IRRIGATION DEVELOPMENT OPTIONS AND INVESTMENT STRATEGIES FOR THE 1980'S

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WMS Report 2

PREFACE

This study was conducted as part of the Water Management Synthesis Project, a program funded and assisted by the United States Agency for International Development through the Consortium for International Development. Utah State University and Colorado State University serve as lead universities for the project.

The key objective is to provide services in irrigated regions of the world for improving the design and operation of existing and future irrigation projects and give guidance to USAID for selecting and implementing development options and investment strategies.

For more information, contact the Water Management Synthesis Project for information about the project and any of its services.

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FOREWORD

This preliminary report was produced by Thomas F. Weaver, Agricultural Economist, and Howard B. Peterson, Agronomist. The team traveled to Nepal July 4, 1980, and departed July 10, 1980. While there they traveled with Douglas R. Pickett from the Office of Agriculture and Resource Conservation, USAID/Nepal. This trip took the members into the "Central Hill Country" to observe intensive irrigation carried out under extreme conditions of rough and steep topography. The remainder of time was spent informally discussing the present and proposed activities supported by USAID.

The Mission did not have personnel and time to engage in a full review of the projects at that time, and hence, this report constitutes some observations and notes on impressions, rather than a formal report of a review. The team was informed prior to arrival that there was to be a preliminary contact.

The team wishes to thank Douglas R. Pickett and his staff for their time and assistance. Mr. Pickett went out of his way to provide help during the weekend the team was there. He conducted the field trip for us on Sunday, July 6, at a time when he was trying to arrange his work and personal affairs prior to going on extended leave.

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SECTION I

Introduction

The USAID Nepal Mission was not able to engage in a study of irrigation strategy and development options. This was because of prior commitments and responsibilities at a very critical time of the year. The purpose of the visit was, therefore, to gain some preliminary background information, impressions and comments on the irrigation component of USAID projects.

A comprehensive assessment of the irrigation needs of the country was not possible given the assignment of and resources available to the team. The conventional wisdom is that irrigation is an important input for production in the Terai (flatlands). Irrigation has long been considered important to the hill people engaged in survival agriculture and donors such as USAID are considering support for new developments.

Background

Nepal is a landlocked country about 500 miles long and 100 miles wide. In the south is a flat fertile strip of territory known as the Terai. Central Nepal, known as the "hill country," is crisscrossed by the lower ranges of the Himalayas and by numerous mountain rivers. The high Himalayas border with Tibet on the north.

There is great climatic diversity within the country. In general, three large ecosystem types are recognized: (1) the flatlands (the Terai); (2) the middle hills; and (3) the mountains. There is "great" diversity of micro-climate within these regions, particularly the hills and mountains. This great diversity means great variability in both the need for and returns from irrigation.

The population density of Nepal is about 92 per square kilometer. Approximately one-third of the population lives in the Terai region (flatlands) and about two-thirds in the central, or hilly, region.

Nepal is one of the least developed countries in Asia. In 1977 average per capital income was estimated at $108. Agriculture

provides two-thirds of the country's income and 90 percent of employment. About 30 percent of the total country is cultivatable and another 33 percent is forested. Rice, wheat and jute are the main crops.

Irrigation Development

To date, irrigation development has been almost exclusively focused on the flatlands (Terai). Over the past two decades not only irrigation but almost all other developments have been directed to this area.

Twenty to 30 years ago the Terai was relatively sparsely populated forest with a rich development potential. Massive land clearing, road building and other infrastructive investment has been and continues to be made. This strategy was deemed appropriate given the extreme population pressure and outward migration from the hill country.

In more recent years (1975-1980 Fifth Five Year Plan) more emphasis was given to social services (education health, etc.) and the Sixth Five Year Plan focuses some attention to the hill areas where the majority of the population still lives. Overall the plan calls for increasing agricultural production, particularly in the hill country, increasing employment in all sectors and providing minimum household needs for food, fuel, drinking water, health and sanitation, and improving communication and transportation.

Under the above strategy, irrigation investment in large scale development is going forward in the Terai supported by such donors as the World Bank. USAID is, however, focusing its attention on the hill country, consistent with the objectives of the Government of Nepal and with its own mission to reach small farmers and the poorest of the poor.

Current Irrigation Investment by USAID

At the present time there are no USAID financed irrigation projects. Irrigation development is, however, a part of two projects which are to begin within the next year. These are: (1) rural area development, Rapati zone; and (2) resource conservation and utilization project.

The Rural Area Development (RAD) Rapati Zone. This project is seen as the first step in a 15 to 20 year USAID commitment to rural development in the project area to include: (1) increasing food production and consumption; (2) increasing income opportunities to the disadvantaged, including the poor, landless laborers, occupational castes and women; (3) strengthening local government planning and implementing capability; and (4) integrating the zone with national efforts and agencies. Some of the activities which will be undertaken to achieve these objectives are: (1) farming systems (animals, annual crops, fruits, nuts, etc.); (2) kitchen gardens; (3) nutrition education; (4) on-farm processing and storage; (5) recruiting extension workers; (6) "leader farmers" program; and (7) developing local headquarters for the Department of Agriculture and its agencies.

In addition, the project will deal with renewable resource management (forestry and soil and water conservation), employment and skills development, rural industry, education, appropriate technology and alternative energy, rural works, roads, institutional development and training. The total project costs over the next five years are estimated at $33.7 million.

Irrigation will be a relatively modest proportion of the total project. Some 1,250 hectares are programmed to be fully irrigated. There will be both minor systems (under 50 hectares) and medium systems (up to 100 hectares). For minor schemes grants and technical assistance will be given to local participants to improve existing systems and construct some new ones. The medium schemes will be under the authority of the Department of Irrigation, which will carry out on-site design investigations and direct and monitor construction.

Some perspective on the relative importance of the irrigation component of the project comes from noting that the total project area is 10,131 square kilometers, of which 12 percent, or 1,215 square kilometers, is cultivated. Under the project 1,250 are to be fully irrigated (and an unknown amount of this is improvement of existing systems). Another perspective comes from comparing total population of the zone (850,000 estimated for 1980) with the total irrigated acreage.

Resource Conservation and Utilization Project. This project is described as a multi-faceted and integrated project designed to halt the degradation of the environment. It includes reforestation, range management, alternative energy sources, soil conservation and water

resource management. The overall project objective will be to improve the standard of living of the rural poor by protection of the soil, water and plant resource base of the project area. There will be activities associated with agricultural production, road and bridge building and irrigation. The irrigation development will be both the upgrading of existing systems and the building of new. There were no project documents available to the study team which describing these projects. They were reported to be small overall (36 (36 projects over 530 hectares) with an estimated cost of around $750,000 (out of a total project cost of approximately $42.5 million).

SECTION II

Irrigation Development Options

The decision to focus development efforts on the hill country immediately limits development options. For example:

Expansion vs. Intensification

There is relatively little new irrigation development in the hill country. The system of water transfer from field to field down the steep terraced hills is well developed. There is an uncounted number of very small irrigation systems which utilize water from mountain springs and streams. There may be some opportunities for improving these systems, but because of the relatively small acreages the overall project potential for expansion is limited.

Large vs. Small

Given the nature of the topography, the possibilities for large scale irrigation projects in the hill country are extremely limited. There are, however, decisions to be made regarding the type and design of small scale projects. For example, there is land that can be developed in the narrow mountain valleys. These lands are rough and often bisected by ravines. The water in nearby rivers is abundant but the diversions and lifts will be complex for the amount of land to be improved. Water power development of these same rivers could provide the electrical energy for pump irrigation, but it will be

difficult to develop this potential given the steep terrain and existing limited road system. In the opinion of the study team, considerable effort should be devoted to the design phase of hill irrigation development. The experimental program in India with tank and sprinkler type system might be usefully monitored. Experimental delivery systems using pipe and conduits might be considered. All system designs should be considered for their organizational implications.

Appendix A describes a system used in Guatemala. Small streams were diverted into plastic pipes and the difference in elevation used to operate sprinkler systems. Something similar might be adapted for use in Nepal.

Irrigation vs. Rainfed

Mean monthly rainfall records were inspected for 94 locations. At most rainfall stations there is a period of excessive precipitation. Amounts in the range of 300 to 600 mm are common. Irrigation is of importance during most months at some locations and can be of value during some months at most locations. It is, however, evident that the emphasis needs to be mainly on water resource management and upon optimizing production under conditions of rainfed agriculture.

At elevations below about 4,000 to 5,000 feet or 1,200 to 1,500 meters the mean monthly temperatures are generally favorable for some level of crop production during the entire year. At higher elevations temperatures may be too low for good production during about three months.

For high rainfall areas of slopes of two percent or less (three percent or less if the soil surface is quite irregular), very outstanding increases in crop production are often possible through improved surface drainage. Also, optimization of yields through promoting programs of fertilization consistent with the available water offer a large potential for increased production.

The nature of the terrain, steep slopes with narrow valley floors, seems to provide limited overall opportunity for irrigation development. This suggests that rainfed cropping systems may be of major importance in improving the overall agricultural economy of the hill country. The great climatic diversity within these hills will require a considerable research effort in developing cropping systems appropriate to the various micro-climates.

There has been an ongoing cropping system research project for a number of years. According to the research workers involved, a number of very promising varieties and cropping systems have been developed for rainfed conditions. It appeared to the study team that this had been a very wise and appropriate effort. Given the generally limited potential for developing irrigation systems in the hill country, research efforts on rainfed cropping systems will be a very high priority requirement well into the future.

The study team was not able to determine to what extent such research has been planned for the years ahead. It was reported by one source, however, that the USAID financed project would be ending. Given the obvious needs of the hill country, the study team assumes that this research function will be provided by other means.

SECTION III

Investment Strategies

Direct vs. Indirect

The two USAID projects in Nepal which include an irrigation component are both briefly described in Section I of this report. Clearly, the indirect or integrated approach has been adopted. The two projects are not "integrated" in the same way. The Rural Area Development Project is integrated in the conventional sense, i.e., it includes government institutions, farmer institutions, agriculture, village industries, capital infrastructure, and so forth. The second project. the Rural Conservation and Utilization Project, is integrated in that the project gives attention to the total ecosystem rather than single elements of that system. Since the project documents were not reviewed, it was not clear to what extent human resource and institutional development are to be a part of the project.

Common to both projects is the small irrigation component relative to the total and that the systems to be built and renovated will be small.

In the case of both projects, the study team was led to believe that the site selection would be left mainly to the political process. It is recognized by the team that political realities play a strong role in selection, both at the national and local level in all

countries. Nevertheless, given the great physical and socio-economic diversity of the hill country, the team felt that the development of some broad guidelines for project selection would be well considered.

In part, the recommendation stems from the constant reference to the reported difficulty in gaining cooperation among Nepalese farmers in controlling and allocating water and in maintaining and repairing systems.

Recently, there was an evaluation of some 29 small scale irrigation projects which had been built or renovated under a program financed by the British Government. One year after completion, only two of the projects were in operating condition. The reason for failure of the others was attributed to lack of cooperation between cultivators. Instances were cited where violence and threats of violence resulted from arguments over water.

The study team decided that the evidence regarding the inability of the cultivators to work together was contradictory. On the one hand there were numerous reports of noncooperation, on the other hand were the complex interaction of crops and cropping patterns in fields on the terraced hillsides. The patterns observed suggested considerable cooperation between cultivators in the control of water movement down the slopes.

In any event, the complex physical and social environment suggested the need for developing a project identification procedure which would select the simpler physical and social situations for initial projects and then proceed to the more complex situations after experience had been gained with succesful projects. For example, projects which involved cultivators from the same caste might be chosen before ones requiring inter-caste cooperation, or perhaps cultivators should be required to develop their own irrigation association prior to beginning any construction under guidelines established by the project authorities.

Given the reported difficulties with developing successful farmer irrigation associations, the study team felt that very careful attention should be given to design. Systems might well be designed which minimized the need for farmer cooperation. For example, plastic pipe distribution systems could be used to avoid field-to-field water transfer. Such systems may not be the least-cost systems, but may be economically justified if the transition costs and long gestation period associated with traditional systems are considered.

There is clearly a need for research into the nature of and solution to the "cooperation problem."

General Comments on Irrigated Development. The study team did not have an opportunity to talk with the staff for the Resource Conservation and Utilization Project. They did, however, have discussions with the staff for the Rapati Zone Rural Area Development Project.

The team was impressed with the extent to which the project staff had analyzed the difficulties considering the enormity of the task of area development. They seemed very well aware of the need for continual project monitoring and maintaining the capability to change the process and procedures as problems emerged. They were well attuned to the required role and commitment on the part of the Nepalese Government if the project is to achieve success.

It seemed to the team that there might be considerable advantage to having regional seminars for Mission and local government personnel in various countries who are dealing with area development projects. There are similar problems in such areas as line agency involvement, problem identification and monitoring, central government control, and so forth, which might be explored. Such workshops should primarily involve field personnel and agency workers. The U.S. and country academic community might be asked to suggest alternative policies and processes, but should have primarily an advisory role.

Hardware vs. Software

As the projects now stand, there is both a hard and software component and this seems appropriate given country conditions.

Main-System vs. On-Farm

Given the nature of the topography and social considerations, both main and on-farm systems need to be considered. This seems to be the strategy followed in the projects being developed.

Rural Electrical Cooperatives

In areas where a significant portion of agricultural production is at the subsistance level, technological advances may be hard to

promote. Change is greatly facilitated during a period when something else that is new and different is being introduced. Rural electric cooperatives have in other areas been an important factor for change promoting agricultural technological advances. The large differences in elevation over short distances, the very high rainfall (sometimes exceeding 2,000 mm per year) and the large number of streams indicate that numerous opportunities can be found for small hydroelectric plants.

There is also a very large potential for power development in the principal rivers. However, the very rugged terrain and the magnitude of the flood may significantly increase development costs for the larger energy projects.

Additional Comments

The study team made the following observations which seemed particularly relevant in the context of Nepal:

1. Irrigation development should not be supported by USAID unless the other inputs are included such as better crop varieties, proper plant populations, adequate fertility, planting dates and pest control.

2. There is a considerable knowledge and technology known and practiced by farmers and advisors in the hill country.

3. The physical features of the country, the lack of roads, communiction facilities and living quartes for the scientists in the rural areas all make for very difficult tasks when providing assistance to the rural poor.

SECTION IV

For Future Assessment

Irrigation development strategy for Nepal cannot be assessed without a careful consideration of the Terai. The extent to which planned-for development exhausts the irrigation potential of the area was not considered by the team, nor was the effectiveness of systems already in operation.

It seems clear that the Terai is the area where the production increase is necessary if Nepalese agriculture is to supply the increasing demand for food. The study team did not, however, consider the extent to which overall production potential might be realized.

There was a considerable awareness among officials at numerous levels of the strain on the limited number of Nepalese professional workers caused by the great proliferation of development activities in the country. This seemed to be the case for irrigation personnel. Any future study of USAID participation in irrigation development should consider this potential program area.

APPENDIX

SMALL IRRIGATION AND SOIL CONSERVATION PROJECT IN GUATEMALA

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Preliminary work on the project was started in 1975 with a proposal from AID. The first project was completed in May 1978. As of September 1980, 23 projects serving 1200 families have been completed. Several other projects are ir various stages of planning and construction. In 17 of the completed projects, the water is potable. Most of the projects are gravity-operated sprinkler systems, but any kind of system can be built.

To build an irrigation system under the program, there must be a source of water and a group of people who are interested in using it. Any kind of existing organization -- cooperative, village government or an organization of the farmers themselves -- can be used to obtain a loan from the Agricultural Bank of Development to buy the materials necessary for construction. All labor is furnished by the people who will own and use the irrigation system. Engineering, construction supervision and instruction on system use is furnished by the Guatemalan Government at no cost to the project.

It is possible to raise three to four crops of vegetables per year in the highlands of Guatemala if irrigation water is available. Deciduous fruits as well as small fruits such as strawberries or blackberries can be improved by irrigation. With diversification into fruits and vegetables rather than the traditional crops of corn and beans, the farmers have been able to greatly increase their income from the land, provide labor opportunities for themselves and families and decrease the necessity of going elsewhere to work.

The existing gravity-operated projects have been built for between $600 and $800 per hectare. The cost includes the sprinkler and other farm equipment, as well as the main lines.

An added benefit, if the source of water permits, is potable water for the farm home. If the water is potable, a tap is put in everyone's patio. There are many situations where the potable water and irrigation water projects can be combined. Some cooperative projects have been built using funds from both sources. Pure water, as well as the added nutrition due to crop diversification, should greatly improve the general health of the communities served.

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A separate program of soil conservation for the highland farmers was under the same general direction as the irrigation systems. Jerome Arledge, from the U.S. Soil Conservation Service, served as advisor to that group. All of the farmers, including those on the irrigation systems, were encouraged to begin soil conservation measures on their farms.

The funds for the projects came from a loan from the Agency for International Development to the Guatemalan Government. The Guatemalan Agricultural Bank of Development made loans at low interest rates to the groups of farmers. The Inter-American Development Bank is interested in making loans to continue to expand the development in Guatemala. The same farmer self-help projects could be applicable in many parts of the world.