adjustment for purposes of economic analysis (Chapter VII) and they should hence be made readily identifiable.

Worksheets IV.6 and IV.7 Annual Changes for New Marketing Facilities

Associated with the new marketing facilities are numerous annual reoccurring costs which need to be taken into consideration. Worksheet IV.6 is to be used for assembling these costs plus any other additional marketing costs not reflected in Worksheet III.6.

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Worksheet IV-A Project Annual Operating Costs
Project _____

(1)

(2)

Input Item	Fiscal Year Period																								
	Q	P/A	C	Q	P/A	C	Q	P/A	C	Q	P/A	C	Q	P/A	C	Q	P/A	C	Q	P/A	C	Q	P/A	C	
Raw Material																									
Energy																									
Elect.																									
Coal																									
Oil																									
Other																									
Labor																									
Management																									
Repair and maintenance																									
Operations																									
Travel																									
Office																									
Other																									
Total Production Costs																									
Research and Development																									
Total Project Costs																									
Financial Accounts																									
Depreciation																									
Taxes																									
Interest																									
Total Project Annual Cost																									

1. The value of equipment, including land, is included in the project costs. The value shown in the above is based on the equivalent value of the equipment at the time of the project.

In Column (1) the cost categories relevant for each marketing facility are listed. Items may be sub-listed by marketing function as was done in Worksheet III.6 as desired. Estimated annual costs are recorded under the appropriate date in Column (2). Worksheet IV.7 provides necessary space to aggregate annual charges for different marketing facilities (i.e., for different commodities, markets, or items) into a single annual charge for the new marketing facilities.

Worksheet IV.8 Total Annual Operating Costs Project and Related New Marketing Facilities

This worksheet is completed by transferring the annual Total Project Annual Costs from Worksheet IV.5 and the Total Annual Marketing Costs from Worksheet IV.7 to the appropriate lines and columns. Summation of the annual project costs and the associated marketing costs gives the combined total annual charge for these items. These values will later be assembled with other project related costs and revenues to determine the net gains created by the project.

F. Farm Management Plan With Project

1. Discussion

In many cases the project proposal under examination will include changes at the farm level by project participants as well as the works, credit programs and/or any other action carried out and administered

Worksheet IV.7 Recap Annual Charges New Marketing Facilities
Project _____

(1)

(2)

Marketing Facilities	Project Planning Period : Year from present and date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Commodity																										
Market																										
Item																										
Total Cost																										
Commodity																										
Market																										
Item																										
Total Cost																										
Commodity																										
Market																										
Item																										
Total Cost																										
Commodity																										
Market																										
Item																										
Total Cost																										
Commodity																										
Market																										
Item																										
Total Cost																										
Total Annual Marketing Cost																										

directly by the public sector. These farm level changes may involve new enterprise combinations, new agronomic and animal husbandry practices, use of new production techniques etc., which are to be considered as part of the participant input in the overall project. Since a basic principal of project analysis calls for a comparison of what is likely to happen with the project vs. what is expected in its absence, it is necessary to make explicit the expected changes in operations at the farm or participant level. This is to be carried out in Section F. of the manual. The data worked up herein follows the same format as Chapter III. Section F. where the farm operations expected in the absence of the project were prepared. Thus, Chapter II. Section F. and Chapter IV. Section F. form a basis for the "with-out" comparison at the farm level.

As before, the analysis is carried out through the use of a series of Worksheets designed to facilitate collection of necessary data. These worksheets are described in detail in the material which follows.

Worksheet IV.9 Projected Farm Land Use With Project

Worksheet IV.9 is identical to Worksheet III.8 except that it refers to conditions expected with the proposed project in place. Thus, prior to completion of this Worksheet there should be put together the specific farm enterprise combinations and farm livestock

management practices which will be followed in the project area. These may or may not be the same as currently in effect, or as expected in the future in the absence of the project. In most cases new ways of doing things at the farm level will be encouraged with all agricultural development projects. To the extent this is true these new practices in a very real sense are also part of the project. Once the farm management plan for the project area has been worked out, and the effect of new technology, i.e., new input/output relationships and institutions, etc., have been identified, Worksheets IV.9 (as well as IV.10) can be filled out. In order to have the necessary number of columns for the entire planning period, the worksheet may be extended to a second page.

Worksheet IV.10 Farm Capital Investment Required With Project by Area

In addition to public expenditures for capital goods within the project or program itself the developmental alternative under examination may also require new investments by the agricultural population served by the project. Such outlays may be for items such as purchase of additional land^{1/} construction of buildings purchase of

1/ When including the cost of land purchase as part of farm investments care must be taken to insure that the value of foregone annual productivity from the same land has not already been included as a cost. Since the purchase price of the land involved should reflect its future productivity to include both the purchase price and the present value of future production will be double-counting. However, to the extent that the sale price includes the present value of income over and above any included agricultural returns this may be added in as part of the land investment component. Nevertheless, even in the latter case a much more straightforward approach would be to estimate these separate aspects and include them all as the opportunity cost of foregone land income. When these can not be adequately estimated, or when the present value

Worksheet IV.9 Projected Farm Land Use With Project (Acres)
Project _____

(1)

(2)

Projected Crop/Livestock Activity	Project Planning Period - Year From 1974 and 1980																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Crops (Wheat)																												
Land class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Barley																												
Land class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Sugar Beets																												
Land class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Potatoes																												
Land class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Other																												
Total																												
Total Crops																												
Livestock (Sheep)																												
Land class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Goats																												
Land Class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Cattle																												
Land Class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Other																												
Land Class 1																												
" " 2																												
" " 3																												
" " 4																												
Total																												
Total Livestock																												
Total Crop and Livestock																												

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Worksheet IV.9 Projected Farm Land Use With Project (Acres) (Cont. 1)
Project _____

(1)

(2)

Projected Crop/Livestock Activity	Project Planning Period - Year From Present and Date																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Crops (Wheat)																									
Land class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Barley																									
Land class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Sugar Beets																									
Land class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Potatoes																									
Land class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Total Crops																									
Livestock (Cows)																									
Land class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Goats																									
Land Class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Cattle																									
Land Class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Other																									
Land Class 1																									
" " 2																									
" " 3																									
" " 4																									
Total																									
Other																									
Total																									
Total Livestock																									
Total Crops and Livestock																									

tractors, etc., which would not occur in the absence of the project. Since these expenditures represent real costs arising in association with the project they must be carefully calculated and entered into the estimates of capital outlays.

Worksheet IV.10 is designed to accommodate computation of capital investments which will be required of the farm operators, service entrepreneurs, etc., who will be involved in the project. Since the requirements may differ from farm to farm and region to region, the worksheet will consist of one sheet (or more depending upon the number of items) for separate geographical areas in the project. As many investment items as needed are listed in Column (1) for the relevant time periods of Column (2).

Worksheet IV.11 Total Farm Capital Investment Required With Project

Worksheet IV.11 is identical to Worksheet IV.10 in that it is designed to indicate the investments which will be required and/or carried out by farmers and others participating in the proposed project. Here, however, the purpose is to aggregate the area investments of Worksheet IV.10 into total sub-totals for the entire project area. As before, investment items are listed in Column (1) and expected invest-

Cont'd from page 154

of annual net returns differ largely from market values for the land, the actual current sale price may be a better indicator of future expectations regarding returns to land. In any event great care must be exercised in estimating the opportunity cost of land utilized in the farm area influenced by the project to not only avoid double-counting but to select the proper values themselves.

Worksheet 7.7 Farm Capital Investment Required with Project By Area (Cont.)
 Project _____ Farm Area _____

(1)

(2)

Investment Item	Project Planning Period - Year from Present and Date.																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Land a/																									
Total																									
Buildings																									
Total																									
Equipment																									
Total																									
Inventories																									
Total																									
Other																									
Total																									
Total Investment																									

Worksheet IV.10 Farm Capital Investment Required with Project by (City)
 Project Farm Area

(1)

(2)

Investment Item	Project Planning Period - Year from Present and Date																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Land g/																									
Total																									
Buildings																									
Total																									
Equipment																									
Total																									
Inventories																									
Total																									
Other																									
Total																									
Total Investment																									

ment totals under the appropriate time period in Column (2). Once this data has been assembled it is then combined in Worksheet IV.12 with similar information from Worksheet III.10 to determine the added investments occurring with the project in place.

Worksheet IV.12 Added Farm Capital Investment With Project

Worksheet IV.12 calls for two kinds of data: (1) Capital expenditures which can be expected to take place with the proposed project in place (from Worksheet IV.11) and (2) Capital expenditures expected in the absence of the proposal (from Worksheet III.10). For each investment item listed in Column (1) the difference between the yearly expenditures on a with and without basis represents the added capital expenditures associated with the project. Sumation of the added investments yields the total added investment for each year of the project planning period.

The various investment items are listed as shown in Column (1) of the Worksheet. The added outlays for each class of investment are kept separate from the aggregate total. The annual total expenditures are then derived from these sub-totals. Once Worksheet IV.12 has been completed, the annual totals will later be transferred to the appropriate line in Worksheet IV.19.

Worksheet IV.11 Total Farm Capital Investment Required With Project
 Project _____

Investment	Project Planning Period : Year From Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
Land <u>a/</u>																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Buildings																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Equipment																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Inventories																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Other																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Total Capital Investment																										

a/ cfs. 7p. and 8p.

Worksheet IV.11 Total Farm Capital Investment Required With Project (Cont')
 Project _____

Investment	Project Planning Period : Year From Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Land a/																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Buildings																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Equipment																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Inventories																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Other																										
Area 1																										
Area 2																										
Area 3																										
Area 4																										
Total Capital Investment																										

a/ cfs. 7p. and 8p.

Worksheet IV.12 Added Farm Capital Investment With Project
 Project _____

(1)

(2)

Investment Item	Project Planning Period : Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Land																									
Total land with project (from IV.11)																									
Total land without project (from III.10)																									
Added land investment																									
Buildings																									
Total buildings with project (from IV.11)																									
Total buildings without project (from III.10)																									
Added buildings investment																									
Equipment																									
Total equipment with project (From IV. 11)																									
Total equipment without project (from III.10)																									
Total equipment investment																									
Inventories																									
Total inventories with project (From IV.11)																									
Total inventories without project (from III.10)																									
Total inventories investment																									
Other																									
Total Added Capital Investment Required																									

Worksheet IV.12 Added Farm Capital Investment With Project (Cont')
 Project _____

(1)

(2)

Investment Item	Project Planning Period : Year from Present and Date																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Land																									
Total land with project (from IV.11)																									
Total land without project (from III.10)																									
Added land investment																									
Buildings																									
Total buildings with project (from IV.11)																									
Total buildings without project (from III.10)																									
Added buildings investment																									
Equipment																									
Total equipment with project (from IV.11)																									
Total equipment without project (from III.10)																									
Total equipment investment																									
Inventories																									
Total inventories with project (from IV.11)																									
Total inventories without project (from III.10)																									
Total inventories investment																									
Other																									
Total Added Capital Investment Required																									

Worksheet IV.13 Farm Yields, Revenue and Production Costs With Project

This Worksheet is identical to Worksheet III.11 and is filled out in the same way. The data, however, now refers to conditions expected with the project in place.

Worksheet IV.14 Farm Revenue and Costs All Crop/Livestock With Project

As with Worksheet III.12, this worksheet is used to pull together total revenue, costs, and net income to the project farm area for each year of the project's life. The data entered under the various crop/livestock activities are taken from Column (9) (enterprise totals) of the yearly sheets of Worksheet IV.13. The explanation on pp.110-112 outlining the procedure for working up Worksheet III.12 applies here also.

Worksheet IV.15 Projected Added Farm Net Income All Crop/Livestock
With Project

The purpose of Worksheet IV.15 is to summarize net income information (at the farm level) for the project area with and without the proposed project in place.

There are five key items to be listed as shown in Column (1), viz., revenue, costs, and net income expected with the project, net income anticipated without the project, and added farm level income with the

Worksheet IV.14 Farm Revenue and Costs All Crops/Livestock With Project (Cont.)
 Project _____ Project Period _____

Budget Item	Crop / Livestock Activities										Salvage	Total	
I. Revenue-Income with project													
a. Farm cash revenue													
Crop-Livestock													
Loans													
Subsidies													
b. Farm home consumption													
c. Total farm revenue (Ia. plus Ib.)													
d. Total farm revenue less subsidies and loans													
II. Cost													
a. Cash Costs													
1. Seed													
2. N. fertilizer													
3. P. fertilizer													
4. K. fertilizer													
5. Manure													
6. Pesticides													
7. Herbicides													
8. Hired labor													
9. Animal charge													
10. Tractor charge													
11. Tool charge													
12. Building "													
13. Water "													
14. Doctor service													
15. Other													
Energy													
Working capital													
16. Sub total													
17. Payments on principal													
18. Interest													
19. Taxes													
20. Depreciation													
21. Total cash costs													
b. Non-Cash Costs													
1. Family labor													
2. Annual land charge													
3. Annual maint. charge													
4. Other													
5. Total non-cash cost													
III. Total Production Costs													
a. Farm cash costs (IIa.21)													
b. Farm total costs (IIa.21 plus IIb.5)													
c. Economic costs (IIa.21 plus IIb.5)													
IV. Net Returns													
a. Net farm cash income (Ic. minus IIa.)													
b. Net farm income (Ic. minus IIb.)													
c. Net economic income (Ic. minus IIc.)													

project. Revenue, cost, net income, and added income information is assembled for (1) the strictly financial cash flow situation, (2) the cash flow plus value of home consumption case, and (3) the net economic return situation wherein transfer items such as taxes, depreciation, loan repayment interest, and subsidy income, are left out. It will be recalled that in economic analysis the intent is to measure real gains and costs to the economy at large arising with and without the project and for that reason transfers between the various entities in the economy are to be ignored.

The values entered in the yearly columns of IV.15 for Items I, II, and III are taken directly from the totals of the respective annual (or period) sheet of Worksheet IV.14. Values for Item IV, (Net Income Without the Project) come directly from Worksheet III.12. Added Net Farm Income With the Project (Item V.) is the difference between Items III. and IV.

Thus, Worksheet IV.15 summarizes the complete annual flow of costs and returns within the project farming area as they are expected under conditions without the proposed project and as expected with the project. This data when combined with project operating costs, project capital costs, and benefits and costs extending beyond the farm level, will be used in the project feasibility analysis of Chapters VI. VII. and VIII.

Worksheet IV.1) Projected Added Farm Net Income All Crop/Livestock With Project
 Project _____

(1)

(2)

Budget Item	Project Planning Period - 1 Year from Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
I. Revenue Income with Project (From IV.1)																										
a. Farm cash revenue																										
Crops-Livestock																										
Land																										
Subsidies																										
b. Farm home consumption																										
c. Total farm income (Ia plus Ib)																										
d. Total farm revenue less b. subsidies and farm																										
II. Costs With Project (from IV.1)																										
a. Farm cash costs (line III a.)																										
b. Farm non-cash costs (line III b.)																										
c. Total farm costs (line III c.)																										
d. Total depreciable costs (line III d.)																										
III. Net Income With Project																										
a. Net farm cash income (Ic. minus III a.)																										
b. Net farm income (Ic. minus III b.)																										
c. Net economic income (Ic. minus III d.)																										
IV. Net Income Without Project (From III.1)																										
a. Net farm cash income (line IV a.)																										
b. Net farm income (line IV b.)																										
c. Net economic income (line IV c.)																										
V. Added Farm Income With Project																										
a. Added net farm cash income (IIIc. minus IVc.)																										
b. Added net farm income (IIIb. minus IVb.)																										
c. Added net economic income (IIIc. minus IVc.)																										

Worksheet IV.15 Projected Added Farm Net Income All Crops/Livestock With Project (Cont.)
 Project _____

(1)

(2)

Subject Item	Project Planning Period - Year From Possible Start Date																								
	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00	
I. Revenue Income with Project (from IV.14)																									
a. Farm cash revenue																									
Crops- Livestock																									
Irrigation																									
Subsidies																									
b. Farm home consumption																									
c. Total farm income (Ia. plus Ib.)																									
d. Total farm revenue less subsidies and loans																									
II. Costs With Project (from IV.14)																									
a. Farm cash costs (line III a.)																									
b. Farm non-cash costs (line III b.)																									
c. Total farm costs (line III c.)																									
d. Total economic costs (line III d.)																									
III. Net Income With Project																									
a. Net farm cash income (Ia. minus IIa.)																									
b. Net farm income (Ib. minus IIb.)																									
c. Net economic income (Ic. minus IIc.)																									
IV. Net Income Without Project (from III.12)																									
a. Net farm cash income (line IV a.)																									
b. Net farm income (line IV b.)																									
c. Net economic income (line IV c.)																									
V. Added Farm Income With Project																									
a. Added net farm cash income (IIIa. minus IV a.)																									
b. Added net farm income (IIIb. minus IV b.)																									
c. Added net economic income (IIIc. minus IV c.)																									

G. Indirect Project Effects

In addition to the two broad classes of project related activities discussed in Sections D., E., and F. (viz., (1) the capital investment, operating costs, and managerial/administrative aspects of the projects itself, and (2) the farm management practices of, and resulting costs and returns to, project participants there is a third category of project impacts generally treated apart from these. The latter are referred to here as Indirect Project Effects and are divided into two subcategories; (a) secondary cost and benefits (b) and external technological impacts. The nature of these project consequences is such that initially they are best identified and evaluated separately from other impacts; however, the term "indirect" is somewhat of a misnomer because many of these consequences are in fact a direct result of a project even though they may not fall upon those identified as direct project participants.

1. Secondary Costs and Benefits

It is possible that under certain circumstances projects can lead to very real benefits and costs which arise outside of the project area or upon individuals who are not associated with the project itself. To the extent that such impacts exist they become important only within the framework of the economic analysis of the project wherein the concern is with the full range of project consequences

where ever they may fall. Financial analysis on the other hand does not include secondary impacts for by definition it deals only with

those individuals who are directly involved in the project and not with those individuals who are indirectly involved in the project.

the project however, remote their linkage to the project, the project however, remote their linkage to the project.

investment, operating costs, and managerial costs, and managerial costs, and managerial costs, and managerial costs.

of the project itself, and (2) the farm management practices of the project itself, and (2) the farm management practices of the project itself.

Proper handling of indirect impacts in economic analysis requires clear understanding of the conditions which must exist in order for these effects to be valid project benefits and or costs.

and resulting costs and returns to project participants there is a third category of project impacts generally treated apart from

order for these effects to be valid project benefits and or costs, these. The latter are referred to here as indirect project effects

and of the means for identification and valuation. On all points and are divided into two subcategories; (a) secondary cost and

there has been general confusion and uncertainty as to the proper and external technological impacts. The nature of

way to deal with secondary affects in project analysis. Moreover, these project consequences as such that initially they are best

procedures will differ depending upon conditions within the identified and evaluated separately from other impacts; however,

described for which the project is proposed. the term "indirect" is somewhat of a misnomer because many of these

though they may not fall upon those identified as direct project participants.

of secondary effects, they may not fall upon those identified as direct project participants.

of secondary effects, they may not fall upon those identified as direct project participants.

(a) those arising because of interrelationships (linkages) between direct project participants and suppliers of

inputs (backward linkages) and those who handle the outputs (forward linkages),

of the project, and (b) those arising because of interrelationships between direct project participants and suppliers of

of project scale wherein cost or income increases or decreases upon individuals or groups associated with the project

relationships are changed because of the project. only within the framework of the economic analysis of the project

relationships are changed because of the project. only within the framework of the economic analysis of the project

relationships are changed because of the project. only within the framework of the economic analysis of the project

relationships are changed because of the project. only within the framework of the economic analysis of the project

Gittinger maintains that items (b) and (c) are "by nature so difficult to evaluate that few attempts have been made to deal with them empirically." (p. 25). Given the lack of data which prevails in Turkey regarding scale effects and structural changes in physical relationship which result in the rest of the economy following agricultural projects, the discussion herein is limited to the economic linkages between project participants and associated activity (Class 1 above). Examples of this kind of interaction are the increased economic activity needed to produce the added supplies of farm inputs associated with increased project output, and also the added activity needed to process the new output. The project may result in more profits for both input suppliers and output handlers. The question that arises is, are these increased profits genuine project benefits and should they therefor be added to direct gains (added profits of farm operators) in computing total project benefits.

If there were a perfectly functioning market for inputs and outputs it would not be necessary to "consider" secondary profit gains as separate impacts because these potential gains would already be reflected in the prices of the respective inputs and outputs. Two conditions typically exist in Turkey which prevent us from handling secondary impacts through pricing data: (1) many prices are set by governmental policy and thus may not be good guides to the true costs and returns associated with project output, and (2) considerable

underemployment of certain resources exists particularly of labor, so that wages are not good indications of productivity. Although we may make adjustments to prices for some of the more obvious price distortions, we cannot do them all, hence, linkage effects remain a problem for separate estimation. But, linkage effects can only be included in project economic benefits and costs if:

"the funds available for investment in the project would not be available for investment in any other project, or the linkage giving rise to the benefit or cost, forward or backward, is iniquely attributable to the particular project under analysis, i.e., it would not occur at all, or in the same degree, if some alternative project is selected."

What these two (alternative) conditions mean is that in order for secondary benefits to exist, it must be proven that these same income gains would not have occurred in any other way, except via the project under discussion. In other words, it may well be that if the project is not carried out these same income gains will occur somewhere else through an alternative investment either public or private which will take its place. This condition is very restrictive for in all probability any project carried out will lead to similar secondary impacts. In any event, it is up to the analyst to prove that "his" project will add a significantly greater amount than otherwise will exist and it is only this difference that can be added into his project benefit (cost) account. Obviously the conceptual and empirical difficulties of doing this weaken the case for adding in

the (apparent) effects which perhaps can be readily observed within a project area.

Where unemployed or underemployed resources exist in an area a project may put them to work and thereby increase net incomes; however, once again it must be shown that the alternative to the reference project (either another government investment or a private investment) will not yield equal or greater income gains albeit to other segments of the population. Thus, from a purely regional or local perspective, the gains in income and cost and in employment are real gains and should be identified,^{2/} but it is very improbable that the full amount, if any at all, can be considered a bonafide national efficiency benefit or cost.

Another issue concerns the use of the "multiplier concept" in evaluating secondary effects. Project investments may result in increased incomes to "associated activities" through the stimulus it provides for greater production and consumption stemming from some initial change in beneficiary incomes. The conditions under which the multiplier effect will operate are:^{3/}

- (a) the public expenditure must not be financed out of tax revenues so that the multiplier creating expenditures are not drawn away from the private sector;

^{2/} These impacts and procedures for taking them into account are discussed in Chapter VIII.

^{3/} See Gittinger p. 27.

- (b) supply prices for all inputs utilized in the chain of increased output which generates the new income remain unchanged;
- (c) there is no alternative demand for those inputs which is foregone by their utilization in the chain of production associated with the investment;
- (d) the chain of outputs which result from initial investment do not substitute for other products in the market and hence do not create unemployment of other factors of production.

Thus, the use of income multipliers to estimate added gains to an agricultural projects rests upon very spurious foundations. For that reason calculating secondary benefits is to be avoided unless the qualifying conditions can be shown to prevail. In addition, only the difference between income changes with the project and those that will result anywhere else in the economy without the project can be included.

On balance, the position taken in this manual of procedures is that as a general rule secondary impacts are not to be calculated in economic analysis. It is only when the above conditions are met and when "with-without" impact differences can be shown that they should be included. Multiplier analysis in particular is to be avoided for no provisions in the multiplier per se allows for the opportunity costs of the added income. A net income multiplier is conceptually possible, but empirical estimates of what that might be in a given project analysis situation will at best be extremely difficult, if not impossible, to prepare with any meaningful accuracy.

2. External Technological Impacts

In addition to those costs and returns which accrue to project participants there may arise adverse and/or beneficial effects upon others who are not involved with the project per se but who are influenced by it through a physical (or technological) connection between project functions and their own activities. The economics literature refers to these off-project impacts as external technological economics and diseconomics. For project preparation these costs and returns must be evaluated and included in the feasibility analysis for they represent a class of project impacts which influence the desirability of any project.^{4/}

Examples of off-site technological economies (returns) are: An improved supply of irrigation water downstream from a project due to the better water control function carried out; increased use of fertilizer within a project area coupled with drainage into a stream may increase the nutrient content of irrigation water downstream; improvements in the quality and quantity of certain crops may also improve the forage or browse for livestock. Off-site diseconomics include: Increased costs for dredging downstream when a water control structure reduces the flow; ground water contamination due to increased use of fertilizer;

^{4/} Cost and returns due to physical interactions between participants to a project and/or any such effects induced by the project itself, directly upon participants should be picked up in the cost-return analysis carried out in worksheet IV.14.

structural works which eliminate a farm transport route making a more circuitous and costly route necessary. These are but a few of the many interactions which can arise between the project and other segments of the population. Environmental impacts are a particularly pervasive class of externalities which most often affect the costs of those involved.

Two points are important to note about off-site technological impacts: (1) they are due to physical interrelationships, i.e., the actions of those connected with the project and the functions performed by the project itself affect the production functions of others in such a way that the latter's costs or their returns (or both) are increased, and (2) these added costs or returns are in no way compensated for by either the beneficiary or the damaging party. It is also worth noting that many off-site impacts may be difficult to quantify in economic terms. When such quantification is not possible, either through direct calculation of added costs of production or increased returns, or by estimates of the costs of preventing damage, then qualitative descriptions of the impacts must suffice. Under no circumstances should they be ignored:

Worksheets IV.16 and IV.17 are designed to facilitate the computation of external costs and returns on an annual basis for the project planning period. Worksheet IV.16 is for recording information regarding off-site costs and Worksheet IV.17 is for returns. The design of the

two worksheets is identical except for this difference.

Worksheets IV.16 and IV.17 off Project Costs and Returns Due

Interaction with Project.

In Columns (1), (2), (3) respectively for each worksheet the location, type and amount of each particular impact is entered. Column (2) should contain a descriptive entry while Column (3) should, to the extent possible, contain a more specific quantitative measure of the impact, e.g., the parts-per-million of induced ground water contamination at the location listed in Column (1). Column (4) provides space for identifying the source of the off-site impact. A source may be the entire project itself, or it may be some segment of the project or some particular locale serviced by the project. Identification of the precise source of an impact is important because it may be that the project should be redesigned to eliminate or reduce any detrimental impacts stemming from only parts of the whole. On the other hand, induced benefits may be large enough to warrant reimbursement to project segments where they originate. In Column (5) the basis for economic evaluation of off-site impacts is to be set forth. This may be a per unit cost of damage/benefit price, or any other formulation used to arrive at the annual cost-returns generated. Column (6) provides necessary space for the annual values computed as indicated in Column (5).

Since some impacts can not realistically be expressed in terms of lira equivalent no values will be appropriate for Column (6). When such situations arise, the procedure to follow is to note in Column (5) that economic values are not to be computed and enter an X in each annual column of Column (6) during which the impact described in Column (1), (2), (3), and (4) will persist. In this way the time occurrence of such off-site impacts will then be listed and described in a section of a final table (worksheet IV.19) which summarize economic and financial flows of the project.

Worksheet IV.18 Net Economic Off-Project Returns Due to Technological Interaction With Project

The purpose of Workseet IV.18 is to provide space to compute net annual cost/return values for off-site technological impacts which can be expressed in economic terms. Costs are taken directly from Worksheet IV.16 and entered under the appropriate year in Column (2). Economic returns from Worksheet IV.17 are recorded on the appropriate line and the difference between annual returns and costs listed as a net value. Whenever costs exceed returns the value entered as a net figure should be a negative amount. These net off-site values will later be summed with other flows of economic returns (Worksheet IV.19) to yield the total net economic flow generated by the project. Non-economic impacts recorded in Worksheets IV.16 and IV.17 will

also be listed in Worksheet IV.19 so that project economic and non-economic values may be displayed together.

Other impacts such as employment generated, income changes etc., will be worked-up and displayed in separate Worksheets in Chapter VIII.

H. Summary Data

1. Discussion

Completion of the worksheets described in the previous sections has resulted in a compilation of the basic economic and financial data including off-site technological impacts necessary for project evaluation. Much of this data is, however, scattered in various worksheets and there is a need to pull it together in a form suitable for direct use in the financial and economic analysis of Chapters VI., VII., and VIII. Worksheet IV.19 is designed to facilitate a summarization of these principal impacts. As indicated other project effects such as employment and income changes will be handled separately in Chapter VIII.

Worksheet IV.19 Capital Costs, Net Annual Returns, and Non-Economic Technological Impacts

This worksheet to be filled out is a recap of several others which have been completed previously. Its purpose is two-fold: (1) to

assemble in one place all the relevant information about the project in terms of its economic and financial impacts, and (2) to display a class of direct project impacts (technological externalities) which in most cases have economic implications but which may be extremely difficult if not impossible to quantify in economic terms. These latter project consequences are therefore to be listed and described in Worksheet IV.19 (from Worksheet IV.16 and IV.17) so that a complete information display may be prepared.

Thus, Worksheet IV.19 contains economic, financial, and a portion of non-economic project effects.

In Column (1) of this worksheet are listed the six main categories of economic impacts as follows: (I.) Project Capital Investment (from Worksheet IV.4); (II.) Project Operating, Maintenance and Repair Costs (from Worksheet IV.8); (III.) Added Farm Capital Investment (from Worksheet IV.12); (IV.) Added Farm Net Income (from Worksheet IV.15); (V.) Project Secondary Impacts (to the extent that they can be included); and (VI.) Net Off-Project Technological Impacts: Economic (from Worksheet IV.18).

Category (IV.) includes three income accounts: (a) cash income received by farmers; (b) cash income plus home consumption; and (c) purely economic values relevant for national efficiency accounting (i.e., costs and returns net of transfers). The annual flows of costs

and returns as reflected in Categories I. through VI., are then utilized to complete a net annual flow for each accounting classification listed under Category VII., Net Annual Income Impacts. This latter stream of values (positive in sign whenever annual returns exceed annual costs and negative when the reverse is true) becomes the basis for computing various feasibility parameters such as the projects present net worth, the benefit to cost ratio, the internal rate of return, etc., (Procedures for making these computations are outlined in Chapters VI and VII).

Category VIII. Off-Project Technological Impacts, Non-economic, is based upon the descriptive material initially prepared in Worksheets IV.16 and IV.17. In Column (1), the specific location of each off-site impact is to be noted. A description of each impact is then to be entered on the appropriate line, or lines, to the right. Notation should be included to show the period, or periods, of time during the planning horizon in which the specific impact will exist.

When completed Worksheet IV.19 presents a summary picture of the annual flow of investments, annual net returns to project participants, net secondary returns, and net off-site technologically related returns all evaluated in terms of market prices, plus descriptions of non-economic impacts occurring to others who are influenced by the project but who are not direct project participants. Portions

of these data will again be brought forward to other worksheets in Chapters VI., VII., VIII., which are designed to facilitate computation of project feasibility indices.

Worksheet IV.19 Capital Costs, Net Annual Returns, and Non-Economic Technological Impacts
 Project _____

(1)

(2)

Cost (Income) Items	Project Planning Period: Year from Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
I. Project Capital Investment (from IV. 4)																									
a. Domestic currency																									
b. Foreign Exchange																									
c. Total																									
II. Project Operating, maintenance and Repair Costs (from IV.8)																									
III. Added Farm Capital Investment (from IV.12)																									
IV. Added Farm Net Income																									
a. Added Net Cash Income (from IV.15 line Va.)																									
b. Added Net Farm Income (from IV.15 line Vb.)																									
c. Added Net Economic Income (from IV.15 line Vc.)																									
V. Project Secondary Impacts																									
a.																									
b.																									
c.																									
d.																									
VI. Net Off-Project Technological Impacts - Economic (from IV.18)																									
VII. Net Annual Income Impacts																									
a. Net Farm Cash Income																									
b. Net Farm Income																									
c. Net Economic Income																									
VIII. Off-Project Technological Impacts - Non-economic (from IV.16-17)																									
a. Annual (V+VIg-VIIg)																									
b. Cumulative																									

Worksheet IV.19 Capital Costs, Net Annual Returns, and Non-Economic Technological Impacts
Project _____

(1)

(2)

Cost(Income) Items	Proj. 16 Planning Period: Year from Present and Last																			
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
I. Project Capital Investment (from IV. 8)																				
a. Domestic currency																				
b. Foreign Exchange																				
c. Total																				
II. Project Operating, maintenance and Repair Costs (from IV.9)																				
III. Added Farm Capital Investment (from IV.12)																				
IV. Added Farm Net Income																				
a. Added Net Cash Income (from IV.15 lines Va.)																				
b. Added Net Farm Income (from IV.15 line Vb.)																				
c. Added Net Economic Income (from IV.15 line Vc.)																				
V. Project Secondary Impacts																				
a.																				
b.																				
c.																				
d.																				
VI. Net Off-Project Technological Impacts: non-economic (from IV.16)																				
VII. Net Annual Income Impacts																				
a. Net Farm Cash Income																				
b. Net Farm Income																				
c. Net Economic Income																				
VIII. Off-Project Technological Impacts: Non-economic (from IV.16-17)																				
a. Annual (V+VI-VII)																				
b. Cumulative																				

CHAPTER V

THE LOGIC OF PROJECT DESIGN: GOALS, OBJECTIVES, INPUTS AND OUTPUTS

A. Discussion

All too often project reports fail to contain adequate information pertaining to the purpose of the project and to the relationship between the project, a problem, and necessary assumptions. Reports should make explicit the fundamental logic of the proposal so that the reason for the project, what it can accomplish, and what must occur for its success is unmistakably clear.^{1/}

Inherent in developmental plans is a cause-effect relationship whereby, given various assumptions, inputs to a productive process will result in project outputs that achieve the objectives of the project which in turn help to reach an overall developmental policy goal. Implied also in the project design framework, is the expectation that the benefits which projects produce and, hence, the improve-

^{1/} The material of this Chapter is based upon the logical framework analysis utilized by the United States Agency for International Development.

ment in economic growth and social welfare which occur, can be verified through appropriate use of quantitative and/or qualitative indices. Thus, project design is a process of moving rationally from one set of facts to another, the result being a project proposal that is internally consistent, i.e., that the stated end (solution of a problem) and the means put forth (the project) logically follow from one to the other.

Although we are all aware of the importance in project design of proper identification of planning goals, project objectives and outputs, and necessary inputs, it is perhaps helpful to review the steps which must be taken to insure that project documentation makes this material clear. There are four basic pieces of information that need to be covered. These are:

- a. Identification of project related national goals, their measurement, and necessary assumptions,
- b. Identification of project objectives, their measurement, and necessary assumptions
- c. Enumeration of project outputs, the relationship between outputs and project objectives, and necessary assumptions
- d. Enumeration of project inputs, the relationship between inputs and outputs and necessary assumptions

Let us look at what is involved with the reporting of facts relating to each of these topics. We will take them one by one and try to outline in some detail what must be done.

**B. Identification of Project Related National Development Goals,
Their Measurement, and Necessary Assumptions**

In preparing support material dealing with this issue, the analyst must carefully

- Describe the national and related sector/sub-sector developmental goals which the project serves.
- Outline the quantitative and/or qualitative indices which will be used to translate broad national and sector goals into more specific ends and targets
- Identify and justify assumptions which are necessary in order to conclude that events occurring outside the scope of the project will happen when, where, and to the extent needed.

Now, what do these steps mean.

1. The Development Goal

In order to come to grips with the idea of a project related development goal, we may offer the following definition.

A PROJECT RELATED DEVELOPMENTAL GOAL is achievement of a general condition characterizing a country, a sector, or a region through the use of a project

Thus, a GOAL is the end to which government policy is directed and is one or more ultimate results desired from public programs and actions. A goal typically deals with broad economic, social and political problems and goes beyond the immediate or direct impacts

brought about by any one project. A policy goal, however, also identifies in a general way the purpose of a project in that it articulates a socially desired end applying to individuals which the project may also serve or help to achieve. A goal may not be measurable in quantitative terms, but may be described by qualitative and behavioral parameters.

Whatever indices are used, RELEVANT GOALS should be spelled out in project documentation. This should primarily be a narrative statement, not necessarily very long, (in fact the more brief and to the point the better) of how the project contributes to some developmental goal.

2. Measurement of Goal Achievement Indicators

Basic to project planning is the existence of a causative relationship between projects and the solution to problems, i.e. actions taken to bring about a movement in the direction of policy goals. Since project report must show or verify that anticipated project impacts will in fact help to achieve the stated goal, recourse to some sort of indices either quantitative or qualitative, cannot be avoided.

Measurement of goal achievement involves two necessary conditions: (1) a narrative statement summarizing the specific development goals sought, such as a significant increase in the production of a specific crop such as wheat, and (2) a specific target which is to be reached,

e.g., a 4 percent annual increase in wheat production over the next 7 years. Furthermore, documentation should be given as to the nature of the benefits to be received by the achievement of these goals and targets, and who among the population will receive the benefits (the incidence of project benefits).

The specific indices used to show project impact upon a goal, will depend upon which goals are relevant. Any one project may reach more than one goal. Examples of PROJECT GOALS and of related INDICATORS may be taken from the Agricultural Targets for the Third Five-Year Development Plan (TFYP) for Turkey, (See Table 1).

3. Basic Assumptions about Goal Achievement

Achievement of a goal through a project is usually based upon the expectation that various actions beyond the influence of a particular project or even group of projects will occur. Although some of the actions may play only a minimal role in determining the effectiveness of a project vis-a-vis goals, others may be quite significant. When the latter is true the failure of events to happen as expected can mean project failure as well. These factors should be stated clearly as assumptions important for goal achievement. Also, justification of each assumption is necessary.

As an example of the importance of assumptions we might consider the goal of increasing the productivity of the agricultural sector. Increasing agricultural productivity may be a realistic goal; however, achievement of that end may be dependent upon such things as motivation of the farm labor force, establishing an efficient marketing system, construction of distribution centers, a national pricing policy, as well as improved technology and acts of God such as weather all of which cannot be predicted with certainty. Control of these factors may be entirely outside the scope of a particular project, yet because success of the project is contingent upon their adequacy and timing they should be spelled out.

C. Project Objectives, Their Measurement, and Necessary Assumptions

Here again we can break this down into three components. What is necessary is very much the same as the preceding material dealing with broad developmental goals, i.e., a descriptive-narrative section, a quantitative-indicator section, and a list of assumptions. The format may vary -- three separate paragraphs for each topic, two paragraphs and a table, or some other arrangement. One separate section (paragraph) devoted to each issue with supporting tables for display of indices would do nicely.

Table 1. Examples of Project Goals and Indicators^{1/}

<u>National and Sector Goals a/</u>	<u>Indicators Narrative Statement</u>	<u>Targets b/</u>
Meeting the growing demand of agricultural products resulting from high rates of growth both in population and per capita income	A significant increase in annual output of basic commodities in the agricultural subsectors, - cereals, pulses, oil seeds, fruits, meat, fishery products and forestry output.	A 3.4% annual increase in cereals; A 5.6% annual increase in pulses; A 5.5% annual increase in oil seed; A 3.9% annual increase in fruits; A 5.9% annual increase in meat; A. 8.4% annual increase in fishery; A 8.9% annual increase in forestry;
Increase living standards of the rural population	<u>c/</u> Increased exports of crops, forestry and fishery products, plus a decrease in meat imports	<u>c/</u> A 2.8% annual increase in crops; A 10.0% annual increase in forestry; A 9.5 annual increase in fishery; A 5.1% annual decrease in meat.

1/ Source: State Planning Organization, A Summary of the Third Five Year Development Plan, 1973-1977 Pub. No. SPO: 1314, Ankara, 1973.

a/ Ibid., p. 95

b/ Ibid. p. 100 and p. 101

c/ Not made explicit in the Plan.

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The details for Part C are as follows:

- identify the local, area, and regional problems to which the project is directed;
- describe the quantitative and/or qualitative indices which will be used to further define the problems identified in item (B) in order to verify that project impacts bear upon these problems;
- identify and justify necessary assumptions covering the events and activities which must occur in order for the project to meet its stated objectives.

In other words, as with specification of goals, project documentation should state in a narrative fashion what project results will be vis-a-vis a lower level problem than that of the national developmental thrust using relevant indices, and should point out any assumptions employed. Let's examine this more closely.

1. Project Objectives

Definition of a Project Objective:

A PROJECT OBJECTIVE is the motive for producing project outputs, i.e., it is the specific END POINT (quantitative and/or qualitative) of the project.

As used here, the difference between a project goal and a project objective is one of magnitude and scope. Project objectives relate to the solution of problems of the regional, provincial and/or local level. Goals relate to broad macro relationships at the level of the national

economy and general well being of large populations. An example of a project objective is increasing the income of farmers in particular region by 10 percent. This objective may also be consistent with the goal of increasing average income of all farmers in the agricultural sector. In other words, objectives are more specific than goals. A project should achieve its objectives. But it is very unlikely that a single project will reach a national goal; it should help however! A well-designed project may be capable of satisfying one or more specific OBJECTIVES each of which should be DEFINED.

2. Measurement of Objectives Achievement

Determination of whether a project has achieved its objectives should be based upon an examination of conditions expected WITH AND WITHOUT the project in place. Therefore, project documentation pertaining to this section should include a description of the CHANGES that occur due to the project stated in either quantitative, qualitative, or behavioral terms. Care should be taken to insure that only those changes which can be directly attributable to the project and not changes due to other causes are included as project achievements. Project objectives are not the same as project outputs in that objectives should relate to social problems while outputs are produced goods and services. Listing outputs as the objective of the project is likely to be inadequate because only rarely are project objectives limited to production outputs.

Examples of alternative project objectives and verifying indicators are given as follows in Table 2. Indices pertaining to project achievements may thus be displayed in tabular form and related to the narrative discussion of these impacts.

3. Basic Assumptions About Achievement of Project Objectives

Despite the stress given to 'scientific objectivity' the fact remains that all project designs are based upon various assumptions in addition to hard facts and figures. Although assumptions may be less tangible than other aspects of project preparation, they are important and should be made explicit for they set forth the numerous conditions which affect the project. Assumptions should reflect the analysts' considered judgement regarding the uncertainty of future events as well as expected directions in government policy and the course of economic and political activity.

To state as a project purpose the improvement of a specific capability within a sector assumes the 'interplay' of a number of factors. For example, an important assumption may be that governmental agencies will give proper recognition to improved skills of employees taking additional training and assign them to appropriate positions with corresponding remunerative rewards. In the case of a project to increase production of exports crops a critical assumption is that adequate price incentives and international markets will exist at appropriate future dates.

Table 2. Examples of Project Objectives and Indicators

<u>Project Objectives</u>	<u>Indicators Narrative Statement</u>	<u>Targets</u>
To improve standard of living in area A	To increase cash income in province A.	A 25% increase in annual family net revenue A 10% decrease in annual farm operating costs
To improve nutrition in province B	To increase livestock production and home consumption of meat	A 10% increase in meat production A 15% change in the quantity of meat entering the local market.

Project assumptions are, therefore, not wild guesses about project related phenomena, but represent judgement decisions based upon the analysts training, experience, knowledge of the country or area, the specific characteristics of the project, and the nature of other government programs. The specific assumptions adopted should, therefore, be made explicit and justified. Also, the direct relation between assumptions at this level and achievement of developmental goals to the extent there is one should be explained.

D. Enumeration of Project Outputs, the Relationship Between Output and Project Objectives, and Necessary Assumptions

The critical factor here is pointing out how producing the project outputs and services will help solve the specific problems outlined in the objectives.

Needed here is a section which:

- lists and describes in quantitative and/or qualitative terms (1) the specific goods and services which will be produced by the project, (2) how project goods and services will serve to meet the project objectives (vis., how project output will relieve the problems outlined in item C.1 above) and (3) what alternative project outputs, or different technical approaches were examined, and
- identifies the assumptions which must be made relative to the ability of the project to produce the goods and services listed above.

The details are as follows:

1. Project Outputs

Definition of Project Outputs:

PROJECT OUTPUTS are the specific GOODS AND SERVICES which are PRODUCED through the utilization of project inputs.

This section of the project report should, therefore, contain what is essentially a narrative description of the direct results of the project and should point out how these outputs meet the projects' objectives. The Section should make clear why the technological mix and the product mix chosen is the most appropriate way to achieve project objectives.

Technological mix refers to the processes chosen to produce the desired output and product mix refers to the particular set of outputs which have been judged to be the best way of bringing about the changes desired. It is important that this aspect of project design be given sufficient attention for the decisions reached can have far reaching impact upon the success of the project. For example, if unemployment or underemployment is a problem then a labor intensive technology as opposed to a capital intensive one may be preferred. Similarly, the project output mix should be one which is not only physically possible to produce in the way suggested (technologically possible) but is the best way of solving the several problems which the region and the nation may face.

The use of qualitative data is not inappropriate. Stress should be given to presenting a brief but clear picture of what is to be produced or provided by the project and descriptive methods can serve here very well. Project rationale also relates to the choice of project outputs as well as means of attaining them; hence, the justification for the particular project under review, vis-a-vis, other outputs and technical approaches, should be established. Other alternatives which were considered, and the reason for rejection should be included in this section of the project report. Table 3 contains examples of project outputs and related output indicators.

2. Basic Assumptions About Production of Outputs

As before, critical assumptions may underlie the justification of the project. In this case, assumptions will involve the premises for expectations that project outputs as specified will in fact be forthcoming. For example, critical decisions may have been made regarding input/output relationships at the farm level, such as, crop response to irrigation water or fertilizer. Obviously, these kind of decisions will have a strong bearing on the cost and returns of projects; hence, they should be made explicit in project reports.

Table 3. Examples of Project Outputs and Indicators

<u>PROJECT OUTPUTS</u>	<u>OUTPUT INDICATORS</u>
Trained indigeneous personnel for extension posts to be located in province 'A'	Fifteen trained staff placed in (specified) posts by 1975.
Improved access to Bank Development Credit	Loans to new business increase by X% (or) by X TL.
Improve Agricultural Training	1500-2000 new students enrolled per year for 10 years
To establish a livestock artificial insemination program in Region 'C'	X numbers of successful inseminations per year
Co-ops organized and surviving to serve low income farmers directly and indirectly	Membership of 10,000 in co-ops in 2nd year and increasing by 15,000/yr thereafter
	Formation of 'X' co-ops in year 2, 'Y' co-ops in year 3, 'Z' co-ops in year 5, and national federation in year 5.

E. Enumeration of Project Inputs, the Relationship Between Inputs and Outputs, and Necessary Assumptions

This is the last topic for discussion in connection with project logics. The three points to be covered are:

- a list of all resources which are necessary for the production of project output, vis., all commodities, personnel, training, and financial resources, as well as required action such as new legislation, contractual arrangements, policy decisions, etc.

- a discussion of how the utilization of project inputs will lead to project outputs.
- identify any assumptions required in order for project inputs to result in expected outputs.

These are straightforward and we do not need to go much further in elaborating upon what is meant. Nevertheless, a few brief words may be in order.

1. Project Inputs

Definition of Project Inputs:

Project inputs are the RESOURCES which are necessary for the production of project output.

Inputs to a project will consist of personnel, commodities, training, financial resources, as well as required action such as new legislation, negotiation of a contract, or a policy decision.

These requirements should be spelled out.

2. Measurement of Project Inputs

Project inputs may be described in any terms befitting their nature. Although quantitative indices are usually the most desirable, they may not always be sufficient to describe the kind of input required to produce project outputs. For example, in the case of personnel the important input is the service which is performed and not merely the assignment of people to a project, i.e., the fact that an

advisor is assigned to a position is not the same as a statement of the input expected from that advisor.

Table 4. Examples of Project Inputs and Indicators

<u>INPUTS</u>	<u>INDICATORS</u>
Fertilizer	Tons per year
Roads	Miles per cultivated acre Miles per ton of production
Warehouses	Square meters of floor space Cubic meters of storage volume
Advisors	Number and job description of each
Artificial Insemination Supplies and Equipment	Items utilized and their amounts

3. Utilization of Inputs

Here the analyst should briefly describe the technical and managerial (administrative) process by which the listed inputs will be converted to the required outputs. Project organization and management is an important consideration.

4. Basic Assumptions About Management of Inputs

Assumptions at this level concern expectations that certain goods and services will be provided to the project on a timely basis. Therefore, the logistic support for a project, the cost, the delivery of the services, and the manner of providing inputs must be explicitly

stated. Past performance and budget sufficiency can be used to help produce the availability and effectiveness of support activities affecting project inputs.

Worksheet V.1 provides space for recording a summary of information necessary to make clear the underlying logic and rationale of the project proposal. The worksheet should be filled out in as brief a fashion as possible while still conveying the meaning. The point should be kept in mind that the purpose of the worksheet is to show the relationship between the resources committed to the development plan (i.e., the inputs) and the desired goals, and the assumptions made in formulating the plan. The worksheet is not intended for restating all the details pertaining to project/plan design and inputs and outputs. The worksheet should therefore, be used as a supplement to the narrative portions of this section of the feasibility analysis.

Descriptive Summary	Indicators		Important Assumptions	Justification for Assumptions
	Narrative Statement	Targets		
National Goals :	a. Measurements		a.	a.
	b. Benefits		b.	b.
Sector Goals :	c. Incidence of Benefits		c.	c.
Project Objectives :	a. Measurements			
	b. Benefits			
	c. Incidence of Benefits			
Project Output :				
Project Input :				

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CHAPTER VI

FINANCIAL FEASIBILITY ANALYSIS

A. Discussion

The purpose of the financial analysis of a project proposal is to (a) identify the financial impact of the project upon participants and (b) to determine if individual participants will receive sufficient economic returns to bring about their involvement.^{1/} Participants may be individual farmers, commercial farming organizations, private firms including capital lending institutions, and government agencies. Project documentation should therefore include material relating to the actual financial returns and costs which can be expected to accrue to each of these various involved entities.

Although financial analysis is similar to economic analysis, the differences are important and should be thoroughly understood by those preparing the project report as well as by those reviewing it. While

^{1/} With respect to the latter purpose, a financial analysis should allow examination of alternative financial terms and to provide for a sound financial plan for project participants.

many of the data and the calculations performed in financial analysis are the same as in economic analysis, the fundamental difference is that the latter seeks to ascertain whether the project is beneficial from the standpoint of the economy as a whole, whereas financial analysis is concerned with the incidence of project benefits and costs as actually experienced by the direct participants. This distinction leads to the following characteristics of financial analysis as compared to economic analysis:

- (1) prices are market prices
- (2) in computing cash flows for each participant all cash received and disbursed are to be included, viz., all subsidies, loans, interest, dividends, depreciation, taxes, duties, etc., are entered as either income earned or payments made
- (3) financial data is calculated for each participant, or class of participants when aggregation of individual units into homogenous groups is possible

B. Financial Feasibility Indices

Given these characteristics, project documentation should display, for each participant group, cash flows, annual income/expenditures, and a balance sheet. Aggregate cash flows for the project as a whole should also be presented. Specific financial data and indices should also be prepared in order to summarize project financial relationships. These are as follows: Net cash income; the sources of all loans received; the internal financial rate of return; the payback period on participants invested capital; debt service ratios; debt equity ratios; liquidity

ratios; current assets current liability ratios, and short term/long term debt ratios. The worksheets to be prepared in this section facilitate financial analysis.

C. Preparation of Financial Worksheets

Preparation of financial information draws upon data previously assembled in Chapter IV. of this Manual. Here, special worksheets are set up to facilitate pulling together the specific data needed. These worksheets and the methods for filling them out are described in the following material.

Worksheet VI.1 Participant Cash Flow Summary

The financial cash flow for each project participant, or class of participants, is prepared in order to make explicit the net income received and the terms of any financing needed and to ascertain whether or not participants will be able to meet required payments of interest and principal. The cash flow projected is based upon expected annual cash requirements (including the investment schedule), the probable cash income stream, the equity capital made available from outside sources (such as government grant agencies) or capital goods transferred (such as irrigation works and equipment) to participants, and the schedule for borrowing and repayment of loans.

Preparation of the cash flow worksheet requires specification of the terms of all financing provided to participants including the equity

capital transferred, the amounts to be borrowed annually, principal repayment schedule and the interest rate and timing of interest payments. One or more financial plans may be evaluated through use of Worksheet VI.1 using one sheet for each alternative plan. When completed, each worksheet should show the impact of various financial plans upon participant's cash balances and should help to identify the financial plan which is most desirable from his point of view. Aggregation of separate participant cash flow statements for all participants can show the financial situation for the project as a whole.

Worksheet VI.1 is filled out in the following fashion. The participant (group) is identified at the top. The relevant cash flow items are listed in Column (1). Cash Revenue Received is the actual cash income earned by the participant. The data for this item is taken directly from line I a. Worksheet IV.15. Item II, Cash Outlays refers to all cash expenditures which must be made during the project planning horizon; viz. Capital investment required (from Worksheet IV.11) and annual cash costs (from line II.a. Worksheet IV.15). Item III, Participant equity is important to note for it provides the collateral base for borrowing and for covering business risks. Equity Public Investment, Item IV., is the capital transferred to participants in support of their needs (from Worksheets IV.2 and IV.3). Item V., Financing Required is the difference between Items I., III., IV., and Item II.c.,

Loan Funds. Item VI. provides space to record the amount of financing made available to participants and the annual interest rate. If several loans are provided as many lines as needed are utilized under Item VI.; and the source of each, the amount, and the respective interest rate, should be spelled out in a footnote. Net Cash Balance reflects the resulting annual cash balances after the repayment plan for the project loan is taken into consideration in the cash flow position. The cash balance figure reflects the ability of the participant to cover all costs including project loans. If the cash balance is negative for any year, then the terms of financing must be adjusted to bring the balance to at least zero. If the value is positive by a large amount for one or more years, then it may be desirable to either reduce the amount of borrowing or increase the annual repayment schedule, or both.

Worksheet VI.2 Aggregate Participant Cash Flow Summary

This Worksheet is identical to Worksheet VI.1 except that the values entered are the sum for all individual participants. It thus shows the financial picture for the project participants as a whole.

Worksheet VI.3 Annual Income/Expenditures

Worksheet VI.3 is designed to show the annual income and expenditure figures for individual participants. In this regard it is similar to Worksheet VI.3 however, here the income and expenditure accounts

Worksheet VI. 1 Participant Cash Flow Summary
 Project _____ Participant or Group _____

(1)

(2)

Cash Flow Items	Project Planning Period : Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
I. Cash Revenue Received (From IV.15 line Ia.)																									
II. Cash Outlay																									
a. Capital Investment Required (From IV.11)																									
b. Annual Costs Required (From IV.15 line IIa.)																									
c. Total Cash Outlays (From IV.15 line)																									
III. Participant Equity Investment (From IV.11)																									
IV. Equity Public Investment (From IV.2 and IV.3)																									
V. Financing Required (From IV.11c)																									
VI. Loan Funds(x)																									
a. Principal																									
b. Interest Rate																									
c. Principal																									
d. Interest rate																									
e. Principal																									
f. Interest Rate																									
g. Total loan income																									
VII. Cash Payments																									
a. Principal																									
b. Interest																									
c. Principal																									
d. Interest																									
e. Principal																									
f. Interest																									
g. Total payments																									
VIII. Net Cash Balance																									
a. Annual (V+VI _g -VII _g)																									
b. Cumulative																									

Worksheet VI. 1 Participant Cash Flow Summary
 Project _____ Participant or Group _____

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Cash Flow Items	Project Planning Period : Year From Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Cash Revenue Received (from IV.15 line Ia.)																										
II. Cash Outlay																										
a. Capital Investment Required (from IV.11)																										
b. Annual Costs Required (from IV.15 line IIa.)																										
c. Total Cash Outlays (from II.15 line)																										
III. Participant Equity Investment (from IV.11)																										
IV. Equity Public Investment (from IV.2 and IV.3)																										
V. Financing Required (I+III+IV - IIa)																										
VI. Loan Funds(x)																										
a. Principal																										
b. Interest Rate																										
c. Principal																										
d. Interest rate																										
e. Principal																										
f. Interest Rate																										
g. Total loan income																										
VII. Cash Repayments																										
a. Principal																										
b. Interest																										
c. Principal																										
d. Interest																										
e. Principal																										
f. Interest																										
g. Total payments																										
VIII. Net Cash Balance																										
a. Annual (V+VI _g - VII _g)																										
b. Cumulative																										

Worksheet VI. 2 Aggregate Participant Cash Flow Summary
 Project _____

Cash Flow Item	Project Planning Period : Year from Present and Late																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
I. Cash Revenue Received																									
II. Cash Outlays																									
a. Capital Investment Required																									
b. Cash Costs Required																									
c. Working Capital																									
d. Total Cash Outlay																									
III. Participant Equity Investment																									
IV. Equity Public Investment																									
V. Financing Required (I+III+IV+IIc)																									
VI. Loan Funds (x)																									
a. Principal																									
b. Interest Rates																									
VII. Cash Repayments																									
a. Principal																									
b. Interest																									
c. Total																									
VIII. Net Cash Income																									
a. Annual (V+VIa - VIIa)																									

(x) Identify source of loan funds, amount, and interest rates in footnotes

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displayed are comparisons of various income effects with and without the project.

Income and expenditure items are listed in Column (1) as shown. Loan funds, with the source and rate of interest identified are listed as income. The cash revenues should correspond with the values in Worksheet VI.2. Expenditures are broken into five categories: operational expenses; payments on outstanding loans; interest; taxes; and depreciation. All data for these expenditure items are taken directly from Worksheet IV.14 which has previously been completed.

The difference between income and expenditure totals equals Net Cash Income, Item III. Net Cash income should be shown for the participant, or the participant group, as well as for the average participant family. The latter value is obtained by dividing Net Cash Income for a group by the number of families in the group, and is entered on line III b. Item IV displays Net Cash Income plus the value of home consumed production (from line I b., Worksheet IV.14). In order to compare the net financial gain to project participants, their net cash income estimated as it would be without the project (line IV.a, Worksheet IV.15) is shown as Item V. As before, family income without the project should be shown as well.

Worksheet VI.3 thus provides another view of the expected annual net financial position of project participants, plus two financial indices summarizing project financial impacts--net cash income, and net cash income plus home consumption-- with and without the project. It also provides space for identifying the source of loan financing received.

Worksheet VI. 3 Annual Income Expenditures
 Project _____ Participant or Group _____

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(1)

(2)

Income/Expenditure Items	Project Planning Period : Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
I. Income																									
a. Cash Revenue (from IV.19)																									
b. Loan Funds																									
Source/rate																									
c. Total income																									
II. Expenditures (from IV.14)																									
a. Operations Cash Costs (line IIa.14)																									
b. Payments on Principal (line IIa.17)																									
c. Interest (line IIa.18)																									
d. Taxes (line IIa.19)																									
e. Sub-Totals: Cash Costs+Taxes+ Int.																									
f. Depreciation (line IIa.20)																									
g. Total Cash Expenditures																									
III. Net Cash Income (Ic-IIg)																									
a. Per participant group																									
b. Per farm family																									
IV. Net Income Plus Home Consumption (from V.17 line Ib.)																									
a. Per participant group																									
b. Per farm family																									
V. Net Cash Income Without Project (from IV.17 line IV a.)																									
a. Per participant group																									
b. Per farm family																									

Worksheet VI. 3 Annual Income Expenditures (Cont')

Project _____ Participant or Group _____

(1)

(2)

Income/Expenditure Items	Project Planning Period : Year From Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Income																										
a. Cash Revenue (from IV.19)																										
b. Loan Funds																										
Source/rate																										
c. Total income																										
II. Expenditures (from IV.14)																										
a. Operations Cash Costs (line IIa 16)																										
b. Payments on Principal (line IIa 17)																										
c. Interest (line IIa.18)																										
d. Taxes (line IIa. 19)																										
e. Sub-Total: Cash Costs+Taxes+Int.																										
f. Depreciation (line IIa. 20)																										
g. Total Cash Expenditures																										
III. Net Cash Income (Ie-IIg)																										
a. Per participant group																										
b. Per farm family																										
IV. Net Income Plus Home Consumption (from V.26 line Ib.)																										
a. Per participant group																										
b. Per farm family																										
V. Net Cash Income Without Project (from IV.15 line IV a.)																										
a. Per participant group																										
b. Per farm family																										

Worksheet VI.4 Project Balance Sheet

This worksheet follows standard balance sheet form and is utilized in the same way -- to provide an internal check for balancing total assets against total liabilities and net worth. Once again the figures used are developed in part from previously completed worksheets as well as from additional data. The balance sheet is utilized primarily for commercial enterprises involved in the project which are business in orientation and not farm units; however, balance sheets for farming enterprises may be prepared if desired. Solvency requires that total assets plus net worth equal total liabilities.

Worksheet VI.4 also provides the necessary data for computing financial indices which are commonly used to judge the financial gains created by the project. Four such parameters may be shown in the lower portion of the worksheet. They are: (1) the debt equity ratio; (2) the liquidity ratio; (3) the ratio of current assets to current liabilities; and, (4) the ratio of short term debt to long term debt.

D. Calculation of Financial Indices

In addition to the information displayed in Worksheets VI.1-4 there are several specific financial indices which should also be computed for each project participant. These indices are the internal financial rate of return (fi_T), the debt service ratio, and the pay-back period. The following material outlines procedures for making the necessary computations.

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Worksheet VI.4 Project Balance Sheet

Project _____

Participant _____

Item	Project Planning Period: Year from Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
I. Current Liabilities																									
a. Accounts payable																									
b. Notes payable current																									
c. Notes payable short term																									
d. Other																									
e. Total current liabilities																									
II. Deferred Liabilities																									
a. Notes payable deferred																									
b. Development loans																									
c. Other																									
d. Total Deferred Liabilities																									
III. Total Liabilities																									
IV. Current Assets																									
a. Cash and bank balances																									
b. Accounts Receivable																									
c. Inventories ^(a)																									
d. Less Current Liabilities																									
e. Working Capital																									
V. Net Current Assets																									
VI. Fixed Assets																									
a. Machinery - equipment																									
b. Less Depreciation																									
c. Net Machinery & Equipment																									
d. Buildings and facilities																									
e. Less Depreciation																									
f. Net Buildings and Facilities																									
g. Land																									
h. Other Assets																									
i. Total Fixed Assets																									
VII. Total Assets																									
VIII. Net Worth																									
a. Paid in Capital																									
b. Investments																									
c. Undistributed profits																									
d. Retained earnings																									
IX. Debt Equity Ratio (b)																									
X. Liquidity Ratio (c)																									
XI. Current Ratio (d)																									
XII. Short Term Long Term Debt Ratio																									

(a) The basis for inventory retention is as follows:

(b) Total Liabilities - Net Worth. (c) Current Liabilities ÷ Liquid Assets. (d) Current Liabilities ÷ Current Assets.

Worksheet VI.4 Project Balance Sheet (Cont'd)

Project _____ Participant or Group _____

Item	Project Planning Period - Year from Present and Into																									
	06	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Current Liabilities																										
a. Accounts payable																										
b. Notes payable current																										
c. Notes payable short term																										
d. Other																										
e. Total current liabilities																										
II. Deferred Liabilities																										
a. Notes payable, deferred																										
b. Development loans																										
c. Other																										
d. Total Deferred Liabilities																										
III. Total Liabilities																										
IV. Current Assets																										
a. Cash and bank balances																										
b. Accounts receivable																										
c. Inventories ^(a)																										
d. Less Current Liabilities																										
e. Working Capital																										
V. Net Current Assets																										
VI. Fixed Assets																										
a. Machinery - equipment																										
b. Less Depreciation																										
c. Net Machinery - equipment																										
d. Buildings and facilities																										
e. Less Depreciation																										
f. Net Buildings and Facilities																										
g. Land																										
h. Other Assets																										
i. Total Fixed Assets																										
VII. Total Assets																										
VIII. Net Worth																										
a. Paid-in Capital																										
b. Inventories																										
c. Undistributed profits																										
d. Total Net Worth																										
IX. Debt-Equity Ratio^(b)																										
X. Liquidity Ratio^(c)																										
XI. Current Ratio^(d)																										
XII. Short Term Long Term Debt Ratio																										

(a) The basis for inventory valuation is as follows:
 (b) Total Liabilities - Net Worth; (c) Current Liabilities ÷ Liquid Assets; (d) Current Liabilities ÷ Current Assets.

Since each of these financial parameters is based upon the present value of financial returns and costs, the present worth figures are computed first. Worksheet VI.5 is devoted to the participant investment component, Worksheet VI.6 deals with the payment to principal and interest on loans, and Worksheet VI.7 covers the financial returns. In each case several discount rates are utilized to prepare an array of present worths in order to (later) judge the sensitivity of financial indices to the discount rate chosen. These worksheets are identical to those which will be utilized in the economic analysis of the next section. Here, however, the values used are participant investment (from line III. Worksheet VI.1), interest and principal repayments (from lines II.b and II.c Worksheet VI.3) and financial returns net of all costs except interest and principal repayments (i.e., line III.a. Worksheet VI.3 plus interest and principal repayments) are used as the base values. Including interest and principal payments in the figure for returns facilitates calculations of the present value of net financial worth in Worksheet VI.8, Both Worksheets VI.8 and VI.9 utilize the present worth values assembled in Worksheets VI.5-7.

Worksheet VI.7 Present Value of Participant Financial Return
Project _____ Participant or group _____

Planning Period Year-1 Date	Financial Return (FR_t) a/ (FR_t) b/	Discount Values																			
		1		2		3		4		5		6		7		8		9		10	
		P.V.	F	P.V.	F	P.V.	F	P.V.	F	P.V.	F	P.V.	F	P.V.	F	P.V.	F	P.V.	F	P.V.	F
1																					
2																					
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48																					
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50																					

a/ Financial Return is here Net cash income plus Interest and Principal Repayments
b/

Calculation of Internal Financial Rate of Return and Debt Service Ratio

The Internal Financial Rate of Return (fi_I) of a project may be defined as the discount rate which makes the present net financial worth of the project equal to zero. Thus, the financial rate of return is the value of the discount rate such that the following condition exists:

$$(1) \text{ PNFW} = \sum_{t=1}^T \frac{FR_t - FC_b}{(1 + i)^t} - \sum_{t=1}^T \frac{PI_t}{(1 + i)^t} = 0$$

Where:

PNFW= Present net financial worth

t= a time period

T= the length of project life in years over which returns and costs are discounted.

FR_t = financial returns in period t

FC_t = financial costs in period t

PI_t = participant investment in period t

i= the discount rate

The similarity of the above expression with the formula for computing the present net financial worth (PNFW) of a project is obvious. With the PNFW index however the expression does not have to equal zero and the analyst must choose beforehand the discount rate to use in solving for PNFW. With the internal rate of return index (fi_I) on the other hand the discount rate which satisfies expression (1) must be computed.

This rate measures the average annual earning power of the capital invested in the project over the projects life.

Calculation of the internal rate of return index generally presents a clear picture of the return to the capital component of project costs expressed as a percent.^{2/} Use of this index avoids the difficulty of having to decide upon a specific discount rate to use in assessing the productivity of the investment. It does not eliminate all such problems however because it requires that the project analyst specify the minimum, or "cut-off", rate of return which must be achieved before a project will be considered for implementation. Financial investment criteria require that a project's rate of return should be at least equal to the rate of return in the best alternative investment opportunity available. Hence those projects whose earning power as measured by their internal rate of return is less than that of other alternatives ought not to be carried out for they represent a less productive use of the scarce capital resources. Thus, whenever the internal rate of return criterion is to be employed in project selection it is necessary to state both the "cut-off" rate of interest used for comparison and the rationale employed in its selection.^{3/}

^{2/} In some cases the nature of the projects capital investment and annual costs and returns may be such that more than one discount rate may satisfy equation 1. In these situations the internal rate of return index presents ambiguous results. See R.N. McKean, Efficiency in Government Through Systems Analysis. Rand 1958.

^{3/} It should be recognized that the computational procedures to be followed in computing the financial internal rate of return are the same as those utilized in calculating the economic internal rate. The difference arises in the return-cost values themselves and not in the mathematics.

The Debt Service Ratio is a straight forward comparison of the net cash flow generated by the project and associated farm operations and the debt incurred by the project participants. The index is computed as the ratio of the present value of net financial returns to the present value of annual payments for principal and interest on outstanding participant obligations.

Calculations of both the internal financial rate of return and debt service rate for individual project participants or groups can be carried out in Worksheet VI.8.

Worksheet VI.8 Internal Financial Rate of Return and Debt Service Ratio

In Column (1) various interest rates, which may be used to compute the present values of data from Worksheets VI.5-7 are listed. Columns (2), (3), and (4) provide space to respectively record the present worth of participant investment, debt repayments, and net financial return^{4/}, at each discount rate. In column (5) the present value of net financial worth (PNFW) at each rate of discount is entered. Additional space for comments notes, and side calculations is available in Columns 6 through 11.

4/ For ease in computing present financial worth as well as the present value of debt repayment as separate items the financial return figure is here gross of payments for principal and interest.

The lower portion of the Worksheet contains the formulas to use for computing the financial internal rate of return and the debt service ratio. In order to evaluate the productivity of the project for each participant using the rate of return criterion the rate of return in the next best alternative investment should be shown as suggested. If the project does not yield a return to participants capital at least equal to the alternative, then there is no financial incentive for him to cooperate in the project. The debt service ratio should exceed unity. If it does not, then the present worth of all net income is not sufficient to cover debt liquidation and payments of interest.

Calculation of Capital Recovery (Financial Payback) Period.

In planning development programs and projects the "turn-over time" for invested capital is of special interest. On balance the quicker projects pay-out the better. Project documentation should therefore include the calculation performed for determining the payback period for any investment expenditures made by project participants. The payback period is, more specifically, the length of time it takes for financial net returns to equal participants capital investment.

Worksheet VI. 8 Internal Financial Rate of Return and Debt Service Ratio

Project _____ Participant or group _____

	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Present Value Investment	Present Value Total Debt Repayment	Present Value Net Financial Return $a/$	Present Value Net Financial Worth PNFW							
$\sum_{t=1}^T PI_t(1+i)^{-t}$	$\sum_{t=1}^T DR_t(1+i)^{-t}$	$\sum_{t=1}^T FR_t(1+i)^{-t}$	(4)-(2)+(3)							
3										
5										
7										
9										
10										
12										
15										
20										

Debt Service Ratio ^{b/} = $\frac{\text{Cash Earnings}}{\text{Principal+Interest}}$ = $\frac{\text{Present Value Net Financial Return } a/}{\text{Present Value Debt Repayment}}$ = _____

Internal Financial Rate of Return = Lower Discount Rate + Difference Between Rates $\left(\frac{\text{PNFW At Lower Rate}}{\text{Difference Between PNFW's}} \right) =$ _____

Rate of Return in Next Best Alternative = _____ Investment

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a/ Financial return here is Net Cash Income plus Interest and Principal Repayments. For calculation of the Debt Service Ratio the present value of total debt repayment will first have to be subtracted from the value shown in column (4)

b/ Calculated at Discount Rate equal to Internal Financial Rate of Return

Worksheet VI.9 Period of Capital Recovery (Financial Payback)

Period

Annual Investment, Column (2) refers to participants equity capital contribution (from Line III. Worksheet VI.1), Annual Net Financial Returns are Net Cash Income (line III a. Worksheet VI.3). The payback period is the length of time it takes cumulative financial returns (Col. 5) to equal cumulative participant investment (Col. 3). Whenever the payback period falls between two periods of time shown in Col. 1, the following extrapolation formula may be utilized to compute the period in terms of years and portions thereof:

$$(2) \quad Y + 12 \frac{(CI - CB_Y)}{CB_X - CB_Y} = \text{Payback period in years and months}$$

Where:

- Y = The last year of investment
- CI = Cumulative investment in Year Y
- CB_Y = Cumulative net financial returns in year Y.
- CB_X = Cumulative net financial returns in year Y + 1.

CHAPTER VII

ECONOMIC FEASIBILITY ANALYSIS

A. Discussion

The purpose of economic feasibility analysis is to help determine through the use of economic efficiency criteria the desirability of carrying out the proposed project.^{1/} Efficiency criteria relate to the economic returns to the resources committed to the project regardless of who receives the benefits. Economically efficient projects are thus those that serve the goal of national income maximization. Other considerations such as income distribution, regional growth, and social justice or equity are ignored in economic feasibility studies. These latter factors, however, often are of equal if not greater importance in project selection than efficiency since they reflect important welfare impacts of a project. Discussions of non-efficiency criteria and the details of related feasibility analysis are reviewed in Chapter VIII.

^{1/} In broader framework, project analysis can serve to identify the incidence of benefits and costs and to suggest guidelines for pricing of project output.

Economic analysis is carried out by a series of calculations pertaining to the economic costs and returns of project inputs and outputs. Total project costs and benefits are computed for each year of the project life. Incremental changes in these costs and benefits as the project is enlarged in size should be compared to determine optimal project scale. Various indices, such as the projects' economic internal rate of return, present net worth, and benefit to cost ratio are then computed using appropriate discounting techniques. These indices reflect the relationship between inputs and outputs measured in economic terms and are used as the parameters summarizing the project's economic profitability.

Basic to the economic analysis of a project are a number of fundamental principles which must be followed.

First of all, project net benefits must be calculated in terms of the difference between what will happen with the project and what can be expected to occur in the absence of the project. (As mentioned previously. This is what is known as the "with-without" principle). In economic analysis the notion of what will occur in the absence of the proposed project extends to income gains and losses which may arise in any sector of the economy and/or in any geographic location. Thus, the opportunity costs of a project must be taken into consideration from a broad as well as a penetrating view point regarding real project gains.

Second, the alternative project under review must be the least-cost way of achieving project objectives. The least-cost condition should be verified through a cost comparison of alternative technology and/or administrative organization.

Third, economic analysis relies upon market prices to evaluate costs and benefits which, when necessary, have been properly adjusted to reflect the true cost and benefit of the project to society.

Fourth, since project objectives and national/regional goals may be achieved in other ways, the feasibility analysis should compare the particular project discussed with the other alternatives whenever they exist. The comparison should be in terms of summary information relating to the principal impacts of the project and any alternative to it.

Fifth, any constraints or bottlenecks which have limited the scope of the project examined should be made known; for example, project planning may have been constrained by physical or technological reasons, by legal requirements, by the desire to achieve goals other than economic efficiency (e.g., redistribution of national income to low income segments of the population, increased regional employment, achievement of export/import balance, to conserve foreign exchange, etc.), by budgetary constraints which have limited planning activities as well as implementation, and by policy requirements pertaining to necessary contributions to projects costs by individual beneficiaries.

Sixth, relevant sensitivity analysis should be presented showing the dependence of project impacts upon data subject to risk and uncertainty.

Seventh, whenever several investment alternatives for reaching similar objectives exist, the projects should be ranked in order of preference using the various criteria which are relevant.

The materials presented in this chapter are designed to facilitate making the necessary economic analysis. Procedures are outlined for calculating various economic indices or parameters which can be used to summarize project impacts and to make comparisons among alternative project possibilities.

B. Economic Feasibility Indices

Economic feasibility indices are calculated by comparing project benefits and costs so as to identify the net return to investment of scarce resources. Both costs and benefits are measured from the national viewpoint as pointed out. This means that market prices adjusted to reflect the real gains and opportunity costs to society are used as the input data.^{2/}

^{2/} In some situations, however, not all gains and costs can be adequately expressed in monetary terms and here a comparison between physical (scarce) inputs and the value of goods produced, or between the economic cost and an associated physical output will be necessary. Cost-effectiveness and cost minimization are appropriate analytical techniques under these circumstances. Additional discussion and Worksheets relevant for these approaches are contained in Chapter VIII.

Different indices bring to light different aspects of project feasibility. Hence, various indices, or project economic impact parameters, may be employed for estimating project desirability depending upon the specific input/output comparison of interest. Since project benefits and costs are flows through time which may differ in time occurrence as well as magnitude, discounting procedures are again necessary in order to render these values comparable as to their present worth to society. In this manual it is recommended that eight indices be calculated and used to judge the economic feasibility of the project. These indices are:

- (1) the capital/output ratio
- (2) the benefit/cost ratio
- (3) the present net worth
- (4) the internal rate of return
- (5) the pay back period
- (6) the returns to skilled manpower ratio
- (7) the ratio of foreign exchange investment to domestic currency investment
- (8) foreign exchange savings.

Each index will tell a slightly different story about the investment project under review.

Considerable discussion exists in the economic literature about their pro's and Con's and whether the benefit/cost ratio, the present net worth, or the internal rate of return is best suited to serve as the primary choice criteria.^{3/} Although no single index is clearly

^{3/} See Appendix D for a discussion of the relative advantages and disadvantages of the various efficiency criteria which may be employed.

the best choice in all circumstances, the position taken in this manual is that if a single criterion of economic effectiveness is needed then the internal rate of return is the preferred choice, but that both (3) and (8) should also be computed for they provide insight as to project impacts not made apparent in the rate of return figure. Items (1), (2), (5), (6), and (7) provide additional information which is helpful for making choices among project alternatives.

In the balance of this section procedures are set out for computing the value of each index listed above. The data which was assembled in Chapter IV. provides the basis for these calculations; however, since all cost and return data assembled in that Chapter are based upon market prices as taken from marketing reports or as estimated on the basis of purely marketing information they must be systematically reviewed and adjusted in order to render them suitable for use in economic analysis. Here worksheets are presented and discussed which facilitate making the adjustments and which can be used to assemble the specific information needed to compute the necessary economic indices. Thus, the steps outlined in this Chapter build upon the work of previous portions of the manual.

C. Evaluation of Economic Benefits and Costs

Evaluation of project economic benefits and costs involves placing lira values upon the goods and services produced, and upon the inputs utilized in the production of those goods and services. Like financial

analysis, the purpose of assigning monetary values to inputs and outputs is to ascertain the net income gains created by the project. Unlike financial analysis, however, economic analysis cannot rely upon market prices as suitable measures of the benefits and costs associated with the project; hence, market prices may serve as the initial starting point for determining project net economic gains, but very frequently these values must be adjusted before using them in the analysis.

The fundamental rationale for the use of prices in measuring project benefits and costs rests upon the notion that the income gains and expenditures are proxy measures of the utility generated by the goods and services produced and the productivity of input resources. Thus, the added income generated by a project reflects an improvement in monetary well-being which can enhance general well-being by allowing individuals to improve their standard of living. But, that income increase is based upon the prices consumers of the goods and/or services are willing to pay for them. Similarly, on the cost side the prices paid for resources consumed in the production of project outputs should reflect their real productivity i.e., they should reflect the value of such inputs in their most productive use. Whenever market prices do in fact measure the true monetary value consumers are willing to pay to acquire project outputs and the real income generating potential of project inputs, they may be employed in economic analysis just as they were in the

financial analysis. In the latter case, the monetary income gains and costs to project participants are equivalent to the gains and costs to society at large. Unfortunately, market imperfections are likely to exist which render market prices poor measures of social gains and costs.

In order to better understand the adjustments to market prices which are necessary in economic analysis, a brief discussion dealing with the relationship between market imperfections and the use of pricing data in project planning is necessary.

Under perfectly competitive conditions, the prices prevailing in an economic system in equilibrium would be, with one exceptional situation, accurate measures of the true monetary value consumers and producers place upon goods and services. The exception is the case where technological external economics and diseconomics exist wherein costs or benefits (income/cost increases) originating in one enterprise, or sector of the economy, are passed on to others without just compensation. The existence of these benefits and costs external to a particular economic unit means that calculation of incomes and costs based upon market prices underestimate overall (social) benefits and costs by the amount of externality. Since technological externalities tend to be ignored in prices, the usual practice in project analysis and the procedure followed here is to estimate off-site benefits and costs separately from project participant net income and

then combine the two sets of values to yield the overall net benefit of the project.

In addition to the problems caused by technological externalities, there are others which arise because in the real world economic systems are never in equilibrium for more than a very short period of time, if at all, and because very few markets can be classified as perfectly competitive.^{4/} When markets violate the perfectly competitive conditions they are then said to exhibit market imperfections.

The market imperfections which are particularly relevant for project analysis in developing economies can be lumped into four categories:

- (1) Monopoly elements
- (2) Governmental price controls
- (3) Lack of complete information on the part of consumers
- (4) Institutional rigidities which restrict the free flow of goods and services to points of demand.

Each of these conditions means that prices which prevail in the markets for project inputs and outputs are not consistent with the basic requirement that they reflect real productivity and consumer preference.

^{4/} Economic theory states that in order for a market to be perfectly competitive it must have the following characteristics: (1) there are large numbers of buyers and sellers, (2) no one individual commands monopoly control on output, input and prices, (3) profit maximization is the motive of firms; (4) there is complete freedom of movement of goods and services, and (5) producers and consumers have perfect knowledge about present and future prices.

Monopoly pricing means that output is restricted in order to generate maximum profit to the monopolist, and that the resources utilized in the productive prices are not paid the full value of their productivity. Thus, if monopoly prices are used to establish project costs and benefits project inputs may be overvalued in relation to their productivity in alternative uses, and project outputs will be overvalued in terms of what would prevail if output were not artificially restricted. In other words, under competitive equilibrium conditions not only would more inputs and outputs be available in the economy but the resulting price would be one where the price paid equaled productivity received.

Government price controls similarly distort the relationship between unit productivity and prices. Lack of adequate information regarding alternative markets for goods and services, and restrictions on the ability of goods and services to move to alternative markets also create this distortion. The result is that before using the pricing data taken from market reports the analyst must determine if market imperfections of these types exist. If so, "shadow prices" must be computed and utilized in lieu of market prices.^{5/}

In most developing countries market imperfections do exist and Turkey is no exception. Therefore, before an economic analysis can be performed the cost-return data assembled in Chapter IV. of this manual

^{5/} Shadow prices may be defined as an artificially determined price calculated to be that likely to prevail under competitive equilibrium.

must be reworked. The following material is presented as a guide to the adjustments to be made to market prices whenever shadow prices are needed.

Gittinger (p.37,) maintains that in agricultural projects there are three classes of inputs and outputs where shadow pricing is likely to be important; viz., foreign exchange, labor, and inputs and outputs where price regulation is practiced.

Foreign Exchange

The need for foreign exchange shadow prices arises because due to inflationary forces, official governmental exchange rates are frequently out of line with the actual exchange rate as exhibited in the markets for the domestic currency. For economic analysis, therefore, it is necessary to compute the Turkish lira value of foreign exchange utilized in the project on the basis of the real value of the liras. Thus, whenever it is desirable to express foreign exchange values in domestic currency equivalents it is necessary to use a conversion factor which reflects the actual as opposed to the official exchange rate. The conversion factor is computed as follows:

$$C_f = \frac{r^A}{r^O}$$

Where:

C_f = the conversion factor

r^A = the actual exchange rate effective in the trading markets for the domestic currency

r^O = the official exchange rate

To convert foreign exchange to its effective real value in terms of domestic currency when the official rate has previously been used the following calculation is necessary:

$$E_f = F_c \cdot C_f$$

Where:

E_f = the real domestic currency value of foreign exchange

F_c = the domestic currency equivalent of foreign exchange based upon the official rate of exchange.

While the above formulas are straightforward and should present no difficulties, a very real problem is deciding upon the actual rate of exchange, i.e., r^A , to use in the calculations. In practice the choice will rest upon a comparison of the official rate with the rates at which lira currency is exchanged in the various market. At the project planning level two difficulties face the analyst in regard to proper values for foreign exchange: (1) the time involved in estimating an average actual rate may be considerable and will tend to divert the planning group into areas where relative expertise is not likely to be great, and (2) independent estimation of exchange rates by different

planning groups could result in many different results which will tend to distort the comparability of projects put together by different agencies. On balance, it seems better to use the exchange which the central planning body (SPO) recommends, and if differences of opinion arise discussions should be carried on to verify their accuracy.^{6/}

Labor

With respect to the shadow price of labor utilized in the construction and operation of the project the issue arises because of the probable unemployment, or underemployment, of these resources in the absence of the project. Since even unemployed workers will be paid a wage, the question that comes up in economic analysis is "should the wage bill of the project be taken as the true measure of productivity foregone of these otherwise unemployed resources." Economists are agreed that to the extent unemployment or underemployment exists among the project labor force, the wage bill will overstate true costs; hence, the shadow price of labor must be computed. The empirical problem is how much to reduce the wage bill to bring it in line with the productivity of the newly employed workers.

If laborers are (a) employed at the time they are put to work on the project, and (b) they will remain unemployed throughout the life of the project, then the shadow wage rate is equal to zero.^{7/} On

^{6/} This is a very pragmatic approach but one which recognizes that the responsibility for proper estimation of these basic values lies beyond the project planner per se. This is also the recommendation of Gittinger (p.39).

^{7/} This does not mean that for project budgeting and accounting purposes labor is entered at zero cost.

the other hand if laborers are only underemployed and the project will either give them full employment, or it will add an increment to their employment so that they are now less underemployed than before, the shadow wage rate is something between zero and the rate at which they are hired to work on the project.

Since the definition of "underemployed" is employment anything less than 100 percent of capacity, an infinite number of underemployment conditions may be possible. For example, the labor force in an area may be seasonally scarce during harvest periods but at other times in abundant supply so that for 60 days of the year laborers are fully employed at a relatively high wage and the balance of the year i.e., 305 days, employed only 20 percent of the time at a very low wage. Other similar combinations of full employment and underemployment may be possible.

There is a need therefore in this project planning manual to establish a general rule for computing the shadow-price of these underemployed workers. The method suggested is to use the actual annual wages earned by laborers in their various employment alternatives as they will exist in the absence of the project. Unless unusual circumstances can be shown as likely changes in the future, the income pattern during the years just preceding implementation of the project may be used as the basis of the calculations.

To illustrate, assume that laborers will be hired full time on the project. Assume also that for the 60 days of previous full employment

(example above), the wage paid was 20 TL. per day, and for the balance of the annual working period of 71 days or (.20 X 305 days) the going wage was 5 TL. per day. The shadow price (wage) of labor per year is thus computed as follows:

$$60 (20 \text{ TL}) + 71 (5 \text{ TL}) = \text{shadow wage}$$

$$1200 \text{ TL.} + 355 \text{ TL.} = 1555 \text{ TL.}$$

Although the project will employ these workers full time during construction, and/or during operation, and the total annual wage per worker is 5000 TL., 1555 TL. is recorded as the labor cost per worker in the economic analysis. As alternate employment opportunities change through time, the future shadow wage will need to be adjusted accordingly.

One other situation may arise in evaluating the shadow wage of labor. Farm labor may be put to work with special activities relating to the construction of capital works on their own farms and/or with general improvements such as land clearing and levelling, and building stock pens, etc. which is considered as necessary project labor input. If the farm labor utilized in these activities is otherwise wholly unemployed in even their own farming enterprises, e.g., unutilized family labor then the shadow wage is zero. If such labor is utilized on a spare time basis, i.e., after normal working periods, then the conventional practice is to set the shadow wage again at zero. However, if the labor works full time on such activities, then the usual approach is to value the labor at its subsistence cost, the theory being that the

productivity of the workers in any other alternative may in fact be zero, but that they are here engaged in potentially productive activities and as a minimum the cost of their sustenance is a better measure of their worth than zero. If of course alternatives exist to farm improvement activities, the shadow wage can be computed as shown above.

Goods and Services with Regulated Domestic Prices

The third category of goods and services which require the use of shadow prices are those where market prices are regulated. To the extent such regulation exists, the reported price of a commodity departs from that which would obtain if competitive conditions were allowed to prevail. For example, if the price of wheat is held low by government order so that the price of bread may be low, then the use of the market quotation on wheat as a basis for computing the benefits of increased wheat production is in error. Similarly, if an import limit on foreign made goods is in effect the resulting domestic price for the item is again artificially high compared to what would obtain without the restriction on trade.

A general rule to follow under situations where market price is regulated either directly or indirectly is to use the world market price for the items, plus any transportation costs from the market point to the point of domestic consumptions. Thus, if the import price of wheat at Istanbul is 30 TL. per kilo this price, plus internal

transportation and storage costs, may be a better approximation to the free market price than the domestic price. The shadow price rule is therefore to use a world market price or the price at the border as the base for "restricted" goods whenever these goods are also traded on the world market. When project outputs and/or inputs are domestically sold under restrictive pricing conditions, but such goods themselves are not traded on the world market, once again world prices may be used as a basis for shadow prices but due regard must be given to differences in quality, or design, and any other product characteristics which may differ from the goods for which the world price is used.

Now, having outlined the general cases where shadow prices must be utilized in lieu of market prices, and the rationale to follow in selecting those shadow values it remains to describe worksheets which can facilitate the conversion of the market values assembled in Chapter IV. Project Formulation and in Chapter VI, Financial Analysis. The worksheets required are for adjusting basic pricing data used previously and for recomputing the economic costs and returns. The latter are identical in nature to the project and farm area capital investments and annual costs and returns categories, plus the technologically related off-site costs and returns.

Worksheets VII.1-7 Shadow Costs for Domestic Currency Project

Inputs

The simplest way to prepare estimates of the economic costs for project construction and operation when locally or nationally supplied inputs are purchased is to re-do Worksheets VI.2, 3, 4, 5, 6, 7, and 8 using the proper shadow prices for domestic purchases rather than the market prices previously employed. The same procedures are therefore followed for these new Worksheets except for the basic unit cost data.

Worksheets VII.8 and 9 Shadow Costs of Foreign Exchange Purchased
Project Investment and of Annual Operations

This worksheet deals with the two main categories of costs associated with the project itself, viz., the capital investment component and expenditures for annual operation, maintenance, and repair. Costs arising with new marketing facilities are included. In these cost items the adjustment required is only for items purchased with foreign exchange capital when the actual exchange rate differs from the official rate quoted by government sources.

The worksheets are completed by first listing in Column (1) all input items purchased with foreign exchange. The lira equivalent expenditures are then entered in the appropriate annual columns. Next the correction factor applicable to each item and year are entered also

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Technology/Equipment	In. No.	Investment		Investment Cost			Investment	Completion	Replacement	Yr. 1970	Investment		Total
		Foreign Exchange	Domestic Exchange	Foreign Exchange	Domestic Exchange	Total					Foreign Exchange	Domestic Exchange	
										1			
										2			
										3			
										4			
										5			
										6			
										7			
										8			
										9			
										10			
										11			
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										40			

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If Exchange in _____ (official annual _____)

See Appendix B for f values at alternative discount rates.

(1)

(2)

Investment Item	Project Planning Periods from Present and Late																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Participating Association (From IV.3)																									
Domestic currency																									
Foreign exchange																									
Ex,Rate																									
Ex,Rate																									
Ex,Rate																									
Capital Item (From IV.2)																									
Domestic currency																									
Foreign exchange																									
Ex,Rate																									
Ex,Rate																									
Ex,Rate																									
Ex,Rate																									
Raw Materials																									
Domestic currency																									
Foreign exchange																									
Ex,Rate																									
Ex,Rate																									
Ex,Rate																									
Loan Capital																									
Working Capital																									
Labor																									
Other Investment																									
Total Investment																									
Domestic currency																									
Foreign exchange																									

Worksheet VII 6 Recap Annual Charges New Marketing facilities
 Project _____

(1)

(2)

Marketing facility	Project Planning Period : Year from present and date																										
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
Commodity																											
Market																											
Item																											
Total Cost																											
Commodity																											
Market																											
Item																											
Total Cost																											
Commodity																											
Market																											
Item																											
Total Cost																											
Commodity																											
Market																											
Item																											
Total Cost																											
Commodity																											
Market																											
Item																											
Total Cost																											
Total Annual Marketing Cost																											

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 BY _____

Worksheet VII.6 Recap Annual Charges New Marketing Facilities (Cont'd)
 Project _____

(1)

(2)

Marketing Facility	Project Planning Period : Year from present and date																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Commodity																									
Market																									
Item																									
Total Cost																									
Commodity																									
Market																									
Item																									
Total Cost																									
Commodity																									
Market																									
Item																									
Total Cost																									
Commodity																									
Market																									
Item																									
Total Cost																									
Total Annual Marketing Cost																									

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under Section (2). The adjusted cost is computed by multiplying the market lira values by the correction factor for each year. The total adjusted lira cost, plus direct domestic currency expenditures (as computed in IV.8) are then added to yield the total economic investment and operating costs.

Worksheets VII.10 and 11 Adjustments to Farm Net Economic Revenue
Without and With Project Using Shadow Prices

Both worksheets are the same except for the with-without condition. Input items utilized and revenue items produced which require adjustments are listed in Column (1). Market prices as utilized previously are listed for each item in Column (2), the appropriate shadow price is then listed in Column (3), and the ratio between the shadow price and the market price is listed in Column (4). Two figures are entered in the annual columns under (5): First, in each space the original market cost for that period is recorded, and then below that, in parenthesis, the adjusted cost computed as the product of Column (4) and the original market cost.

Once the annual shadow price adjusted values for each input/output items has been recorded the balance of the Worksheet can be completed. First, the total market value of the affected items is listed across the worksheet. Then the totals for the shadow cost values are recorded. The item Increase/Decrease refers to the difference between the original

Worksheet 11.8 Shadow Cost of Foreign Exchange Purchased Project Investment
Project _____

(1)

(2)

Item	Project Planning Period : Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Foreign Exchange Investment (I ₀)																									
Marketing Facilities (from IV.3)																									
1. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})^a$																									
Adjusted Cost																									
2. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
Capital Issues (Project) (from VI.4)																									
1. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
2. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
3. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
Raw materials																									
1. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
2. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
3. (ex. rate)																									
Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
Other																									
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Correction factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
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Adjusted Cost																									
3. (ex. rate)																									
Correction Factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
4. (ex. rate)																									
Correction Factor $(\frac{r^A}{r^0})$																									
Adjusted Cost																									
Total Adjusted Life Investment																									
Domestic Currency Investment (from VII.1)																									
Total Domestic Investment																									

a/ The correction factor is the ratio of the actual rate of exchange (r^A) to the official rate (r^0).

Worksheet VII, A Method Cost of Foreign Exchange Purchased Project Investment (Cont.)
 Project _____ (1) (2)

Item	Project Planning Period: Year From Present and Date																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
Marketing facilities investment (from IV.3)																									
1. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$ g/																									
Adjusted Cost																									
2. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
Capital Items (Project) (from VI.4)																									
1. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
2. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
3. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
Raw materials																									
1. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
2. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
3. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
Other																									
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Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
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Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
3. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
4. (ex. rate)																									
Correction factor $(\frac{R^A}{R^O})$																									
Adjusted Cost																									
Total Adjusted Lira Investment																									
Domestic Currency Investment (from VII.2)																									
Total Domestic Investment																									

g/ The correction factor is the ratio of the actual rate of exchange (R^A) to the official rate (R^O)

Item	Project Planning Period - Year from Present and Date																											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
Foreign Exchange Annual Project Cost (from IV, 5 - 6)																												
Material																												
1. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
2. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
3. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
Energy																												
1. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
2. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
3. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
Labor and management																												
1. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
2. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
3. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
Other																												
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Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
2. (ex. rate)																												
Correction factor $(\frac{r^A}{r^D})$																												
Adjusted Cost.																												
Total Adjusted Lira Cost																												
Domestic Currency Cost (from VII, 6)																												
Total Economic Annual Cost																												

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a/ The correction factor is the ratio of the actual rate of exchange (r^A) to the official rate (r^D)

(8)

Item	Project Planning Period: Year From Present and Date																								
	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	00
Foreign Exchange Annual Project Costs (Lines 14-21)																									
Material																									
1. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$ ^{a/}																									
Adjusted Cost.																									
2. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
3. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
Energy																									
1. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
2. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
3. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
Labor and management																									
1. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
2. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
3. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
Other																									
1. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
2. (ex.rate)																									
Correction factor $(\frac{r^A}{r^U})$																									
Adjusted Cost.																									
Total Adjusted Lira Cost																									
Domestic Currency Cost (from 11.6)																									
Total economic Annual Cost																									

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a/ The correction factor is the ratio of the actual rate of exchange (r^A) to the official rate (r^U)

market cost and the new shadow cost. If the shadow cost is greater than the market cost the difference is listed as a positive value. If the shadow cost is less than the difference is shown as a negative value in parenthesis.

At the bottom of the sheet, the net difference between the "change" in costs and the "change" in revenues is shown, i.e., the amount by which previously calculated net economic costs should be either increased or decreased because of the new shadow prices. Next, the original (previous) net economic income figures are listed to which the increment or decrement of the preceding line is added or subtracted, whichever the case may be, to give the final values of the last row Adjusted Net Income.

Worksheet VII.11 goes one step further and lists the Adjusted Net Income Without the Project and on the last line provides space to record the Adjusted Added Net Income With the Project.

Worksheets VII.12, 13 and 14 Adjusted Off-Project Costs, Revenues,
and Net Revenues

The off-site costs and returns associated with a project must also be adjusted for shadow pricing. The most straight forward way to make the adjustments to these project impacts is to simply re-do Worksheets IV.16, 17, and 18 using the new unit cost return data just previously computed.

Worksheet VII.12 Adjusted off-Project Costs Due to Technological Interaction With Project (Cont'),
 Project _____

Off-Project Impacts	Project Planning Period : Year from present and Date																									
	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	

Worksheet VII.15 Summary Adjusted Capital Costs, Annual Net Returns
and Non-Economic Impacts

As before, Worksheet VII.15 is designed to facilitate pulling together in one place all the adjusted costs and returns, plus those that do not require adjustment, preparatory to computing the various economic feasibility parameters. In format, Worksheet VII.15 is identical to Worksheet IV.19 of Section H, Chapter IV, and need not be discussed again, the procedure being to draw upon Worksheets VII.1-14 for the necessary data.

Once these adjustments have been made, the next step in the economic analysis is to compute the present worths of project monetary benefits and costs. This is then followed by computation of the economic feasibility parameters. The general format for these last steps and the computations themselves are the same as followed in the financial analysis. Different parameters are, of course, now brought in.

D. Calculation of Economic Feasibility Indices

Worksheet VII.16 Present Value of Capital Investment

The purpose of Worksheet VII.16 is to facilitate computation of the present value of the capital investment (K) component of the project. Since it is important to know how sensitive the value of project impacts are to the interest rate chosen for discounting, a key feature of Worksheet VII.16 is the use of an array of discount rates.

Worksheet VII.15 Summary, Adjusted Capital Costs Annual Net Returns and Non Economic Impacts
Project _____

Cost (Income) Item	Project Planning Period : Year from Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
I. Project Capital Investment (From IV. 4)																										
a. Domestic currency																										
b. Foreign Exchange																										
c. Total																										
II. Project Operating, maintenance and Repair Costs (From IV. 8)																										
III. Added Farm Capital Investment (From IV. 12)																										
IV. Added Farm Net Income																										
a. Added Net Cash Income (From IV. 15 line Va.)																										
b. Added Net Farm Income (From IV. 15 line Vb.)																										
c. Added Net Economic Income (From IV. 15 line Vc.)																										
V. Project Secondary Impacts																										
a.																										
b.																										
c.																										
d.																										
VI. Net (To-Project) Technological Impacts Economic (From IV. 13)																										
VII. Net Annual Income Impacts																										
a. Net Farm Cash Income																										
b. Net Farm Income																										
c. Net Economic Income																										

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In Column (1) of the worksheet the year of the planning period and the date during which capital investments occur is entered. The investment figures are shown in Cols. (2), (3), and (4). Total project capital investments (Col. 1) are taken directly from Worksheet VII.15. Added Farm Investment (Col. 2) comes from line III., Worksheet VII.15. The total investment (Col. 3) is the sum of Project Capital Investment and Added Farm Capital Investment. The remaining columns in Worksheet VII.16 provide the space necessary to record the discount rates to be used, the corresponding discount factors (f) for each year of the planning period, and the resulting present values of the yearly investments. For any rate, present values are obtained by multiplying the annual total investment figure by the discount factor corresponding to that period.

Once the present value of each yearly investment has been calculated as described above it remains to compute the present value of the entire investment schedule. This is accomplished by summing vertically the present value figures listed on each line under the various interest rates used. Thus the last line in Worksheet VII.16 shows for each discount rate the present value of all investments during the planning period.

Worksheet VII.17 Present Value of Net Annual Project Benefits

Worksheet VII.17 performs the same function as VII.16 in that flows of impacts through time are reduced to their present value equivalent using various discount rates. Here the flows, however, are benefits (B).

Worksheet VII. 16 Present Value of Capital Investment (Cont')

(1) Project (2) (3) (4) (5)

Planning Period	Investment			Discount Values															
	Yr.	Project	Total	\$2															
				Added	P.V.		P.V.		P.V.		P.V.		P.V.		P.V.		P.V.		
	Farm		f	f	f	f	f	f	f	f	f	f	f	f	f	f	f		
1																			
2																			
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40																			

As with Worksheet VII.16 Column (1) refers to the year and date at which benefits are expected. Column (2) lists Net Farm Economic Impact taken from Worksheet VII.16.^{8/} Project economic costs for operation, maintenance and repair (OMR) are entered in Col. (3). The differences between Col. (2) and Col. (3) are the Net Annual Project Benefits and are listed in Column (4). Discount factors and present worth values of Net Annual Project Benefits (i.e., discount factor times Net Annual Project Benefits) are recorded in Columns (5) through (10). Present value of the entire stream of returns is obtained by vertical summation.

Once Worksheets VII.16 and VII.17 are completed all the data is thereby available for computing the specific feasibility indices needed to judge whether or not the project is an economically desirable choice. The balance of the material in this Section deals with descriptions of each index and the methods of calculation.

The Capital/Output Ratio

The Capital Output Ratio $\frac{K}{B-C}$ is used to express the amount of capital required to produce one monetary unit of yearly annual output. This index is written as an expression with Capital (K) as the numerator

^{8/} Net Farm Economic Impact has previously been defined as the net annual economic returns to the project and include economic benefits at the farm level, net secondary impacts, and net off project economic impacts due to technological impacts.

Worksheet 1 - Present Value of Net Annual Project Benefits

(1) Project _____ (2) _____ (3) _____ (4) _____ (5) _____

Planning Period Yr. Date	Net Base Income	Project CWR	Net annual project benefits	Discount Values															
				1		2		3		4		5		6		7		8	
				r	P.V.	r	P.V.	r	P.V.	r	P.V.	r	P.V.	r	P.V.	r	P.V.	r	P.V.
1																			
2																			
3																			
4																			
5																			
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Appendix 17 Present Value of Net Annual Project Benefits (Cont'd)

(1)

Project
(2)

(3)

(4)

(5)

Planning Period	Tot Farm Income	Project Cost	Net annual project benefits	Discount Values																
				%		%		%		%		%		%		%				
				f.	P.V.	f.	P.V.	f.	P.V.	f.	P.V.	f.	P.V.	f.	P.V.	f.	P.V.			
1																				
2																				
3																				
4																				
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40																				

and the net value of project output (B-C) as the denominator. In general usage, the capital output ratio refers to the productive capacity of an economy at a particular point in time, and the denominator is taken to be either the total value of output produced by the capital or as the value added by capital. Also, in general useage, neither the numerator nor the denominator are discounted.

For purposes of project feasibility analysis the appropriate denominator is the yearly net benefit of the project. Since capital investment and net benefits are flows through time, both should be discounted to their present values. In this form the Capital Output Ratio measures the present value of the capital required to produce one present value dollar of net benefit. When used in this fashion the Capital Output Ratio is the inverse of the discounted Benefit Cost Ratio and can be written as follows:

$$\frac{K}{B-C} = \frac{\sum_{t=1}^T \frac{K_t}{(1+i)^t}}{\sum_{t=1}^T \frac{B_t}{(1+i)^t} - \sum_{t=1}^T \frac{C_t}{(1+i)^t}}$$

Where:

t = a time period

T = the length of project life in years over which returns and costs are discounted.

K_t = capital invested in time period t in project construction and/or set-up.

B_t = the annual gross return in time period t

C_t = the annual cost in time period t

i = the discount rate

It should be noted that calculation of the ratio requires not only knowledge of the annual capital investment and net return values but a specific discount rate as well. Since the ratio value is highly dependent upon the discount rate the rationale for any rate used in the calculation should be clearly set forth.

The Benefit/Cost Ratio

The Benefit/Cost Ratio $\frac{B - C}{K}$ index may be written in general

form as follows:

$$(2) \frac{B - C}{K} = \frac{\sum_{t=1}^T \frac{B_t}{(1-i)^t} - \frac{C_t}{(1+i)^t}}{\sum_{t=1}^T \frac{K_t}{(1+i)^t}}$$

where all symbols are as before.

The numerator in the index is thus the present worth of the projects net annual benefits. The denominator is the present value of capital investments. The Benefit/Cost Ratio measures the efficiency of capital in terms of the present dollar value of net benefits per present value dollar of capital input at the chosen rate of discount. This index is

a standard guide to the economic efficiency of the project. The rules of economic efficiency require that the value of the Benefit/Cost ratio be equal to or greater than one; or in other words that the present value of net benefits be not less than the present value of the costs, when the discount rate is set equal to the rate of return to capital in the next best investment alternative. Once again the interest rate chosen for any calculation should be justified.

The Present Net Worth

The present Net Worth (PNW) index may be written in general form as follows:

$$(3) \quad \text{PNW} = \sum_{t=1}^T \frac{B_t - C_t}{(1+i)^t} - \sum_{t=1}^T \frac{K_t}{(1+i)^t}$$

Where all notation is the same.

The PNW of a project is thus computed by finding the difference between the present worth of the net benefit stream and the present worth of the investment stream. As with the Capital Output Ratio and the Benefit Cost Ratio use of the Present Net Worth index requires a decision with respect to the discount rate to be used. Economic efficiency requires that the rate be that of the earning power of public capital in the best alternative investment, and that the PNW value equals or exceed zero. A Present Net Worth of less than zero signifies that at the dis-

count rate used, the present value of the net benefit earned by the project are less than the present value of their cost. Here again, the choice of discount rate must be rationalized.

The Internal Rate of Return

The Internal Rate of Return (i_I) of a project may be defined as "the discount rate which makes the present net worth of the project equal to zero". Thus the internal rate of return is the value of the discount rate; such that:

$$(4) \quad \text{PNW} = \sum_{t=1}^T \frac{B_t - C_t}{(1+i)^t} - \sum_{t=1}^T \frac{K_t}{(1+i)^t} = 0$$

where the notation is as before.

The similarity of the above expression with the PNW parameter is obvious. With the PNW index the analyst must choose the discount rate to use while for the internal rate of return index the discount rate which satisfies expression (4) must be computed. The rate measured the average annual earning power of the capital used in the project over the project life.

The use of the internal rate of return index generally presents a clear picture of the percent return to the capital component of project

costs.^{9/} It also avoids the difficulty of having to decide upon a specific discount rate to use in the calculation. It does not eliminate all such problems, however, because it requires that the analyst specify the minimum, or "cut-off", rate of return which must be achieved before a project will be considered for implementation. In this case the economic efficiency criteria requires that a project's rate of return should be at least equal to the rate of return in the best alternative investment. Hence, those projects whose earning power as measured by their internal rate of return is less than that of other alternatives ought not to be carried out for they represent a less productive use of the scarce capital resources. Thus, whenever the internal rate of return criterion is to be employed in project selection, it is necessary to state both the "cut-off" rate of interest used for comparison and the rationale employed in its selection.

Returns to Skilled Manpower

In many situations skilled manpower during project construction and/or program implementation, and during operation is a bonafide scarce resource which should be allocated to activities where it is most productive. The project index Returns to Skilled Manpower is one way of showing the production achieved per skilled man unit of this resource. While, strictly speaking this index is not a parameter that

^{9/} Cf. 2, p. 234.

can measure economic efficiency, it does represent an input output relationship that can be extremely important for national planning. For that reason, it is included here in the Economic Feasibility Section of the Manual.

The index can be defined as the net project benefits produced per unit of skilled labor. It can be written as follows:

$$(5) \quad R_{sm} = \frac{\sum_{t=1}^T \frac{B_t - C_t}{(1+i)^t} - \sum_{t=1}^T \frac{K_t}{(1+i)^t}}{\text{Number of Skilled Workers}}$$

Where:

R_{sm} = returns to skilled manpower

and all other notation is as before

It can be seen that R_{sm} is the ratio of Project Net Worth to the number of skilled workers necessary to implement and operate the project. This index is useful for the insight it offers as to the productivity of scarce trained workers. It can be used as a basis for comparing alternative projects. For example, if all other index values were equal for two projects except one required fewer skilled technicians than the other, then on this balance the former would be preferred since it tied up fewer skilled workers, i.e., the R_{sm} ratio for the project with fewer skilled workers will be larger. While in actual practice it is not likely that two (or more) projects are

identical in every respect vis-a-vis feasibility indices except skilled input requirements, nevertheless the R_{sm} ratio can be helpful. Moreover, it can be computed very easily once Worksheets VII.16 and VII.17 (and VII.18 to follow) have been completed.

The Payback Period

In planning developmental programs and projects, the "turnover time" for invested capital is of special interest. All other things being equal the quicker a project pays out the better. Project documentation should therefore include a calculation for determining the payback period for the investment expenditures. The payback period is, more specifically, the length of time it takes for a project's net benefits to equal the capital investment.

The Ratio of Foreign Exchange Investment to Domestic Currency Investment

Since foreign exchange holdings represent a scarce and valuable resource project documentation should show the relationship between the amount of this resource required and the amount of domestic currency involved. High ratios, certainly those exceeding unity, indicate that the project is an intensive utilizer of foreign exchange relative to the domestic currency component. Whenever this situation occurs, the project should be carefully scanned to verify that the proposal represents a desirable way to spend foreign reserves. In addition, whatever the value of the ratio the foreign exchange expenditure should be made explicit in project documentation.

Foreign Exchange Savings

If the project results in savings of foreign exchange, for example through the production of a commodity which here-to-fore has been available only through importation and whose import level may now be reduced because of the project, the difference between these savings and any foreign exchange expended in the construction and operation of the project should be shown. This value may be computed from data already assembled in previous worksheets; hence no new worksheet are required. However, the information should be made explicit in this section of the (economic) analysis and discussed in a specific paragraph in the report.

E. Computational Methods

Given the above definitions and brief discussion of each of the (8) principal indices utilized in this manual for economic feasibility analysis, there remains the task of illustrating how each index is computed. Worksheets VII.18 and VII.19 perform this function. Each builds upon the data assembled in Worksheet VII.16 and VII.17.

Worksheet VII.18 Present Values of Project Investment Costs and Economic Benefits and Economic Feasibility Indices

Worksheet VII.18 is one of two summary sheets which, when completed, will contain information to be used directly in assessing the economic

feasibility of the project. The worksheet provides space for computing the value of five (of the 8) project feasibility index numbers, viz., the Capital Output Ratio, the Benefit Cost Ratio, the Present Net Worth, the Internal Rate of Return, and the Return to Skilled Manpower.

In Column (1) Worksheet VII.18 the various interest rates to be used for computing present values are entered. As pointed out before, present worth values are sensitive to the discount rate chosen and the choice of rate may not be unequivocally clear. Hence, it is necessary, under most cases, (and certainly desirable in any event), to compute present values using several rates which span the range of possibilities. In Columns (2) and (3) the present values for investment (from Worksheet VII.16) and the net benefit components (from VII.17) are entered on the line corresponding to the proper discount rate used.

Columns (4), (5), (6) and (7) are used to enter the value of the respective feasibility parameter calculated as shown and outlined above. Thus, for each discount rate there is a new value for each indices.

The Internal Rate of Return generally works out to be a rate somewhere between two discount rates chosen. Whenever this happens the two rates must be identified -- one where PNW is just greater than zero and one where it is slightly less than zero. The Internal Rate of Return is between these two rates because, as pointed out, the rate at which

PNW = 0 is the required internal rate. Once the upper and lower discount rate "bound" is located, the precise internal rate can be computed by interpolation between them using the formula given at the bottom of Worksheet VII.18. Note that the "cut off" criterion to which the project's internal rate is to be compared is entered at the top of Worksheet VII.18.

The project index values computed in Worksheet VII.18 will later be combined with other feasibility indices (financial feasibility, social and political acceptability indices) in a master table (Worksheet VIII.10) so that all project impacts will be displayed together.

Worksheet VII.19 Period of Capital Recovery (Payback Period)

Worksheet VII.19 is for the purpose of computing the payback period of the project. In Column (1) the year and date of investments and receipt of net benefits is listed. Undiscounted Investments are (from VII.16) recorded on a yearly basis on Column (2) and added cumulatively in Column (3). Undiscounted Annual Net Benefits (from VII.17) are listed in Column (4) and added cumulatively in Column (5). The year in which cumulative net benefits equal cumulative total investments is the payback period. An interpolation between years can give the precise payback period in fractions of a year. The following formula may be used for the latter situation.

$$\text{Payback Period} = Y + 12 \frac{(CI - CB_Y)}{(CB_X - CB_Y)}$$

Where:

- Y = the last year of investment
- CI = cumulative investment in year Y
- CB_Y = cumulative net returns in year Y
- CB_X = cumulative net returns in year Y + 1

The calculated payback period is then recorded in the space provided in the worksheet. This value will also be brought forward to Worksheet VIII.10 to add to the complete picture of project impacts.

Social Acceptability documentation outlined below is required in order to make relevant project impacts known.

2. Political and Social Acceptability Indices

Project documentation should identify the following:

- a) Employment Impacts
- b) Project Income Impacts
- c) Improved Access to Modern Agricultural Technology
- d) Increased Access to Farm Credit
- e) Improved Capacity of Marketing and Distribution System
- f) Increased Production Efficiency
- g) Regional Growth

Each index requires specialized data pertaining to the project area. Once the data has been assembled the analyst and project implementation decision makers should have for their use a display of all the projects impacts. Although no objective criteria exists by which all projects may be judged acceptable or unacceptable using these indices, nevertheless the information so made available should be taken into consideration when choosing new investment. As before various worksheets may be effectively used to (a) identify the data needed and (b) provide a format for data collection and impact display. Worksheets appropriate for this section are outlined in the following material.

Worksheet VIII.1 Project Employment Impacts

The purpose of Worksheet VIII.1 is to facilitate presentation of data pertaining to the employment generated by the proposed project.

CHAPTER VIII

ADDITIONAL PROJECT FEASIBILITY ANALYSIS

A. Political and Social Acceptability

1. Discussion

In addition to the examination of project impacts from the technical, financial and economic perspective, it is necessary to ascertain how the project performs in relation to other considerations such as employment opportunities generated, the effect upon income levels and income distribution, regional growth, agricultural sector development, and the quality of life. Since these additional project consequences are important for the improvement of social welfare, project documentation should make them explicit. By so doing, planners and public officials, as well as the social groups affected by the project will have a better basis for selecting and accepting projects than if the criteria was based only upon economic and financial impacts. Thus, there are many criteria involving non-economic and social justice considerations which should be utilized in project planning and the Political and

Three categories of employment information are called for: (1) the absolute level of employment (in per cent) for the various sub-areas influenced by the project with and without the project in place; (2) the increased number of permanent jobs which will be generated for the various household income classes within the project area; and (3) the resulting ratio of value of mechanization in the project area to employment force. Data pertaining to the "without" case comes from Worksheet III.13.

Category (1) shows the comparison of unemployment with the project and without it, and can be used to ascertain the resulting overall gain in employment which can be expected. Category (2) is important for it identifies who among the area population will benefit by the creation of the new jobs. The last category can be used as a guide to the level of capital or labor intensity of the project during construction and during operation. Comparisons between other projects using the mechanization - labor ratio can indicate which among the alternative are either more or less labor intensive.

Worksheet VIII.2 Project Income Impacts

Worksheet VIII.2 provides space to record an extensive array of data pertaining to the incidence of various changes in income due to the project as well as rather general information concerning the

Worksheet VIII.1 Project Employment Impacts
 Project _____

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Impact Category	Project Planning Period : Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Level of Unemployment Without Project																									
Area																									
Area																									
Area																									
Area																									
Total																									
Level of Unemployment With Project (%)																									
Area																									
Area																									
Area																									
Area																									
Total																									
Increased No. of Permanent Jobs																									
Income Class:																									
0-2499 \$/Yr.																									
2500-7199 \$/Yr.																									
7200-9999 \$/Yr.																									
Over 10,000 \$/Yr.																									
Ratio of Value of Mechaniza-																									
tion to Labor Force																									
During Construction																									
During Operation																									

Worksheet VIII.1 Project Employment Impacts (Cont')

Project _____

Impact Categories	Project Planning Period : Year From Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
Level of Unemployment Without Project. %																										
Area																										
Area																										
Area																										
Area																										
Total																										
Level of Unemployment With Project (%)																										
Area																										
Area																										
Area																										
Area																										
Total																										
Increased No. Of Permanent Jobs																										
Income Class																										
0-2499 \$/Yr.																										
2500-7199 \$/Yr.																										
7200-9999 \$/Yr.																										
Over 10,000 \$/Yr.																										
Ratio of Value of Mechanization to Labor Force																										
During Construction																										
During Operation																										

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economic health of the project area. These latter considerations indirectly reflect income situations in the area.

Four categories of project impacts which bear directly upon incomes are set up. These are; (1) changes in annual income; (2) the share of national income enjoyed by project participants with and without the project; (3) the variation from year to year in participant income; and (4) the land ownership pattern within the project area. Each of these impacts are calculated on a with-without (see Worksheet III.4) basis for income classes showing the incidence of their occurrence.

For small projects it may prove difficult to estimate accurately the share of national income received by project beneficiaries. Whenever this situation arises it may be more desirable to show the share of regional or area income received instead. Also, data may not support calculation of annual income variations to be experienced by participants; however, every effort should be made to at least approximate on a plus or minus basis any fluctuation in yearly earnings. Smoothing out wide variations in income from year to year is a definite project benefit and should be shown even if only rough approximations can be made.

Three other income-related project impacts are possible and information about them can be helpful in assessing the relative merits

of any proposal. These effects are, changes in the bankruptcy rate, the demand for short term loans for relieve during economic stress, and the expected change in the trend of inflation in the project area.

Worksheet VIII.3 Improved Access to Modern Farm Technology

Many project impacts have an affect upon incomes and welfare through improvements made in the physical conditions under which farm and livestock operations are carried out. Utilization of new inputs as well as changes in the quality and quantity of those traditionally employed are typical project functions which serve to enhance the well being of those who participate. As a general rule these changes are the result of the introduction of modern farm technology. Creating, or improving, the situation in an area whereby project participants have access to modern farm technology is thus an important project impact. Worksheet VIII.3 is designed to facilitate identification of the physical changes brought about in an area through a project. When completed the Worksheet will provide insight as to the extent modern agricultural techniques are available.

Seven categories of impacts have been listed in Column (1) as examples of some of the principal technological changes which may occur within a farm-livestock operation. Other categories may be appropriate depending upon the nature of the particular proposal under examination and these should be added to Worksheet VIII.3. On the other hand, not all those listed will be relevant for all projects.

Project _____

(1)

(2)

Impact Categories	Project Planning: Period 1 Year From Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Income of Households with Annual Income of \$1,000 or Less																									
0-2499																									
2500-7199																									
7200-9999																									
Over 10,000																									
Share of National Income by Income Class (Direct Participants - %)																									
Without Project																									
0-2499																									
2500-7199																									
7200-9999																									
Over 10,000																									
With Project																									
0-2499																									
2500-7199																									
7200-9999																									
Over 10,000																									
Annual Income Variation																									
Without Project																									
0-2499																									
2500-7199																									
7200-9999																									
Over 10,000																									
With Project																									
0-2499																									
2500-7199																									
7200-9999																									
Over 10,000																									
Area of Total Arable Land (Acres)																									
Without Project																									
0-2499																									
2500-7199																									
7200-9999																									
Over 10,000																									
With Project																									
0-2499																									
2500-7199																									
7200-9999																									
Over 10,000																									
Expected Population in Project Area																									
Without Project																									
With Project																									
Number of Short-Term Emergency Camps in Project Area																									
Without Project																									
With Project																									
Inflationary Trend in Project Area																									
Without Project																									
With Project																									

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Categories I., II., III., deal with changes which occur within basic farm-livestock inputs groups. Category I, serves to identify the proportion of farmers which will utilize modern inputs following implementation of the project. Category II. pertains to the utilization of modern techniques on a per hectare basis for crops and/or a unit basis for improved livestock breeding, feeding, and health practices improvements in buildings used to house and service livestock are to be shown on a per head basis. Category III. relates to the percent change in utilization of new techniques thereby indicating the rate of improvement in the subject categories brought about by the project.

Categories IV., V., VI., VII., pertain to outputs which may be provided, or produced, by the project itself which go beyond specific inputs or practices utilized by individual farmers. Although these impacts are not direct producer inputs, they definitely affect the quantity and quality of the inputs he will use and hence, are relevant for assessing the degree of technological development in the project area.

Worksheet VIII.4 Improved Access to Farm Credit

An important element in agricultural activity in any environment is the amount of credit available to individual producers. Increasing the amount and the availability of credit is often a critical need in

developing rural areas and agricultural projects may deal with this problem exclusively, or contain a credit component as part of a package program. In either case, changes in the access to credit brought about by the project must be shown. Worksheet VIII.4 is designed to display the principal features of a credit program.

Worksheet VIII.4 is divided into two parts. The upper portion lists three parameters which can serve to indicate the extent of, (1) increased credit availability in total (Category I.), (2) the expected change in outstanding loan value by farm size (Category II.), and (3) the expected change in outstanding loan value by income class (Category III.). Categories II. and III. focus upon the incidence of improved access to credit as evidenced by loan value.

The lower portion of Worksheet VIII.4 provides space to record the financial terms associated with the project credit program. Again, the terms which will be in effect for participants with different incomes and size of operation are an important aspect of the credit provisions of the project. For each farm size, size of herd, and income level five characteristics of the loans provided are listed, viz., the source of the loans received, the average value of loans, the required collateral, the interest rate, and the repayment terms specified. Other financial information can be include as needed.

Attachment VIII - Improved Access to Farm Credit
Project _____

(1)

(2)

Years	Project Planning Period: Year from Present and Date																									
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
I. Change in Ratio of Farm Loans With Project																										
Loan Value																										
Per Cent																										
II. Change in Average Loan Value By Farm Size (Hr.)																										
Under 5 ac.																										
5 - 15 ac.																										
15 - 25 ac.																										
25 - 50 ac.																										
51 - 100 ac.																										
Over 100 ac.																										
III. Change in Average Loan Value By Income Class (Hr./yr.)																										
0 - 2499																										
2500 - 7199																										
7200 - 9999																										
Over 10,000																										
IV. Lending Terms/ Beneficiary																										
a. Farm Size																										
Under 5 ac.																										
5 - 15 ac.																										
15 - 25 ac.																										
25 - 50 ac.																										
51 - 100 ac.																										
Over 100 ac.																										
b. Size of Farms																										
1 - 1000																										
1000 - 10000																										
10000 - 100000																										
Over 100000																										
c. Income Class (Hr./yr.)																										
0 - 2499																										
2500 - 7199																										
7200 - 9999																										
Over 10,000																										

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Article III, 4 Improved Access to Farm Credit (Cont.)
 Project _____

(1)

(2)

Item	Project Planning Period: 1 Year																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Change in Total of Farm Loans With Project																										
Loan Value																										
Per Cent																										
II. Change in Average Loan Value By Farm Size (Ha.)																										
Under 5 ha.																										
5- 15 ha.																										
16- 25 ha.																										
26- 50 ha.																										
51- 100 ha.																										
Over 100 ha.																										
III. Change in Average Loan Value By Income Class(\$/yr.)																										
0 - 2499																										
2500- 7199																										
7200- 9999																										
Over 10,000																										

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Worksheet VIII.5 Improved Capacity of Marketing and Distribution

System

Agricultural development is frequently highly dependent upon infrastructure as well as increased productive efficiency as measured by physical yields per hectare or per head of livestock. Thus, the capacity of the marketing and distribution system within an area can either enhance the ability of the area to move its products into the mainstream of commercial activity, or it can act as a bottleneck. In the latter case, no matter how great the productive potential at the farm level, overall productivity will remain low because commodities simply will not be produced on a scale exceeding local demand. A key element in project design is an assessment of the ability of the marketing system to provide necessary inputs when needed and to store or market outputs as they are produced.

Several characteristics of an agricultural area have been listed in Column (1) of Worksheet VIII.5. Each of them relate to the extent to which a system exists to service the project. Items I., III., IV., V., specifically deal with the capacity of that system to store and transport commodities. Item II. summarizes information reflecting the degree of commercial organization which will exist, and items VI. and VII. indicate the extent to which project area output is destined for other than home consumption.

(11)

Item	Project Planning Period: 1 Year (from year 10 to year 16)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
I. Project Area - water heads (Parallel)																
All-Weather/All-Vehicle																
Total Kilometers																
Improvement																
Restricted																
Total Kilometers																
Improvement																
II. Agricultural Operations																
Number																
Improvement																
Participation Rate																
Farm Size																
Under 5 ha.																
5 - 15 ha.																
15 - 25 ha.																
25 - 50 ha.																
50 - 100 ha.																
Over 100 ha.																
Income (US\$ 1000/yr.)																
0-199																
200-499																
500-999																
1000-9999																
Over 10,000																
III. Storage and Transport Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
IV. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
V. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
VI. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
VII. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
VIII. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
IX. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
X. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																
XI. Storage Capacity																
Per ha.																
Per hectare 1000/ha/yr.																

Project Planning Period: Year from Present and Date

(1)

(2)

Item	Project Planning Period: Year from Present and Date																								
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
I. Project Area leader Roads (Per. II)																									
All-Weather/III-Vehicles																									
Total Kilometers																									
Increases																									
Routinized																									
Total Kilometers																									
Increases																									
II. Agricultural Cooperatives																									
Number																									
Increases																									
Participation Rate																									
Farm Size																									
Under 5 ha.																									
10 - 25 ha.																									
15 - 75 ha.																									
26 - 50 ha.																									
51 - 100 ha.																									
Over 100 ha.																									
Income class (M. r.)																									
0-299																									
300-749																									
750-1199																									
Over 1200																									
Total Income and Transport Capacity																									
Per ha.																									
Per head of livestock																									
IV. Storage Capacity																									
Per ha.																									
Per head of livestock																									
V. Processing Capacity																									
Per ha.																									
Per head of livestock																									
VI. Substations Areas																									
Number																									
Increases																									
VII. Total of Project Area Capital																									
Per ha.																									
Per head of livestock																									

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Worksheet VIII.6 Increased Productive Efficiency

A key element in economic development is the efficiency with which output is produced relative to inputs. Although total output of a country, or region, or sector, may be very high, if the resources required to produce it are also very large little or no economic gain may result.

Worksheet VIII.6 provides space to record important input-output relationships for the project. Items I. and III. as indicated refer to the physical yield per unit of selected inputs. These relationships indicate the efficiency of farm labor, the rural population, land, and/or animal units within the project. Items III. and IV., are aggregate measures of the efficiency of the agricultural sector as it is expected to be due to the project.^{1/} Small projects may have negligible effects upon the parameters of III. and IV.

Worksheet VIII.7 Regional Growth Parameters

Regional growth is very frequently taken to be an objective of public policy and has specific relevance as a goal for agricultural development project. Without going into detail about the relationship between regional growth, agricultural projects and social welfare, let

^{1/} Note that the efficiency of capital and other monetary resources committed to the project have been measured in Chapters VI. and VII. of this manual which deal with financial and economic feasibility.

Worksheet VIII.6 Increased Productive Efficiency

Project _____

(2)

Item	Project Planning Period : Year from Present and Date																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
1. Yield in project area																									
per farmer																									
per capita																									
per ha.																									
per head of livestock																									
2. Increase in output yield in Project Area																									
per farmer																									
per capita																									
per ha.																									
per head of livestock																									
3. Share of National population devoted to Primary Agricultural Production																									
without project																									
with project																									
4. Proportion of Agricultural Exports to Total Exports																									
without project																									
with project																									

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WORKSHEET VIII.6 Increased Productive Efficiency (Cont')

Project _____

(1)

(2)

Item	Project Planning Period : Year from Present and Date																									
	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	
I. Output Yield in project area																										
Per farmer																										
Per capital																										
Per ha.																										
Per head of livestock																										
II. Increase in Output Yield in Project Area																										
Per farmer																										
Per capita																										
Per ha.																										
Per head of livestock																										
III. Share of National Population Devoted to Primary Agricultural Production																										
Without Project																										
With Project																										
IV. Proportion of Agricultural Exports to Total Exports																										
Without Project																										
With Project																										

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it suffice to state here that a project may stimulate a host of changes within an area which ultimately can improve the welfare of those affected.

The kinds of changes which can occur are numerous and often difficult to identify with a great degree of precision. Moreover, the connection between many changes and personnel income, for example, of the poor may be difficult to trace. Nevertheless, to the extent a project influences the regional economic system the impacts should be noted. Worksheet VIII.7 is thus designed to facilitate identification of project impacts which occur at the regional level and which indicate its level of economic development. Other impact categories may be utilized as needed.

E. Cost-Minimization and Cost-Effectiveness Analysis

1. Discussion

In addition to those impacts which may be measured as outlined above, there are often project consequences which do not lend themselves to such quantification. One class of these latter affects involve quality of life considerations such as improvements in education, health and nutrition, housing, etc., for which it may not be possible to calculate benefits and costs in commensurable terms. Other project impacts may be of such a nature that while project benefits may be expressed in economic terms, a comparison between such values and pro-

ject costs may not present meaningful information for decision-making purposes. In cases of these kinds, two approaches to preparing helpful information may be followed, viz., cost-minimization and cost-effective studies.

Cost-minimization analysis is appropriate where a clearly defined objective has been identified as justifying the efforts of the public sector to provide it. The approach then involves a search among all possible ways of achieving the objective to find the least costly alternative. Cost-effectiveness studies, on the other hand, involve enumeration of ends which can be achieved with given outlays of funds. A cost-effectiveness analysis would therefore, seek to achieve the most from given investment levels while cost-minimization seeks to achieve given ends from the smallest investment budget. Both approaches will provide useful informations which can support the proposed project providing the nature of the project, or parts thereof, require the use of these methods.

Worksheets which will facilitate preparation of both cost effectiveness and cost-minimization studies can be adapted from the several cost and return worksheets described in preceding sections of this manual. For example, if one were to conduct a cost-minimization analysis the first step would be to describe clearly the objectives which are sought and develop alternative procedures (projects or parts of projects)

which reach those ends. Next the analyst must "cost-out" each alternative to determine which is the least costly choice. All of the previous worksheets which were used to assemble cost data may again be utilized, including the feasibility worksheets of Chapters III., IV., VI. and VII. which are relevant. A simple summary table can then be prepared listing the investment alternatives and their respective costs. From this it should be possible to identify the choice which satisfies the least cost requirement.

A cost-effectiveness study would use the same cost data worksheets as above; however, here the process would operate more or less in the opposite way, viz., alternatives would be specified, then costed-out to eliminate those that over extend the pre-set budget. When a group of projects has been identified as acceptable in terms of their cost, the next step is to calculate the output or gains which each produces. At this point the analyst must then utilize the "return" side of the appropriate worksheets previously prepared. Once the array of impacts have been determined, by inspection and given agreement as to the relative importance of differing impacts, it should be possible to select the alternative course of action which is most desirable.

In terms of data utilization cost-minimization is less demanding than cost-effectiveness. The latter eventually requires preparation of both input costs and output gains. In this regard cost effectiveness

is very similar to normal feasibility analysis except that initial screening on the basis of project costs will eliminate many alternatives and hence will reduce the number of "return" calculations which may be required in order to make a decision. Note that "returns" in cost effectiveness will not necessarily, if at all, be the same as those specified in previous sections, i.e., the economic, financial and social political data however, some of these project impacts may also be specified as necessary data in even cost-effectiveness studies.

2. Analysis

Since all of the worksheets for preparing basic cost return information have been reviewed in previous sections, no special worksheets for that purpose are presented here. Worksheet VIII.8 however provides space for a simple listing by cost of project alternatives which meet the specified objective as outlined in a cost minimization problem. VIII.9 on the other hand can be used to compare alternatives in a cost effectiveness study. It will be noted that no effectiveness parameters are listed in Worksheet VIII.8. The reason is that there are numerous possibilities and each situation will call for its own set of indices. Both worksheets may be utilized to set up a ranking of alternatives on the basis of preferred objectives viz., either minimization of cost or maximization of the (constrained) ends desired. In Worksheet VIII.8 the ranking is done through a vertical listing of

projects in descending order of preferrability (i.e., in increasing order of cost). In Worksheet VIII.9 the ranking is horizontally for each project output.

C. Sensitivity Analysis

1. Discussion

We have said that the basic purpose of project feasibility analysis is to assemble data about alternatives so that we may decide which among them, if any, are worthy of implementation. Up to this point, the procedures outlined have implicitly assumed that the data utilized in making a project analysis were accurate and sufficiently precise to adequately portray various project impacts. The fact of the matter is, however, that we cannot be entirely sure that the data is correct, or that serious errors in estimation have not crept into our analysis. Since we are forced to make judgements or assumptions about future events which we cannot forsee with perfect certainty, the problems of data validity are very real and must be recognized in project feasibility work.

Sensitivity analysis is a series of recalculations of project impacts using alternative data. It is a methodical approach to the testing of the stability of project indices (e.g., internal rate of return) to

data subject to risk and uncertainty.^{2/} If project feasibility is not sensitive to large errors in the data, or to data which exhibits great variability in unpredictable ways, then we can be reasonably sure that no matter what happens in the future the project will still be worthwhile.^{3/} On the other hand, if feasibility is shown to be greatly dependent upon single valued estimates or upon data that must not vary beyond very narrow ranges, then we must be much more cautious about carrying out the proposed investment. In the latter case much closer examination of the original data is in order before a final decision is to be made. Because of this situation, all projects should be subjected to a sensitivity analysis.

In designing a project numerous assumptions will be made which affect project results. For example, assumptions will typically be made to the effect that:

- 1) Project management involving a prescribed level of training and skill will be provided as needed
- 2) Project participants will react in a prescribed way

..... via-a-via incentives

^{2/} In conventional usage, risk is defined as variability associated with a known (estimated) probability of occurrence. Whenever variations in data can be described in terms of a probability such as with floods or storms, the resulting cost or gain can be given an average annual expected value and recorded directly as part of project costs or income. Thus, sensitivity analysis refers primarily to those occurrences for which no probability can be assigned, hence, no expected value can be computed and no cost or gain item can be included. These latter are uncertainty effects and must be handled through iterative procedures.

^{3/} Sensitivity testing can reveal however that the relative desirability of a project (i.e., its rank compared to other project choices) may change significantly due to small changes in forecast data input.

- 3) The required inputs will be available as needed
- 4) Input prices will be as forecasted
- 5) The input/output relationships will hold throughout the life of the project as forecasted
- 6) Output price will be as expected.

Many other assumptions may be necessary as well. Within each there may be various sub-assumptions, e.g., yield relationships are usually based upon the expectation that no new plant diseases will develop, and that precipitation, temperature, and general growing conditions will remain "normal". Each of these affect project outcome.

The general rule in sensitivity analysis is to test all variable factors which could affect the outcome of the project. Four main classes of uncertainty exist:

- 1) Prices of inputs and outputs
- 2) Input/output ratios
- 3) Capital Investment and Cost Overruns
- 4) Timing of implementation, construction and completion

A key decision variable often tested is the discount rate chosen.

2. Analysis

The usual procedure in a sensitivity test is to vary each class of data by small amounts and examine the effect of each change upon project indices. For example, input prices may be varied by 5 per cent,

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10 per cent, 15 per cent, plus and minus, and the internal rate of return, present net worth and other indices recalculated at each change. Combinations of variable factors should be tested also. Moreover, the analyst should look at these effects upon as many of the project indices as is practical. Ideally, they all should be recalculated, however, time and other limited resources may force the sensitivity analysis to include only some of the main indices. Care should be exercised to insure that only realistic values are included in the analysis since the time and effort involved is substantial if a thorough test is to be performed. It serves little purpose to arbitrarily "range" all values over say plus or minus 75 per cent if informed judgement would tell us that a 20 per cent fluctuation is the maximum possibility.

The large number of recalculations which ideally should be performed (at a minimum one for each project index) can be facilitated through the use of modern high speed electronic computers. Computer programs can be written for such equipment whereby a complete sensitivity analysis on a variable can be carried out by changing just one data input card. The savings in time and effort, the usefulness of results obtained, and the relatively low cost for computarization of the entire project feasibility process indicate that every effort be made to prepare the necessary computer routines. Lacking that, however, the work must be performed "by hand".

Worksheets for preparing sensitivity analysis are not presented here. The form for such worksheets will be identical to those already prepared. The analysis will involve first deciding which factors are going to be varied, and by how much, and then going back to the tables wherein the original values first appeared, and reworking them. New sheets may be set up showing just the changes, and new summary tables completed. Once the reworked values have been integrated with the unchanged data and new totals obtained the feasibility indices may be redone. In some cases, the worksheets for feasibility tests can accommodate changes directly, e.g., variations in capital outlay or annual costs by a flat percentage. Note that sensitivity to the discount rate chosen has already been completed in Chapters VI. and VII. through the use of an array of rates; however a display of results (i.e., new indices) must be included again here in order to present a complete picture of the sensitivity of project impacts to data uncertainty.

D. Project Authorization, Implementation and Operation, Progress Reporting

1. Discussion

Appraisal of the official project authorization and support documentation from participating groups (viz., governmental agencies, provincial organizations, farmers, and foreign assistance donor bodies), and the managerial aspects of the project plan is necessary to be certain that its administrative structure, the staffing and manpower requirements, and the implementation/operation schedules are adequate. The

appraisal should look closely at the project plan as it relates to what is to be done, when is it to be done, where it is to be done, and who is to do it. The preparation of material for this section, therefore, involves verification that inter and intra-departmental cooperation has been achieved, that coordinated planning of activities has been carried out, that efficient methods have been set up for project implementation and operation, and that a project review mechanism has been established.

The organizational questions surrounding project planning are often the most difficult ones. Yet they are critical factors which can determine the success or failure of a project. No matter how well the proposal has been designed in terms of its technical aspects if the organizational planning is poor the project will not meet expectations. The material of this section identifies key information which must be assembled in order to verify that sound organizational planning has been followed.

All of the material called for here will have been prepared at one stage or another during the project formulation phase of project design. The need here is to pull the organizational information together in one place where it can readily be examined. To the extent that project formulation has not covered issues raised in this section, a feedback effect can operate so that the analyst can go back to the project formation step and build in the required planning.

2. Project Authorization

With respect to the legal and statutory basis of the project the analyst should prepare narrative material relating to the following questions:

- a. What is the legislative basis for implementation of the project? What inter and intra-agency protocols are necessary and have been secured?
- b. What will be the coordinating and policy making authority? Who will adjudicate disputes?
- c. How is the Government to be represented?
- d. Is foreign assistance required, and if so have the necessary commitments been received?
- e. Have necessary official authorizations and commitments at local and provincial levels been received?

3. Management Plans for Implementation and Operation Phase

A key part of project planning is the preparation of a schedule for the implementation of the project and its operation and maintenance following completion of the planning stage. A critical element in the success of any project for both the implementation and operational stages is timely coordination of all activities which need to be carried out. Project documentation therefore should set forth the proposed implementation and management plan making explicit the organizational system to be followed in achieving the necessary coordination of action among participants through time. In order to convey the information needed the following items need to be covered:

- a. A list identifying all agencies and groups participating in the project during its implementation and operational stages.
- b. Identification of the individual or group responsible for the coordination of project activity during the implementation and operational stages of the project and the procedure to be followed to insure that such coordination is successfully carried out according to the relevant schedules. Included in this documentation should be a description of the coordination staff needed, the specific jobs of each individual involved, and the lines of responsibility of the coordinating staff.
- c. The time schedule for implementation outlining the necessary timing of all inputs, the identity of the groups or agencies involved at each stage, the specific functions of each group, and the necessary coordination of action between participants.
- d. A summary of the role, responsibility, activities and training needs of each participant group, together with an organizational chart setting forth the functions of the various groups, and the interrelationships between them.
- e. A separate schedule should be presented summarizing the physical requirements and the timing of necessary project inputs as well as the agency or group responsible for each item and how they will be obtained.
- f. A schedule should be presented setting forth the timing of all procurement and disbursement of funds and the sources of financing for project expenditures.
- g. The relevant maintenance, repair, and replacement schedules.

Programming the implementation and operation of projects typically involves controlling and coordinating a large number of activities. This work, more specifically, involves planning the tasks required to produce project output, scheduling what is to be done, and controlling the work as it is carried out. For problems of this sort "network

planning" techniques such as Critical Path Analysis (C.P.A.) and Program Evaluation and Review Technique (PERT) can be very helpful to the project planner, Network flow diagrams and charts can also be used to prepare summary material relating to the implementation and operation schedules suitable for use in this section of the feasibility analysis. References are given to those who desire a detailed explanation of the methodology of network design.

4. Project Reviews and Progress Reporting

The final section relating to project feasibility analysis should identify the formal review and evaluation process which will be followed. The implementation and operations schedules (above) have identified what will be done, by whom, and when. The objective of the review and progress evaluation is to check actual performance against the relevant schedules, to identify bottlenecks and other factors which may be impeding progress, and to suggest new schedules and/or organizational-operational methods.

In order to accomplish this objective the evaluation process must be clearly specified in terms of who is responsible for the review, to whom do reviewers report, and how often and by what methods are the reviews to be carried out. Reviews should be frequent enough to bring to light problems as quickly as possible, yet not too often to impede progress themselves. Therefore, there should be prepared

the proposed schedule for periodic review of project progress, the methods to be followed in formal interim reporting, and the individuals or groups to be involved in review procedures. Whenever project alternatives are mutually exclusive, the relationship should be pointed out and the effect upon the ranking should be noted.

E. Comparison of Alternatives

1. Discussion

In the previous sections methods of analyzing individual project proposals have been outlined. In order to select an investment program involving several projects it is necessary to compare the various possibilities on the basis of the qualitative and/or quantitative indices which are relevant for each one.

2. Analysis

Whenever a given project proposal is a part of an agencies investment program, each project should be ranked in order of preference by economic, financial, and political-social criteria as outlined in the appropriate sections above.^{4/} The format for such a ranking should be a display listing the various criteria to be utilized, the projects making up the proposed investment program, and the rank of each project vis-a-vis each criteria. Worksheet VIII.10 is one format for such a display.

^{4/} In order for such a comparison to have meaning each project must be based upon the same basic assumptions and input/output data. For example, consistency requires that the discount rates utilized for the various alternatives be the same. Similarly, input-output prices, and technological relationships must be uniform.

Whenever project alternatives are mutually exclusive, the relationship should be pointed out and the affect upon the rankings noted if one or another choice.among them is made.

Worksheet VIII.10 Comparison of Alternative Projects

Project _____

Project/Impact Parameter	Alternative projects																							
	1		2		3		4		5		6		7		8		9		10		11		12	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
Capital Output Ratio																								
Capital Cost Ratio																								
Present Net Worth																								
Internal Rate of Return																								
Return to Skilled Manpower																								
Foreign Exchange/Domestic Currency Ratio																								
Foreign Exchange Savings																								
Payback Period																								
Increased Employment																								
Class I																								
Class II																								
Class III																								
Class IV																								
Increased Income																								
Class I																								
Class II																								
Class III																								
Class IV																								
Increased Output Yield																								
Per farmer																								
Per capita																								
Per Ha.																								
Per head																								

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APPENDIX A

**ILLUSTRATION DATA
FOR
AREA PROFILE**

CENTRAL ANATOLIA PROJECTSOCIAL INDICATORSMICROFILMED FROM BEST
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<u>Item</u>	<u>Cankiri</u>	<u>Corum</u>	<u>National</u>
(a) <u>Numbers of doctors, pharmacies, hospital beds</u>			
Doctors	16	38	
Hospital beds	265	565	
Pharmacies			
- Dispensary	1	3	
- Chemist shop	4	12	
- Doctors selling medicine	6	8	
(Data refer to 1969)			
(b) <u>Literacy rate</u> (percentage of population over 6 years)			
Urban	62	57	67
(Male)	(76)	(72)	(79)
(Female)	(47)	(40)	(52)
Rural	35	28	39
(Male)	(51)	(42)	(55)
(Female)	(22)	(16)	(23)
(Data refer to 1965)			
(c) <u>Village electrification</u>			
With electricity	1	9	
Without electricity	481	739	
(Data refer to 1969)			
(d) <u>Village water supplies</u>			
Modern units	434	515	
Insufficient	326	756	
None	214	21	
(Data refer to 1969)			
(e) <u>Transportation</u>			
Cars	110	250	
Buses	69	116	
Trucks	366	686	
Km ² /km road	22	18	
Population/km road	618	679	
Population/transport unit	460	462	
(Data refer to 1965)			

SOCIAL INDICATORS
(cont.)

	<u>Gankiri</u>	<u>Corum</u>
(f) <u>Banks and post offices</u>		
<u>Post offices (1968)</u>		
Main	9	10
Branch	3	5
Agency	3	9
Stamp sellers	10	11
Telephones - Office -	170	489
- Home -	284	803
<u>Bank offices (1970)</u>		
Commercial banks	5	12
Sekerbank	1	-
Agricultural bank	10	9
Agricultural credit cooperatives	17	52

Sources: (n) - (e) Ministry of Reconstruction and Development
(f) Various

CENTRAL ANATOLIA PROJECTINCOME IN AGRICULTURE

	<u>Çankiri</u>	<u>Çorum</u>
Value of agricultural production (TL) ^{1/}	195,000,000	129,000,000
Agricultural area (ha)	173,000	331,000
Number of workers in agriculture	106,000	200,000
Agricultural production/worker (TL)	1,840	2,141
Hectares/worker	1.6	1.7
Agricultural production/ha (TL)	1,130	1,285

YATIRIM VE EKONOMİK GELİŞTİRME BAKANLIĞI
 İÇİŞİLERİ BAKANLIĞI

^{1/} Source: Ministry of Reconstruction and Development

CENTRAL ANATOLIA PROJECT

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CANKIRI AND CORUM: POPULATION (1970)

<u>Province and County</u>	<u>Urban</u>		<u>Rural</u>		<u>Total</u>	<u>Growth Rates (%)</u>		
	<u>No</u>	<u>(000)</u>	<u>%</u>	<u>No</u>		<u>(000)</u>	<u>Urban</u>	<u>Rural</u>
Cankiri- Centre	26.5		37	44.2	63	70.7	2.8	1.2
Cerkes	5.1		21	19.5	79	24.6	0.4	0.2
Eldivan	3.4		34	6.5	66	9.9	1.9	0.9
Eskipazar	2.4		11	19.4	89	21.8	5.0	2.0
Ilgaz	2.9		11	23.7	89	26.6	3.3	0.4
Kursunlu	5.0		13	34.6	87	39.6	2.4	0.4
Orta	3.0		12	21.9	88	24.9	1.4	0.6
Ovacik	0.9		8	9.5	92	10.4	4.6	-0.7
Sabanozu	2.5		15	13.8	85	16.3	1.2	0.4
Yaprakli	2.8		15	15.9	85	18.7	4.0	1.2
(Sub-Total)	<u>54.4</u>		<u>21</u>	<u>209.1</u>	<u>79</u>	<u>263.5</u>	<u>2.5</u>	<u>0.6</u>
Corum- Centre	55.9		38	89.6	62	145.5	4.4	1.3
Alaca	9.7		17	46.9	83	56.7	5.3	1.1
Bayat	4.2		15	23.5	85	27.7	3.5	2.4
Iskilip	16.3		24	51.3	76	67.5	1.5	1.6
Kargi	4.3		13	27.8	87	32.1	2.8	1.3
Mecitozu	5.6		16	30.0	84	35.7	1.8	1.6
Ortakoy	2.6		24	8.4	76	11.0	2.3	1.8
Osmancik	10.1		19	43.7	81	53.8	3.8	2.2
Sungurlu	17.2		19	74.0	81	91.2	4.7	1.5
(Sub-Total)	<u>126.0</u>		<u>24</u>	<u>395.3</u>	<u>76</u>	<u>521.3</u>	<u>3.5</u>	<u>1.5</u>
TOTAL	180.4		23	604.4	77	784.8		

CENTRAL ANATOLIA PROJECT

WORKING POPULATION (OVER 15) BY ECONOMIC ACTIVITY

<u>Sector</u>	<u>Cankiri</u>			<u>Corum</u>			<u>Both Provinces</u>			<u>Proportion</u> %
	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	<u>Male</u>	<u>Female</u>	<u>Total</u>	
Agriculture Forestry Fishing	48.8	57.3	106.1	97.5	102.5	200.0	146.3	159.3	306.1	59
Extraction industry (Mining etc.)	0.1	-	0.1	1.5	-	1.5	1.6	-	1.6	-
Manufacturing	2.4	0.1	2.5	6.4	0.1	6.5	8.8	0.2	9.0	3
Construction	1.2	-	1.2	2.9	-	2.9	4.1	-	4.1	1
Public Services	0.1	-	0.1	0.1	-	0.1	0.2	-	0.2	-
Commerce, Banking	1.2	-	1.2	3.0	-	3.0	4.2	-	4.2	2
Transportation	1.7	-	1.7	2.0	-	2.0	3.7	-	3.7	1
General Services	3.6	0.3	3.9	6.7	0.5	7.2	10.3	0.9	11.1	3
Miscellaneous	2.0	0.1	2.1	3.2	0.4	3.6	5.2	0.5	5.7	2
TOTAL WORKING	61.1	57.9	118.9	123.2	103.5	226.7	184.3	161.4	345.7	100

Date: 1965
Source: Ministry of Agriculture Project Brief

Note: Totals may not tally due to rounding.

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POPULATION GROWTH (000)

<u>Year</u>	<u>Cankiri</u>			<u>Corum</u>			<u>Total</u>		
	<u>Urban</u>	<u>Rural</u>	<u>Total</u>	<u>Urban</u>	<u>Rural</u>	<u>Total</u>	<u>Urban</u>	<u>Rural</u>	<u>Total</u>
1955	28.3	199.8	228.1	63.0	338.6	401.6	91.3	338.1	629.7
1960	38.5	203.0	241.5	83.9	362.5	446.4	112.4	345.5	697.8
1965	44.0	206.0	250.0	98.4	387.3	485.7	142.4	333.1	818.8
1970	54.4	209.1	263.5	126.0	395.3	521.3	150.4	351.1	872.8

Source: Ministry of Agriculture Project Brief

CENTRAL ANATOLIA PROJECT

LAND UNDER INDIVIDUAL OWNERSHIP, CLASSIFIED BY FARM SIZE

<u>Item</u>		<u>Size of Farm</u>				<u>All Farms</u>
		<u>0-5 ha</u>	<u>5.1-10 ha</u>	<u>10.1-20 ha</u>	<u>Over 20.1 ha</u>	
<u>1. Number of farm units</u>						
<u>by size of farm</u>						
Cankiri	(No)(000)	27.8	4.5	1.6	0.5	34.4
	(% of total)	81	13	5	1	100
Corum	(No)(000)	37.2	10.9	5.3	1.6	55.0
	(% of total)	67	20	10	3	100
Both Provinces	(No)(000)	65.0	15.4	6.9	2.1	89.4
	(% of total)	73	17	8	2	100
<u>2. Area of land on farm units</u>						
<u>by size of farm</u>						
Cankiri	(000ha)	54.1	31.8	21.6	14.2	121.7
	(% of total)	44	26	18	12	100
Corum	(000 ha)	73.8	77.6	73.1	52.1	276.6
	(% of total)	27	28	26	19	100
Both Provinces	(000 ha)	127.9	109.4	94.7	66.3	398.3
	(%of total)	32	27	24	17	100

Date: 1960

Source: Ministry of Agriculture Project Brief

CENTRAL ANATOLIA PROJECT

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CANKIRI AND CORUM

AREA UNDER CULTIVATION ANNUALLY (000 ha)

<u>Crop</u>	<u>1961</u>			<u>1965</u>			<u>1970</u>			<u>Change (1961-70)</u>
	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	
1. Cereals										
Wheat	72.1	185.7	257.8	72.4	203.9	276.3	87.3	211.7	299.0	+ 41.2
Barley	42.7	115.4	158.1	58.7	87.9	146.6	46.6	86.8	133.4	- 24.7
Maize	1.3	1.2	2.5	1.4	1.2	2.6	1.5	0.5	2.0	- 0.5
Rice	0.8	4.0	4.8	1.0	4.9	5.9	0.6	5.1	5.7	+ 0.9
Other	-	9.4	9.4	4.9	10.4	15.3	2.0	4.2	6.2	- 3.2
Sub-Total	116.9	315.7	432.6	138.4	308.3	446.7	138.0	308.3	446.3	+ 13.7
2. Legumes										
Peas, Beans, lentils	3.1	3.4	6.5	3.8	4.7	8.5	4.3	4.5	8.8	+ 2.3
Vetches	18.9	4.1	23.0	18.1	4.0	22.1	18.2	1.0	19.2	- 3.9
Sub-Total	22.0	7.5	29.5	21.9	8.7	30.6	22.5	5.5	28.0	- 1.5
3. Industrial Crop										
Potatoes	4.1	1.3	5.4	4.8	1.3	6.1	5.4	1.6	7.0	+ 1.6
Beets	-	1.9	1.9	0.6	3.0	3.6	0.6	2.7	3.3	+ 1.4
Onion + garlic	0.3	0.7	1.0	0.4	0.9	1.3	0.5	1.2	1.7	+ 0.7
Sunflower	-	-	-	-	0.1	0.1	-	2.2	2.2	+ 2.2
Others	-	1.7	1.7	-	1.8	1.8	-	1.8	1.8	+ 0.1
Sub-Total	4.4	5.6	10.0	5.8	7.1	12.9	6.5	9.5	16.0	+ 6.0
4. Soft fruit and vegs	1.9	1.1	3.0	1.6	0.7	2.3	2.8	2.8	5.6	+ 2.6
5. Grapes	3.5	9.3	12.8	3.3	6.9	10.2	3.4	10.8	14.2	+ 1.4
TOTAL	148.7	339.2	487.9	171.0	331.7	502.7	173.2	336.9	510.1	+ 22.2

NOTE: Totals may not tally due to rounding.

Source: State Institute of Statistics Annual Crop Production Statistics

CENTRAL ANATOLIA PROJECT
CANKIRI AND CORUM
ANNUAL CROP PRODUCTION (000 tons)

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<u>Group</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>
1. <u>Cereals</u>									
Wheat	36.0	324.7	360.7	64.4	251.1	315.5	95.0	211.9	306.9
Barley	25.3	208.0	233.3	47.4	132.5	179.9	46.9	120.6	167.5
Maize	2.0	2.3	4.3	1.7	1.3	3.0	1.8	1.0	2.8
Rice	3.0	11.0	14.0	4.3	11.5	18.8	1.8	10.1	11.9
Other	-	11.4	11.4	3.2	9.5	12.7	1.6	4.6	6.2
Sub-Total	66.3	560.4	626.7	121.0	408.9	529.9	147.1	351.2	498.3
2. <u>Legumes</u>									
Peas, beans, lentils	2.8	4.9	7.7	3.3	4.8	8.1	4.3	4.8	9.1
Vetches	9.4	5.4	14.8	14.7	7.6	22.3	19.6	0.9	20.5
Sub-Total	12.2	10.3	22.5	18.0	12.4	30.4	23.9	5.7	29.6
3. <u>Industrial Crops</u>									
Potatoes	4.1	13.5	17.6	18.1	13.9	32.0	26.0	20.3	46.3
Beets	-	63.8	63.8	14.2	85.4	99.6	15.2	100.1	115.3
Onion + garlic	0.9	4.4	5.3	0.7	6.1	6.8	1.1	11.1	12.2
Sunflower	-	-	-	-	0.2	0.2	-	2.1	2.1
Others	-	3.7	3.7	-	3.6	3.6	-	3.7	3.7
Sub-Total	5.0	85.4	90.4	33.0	109.2	142.2	42.3	137.3	179.6
4. <u>Soft fruit and vegs</u>	18.9	21.9	40.8	20.6	12.3	32.3	n.a.	n.a.	n.a.
Grapes and other fruits	20.1	49.1	79.2	20.4	125.1	145.5	26.9	55.0	81.9

Note: Totals may not tally due to rounding.

Source: State Institute of Statistics: Annual Crop Production Statistics

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CENTRAL ANATOLIA PROJECT
CANKIRI AND CORUM
CROP YIELDS (tons/ha)

Crop	<u>1961</u>		<u>1965</u>		<u>1970</u>		<u>5-Year Ave.</u> <u>(1955-70)</u>		<u>Range</u> <u>(1955-70)</u>	
	<u>Cankiri</u>	<u>Corum</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Cankiri</u>	<u>Corum</u>
1. Cereals										
Wheat	0.5	1.7	0.9	1.2	1.1	1.0	1.0	1.3	0.8-1.1	1.0-2.0
Barley	0.6	1.8	0.8	1.5	1.0	1.4	1.0	1.5	0.8-1.1	1.3-2.0
Maize	1.5	1.9	1.2	1.0	1.2	2.0	1.2	1.6	0.9-1.3	1.1-2.0
Rice	3.7	2.8	4.3	2.8	3.0	2.0	3.6	2.5	1.4-4.7	2.0-3.1
2. Legumes										
Kidney beans	1.0	1.6	1.1	1.2	1.1	1.2	1.0	1.2	0.9-1.1	1.0-1.5
Lentils	0.8	(0.8)	0.7	(0.8)	0.7	0.8	0.7	0.9	0.6-0.8	0.8-1.0
3. Industrial Crops										
Potatoes	1.0	10.0	3.8	10.4	4.8	13.0	5.1	14.1	3.7-4.8	13.0-15.0
Sugar beet	-	33.3	22.0	28.5	23.9	37.3	26.4	39.1	23.3-31.6	33.2-35.4
Onion	4.0	7.0	2.5	8.0	3.9	9.0	3.1	10.2	2.4-3.9	5.1-12.2
Garlic	3.0	3.0	1.3	2.0	1.5	8.5	1.3	8.5	1.2-1.4	3.1-3.5
Sunflower	-	1.0	-	3.0	-	0.9	-	1.2	-	1.2-1.4

Source: State Institute of Statistics:

Annual Crop Production Statistics

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CENTRAL ANATOLIA PROJECT

A - 10

CANKIRI AND CORUM

LIVESTOCK NUMBERS (000 head)

<u>Type of stock</u>	<u>1961</u>			<u>1965</u>			<u>1970</u>			<u>Change</u>
	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>	<u>1961-70</u>
Sheep	330.5	433.2	763.7	326.1	433.8	756.9	420.2	434.4	854.6	+ 90.9
Goats Ordinary	7.6	302.3	309.9	7.4	303.8	311.2	5.3	260.9	266.2	- 43.7
- Angora	351.5	251.3	602.8	388.3	252.1	640.4	274.3	205.6	480.9	-121.9
Cattle	162.5	279.1	441.6	165.7	278.2	443.9	178.2	229.4	407.6	- 34.0
Horses	14.2	18.4	32.6	14.5	19.0	33.5	18.4	16.4	34.8	+ 2.2
Buffalo	23.2	55.2	78.4	24.6	63.8	88.4	28.9	55.1	84.0	+ 5.6

Source: Ministry of Agriculture Project Brief

CENTRAL ANATOLIA PROJECT

A - 11

TRACTOR NUMBERS BY SIZE AND DISTRICT (1965 & 1970)

<u>District</u>	(<u>Under</u> <u>35 HP</u>)	<u>35-50</u> <u>HP</u>	<u>1965</u> <u>Over</u> <u>50 HP</u>	<u>UNIMOG</u>	<u>Total</u>	(<u>Under</u> <u>35 HP</u>)	<u>35-50</u> <u>HP</u>	<u>1970</u> <u>Over</u> <u>50 HP</u>	<u>UNIMOG</u>	<u>Total</u>
<u>Cankiri</u>										
Merkez	6	56	4	--	66	14	150	30	-	194
Cerkes	4	1	-	-	5	41	20	5	-	66
Eldivan	-	8	-	-	8	-	26	-	-	26
Eskisazur	-	9	1	-	10	-	60	-	-	60
Ilgas	9	-	-	-	9	4	40	1	-	45
Kursunlu	2	-	3	-	5	42	-	83	-	125
Orta	47	4	-	-	51	93	30	-	2	125
Oracik	-	-	-	-	-	1	7	2	-	10
Sabaczu	-	-	-	-	-	20	50	20	-	90
Yaprakli	4	-	-	-	4	-	15	1	-	16
TOTAL	72	78	8	-	158	215	398	142	2	757
<u>Corun</u>										
Merkez	160	50	50	-	260	86	280	118	-	454
Alaca	3	28	50	-	91	170	200	30	-	400
Bayat	12	4	-	1	17	4	40	15	1	60
Iskilip	26	26	-	2	54	35	153	43	2	233
Kargi	-	-	1	-	1	11	-	4	-	15
Mecitozu	58	8	-	-	66	160	25	-	-	185
Ortakoy	-	2	2	-	4	-	20	5	-	25
Ossancik	14	-	-	-	14	40	-	-	-	40
Sungurlu	90	43	22	-	155	100	215	100	-	415
TOTAL	363	171	125	3	662	605	913	315	3	1,857
GRAND TOTAL	435	249	133	3	820	821	1,311	457	5	2,614

Source: State Institute of Statistics (unpublished)

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CENTRAL ANATOLIA PROJECT

A - 12

BALANCE OF PRODUCTION, CONSUMPTION AND

EXPORT OF WHEAT AND POTATOES
('000 Tons)

Province: Year:	<u>1961</u>	<u>Cankiri</u> <u>1965</u>	<u>1970</u>	<u>1961</u>	<u>Corum</u> <u>1965</u>	<u>1970</u>
<u>Wheat</u>						
A. Production	36	64	95	325	251	215
B. Consumption ^{1/} (200 kg/capita)	48	50	53	89	97	104
C. Balance	-12	14	42	236	154	111
D. Purchase by TMO	-	-	0.5	-	-	3
E. Purchase by Private Sector for export ^{2/} outside province	-	14	41.5	236	154	108
<u>Potatoes</u>						
A. Production	4.1	18.1	26.0	13.5	13.9	20.3
B. Consumption ^{1/} (37 kg/capita)	8.9	9.3	9.8	16.5	18.0	19.3
C. Balance for export	-4.8	8.8	16.2	7.0	5.9	1.0

^{1/} Third Five Year Plan, 1972.

^{2/} Estimated by difference.

CENTRAL ANATOLIA PROJECT

CANKIRI AND CORUM

A - 13

AGRICULTURAL CREDIT

LOANS OUTSTANDING AT 31 DECEMBER 1971 (TL)

<u>Institution - Programme</u>	<u>Cankiri</u>	<u>Corum</u>	<u>Total</u>
<u>Agricultural Bank</u>			
(a) General agricultural loans	34 869 267	39 235 428	74 104 695
(b) Supervised credit 1/	534 308	-	534 308
(c) Other	-	111 436	111 436
Sub-Total	35 403 575	39 346 864	74 750 439
<u>Agricultural Credit Cooperatives</u>			
(a) Seeds	227 390	1 423 404	1 650 794
(b) Fertilizers	679 744	4 657 327	5 337 071
(c) Operating costs	18 156 166	39 954 107	58 110 273
Sub-Total	19 063 300	46 035 838	65 099 138
Sugar Bank	683 263	-	683 263
TOTAL	55 200 138	65 382 502	120 582 640

Source: Agricultural Bank

1/ Commenced in Cankiri in 1970 and Corum in 1972.

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CENTRAL ANATOLIA PROJECTREGIONAL VALUE ADDED

<u>Sector</u>	<u>Cankiri</u>		<u>Corum</u>		<u>Cankiri</u>		<u>Corum</u>	
	<u>Million TL</u>	<u>%</u>	<u>Million TL</u>	<u>%</u>	<u>TL per worker</u>			
Agriculture	195.3	64.7	428.7	66.1	1,840		2,144	
Mineral	0.2	0.1	5.2	0.8	2,103		3,504	
Industry	19.4	6.5	51.8	8.0	7,868		7,905	
Construction	6.8	2.3	14.5	2.2	5,743		5,026	
Electricity gas, water	0.9	0.3	0.7	0.1	15,512		5,514	
Trade	16.0	5.3	32.8	5.1)17,070		13,042	
Banks, insurance	5.1	1.7	6.6	1.0				
Transport	21.7	7.2	39.4	6.1	12,616		20,198	
Services	<u>36.2</u>	<u>12.0</u>	<u>68.6</u>	<u>10.6</u>	<u>7,184</u>		<u>8,400</u>	
Average per worker:					2,558		2,892	
Average per head of population					1,203		1,335	

NOTE: Data refer to 1965, valued at 1961 prices.

Source: Ministry of Reconstruction and Development.

CENTRAL ANATOLIA PROJECTINDUSTRIAL ACTIVITY

	<u>Cankiri</u>			<u>Corum</u>		
	<u>1960</u>	<u>1965</u>	<u>1967</u>	<u>1960</u>	<u>1965</u>	<u>1967</u>
Number of organized factories			4			14
Employment in organized industrial work	213	184	191	531	649	798
Value of industrial production (1000 TL)	1,415	2,767	1,358	8,692	18,152	17,305

Source: Ministry of Reconstruction and Development

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APPENDIX B
CRITERIA FOR SELECTION
OF
PROJECT AREA

Eight criterion describe in a general way parameters for various considerations given to all provinces. They are as follows (the other does not correspond to importance):

1. NEED - It would obviously be unwise to prepare a project for an area when there was no need. Questions to be asked should include: What is the income situation in the area (both the mean and distribution are important)? What are the other income earnings alternatives? How does the area compare with the rest of Turkey? What are the social conditions? How many people are involved?
2. OPPORTUNITIES - Questions to be asked should include: Do we have technical innovations which if applied, would earn a high rate of return? Are the farm and grazing units large enough to take economic advantage of those things which might be included in a project? Do we have reason to believe variable, bankable projects can be developed? Is the infrastructure needed for potential projects within reason?
3. THE PLACE OF PROJECT IN THE FIVE YEAR PLAN - Questions that should be asked include: Would the activities likely to be in a project in each province contribute to the rationalization of the agricultural program of Turkey? Is what would be done consistent with plan goals? Would exports be increased?

4. WOULD AN INTEGRATED, AREA APPROACH BE THE BEST APPROACH FOR DOING THOSE THINGS WHICH WOULD MOST LIKELY BE INCLUDED IN A PROJECT - Question: Would an alternative approach be better?
5. MARKET CONSIDERATIONS - Questions to be asked should include: Is there a ready market for the products which would be stressed? What investment in market improvement would be required? Is the market sufficiently "deep" so that additional supplies from the area would not cause a disastrous drop in prices? Is there more than one market available, thus reducing market risk?
6. TIMING OF BENEFITS - Question: Does the increase in productivity occur soon, or in the distant future?
7. CAPABILITY TO MANAGE A PROJECT - Questions to be asked should include: Could current technicians handle more work? How many additional technically trained personnel would be required? Are the provincial officials very interested? How accessible is the area from Ankara? How interested are the people? Do the provinces under consideration "relate" to one another harmoniously?
8. CONTRIBUTION TO "BALANCE" IN REGIONAL DEVELOPMENT, AND RECEIPT OF OTHER GOVERNMENT OF TURKEY ATTENTION - Questions to be asked should include: Would the project contribute to increased incomes in an area that is already above other areas? How many people would benefit? Has the Government provided considerable quantities of assistance to the area through other programs and investments? Is the Government to be involved with planning other major projects or investments for the area?

APPENDIX C

**Income
Elasticity Coefficients**

Table C-1 contains income elasticities for various agricultural commodities as computed by different groups in Turkey using alternative computational methods.

Tablo C-1
1 4

XII. PLAN PLANI ANALİZİNİN ÖZETİNE GÖRE TÜKETİM GİRİŞİMLERİNİN

GRUPLAR	T. Beklenen		E. Beklenen		Suriye		İran		E.A.G.		D.P.T. nin Ge- cişim Subansileri (Ülke)*	MADDE GRUPLARI	D.P.T. nin Sıhhi Subansileri		
	F.A.O. (Ülke)	Planlama (Kontrol)	Kontrol	(Kontrol)	F.A.O. (Ülke)	(Kontrol)	F.A.O. (Ülke)	(Kontrol)	F.A.O. (Ülke)	(Ülke)					
BİTKİSEL ÜRÜNLER												SARILIKAT	TUTAN		
TAN HAYDAR	.20 LL	.20 LL	.015	.015	.20 LL						.04 LL	ROBET	.45		
Baglay	.20 LL	.20 LL	.088	.088	.20 LL						.20 LL	Famlye	.00		
Sarı Baglay			.775	.775								Harcamak	.06		
Yumşak Bag.												Mıçerleri	.44		
Çelik	.30 LL		1.076	1.076	.60 LL							SEKİMLER			
BAKLİYAT	.30 LL				.60 LL	.45	.60					Soğun	.10		
												Sarımsak	.10		
												Soğan	.30		
												D. Sebze	.30		
MEYVELER												MEYVELER			
SEKİ	.30 LL				.60 LL	1.34	.66					.30 LL	İkme + grup.	.90	
ET	1.00 LL		1.008	1.008								.60 LL	İkme + armut	.70	
Bıçır	1.00 LL		.374	.374	1.20 LL	.11	1.37					1.30 LL	Kayun + sardall	.30	
Deniz	1.00 LL		.174	.174			.11	1.37				1.30 LL	Şeftali	1.00	
Kayun	1.00 LL		.734	.734	1.20 LL	.94	1.40					2.00 LL	İncir	.30	
Kepi			.734	.734								.30 LL	Sekizlik Soğan	.30	
Tavuk Et	1.30 LL		2.212	2.212	1.60 LL	1.14	1.97					2.00 LL	Fındık	.30	
SEKİ	.30 LL		.844	.844	1.00 LL	.77	.90					1.30 LL	Zir Kayunlar	.80	
YUMURTA	1.00 LL		1.322	1.322	1.20 LL	.77	.85					1.30 LL	Famak (Yatak v.a.)	.60	
BALIKLAR	1.00 LL		2.683	2.683	1.00 LL	.82	1.14					1.00 LL	Futubas	.60	
ŞEKER	.30 LL				.70 LL							.30 LL	Etnek (Sarı)	.30	
ÇAY	.30 LL				.30 LL	.13	.15					.30 LL	Etnek (Koyun)	.30	
F. Süt	.30 LL					.45	.16					1.30 LL	Makarna	.30	
KOŞKUNLUK			1.902	1.902								.30 LL	Rizikli	.30	
MEKKE			1.289	1.289			.22	.30				.30 LL	Parte-Bürek v.a.	.75	
Kayunluğa	.60 LL		.734	.734	.60 LL			1.00 LL				.30 LL	Balgur	.30	
Kayunluğa	.60 LL		1.171	1.171								.30 LL	Un	.05	
Hayat A. Yağlar	.60 LL		1.791	1.791	.60 LL			1.00 LL				.30 LL	Pirinç	.30	
ŞEKER KANULLARI							.41	1.05				.30 LL	Fıstık Emeği	.30	
Hayat Fovair			1.175	1.175			.63	.85				.70 LL	Elgane	.60	
Yakun			.377	.377								.30 LL	Çardır Emeği	.30	
Sanayi Unu			.789	.789			.34	.34				.30 LL	Toplam Sebze Yağ	.60	
Balgur - Makarna												.60 LL	SEKİ	1.00	
Pirinç			1.076	1.076								.30 LL	Yumurta	.75	
İÇİ SİYAT			.268	.268								1.36 LL	Yapağı-Fıstık-Eli	.60	
Bakı - Votka												.75 LL	Balıklar	.50	
Bira												2.00 LL	E. Öküz	1.50	
Şarap												1.00 LL	Şeker	.60	
Çocuklar												2.00 LL	Çay	.30	
Mıçerleri												.75 LL	T. Yağ-F. Süt-Peynir	1.00	
MEKKE												.30 LL	A. Kanulları	.60	
F. DÜZÜM												1.00 LL	U. Kanulları	.50	
F. DÜZÜM												2.00 LL	Balık ve Kanulları	1.20	
TUKOTAJ												1.30 LL	Etler	1.60	
ZALİ												4.00 LL	Şeker Kanulları	.75	
													1.05	Famak İpliği	1.05
													1.50	Yük. İpliği	1.50
													1.10	A. Akıntı-Tarlık	1.10

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Source: Türkiye Tarımsal Planlama Çalışmaları (Girdi-Çıktı Analizleri ile Tüketim) Projeksiyonları, 1977. I. RAPOR. DPT - İPD - Sektör Programları Şubesi, Dr. Nazmi DEMİR, Orhan Saygıdeğer, Arif Uğur, Dr. Mehmet Peker, Turhan Conkbayır, Ocak 1974, Ankara.

APPENDIX D

**SOME PRO'S AND CON'S
OF
PRESENT NET WORTH, BENEFIT-COST RATIO,
AND
INTERNAL RATE OF RETURN**

The present net worth, the benefit to cost ratio, and the projects' internal rate of return are three indices which may be used to assess the monetary returns generated by an investment. Although the three are often taken to be substitutes for one another they are not the same and hence, measure different things about a particular project. For that reason the ranking of alternative projects by one criteria will not be the same as the ranking of those projects using another criteria. Moreover, because of the way they are calculated they find to give bias, and sometimes ambiguous, answers to the question of project desirability. The following material summarizes very briefly some of the advantages, disadvantages, and biases of each of these criteria when used to compare different projects.

1. The Present Net Worth Criteria:

- favors large projects over small ones
- does not reflect earnings per unit of scarce resources
- shows magnitude of net gain analysis
- must choose appropriatediscount rate
- ranking of projects depends upon the discount rate chosen

2. The Benefit-Cost Ratio:

- reflects return per unit of capital investment
- is based forward projects with low annual cost/capital costs relationship
- says nothing about the magnitude of investment or

- analyst must choose appropriate discount rate
- ranking of projects depends upon the discount rate chosen.

3. The Internal Rate of Return

- a project may have more than one internal rate of return depending upon the cost returns streams through time
- choosing the "cut-off" internal rate may be difficult for public projects due to uncertainty of payoff to alternative public investments
- per cent yield alone does not indicate the magnitude of the net earnings
- is based against capital intensive projects i.e., the higher the capital investment component relative to annual costs the lower the internal rate of return.

APPENDIX E

**Discount Factors
for
Alternative Discount Rates**

The discount factors to be utilized in this manual correspond to the Present Worth of 1 Received in Period n. This value is computed and shown below for $n = 1 \dots\dots 60$, $i = 1 \dots\dots 20, 22, 25$, and 30 percent. The appropriate formula is as follows,

$$v^n = \frac{1}{(1 + i)^n}$$

and the values are found in the first column on the left of each page.

Two additional sets of values are also included for general use:

- (1) the Present Worth of 1 Received in n Periods (Column 2). and
- (2) the Capital Recovery Factor (Column 3).

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	P E R I O D S	Discount factor Present worth of 1 received in period n. $v^n = \frac{1}{(1+i)^n}$	Present worth of 1 received in n periods. $\frac{1 - v^n}{i}$	Capital recovery factor. Periodic payment to retire debt of 1 $\frac{i}{1 - v^n}$	P E R I O D S
	1	0.990 099	0.990 099	1.010 099	1
	2	0.980 296	1.970 395	0.507 312	2
	3	0.970 590	2.940 985	0.340 022	3
	4	0.960 980	3.908 966	0.256 881	4
	5	0.951 466	4.853 431	0.206 040	5
	6	0.942 045	5.795 478	0.172 348	6
	7	0.932 718	6.728 195	0.148 628	7
	8	0.923 483	7.651 678	0.130 690	8
	9	0.914 340	8.566 019	0.116 740	9
	10	0.905 287	9.471 305	0.105 582	10
	11	0.896 324	10.367 629	0.096 494	11
	12	0.887 449	11.255 077	0.088 609	12
	13	0.878 663	12.133 740	0.082 415	13
	14	0.869 963	13.003 703	0.076 901	14
	15	0.861 349	13.865 053	0.072 124	15
	16	0.852 821	14.717 874	0.067 945	16
	17	0.844 377	15.562 251	0.064 258	17
	18	0.836 017	16.398 269	0.060 992	18
	19	0.827 740	17.226 008	0.058 052	19
	20	0.819 544	18.045 553	0.055 415	20
	21	0.811 430	18.856 983	0.053 031	21
	22	0.803 396	19.660 379	0.050 864	22
	23	0.795 442	20.455 821	0.048 886	23
	24	0.787 566	21.243 387	0.047 073	24
	25	0.779 768	22.023 156	0.045 407	25
	26	0.772 048	22.795 204	0.043 869	26
	27	0.764 404	23.559 608	0.042 446	27
	28	0.756 836	24.316 443	0.041 124	28
	29	0.749 342	25.065 785	0.039 895	29
	30	0.741 923	25.807 708	0.038 748	30
	31	0.734 577	26.542 285	0.037 676	31
	32	0.727 304	27.269 589	0.036 671	32
	33	0.720 103	27.989 693	0.035 727	33
	34	0.712 973	28.702 666	0.034 840	34
	35	0.705 914	29.408 580	0.034 004	35
	36	0.698 925	30.107 505	0.033 214	36
	37	0.692 005	30.799 510	0.032 468	37
	38	0.685 153	31.484 603	0.031 761	38
	39	0.678 370	32.163 033	0.031 092	39
	40	0.671 653	32.834 686	0.030 456	40
	41	0.665 003	33.499 689	0.029 851	41
	42	0.658 419	34.158 108	0.029 276	42
	43	0.651 900	34.810 006	0.028 727	43
	44	0.645 445	35.455 454	0.028 204	44
	45	0.639 055	36.094 508	0.027 705	45
	46	0.632 728	36.727 236	0.027 228	46
	47	0.626 463	37.353 699	0.026 771	47
	48	0.620 260	37.973 959	0.026 334	48
	49	0.614 119	38.588 070	0.025 915	49
	50	0.608 039	39.196 118	0.025 513	50
	51	0.602 019	39.798 136	0.025 127	51
	52	0.596 058	40.394 194	0.024 756	52
	53	0.590 156	40.984 351	0.024 400	53
	54	0.584 313	41.568 664	0.024 057	54
	55	0.578 528	42.147 192	0.023 726	55
	56	0.572 800	42.719 992	0.023 408	56
	57	0.567 129	43.287 121	0.023 102	57
	58	0.561 514	43.848 635	0.022 806	58
	59	0.555 954	44.404 589	0.022 520	59
	60	0.550 450	44.955 038	0.022 244	60

RATE
IX

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RATE 2%	PERIODS	Discount factor.	Present worth	Capital recovery	PERIODS	RATE 2%
		Present worth of 1 received in period n.	of 1 received in n periods.	factor. Periodic payment to retire debt of 1.		
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{a_{\overline{n} i}} = \frac{i}{1 - \frac{1}{(1+i)^n}}$		
	1	0.980 392	0.980 392	1.020 000	1	
	2	0.961 169	1.941 561	0.515 050	2	
	3	0.942 322	2.883 883	0.346 755	3	
	4	0.923 845	3.807 729	0.262 624	4	
	5	0.905 731	4.713 460	0.212 158	5	
	6	0.887 971	5.601 431	0.178 526	6	
	7	0.870 560	6.471 991	0.154 512	7	
	8	0.853 490	7.325 481	0.136 510	8	
	9	0.836 755	8.162 237	0.122 515	9	
	10	0.820 348	8.982 585	0.111 327	10	
	11	0.804 263	9.786 848	0.102 178	11	
	12	0.788 493	10.575 341	0.094 560	12	
	13	0.773 033	11.348 374	0.088 119	13	
	14	0.757 875	12.106 249	0.082 602	14	
	15	0.743 015	12.849 264	0.077 825	15	
	16	0.728 446	13.577 709	0.073 650	16	
	17	0.714 163	14.291 872	0.069 970	17	
	18	0.700 159	14.992 031	0.066 702	18	
	19	0.686 431	15.678 462	0.063 782	19	
	20	0.672 971	16.351 433	0.061 157	20	
	21	0.659 776	17.011 209	0.058 785	21	
	22	0.646 839	17.658 048	0.056 631	22	
	23	0.634 156	18.292 204	0.054 668	23	
	24	0.621 721	18.913 926	0.052 871	24	
	25	0.609 531	19.523 456	0.051 220	25	
	26	0.597 579	20.121 035	0.049 699	26	
	27	0.585 862	20.706 898	0.048 293	27	
	28	0.574 375	21.281 272	0.046 990	28	
	29	0.563 112	21.844 385	0.045 778	29	
	30	0.552 071	22.396 456	0.044 650	30	
	31	0.541 246	22.937 702	0.043 596	31	
	32	0.530 633	23.468 335	0.042 611	32	
	33	0.520 229	23.988 564	0.041 687	33	
	34	0.510 028	24.498 592	0.040 819	34	
	35	0.500 028	24.998 619	0.040 002	35	
	36	0.490 223	25.488 842	0.039 233	36	
	37	0.480 611	25.969 453	0.038 507	37	
	38	0.471 187	26.440 641	0.037 821	38	
	39	0.461 948	26.902 589	0.037 171	39	
	40	0.452 890	27.355 479	0.036 556	40	
	41	0.444 010	27.799 489	0.035 972	41	
	42	0.435 304	28.234 794	0.035 417	42	
	43	0.426 769	28.661 562	0.034 890	43	
	44	0.418 401	29.079 963	0.034 388	44	
	45	0.410 197	29.490 160	0.033 910	45	
	46	0.402 154	29.892 314	0.033 453	46	
	47	0.394 268	30.286 582	0.033 018	47	
	48	0.386 538	30.673 120	0.032 602	48	
	49	0.378 958	31.052 078	0.032 204	49	
	50	0.371 528	31.423 606	0.031 823	50	
	51	0.364 243	31.787 849	0.031 459	51	
	52	0.357 101	32.144 950	0.031 109	52	
	53	0.350 099	32.495 049	0.030 774	53	
	54	0.343 234	32.838 283	0.030 452	54	
	55	0.336 504	33.174 788	0.030 143	55	
	56	0.329 906	33.504 694	0.029 847	56	
	57	0.323 437	33.828 131	0.029 561	57	
	58	0.317 095	34.145 226	0.029 287	58	
	59	0.310 878	34.456 104	0.029 022	59	
	60	0.304 782	34.760 887	0.028 768	60	

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PERIODS	Discount factor.		Present worth of 1 received in a period n.		Capital recovery factor. Periodic payment to retire debt of 1.		PERIODS
	$v^n = \frac{1}{(1+i)^n}$		$\frac{1 - \frac{1}{(1+i)^n}}{i}$		$\frac{1}{1 - \frac{1}{(1+i)^n}}$		
1	0.970 874		0.970 874		1.030 000		1
2	0.942 596		1.913 470		0.522 611		2
3	0.915 142		2.828 611		0.353 530		3
4	0.888 487		3.717 098		0.269 027		4
5	0.862 609		4.579 707		0.218 355		5
6	0.837 484		5.417 191		0.184 598		6
7	0.813 092		6.230 283		0.160 506		7
8	0.789 409		7.019 692		0.142 456		8
9	0.766 417		7.786 139		0.128 434		9
10	0.744 094		8.530 203		0.117 231		10
11	0.722 421		9.252 624		0.108 077		11
12	0.701 380		9.954 304		0.100 462		12
13	0.680 951		10.634 955		0.094 030		13
14	0.661 118		11.296 073		0.088 526		14
15	0.641 862		11.937 935		0.083 767		15
16	0.623 167		12.561 102		0.079 611		16
17	0.605 018		13.166 118		0.075 953		17
18	0.587 399		13.753 513		0.072 709		18
19	0.570 286		14.323 799		0.069 914		19
20	0.553 676		14.877 475		0.067 216		20
21	0.537 549		15.415 024		0.064 872		21
22	0.521 893		15.936 917		0.062 747		22
23	0.506 692		16.443 608		0.060 814		23
24	0.491 934		16.935 542		0.059 047		24
25	0.477 606		17.413 148		0.057 428		25
26	0.463 699		17.876 942		0.055 938		26
27	0.450 189		18.327 031		0.054 564		27
28	0.437 077		18.764 108		0.053 293		28
29	0.424 346		19.188 455		0.052 115		29
30	0.411 987		19.600 441		0.051 019		30
31	0.399 987		20.000 428		0.049 999		31
32	0.388 337		20.388 766		0.049 047		32
33	0.377 026		20.765 792		0.048 156		33
34	0.366 045		21.131 837		0.047 322		34
35	0.355 383		21.487 220		0.046 539		35
36	0.345 032		21.832 252		0.045 804		36
37	0.334 983		22.167 235		0.045 112		37
38	0.325 226		22.492 462		0.044 459		38
39	0.315 754		22.808 215		0.043 844		39
40	0.306 557		23.114 772		0.043 262		40
41	0.297 624		23.412 400		0.042 712		41
42	0.288 959		23.701 359		0.042 192		42
43	0.280 543		23.981 902		0.041 698		43
44	0.272 372		24.254 274		0.041 230		44
45	0.264 439		24.518 713		0.040 785		45
46	0.256 737		24.775 449		0.040 363		46
47	0.249 269		25.024 708		0.039 961		47
48	0.241 999		25.266 707		0.039 578		48
49	0.234 950		25.501 657		0.039 213		49
50	0.228 107		25.729 764		0.038 865		50
51	0.221 463		25.951 227		0.038 534		51
52	0.215 013		26.166 240		0.038 217		52
53	0.208 750		26.374 990		0.037 913		53
54	0.202 670		26.577 660		0.037 624		54
55	0.196 767		26.774 428		0.037 349		55
56	0.191 036		26.965 464		0.037 084		56
57	0.185 472		27.150 936		0.036 831		57
58	0.180 070		27.331 009		0.036 588		58
59	0.174 825		27.505 831		0.036 354		59
60	0.169 733		27.675 564		0.036 133		60

RATE
3%

RATE
3%

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P E R I O D S	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P E R I O D S
	$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{\frac{1 - \frac{1}{(1+i)^n}}{i}}$	
1	0.961 538	0.961 538	1.040 000	1
2	0.914 556	1.886 095	0.530 196	2
3	0.888 956	2.775 091	0.360 349	3
4	0.854 104	3.629 895	0.275 490	4
5	0.821 927	4.451 822	0.224 627	5
6	0.790 315	5.242 137	0.190 762	6
7	0.759 918	6.002 055	0.166 610	7
8	0.730 690	6.732 745	0.148 528	8
9	0.702 587	7.435 332	0.134 493	9
10	0.675 564	8.110 896	0.123 291	10
11	0.649 581	8.760 477	0.114 149	11
12	0.624 597	9.385 074	0.106 552	12
13	0.600 574	9.985 648	0.100 144	13
14	0.577 475	10.563 123	0.094 669	14
15	0.555 265	11.118 387	0.089 941	15
16	0.533 908	11.652 296	0.085 920	16
17	0.513 373	12.165 669	0.082 199	17
18	0.493 628	12.659 297	0.078 992	18
19	0.474 642	13.133 939	0.076 139	19
20	0.456 387	13.590 326	0.073 582	20
21	0.438 834	14.029 160	0.071 280	21
22	0.421 955	14.451 115	0.069 199	22
23	0.405 726	14.856 842	0.067 309	23
24	0.390 121	15.246 963	0.065 587	24
25	0.375 117	15.622 080	0.064 012	25
26	0.360 689	15.982 769	0.062 567	26
27	0.346 817	16.329 586	0.061 239	27
28	0.333 477	16.663 063	0.060 013	28
29	0.320 651	16.983 715	0.058 880	29
30	0.308 319	17.292 033	0.057 830	30
31	0.296 460	17.588 494	0.056 855	31
32	0.285 058	17.873 551	0.055 949	32
33	0.274 094	18.147 646	0.055 104	33
34	0.263 552	18.411 198	0.054 315	34
35	0.253 415	18.664 613	0.053 577	35
36	0.243 669	18.908 282	0.052 887	36
37	0.234 297	19.142 579	0.052 240	37
38	0.225 285	19.367 864	0.051 632	38
39	0.216 621	19.584 485	0.051 061	39
40	0.208 289	19.792 774	0.050 523	40
41	0.200 278	19.993 052	0.050 017	41
42	0.192 575	20.185 627	0.049 540	42
43	0.185 168	20.370 795	0.049 090	43
44	0.178 046	20.548 841	0.048 665	44
45	0.171 198	20.720 040	0.048 262	45
46	0.164 614	20.884 654	0.047 882	46
47	0.158 283	21.042 936	0.047 522	47
48	0.152 195	21.195 131	0.047 181	48
49	0.146 341	21.341 472	0.046 857	49
50	0.140 713	21.482 185	0.046 550	50
51	0.135 301	21.617 485	0.046 259	51
52	0.130 097	21.747 582	0.045 982	52
53	0.125 093	21.872 675	0.045 719	53
54	0.120 287	21.992 957	0.045 469	54
55	0.115 656	22.108 612	0.045 230	55
56	0.111 207	22.219 819	0.045 005	56
57	0.106 930	22.326 749	0.044 789	57
58	0.102 817	22.429 567	0.044 584	58
59	0.098 863	22.528 430	0.044 388	59
60	0.095 060	22.623 490	0.044 202	60

RATE
4%

RATE
4%

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	P R i o d s	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P R i o d s
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i}$	$\frac{1}{1 - v^n}$	
	1	0.952 381	0.952 381	1.040 000	1
	2	0.907 029	1.859 410	0.537 805	2
	3	0.863 838	2.723 248	0.367 209	3
	4	0.822 702	3.545 951	0.282 012	4
	5	0.783 526	4.329 477	0.230 975	5
	6	0.746 215	5.075 692	0.197 017	6
	7	0.710 681	5.786 373	0.172 820	7
	8	0.676 839	6.463 213	0.154 722	8
	9	0.644 609	7.107 822	0.140 690	9
	10	0.613 913	7.721 735	0.129 505	10
	11	0.584 679	8.306 414	0.120 389	11
	12	0.556 837	8.863 252	0.112 825	12
	13	0.530 321	9.393 573	0.106 456	13
	14	0.505 068	9.898 641	0.101 024	14
	15	0.481 017	10.379 658	0.096 342	15
	16	0.458 112	10.837 770	0.092 270	16
	17	0.436 297	11.274 066	0.088 699	17
	18	0.415 521	11.689 587	0.085 546	18
	19	0.395 734	12.085 321	0.082 745	19
	20	0.376 889	12.462 210	0.080 243	20
	21	0.358 942	12.821 153	0.077 996	21
	22	0.341 850	13.163 003	0.075 971	22
	23	0.325 571	13.488 574	0.074 137	23
	24	0.310 068	13.798 642	0.072 471	24
	25	0.295 303	14.093 945	0.070 952	25
	26	0.281 241	14.375 185	0.069 564	26
	27	0.267 848	14.643 034	0.068 292	27
	28	0.255 094	14.899 127	0.067 123	28
	29	0.242 946	15.141 974	0.066 046	29
	30	0.231 377	15.372 451	0.065 051	30
	31	0.220 359	15.592 811	0.064 132	31
	32	0.209 866	15.802 677	0.063 280	32
	33	0.199 873	16.002 549	0.062 490	33
	34	0.190 355	16.192 904	0.061 755	34
	35	0.181 290	16.374 194	0.061 072	35
	36	0.172 657	16.546 852	0.060 434	36
	37	0.164 436	16.711 287	0.059 840	37
	38	0.156 605	16.867 893	0.059 284	38
	39	0.149 148	17.017 041	0.058 765	39
	40	0.142 046	17.159 086	0.058 278	40
	41	0.135 282	17.294 368	0.057 822	41
	42	0.128 840	17.423 208	0.057 395	42
	43	0.122 704	17.545 912	0.056 993	43
	44	0.116 861	17.662 773	0.056 616	44
	45	0.111 297	17.774 070	0.056 262	45
	46	0.105 997	17.880 066	0.055 928	46
	47	0.100 949	17.981 016	0.055 614	47
	48	0.096 142	18.077 158	0.055 318	48
	49	0.091 564	18.168 722	0.055 040	49
	50	0.087 204	18.255 925	0.054 777	50
	51	0.083 051	18.338 977	0.054 529	51
	52	0.079 096	18.418 073	0.054 294	52
	53	0.075 330	18.493 403	0.054 073	53
	54	0.071 743	18.565 146	0.053 864	54
	55	0.068 326	18.633 472	0.053 667	55
	56	0.065 073	18.698 545	0.053 480	56
	57	0.061 974	18.760 519	0.053 303	57
	58	0.059 023	18.819 542	0.053 136	58
	59	0.056 212	18.875 754	0.052 978	59
	60	0.053 536	18.929 290	0.052 828	60

RATE
5%

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RATE 6%	PERIODS	Discount factor.	Present worth	Capital recovery	PERIODS	RATE 6%
		Present worth of 1 received in period n.	of 1 received in n periods.	factor. Periodic payment to retire debt of 1.		
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{a} = \frac{i}{1 - \frac{1}{(1+i)^n}}$		
	1	0.943 396	0.943 396	1.060 009	1	
	2	0.889 996	1.833 393	0.545 437	2	
	3	0.839 619	2.673 012	0.374 110	3	
	4	0.792 094	3.465 106	0.288 591	4	
	5	0.747 258	4.212 364	0.237 396	5	
	6	0.704 961	4.917 324	0.203 363	6	
	7	0.665 057	5.582 381	0.179 135	7	
	8	0.627 412	6.209 794	0.161 036	8	
	9	0.591 898	6.801 692	0.147 022	9	
	10	0.558 395	7.360 087	0.135 868	10	
	11	0.526 788	7.886 875	0.126 793	11	
	12	0.496 969	8.383 844	0.119 277	12	
	13	0.468 839	8.852 683	0.112 950	13	
	14	0.442 301	9.294 984	0.107 585	14	
	15	0.417 265	9.712 249	0.102 963	15	
	16	0.393 646	10.105 895	0.098 952	16	
	17	0.371 364	10.477 260	0.095 445	17	
	18	0.350 344	10.827 803	0.092 357	18	
	19	0.330 513	11.158 116	0.089 621	19	
	20	0.311 805	11.469 921	0.087 185	20	
	21	0.294 155	11.764 077	0.085 005	21	
	22	0.277 505	12.041 582	0.083 046	22	
	23	0.261 797	12.303 379	0.081 278	23	
	24	0.246 979	12.550 358	0.079 679	24	
	25	0.232 999	12.783 356	0.078 227	25	
	26	0.219 810	13.003 166	0.076 904	26	
	27	0.207 368	13.210 534	0.075 697	27	
	28	0.195 630	13.406 164	0.074 593	28	
	29	0.184 557	13.590 721	0.073 580	29	
	30	0.174 110	13.764 831	0.072 649	30	
	31	0.164 255	13.929 086	0.071 792	31	
	32	0.154 957	14.084 043	0.071 002	32	
	33	0.146 186	14.230 230	0.070 273	33	
	34	0.137 912	14.368 141	0.069 598	34	
	35	0.130 105	14.498 246	0.068 974	35	
	36	0.122 741	14.620 987	0.068 395	36	
	37	0.115 793	14.736 780	0.067 857	37	
	38	0.109 239	14.846 019	0.067 358	38	
	39	0.103 056	14.949 075	0.066 894	39	
	40	0.097 222	15.046 297	0.066 462	40	
	41	0.091 719	15.138 016	0.066 059	41	
	42	0.086 527	15.224 543	0.065 683	42	
	43	0.081 630	15.306 173	0.065 333	43	
	44	0.077 009	15.383 182	0.065 006	44	
	45	0.072 650	15.455 832	0.064 700	45	
	46	0.068 538	15.524 370	0.064 415	46	
	47	0.064 658	15.589 028	0.064 148	47	
	48	0.060 998	15.650 027	0.063 898	48	
	49	0.057 546	15.707 572	0.063 664	49	
	50	0.054 288	15.761 861	0.063 444	50	
	51	0.051 215	15.813 076	0.063 239	51	
	52	0.048 316	15.861 393	0.063 046	52	
	53	0.045 582	15.906 974	0.062 866	53	
	54	0.043 001	15.949 976	0.062 696	54	
	55	0.040 567	15.990 543	0.062 537	55	
	56	0.038 271	16.028 814	0.062 388	56	
	57	0.036 105	16.064 919	0.062 247	57	
	58	0.034 061	16.098 980	0.062 116	58	
	59	0.032 133	16.131 113	0.061 992	59	
	60	0.030 314	16.161 428	0.061 876	60	

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RATE 7%	P E R I O D S Discount factor. Present worth of 1 received in period n.			P E R I O D S Present worth of 1 received in n periods.			P E R I O D S Capital recovery factor. Periodic payment to retire debt of 1.			RATE 7%
	$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i}$	$\frac{1 - v^n}{i}$	$\frac{1}{v^n} = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i}$	$\frac{1}{v^n} = \frac{1}{(1+i)^n}$				
1	0.934 579	0.934 579	0.934 579	1.070 900	1	1				
2	0.873 439	1.808 018	1.808 018	0.553 092	2	2				
3	0.816 298	2.624 316	2.624 316	0.381 052	3	3				
4	0.762 895	3.387 211	3.387 211	0.295 228	4	4				
5	0.712 986	4.100 197	4.100 197	0.243 891	5	5				
6	0.666 342	4.766 540	4.766 540	0.209 796	6	6				
7	0.622 750	5.389 289	5.389 289	0.185 553	7	7				
8	0.582 009	5.971 299	5.971 299	0.167 468	8	8				
9	0.543 934	6.515 232	6.515 232	0.153 486	9	9				
10	0.508 349	7.023 582	7.023 582	0.142 378	10	10				
11	0.475 093	7.498 674	7.498 674	0.133 357	11	11				
12	0.444 012	7.942 686	7.942 686	0.125 402	12	12				
13	0.414 964	8.357 651	8.357 651	0.119 651	13	13				
14	0.387 817	8.745 468	8.745 468	0.114 345	14	14				
15	0.362 446	9.107 914	9.107 914	0.109 795	15	15				
16	0.338 735	9.446 649	9.446 649	0.105 858	16	16				
17	0.316 574	9.763 223	9.763 223	0.102 425	17	17				
18	0.295 864	10.059 087	10.059 087	0.099 413	18	18				
19	0.276 508	10.335 595	10.335 595	0.096 753	19	19				
20	0.258 419	10.594 014	10.594 014	0.094 393	20	20				
21	0.241 513	10.835 527	10.835 527	0.092 289	21	21				
22	0.225 713	11.061 240	11.061 240	0.090 406	22	22				
23	0.210 947	11.272 187	11.272 187	0.088 714	23	23				
24	0.197 147	11.469 334	11.469 334	0.087 189	24	24				
25	0.184 249	11.653 583	11.653 583	0.085 811	25	25				
26	0.172 195	11.825 779	11.825 779	0.084 561	26	26				
27	0.160 930	11.986 709	11.986 709	0.083 426	27	27				
28	0.150 402	12.137 111	12.137 111	0.082 392	28	28				
29	0.140 563	12.277 674	12.277 674	0.081 449	29	29				
30	0.131 367	12.409 041	12.409 041	0.080 586	30	30				
31	0.122 773	12.531 814	12.531 814	0.079 797	31	31				
32	0.114 741	12.646 555	12.646 555	0.079 073	32	32				
33	0.107 235	12.753 790	12.753 790	0.078 408	33	33				
34	0.100 219	12.854 009	12.854 009	0.077 797	34	34				
35	0.093 663	12.947 672	12.947 672	0.077 234	35	35				
36	0.087 535	13.035 208	13.035 208	0.076 715	36	36				
37	0.081 909	13.117 017	13.117 017	0.076 237	37	37				
38	0.076 457	13.193 473	13.193 473	0.075 795	38	38				
39	0.071 455	13.264 928	13.264 928	0.075 387	39	39				
40	0.066 780	13.331 709	13.331 709	0.075 009	40	40				
41	0.062 412	13.394 120	13.394 120	0.074 660	41	41				
42	0.058 329	13.452 449	13.452 449	0.074 336	42	42				
43	0.054 513	13.506 962	13.506 962	0.074 036	43	43				
44	0.050 946	13.557 908	13.557 908	0.073 758	44	44				
45	0.047 613	13.605 522	13.605 522	0.073 500	45	45				
46	0.044 499	13.650 020	13.650 020	0.073 260	46	46				
47	0.041 587	13.691 608	13.691 608	0.073 037	47	47				
48	0.038 867	13.730 474	13.730 474	0.072 831	48	48				
49	0.036 324	13.766 799	13.766 799	0.072 639	49	49				
50	0.033 948	13.800 746	13.800 746	0.072 460	50	50				
51	0.031 727	13.832 473	13.832 473	0.072 294	51	51				
52	0.029 651	13.862 124	13.862 124	0.072 139	52	52				
53	0.027 711	13.889 336	13.889 336	0.071 995	53	53				
54	0.025 899	13.915 735	13.915 735	0.071 861	54	54				
55	0.024 204	13.939 939	13.939 939	0.071 736	55	55				
56	0.022 621	13.962 560	13.962 560	0.071 620	56	56				
57	0.021 141	13.983 701	13.983 701	0.071 512	57	57				
58	0.019 758	14.003 458	14.003 458	0.071 411	58	58				
59	0.018 465	14.021 924	14.021 924	0.071 317	59	59				
60	0.017 257	14.039 181	14.039 181	0.071 229	60	60				

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RATE	PERIODS	Discount factor.	Present worth	Capital recovery	PERIODS	RATE
		Present worth of 1 received in period n.	of 1 received in n periods.	factor. Periodic payment to retire debt of 1.		
8%		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{i} - \frac{1}{i(1+i)^n}$		8%
	1	0.925 926	0.925 926	1.080 000	1	
	2	0.857 339	1.783 265	0.560 769	2	
	3	0.793 832	2.577 097	0.388 034	3	
	4	0.735 030	3.312 127	0.301 921	4	
	5	0.680 583	3.992 710	0.250 456	5	
	6	0.630 170	4.622 880	0.216 315	6	
	7	0.583 490	5.206 370	0.192 072	7	
	8	0.540 269	5.746 639	0.174 015	8	
	9	0.500 249	6.246 888	0.160 080	9	
	10	0.463 193	6.710 081	0.149 029	10	
	11	0.428 883	7.138 964	0.140 076	11	
	12	0.397 114	7.536 078	0.132 695	12	
	13	0.367 698	7.903 776	0.126 522	13	
	14	0.340 461	8.244 237	0.121 297	14	
	15	0.315 242	8.559 479	0.116 830	15	
	16	0.291 890	8.851 369	0.112 977	16	
	17	0.270 269	9.121 638	0.109 629	17	
	18	0.250 249	9.371 887	0.106 702	18	
	19	0.231 712	9.603 599	0.104 128	19	
	20	0.214 548	9.818 147	0.101 852	20	
	21	0.198 656	10.016 803	0.099 832	21	
	22	0.183 941	10.200 744	0.098 032	22	
	23	0.170 315	10.371 059	0.096 422	23	
	24	0.157 699	10.528 758	0.094 978	24	
	25	0.146 018	10.674 776	0.093 679	25	
	26	0.135 202	10.809 978	0.092 507	26	
	27	0.125 187	10.935 165	0.091 448	27	
	28	0.115 914	11.051 078	0.090 489	28	
	29	0.107 328	11.158 406	0.089 619	29	
	30	0.099 377	11.257 783	0.088 827	30	
	31	0.092 016	11.349 799	0.088 107	31	
	32	0.085 200	11.434 999	0.087 451	32	
	33	0.078 889	11.513 888	0.086 852	33	
	34	0.073 045	11.586 934	0.086 304	34	
	35	0.067 635	11.654 568	0.085 803	35	
	36	0.062 625	11.717 193	0.085 345	36	
	37	0.057 986	11.775 179	0.084 924	37	
	38	0.053 690	11.828 869	0.084 539	38	
	39	0.049 713	11.878 582	0.084 185	39	
	40	0.046 031	11.924 613	0.083 860	40	
	41	0.042 621	11.967 235	0.083 561	41	
	42	0.039 464	12.006 699	0.083 287	42	
	43	0.036 541	12.043 240	0.083 034	43	
	44	0.033 834	12.077 074	0.082 802	44	
	45	0.031 328	12.108 402	0.082 587	45	
	46	0.029 007	12.137 409	0.082 390	46	
	47	0.026 859	12.164 267	0.082 208	47	
	48	0.024 869	12.189 136	0.082 040	48	
	49	0.023 027	12.212 163	0.081 886	49	
	50	0.021 321	12.233 485	0.081 743	50	
	51	0.019 742	12.253 227	0.081 611	51	
	52	0.018 280	12.271 506	0.081 490	52	
	53	0.016 925	12.288 432	0.081 377	53	
	54	0.015 672	12.304 103	0.081 274	54	
	55	0.014 511	12.318 614	0.081 178	55	
	56	0.013 436	12.332 050	0.081 090	56	
	57	0.012 441	12.344 491	0.081 008	57	
	58	0.011 519	12.356 010	0.080 932	58	
	59	0.010 666	12.356 676	0.080 862	59	
	60	0.009 876	12.376 552	0.080 798	60	

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	P E R I O D S	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P E R I O D S
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i} = \frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{a_{\overline{n} i}} = \frac{i}{1 - \frac{1}{(1+i)^n}}$	
RATE	1	0.917 431	0.917 431	1.090 000	1
9%	2	0.841 680	1.759 111	0.568 469	2
	3	0.772 183	2.531 295	0.395 055	3
	4	0.708 425	3.239 720	0.308 669	4
	5	0.649 931	3.889 651	0.257 092	5
	6	0.596 267	4.485 919	0.222 920	6
	7	0.547 034	5.032 953	0.198 691	7
	8	0.501 866	5.534 819	0.180 674	8
	9	0.460 428	5.995 247	0.166 799	9
	10	0.422 411	6.417 658	0.155 820	10
	11	0.387 533	6.805 151	0.146 947	11
	12	0.355 535	7.160 725	0.139 651	12
	13	0.326 179	7.486 904	0.133 567	13
	14	0.299 246	7.786 150	0.128 433	14
	15	0.274 538	8.060 688	0.124 059	15
	16	0.251 870	8.312 558	0.120 300	16
	17	0.231 073	8.543 631	0.117 046	17
	18	0.211 994	8.755 625	0.114 212	18
	19	0.194 490	8.950 115	0.111 730	19
	20	0.178 331	9.128 546	0.109 546	20
	21	0.163 698	9.292 244	0.107 617	21
	22	0.150 182	9.442 425	0.105 905	22
	23	0.137 781	9.580 207	0.104 382	23
	24	0.126 405	9.706 612	0.103 023	24
	25	0.115 968	9.822 580	0.101 806	25
	26	0.106 393	9.928 972	0.100 715	26
	27	0.097 602	10.026 580	0.099 735	27
	28	0.089 548	10.116 128	0.098 852	28
	29	0.082 155	10.199 283	0.098 056	29
	30	0.075 371	10.273 654	0.097 336	30
	31	0.069 148	10.342 802	0.096 686	31
	32	0.063 438	10.406 240	0.096 096	32
	33	0.058 200	10.464 441	0.095 562	33
	34	0.053 395	10.517 835	0.095 077	34
	35	0.048 986	10.566 021	0.094 636	35
	36	0.044 941	10.611 763	0.094 235	36
	37	0.041 231	10.652 993	0.093 870	37
	38	0.037 826	10.690 820	0.093 539	38
	39	0.034 703	10.725 523	0.093 236	39
	40	0.031 800	10.757 360	0.092 960	40
	41	0.029 209	10.786 569	0.092 708	41
	42	0.026 797	10.813 366	0.092 478	42
	43	0.024 584	10.837 950	0.092 268	43
	44	0.022 555	10.860 505	0.092 077	44
	45	0.020 692	10.881 197	0.091 902	45
	46	0.018 984	10.900 181	0.091 742	46
	47	0.017 416	10.917 597	0.091 595	47
	48	0.015 978	10.933 575	0.091 461	48
	49	0.014 659	10.948 234	0.091 339	49
	50	0.013 449	10.961 683	0.091 227	50
	51	0.012 338	10.974 021	0.091 124	51
	52	0.011 319	10.985 340	0.091 030	52
	53	0.010 385	10.995 725	0.090 944	53
	54	0.009 527	11.005 252	0.090 866	54
	55	0.008 741	11.013 993	0.090 794	55
	56	0.008 019	11.022 012	0.090 728	56
	57	0.007 357	11.029 369	0.090 667	57
	58	0.006 749	11.036 118	0.090 612	58
	59	0.006 192	11.042 310	0.090 561	59
	60	0.005 681	11.047 991	0.090 514	60

RATE
9%

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PERIODS	Discount factor.	Present worth	Capital recovery	PERIODS
	Present worth of 1 received in period n.	of 1 received in n periods.	factor. Periodic payment to retire debt of 1.	
	$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i}$	$\frac{1}{v^n} = \frac{1}{1 - v^n}$	
1	0.909 091	0.909 091	1.100 000	1
2	0.826 446	1.735 537	0.576 190	2
3	0.751 315	2.486 852	0.402 115	3
4	0.683 013	3.169 865	0.315 471	4
5	0.620 921	3.790 787	0.263 797	5
6	0.564 474	4.355 261	0.229 607	6
7	0.513 158	4.868 419	0.205 405	7
8	0.466 507	5.334 926	0.187 444	8
9	0.424 098	5.759 024	0.173 641	9
10	0.385 543	6.144 567	0.162 745	10
11	0.350 494	6.495 861	0.153 963	11
12	0.318 631	6.813 692	0.146 763	12
13	0.289 664	7.103 356	0.140 779	13
14	0.263 331	7.366 687	0.135 746	14
15	0.239 392	7.606 080	0.131 474	15
16	0.217 629	7.823 709	0.127 817	16
17	0.197 845	8.021 553	0.124 664	17
18	0.179 859	8.201 412	0.121 930	18
19	0.163 500	8.364 920	0.119 547	19
20	0.148 544	8.513 564	0.117 460	20
21	0.135 131	8.648 694	0.115 624	21
22	0.122 846	8.771 540	0.114 005	22
23	0.111 678	8.883 718	0.112 572	23
24	0.101 526	8.986 744	0.111 300	24
25	0.092 296	9.077 040	0.110 168	25
26	0.083 905	9.160 945	0.109 159	26
27	0.076 278	9.237 223	0.108 258	27
28	0.069 343	9.307 567	0.107 451	28
29	0.063 039	9.372 606	0.106 728	29
30	0.057 309	9.426 914	0.106 079	30
31	0.052 099	9.479 013	0.105 496	31
32	0.047 362	9.526 376	0.104 972	32
33	0.043 057	9.569 432	0.104 499	33
34	0.039 143	9.608 575	0.104 074	34
35	0.035 584	9.644 159	0.103 690	35
36	0.032 349	9.676 508	0.103 343	36
37	0.029 408	9.705 917	0.103 030	37
38	0.026 735	9.732 651	0.102 747	38
39	0.024 304	9.756 956	0.102 491	39
40	0.022 095	9.779 051	0.102 259	40
41	0.020 086	9.799 137	0.102 050	41
42	0.018 260	9.817 397	0.101 860	42
43	0.016 600	9.833 998	0.101 688	43
44	0.015 091	9.849 089	0.101 532	44
45	0.013 719	9.862 808	0.101 391	45
46	0.012 472	9.875 280	0.101 263	46
47	0.011 338	9.886 618	0.101 147	47
48	0.010 307	9.896 926	0.101 041	48
49	0.009 370	9.906 296	0.100 946	49
50	0.008 519	9.914 814	0.100 859	50
51	0.007 744	9.922 559	0.100 780	51
52	0.007 040	9.929 594	0.100 709	52
53	0.006 400	9.935 999	0.100 644	53
54	0.005 818	9.941 817	0.100 585	54
55	0.005 289	9.947 106	0.100 532	55
56	0.004 809	9.951 915	0.100 483	56
57	0.004 371	9.956 286	0.100 439	57
58	0.003 974	9.960 260	0.100 399	58
59	0.003 613	9.963 873	0.100 363	59
60	0.003 284	9.967 157	0.100 330	60

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P	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1	P
1				1
0				0
D	$v^n = \frac{1}{(1+i)^n}$	$\frac{1}{(1+i)^n}$	$\frac{1}{1 - \frac{1}{(1+i)^n}}$	D
S				S
1	0.900 901	0.900 901	1.110 000	1
2	0.811 622	1.712 523	0.583 934	2
3	0.731 191	2.443 715	0.409 213	3
4	0.658 731	3.102 446	0.322 326	4
5	0.593 451	3.695 897	0.270 570	5
6	0.534 641	4.230 538	0.236 377	6
7	0.481 658	4.712 196	0.212 215	7
8	0.433 926	5.146 123	0.194 321	8
9	0.390 925	5.537 048	0.180 602	9
10	0.352 184	5.889 232	0.169 801	10
11	0.317 283	6.206 515	0.161 121	11
12	0.285 841	6.492 356	0.154 027	12
13	0.257 514	6.749 870	0.148 151	13
14	0.231 995	6.981 865	0.143 228	14
15	0.209 004	7.190 870	0.139 065	15
16	0.188 292	7.379 162	0.135 517	16
17	0.169 633	7.548 794	0.132 471	17
18	0.152 822	7.701 617	0.129 843	18
19	0.137 678	7.839 294	0.127 563	19
20	0.124 034	7.963 328	0.125 576	20
21	0.111 742	8.075 070	0.123 838	21
22	0.100 669	8.175 739	0.122 313	22
23	0.090 693	8.266 432	0.120 971	23
24	0.081 705	8.348 137	0.119 787	24
25	0.073 608	8.421 745	0.118 740	25
26	0.066 314	8.488 058	0.117 813	26
27	0.059 742	8.547 800	0.116 989	27
28	0.053 822	8.601 622	0.116 257	28
29	0.048 488	8.650 110	0.115 605	29
30	0.043 683	8.693 793	0.115 025	30
31	0.039 354	8.733 146	0.114 506	31
32	0.035 454	8.768 600	0.114 043	32
33	0.031 940	8.800 541	0.113 629	33
34	0.028 775	8.829 316	0.113 259	34
35	0.025 924	8.855 240	0.112 927	35
36	0.023 355	8.878 594	0.112 630	36
37	0.021 040	8.899 635	0.112 364	37
38	0.018 955	8.918 590	0.112 125	38
39	0.017 077	8.935 666	0.111 911	39
40	0.015 384	8.951 051	0.111 719	40
41	0.013 860	8.964 911	0.111 546	41
42	0.012 486	8.977 397	0.111 391	42
43	0.011 259	8.988 646	0.111 251	43
44	0.010 134	8.998 780	0.111 126	44
45	0.009 130	9.007 910	0.111 014	45
46	0.008 225	9.016 135	0.110 912	46
47	0.007 410	9.023 545	0.110 821	47
48	0.006 676	9.030 221	0.110 739	48
49	0.006 014	9.036 235	0.110 666	49
50	0.005 418	9.041 653	0.110 599	50
51	0.004 881	9.046 534	0.110 540	51
52	0.004 397	9.050 932	0.110 486	52
53	0.003 962	9.054 894	0.110 438	53
54	0.003 569	9.058 463	0.110 394	54
55	0.003 215	9.061 678	0.110 355	55
56	0.002 897	9.064 575	0.110 320	56
57	0.002 610	9.067 185	0.110 288	57
58	0.002 351	9.069 536	0.110 259	58
59	0.002 118	9.071 654	0.110 233	59
60	0.001 908	9.073 562	0.110 210	60

RATE
11%

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	P E R I O D S	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P E R I O D S
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i} = \frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{i} - \frac{1}{i(1+i)^n}$	
RATE 12%	1	0.892 857	0.892 857	1.120 000	1
	2	0.797 194	1.690 051	0.591 698	2
	3	0.711 780	2.401 831	0.416 349	3
	4	0.635 518	3.037 349	0.329 234	4
	5	0.567 427	3.604 776	0.277 410	5
	6	0.506 631	4.111 407	0.243 226	6
	7	0.452 349	4.563 757	0.219 118	7
	8	0.403 883	4.967 640	0.201 303	8
	9	0.360 610	5.328 250	0.187 679	9
	10	0.321 973	5.650 223	0.176 984	10
	11	0.287 476	5.937 699	0.168 415	11
	12	0.256 675	6.194 374	0.161 437	12
	13	0.229 174	6.423 548	0.155 677	13
	14	0.204 620	6.628 168	0.150 871	14
	15	0.182 696	6.810 864	0.146 824	15
	16	0.163 122	6.973 986	0.143 397	16
	17	0.145 644	7.119 630	0.140 457	17
	18	0.130 040	7.249 670	0.137 937	18
	19	0.116 107	7.365 777	0.135 763	19
	20	0.103 667	7.469 444	0.133 879	20
	21	0.092 560	7.562 003	0.132 240	21
	22	0.082 643	7.644 646	0.130 811	22
	23	0.073 788	7.718 434	0.129 560	23
	24	0.065 882	7.784 316	0.128 463	24
	25	0.058 823	7.843 139	0.127 500	25
	26	0.052 521	7.895 660	0.126 652	26
	27	0.046 894	7.942 534	0.125 904	27
	28	0.041 869	7.984 423	0.125 244	28
	29	0.037 383	8.021 806	0.124 660	29
	30	0.033 378	8.055 184	0.124 144	30
	31	0.029 802	8.084 986	0.123 686	31
	32	0.026 609	8.111 594	0.123 280	32
	33	0.023 758	8.135 352	0.122 920	33
	34	0.021 212	8.156 564	0.122 601	34
	35	0.018 940	8.175 504	0.122 317	35
	36	0.016 910	8.192 414	0.122 064	36
	37	0.015 098	8.207 513	0.121 840	37
	38	0.013 481	8.220 993	0.121 640	38
	39	0.012 036	8.233 030	0.121 462	39
	40	0.010 747	8.243 777	0.121 304	40
	41	0.009 595	8.253 372	0.121 163	41
	42	0.008 567	8.261 939	0.121 037	42
	43	0.007 649	8.269 589	0.120 925	43
	44	0.006 830	8.276 418	0.120 825	44
	45	0.006 098	8.282 516	0.120 736	45
	46	0.005 445	8.287 961	0.120 657	46
	47	0.004 861	8.292 822	0.120 586	47
	48	0.004 340	8.297 163	0.120 523	48
	49	0.003 875	8.301 038	0.120 467	49
	50	0.003 460	8.304 498	0.120 417	50
	51	0.003 089	8.307 588	0.120 372	51
	52	0.002 758	8.310 346	0.120 332	52
	53	0.002 463	8.312 809	0.120 296	53
	54	0.002 199	8.315 008	0.120 264	54
	55	0.001 963	8.316 972	0.120 236	55
	56	0.001 753	8.318 725	0.120 211	56
	57	0.001 565	8.320 290	0.120 188	57
	58	0.001 398	8.321 687	0.120 168	58
	59	0.001 248	8.322 935	0.120 150	59
	60	0.001 114	8.324 049	0.120 134	60

REPRODUCED FROM THE
 NATIONAL BUREAU OF STANDARDS
 MONOGRAPH SERVICE

	P E R I O D S	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P E R I O D S
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i} = \frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{a_{\overline{n} i}} = \frac{i}{1 - \frac{1}{(1+i)^n}}$	
RATE	1	0.884 956	0.884 956	1.130 000	1
	2	0.783 147	1.668 102	0.599 484	2
13%	3	0.693 050	2.361 153	0.423 522	3
	4	0.613 319	2.974 471	0.336 194	4
	5	0.542 760	3.517 231	0.284 315	5
	6	0.480 319	3.997 550	0.250 153	6
	7	0.425 061	4.422 610	0.226 111	7
	8	0.376 160	4.798 770	0.208 387	8
	9	0.332 885	5.131 655	0.194 869	9
	10	0.294 588	5.426 243	0.184 290	10
	11	0.260 698	5.685 941	0.175 841	11
	12	0.230 706	5.917 647	0.168 986	12
	13	0.204 165	6.121 812	0.163 350	13
	14	0.180 677	6.302 488	0.158 667	14
	15	0.159 891	6.462 379	0.154 742	15
	16	0.141 496	6.603 875	0.151 426	16
	17	0.125 218	6.729 093	0.148 608	17
	18	0.110 812	6.839 905	0.146 201	18
	19	0.098 064	6.937 969	0.144 134	19
	20	0.086 782	7.024 752	0.142 354	20
	21	0.076 798	7.101 550	0.140 814	21
	22	0.067 963	7.169 513	0.139 479	22
	23	0.060 144	7.229 658	0.138 319	23
	24	0.053 225	7.282 883	0.137 308	24
	25	0.047 102	7.329 985	0.136 426	25
	26	0.041 683	7.371 669	0.135 655	26
	27	0.036 888	7.408 550	0.134 979	27
	28	0.032 644	7.441 200	0.134 387	28
	29	0.028 889	7.470 068	0.133 867	29
	30	0.025 565	7.495 653	0.133 411	30
	31	0.022 624	7.518 277	0.133 009	31
	32	0.020 021	7.538 299	0.132 656	32
	33	0.017 718	7.556 016	0.132 345	33
	34	0.015 680	7.571 696	0.132 071	34
	35	0.013 876	7.585 572	0.131 829	35
	36	0.012 279	7.597 851	0.131 616	36
	37	0.010 867	7.608 718	0.131 428	37
	38	0.009 617	7.618 334	0.131 262	38
	39	0.008 510	7.626 844	0.131 116	39
	40	0.007 531	7.634 376	0.130 986	40
	41	0.006 665	7.641 040	0.130 872	41
	42	0.005 898	7.646 938	0.130 771	42
	43	0.005 219	7.652 158	0.130 682	43
	44	0.004 619	7.656 777	0.130 603	44
	45	0.004 088	7.660 864	0.130 534	45
	46	0.003 617	7.664 482	0.130 472	46
	47	0.003 201	7.667 683	0.130 417	47
	48	0.002 833	7.670 516	0.130 369	48
	49	0.002 507	7.673 023	0.130 327	49
	50	0.002 219	7.675 242	0.130 289	50
	51	0.001 963	7.677 205	0.130 256	51
	52	0.001 737	7.678 942	0.130 226	52
	53	0.001 538	7.680 480	0.130 200	53
	54	0.001 361	7.681 841	0.130 177	54
	55	0.001 204	7.683 045	0.130 157	55
	56	0.001 066	7.684 111	0.130 139	56
	57	0.000 943	7.685 054	0.130 123	57
	58	0.000 835	7.685 888	0.130 109	58
	59	0.000 739	7.686 627	0.130 096	59
	60	0.000 654	7.687 280	0.130 085	60

RATE
13%

MICROFILMED FROM RESEARCH
 AVAILABLE TO

RATE	PERIOD	Discount factor.	Present worth	Capital recovery	PERIOD	RATE
		Present worth of 1 received in period n.	of 1 received in n periods.	factor. Periodic payment to retire debt of 1.		
14%		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - v^n}{i}$	$\frac{1}{a_{\overline{n} i}} = \frac{i}{1 - v^n}$		14%
	1	0.877 193	0.877 193	1.140 000	1	
	2	0.767 468	1.646 661	0.607 290	2	
	3	0.674 972	2.321 632	0.430 731	3	
	4	0.592 080	2.913 712	0.343 205	4	
	5	0.519 369	3.433 081	0.291 284	5	
	6	0.455 587	3.888 668	0.257 157	6	
	7	0.399 637	4.288 305	0.233 192	7	
	8	0.350 559	4.638 864	0.215 570	8	
	9	0.307 508	4.946 372	0.202 168	9	
	10	0.269 744	5.216 116	0.191 714	10	
	11	0.236 617	5.452 733	0.183 394	11	
	12	0.207 559	5.660 292	0.176 669	12	
	13	0.182 069	5.842 362	0.171 164	13	
	14	0.159 710	6.002 072	0.166 609	14	
	15	0.140 096	6.142 168	0.162 809	15	
	16	0.122 892	6.265 060	0.159 615	16	
	17	0.107 800	6.372 859	0.156 915	17	
	18	0.094 561	6.467 420	0.154 621	18	
	19	0.082 948	6.550 369	0.152 663	19	
	20	0.072 762	6.623 131	0.150 986	20	
	21	0.063 026	6.686 957	0.149 545	21	
	22	0.055 998	6.742 944	0.148 303	22	
	23	0.049 112	6.792 056	0.147 231	23	
	24	0.043 081	6.835 137	0.146 303	24	
	25	0.037 790	6.872 927	0.145 498	25	
	26	0.033 149	6.906 077	0.144 800	26	
	27	0.029 078	6.935 155	0.144 193	27	
	28	0.025 507	6.960 662	0.143 664	28	
	29	0.022 375	6.983 037	0.143 204	29	
	30	0.019 627	7.002 664	0.142 803	30	
	31	0.017 217	7.019 881	0.142 453	31	
	32	0.015 102	7.034 983	0.142 147	32	
	33	0.013 248	7.048 231	0.141 880	33	
	34	0.011 621	7.059 852	0.141 646	34	
	35	0.010 194	7.070 045	0.141 442	35	
	36	0.008 942	7.078 987	0.141 263	36	
	37	0.007 844	7.086 831	0.141 107	37	
	38	0.006 880	7.093 711	0.140 970	38	
	39	0.006 035	7.099 747	0.140 850	39	
	40	0.005 294	7.105 041	0.140 745	40	
	41	0.004 644	7.109 685	0.140 653	41	
	42	0.004 074	7.113 759	0.140 573	42	
	43	0.003 573	7.117 332	0.140 502	43	
	44	0.003 135	7.120 467	0.140 440	44	
	45	0.002 750	7.123 217	0.140 386	45	
	46	0.002 412	7.125 629	0.140 338	46	
	47	0.002 116	7.127 744	0.140 297	47	
	48	0.001 856	7.129 600	0.140 260	48	
	49	0.001 628	7.131 228	0.140 228	49	
	50	0.001 428	7.132 656	0.140 200	50	
	51	0.001 253	7.133 909	0.140 176	51	
	52	0.001 099	7.135 008	0.140 154	52	
	53	0.000 964	7.135 972	0.140 135	53	
	54	0.000 846	7.136 818	0.140 118	54	
	55	0.000 742	7.137 559	0.140 104	55	
	56	0.000 651	7.138 210	0.140 091	56	
	57	0.000 571	7.138 781	0.140 080	57	
	58	0.000 501	7.139 281	0.140 070	58	
	59	0.000 439	7.139 720	0.140 062	59	
	60	0.000 385	7.140 106	0.140 054	60	

MICROFILMED FROM COPY AVAILABLE COPY

RATE	PERIODS	Discount factor.	Present worth	Capital recovery	PERIODS	RATE
		Present worth of 1 received in period n.	of 1 received in n periods.	factor. Periodic payment to retire debt of 1.		
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{1 - \frac{1}{(1+i)^n}}$		
15%	1	0.869 565	0.869 565	1.150 000	1	
	2	0.756 144	1.625 709	0.615 116	2	
	3	0.657 516	2.203 225	0.437 977	3	
	4	0.571 753	2.854 978	0.350 265	4	
	5	0.497 177	3.352 155	0.298 316	5	
	6	0.432 328	3.784 483	0.264 237	6	
	7	0.375 937	4.160 420	0.240 360	7	
	8	0.326 902	4.487 322	0.222 850	8	
	9	0.284 262	4.771 584	0.209 574	9	
	10	0.247 185	5.018 769	0.199 252	10	
	11	0.214 943	5.233 712	0.191 069	11	
	12	0.186 907	5.420 619	0.184 481	12	
	13	0.162 528	5.583 147	0.179 110	13	
	14	0.141 329	5.724 476	0.174 688	14	
	15	0.122 894	5.847 370	0.171 017	15	
	16	0.106 865	5.954 235	0.167 940	16	
	17	0.092 926	6.047 161	0.165 367	17	
	18	0.080 805	6.127 966	0.163 186	18	
	19	0.070 265	6.198 231	0.161 336	19	
	20	0.061 100	6.259 331	0.159 761	20	
	21	0.053 131	6.312 462	0.158 417	21	
	22	0.046 201	6.358 663	0.157 266	22	
	23	0.040 174	6.398 837	0.156 278	23	
	24	0.034 934	6.433 771	0.155 430	24	
	25	0.030 378	6.464 149	0.154 699	25	
	26	0.026 415	6.490 564	0.154 070	26	
	27	0.022 970	6.513 534	0.153 526	27	
	28	0.019 974	6.533 508	0.153 057	28	
	29	0.017 369	6.550 877	0.152 651	29	
	30	0.015 103	6.565 980	0.152 300	30	
	31	0.013 133	6.579 113	0.151 996	31	
	32	0.011 420	6.590 533	0.151 733	32	
	33	0.009 931	6.600 463	0.151 505	33	
	34	0.008 635	6.609 099	0.151 307	34	
	35	0.007 509	6.616 607	0.151 135	35	
	36	0.006 529	6.623 137	0.150 986	36	
	37	0.005 678	6.628 815	0.150 857	37	
	38	0.004 937	6.633 752	0.150 744	38	
	39	0.004 293	6.638 045	0.150 647	39	
	40	0.003 733	6.641 778	0.150 562	40	
	41	0.003 246	6.645 025	0.150 489	41	
	42	0.002 823	6.647 848	0.150 425	42	
	43	0.002 455	6.650 302	0.150 369	43	
	44	0.002 134	6.652 437	0.150 321	44	
	45	0.001 856	6.654 293	0.150 279	45	
	46	0.001 614	6.655 907	0.150 242	46	
	47	0.001 403	6.657 310	0.150 211	47	
	48	0.001 220	6.658 531	0.150 183	48	
	49	0.001 061	6.659 592	0.150 159	49	
	50	0.000 923	6.660 515	0.150 139	50	
	51	0.000 802	6.661 317	0.150 120	51	
	52	0.000 698	6.662 015	0.150 105	52	
	53	0.000 607	6.662 622	0.150 091	53	
	54	0.000 528	6.663 149	0.150 079	54	
	55	0.000 459	6.663 608	0.150 069	55	
	56	0.000 399	6.664 007	0.150 060	56	
	57	0.000 347	6.664 354	0.150 052	57	
	58	0.000 302	6.664 656	0.150 045	58	
	59	0.000 262	6.664 918	0.150 039	59	
	60	0.000 228	6.665 146	0.150 034	60	

UNREPRODUCIBLE COPY
 AVAILABLE COPY

	P R I O D S	Discount factor. Present worth of 1 received in period n. $v^n = \frac{1}{(1+i)^n}$	Present worth of 1 received in n periods. $a_{\overline{n} i} = \frac{1 - \frac{1}{(1+i)^n}}{i}$	Capital recovery factor. Periodic payment to retire debt of 1. $\frac{1}{a_{\overline{n} i}} = \frac{i}{1 - \frac{1}{(1+i)^n}}$	P R I O D S	
RATE	1	0.862 069	0.867 139	1.160 000	1	RATE
16%	2	0.743 163	1.605 232	0.622 963	2	16%
	3	0.640 658	2.245 890	0.445 258	3	
	4	0.552 291	2.798 181	0.357 375	4	
	5	0.476 113	3.274 294	0.305 409	5	
	6	0.410 442	3.684 736	0.271 390	6	
	7	0.353 830	4.038 565	0.247 613	7	
	8	0.305 025	4.343 591	0.230 224	8	
	9	0.262 953	4.606 544	0.217 082	9	
	10	0.226 684	4.833 227	0.206 901	10	
	11	0.195 417	5.028 644	0.198 861	11	
	12	0.168 463	5.197 107	0.192 415	12	
	13	0.145 227	5.342 334	0.187 184	13	
	14	0.125 195	5.467 529	0.182 898	14	
	15	0.107 927	5.575 456	0.179 358	15	
	16	0.093 041	5.668 497	0.176 414	16	
	17	0.080 207	5.748 704	0.173 952	17	
	18	0.069 144	5.817 848	0.171 885	18	
	19	0.059 607	5.877 455	0.170 142	19	
	20	0.051 385	5.928 841	0.168 667	20	
	21	0.044 298	5.973 139	0.167 416	21	
	22	0.038 189	6.011 326	0.166 353	22	
	23	0.032 920	6.044 247	0.165 447	23	
	24	0.028 380	6.072 627	0.164 673	24	
	25	0.024 465	6.097 092	0.164 013	25	
	26	0.021 091	6.118 183	0.163 447	26	
	27	0.018 182	6.136 364	0.162 963	27	
	28	0.015 674	6.152 038	0.162 548	28	
	29	0.013 512	6.165 550	0.162 192	29	
	30	0.011 648	6.177 198	0.161 886	30	
	31	0.010 042	6.187 240	0.161 623	31	
	32	0.008 657	6.195 897	0.161 397	32	
	33	0.007 463	6.203 359	0.161 203	33	
	34	0.006 433	6.209 792	0.161 036	34	
	35	0.005 546	6.215 338	0.160 892	35	
	36	0.004 781	6.220 119	0.160 769	36	
	37	0.004 121	6.224 241	0.160 662	37	
	38	0.003 553	6.227 794	0.160 571	38	
	39	0.003 063	6.230 857	0.160 492	39	
	40	0.002 640	6.233 497	0.160 424	40	
	41	0.002 276	6.235 773	0.160 365	41	
	42	0.001 962	6.237 736	0.160 315	42	
	43	0.001 692	6.239 427	0.160 271	43	
	44	0.001 458	6.240 886	0.160 234	44	
	45	0.001 257	6.242 143	0.160 201	45	
	46	0.001 084	6.243 227	0.160 174	46	
	47	0.000 934	6.244 161	0.160 150	47	
	48	0.000 805	6.244 966	0.160 129	48	
	49	0.000 694	6.245 661	0.160 111	49	
	50	0.000 599	6.246 259	0.160 096	50	
	51	0.000 516	6.246 775	0.160 083	51	
	52	0.000 445	6.247 220	0.160 071	52	
	53	0.000 383	6.247 603	0.160 061	53	
	54	0.000 331	6.247 934	0.160 053	54	
	55	0.000 285	6.248 219	0.160 046	55	
	56	0.000 246	6.248 465	0.160 039	56	
	57	0.000 212	6.248 676	0.160 034	57	
	58	0.000 183	6.248 859	0.160 029	58	
	59	0.000 157	6.249 016	0.160 025	59	
	60	0.000 136	6.249 152	0.160 022	60	

MICROFILMED FROM ORIGINAL COPY AVAILABLE COPY

	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	
	$v^n = \frac{1}{(1+i)^n}$	$a_{\overline{n} i} = \frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{a_{\overline{n} i}} = \frac{i}{1 - \frac{1}{(1+i)^n}}$	
1	0.854 701	0.854 701	1.170 000	1
2	0.730 514	1.585 214	0.630 829	2
3	0.624 371	2.209 585	0.452 574	3
4	0.533 650	2.743 235	0.364 533	4
5	0.456 111	3.199 346	0.312 564	5
6	0.389 839	3.589 185	0.278 615	6
7	0.333 195	3.922 380	0.254 947	7
8	0.284 782	4.207 163	0.237 690	8
9	0.243 404	4.450 566	0.224 691	9
10	0.208 037	4.658 604	0.214 657	10
11	0.177 810	4.836 413	0.206 765	11
12	0.151 974	4.988 387	0.200 466	12
13	0.129 892	5.118 280	0.195 378	13
14	0.111 019	5.229 299	0.191 230	14
15	0.094 888	5.324 187	0.187 822	15
16	0.081 101	5.405 288	0.185 004	16
17	0.069 317	5.474 605	0.182 662	17
18	0.059 245	5.533 851	0.180 706	18
19	0.050 637	5.584 488	0.179 067	19
20	0.043 280	5.627 767	0.177 690	20
21	0.036 991	5.664 758	0.176 530	21
22	0.031 616	5.696 375	0.175 550	22
23	0.027 022	5.723 397	0.174 721	23
24	0.023 096	5.746 493	0.174 019	24
25	0.019 740	5.766 234	0.173 423	25
26	0.016 672	5.783 106	0.172 917	26
27	0.014 421	5.797 526	0.172 487	27
28	0.012 325	5.809 851	0.172 121	28
29	0.010 534	5.820 386	0.171 810	29
30	0.009 004	5.829 390	0.171 545	30
31	0.007 696	5.837 085	0.171 318	31
32	0.006 577	5.843 663	0.171 126	32
33	0.005 622	5.849 284	0.170 961	33
34	0.004 805	5.854 089	0.170 821	34
35	0.004 107	5.858 196	0.170 701	35
36	0.003 510	5.861 706	0.170 599	36
37	0.003 000	5.864 706	0.170 512	37
38	0.002 564	5.867 270	0.170 437	38
39	0.002 192	5.869 461	0.170 373	39
40	0.001 873	5.871 335	0.170 319	40
41	0.001 601	5.872 936	0.170 273	41
42	0.001 368	5.874 304	0.170 233	42
43	0.001 170	5.875 473	0.170 199	43
44	0.001 000	5.876 473	0.170 170	44
45	0.000 854	5.877 327	0.170 145	45
46	0.000 730	5.878 058	0.170 124	46
47	0.000 624	5.878 682	0.170 106	47
48	0.000 533	5.879 215	0.170 091	48
49	0.000 456	5.879 671	0.170 078	49
50	0.000 390	5.880 061	0.170 066	50
51	0.000 333	5.880 394	0.170 057	51
52	0.000 285	5.880 678	0.170 048	52
53	0.000 243	5.880 922	0.170 041	53
54	0.000 208	5.881 130	0.170 035	54
55	0.000 178	5.881 307	0.170 030	55
56	0.000 152	5.881 459	0.170 026	56
57	0.000 130	5.881 589	0.170 022	57
58	0.000 111	5.881 700	0.170 019	58
59	0.000 095	5.881 795	0.170 016	59
60	0.000 081	5.881 876	0.170 014	60

RATE
17%

	P R E S E N T	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P E R I O D S	
		$v^n = \frac{1}{(1+i)^n}$	$a_{\overline{n} i} = \frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{a_{\overline{n} i}} = \frac{1}{1 - \frac{1}{(1+i)^n}}$		
RATE 18%	1	0.847 458	0.847 458	1.180 000	1	RATE 18%
	2	0.718 184	1.565 642	0.638 716	2	
	3	0.608 631	2.174 273	0.459 924	3	
	4	0.515 789	2.690 062	0.371 739	4	
	5	0.437 109	3.127 171	0.319 778	5	
	6	0.370 432	3.497 603	0.285 910	6	
	7	0.313 925	3.811 528	0.262 362	7	
	8	0.266 038	4.077 566	0.245 244	8	
	9	0.225 456	4.303 022	0.232 395	9	
	10	0.191 064	4.494 086	0.222 515	10	
	11	0.161 919	4.656 005	0.214 776	11	
	12	0.137 220	4.793 225	0.208 628	12	
	13	0.116 288	4.909 513	0.203 686	13	
	14	0.098 549	5.008 062	0.199 678	14	
	15	0.083 516	5.091 578	0.196 403	15	
	16	0.070 776	5.162 354	0.193 710	16	
	17	0.059 980	5.222 334	0.191 485	17	
	18	0.050 830	5.273 164	0.189 639	18	
	19	0.043 077	5.316 241	0.188 103	19	
	20	0.036 506	5.352 746	0.186 820	20	
	21	0.030 937	5.383 683	0.185 746	21	
	22	0.026 218	5.409 901	0.184 846	22	
	23	0.022 218	5.432 120	0.184 090	23	
	24	0.018 829	5.450 949	0.183 454	24	
	25	0.015 957	5.466 906	0.182 919	25	
	26	0.013 523	5.480 429	0.182 467	26	
	27	0.011 460	5.491 889	0.182 087	27	
	28	0.009 712	5.501 601	0.191 765	28	
	29	0.008 230	5.509 831	0.181 494	29	
	30	0.006 975	5.516 806	0.181 264	30	
	31	0.005 911	5.522 717	0.181 070	31	
	32	0.005 009	5.527 726	0.180 906	32	
	33	0.004 245	5.531 971	0.180 767	33	
	34	0.003 598	5.535 569	0.180 650	34	
	35	0.003 049	5.538 618	0.180 550	35	
	36	0.002 584	5.541 201	0.180 466	36	
	37	0.002 190	5.543 391	0.180 395	37	
	38	0.001 856	5.545 247	0.180 335	38	
	39	0.001 573	5.546 819	0.180 284	39	
	40	0.001 333	5.548 152	0.180 240	40	
	41	0.001 129	5.549 281	0.180 204	41	
	42	0.000 957	5.550 238	0.180 172	42	
	43	0.000 811	5.551 049	0.180 146	43	
	44	0.000 687	5.551 737	0.180 124	44	
	45	0.000 583	5.552 319	0.180 105	45	
	46	0.000 494	5.552 813	0.180 089	46	
	47	0.000 418	5.553 231	0.180 075	47	
	48	0.000 355	5.553 586	0.180 064	48	
	49	0.000 300	5.553 886	0.180 054	49	
	50	0.000 255	5.554 141	0.180 046	50	
	51	0.000 216	5.554 357	0.180 039	51	
	52	0.000 183	5.554 540	0.180 033	52	
	53	0.000 155	5.554 695	0.180 028	53	
	54	0.000 131	5.554 826	0.180 024	54	
	55	0.000 111	5.554 937	0.180 020	55	
	56	0.000 094	5.555 032	0.180 017	56	
	57	0.000 080	5.555 111	0.180 014	57	
	58	0.000 068	5.555 179	0.180 012	58	
	59	0.000 057	5.555 237	0.180 010	59	
	60	0.000 049	5.555 285	0.180 009	60	

	P R I O D S	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P R I O D S
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{1 - \frac{1}{(1+i)^n}}$	
	1	0.840 336	0.840 336	1.190 000	1
	2	0.706 165	1.546 501	0.646 621	2
	3	0.593 416	2.139 917	0.467 308	3
	4	0.498 669	2.638 586	0.378 991	4
	5	0.419 049	3.057 635	0.327 050	5
	6	0.352 142	3.409 777	0.293 274	6
	7	0.295 918	3.705 695	0.269 855	7
	8	0.248 671	3.954 366	0.252 885	8
	9	0.208 967	4.163 332	0.240 192	9
	10	0.175 602	4.338 935	0.230 471	10
	11	0.147 565	4.486 500	0.222 891	11
	12	0.124 004	4.610 504	0.216 896	12
	13	0.104 205	4.714 709	0.212 102	13
	14	0.087 567	4.802 277	0.208 235	14
	15	0.073 586	4.875 863	0.205 092	15
	16	0.061 837	4.937 700	0.202 523	16
	17	0.051 964	4.989 664	0.200 414	17
	18	0.043 667	5.033 331	0.198 676	18
	19	0.036 695	5.070 026	0.197 238	19
	20	0.030 836	5.100 962	0.196 045	20
	21	0.025 913	5.126 775	0.195 054	21
	22	0.021 775	5.148 550	0.194 229	22
	23	0.018 299	5.166 849	0.193 542	23
	24	0.015 377	5.182 226	0.192 967	24
	25	0.012 922	5.195 148	0.192 487	25
	26	0.010 859	5.206 007	0.192 086	26
	27	0.009 125	5.215 132	0.191 750	27
	28	0.007 668	5.222 800	0.191 468	28
	29	0.006 444	5.229 243	0.191 232	29
	30	0.005 415	5.234 658	0.191 034	30
	31	0.004 550	5.239 209	0.190 869	31
	32	0.003 824	5.243 033	0.190 729	32
	33	0.003 213	5.246 246	0.190 612	33
	34	0.002 700	5.248 946	0.190 514	34
	35	0.002 269	5.251 215	0.190 432	35
	36	0.001 907	5.253 122	0.190 363	36
	37	0.001 602	5.254 724	0.190 305	37
	38	0.001 347	5.256 071	0.190 256	38
	39	0.001 132	5.257 202	0.190 215	39
	40	0.000 951	5.258 153	0.190 181	40
	41	0.000 799	5.258 952	0.190 152	41
	42	0.000 671	5.259 624	0.190 128	42
	43	0.000 564	5.260 188	0.190 107	43
	44	0.000 474	5.260 662	0.190 090	44
	45	0.000 398	5.261 061	0.190 076	45
	46	0.000 335	5.261 396	0.190 064	46
	47	0.000 281	5.261 677	0.190 053	47
	48	0.000 236	5.261 913	0.190 045	48
	49	0.000 199	5.262 112	0.190 038	49
	50	0.000 167	5.262 279	0.190 032	50
	51	0.000 140	5.262 419	0.190 027	51
	52	0.000 118	5.262 537	0.190 022	52
	53	0.000 099	5.262 636	0.190 019	53
	54	0.000 083	5.262 720	0.190 016	54
	55	0.000 070	5.262 790	0.190 013	55
	56	0.000 059	5.262 848	0.190 011	56
	57	0.000 049	5.262 898	0.190 009	57
	58	0.000 042	5.262 939	0.190 008	58
	59	0.000 035	5.262 974	0.190 007	59
	60	0.000 029	5.263 004	0.190 006	60

RATE
19%

MICROFILMED FROM ORIGINAL
 AVAILABLE FROM
 UNIVERSITY MICROFILMS
 ANN ARBOR, MICHIGAN

RATE 20%	P E R I O D S	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P E R I O D S	RATE 20%
		$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{\frac{i}{1 - \frac{1}{(1+i)^n}}}$		
	1	0.833 333	0.833 333	1.200 000	1	
	2	0.694 444	1.527 778	0.654 545	2	
	3	0.578 704	2.106 481	0.474 725	3	
	4	0.482 253	2.580 735	0.386 289	4	
	5	0.401 878	2.990 612	0.334 380	5	
	6	0.334 898	3.325 510	0.300 706	6	
	7	0.279 082	3.604 592	0.277 424	7	
	8	0.232 568	3.837 160	0.260 609	8	
	9	0.193 807	4.030 967	0.248 079	9	
	10	0.161 506	4.192 472	0.238 523	10	
	11	0.134 588	4.327 060	0.231 104	11	
	12	0.112 157	4.439 217	0.225 265	12	
	13	0.093 464	4.532 681	0.220 620	13	
	14	0.077 887	4.610 567	0.216 893	14	
	15	0.064 905	4.675 473	0.213 882	15	
	16	0.054 088	4.729 561	0.211 436	16	
	17	0.045 073	4.774 634	0.209 440	17	
	18	0.037 561	4.812 195	0.207 805	18	
	19	0.031 301	4.843 496	0.206 462	19	
	20	0.026 084	4.869 580	0.205 357	20	
	21	0.021 737	4.891 315	0.204 444	21	
	22	0.018 114	4.909 430	0.203 690	22	
	23	0.015 095	4.924 525	0.203 065	23	
	24	0.012 579	4.937 104	0.202 548	24	
	25	0.010 483	4.947 587	0.202 119	25	
	26	0.008 735	4.956 323	0.201 762	26	
	27	0.007 280	4.963 602	0.201 467	27	
	28	0.006 066	4.969 668	0.201 221	28	
	29	0.005 055	4.974 724	0.201 016	29	
	30	0.004 213	4.978 936	0.200 846	30	
	31	0.003 511	4.982 447	0.200 705	31	
	32	0.002 926	4.985 372	0.200 587	32	
	33	0.002 438	4.987 810	0.200 489	33	
	34	0.002 032	4.989 842	0.200 407	34	
	35	0.001 693	4.991 535	0.200 339	35	
	36	0.001 411	4.992 946	0.200 283	36	
	37	0.001 176	4.994 122	0.200 235	37	
	38	0.000 980	4.995 101	0.200 196	38	
	39	0.000 816	4.995 918	0.200 163	39	
	40	0.000 680	4.996 598	0.200 136	40	
	41	0.000 567	4.997 165	0.200 113	41	
	42	0.000 472	4.997 638	0.200 095	42	
	43	0.000 394	4.998 031	0.200 079	43	
	44	0.000 328	4.998 359	0.200 066	44	
	45	0.000 273	4.998 631	0.200 055	45	
	46	0.000 228	4.998 861	0.200 046	46	
	47	0.000 190	4.999 051	0.200 038	47	
	48	0.000 158	4.999 209	0.200 032	48	
	49	0.000 132	4.999 341	0.200 026	49	
	50	0.000 110	4.999 451	0.200 022	50	
	51	0.000 092	4.999 542	0.200 018	51	
	52	0.000 076	4.999 618	0.200 015	52	
	53	0.000 064	4.999 682	0.200 012	53	
	54	0.000 053	4.999 735	0.200 011	54	
	55	0.000 044	4.999 779	0.200 009	55	
	56	0.000 037	4.999 816	0.200 007	56	
	57	0.000 031	4.999 847	0.200 006	57	
	58	0.000 026	4.999 872	0.200 005	58	
	59	0.000 021	4.999 894	0.200 004	59	
	60	0.000 018	4.999 911	0.200 004	60	

UNITED STATES GOVERNMENT
 PRINTING OFFICE: 1965

PERIODS	Discount factor.	Present worth	Capital recovery	PERIODS
	Present worth of 1 received in period n.	of 1 received in n periods.	factor. Periodic payment to retire debt of 1.	
	$v^n = \frac{1}{(1+i)^n}$	$A_n = \frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{A_n} = \frac{i}{1 - \frac{1}{(1+i)^n}}$	
1	0.819 672	0.819 672	1.220 000	1
2	0.671 862	1.491 535	0.670 450	2
3	0.550 707	2.042 241	0.489 658	3
4	0.451 399	2.493 641	0.401 029	4
5	0.369 999	2.863 640	0.349 206	5
6	0.303 278	3.166 918	0.315 764	6
7	0.248 589	3.415 506	0.292 782	7
8	0.203 761	3.619 268	0.276 299	8
9	0.167 017	3.786 285	0.264 111	9
10	0.136 890	3.923 184	0.254 895	10
11	0.112 213	4.035 397	0.247 807	11
12	0.091 978	4.127 375	0.242 285	12
13	0.075 391	4.202 766	0.237 939	13
14	0.061 796	4.264 562	0.234 491	14
15	0.050 653	4.315 215	0.231 738	15
16	0.041 519	4.356 734	0.229 530	16
17	0.034 032	4.390 765	0.227 751	17
18	0.027 895	4.418 660	0.226 313	18
19	0.022 865	4.441 525	0.225 148	19
20	0.018 741	4.460 266	0.224 202	20
21	0.015 362	4.475 628	0.223 432	21
22	0.012 592	4.488 220	0.222 805	22
23	0.010 321	4.498 541	0.222 294	23
24	0.008 460	4.507 001	0.221 877	24
25	0.006 934	4.513 935	0.221 536	25
26	0.005 684	4.519 619	0.221 258	26
27	0.004 659	4.524 278	0.221 030	27
28	0.003 819	4.528 096	0.220 843	28
29	0.003 130	4.531 227	0.220 691	29
30	0.002 566	4.533 792	0.220 566	30
31	0.002 103	4.535 895	0.220 464	31
32	0.001 724	4.537 619	0.220 380	32
33	0.001 413	4.539 032	0.220 311	33
34	0.001 158	4.540 190	0.220 255	34
35	0.000 949	4.541 140	0.220 209	35
36	0.000 778	4.541 918	0.220 171	36
37	0.000 638	4.542 555	0.220 140	37
38	0.000 523	4.543 078	0.220 115	38
39	0.000 429	4.543 507	0.220 094	39
40	0.000 351	4.543 858	0.220 077	40
41	0.000 288	4.544 146	0.220 063	41
42	0.000 236	4.544 382	0.220 052	42
43	0.000 193	4.544 575	0.220 043	43
44	0.000 159	4.544 734	0.220 035	44
45	0.000 130	4.544 864	0.220 029	45
46	0.000 107	4.544 970	0.220 023	46
47	0.000 087	4.545 058	0.220 019	47
48	0.000 072	4.545 129	0.220 016	48
49	0.000 059	4.545 188	0.220 013	49
50	0.000 048	4.545 236	0.220 011	50
51	0.000 039	4.545 275	0.220 009	51
52	0.000 032	4.545 308	0.220 007	52
53	0.000 026	4.545 334	0.220 006	53
54	0.000 022	4.545 356	0.220 005	54
55	0.000 018	4.545 374	0.220 004	55
56	0.000 015	4.545 388	0.220 003	56
57	0.000 012	4.545 400	0.220 003	57
58	0.000 010	4.545 410	0.220 002	58
59	0.000 008	4.545 418	0.220 002	59
60	0.000 007	4.545 425	0.220 001	60

RATE
22%

REPRODUCED FROM THE
 FEDERAL RESERVE BOARD
 OF RESERVES
 BOARD OF GOVERNORS
 FEDERAL RESERVE SYSTEM
 WASHINGTON, D. C. 20540

P E R I O D S	Discount factor. Present worth of 1 received in period n.	Present worth of 1 received in n periods.	Capital recovery factor. Periodic payment to retire debt of 1.	P E R I O D S
	$v^n = \frac{1}{(1+i)^n}$	$\frac{1 - \frac{1}{(1+i)^n}}{i}$	$\frac{1}{\frac{1 - \frac{1}{(1+i)^n}}{i}} = \frac{i}{1 - \frac{1}{(1+i)^n}}$	

RATE 25%	1	3.800 000	0.800 000	1.250 000	1	RATE 25%
	2	0.640 000	1.440 000	0.694 444	2	
	3	0.512 000	1.952 000	0.512 295	3	
	4	0.409 600	2.361 600	0.423 442	4	
	5	0.327 680	2.689 280	0.371 847	5	
	6	0.262 144	2.951 424	0.338 819	6	
	7	0.209 715	3.161 139	0.316 342	7	
	8	0.167 772	3.328 911	0.300 399	8	
	9	0.134 218	3.463 129	0.288 756	9	
	10	0.107 374	3.570 503	0.280 073	10	
	11	0.085 899	3.656 403	0.273 493	11	
	12	0.068 719	3.725 122	0.268 448	12	
	13	0.054 976	3.780 098	0.264 543	13	
	14	0.043 980	3.824 078	0.261 501	14	
	15	0.035 184	3.859 263	0.259 117	15	
	16	0.028 147	3.887 410	0.257 241	16	
	17	0.022 518	3.909 928	0.255 759	17	
	18	0.018 014	3.927 942	0.254 586	18	
	19	0.014 412	3.942 354	0.253 656	19	
	20	0.011 529	3.953 883	0.252 916	20	
	21	0.009 223	3.963 107	0.252 327	21	
	22	0.007 379	3.970 485	0.251 859	22	
	23	0.005 903	3.976 388	0.251 485	23	
	24	0.004 722	3.981 111	0.251 186	24	
	25	0.003 778	3.984 888	0.250 948	25	
	26	0.003 022	3.987 911	0.250 758	26	
	27	0.002 418	3.990 329	0.250 606	27	
	28	0.001 934	3.992 263	0.250 465	28	
	29	0.001 547	3.993 810	0.250 387	29	
	30	0.001 238	3.995 048	0.250 310	30	
	31	0.000 990	3.996 039	0.250 248	31	
	32	0.000 792	3.996 831	0.250 198	32	
	33	0.000 634	3.997 465	0.250 159	33	
	34	0.000 507	3.997 972	0.250 127	34	
	35	0.000 406	3.998 377	0.250 101	35	
	36	0.000 325	3.998 702	0.250 081	36	
	37	0.000 260	3.998 962	0.250 065	37	
	38	0.000 208	3.999 169	0.250 052	38	
	39	0.000 166	3.999 335	0.250 042	39	
	40	0.000 133	3.999 468	0.250 033	40	
	41	0.000 106	3.999 575	0.250 027	41	
	42	0.000 085	3.999 660	0.250 021	42	
	43	0.000 068	3.999 728	0.250 017	43	
	44	0.000 054	3.999 782	0.250 014	44	
	45	0.000 044	3.999 826	0.250 011	45	
	46	0.000 035	3.999 861	0.250 009	46	
	47	0.000 028	3.999 888	0.250 007	47	
	48	0.000 022	3.999 911	0.250 006	48	
	49	0.000 018	3.999 929	0.250 004	49	
	50	0.000 014	3.999 943	0.250 004	50	
	51	0.000 011	3.999 954	0.250 003	51	
	52	0.000 009	3.999 963	0.250 002	52	
	53	0.000 007	3.999 971	0.250 002	53	
	54	0.000 006	3.999 977	0.250 001	54	
	55	0.000 005	3.999 981	0.250 001	55	
	56	0.000 004	3.999 985	0.250 001	56	
	57	0.000 003	3.999 988	0.250 001	57	
	58	0.000 002	3.999 990	0.250 001	58	
	59	0.000 002	3.999 992	0.250 000	59	
	60	0.000 002	3.999 994	0.250 000	60	

MICROFILMED FROM BEST AVAILABLE

	P E R I O D S	Discount factor. Present worth of 1 received in period n. $v^n = \frac{1}{(1+i)^n}$	Present worth of 1 received in n periods. $a_{\overline{n} i} = \frac{1 - \frac{1}{(1+i)^n}}{i}$	Capital recovery factor. Periodic payment to retire debt of 1. $\frac{1}{a_{\overline{n} i}} = \frac{i}{1 - \frac{1}{(1+i)^n}}$	P E R I O D S
	1	0.769 231	0.769 231	1.300 000	1
	2	0.591 716	1.360 947	0.734 763	2
	3	0.455 166	1.816 113	0.550 627	3
	4	0.350 128	2.166 241	0.461 629	4
	5	0.269 329	2.435 570	0.410 582	5
	6	0.207 176	2.642 746	0.378 394	6
	7	0.159 366	2.802 112	0.356 874	7
	8	0.122 589	2.924 702	0.341 915	8
	9	0.094 300	3.019 001	0.331 235	9
	10	0.072 538	3.091 539	0.323 463	10
	11	0.055 799	3.147 338	0.317 729	11
	12	0.042 922	3.190 260	0.313 454	12
	13	0.033 017	3.223 277	0.310 243	13
	14	0.025 398	3.248 675	0.307 818	14
	15	0.019 537	3.268 211	0.305 978	15
	16	0.015 028	3.283 239	0.304 577	16
	17	0.011 560	3.294 800	0.303 509	17
	18	0.008 892	3.303 692	0.302 692	18
	19	0.006 840	3.310 532	0.302 066	19
	20	0.005 262	3.315 794	0.301 587	20
	21	0.004 048	3.319 842	0.301 219	21
	22	0.003 113	3.322 955	0.300 937	22
	23	0.002 395	3.325 350	0.300 720	23
	24	0.001 842	3.327 192	0.300 554	24
	25	0.001 417	3.328 609	0.300 426	25
	26	0.001 090	3.329 700	0.300 327	26
	27	0.000 839	3.330 538	0.300 252	27
	28	0.000 645	3.331 183	0.300 194	28
	29	0.000 496	3.331 679	0.300 149	29
	30	0.000 392	3.332 061	0.300 115	30
	31	0.000 294	3.332 355	0.300 088	31
	32	0.000 226	3.332 581	0.300 068	32
	33	0.000 174	3.332 754	0.300 052	33
	34	0.000 134	3.332 888	0.300 040	34
	35	0.000 103	3.332 991	0.300 031	35
	36	0.000 079	3.333 070	0.300 024	36
	37	0.000 061	3.333 131	0.300 018	37
	38	0.000 047	3.333 177	0.300 014	38
	39	0.000 036	3.333 213	0.300 011	39
	40	0.000 028	3.333 241	0.300 008	40
	41	0.000 021	3.333 262	0.300 006	41
	42	0.000 016	3.333 279	0.300 005	42
	43	0.000 013	3.333 291	0.300 004	43
	44	0.000 010	3.333 301	0.300 003	44
	45	0.000 007	3.333 308	0.300 002	45
	46	0.000 006	3.333 314	0.300 002	46
	47	0.000 004	3.333 319	0.300 001	47
	48	0.000 003	3.333 322	0.300 001	48
	49	0.000 003	3.333 325	0.300 001	49
	50	0.000 002	3.333 327	0.300 001	50
	51	0.000 002	3.333 328	0.300 000	51
	52	0.000 001	3.333 329	0.300 000	52
	53	0.000 001	3.333 330	0.300 000	53
	54	0.000 001	3.333 331	0.300 000	54
	55	0.000 001	3.333 332	0.300 000	55
	56	0.000 000	3.333 332	0.300 000	56
	57	0.000 000	3.333 332	0.300 000	57
	58	0.000 000	3.333 333	0.300 000	58
	59	0.000 000	3.333 333	0.300 000	59
	60	0.000 000	3.333 333	0.300 000	60

RATE
30%

RATE
30%

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