Helmand Arghandab Valley Development Project
Afghanistan

SHAMALAN UNIT
DRAFT FEASIBILITY REPORT

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For

Helmand Arghandab Valley Authority

and
Agency for International Development
U.S. Department of State

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Summary

Location

The Shamalan Unit is located in the Helmand River Valley of southwest Afghanistan. Project lands comprise the alluvial bottoms along the west side of the river for about 64 kilometers, ranging from about latitude 31° north to latitude 31°-30' north.

Present Development.

In the early 1950's Kajakai Dam and Reservoir was constructed on the Helmand River, about 136 kilometers north of Lashkar Gah, to regulate irrigation supplies, control floods, and, in the future, produce electrical power. The Boghra Canal was extended from the diversion works on the Helmand River above Girishk to a point southwest of Marja. The Shamalan Canal was constructed as a branch of the Boghra Canal and it extends from its point of diversion from the Boghra Canal, about 30 kilometers below the Boghra Diversion Dam, along the right bank of the valley alluvial lands nearly to Darweshan. The Darweshan Diversion Dam and Canal were built to serve lands along the left bank of the Helmand River for a distance of 50 kilometers (see Key Map, Drawing No. 501-91). In addition, extensive irrigation laterals and drainage systems were constructed in the Nad-i-Ali and Marja areas and a substantial part of the major drains required were constructed in the Shamalan and Darweshan areas. This construction activity was carried out by MKA through agreements with Helmand Valley Authority (now Helmand-Arghandab Valley Authority) during the period 1946-1959.

Although a limited amount of land is completely developed within the service area of the Shamalan Canal, most of the irrigable lands are still without efficient distribution and drainage facilities, and need smoothing and leveling to increase crop production.

Most of the lands along the Helmand River have been irrigated at one time or another for many centuries. Where good drainage and an adequate water supply have been available, lands have remained under cultivation. Where poor drainage, poor irrigation practices, or a combination of these factors have occurred, and high water tables, salinization, and excessive exchangeable sodium levels have developed, extensive areas have been abandoned. The great majority of lands which have remained under cultivation have been seriously depleted of fertility and organic matter.

Present agriculture can be characterized essentially as subsistence farming. In good years the better areas produce some marketable surplus; in average years the farmers operate almost completely on a subsistence basis; and in poor years they require supplementation by wheat brought in from outside sources.

The farms are small, fragmented, and operated with tenants and oxen. The typical farmer owns about five hectares (12 to 13 acres). The land is plowed with oxen and a steel pointed stick plow, and fields are irrigated by running water into small basins bounded by low dikes. The distribution system which serves the land is inadequate, consisting of meandering water courses with high, irregular spoil banks with only the most primitive of water control structures, if any at all.

Problems and Needs.

There is a great need for increased agricultural production in Afghanistan, and the physical potential of the Shamalan Unit with respect to lands, water, and climate is favorable for increased production of agricultural goods. However, the area requires additional physical facilities before the base for successful development is complete.

The Afghan Government has made a concentrated effort in the past to reestablish population in this area and increase agricultural production. Beginning in the early years of the century and intensifying activities throughout the 1950's, large capital investments were made in the development of the Helmand Valley, notably in the construction of dams, main canals, and outlet drains, but the agricultural returns have been disappointingly low.

A number of reasons contribute to these low returns. Among them exist inadequate distribution of irrigation water, irrigation of unsuitable lands, waterlogging, salinity, incomplete or poor land preparation, and poor farming and irrigation practices. Physical inputs in the form of improved seeds, livestock, fertilizers, insecticides and machinery are not available, agricultural credit is non-existent except at excessive interest charges, and much work needs to be done in the way of social reform to change traditional attitudes of the people away from mere subsistence.

Project Lands.

A detailed land classification survey of the Shamalan Unit was made during the two year period 1965 to 1967 to determine the extent and character of the lands and their suitability for irrigation farming under present conditions. Results of that survey are as follows:

Land Class	Acres	Hectares
Class 1	6,788	2,747
Class 2	15,272	6,180
Class 3	10,648	4,309
Total Arable	32,708	13,236
Irrigated Class 6	11,112	4,497
Non-irrigated Class 6	20,116	8,141
Total Classified	63,936	25,874

The data from the field classification was interpreted in terms of final economic land classes as they would be following full project development, assuming correction of all remediable deficiencies. The final or "Following Project Development" classification is the basis of the irrigable land classes. Deduction for rights-of-way have been made in the following tabulation:

Land Class	Acres	Hectares
Class 1	29,265	11,843
Class 2	1,380	559
Class 3	754	305
Total Irrigable	31,399	12,707

The Plan of Development.

The plan of development includes plans, estimates and recommendations for an enlarged, controlled and more efficient irrigation distribution system, an adequate drainage system, land development, soil amendments as required, a road system, and a system of domestic water supply wells. Such improvements would provide a sound physical base upon which successful and prosperous commercial agriculture could be built.

The main features of project development would involve the construction of:

- Main distribution laterals - 148 kilometers
- Outlet and lateral drains - 120 kilometers
- Roadways - 396 kilometers
- Land development for 31,400 acres
- Domestic wells, at least 100

Capital Costs

Feature	Dollars
Distribution system	5,116,000
Drainage system	1,562,000
Land development	1,962,000
Roads	392,000
Domestic water system	287,000
Soil Amendments	540,000
Resettlement costs	191,000
Interest during construction	528,000
Total	$10,578,000

Average Annual Benefits

Total	$ 2,505,000
Primary only	842,000

Annual Project Costs

Capital costs	451,000
O & M costs (increase over present)	20,000
Total	$ 471,000

Benefit Cost Ratio

Total	5.32 to 1.00
Primary	1.79 to 1.00

Recommended Action.

It is recommended that HAVA adopt the proposed plan substantially as presented for full development of the Shamalan Unit of the Helmand Valley project.

If project development is to be successful it is essential that the following steps be taken by the responsible agencies of HAVA and RGA prior to construction, and be continued for years after development.

(1) Instruct farmers in methods of modern agriculture and irrigation practices.

(2) Provide an available source of credit to purchase new inputs.

(3) Make new inputs available for purchase in the local area on a proper schedule.

(4) Give the kind of support to the project farmers which will create confidence and instill incentives that are required to raise crop yields and income levels.

(5) Devise a plan for the orderly removal and care of existing farmers from the land to be developed by blocks during the construction period, so that successful and complete development of the lands and project features can be accomplished.

Coinciding with construction of the project facilities, a program for efficient operation and maintenance of the system must be formulated and carried out. A system should be adopted for instituting water charges on project lands to create a fund for operations and maintenance of facilities and for repayment of constructed works under the project plan.

CHAPTER I

Conclusions and Recommendations

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Conclusions.

There is a great need for increased agricultural production in Afghanistan. The dietary level of the population, both in quantity and quality, is poor, especially for the sharecroppers and rural laborers. The domestic livestock is ill-fed and starvation occurs in winter months. Large amounts of wheat, cotton goods, fats and oils must be imported yearly to meet national requirements, and such Afghan products as fresh and dried fruit and grapes could reach larger markets in the subcontinent if their production were enhanced. These statements are generally true for the Helmand Valley area, including the Shamalan Unit, as well as for the nation.

The physical potential of the Shamalan Unit, with respect to lands, water, and climate, is favorable for increased production of agricultural goods. However, many physical, social, and institutional weaknesses must be corrected before production can advance significantly over present levels, and such correction must be continuous before high projected levels of output can be attained. Irrigation deficiencies must be removed, drainage problems remedied, land properly prepared, the road network enlarged, a system of domestic wells installed, soil amendments applied where needed, and research conducted in the area of fertilizer deficiencies. After installation, the project works must be properly operated and maintained. This will prepare the base for sound agriculture, and must be followed by improved farming practices. Farm credit, improved seed and stock, fertilizer, insect and disease control agents, and machinery must be introduced and successfully used to create the returns of which the project is capable. At the same time pertinent rules and regulations should be operating for land ownership, and adequate farm size, and charges should be made against water and land to cover operation and maintenance costs and a portion of capital costs. If the Shamalan Unit plan is implemented as recommended, the project works correctly installed, operated, and maintained, and agriculture developed, all within a framework of guiding legislation, then the project will be financially feasible. The ratio of primary benefits to costs under these conditions is estimated to be 1.79 to 1.00; the ratio of primary plus secondary benefits to costs 5.06 to 1.00; and the ratio of primary, secondary, plus development costs 5.32 to 1.00.

Economic feasibility of the project will depend largely upon successful operation of the farm units. There is a definite and direct relationship between farm size and successful farm operation, and it is recommended that the average farm in the future should be somewhat larger, and certainly no smaller than the average size existing today, after consolidation of fragmented and scattered holdings. Recommended farm size should be not less than 9.0 irrigable hectares (22.2 acres), plus additional nonarable grazing lands. This size should be a long-term goal, and should evolve as individual farmers become more efficient, release their sharecroppers, replace their oxen with machinery, and gradually expand their holdings. Farm units of inadequate size will only perpetuate subsistence agriculture by denying the farmer the base and business volume upon which to build a commercial unit.

Recommendations.

The Shamalan Unit should be approved for development substantially in accordance with the existing plan as presented, and with the provisions set out in detail in the Engineering, Agricultural Economics, and Financial Analysis chapters of this report. It must be emphasized that this analysis is valid only if the provisions are followed and adhered to, but if they are not, no base exists for justifying further investment in the Shamalan Project.

Partial or laggard implementation of the provisions, which could include incomplete construction and land leveling; failure to provide for adequate operation and maintenance, water delivery, and administration; subsistence-sized farm units; failure to increase crop and livestock yields; or any or all of these; will not produce the farm surpluses required to raise living standards or to cover project costs. Partial implementation of these provisions would have the effect of delaying project development and perpetuating subsistence conditions. Conditions which result in lowered returns and incomplete development could not meet the requirement of economic soundness demanded by Section 101 of the Foreign Aid and Related Agencies Appropriation Act of 1963.

CHAPTER II

Problems and Needs

CHAPTER II

Problems and Needs

Many problems must be solved and needs fulfilled if the Shamalan Unit is to achieve successful development. The area requires additional facilities before the base for successful development is complete; farming is little different now than it was in centuries past, and there is great need for an institutional framework to implement development of its facilities and its agriculture. The problems and needs of the Shamalan area may be considered to fall into three principal categories: project, agriculture, and institutional.

Project Problems and Needs.

The Shamalan Unit lands are handicapped by an insufficient water supply in some areas, and by an inadequate and antiquated lateral system in general. The design capacity of the main Shamalan Canal is insufficient, diverting only 21.24 cubic meters per second (750 cubic feet per second) from the Boghra Canal. The arable area under the Shamalan Canal is 13,236.5 hectares (32,707.6 acres), of which 12,706.9 hectares (31,399.3 acres) are considered irrigable. In addition, some 4,497.3 hectares (11,112.7 acres) of class 6W lands have a history of irrigation and an established water right. Under present estimated diversion requirements, peak demand would require a total diversion capacity of about 27.75 cubic meters per second (980 cfs). A feasible means of introducing new water into the Shamalan system is required.

Drainage in the project area ranges from adequate in certain local areas, to inadequate in general, to poor in other areas. Present drainage deficiencies result in high groundwater tables, salinization of soils, and low crop yields in selected areas. With an increased water supply made available by a more highly developed distribution system, drainage problems will be aggravated and a more adequate drainage system will be required. Since most lands in the area are situated long distances from outlet drains, consideration must be given first to constructing new outlet drains and to rehabilitating existing outlet and lateral drains. The location and order of construction of new lateral drains should be based on continuing investigations, based on physical requirements and economic studies, after the existing drains have been improved and new outlet drains constructed.

Land preparation in the project area today is done by hand and with oxen-powered drags, and to some degree conforms to the present pattern of irrigation service facilities; but very small fields and basins, suitable for oxen plowing and hand cultivation only, are the final products. Future development should be considered a project function, to follow construction of the distribution and drainage systems, and to precede the resettlement of farmers on their project lands. The fields should be leveled, smoothed, and shaped by mechanical means to fit the designed water distribution, drainage, and road systems as much as possible, and with regard to the portions of the existing systems that will be preserved and rehabilitated for the future. Fields should be of sufficient size to permit both efficient irrigation practices and efficient machinery use as these skills develop and machinery becomes available in the future.

Many areas in the project are characterized by sodic lands, i.e., high levels of exchangeable sodium. Use of gypsum amendments is planned to replace the sodium with calcium at an average rate of 13,500 kilograms per hectare (6.0 short tons per acre) on the affected lands. Mining, screening, handling and hauling this amendment to the farm site would be project functions and costs, while spreading the material on the land and plowing it in would be farmer responsibilities.

The Shamalan area at present is handicapped by an inadequate and poorly maintained road system. Roads have been constructed on and adjacent to the banks of the Shamalan Canal and the main drains, and a fair road exists on the desert floor parallel to the western border of the project, but there is a complete lack of farm and farm to secondary roads. The average farmer has access to these existing secondary roads only on foot or by draft animal. With the projected development of agriculture, farm surpluses will emerge and will require transportation to the secondary roads. Therefore a system of service or tertiary roads is planned as a project expense at intervals of two kilometers (1.2 miles) throughout the area. This will place no farm further than one kilometer (0.6 mile) from a vehicular road.

Domestic water supplies for drinking, cooking, and bathing are traditionally obtained from adjacent canals, juis, or drains, or in some cases from private shallow wells. This practice not only is a health hazard, but requires year-round irrigation service to supply domestic water. The main canal at present cannot be closed for cleaning for more than 45 days per year, which tends to aggravate drainage problems and to prevent sufficient "down time" for corrective maintenance. During the construction period, approximately 100 wells should be drilled at appropriate intervals in the area, to provide potable water to residents, and to increase average canal down time to 75 to 90 days per year.

The Shamalan Project area soils are suspected of having massive deficiencies of levels of adsorbed phosphates. Iron and zinc may also be low. Actual requirements can be determined only by continuing field tests, but on the basis of findings in other old irrigated areas, deficiencies ranging up to 450 to 900 kilograms of P_2O_5 per hectare (400 to 800 pounds per acre) could exist. Although no specific project cost is allowed for this function, the 25% overhead and engineering contingency may cover the costs, if tests and field work indicate that such deficiencies exist and should be overcome as part of project development. Initial application of such large amounts of fertilizer would be beyond the capacity of project farmers, but annual applications would be farmer responsibilities and costs.

Operation and maintenance of the present irrigation, drainage, and road system is not adequate. Methods must be improved and expanded to cover upkeep and cleaning of main canals, laterals, the drainage system, and the road network. This should include provision for collection of water charges.

Agricultural Problems and Needs

Agricultural problems and needs are the outgrowth of centuries of farming with methods which tend to impoverish lands and depress yields. Many of the agricultural problems can be traced to physical causes; others have an institutional or social base.

A host of physical factors contribute to poor farm returns. These include inadequate land preparation; poor seed and inefficient seeding; inferior crop and livestock varieties; lack of soil-building rotations (although some alfalfa is grown, none is ever plowed under as green manure); the nonavailability of commercial fertilizer, and pest and disease control agents; and lack of farm machinery. Other important factors are the use of much farm manure for household fuel rather than being used for soil building, poor weed control during the growing season, and the failure to use locally available gypsum as an amendment for sodic soils.

The basic negating social causes for poor performance can be said to be the traditional attitude of the farmers, their lack of encentive, and a scanty understanding of scientific principles of farming. Among the results of inhibiting or negative attitudes are the nonavailability of farm credit, continued use of oxen, a feudal farm sharecropper situation, holdings which conform to the oxen-sharecropper complex of labor, fragmentation of farms, rudimentary development of an urban market and resultant low demand and weak price structures for farm products, and poor transportation, handling, and marketing systems. Low levels of education, sanitation and health, and a shortage of practical extension, demonstration, and training programs also result from these negative attitudes.

The traditional attitudes of subsistence peasants must yield if the area is to progress, but transformation of subsistence peasants to commercial farmers will require a revolution in mental concepts.

Institutional Problems and Needs

It is obvious that a great change must occur if the area is to progress and to realize its potential. Not only must project works be installed and operated efficiently, but the farmers must develop and apply agricultural techniques which will result in greater returns. To facilitate the change in social attitudes which must precede and accompany any physical development, the government should smooth the way by preparing and enacting basic social and financial legislation. The Cadastral Survey of the Shamalan area presently being completed is essential for determining land ownership. When farmers are resettled on consolidated blocks they should, in fairness, be placed on farms of adequate size and quality, and the Cadastral Survey will be the base of such distribution. In certain areas of the Shamalan where lands are presently water-short and are irrigated only on an intermittent basis, but will receive a full water supply in the future, redistribution of land after construction on the basis of exchange of land for water rights may be considered.

A series of institutional changes must come about in the field of farm inputs before substantial progress can be realized. The HAVA or RGA should initially establish a mechanism to make credit available to farmers at reasonable interest rates and repayment periods; simultaneously it should make available in the local area the physical inputs which will raise the level of agriculture. The improved seed, livestock, fertilizer, insecticide, disease control materials, and machinery should be readily purchasable by the farmer with his credit, so he can procure his requirements on site and in proper season. Initially the Afghan Government will have to provide the credit and purchase and resell the inputs, but private business should be encouraged and be allowed to engage in these operations as they develop. Credit should also be made available for custom hiring of farm machinery, and possibly for paying the seasonal labor which may become important as the use of tenants decreases.

Another basic question that can be solved only by legislation is the settlement of new farmers on Shamalan lands. The RGA enacted a law in 1965 which would place new farmers on units that are too small to provide a sound base for commercial agriculture, and which in effect would tend to perpetuate subsistence farming. Recommendations are made in the Economic and Financial Analysis chapter regarding farm size, and these should be considered if new settlement is contemplated. However, the bulk of Shamalan lands are privately owned, and new settlement appears unwarranted. First preference for any surplus lands should be made available to existing farmers whose present holdings are too small.

Strong legislation is required in the field of project repayment. If the project develops as projected, the farmers would definitely have the ability to pay the annual operation and maintenance charges, and also to repay a part of project capital costs. However, it would be unfair to ask the farmers to repay full capital costs, for many secondary beneficiaries of project development would emerge and operate businesses which could not exist in the absence of the project. Therefore the farmers should be assigned repayment of the principal portion of capital costs; the interest portion would be collected indirectly from secondary sources.

Rules on correct operation and maintenance should be promulgated and enforced. Irrigation water should be measured, and releases made by right and on a demand basis. Assessments should be made accurately and promptly, and collected systematically. The collection of water tolls and land taxes could be consolidated to reduce administrative costs. In any case rules and regulations on tax collection of all types in the area are sorely needed.

Other Problems and Needs.

There are roughly 1,000 hectares (2,500 acres) of low lying land, bordering the Helmand River along the eastern part of the unit area, subject to periodic flooding, part or nearly all of which could possibly be developed for woodlot or seasonal irrigated pasture. Surplus water available during periods of low demand would be used for these purposes. It may be feasible to reclaim some of the class 6 lands by leaching and application of gypsum. Practicability of this will have to be determined by field and laboratory studies. Tree planting for watershed protection upstream in the headwaters of the Helmand system could be initiated to retard water runoff in the basin as an aid to flood control. Additional gates could be installed at Kajakai Dam to control floods more accurately.

Sediment encroachment in the Kajakai Reservoir is depleting its storage capacity. This will adversely affect water supply for irrigation and power and flood control capabilities to an extent which cannot be accurately predicted at this time. As the Kajakai Reservoir's capability of controlling floods decreases, erosion and bank control of the Helmand River adjacent to the project lands will become an increasing problem. Protective works of dikes and tree planting in addition to some reinforcement of river banks at critical points should be planned and constructed. The Geological Survey has made recent preliminary studies of sediment inflows to the Kajakai and Arghandab Reservoirs in support of recommendations by USAID/Afghanistan that detailed studies be programed for the future. A statement by the Geological Survey of their preliminary findings is included in the Water Supply chapter of the report.

CHAPTER III

Introduction

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Introduction

Background of Helmand Valley Development

The Royal Government of Afghanistan (RGA) has had a long history of development of the Helmand Valley in southern Afghanistan. Its interest and work has included development of the Helmand River and the Arghandab, its principal tributary. This work dates back some 50 or 60 years, and its objectives have been the creation of productive agriculture in the area, and settlement of landless people from other regions of Afghanistan. Commencing with the early years of this century, and continuing to the present, many attempts to develop the area have been made. The following outlines the history of developmental work here, and brings the time and concepts into focus.

Soon after the turn of the 20th century the Afghan Government became interested in the Helmand region, and undertook repair and rehabilitation work on old irrigation systems. A particular case was the Seraj Canal which heads on the left or east bank of the Helmand above Girishk, and irrigates valley and bench lands downstream as far as the Arghandab River.

The early work on the Seraj Canal evidently was undertaken to improve farming and settlement opportunities in the valley, and apparently much of this work was directed to provide homes and farms for Turkoman and Uzbek refugees from the Soviet Republics north of the Amu Darya or Oxus River. This early work indicated a desire on the part of the Afghan Government to exploit the potential agricultural and settlement opportunities of the Helmand Valley region.

In the late 1930's, the Afghan Government employed a team of Japanese engineers to improve and rehabilitate the old Deh Adam Khan Canal, which later was realined and designated the Boghra Canal. This canal diverted water from the Helmand River above Girishk, and irrigated alluvial valley lands along the right and west bank of the Helmand River. This canal had functioned for some 200 years, and it was planned to enlarge and realine it to provide better service to existing lands, and to bring water to new valley lands along the west bank as far as the system would reach. This work was initiated with hand labor, and had not extended more than 14 kilometers when the Second World War compelled the Japanese to withdraw in February 1942.

During the war years excavation was continued by the Afghans, and by 1946 26 additional kilometers of the canal were completed. This work included an important revision in plans, as the points of diversion and intake were changed and entire canal sections were relocated.

Work on the Deh Adam Khan Canal was the forerunner of the much more extensive Helmand Valley Project development which began soon after World War II and continued through the 1950's. After the war the Royal Government of Afghanistan (RGA) contracted with Morrison-Knudsen Co., Inc., a major American-based construction firm to carryout construction work on various capital projects within the country. In 1946 the firm established an affiliate, Morrison-Knudsen Afghanistan, Inc. (MKA), to handle its Afghan operations. MKA established operating headquarters in Kandahar and continued work on the Deh Adam Khan Canal, and initiated work on roads and other service facilities in the Helmand Valley region.

In 1946 the Afghan Government decided that the canal, now designated the Boghra Canal, should be enlarged and extended to irrigate barren desert bench-land at areas now known as Nad-i-Ali and Marja, as well as valley lands in the vicinity of Girishk. With these new concepts, what had originally started as a modest undertaking of rehabilitation and improvement of the Deh Adam Khan Canal was now a major regional development principally concerned with developing new irrigated lands and improving agriculture. MKA, in addition to Boghra Canal work, over several years built roads, established permanent camps and towns, and trained many people in various skills, performing activities which have had far-reaching effects in the continued development of the country.

Some time after the Boghra Canal work got well under way, it was realized that the Helmand River, although a bountiful supplier of water on an annual basis, often had a very low flow during summer months when water was in most critical demand for irrigation. By 1949 the proposed development plan had expanded, and units and facilities were added until irrigation development embraced both the Helmand Valley from Kajakai to a point about 45 kilometers below Darweshan and the Arghandab Valley in the vicinity of Kandahar. Two major dams were constructed, the Kajakai on the Helmand River about 120 kilometers above Bost, and the Arghandab on the Arghandab River about 30 kilometers northeast of Kandahar. The Boghra Canal was extended from the diversion works above Girishk to a point southwest of Marja; the Shamalan Canal was constructed to branch from the Boghra about 30 kilometers below the diversion dam and extended along the right bank of the valley alluvial lands nearly to Darweshan; and the Darweshan diversion dam and canal were built to serve lands along the left bank for a distance of 50 kilometers. In the Arghandab Valley, Arghandab Reservoir provided a more reliable water supply; the South Canal was constructed to serve land in the Central Arghandab area around Kandahar; and the Tarnak Canal, an extension of the South Canal, served the Tarnak area south and southwest of Kandahar to the vicinity of the present Kandahar International Airport. In addition, extensive irrigation laterals and drainage systems were constructed in the Nad-i-Ali and Marja areas and a substantial part of the major drains required were constructed in the Shamalan and Darweshan areas. A small hydroelectric plant of about 3,000 KVA was constructed on the Boghra Canal about midway between the diversion dam and Girishk as one of MKA's last jobs in the Helmand Valley.

This construction activity between the Helmand Valley Authority (now the Helmand Arghandab Valley Authority) and MKA, was carried out between 1946 and 1959. When contractual arrangements between RGA and MKA were terminated in 1959, it was contemplated that further development work, such as laterals, secondary and farm drains, and land leveling would be done by the Afghan Construction Unit (now the Helmand Arghandab Construction Unit) with the possible exception of some development work on farms to be done by landowners.

At the time MKA closed down its Helmand Valley Project operations and HAVA and HACU assumed primary responsibility for further development work, most units of the Helmand Valley Project, particularly the Shamalan, Darweshan, Central Arghandab and Tarnak, were only partially complete, and efficient irrigated agriculture was not possible over much of the area for which supply canals had been provided. The Marja and Nad-i-Ali areas had been provided fairly elaborate distribution systems, and considerable drainage work had been done in an effort to overcome very bad waterlogging and salinization problems which developed soon after irrigation water became available. In the course of the past six or seven years, HACU has done some land development work in areas, particularly in the South Tarnak area near Kandahar, and has extended supply canals and laterals into such new areas as the Zarest at the lower end of the Shamalan area. Some of this work has been ineffective as the areas have since proven to be unsuited for irrigated agriculture. Although a limited amount of development work is complete within the service area of the Shamalan and Darweshan Canals, most of the irrigable lands in these units are still without modern efficient distribution facilities. Additional drainage is required, and most lands require leveling and smoothing for efficient irrigated farming. No work has been done in the Central Arghandab area with respect to distribution systems and drainage, and land preparation and development work in the Tarnak area is not complete. A serious deficiency is the total absence of roads within most of the farm areas.

In the early 1960's, development of the Helmand Valley entered a new phase. By 1959, Morrison-Knudsen Afghanistan, Inc., and its affiliate the International Engineering Company, Inc., had completed major reservoirs, canals, and other works, but only in a few instances was any land development and related work accomplished. When the contractual arrangement was terminated in 1959, the project could be considered only partially complete, for many lateral systems, major and minor drains, and much land preparation work remained to be done before the project lands could produce full benefits. It was contemplated that further development work would be carried forward by the construction division of the Helmand Valley Authority, or possibly through construction contracts with qualified private contractors.

The Helmand Valley Authority, with its own financial resources and some grant-in-aid funds advanced by USAID, carried work forward to a limited extent. However, as equipment wore out efficient operations were no longer possible and RGA began to consider loans from qualified sources. In 1960 the RGA and USAID agreed to study further development of the project in an expeditious manner, and to advise on existing operations.

USAID in turn requested the Bureau of Reclamation to direct and make the necessary studies, and development of the Helmand Valley entered a new phase.

Accomplishments of Work to 1960

When MKA left the valley, much construction and some land development work had been accomplished. Although exact acreage and expenditures are not known, estimates on development by stage and on amount and allocations of expenditures are shown. Although figures are approximate, they point out the course of work to 1960.

Estimates of irrigated areas in the units developed by the HAVA, and of the older irrigation systems in the Helmand and Arghandab Valleys, indicate that the gross area under irrigation in the Helmand Valley is 101,500 hectares (251,000 acres), including 27,000 hectares (67,000 acres) in the lower Helmand or Chahkansur area, a remote region near the Iranian frontier. This land is provided a regular water supply, largely by Kajakai Reservoir (see Table 1).

In addition there may be 45,000 hectares (112,000 acres) irrigated in the Arghandab region, principally in the North Arghandab, Central Arghandab, and Tarnak units. This region is supplied water regulated by Arghandab Reservoir.

In the Helmand Valley, the Marja, Nad-i-Ali, Shamalan, and Darweshan units are served by major canals constructed by the Helmand Valley Authority. The Seraj and Kajakai area, and the lower Helmand area are served by old diversion and canal systems and receive the benefits of a regulated water supply by Kajakai Reservoir, but are not provided with modern irrigation, drainage, or land preparation.

The gross areas receive full or partial water supply and include lands of various quality. In areas such as Nad-i-Ali and Marja, poor drainage and salinization are so pronounced that very substantial areas are nonirrigable. These lands produce little or no returns, although they receive a water supply.

TABLE I

Estimated Gross Area Served by Kajakai Reservoir

Area or Project Unit	Lands Under New HAVA Canals				Lands Served by Pre-HAVA Systems		Total	
	Distribution System, Drainage System, and Land Leveling Not Complete		Major Distribution and Drainage System Complete. No Project Land Leveling		No Project Distribution System, Drainage System, or Land Leveling			
	Hectares	Acres	Hectares	Acres	Hectares	Acres	Hectares	Acres
Kajakai to Shamalan					14,600	36,000	14,600	36,000
Seraj					14,200	35,000	14,200	35,000
Nad-i-Ali	5,200	13,000					5,200	13,000
Marja	8,100	20,000					8,100	20,000
Shamalan			16,200	40,000			16,200	40,000
Darweshan	1,600	4,000	14,600	36,000			16,200	40,000
Lower Helmand, below Darweshan					27,000	67,000	27,000	67,000
TOTAL	14,900	37,000	30,800	76,000	55,800	138,000	101,500	251,000

In the Shamalan unit, where a detailed land classification survey has been made, approximately 32,000 acres are now classified irrigable of the gross area of 40,000 acres originally thought irrigable. Detailed land classification for the Darweshan area will probably classify substantially less lands as irrigable than are presently irrigated.

With the development of the Helmand Valley Project, beginning in the early years of the century, extending through the 1950's and continuing into the current 1960's, the Afghan Government has made a concentrated effort to re-establish populations in this region. By improving the water supply and bringing in new land under the extensive canal systems, new farm units have been established on which landless valley residents were settled. Emphasis was placed on bringing in settlers from throughout the country, with particular attention to settling Kochies, or pastoral nomads. Farm units allocated to settlers by government policy were small however, and generally inadequate to provide more than a subsistence standard of living. In areas where farm families were located on small tracts where poor drainage and salinization developed, such as the Nad-i-Ali area where several thousand settlers were originally located, many families abandoned their farms. The same situation has prevailed to a considerable extent in the Marja area, and to a lesser extent in other project areas, particularly where abundant water supply was used in combination with poor drainage.

Although large capital investments have been made to develop the Helmand Valley, the returns have been disappointingly low. A number of reasons contribute to these low returns, including irrigation of unsuitable lands with poor soils, waterlogging, salinity, and other inhibiting factors, incomplete or poor land preparation on irrigable lands, and poor farming practices.

To date, the RGA has expended more than $95,000,000 in all currencies for development work in the Helmand Valley. Funding for development of the project has been from three sources. The Afghan Government relied upon its own financial resources during the initial construction work, and has continued to advance funds toward project construction since 1946. Two loans were obtained from the Export-Import Bank, and grants have been made by the U. S. Government through the International Cooperation Administration (now USAID). The loans, grants, and advances are summarized by source in Table 2, and by function in Table 3.

TABLE 2

Source of Funds for Helmand Valley Development, 1946-1965

1st Export-Import Bank Loan, 1950 MKA Contract	$21,000,000
2nd Export-Import Bank Loan, 1954 MKA Contract	18,300,000
ICA Grant - 1954 MKA Contract	2,880,000
USAID Advances for HVA Operations as of 3/20/65	3,611,000
Subtotal	$45,791,000
RGA Advances 1946-1964	21,492,000
Total (dollars)	$67,283,000
Afghanis & Pak Rs. 1/	28,204,000
TOTAL, all Currencies	$95,487,000

1/ Converted to dollars at then current ratio.

TABLE 3

Expenditures in Helmand Valley by Function

Reservoirs and Major Waterway Structures	
Kajakai Dam and Reservoir	$13,431,000
Arghandab Dam and Reservoir	7,490,000
Boghra Diversion and Powerhouse	3,502,000
Boghra Canal	8,761,000
Siphons, etc.	75,000
South Canal and Diversion Dam	3,307,000
Shamalan Canal	5,107,000
Miscellaneous	109,000
Subtotal, Reservoirs and Major Structures	$41,782,000
Land Development	
Nad-i-Ali	2,972,000
Marja	8,393,000
Shamalan	4,709,000
Darweshan, including diversion dam and canal	7,010,000
Seraj	250,000
Tarnak	7,425,000
Arghandab (north)	151,000
Arghandab (south)	109,000
Subtotal, Land Development	$31,019,000
Engineering, Construction and Miscellaneous	
Roads	9,863,000
Powerplants - Girishk, Arghandab and Kandahar	3,580,000
Services, surveys, etc.	2,164,000
Subtotal	$15,607,000
TOTAL	$88,408,000

Other expenditures were made for hydrologic studies, buildings, camps throughout the project areas, and miscellaneous work at various points in the valley and bring the accountable total to almost $93,000,000. Such miscellaneous items as schools probably bring the accountable total since 1964 to more than $95,000,000.

Bureau of Reclamation Activities in the Helmand Valley

From 1960 to the present, the Bureau of Reclamation has been engaged in the Helmand Valley. Its functions to 1964 were advisory, primarily in the fields of design, construction and operation and maintenance. In 1964 the Bureau added a planning team to its staff, to analyze proposed expansions of the project, while continuing its advisory functions.

The Bureau has had long experience and technical competence in planning and in preparing related reports and its studies are geared to determine the best possibilities for project development, and to avoid development of uneconomical projects. This is particularly important in capital-short nations such as Afghanistan, where capital and human resources should be allocated for maximum production. In addition to demonstrating practical development of land and water resources, Bureau analyses satisfy the legal requirements of United States foreign aid criteria.

When loan applications for resource development projects are considered by the Agency for International Development, the applications must demonstrate that a proposed development project meets certain criteria relating to economic and engineering feasibility. This policy, clearly enunciated in Section 101 of the Foreign Aid and Related Agencies Appropriation Act of 1963, "requires that none of the funds therein appropriated (other than funds provided under the Authorization for "International organizations and programs") shall be used to finance the construction of any new flood control, reclamation, or other water or related land resource project or program which has not met the standards and criteria used in determining the feasibility of flood control, reclamation, and other water and related land resources programs and projects proposed for construction within the United States of America as per memorandum of the President dated May 15, 1962." 1/ Senate Document No. 97, 87th Congress, May 29, 1962 sets out policies, standards and procedures for such projects. The provisions of this legislation have been contained in all subsequent appropriation acts since 1963. Therefore, water resources programs are analyzed accordingly, and projects must stand the test of economic justification and financial soundness to qualify for loans under the Foreign Aid and Related Agencies Appropriation Act.

In 1964 the Reclamation planning team was requested to select an area for immediate study. Selection followed the principle that areas with potential for producing the greatest economic returns in the shortest time should be given first priority. After considering soil, remaining engineering and development work and costs of such work, qualification of the farm population, proximity to market, and probable returns after development, the Shamalan area was selected. This unit was considered to have the best chance of successful

1/ Quoted from "Feasibility Studies, Economic and Technical Soundness Analysis, Capital Projects", October 1, 1964 - Department of State, Agency for International Development, Washington, D.C., M. O. 1221.2, pg. IV. Underscoring supplied.

development and of meeting the legal requirements of the Foreign Aid and Related Agencies Appropriation Act.

Shortly after the Shamalan area was selected, a request was received for completed studies on a portion of the unit, to have land available for development by HACU when a proposed equipment loan became available. The western portion of the unit, an area of more than 5,300 arable hectares (over 13,000 acres), was selected for concentrated effort.

Work commenced in the West Shamalan Division as soon as aerial photographs for a mapping base became available, and various phases of the investigations have continued as long as required. These consisted of detailed land classification, drainage, economic, hydrologic, and irrigation demand investigations. The objective is a plan to irrigate and drain the gross area, provide roads, wells, and land development as needed, and to demonstrate the feasibility of such work.

The expenditures made specifically for the Shamalan Canal and for land development from 1946 to date represent almost $10,000,000 and a reasonable share of joint costs of the storage dam, the Boghra Diversion Dam and the Boghra Canal above the Shamalan bifurcation bring this figure to at least $16,000,000. Since the irrigable lands under the Shamalan Canal comprise about 32,000 acres, this represents an existing investment of about $500 per irrigable acre.

In the economic analysis of the project, however, all previous investments are considered as "sunk" costs and will not be considered in estimates of annual cost or constitute any part of the economic analysis. This is based on a legal requirement made in 1963 before Bureau of Reclamation planning investigations were initiated. Project costs are considered on the additional or incremental costs required to complete the irrigation and drainage systems and to properly prepare the lands so that efficient irrigated farming will be possible. Annual project costs are the amortized incremental investment, plus annual operation, maintenance and replacement costs. Benefits are considered the difference between estimated future net farm returns and present net farm returns, less any loss of benefits due to project construction.

This report, which supersedes and updates the "Draft Feasibility Report, West Shamalan Division, Shamalan Unit," December 1966, presents general information on the Helmand Valley Project, and specific information on the economic and physical feasibility of development of the Shamalan Unit. This area includes all lands bounded by the Basharan Wash to the north; the foot of the desert escarpment to the west; the Helmand River to the east; and the Helmand River and the Dasht-i-Margo Desert to the south. These boundaries embrace a gross area of 25,875 hectares (63,936 acres), of which 12,707 hectares (31,399 acres) are irrigable. The plan of development also provides lateral capacity to serve some 4,497 hectares (11,112 acres) of class 6W lands, which are not suited for irrigation but which have been provided water in the past and probably have established water rights.

Previous Reports

During the past 20 years the Helmand Valley has been the subject of many investigations and studies. These studies have covered the field of resource development, but most attention has been given to development and utilization of land and water resources of the basin, with particular emphasis on irrigated agriculture. Some studies and reports have been quite general, usually for the purpose of identifying problems and suggesting programs for achieving logical development. A few investigations and studies, however, are quite comprehensive, and involve detailed research and data relating to agriculture, soil resources, water supply, engineering factors, and economic appraisals. An examination of various available reports and memoranda reveals that a great deal of good information and advice has been supplied, which, if accepted and followed in the past, would have resulted today in a marked improvement in agriculture and irrigated farming within the Helmand Valley region.

Some of the more important reports which give information or make recommendations relating to the Helmand Valley in general, and may apply specifically to the Shamalan Project area are:

"Report on Development of Helmand Valley, Afghanistan" - prepared for the International Cooperation Administration by the Tudor Engineering Company, Washington, D. C., November 1956.

"The Kabul, Kunduz and Helmand Valleys, and the National Economy of Afghanistan" - a study of regional resources and the comparative advantages of development - by Aloys Arthur Michel, sponsored by the Office of Naval Research - Report No. 5, printed by National Academy of Sciences, National Research Council, Washington, D. C., 1959.

"Afghanistan - Drainage and Related Problems" - by C. R. Maierhofer, Bureau of Reclamation, Denver, Colorado, April 1961.

"The Helmand Valley - An Overall Review" - report by J. S. Benz and F. N. Holmgreen for USAID/Afghanistan, November 1962.

"Drainage and Related Problems of Irrigation in the Helmand Valley" - by C. R. Maierhofer, Bureau of Reclamation, Denver, Colorado, April 1964.

"Report on Soil and Water Resources of Southwest Afghanistan" - Volume I - General; Volume III - Project Areas - prepared by the International Engineering Company, Inc. (an affiliate of Morrison-Knudsen Afghanistan), San Francisco, California, September 1959.

"Afghanistan - Economics of Agricultural Production in Helmand Valley" - by Ira M. Stevens, Bureau of Reclamation, and Kamal Tarzi, Helmand Valley Authority, October 1965.

"Draft Feasibility Report, West Shamalan Division, Shamalan Unit, Helmand Valley Project, Afghanistan" - U. S. Bureau of Reclamation, M. G. Barclay and F. G. Whitaker, Bost, Afghanistan, December 1966.

"Appendix A, Agricultural Economics, West Shamalan Division, Shamalan Unit, Helmand Valley Development Project", - U. S. Bureau of Reclamation, Bost, Afghanistan, January 1967.

In addition to these reports, many memoranda, short reports on specific subjects, and other documents pertaining to the Helmand Valley or to specific aspects have been written. Many of these documents were originally in MKA files, or in the files of the Helmand Valley Authority or other agencies. These documents include design memoranda, memoranda relating to proposed development of certain phases of the Helmand Valley Project, Export-Import Bank loan applications, and related feasibility reports. Most of the files of MKA were turned over to the Helmand Valley Authority by MKA in 1959. In the course of moving and reorganization by HVA, much of this material has been lost or misplaced and can no longer be located.

The "Tudor" report, prepared for the International Cooperation Administration in 1956, was made to review developments in the Helmand Valley and identify problems so that decisions could be reached relating to further financing and development. The study was conducted by an outstanding group of experts, contains pertinent information on the existing state of agriculture and project works, and suggests logical steps for further development. This team made strong recommendations relating to the improvement of agriculture, change in land use in some areas, size of farm units, operation and maintenance, and further project development.

The "Kabul, Kunduz, and Helmand Valleys, and the National Economy of Afghanistan" report by Aloys Arthur Michel is generally not available, as its distribution has been on a limited and selective basis. However, sections of the report relating to the Helmand Valley give an incisive picture of the history of development, and related problems.

The C. R. Maierhofer reports in 1961 and 1964 give information on drainage and other problems relating to irrigation in the Helmand Valley. Maierhofer found that although drainage is an important problem in the valley it is by no means the only problem, nor even the principal problem. Maierhofer regarded retarded agriculture and lack of proper operation and maintenance of the irrigation system to be primary problems in this area.

Another general report "The Helmand Valley - An Overall Review" by Benz and Holmgreen for USAID/A in 1962 reviewed problems as of that time. This report recommended concentration on the area under water command, and avoidance of extending irrigation to new areas.

"Report on Soil and Water Resources of Southwest Afghanistan" is commonly known as the "Fly Report" in recognition of Dr. Claude L. Fly, who exercised general supervision of investigations and studies conducted by International Engineering Company, Inc., in connection with this report. The Fly Report is the result of extensive reconnaissance investigations of the soil, water, and climatic and economic aspects of the Helmand Valley Region. This report presents an excellent reconnaissance appraisal of the agricultural and land resources of the region, and also provides important information on the development potentialities of irrigation. It identifies many problems relating to the further development of irrigated agriculture. Unfortunately, much of the work done by Mr. Fly was concurrent, or even after, construction of important engineering works by the Helmand Valley Authority and apparently little recognition was given to information and guidance made available in the report. Land and soil surveys were made to determine land use, soil characteristics, and other factors. These details were mapped by reconnaissance surveys, and maps compiled on a scale of 1:20,000 from survey data sketched on aerial photographs. The original maps were never reproduced for inclusion in these reports as they constitute a massive volume of material, but the original transparencies are now in the files of the Engineering Division of the Helmand Arghandab Valley Authority.

The Stevens-Tarzi report "Afghanistan - Economics of Agricultural Production in the Helmand Valley", presented current general information on the agricultural, economic and social situation in the Helmand Valley Project.

The Draft Report on the West Shamalan Division and the Agricultural Economics Appendix were prepared by the Bureau of Reclamation planning team to meet the request for studies on a portion of the Shamalan Unit. This draft report makes a preliminary economic and engineering analysis of the western portion of the Shamalan Unit, and is scheduled for replacement by a complete analysis and plan of development on the full unit.

CHAPTER IV

General Description

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General Description

Location and Physical Features

The Helmand River basin occupies roughly the southern half of Afghanistan (see General Map.) The central section of the basin in the vicinity of Bost and Kandahar, the general areas where most current Helmand Valley water resource development has occurred to date, lies in the vicinity of longitude 65° east and latitude 31° 30" north. The main stem of the Helmand River rises west of Kabul high on the southern slopes of the Koh-i-Baba and Hazara ranges, which reach elevations of as much as 4,400 meters (14,400 feet). These mountains are part of the renowned Hindu Kush range.

From its source the Helmand flows southwesterly about 550 kilometers (340 miles), descending to an elevation of approximately 750 meters (2,460 feet) at its confluence with the Arghandab River at Kala Bist, an important historical site where Ghaznavid kings established forts and castles and held court some 800 to 900 years ago. Below Kala Bist the river continues in a south and southwest direction for another 120 kilometers (75 miles) then turns and flows westerly for 200 kilometers (125 miles) into the Chahkansur region of southwestern Afghanistan. Here the stream turns abruptly northward, flowing into the Siestan basin on the border between Iran and Afghanistan and reaching its lowest elevation of 484 meters (1,590 feet) above sea level. At this point the stream forms a landlocked lake and marsh area. This lake varies from year to year in content and area according to inflow and evaporation.

The Arghandab River is the most important tributary of the Helmand River. It heads in the region southwest of Ghazni, flows southwesterly about 250 kilometers (155 miles) to a point a short distance below Kandahar, then westerly to its junction with the Helmand at Kala Bist.

Most of the streamflow of the Helmand and Arghandab Rivers originates in the headwater areas, either from rainfall at the intermediate elevations in winter and spring, or from snowmelt at the higher elevations during late spring and early summer. The lower sections of the basin are desert areas with little or no runoff, except for flash floods which result from intense but usually local rainstorms. These streams are the main sustaining resource of the region.

The northern half of the basin, generally the portion north of Kandahar and Girishk, is largely desert upland with rugged terrain and large hills and mountains devoid of trees and shrubs. Other vegetation is sparse. The southern part of the basin is desert plains interspersed with low to intermediate mountain ranges and isolated groups of hills. The mountains rise 200 to 400 meters (650 to 1,310 feet) above the surrounding terrain. The Dasht-i-Margo (Desert of Death), lying north and west of the Helmand River, is a stony desert where the land surface is generally armorplated to a depth of several centimeters with "desert pavement", actually gravel and small stones, blackened from exposure and mineral stain. The Registan Desert (Place of Sands) is a sandy desert lying south of the Arghandab and Helmand Rivers. This is a great wasteland of sand where enormous crescent-shaped dunes spread across the landscape. Due to the prevailing winds, particularly in the southern areas in the vicinity of the Iranian frontier, the dunes continually shift and move across the desert floor.

The Shamalan Unit occupies the alluvial plain along the right or west side of the Helmand River beginning at a point about 8 kilometers (5 miles) above Bost, and extending downstream some 60 kilometers (37 miles) to the vicinity of the Marja and Darweshan Units. The location of these units and their relationship to one another and to the main canals is shown on the key map.

Climate

The climate of the Helmand Valley region is hot and very arid, particularly at the lower elevations where precipitation is scant. Summers are hot, especially during June, July and August, and in the lower section of the basin maximums of above 52° centigrade (126° Fahrenheit) have been reported. The winters are mild, with minimum temperatures not usually below freezing. However, minimum temperatures reach such levels as to make growing tropical and subtropical plants such as citrus, dates, and bananas impractical. In general, the days are bright and sunny and cloudy days generally occur in the winter.

One adverse climatic phenomenon of the Helmand region is the sand and dust storms which may occur at any time throughout the year, but are most common in spring and fall. These storms are usually of local origin and are caused by winds which pick up sand and coarser particles from the desert floor and sweep them along, sometimes severely limiting visibility for several hours.

The regional dust storms which occasionally occur in the central part of the basin are often generated by high winds in the Chakhansur district. Here winds reportedly reaching velocities of 160 or more kilometers per hour (100 miles or more per hour), pick up sand and dust and whip it aloft into great clouds. These clouds move north and northeast and the finest particles eventually reach heights of 2,500 to 3,000 meters (8,200 to 9,840 feet) above the surrounding terrain. Although the dust particles in these high storms are microscopic in size, the atmosphere becomes so saturated that horizontal visibility on the ground may occasionally be reduced to less than one kilometer during periods of highest intensity, and often the ground cannot be seen from an airplane when flying at an elevation of 1,000 to 3,000 meters (3,300 to 10,000 feet) above the surface. These storms may last for several days and dust may sift from the atmosphere for a week or more. Small whirlwinds, creating "dust devils" are common on the desert at any locality or time.

Precipitation in the central section of the basin at and near Bost 1/ averages

1/ Based on water year of October 1 through September 30.

135.5 millimeters (5.3 inches) annually and occurs in the form of rain. The minimum annual precipitation for the period of record, 94.8 millimeters (3.7 inches) occurred in 1959, and the maximum annual precipitation of 195.7 millimeters (7.7 inches) occurred in 1956. Almost all precipitation occurs from November to April, although some precipitation has infrequently occurred in July. During the rest of the year, little or no moisture falls. Average figures for precipitation and distribution during the "rainy" season for the period of record from Bost and Chah-i-Anjir stations follow:

Month	Millimeters	Inches	Annual Distribution
November	9.1	0.36	6.8%
December	30.3	1.19	22.4%
January	33.3	1.31	24.6%
February	7.3	0.29	5.4%
March	25.0	0.98	18.4%
April	16.2	0.64	11.9%
Subtotal	121.2	4.77	89.5%
May-October	14.3	0.56	10.5%
TOTAL	135.5	5.33	100.0%

Almost 90 percent of total rainfall occurs from November to April, and over 65 percent in December, January and March. This fall and spring moisture supplies part of the moisture required for wheat production and provides some sparse pasture for livestock on desert and waste valley lands. However, most of the water supply required for wheat, and all required for summer and fall crops, must be supplied by irrigation.

Most precipitation occurs as small daily amounts of a few millimeters. However, an occasionally fairly heavy rainstorm causes flash floods, resulting in damage to roads, canal structures and bridges. Maximum precipitation occurring in a single month at Bost was in January 1964 when almost 47 millimeters (1.8 inches) fell. Doubtless far greater amounts of high intensity rainfall have occurred in local areas but because of lack of records the volume has not been determined.

Evaporation in the central Helmand Valley is very high and greatly exceeds precipitation. Records were obtained at Chah-i-Anjir for the period of January 1951 through November 1954, and at Bost from April 1955 through September 1965. Using the Chah-i-Anjir record for its entire length and the Bost record through September 1960, the weighted average for a period of approximately nine years of pan evaporation is as follows:

Weighted Evaporation
(Chah-i-Anjir and Bost)

	Pan Evaporation		Free Water Surface (coefficient 0.75)	
	Millimeters	Inches	Millimeters	Inches
October	201	7.91	151	5.93
November	130	5.12	98	3.84
December	83	3.27	62	2.45
January	81	3.19	61	2.39
February	106	4.17	80	3.13
March	164	6.46	123	4.84
April	250	9.84	188	7.38
May	345	13.58	259	10.19
June	438	17.24	328	12.93
July	416	16.38	312	12.25
August	370	14.57	278	10.93
September	268	10.55	201	7.91
TOTAL	2,852	112.28	2,141	84.20

Annual pan evaporation at Chah-i-Anjir was about eight percent above Bost, although during winter and spring evaporation is greater at Bost. Chah-i-Anjir is on the desert terrace some distance from the river, while the weather station at Bost is adjacent to the river, and humidity and wind probably account for differences in overall annual amount.

Evaporation data was collected by use of evaporation pans constructed of galvanized metal with dimensions of 1.46 meters (57 inches) in diameter and 27 cm (10.6 inches) deep. They are set on a brick base on the ground in contrast with the wooden cross slot base normally used by the U. S. Weather Bureau. Therefore, the coefficient normally used for converting pan evaporation to free water surface evaporation may be slightly different from the U. S. Weather Bureau coefficient of 75 percent used to compute free water surface evaporation.

Relative humidity in the area is not known precisely due to lack of reliable records. However, the area is characterized by very low humidity on the desert, rising in the irrigated areas under the influence of the irrigation and drainage systems and transpiration from vegetation.

Temperature data for the Bost area is also based on records for the water year of October 1 through September 30. The data cover the period of January 1955 to September 1965 inclusive collected at the Bost weather station.

Temperature Data for Bost
(Degrees Centigrade)

Month	Avr Max	Avr Min	Max	Year	Min	Year
October	29.5	8.4	38.8	1960	1.2	1958
November	21.9	3.8	31.0	1956	- 4.5	1959
December	15.3	2.7	27.3	1959	-11.6 *	1964
January	14.2	1.9	24.8	1960	- 3.9	1960
February	18.9	2.9	29.0	1960	- 4.1	1959
March	24.0	10.6	33.0	1959	- 3.1	1960
April	29.5	13.0	39.7	1958	2.9	1960
May	35.2	17.0	46.0	1956	8.9	1960
June	40.0	20.8	45.6	1960	14.8	1955
July	41.7	23.4	46.3 *	1955	16.7	1958
August	40.5	20.4	45.7	1955	14.0	1955
September	36.4	14.9	42.7	1960	8.0	1955
Annual, °C	28.9	11.7	37.5		3.3	
Annual, °F	84.0	53.1	99.5		37.9	

* Denotes extreme (46.3° C = 115.3° F; -11.6° C = 11.1° F)

Records at Chah-i-Anjir begin in January 1951 and the station was closed in October 1956. Maximum temperatures recorded at this station are about 3° centigrade above those for the Bost station, and the average maximum is about 1° higher. Since Chah-i-Anjir is situated on the dry desert terrace, the higher temperature probably results from absence of the cooling effect of the river and irrigated lands near the Bost station.

Water Resources

Ground Water. Little information is available concerning the ground water resources of the Helmand Valley region. In certain sections of the basin extensive areas are irrigated by means of kareezes, which drain water from the top of the ground water reservoirs. Most of the ground water sources which are developed by kareezes are relatively shallow, probably not exceeding 10 to 20 meters (30 to 65 feet) in most instances.

In the Kandahar area a few deep artesian wells have been developed which presently produce a continuous flow, generally less than 200 liters (53 gallons) per minute. Deep water aquifers may be available in some localities. Before availability of deep ground water can be known, extensive detailed studies will be required.

Although ground water studies have not been made in the alluvial valleys in the basin, limited information on geology and observation of a few wells indicate a possibility for developing adequate water from this source for domestic and municipal use at some localities. Along the Helmand River the valley alluvial deposits usually extend laterally across the valley from edge to edge, and the depth above bedrock appears to be adequate to form good ground water reservoirs. Some test borings have been made which indicate that permeable gravels overlying bedrock may generally be 10 to 12 meters (32 to 39 feet) or thicker in some localities.

Municipal wells have been developed at Bost to draw potable water in ample amounts to supply town needs. These wells are about 75 meters (250 feet) deep and apparently tap both water in the alluvium and in the underlying bedrock. The water from the Bost wells has total dissolved solids somewhat in excess of 1,000 parts per million as compared to water in the nearby Helmand River which usually varies from 190 to 260 parts per million. At present all villages and farmsteads obtain their domestic water supply from main canals, irrigation ditches, and drains throughout most of the year. In the early winter the main canals are shut down for a period of about 45 days, and during this period domestic water is obtained from pools in the canals, canal drops, receding drains, or shallow wells or pits which tap the high water table. Water supplies now available constitute a health hazard for they transmit various disease organisms. Ground water should be investigated and sanitary wells for domestic water drilled wherever practicable. Wells will not only materially improve the physical environment of the population, but will also make possible more efficient operation of the Shamalan irrigation and drainage systems. With deep wells in operation, the canals can be shut down during the period when irrigation water is not in demand, thereby permitting better maintenance of the system, and also decreasing soil waterlogging and drainage requirements.

Surface Water. Flows of the Arghandab and Helmand Rivers constitute the principal dependable surface water resources of the basin. Both of these streams provide water supply of excellent quality, and with storage provided by the Kajakai and Arghandab Reservoirs, water supplies are essentially regulated throughout the year. Kajakai Reservoir, with a capacity of 184,406 hectare-meters (1,495,000 acre-feet) below the crest of the uncontrolled spillway, provides a high degree of regulation and carryover storage and makes ample water available to irrigate lands lying along the Helmand River below the dam. Records of streamflow have been obtained at several points along the Helmand River, on some of the more important tributaries, and at some of the more important canal diversions. For the concurrent period of record, water years October 1956 through September 1964 the average annual historical flows are:

Helmand River into Kajakai Reservoir	633,900 hectare-meters
	5,139,000 acre-feet
Helmand River below Kajakai Dam	628,100 hectare-meters
	5,092,300 acre-feet

Helmand River at Darweshan . . . . 673,300 hectare-meters
. . . . 5,458,400 acre-feet

Arghandab River at Kala Bist . . . . 94,800 hectare-meters
. . . . 768,900 acre-feet

The complete period of record shows the average annual historical flows at the same stations as follows:

Helmand River into Kajakai, 1953-65 (13 yrs). . . 649,200 hectare-meters
. . 5,262,900 acre-feet

Helmand River below Kajakai Dam, 1948-66 (19 yrs) 623,600 hectare-meters
5,055,500 acre-feet

Helmand River at Darweshan, 1957-64 (8 yrs) . . . 673,300 hectare-meters
. . 5,458,500 acre-feet

Arghandab River at Kala Bist, 1948-64 (17 yrs). . 86,400 hectare-meters
. . 700,200 acre-feet

Kajakai Reservoir began to provide regulation on January 29, 1953 and Helmand River flows reflect its regulating effect subsequent to that date. Since storage was initiated, the natural flow of the Helmand has been subject to depletion by evaporation from the reservoir, which for the water years 1960-1965 inclusive averaged about 7,800 hectare-meters (63,000 acre-feet) annually. The maximum annual flow occurred in the 1957 water year when almost 1,110,000 hectare-meters (9,000,000 acre-feet) passed the gage below Kajakai, compared to the minimum flow in the 1963 water year when 398,000 hectare-meters (3,227,000 acre-feet) were released from the reservoir. For the 14-year 1953 to 1966 period inclusive, the reservoir has filled and spilled 11 years. Although this reservoir provides considerable regulation and has materially reduced flooding along the Helmand, some spills reach significant proportions. The maximum spill of record occurred in May 1957 when a flood flow of 1,700 cubic meters per second (60,000 cubic feet per second) occurred at the gage below the dam. Floods originating below the dam also are of considerable significance, as demonstrated in March 1957 when a maximum flow of 3,770 cubic meters per second (133,000 cfs) occurred. These infrequent but rather large floods inundate large areas of lowland along the river, and in some instances flood some cultivated lands which lie at lower elevations. These floods also damage physical structures near the river.

Arghandab Reservoir has a capacity of 47,900 hectare-meters (388,000 acre-feet) which effectively regulates this river. The quality of water of the Helmand River is good to excellent for irrigation and municipal and industrial use. Analyses of the water from the river and from the Boghra and Shamalan canals, which take water directly from the river, show that total dissolved solids vary from a minimum of about 190 parts per million to a maximum of about 260 parts per million. Sodium constitutes about 16 percent of the total cations.

Part of the drains within the Shamalan Unit and the Nad-i-Ali Wasteway are being considered in the project plan for integration with the irrigation system of the Unit. These have waters with salt concentrations ranging from approximately 1,000 to 1,500 parts per million. They do, however, have favorable calcium-sodium relationships, and, mixed with adequate quantities of river water can be safely used for irrigation.

Land Resources

The best lands in the Helmand Valley region are confined in the main to valley alluvial deposits. These lands usually lie in narrow strips along either side of the river and are generally accessible for irrigation by gravity diversions from the river. The soils are generally deep, mainly loams, silt loams, or silty clay loams and lesser amounts of sandy loams, usually overlying permeable gravel.

This is generally true of the Shamalan Unit, but since this Unit occupies relatively recent river terraces and flood plains, the areas of good land are often spotty and disassociated. Gravel bars, at or near the surface, have been deposited extensively throughout the valley. Wind erosion and washing have created unfavorable topography over parts of the area, particularly adjacent to the river and bordering the desert.

Most of the valley lands along the Helmand River which are now suitable or have been suitable for irrigation, have been irrigated at one time or another for many centuries. Where good drainage and an adequate water supply are available, lands have remained under cultivation. Where poor drainage, poor irrigation practices, or a combination of these factors have occurred, and high water tables, salinization, and excessive exchangeable sodium levels have developed, large areas have been abandoned.

The great majority of lands which have remained under cultivation have been seriously depleted of fertility and organic matter. Very little fertilizer or organic matter has been used, except on small acreages near villages where some animal and human manures have been applied. Soil-moisture relationships are poor due to low organic matter levels, and fertility will be difficult and expensive to build up and maintain.

To rectify these conditions it will be necessary to develop a sound soil improvement program, including good crop rotations, adequate use of green and barnyard manures, plowing under crop residues, probable use of initial massive applications of commercial fertilizers to build up fertility to acceptable levels, and continuing use of fertilizer to meet annual crop requirements.

High to very high exchangeable sodium levels occur in a sizable part of the unit soils. These typically contribute to poor soil physical condition and slow moisture intake rates. High concentrations of exchangeable sodium are also toxic to crops. Affected lands range from those on which crop yields have been materially reduced to those which have gone completely out of production. They include lands ranging from those which can be reclaimed at relatively low costs to those where reclamation would not be economically feasible. The most effective means for reclaiming the sodic lands is by the use of gypsum as a calcium amendment, accompanied by leaching, and by the continuing use of organic residues, green manures and farm manures. Gypsum is available in extensive workable deposits in a number of places in the valley.

The soils of the arable lands have good basic physical characteristics and can be expected to respond well to good reclamation, management, and fertility building practices. These practices are essential to building sound agriculture in the area.

Transportation

Afghanistan is a landlocked nation, surrounded by other countries through which people and goods must pass to enter or leave the nation. Afghanistan is bounded on the north by the Turkoman, Uzbek, and Tadzhik Soviet Socialist Republics of the U.S.S.R; on the east and south by the West Pakistan region of Pakistan; on the west by Iran; and on the extreme east at the tip of the Wakhan Corridor by Sinkiang Province of the Republic of China. The principal port of entry for Afghanistan is Karachi, West Pakistan, although commodities also enter and exit through the Soviet Union and Iran.

Shipments into Afghanistan from Karachi are generally by railroad over two routes. One of these extends to Peshawar some 36 kilometers (23 miles) east of the Afghan border. From this point goods are trucked over paved highway through the Khyber Pass and along the Kabul River canyon to Kabul, which lies some 225 kilometers (140 miles) from Peshawar. The other route, which frequently is used for Helmand Valley shipments, is by rail from Karachi to Chaman, which lies on the Pakistan side of the border, about 110 kilometers (68 miles) southeast of Kandahar. Goods are trucked over a paved highway to Kandahar from Chaman via the Afghan border village of Spin Baldak, and a contract is currently being negotiated for construction of a railway spur on the 11 kilometers (7 miles) between the two towns. This spur would permit sealed or bonded overseas shipments for Afghanistan to pass through West Pakistan more quickly, and avoid various clearing, customs, siding, and handling charges made on goods presently transshipped through Pakistan.

On the north, the Amu Darya or Oxus River is a common border for much of the distance between Afghanistan and the Soviet Union. Exports and imports leave and enter Afghanistan through two principal highway routes. One route is north from Kabul by paved road across the Hindu Kush mountains through the

Salang Tunnel, and into Russia across the Amu Darya River a few kilometers north of Kunduz. The second route, also by paved road, is on the western side of the country north from Herat to Russia. The Amu Darya is a navigable stream on which cargo is moved up and down river by the Soviet Union. Most commodities to and from the U.S.S.R. travel by these two routes, including a substantial part of the petroleum products used by Afghanistan.

Iran bounds Afghanistan on the west. The principal highway route to Iran runs west from Herat through Islam Kala to Meshed, Iran, about 257 kilometers (160 miles) west of Herat. A rail terminal at Meshed provides service to a point near the western boundary of Afghanistan. The Helmand Valley obtains a substantial part of its petroleum products from Iran by this route, by means of tanker trucks operating from Meshed.

No roads or navigable streams connect Afghanistan and the Republic of China.

Within the Shamalan Unit, a gravel road has been constructed and is maintained along most of the length of the Shamalan Canal. This road gives reasonably good access to the central part of the area, while unimproved roads along major drains, although usually poorly maintained, serve some sections of the Unit. However, these drainbank roads, because of poor quality or location, fall far short of meeting requirements for roads and general access to most of the farm areas. At the present time almost all products moved to or from the farms are transported on donkeys, camels, or the backs of human beings. In the past, some roads have been built but abandoned because of lack of maintenance, or due to the simple fact that they were not kept open. As a part of project development, it is essential that farm and service roads be constructed at reasonable intervals to permit vehicular traffic to the farms.

There are no railroads within Afghanistan, and until only recently the highway system within the country was poorly developed. Within the past few years, several paved highways have been constructed which provide good communication between the principal cities and towns. Recently a concrete paved highway was completed from Kandahar through Girishk and Delaram to Herat, which passes within 50 kilometers (31 miles) of Bost and extends north to the Soviet Union. Another branch of this highway is now being paved from Herat westward to the border at Islam Kala and within the last year a modern paved highway has been completed between Kandahar and Kabul.

Under the present network of major roads within Afghanistan, truck, bus, and automobile transportation is available on a wide regional basis. Goods move along a system which connects most major cities, and which describes a great rectangle over the country, linking Kabul, Ghazni, Kandahar, Girishk, Herat, Maimana, Mazar-i-Sharif, Kunduz, Baghlan, and back to Kabul, with spurs to the Soviet, Pakistan and Iranian frontiers. Aside from the existing major highways, roads are generally inadequate, and often are totally lacking for rural areas.

In the Helmand Valley region an improved gravel road about 50 kilometers (31 miles) long extends northeastward from Bost to connect with the paved Kandahar-Girishk-Herat highway. Other improved gravel roads have been constructed locally, serving Chah-i-Anjir, Marja, and Kajakai Dam. The Bost-Chah-i-Anjir road extends to Girishk along the Boghra Canal. In the Kandahar area roads are poor.

Industrial Development

Industrial development is very limited within the Helmand River Basin, and most of what does exist is situated in the Kandahar area. In that city the Afghan Government Monopolies assembles trucks with imported components, raisin drying sheds process raisins for domestic consumption as well as export, a wool cloth weaving plant, a wool sorting plant, a fruit processing and canning plant, and several other establishments either manufacture or provide services and retail outlets for local consumption and export. Numerous small metal workshops, stores, and other cottage industries process goods for local consumption.

Industries situated in the Bost area are generally based on agriculture, although some nonagricultural industries and enterprises have developed. The principal noteworthy industries are a cotton gin, an oilseed processing plant, an alabaster plant, a dairy products processing plant, and a heavy construction enterprise.

The cotton gin is a modern plant which has operated for three seasons. It has a capacity of 130 metric tons (143 short tons) of seed cotton daily, based on a 20 hour operation. This represents about 40 metric tons (44 short tons) of lint, which greatly exceeds cotton production in the service area.

An oil mill is now being constructed to process cotton or other oilseeds. This installation will be complete with crushing and oil expelling apparatus as well as facilities for refining and hydrogenating the crude cottonseed oil and for making soap. The plant as initially planned and designed has a capacity of 76 metric tons (84 short tons) daily. On the basis of a 200 day operational period this represents a capacity of 15,200 metric tons (16,750 short tons) annually which is also considerably in excess of local cottonseed production. Additional cottonseed may possibly be brought in from outlying areas by means of long distance trucking.

The dairy plant has been in operation a little over a year and is presently used to process milk produced at the livestock experimental farm operated by the HAVA. It has almost all kinds of equipment required to process milk and produce butter, cheese, ice cream, and cream. The plant has a capacity of 5,000 pounds of milk daily, but to date production averages 1,000 pounds daily. It also distributes eggs which are produced at the HAVA poultry research farm. It was contemplated that the plant would handle milk from surrounding private farms, and in the winter of 1966-67 the plant began the purchase of milk from local sources.

The alabaster plant is an establishment equipped to saw and polish native stone, which is quarried about 200 kilometers (125 miles) south of Bost. All of the equipment is quite modern and the plant is capable of producing exquisite stone products by hand carving and machine operations. The so-called alabaster is more nearly marble, as it takes a high polish, and is harder than most forms of alabaster. Flat surface products are used for floor tiles, ornamental wall coverings, and such ornamental furniture as coffee and end tables. New equipment has been acquired for woodworking, and this section of the industry is now in operation.

In addition to these industries, there are several minor traditional industries in the Bost area. Among these are small gristmills which grind wheat and corn. Whole wheat flour is used for making unleavened bread ("nahn") which is the principal staple in the diet of the population. Cornmeal is also used for bread to a smaller extent. The gristmills are either water powered stone or steel bur mills situated at drops along the Shamalan Canal, or small steel bur mills driven by internal combustion engines.

There are a few brick kilns which produce soft, lightly fired mud brick, using camelthorn or other shrubs as fuel. A few small shops that produce metal products and tailored goods in the Bost bazaar serve the local trade.

Health

Accurate statistical records regarding disease occurrence and general health conditions are not available for people in the Helmand Arghandab Valley area, but it is known that generally poor health conditions prevail throughout the valley. These can be attributed largely to faulty home and personal sanitation, inadequate diet, contaminated water supplies, and delay in seeking and obtaining medical treatment.

Tuberculosis is probably the most prevailing disease and the majority of the patients seen on an outpatient basis at the Bost Hospital are afflicted.

Approximately 30 percent of the region's population have tuberculosis, and the high rate of infection is an outgrowth of poor health conditions in the area. Tuberculosis is highly communicable, and since the local people have no concept of isolation of infected individuals, this disease is spreading at an alarming rate within families and villages.

Cirrhosis of the liver is due primarily to poor diet. Because of the customary delay in seeking medical treatment, this condition usually has reached an advanced stage when seen by doctors.

Malaria frequency is very high. With exception of some spraying in and near Bost, there has never been general mosquito control in the valley. The only control effort of consequence has been the prohibition of rice growing in the immediate vicinity of villages. Medication, both for prophylaxis and treatment is available at the hospital, but rarely used except when the patient is hospitalized.

Bacillary dysentery is endemic, and the majority of the population suffer from this disease. The high incidence of dysentery is directly attributable to poor sanitary conditions, unsafe water supplies, and unsanitary food handling habits.

Other important diseases are abscesses, ascites (accumulation of serous fluid in the abdomen), various types of intestinal worm infections, and fevers of unknown origin.

Low standards of sanitation and personal cleanliness are probably the greatest contributors to the prevailing health conditions. There are no sanitary facilities in the villages and the prevailing practice of using adjacent fields for open latrines contributes to infection and spread of many diseases. These fields serve as breeding grounds for flies and other disease-transmitting insects and contaminate drinking water supplies as well. There is a great need for sound, comprehensive programs for establishing sanitary facilities, teaching the people to use these facilities, and teaching the need for keeping themselves clean.

The common diet falls far short of maintaining good health. The great majority of the people live largely on bread and tea, occasionally supplemented by small quantities of fruit, vegetables, rice, meat and poultry. Fruits and vegetables are eaten in season and when income permits their purchase, but constitute only a small part of the usual diet. The very low income of the average resident limits consumption to small quantities of meat, far short of adequate daily dietary requirements. Improvement of food production to supply adequate, well balanced diets is essential to building up health levels in the valley.

Water supplies used for drinking, cooking, washing foods, and bathing are nearly all contaminated and constitute a major source of infection. Provision for deep wells for a safe water supply, and educating the people to use only safe water should be part of any future health improvement program.

The attitude toward medicine, hospital admission and treatment is generally favorable. People in need of treatment usually have no objection to coming to the hospital and arrivals at the hospital frequently exceed the number that can be accomodated. The doctors and nurses state that they have had no problem with patients refusing medicines. There is, however, a severe shortage of medical personnel in the valley and their number must be augmented.

Education

Prior to the mid 1940's, when Morrison-Knudsen came into the valley, all of the Government operated schools were under the jurisdiction of the Provincial Directorate of Education. The only other schools were traditional schools operated by mullahs in the villages.

With the development of the Helmand Valley Project and the influx of people into the valley, the need for enlarging the school system in the valley was recognized. The Helmand Valley Authority embarked on a program in 1957 of adding additional schools to those which could not be provided within the limited budget of the Ministry of Education.

There are now ten elementary schools, twelve village schools, one teacher training section, and one high school. Only the Bost, Chah-i-Anjir and Marja elementary schools, and the Lashkar Gah High school are coeducational. The total enrollment in all schools operated under the Department of Education is 2,800 pupils. There are 35 teachers in the HAVA school system, of which nine are graduates from the Dar Mu' Allamein (School of Teachers) teacher training school in Kandahar, and 26 are untrained.

Lashkar Gah High School has to date produced 55 graduates. Of these 11 have been sent to the American University of Beirut for higher training and four have been enrolled in different colleges of Kabul University. The others have been distributed in the various departments of the HAVA, according to needs.

During the Third Five Year Plan (1346 to 1350, or 1967-1971), the Department of Education plans to establish 20 community centers, 25 village schools, 16 elementary schools and eight junior high schools. The department also plans to offer one-year evening courses in typing, drafting, and accounting each year, plus three-year courses in secretarial and clerical training. These courses will be offered to appropriate HAVA officials to increase their competency.

The Department of Education also plans to revise the curriculum of Lashkar Gah High School to better meet the interests and aptitudes of the pupils, provide the type of training needed by the Project, and the needs arising from the environment.

The planned educational system for the valley has high aims, with objectives of providing a program for expanding and improving primary, secondary and village schools, providing adult education, and providing practical training programs in sanitation, health, agriculture, craftsmanship, etc. If these goals are achieved, much will be accomplished toward improving literacy, competency and health conditions in the valley.

Settlement, Population, Tradition, and Custom.

The Helmand Valley region, with its bountiful rivers and arable lands along the valleys and on some of the more favorably situated terraces, is probably one of the cradles of civilization, possibly contemporary with the Tigris and Euphrates Valleys of the Near East. Building materials suitable for creating permanent structures are scarce and it is likely that many of the buildings and structures erected by early residents were constructed then, as now, from mud, and have long since vanished. To date only a limited amount of archaeological work has been done, and ideas concerning the early history of the valley are largely speculative. Although ancient ruins are largely nonexistent, soil borings in valley alluvium along the Helmand have turned up fragments of pottery that give evidence that old civilizations existed along the Helmand long, long ago. This is borne out by the fact that the pottery shards come from depths of two meters or more, and are found in old flood plains which were laid down countless centuries ago.

Alexander the Great visited the valley over three hundred years B.C. and founded the existing city of Kandahar on the Arghandab River about 150 kilometers (93 miles) east of Bost. (Until recently Bost was known as Lashkar Gah, which translated means "Place of the Militia"). Remains of "Alexander's Wall" still stand at Kandahar, and Greek sculptures have recently been discovered in excavations near that city. It is reported that Alexander traveled downstream along the Helmand into the Chakhansur basin, where he discovered flourishing communities and cities along the river.

More recently, probably some 800 or 900 years ago, various Ghaznavid kings established forts and royal palaces along the Helmand River in the vicinity of Bost. One of the most spectacular of these ruins is Kala Bist and its famous Arch, located at the junction of the Arghandab and Helmand Rivers. There are still magnificent old ruins of these forts and palaces up and down the river indicating that a large population resided in the valley at that time. Irrigated agriculture then as now was the principal support of life, as evidenced by the many old irrigation ditches which can be seen along the river, and in terrace areas where underground water tunnels were used to develop the subsurface water supply. Doubtlessly, thousands of people have resided along the Helmand and Arghandab Rivers in past centuries.

Various factors contributed to the decline of the civilizations and recession of population over the past few centuries. Most important of these were the invasions by various conquering armies, particularly the Mongols; the deterioration of irrigation works, salinization of lands, and poor drainage; and the massive depletion of soil fertility through exploitative farming which took more from the land than it returned. By the early 20th century few people remained along the Helmand.

Since 1945 the population of the valley has increased significantly. Since few population statistics have been collected, estimates or fragmentary statistics must be used to obtain some idea of the urban and rural population of the region. Kandahar, capital city of Kandahar Province, is the major urban center and second largest city in Afghanistan. Estimates made by the Ministry of Planning in 1960 indicate a city population of approximately 115,000 persons, and a population in rural areas, including provincial villages, of almost 895,000. The population has undoubtedly increased, particularly in the city proper. Some of the main streets are now paved, and there is considerable building activity in certain residential areas. Most buildings are constructed of lightly fired mud brick, and much of the residential area is enclosed in compounds surrounded by high mud walls. The city is served by an electric power system whose present capacity is overtaxed. Kandahar is a traditional Central Asian city, with small bazaars to serve the retail trade, no sewage system, and no piped water supply system.

Water is obtained from the Patow Canal and its many laterals that pass through the urban area.

Girishk, at the northern end of the Helmand River irrigation system, is the second largest city in the region. No reliable estimates of population are available, but based on an estimate of 1,200 families within the city, with an average of six persons per family, the population of the town may be from 7,000 to 7,500 persons. Girishk is a typical traditional small city common to this section of Asia. Its houses and bazaars are built of soft mud bricks fired in local kilns, and most of the residences are within compounds with high mud walls. The town has electric power from the hydroelectric generating plant located nearby on the Boghra Canal.

Bost, located on the left bank of the Helmand River, is the capital of Helmand Province and headquarters of the Helmand Arghandab Valley Authority, which operates under the Ministry of Planning. No current information is available on the population of this town, but it may have a total population of 3,000 to 4,000 persons, including outlying villages. The central part of the town, with an area of two or three square kilometers, is modern with a piped supply of good quality water obtained from moderately deep wells; a sewage system; an electric power system which distributes energy obtained from the generator at Girishk; and a local diesel standby plant. The central section of the city was initially laid out and constructed with the help of Morrison-Knudsen Afghanistan, Inc. in connection with its development activities, and the architectural plan has been continued by the Helmand Arghandab Valley Authority. The buildings are modern, with thick walls, and no walled compounds are found in the central section of town. There are about 350 homes in the modern section of Bost, and probably one-third to one-half of the total population resides in this area. The outlying areas are supported by traditional Afghan villages, some with electricity but no water or sewage systems. Houses there are constructed of mud brick, and compounds with high mud walls are common. An industrial area lies at the southern edge of town.

The Shamalan area along the west side of the Helmand Valley includes all lands under the Shamalan Canal system. There are about 200 villages within the area, with a combined total population of approximately 24,000 persons. The villages vary in population from a few families to larger communities containing many families. Villages are of traditional construction, usually consisting of mud huts without floors or windows. However, some new farmhouses are built of dried mud brick and are considerably more pretentious than the conventional huts. These houses are usually located outside the villages on individual farm units, and many have recently been constructed by settlers. Shamalan villages have no sewage systems, for domestic water supply depends upon flows of adjacent irrigation ditches and/or drains. Due to mud construction and lack of paint, the Shamalan villages give the impression of great age and permanence. However, the villagers frequently change sites to remove themselves from their waste materials, and a typical life for a village is eight years, after which the huts are demolished and the site farmed. Crop yields are often significantly higher on ex-village sites.

In the Shamalan area, as throughout Afghanistan and Central Asia, the family is the basic and fundamental unit of society, and family groups tend to remain together as clans or extended families. Clans in turn are bound into larger tribal groups which eventually embrace large segments of the national population. Extended families and tribal groups are closely knit by marriage within the tribe, and even by intermarriage within the extended family, the tribe, and finally the country, in that order. Only recently has the government of Afghanistan taken major steps to knit the population of the various tribal groups into an integrated, unified nation. About three years ago a new constitution was adopted by the Government and the Government is now moving forward as a constitutional monarchy functioning in accordance with democratic principles.

Villages within the Shamalan are established and organized politically, economically, and socially largely on the basis of the extended family or clan. The village chief or khan is the individual who exercises overall leadership, and owns land and villages, and through authority vested in him by members of the clan, occupies the position of "head man" in almost all matters concerning the village and its inhabitants. Another important personage found in most villages is the mullah, who presides over and generally directs the religious life of the community. He also exercises considerable influence in political, social, and educational matters. In addition to the quasi-political organization of the various villages, a sub-governor, who resides in Khalach, represents the central government and exercises political and administrative authority in the area under his jurisdiction.

The immediate and extended family members of the village khan usually operate the farms surrounding the village. The individual farms are either owned and operated by a single man, by two or more brothers, a father and son, or other male relatives. In addition most landowners have tenants who work the land on a share basis, and reside in the village. These tenants usually are not related to either the immediate family of the landowner or the extended family.

Land parcels in the Shamalan area are badly fragmented and individual tracts are small. Preliminary information developed by the Cadastral Survey from surveys of the West Shamalan Division indicates that individual tracts average about 1.2 hectares (3 acres) each. Individual or joint owners frequently own several separate tracts, with an average size of holdings in the West Shamalan Division of about 7.4 hectares (18.2 acres) per ownership of irrigated land, plus one or more hectares of dry land. On the average there are two tenants per ownership.

Agriculture

Farming in the basin depends on irrigation, with the bulk of the water supply provided by the Helmand and Arghandab Rivers, and their tributaries. Lands best suited for irrigation farming are alluvial deposits and valley fills along the river, usually occurring in narrow, irregular strips, and include the Shamalan, Darweshan, and Arghandab areas. The Seraj area, lying between the Helmand and Arghandab Rivers north of Bost is irrigated by the Seraj Canal and local jui systems. Other areas, including the Marja and Nad-i-Ali, lie on benches and are irrigated with Helmand River water. In certain localities underground water supplies are tapped by kareezes, or water tunnels, which often extend several kilometers and divert ground water to the surface where benchlands and high terraces are irrigated.

Present agriculture in the Helmand and Arghandab Valleys can be characterized as a mixture of subsistence and commercial farming, with every area having elements of each type. The Arghandab region is generally more commercialized, and the Helmand region inclined more to subsistence. Although few farms exist where farmers do not grow their own food, the area around Kandahar specializes in grapes and tree fruits for the urban market and export. The central portion of the Helmand Valley, principally the Shamalan, Darweshan, Nad-i-Ali, and Marja areas, produces little for market. These project units generally produce food for the farm family and tenants, but little in excess of home needs. In good years the better areas produce some marketable surplus; in average years they operate almost completely on a subsistence basis; and in poor years they require supplementation by wheat brought in from outside sources.

In the Helmand and Arghandab region the farms are small, fragmented, and operated with tenants and oxen. The typical farmer owns about five hectares (12 to 13 acres), keeps one to two oxen, hires one or two tenants, and grows a combination of small grains (principally wheat), alfalfa, grapes, fruit, vegetables, corn, dry beans, and cotton. In certain areas, as the Shamalan, Darweshan, and Marja, cotton growing requirement has been enforced by the HAVA. Most farmers keep cows and young cattle as replacement stock for oxen, purchase sheep and goats in the fall months for fattening and home use, maintain a small farm flock of chickens, and keep donkeys and occasionally horses for pack animals.

On a typical valley farm, land is plowed with oxen and a stick plow with an iron point; fields are irrigated by running water into small enclosed basins bounded by low dikes; seed is broadcast directly on the surface and sometimes plowed in; growing plants are not cultivated or weeded; and crops are harvested by hand,using a small, crude curved knife or sickle for cutting small grains and alfalfa and clover; and other crops are harvested without tools. Wheat and barley are threshed by trampling with oxen or donkey teams and are winnowed on breezy days. Corn is shelled by driving animals over the ears, or by hand. Commercial fertilizers, insecticides, disease control agents, effective crop rotations,machinery, implements, and commercial credit are little known by the average farmer. Under these conditions crop yields are low to very low. Various surveys conducted in the region consistently have reported irrigated yields of less than half of what could be expected under the prevailing soil, water and climatic conditions. In recent years wheat yields have ranged from 170 kilograms per hectare (3 bushels per acre) in the Nad-i-Ali, to 1,990 kilograms per hectare (30 bushels per acre) at Darweshan; barley from 123 kilograms per hectare (2 bushels per acre) in the Nad-i-Ali to 1,510 kilograms per hectare (28 bushels per acre) in the Shamalan; corn from 365 to 1,200 kilograms per hectare (6 to 19 bushels per acre) in various Kandahar localities; cotton yields from 144 kilograms of seed cotton per hectare (128 pounds per acre) or less than one-tenth of a bale per acre of lint in the Nad-i-Ali, to 682 kilograms per hectare of seed cotton (608 pounds per acre, or 0.4 bale of lint) in the Shamalan; alfalfa yields, on a dried basis, have been recorded from 190 kilograms per hectare (170 pounds per acre) in the Nad-i-Ali area to 5,365 kilograms per hectare (4,790 pounds, or 2.4 ton per acre) in the Shamalan; dry beans from 119 kilograms per hectare (106 pounds per acre) in the Nad-i-Ali, to 785 kilograms per hectare (700 pounds per acre) in the Shamalan; grapes range from 338 kilograms per hectare (300 pounds per acre) in the Nad-i-Ali to 3,900 kilograms per hectare (3,480 pounds per acre) in the Shamalan. Other yields for fruit, vegetables, rice, tobacco, and minor crops are correspondingly low. Milk production in the Shamalan is about 770 kilograms (1,690 pounds) per cow per year, and egg production is about 70 per hen per year. The Nad-i-Ali yields are generally lowest, and this area is gradually being abandoned by its inhabitants. Although occasional fields and farms are seen with yields in excess of the averages, others have even lower returns.

Annual farmer income thus is very low in this region. Figures run from zero net income in the poor areas, to the equivalent of $300 per farm in the better areas. The concept of net income here means that farmers have a larger food supply, for little food production is converted into cash. It is possible for farmers to have a negative income, wherein the farmer gradually depreciates his farm investment and working stock without replacing these assets. In this region the more prosperous farmers have more to eat and some cash to spend; the poor farmers consume as they produce with no margin for investment; and almost universally the farm tenants, or sharecroppers, live at the margin of survival.

CHAPTER V

Agricultural Economics

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Present Conditions

General

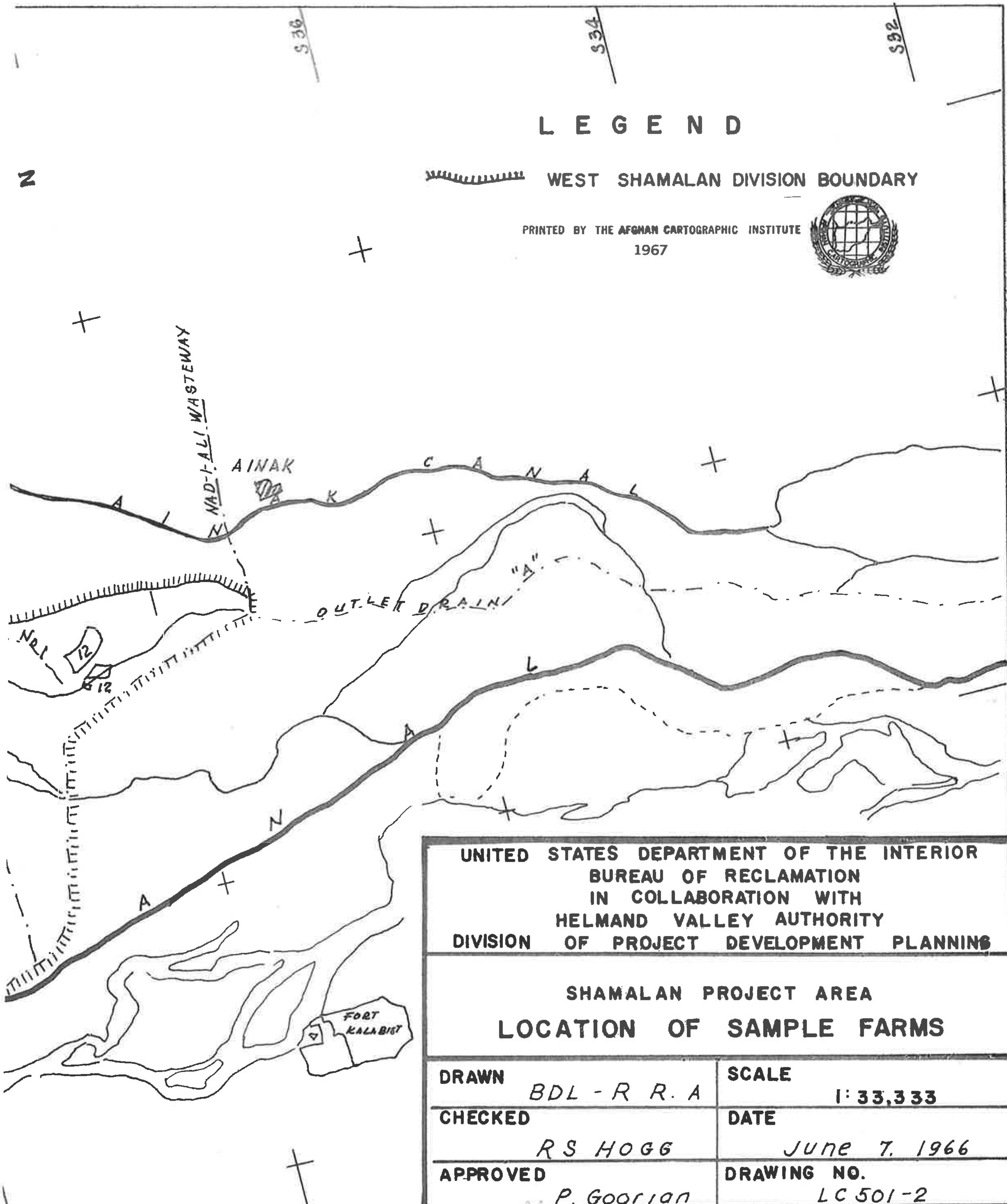
The Shamalan Unit lies south of Bost and west of the Helmand River. It is a strip of alluvial land about 64 kilometers (40 miles) long and 1 - 7 kilometers (0.6 - 4.3 miles) wide. The gross area is 259 square kilometers (100 square miles) or 25,875 hectares (63,936 acres) of which 13,237 hectares (32,708 acres) are classed as arable, and 12,707 hectares (31,399 acres) are classified as irrigable. The area is now largely settled and farmed with the nonarable portions being grazed by pastoral tribes, some of whom remain in the area year around, while others come and go on a nomadic basis.

The Unit, in common with the greater part of the farming areas of the Helmand Valley and of Afghanistan, is worked under what can be best described as subsistence farming. The typical farmer, using archaic equipment, oxen power, and sharecroppers, grows his family food requirements and a small surplus for exchange or sale. His advances since the Helmand River was controlled in 1954 are more of degree than innovation, for his practices and yields have not materially improved since that time. The amount of land under regular cultivation and the percentage of double cropping only have been augmented as a result of the more abundant and reliable water supply.

An assumption of an almost static agriculture, or at the very least an agricultural base that has not changed significantly since completion of Kajakai Dam in 1954, appears valid in view of the traditional pattern of agriculture and the very slowness with which innovations have thus far been accepted.

The future condition of agriculture in the Shamalan area can be improved only with a great and concerted effort on the part of Helmand Arghandab Valley Authority officials and local farmers. Many factors - crop varieties, stock, use of fertilizers, insecticides, green manures, crop rotations, better tillage, cultivation, harvest methods, credit, marketing, tenancy, farm size, education and agricultural extension must be improved before a viable and thriving economy can be developed. These improvements must come in addition to the basic proposed project advances in water distribution and drainage, land leveling, smoothing and shaping, farm roads, domestic water supply, and application of soil amendments.

When the Reclamation planning team was introduced to the Shamalan area late in 1964 very little statistical data were available. Some economic information had been collected which dealt primarily with crop rotations, yields, and social conditions of the inhabitants. The economics team conducted intensive sample surveys in the western portion of the area (see Map LC501-2 on the following page) in order to determine more accurate costs and



LEGEND

WEST SHAMALAN DIVISION BOUNDARY

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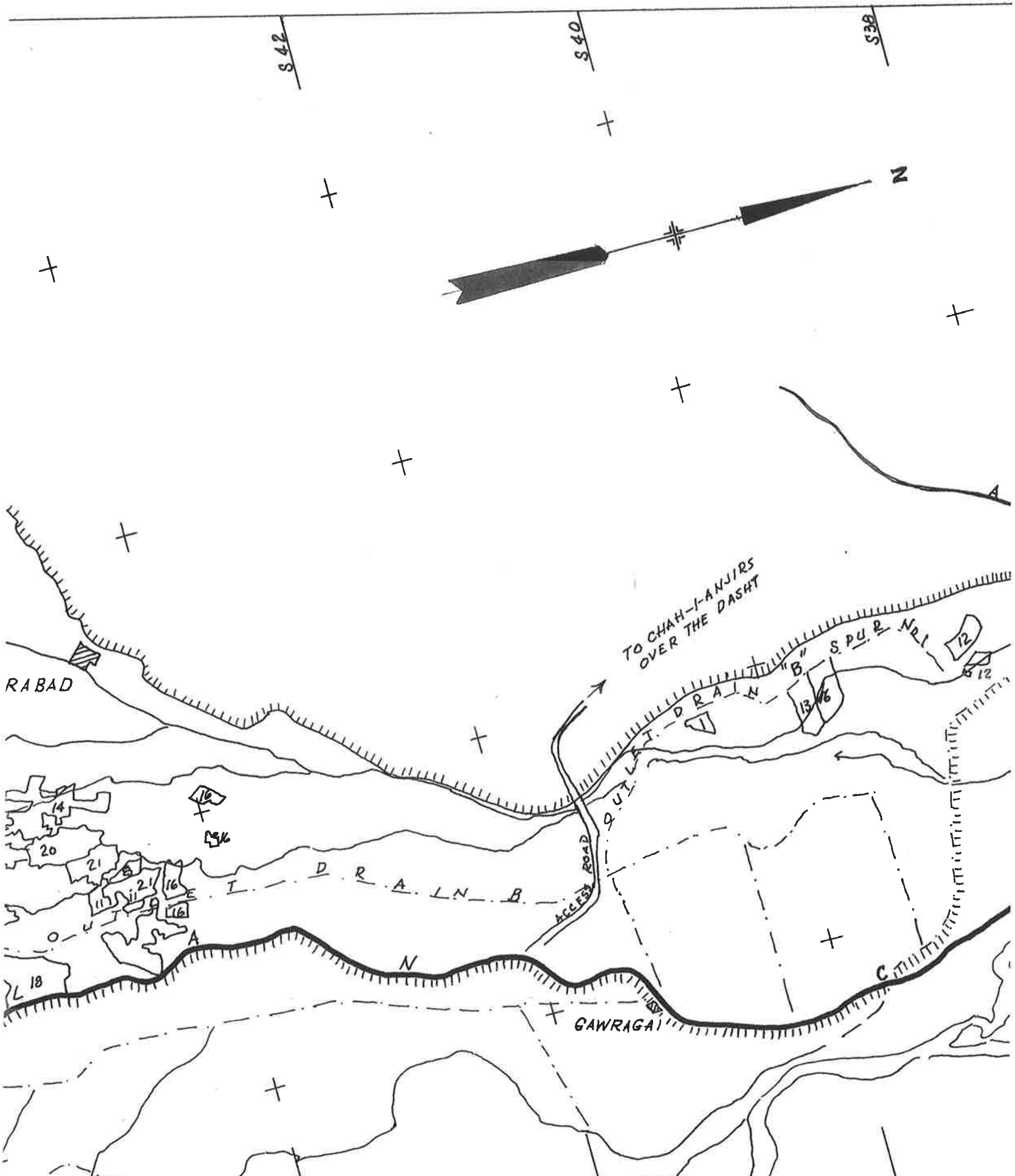
1967

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
IN COLLABORATION WITH
HELMAND VALLEY AUTHORITY
DIVISION OF PROJECT DEVELOPMENT PLANNING

SHAMALAN PROJECT AREA

LOCATION OF SAMPLE FARMS

DRAWN BDL - R R. A	SCALE 1:33,333
CHECKED RS HOGG	DATE June 7. 1966
APPROVED P. Goorian	DRAWING NO. LC 501-2



S42
S40
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N
A
RABAD
TO CHAH-I-ANJIRS OVER THE DASHT
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OUTLET DRAIN B
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GAWRAGAI
C
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20
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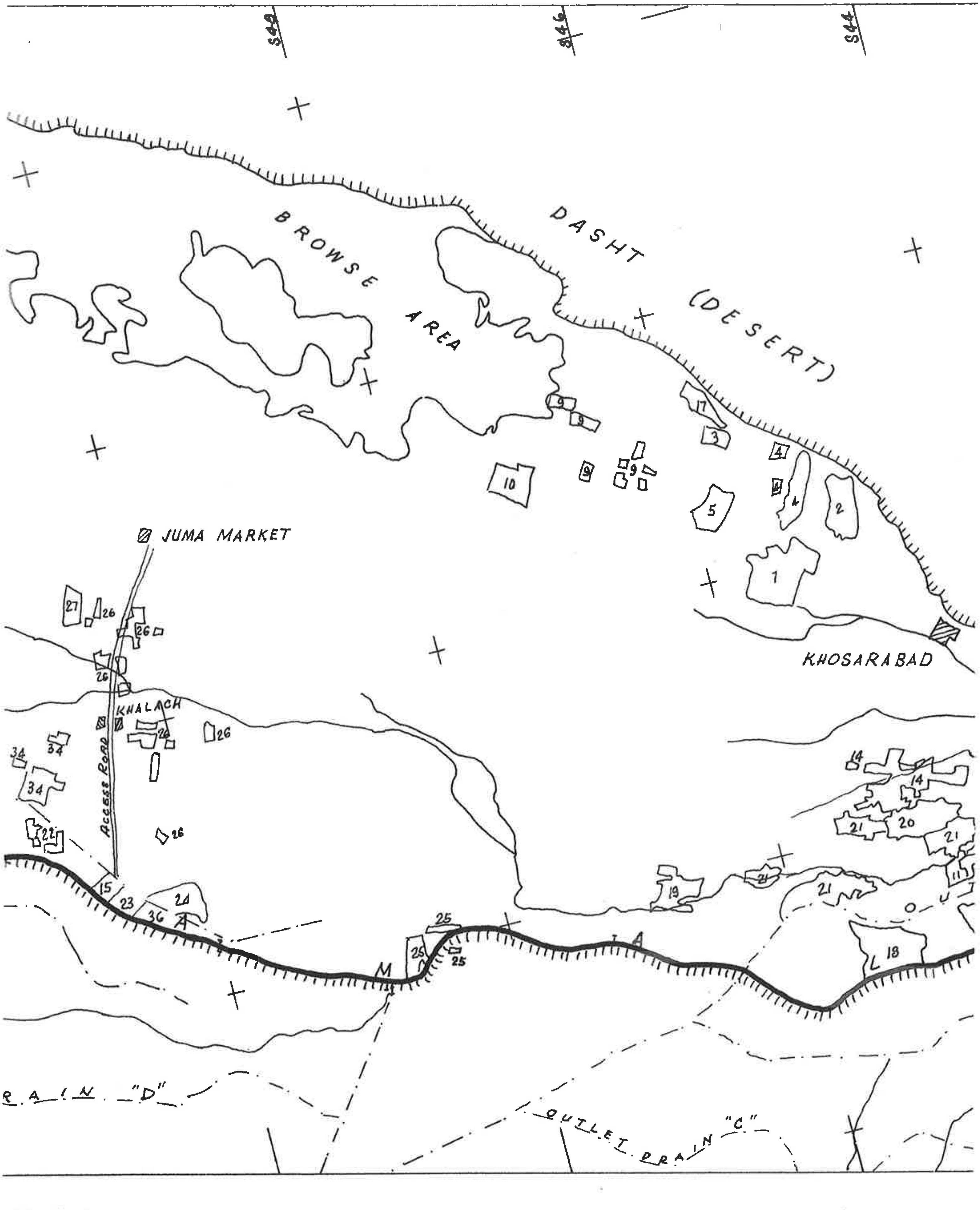
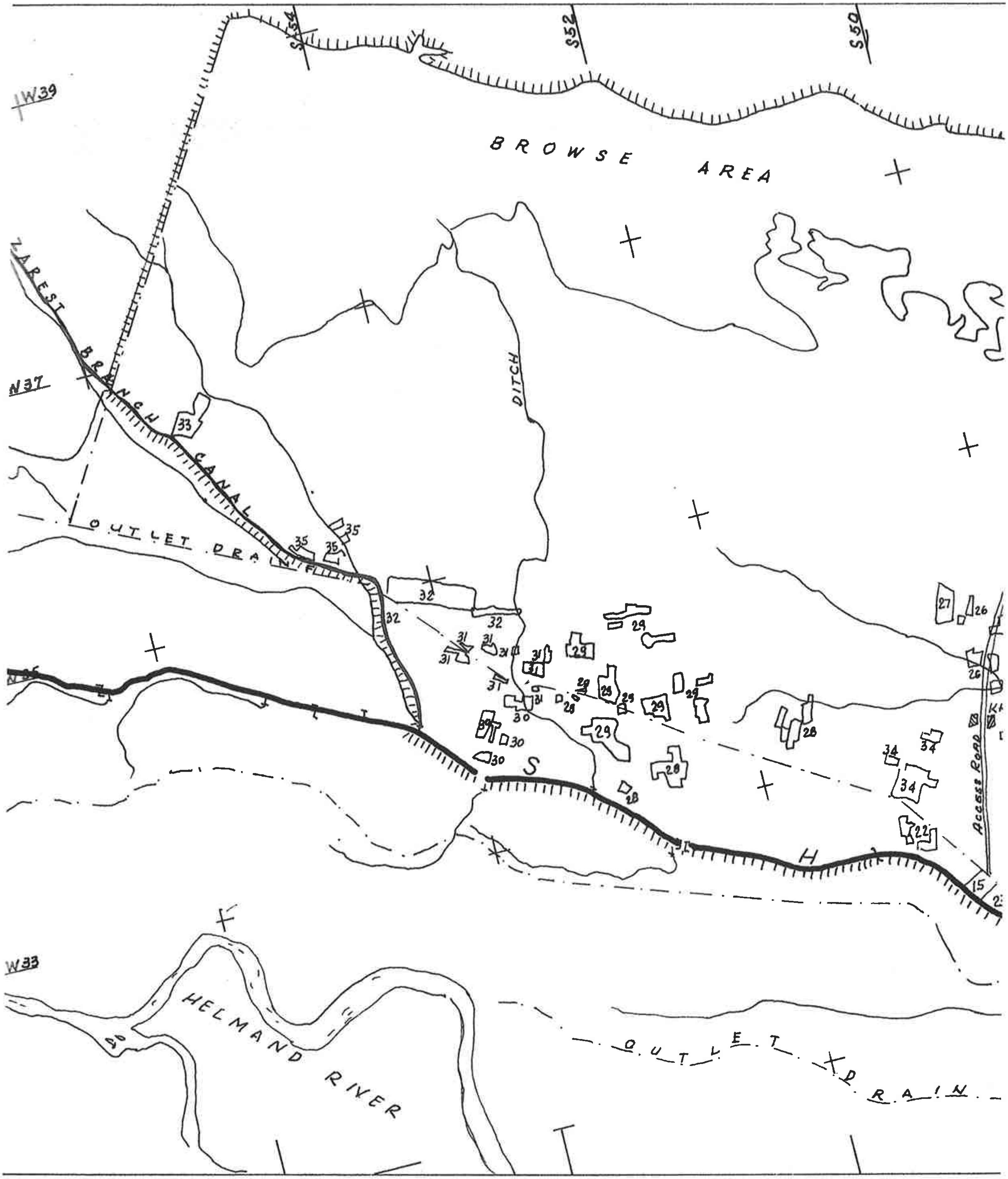
13
18


BROWSE AREA
DASHT (DESERT)
JUMA MARKET
KHOSARABAD
KHALACH
ACCESS ROAD
OUTLET DRAIN "C"
RAIN "D"



W39
S54
S52
S50
BROWSE AREA
ZAREST BRANCH CANAL
N37
DITCH
33
35
OUTLET DRAIN
32
31
30
29
28
27
26
34
22
15
ACCESS ROAD
S
H
W33
HELMAND RIVER
OUTLET DRAIN

returns for the present situation. These data, plus observations made and information collected in other parts of the Shamalan area and other portions of Afghanistan were also used as a base for projection of future conditions. These statistics and observations bear the weight of projections built upon them, and are the base upon which rational project analysis rests. Other data were collected and observations made in the Kandahar, Kabul, Jalalabad, and Mazar-i-Sherif areas of Afghanistan, the SCARP I 1/ Project area at Lahore, West Pakistan, and the Khuzistan Project area at Dezful, Iran. The economics team made an exhaustive economic analysis of the West Shamalan area, and by measurement of the land planted in orchards and vineyards in the East, North, and South Shamalan Divisions, study of aerial photographs, general observation, and land classification data, extrapolated findings to the full Shamalan Unit. Data for the west area were collected from farmers using local weights and measures, standardized to avoid accounting errors. The bulk of the detail and statistical material is included in the agricultural economics appendix.

The Shamalan area operates under a feudal system of subsistence farming. The average landowner employs an average of two tenants on a sharecrop basis, who typically receive one-fifth to one-third of the product. The landlord operates his holdings with oxen, farms an average of 7.4 hectares (18.2 acres), and produces enough crop and animal product to sustain himself and his extended family from harvest to harvest.

The farmers in this area, who are hampered by illiteracy, traditional beliefs, lack of medical attention and poor diet, have acquired a very limited knowledge of the factors of commercial farming. Farmers plow with the oxen team and stick plow, broadcast seed by hand (some cotton is hand seeded in rows), cultivate with a small hookbill sickle, exercise little or no weed control, thresh by driving livestock over the grain heads, and winnow with a wooden pitchfork. They are greatly influenced by concepts of family, clan, and tribe; support a mullah or religious leader in almost every village; and in general attempt to make each farm unit as self-sufficient as possible. Paramount loyalty is placed in the family, and the average landlord family of nine to ten members typically includes brothers, cousins, and more distant relatives.

The landlord family, on the average, has the equivalent of 3.3 workers, and his tenant families 2/ contribute 1.9 worker-equivalents. Each man-equivalent farms only 1.2 hectares (3.0 acres), and human labor is used exclusively for all operations but plowing, threshing, and hauling. The typical operation is arduous, but the total number of hours worked per day or per month on a farm is quite low, averaging not more than 75 full days per year on the main crops, with additional labor on minor crops, livestock, and fuel gathering.

1/ Salinity Control and Reclamation Project.

2/ In this report the terms "tenant" and "sharecropper" are used interchangeably. Both refer to a rural worker who lives on a farm that is not his own, works according to command of the land owner, makes few management decisions, and receives for pay a share of the crop.

The typical oxen team plows 6.7 hectares (16.5 acres). Therefore the pattern emerges of a landlord owning 7.4 hectares (18.2 acres); farming 6.7 hectares (16.5 acres) with two tenants and one team of oxen; paying from 20 to 33% of his crops to his tenants; generally consuming almost all he produces and producing a very small surplus for sale; and typically living at a subsistence standard. The tenant lives at the very margin of subsistence and often must be kept from starving by loans or gifts of wheat from his landlord. The decision-making process on the farm rests with the land owner. The important crops grown in this area are wheat, cotton, corn, and mung beans, with minor amounts of barley, alfalfa, fruit, vegetables, grapes and horticultural crops. Wheat is the basic crop, occupying about half the cropland. It is sown in the fall, winters over, and is harvested early the following summer. Generally wheat is double cropped with corn, and less frequently with mung beans or carrots. Cotton production stems from a government edict which in 1965 required farmers to plant 25% of their land to this crop, and to market the crop at the government monopoly at a low price. Corn and mung beans are grown for human food, and are valuable in stretching the wheat diet, particularly in advance of the new harvest. Barley is used primarily for livestock feed; alfalfa and clover are cut green and fed to oxen as required; fruit, vegetables, and grapes are used locally for food; and corn stalks and wheat, barley, and bean straw are fed to livestock. The average farmer double crops about 1.7 hectares (4.2 acres) per year, or 24% of his land.

Small numbers of livestock are kept, principally for draft purposes. Cows are used less for milk than as a source of bull calves, and the best and strongest young bulls are castrated for the plow. Sheep and goats are purchased from nomads in the fall and fattened for winter meat; small numbers of poultry are kept to scavenge on the farm and to provide occasional eggs and meat; and donkeys, or rarely horses, are used for hauling and riding. In the area few farmers keep camels, but rent them as needed from nomads. Due to the lack of farm to ditchbank roads or farm to desert roads, products moving to and from the farms are carried on the backs of donkeys, camels, oxen or men. Some produce is collected at central points and hauled by truck or camel to Bost.

Yields without exception are low. This is due to poor seedbed preparation, broadcast sowing, uneven coverage of seed, lack of chemical fertilizers and gypsum, inadequate weeding and cultivation, unimproved, mixed, and low yielding varieties of seed and stock, occasional uncontrolled depredations of insects and diseases, small quantities of manure, and low organic matter content of the soil, and lack of proper rotations, nonavailability of farm credit, and in great part to the apathy and indifference on the part of the farmers and a lack of understanding of scientific principles of plant and animal production. The favorable factors are the availability of good quality water, the long, warm growing season, the potential productivity of the soil, and the gradual development of an urban sector in Afghanistan. In the Shamalan area the social and economic rather than the physical factors inhibit development, for all of the basic causes of poor yield and returns can be remedied through rational use of improved inputs, cooperation of farmers and officials, more efficient water control, and a desire to advance.

Primary Income

The derivation and compilation of present primary income, or income without the proposed Shamalan Project, are based on field work, office analysis and summary, and extrapolation. In the fall of 1965 two teams from the Economics Branch conducted intensive interviews in the area, spending roughly five hours on each of 36 farms, and visiting each farmer an average of three times. Analyses of the findings, and general knowledge of the area, comprise the base of the economic analysis of the Shamalan Unit. Map LC501-2 shows the location of the sample farms in the Unit.

The Shamalan Unit is farmed almost entirely by private operators of long tenure, and the remainder generally are recent settlers, all of whom live on the land. Absentee ownership is not observed. Some 12,707 hectares (31,399 acres) are irrigable, and the remainder is used for marginal grazing of sheep and goats by pastoral tribes. The adjacent desert lands are used for camel grazing. Of the irrigable portion today, 20.7% is land class 1; 46.7% is class 2; and 32.6% is land class 3.

An accurate determination of crop and livestock yields and gross and net farm returns was an important objective of this survey. Production data were collected, prices gathered from farmers and markets, and fields were located, walked, and measured with the aid of aerial photographs. Although the bulk of the produce, except cotton, is consumed at home and never marketed, an accurate determination of the cash value of the product that the farmer produces and consumes was made to reduce all physical produce to a common denominator.

Gross income is taken as the sum of the value of crops, livestock products, fuel, and the annual value of livestock. It is the monetary equivalent of the annual production of the area. The value of alfalfa, clover, and crop residue fed entirely to livestock is included with the value of livestock and livestock products.

Net income is the difference between gross farm income and farm costs. Farm costs in this area, whether paid in kind or in legal tender, are the sum of crop payments to tenants, oxen feed, seed, cleaning and storage losses, hauling, livestock purchases, depreciation and repair of the farm investment, interest, taxes, and operation and maintenance.

Calculation of Gross Income. The yield levels and prices recorded in 1965, which is considered to be a more favorable year for crop production in the area than 1964 or 1966, are presented below, and in greater detail in the appendix, in the metric and English systems of weights and measures:

	Kg/Hectare	$/Kilogram	Unit/Acre	$/Unit
Wheat	1,217	0.060	18.1 bu	1.640/bu
Barley	1,286	0.026	23.9 "	0.056/"
Cotton, raw	661	0.157	590 lb	0.071/lb
lint	(207)	0.392	(185 lb)	0.178/"
seed	(454)	0.029	(405 lb)	0.013/"
Alfalfa, dry	5,358	0.001	2.4 ton	6.840/ton
Orchard	8,069	0.026	7,199 lb	0.012/lb
Garden	6,425	0.009	5,732 lb	0.004/"
Vineyard	2,971	0.024	2,651 "	0.011/"
Corn	621	0.039	9.9 bu	1.000/bu
Carrots	3,702	0.007	3,303 lb	0.003/lb
Mung beans	317	0.046	283 lb	0.021/"
Sunflower	340	0.117	305 lb	0.053/"
Milk per cow per year 1/	384 kg	0.030	845 lb	0.014/"
Eggs per hen per year 2/	43 eggs	0.013/egg	43 eggs	0.013/egg

Annual value of livestock	No./Hectare	$/Head	No./Acre
Oxen	0.27	6.35	0.11
Milk cows	0.29	2.89	0.12
Other cattle	0.29	2.31	0.12
Donkeys and horses	0.19	0.26	0.08
Sheep and goats	0.26	10.72	0.11
Poultry	8.07	0.36	3.27

Prices for farm products are based on average 1965 market prices. For cotton the net return received by HAVA exclusive of processing is used to compute gross returns. Under the 1965 cotton program for the Helmand Valley, the price received by farmers is dictated by the Afghan government, and farmers are expected to plant cotton in accordance with acreage allotment. More liberal rules were used in 1966 and 1967. The 1965 gross value of seed cotton was $200.36 per short ton, and from this $58.77 per short ton is deducted to cover the costs of seed returned to the farmers for planting, of hauling raw cotton from the buying stations to the gin in Bost, and of ginning. This leaves a value of $141.59 per short ton to HAVA for seed cotton. HAVA pays the farmer $68.05 per short ton of seed cotton, or 48% of the value for growing, harvesting, and transporting it to the weighing and buying stations. Under this program, cotton production under edict at managed prices constitutes an indirect "tax", which has the effect of making cotton relatively less profitable than other crops.

Gross income is $1,237,893 for the irrigated lands in the Shamalan area, or $97.42 per hectare ($39.42 per acre). This is the 1965 computation of the annual value of all field crops, orchards, vineyards, gardens, livestock

1/ Excludes milk consumed by the calf.
2/ Excludes eggs set under hen.

products, annual sale or consumption value of work or draft stock, the value of poultry, of sheep and goats purchased for fattening and slaughter, and of fuel gathered on the farm and along the river. It excludes the value of crops and crop residue fed to livestock, which are included instead with livestock returns.

The project has a calculated net income of $24,671 on the nonarable grazing lands. The income is based on carrying capacity of the 12,638 hectares (31,229 acres) of nonarable land in the project area. Land subclass 6w is considered to have a carrying capacity of one animal unit per 1.6 hectares (4.0 acres), and subclass 6sa one animal unit per 16 hectares (40 acres). This poor pasture in the future should be included only as adjuncts to the basic farm unit, and should not form the basis of a farm unit. Salt tolerant grasses and trees should be tried in this area. If woodlots are successful, under a carefully controlled cutting program farmers may be able to reduce their dependence on crop residue and manure for fuel, and thus return more organic matter to the land.

Tables I-A and I-B present gross and net income for the present Shamalan area. The details and data are presented in greater detail in the agricultural economics appendix.

Field crops are the mainstay of the Shamalan area, followed by livestock, horticultural crops, fuel, and livestock products. The following tabulation shows the present gross value of these products, and their relative importance.

	$ per Hectare	$ per Acre	Percentage
Field crops - wheat, barley, cotton, corn, carrots, mung beans and sesame	68.52	27.73	70.3
Livestock - annual value of cattle, donkeys, horses, sheep, goats	9.15	3.70	9.4
Horticultural crops - orchard, garden, vineyard, tobacco and drugs	8.44	3.41	8.7
Fuel - cotton stalks, manure, mulberry, corn cobs, weeds	7.41	3.00	7.6
Livestock products - milk and eggs	3.90	1.58	4.0
TOTAL	97.42	39.42	100.0

Farm costs are a vital element in determining the value of the area. The residents are inclined to regard farming as a way of life rather than a business venture, and as a type of living which involves little cash outlay.

TABLE 1-A

Present Conditions, Shamalan Unit
Units in Metric System & U.S. Dollars

	Land Use %	Hectares	Yield: Kg/Hectare	Yield: Total, Kg	Price $/Kg	Gross Income, $: Per Ha	Gross Income, $: Per Composite Ha	Gross Income, $: Total	Gross Costs $	Net Income $
Single Crop										
Wheat	47.0	5,972	1,215	7,255,980	0.060	73.35	34.47	438,047		
Barley	2.2	279	1,287	359,073	0.026	33.15	0.73	9,248		
Cotton: Seed Cotton	27.4	3,482	662	2,305,084	0.157	103.50	28.36	360,380		
Lint			(231)	(804,342)	(0.392)	(90.82)	(24.88)	(316,220)		
Seed			(431)	(1,500,742)	(0.029)	(12.68)	(3.48)	(44,160)		
Alfalfa, Hay	4.6	584	5,364	3,132,576	0.001			- 1/		
Orchard	2.2	280	8,079	2,262,120	0.026	213.19	4.70	59,694		
Garden	1.5	191	6,432	1,228,512	0.009	56.54	0.85	10,799		
Vineyard	3.2	407	2,975	1,210,825	0.024	72.01	2.30	29,307		
Clover	0.7	89	1,502	133,678	0.003			- 1/		
Tobacco	0.2	25	1,147	28,675	0.121	141.80	0.28	3,545		
Drugs	4.164 plants/Ha	52,910 Plants	0.0102/Plant	5,375	7.242	-	0.31	3,889		
Subtotal, Single Crop	89.0	11,309					72.00	914,909		
Double Crop										
Corn	12.8	1,626	622	1,011,372	0.039	24.47	3.13	39,788		
Carrots	1.8	228	3,707	845,196	0.007	24.56	0.44	5,599		
Mung Beans	9.2	1,169	318	371,742	0.046	14.69	1.35	17,169		
Sesame	0.1	13	342	4,446	0.117	38.54	0.04	501		
Subtotal, Double Crop	(23.9)	(3,036)					4.96	63,057		
Crop Residue	-	-						- 1/		
Idle and Farmstead	11.0	1,398								
Subtotal, Crops	100.0	12,707					76.96	977,966		
Livestock and Products			No/Hectare	Number						
Oxen			0.27 hd	3,454 hd	6.35/hd	1.73	1.73	21,933		
Milk Cows			0.30 hd	3,768 hd	2.89 hd	0.86	0.86	10,890		
Other Cattle			0.29 hd	3,768 hd	2.31 hd	0.68	0.68	8,704		
Donkeys & Horses			0.19 hd	2,512 hd	0.26 hd	0.05	0.05	653		
Sheep and Goats			0.26 hd	3,454 hd	10.72 hd	2.92	2.92	37,027		
Chickens & Other Poultry			8.08 hd	102,675 hd	0.36 hd	2.91	2.91	36,963		
Milk			111.05 kg	1,411,112 kg	0.03/kg	3.42	3.42	43,519		
Eggs			36.57 eggs	464,700 eggs	0.013/egg	0.48	0.48	6,041		
Subtotal, Livestock Products							13.05	165,730		
Fuel Income							7.41	94,197		
Total Income							97.42	1,237,893	564,868	673,025
Average per Hectare								97.42	44.45	52.97
Grazing Income Nonarable Land										24,671
Grazing Income per Hectare 2/										1.94
Grand Total Income										697,696
Grand Total Income per Hectare										54.91

1/ Fed to livestock
2/ Per hectare of nonarable land (12,638 hectares)

TABLE 1-B

Present Conditions, Shamalan Unit
Units in English System and U.S. Dollars

	Land Use %	Acres	Yield Unit/Acre	Yield Total	Price/Unit $	Gross Income, $ Per Acre	Gross Income, $ Per Composite Acre	Gross Income, $ Total	Gross Costs $	Net Income $
Single Crop										
Wheat	47.0	14,757	18.1 bu	267,102 bu	1.640 bu	29.68	13.95	438,047		
Barley	2.2	691	23.9 bu	16,515 bu	0.560 bu	13.38	0.29	9,248		
Cotton: Seed Cotten	27.4	8,603	590 lb	5,075,770 lb	0.071 lb	41.89	11.48	360,380		
Lint			(230 lb) (0.46 bale)	(1,776,520 lb) (3,553 bale)	(0.178 lb) (89,000 bale)	(36.76)	(10.07)	(316,220)		
Seed			(430 lb)	(3,299,250 lb)	(0.012 lb)	(5.13)	(1.41)	(44,160)		
Alfalfa, Hay	4.6	1,444	2.39 ton	3,451 ton	6.840 ton	16.35	-	- 1/		
Orchard	2.2	691	7,199 lb	4,974,509 lb	0.012 lb	86.39	1.90	59,694		
Garden	1.5	471	5,732 lb	2,699,772 lb	0.004 lb	22.93	0.34	10,799		
Vineyard	3.2	1,005	2,651 lb	2,664,255 lb	0.011 lb	29.16	0.94	29,307		
Clover	0.7	220	0.67 ton	1,474 lb	2.800 ton		-	- 1/		
Tobacco	0.2	63	1,023 lb	64,449 lb	0.055 lb	56.27	0.11	3,545		
Drugs	1.685 plants/ac	52,910 plants	0.0224 lb/plant	1,185 lb	3.282 lb	-	0.12	3,889		
Subtotal, Single Crop	89.0	27,945					29.13	914,909		
Double Crop										
Corn	12.8	4,019	99 bu	39,788 bu	1.000 bu	9.90	1.27	39,788		
Carrots	1.8	565	3,303 lb	1,866,195 lb	0.003 lb	9.91	0.18	5,599		
Mung Beans	9.2	2,889	283 lb	817,587 lb	0.021 lb	5.94	0.54	17,169		
Sesame	0.1	31	305 lb	9,455 lb	0.053 lb	16.16	0.02	501		
Subtotal, Double Crop	(23.9)	(7,504)					2.01	63,057		
Crop Residue	-	-				0.66	-	- 1/		
Idle and Farmstead	11.0	3,454				-	-	-		
Subtotal, Crops	100.0	31,399					31.14	977,966		
Livestock and Products			No/Acre	Number						
Oxen			0.11 hd	3,454 hd	6.35 /hd	0.70	0.70	21,933		
Milk Cows			0.12 hd	3,768 hd	2.89 hd	0.35	0.34	10,890		
Other Cattle			0.12 hd	3,768 hd	2.31 hd	0.28	0.28	8,704		
Donkeys and Horses			0.08 hd	2,512 hd	0.26 hd	0.02	0.02	653		
Sheep and Goats			0.11 hd	3,454 hd	10.72 hd	1.18	1.18	37,027		
Chickens and Other Poultry			3.27 hd	102,675 hd	0.36 hd	1.18	1.18	36,963		
Milk			99.00 lb	3,108,500 lb	0.014 /lb	1.39	1.39	43,519		
Eggs			14.80 eggs	464,700 eggs	0.013 /egg	0.19	0.19	6,041		
Subtotal, Livestock Products							5.28	165,730		
Fuel Income							3.00	94,197		
Total Income							39.42	1,237,893	564,868	673,025
Average per Acre								39.42	17.99	21.43
Grazing Income, Nonarable Land										24,671
Grazing Income per Acre 2/										0.79
Grand Total Income										697,696
Grand Total Income per Acre										22.22

1/ Fed to Livestock
2/ Per Acre of Nonarable Land (31,229 Acres)

For analysis it is necessary to reduce all cost items to a monetary basis, although the farmers themselves do not conceive of cash costs as such. These items, whether paid in kind or legal tender, involve crops paid to tenants, the value of grain and forage fed to oxen, the value of seed sown, cleaning, storing and hauling expenses, purchases of livestock, depreciation, repair, and interest on the farm investment, taxation, and operation and maintenance.

In the Shamalan area farmers commonly employ sharecroppers who receive no cash wage, but are paid with a fixed share of the crop. On a typical farm the sharecroppers live on the owner's land in huts of their own or the landlord's construction, are permitted to grow and consume small amounts of vegetables or drugs from tiny garden plots surrounding their homes, and typically receive one-fifth of the wheat and barley, one-third of the cotton, corn, and beans, and one-fourth of the carrots produced on the farm. This share of total produce is paid to all tenants on a farm, not per individual sharecropper. Further division is required where farmers employ multiple sharecroppers. The sharecroppers generally do not share in horticultural or livestock products. In the Shamalan area the division is justified by local concept -- the landlord furnishes the land, water, oxen and tools, and seed, while his sharecropper provides only labor. Each of these factors in theory is worth one-fifth of the produce, which in effect places the same value on a year's labor as on seed.

Oxen feeding costs include the value of the wheat, corn, and barley fed and the value of wheat paid for oxen rental. The alfalfa and clover crops grown for forage and the crop residues fed are not computed separately, but their value is considered as part of the annual value of oxen. Other livestock generally receive no supplemental feed, but subsist on ditchbank vegetation and straw.

In 1965 no tractor ownership was reported by the Shamalan farmers. Some minor amounts of custom plowing were done by one farmer who purchased a used tractor from the Marja mechanized farm, but the volume of work was insignificant. By 1967, however, the picture had begun to change when several farmers purchased new tractors for permanent use in the area.

Seed costs are seldom incurred out-of-pocket, but a portion of the previous crop is saved for future planting. With the exception of cottonseed and tree seedlings, which are furnished by the HAVA, farmers produce all of the seed they plant. Since no plant breeding program is followed, this is a partial explanation for heterogeneous stands and possibly poor yields.

The costs of cleaning, storing, and hauling crops are difficult to reduce to concrete figures, for estimated losses vary by crop and occur over a full year, from harvest to harvest. However, some grains and beans are lost in the field during threshing, and some storage loss occurs due to insects, rodents, and winter humidity. A high water table in some areas contributes to high humidity. It is assumed that storage and cleaning losses amount to 5% of the wheat and barley, and 2% of the corn and mung beans. Other crops are consumed fresh, alfalfa is cut and fed as required and carrots are pulled as needed. Cotton is delivered to the government without appreciable loss. Hauling costs apply to the charge made by nomads for the use of their camels to haul cotton to the weigh stations or gin.

The livestock purchase cost refers to the practice of buying sheep and goats from nomads in the fall. This stock is fattened on the farm or ditchbank vegetation and crop residue, and slaughtered in the winter. The meat is air-dried. Mutton, lamb, and goat are almost the only meats consumed in this area, with the occasional exception of poultry. Beef is consumed only when an animal has reached the end of its useful working, milking, or breeding life, or when it is diseased.

Depreciation and repair charges refer to the sum that the farmers must accumulate to maintain their average farm investment. Since most of the physical investment is represented in labor, local materials, and natural increase of livestock and tree and vine growth, the farmers do not recognize this as a cost. However, considering the value of the labor if applied elsewhere, the cost of materials if used for other purposes, and the investment in livestock, orchards, and vineyards that could be liquidated if not used for farm purposes, then rationally a monetary equivalent of the investment can be applied. The factors used are based on current value of money at the Da Afghanistan Bank in Bost, the interest charge made to farmers by the Pashtany Tejaraty Bank and the Agricultural and Cottage Industries Bank in Kabul, and the years of life of the investment as reported by the farmers. Years of useful life vary from one, for certain small tools, to 100 for mulberry trees.

The cost of interest represents the alternative earnings the farmer could realize on his investment, if he sold his land and business and invested the money elsewhere. Although the number of alternative investments is very limited, still the farmer has the option of placing money in a savings account, purchasing a shop or fabrication enterprise in the bazaar, or buying land elsewhere. Although farmers generally have no concept of alternative investment or employment, still the liquidated value of their investment could be earning money elsewhere. It is this alternative earning that constitutes the cost of interest in the Shamalan area today.

In 1967 the first significant purchase of tractors and farm machinery commenced in this area. The Agricultural and Cottage Industries Bank is selling imported tractors and implements and charging interest for this service at the rate of 6% per annum on the unpaid balance, with 25% down and five annual equal installments. These liberal terms represent a calculated endeavor to make initial tractor and equipment purchase attractive to the farmer. This transaction represents the first major farm cost in the Shamalan area on which interest has been charged in cash.

Very low taxation rates are imposed on land and livestock by the RGA. Land taxation rates are uniform by grade throughout the Kingdom, and livestock rates are levied by species and head. In the Shamalan area the land tax is increased by a small operation and maintenance charge. Actual taxes often are lower than the legal assessment, due to widespread delinquency, but the full legal rate is shown as a farm business expense.

The cost of operating and maintaining the present irrigation and drainage system in the Shamalan area is largely paid by the government, and a nominal charge collected from the farmer. The full cost, however, is computed, for this represents a legitimate expense. Since the farmers are unaware of operation and maintenance charges and the Operation and Maintenance Division of the HAVA does not maintain accurate accounts allocated by project, the true cost was synthesized from expenses for machinery, parts, freight, and operation; salaries, wages, and other personnel expenses; and a surcharge added to cover costs incurred to maintain the office buildings, roads, and towns. A portion of total operation and maintenance costs was allocated to the Shamalan area and reduced to an acreage equivalent.

Although project operation and maintenance costs may be considered a lump sum, the HAVA bears the entire cost and the RGA collects a small portion as a surcharge on its land tax. Therefore, for purposes of analysis, the operation and maintenance charge paid by the farmer on his land tax is carried as a farm cost; the remainder as a project cost.

Total farm costs are determined to be $564,870 for the area, or $44.45 per hectare ($17.99 per acre). Table 2 shows present farm costs, and the agricultural economics appendix shows cost derivation in detail. The difference between gross farm returns and costs is $697,696, or $54.91 per hectare (22.22 per acre). This includes $24,671, or $1.94 per hectare ($0.79 per acre) from the marginal nonirrigated grazing lands, and represents the net agricultural income in the present situation. This net figure may also be expressed as $406 per farm, $78 per man-equivalent, or $21 per person per year. It also is the value of 350 kilograms (12.9 bushels) of wheat per person per year. Table 2 shows present farm costs for the Shamalan area, and details are presented in the agricultural economics appendix.

TABLE 2

Shamalan Unit Present Farm Costs

	$ Per Hectare	$ Per Acre	Total $
Crop payment to tenants	11.73	4.74	148,830
Oxen feed	5.38	2.18	68,450
Seed	3.57	1.45	45,530
Cleaning, storage, and hauling	3.93	1.59	49,920
Livestock purchases	2.06	0.84	26,375
Depreciation and repair	5.94	2.40	75,360
Interest	11.07	4.48	140,670
Taxes	0.65	0.26	8,165
Operation and maintenance	0.12	0.05	1,570
TOTAL	$44.45	$17.99	$564,870

Secondary Income.

Secondary income is the increase in income accruing to persons other than project farmers and farm families which arises as a result of project operations. When produce in excess of needs of project residents is sold off the farm, its disposition in the form of processing, hauling, and marketing produces monetary benefits to the enterprises and persons involved. These are measured by determining or estimating the wages, salaries, interest, and profits arising in off-farm enterprises as a result of handling foodstuff and fibers produced on the project. Other secondary income arises through the supply of non-farm goods to project residents.

Whenever products are processed, hauled, or sold, people are provided employment, return on investment, and use of money. This also occurs when farmers purchase manufactured and consumer goods and foodstuffs. In the present situation, the secondary income of the Shamalan area was measured directly on site. For future estimates, industrial plants which process agricultural commodities were visited in Kabul, Kandahar, and Bost, and benefits accruing from processing were taken as a measure of the income that could reasonably be expected to arise with future development of the Shamalan area. In addition to processing, present and estimated future income includes the fish taken from the Shamalan Canal in the early winter; money earned by Kochi tribes who sell sheep and goats and rent camels to project farmers; income arising from sales of tea, sugar, candy, and rice to project residents; income which accrues to itinerant and stationary artisans, mullahs, musicians, and haulers and exporters; and for the future income to be realized by machinery, implement, petroleum product, fertilizer, insecticide, seed, and farm supply dealers.

The development of secondary income is entirely dependent upon prior development of net primary income. Before crops can be processed, they must be produced. At present, no appreciable crop surpluses are produced, and to produce significant quantities of processable crops agriculture must be developed. It is equally true that poor farmers cannot purchase much food, machinery, fertilizer, or other commercial inputs; cannot employ large numbers of artisans or journeymen; and cannot provide a sizable surplus for hauling or export. Therefore, agricultural development is vital for development of secondary income. If the project is to have national as well as local significance, it must produce significant surpluses in its local area.

In the Shamalan area the pattern of typical diet of the farm people was established by interview and personal observation of the rural environment. The volume of crop production, forage and grain consumed by livestock, and cleaning and storage losses was measured in the sample survey. The amount of food available for human consumption, plus the amount of purchased food per family (determined in a supplemental survey of the same farmers) was reduced to kilograms and converted into calories. The total available calorie figure, by crop and livestock product, was divided by the number of landowners and their dependents, and by the number of tenants and their families, with an appropriate allowance for cooking, serving, and consumption wastage. This calculation yields the volume of foodstuff required to feed the area at the local standard of consumption, and surpluses over local consumption are considered available for sale. Other indications of surplus are the small local trade in Bost in seasonal Shamalan products, and scattered truck movement in Bost and the Shamalan.

Disposition of the product after harvest varies with usage and perishability. Product disposition was studied by direct interview of the processors, haulers, and merchants. The findings are summarized in Table 3, and discussed below. The details as collected in local weights, measures, and currency, and converted to the metric system and U. S. dollars, are presented in Appendix Table 37 and Tables 37-A through 37-O.

Processing, Hauling, and Marketing Farm Products. Wheat, barley, corn and mung beans. Wheat, barley and corn are hauled from the farm as whole grains on farm donkeys or oxen to small diesel and gasoline powered mills, ground to a coarse grade of flour, and hauled back to the farm. Water driven mills handle a small portion of the crop. The portion sold exchanges hands at the mill or in town bakeries. Grains are ground on a 1:20 share basis, but the monetary value of the operation has been determined and used. Mung beans are generally consumed whole, but some portion is ground and added to the wheat flour when food becomes short before the new harvest. After grinding, some wheat flour is marketed and baked in the towns and sold as "nahn", a thin, firm nonrising whole wheat bread. Some portion of the corn is baked, and some barley and mung beans are sold as grain for home use in soup and stew.

Cotton. Seed cotton is hauled from the farm to the cotton weigh station or the Bost gin, typically on rented camels, to the point where the government accepts it. From that point hauling is by government truck, and hauling benefits to the gin are included with ginning secondary benefits. Camel rental from farm to government acceptance point provides some cash income for the nomads. These people congregate in the Shamalan Area in the fall when their summer pastures farther north are dry, and in this season purchase fodder from the farmers, sell sheep and goats for fattening, and rent their camels for cotton hauling. Hauling charges have been calculated on the basis of average rates and distance.

Cotton ginning benefits were abstracted from production costs collected at the Bost gin in 1965 and 1966. At present the gin does not operate at a profit, and its lint and seed are sold abroad. No benefits are claimed for spinning, weaving, or seed crushing, but a hauling benefit to the border town of Spin Baldak has been included.

Horticultural Crops. At present a very low volume of Shamalan horticultural crops leaves the immediate area. Some grapes are purchased by buyers from Kandahar, but the bulk of the grapes, fruit, vegetables, tobacco and other horticultural crops is consumed in the area without commercial processing. Only minor shopkeeping and hauling benefits for these crops can reasonably be claimed.

TABLE 3

Summary of Secondary Income, Present Situation
Shamalan Unit

	Grinding Farm $	Grinding Sale $	Shopkeeping, Baking, Butchering & Ginning $	Production $	Hauling $	Total $
Processing, hauling and marketing farm products						
Wheat	5,240	2,305	17,935	-	385	25,865
Barley	290	65	290	-	-	675
Cotton	-	-	122,550	-	5,045	127,595
Orchard	-	-	1,730	-	-	1,730
Garden	-	-	290	-	-	290
Vineyard	-	-	7,065	-	-	7,065
Corn	435	-	190	-	-	625
Mung beans	-	-	190	-	-	190
Carrots	-	-	290	-	-	290
Sesame	-	-	95	-	-	95
Tobacco and Drugs	-	-	1,300	-	-	1,300
Subtotal, **Crops**	5,965	2,400	151,925	-	5,430	165,720
Milk	-	-	-	-	-	-
Eggs	-	-	-	-	-	-
Meat	-	-	1,540	-	-	1,540
Poultry	-	-	1,010	-	-	1,010
Subtotal, Livestock	-	-	2,550	-	-	2,550
Secondary Income, Processing, Hauling, and Marketing Farm Products	5,965	2,400	154,475	-	5,430	168,270

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TABLE 3 - continued

	Grinding Farm $	Grinding Sale $	Shopkeeping, Baking, Butchering & Ginning $	Production $	Hauling $	Total $
Agribusiness						
Camel rental	-	-	-	-	1,010	1,010
Livestock purchases	-	-	-	8,655	-	8,655
Secondary Income, Agribusiness	-	-	-	8,655	1,010	9,665
Subtotal, Secondary Income, Processing, Hauling and Marketing Farm Products and Agribusiness	5,965	2,400	154,475	8,655	6,440	177,935

	Processing $	Shopkeeping $	Production $	Labor $	Hauling $	Total $
Purchased foods						
Rice	-	3,895	-	-	290	4,185
Sugar	625	5,675	-	-	290	6,590
Candy	480	4,470	-	-	140	5,090
Tea	-	815	-	-	50	865
Secondary Income, Purchased Foods	1,105	14,855	-	-	770	16,730
Fishery						
Winter	-	-	850	-	10	860
Summer	-	-	40	-	5	45
Secondary Income, Fishery	-	-	890	-	15	905

TABLE 3 - continued

	Processing $	Shopkeeping $	Production $	Labor $	Hauling $	Total $
Journeymen and Artisans						
Barber	-	-	-	165	-	165
Blacksmith	-	-	-	2,610	-	2,610
Carpenter	-	-	-	5,665	-	5,665
Cobbler	-	-	-	35	-	35
Coppersmith	-	-	-	175	-	175
Goldsmith	-	-	-	125	-	125
Millwright	-	-	-	220	-	220
Mullah	-	-	-	12,995	-	12,995
Musician	-	-	-	145	-	145
Shopkeeper, peddler	-	4,360	-	-		4,360
Tailor	-	-	-	1,000	-	1,000
Watermaster	-	-	-	1,115	-	1,115
Secondary Income, Journeyman	-	4,360	-	24,250	-	28,610
Transporting people	-	-	-	-	305	305
Secondary Income, Transporting People	-	-	-	-	305	305
Subtotal, Secondary Income, Purchased Foods, Fishery, Journeymen and Artisans, and Transporting People	1,105	19,215	890	24,250	1,090	46,550
TOTAL, Secondary Income						$224,485

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Livestock products. The Shamalan is essentially a net deficit area in animal protein, and markets very small quantities of meat, milk, and eggs. Only when an ox or cow has outlived its usefulness or is diseased is it sold. A small bazaar in Bost is supplied partially from this area, and local butchers were interviewed to determine the share of their business that could be considered secondary income. A modern creamery operating in Bost processes and sells whole milk, cream, butter, ice cream, cheese, and eggs, but its sole source of raw material in 1965 was the government dairy and poultry farm in nearby Bolan. The private farms in the Shamalan area supplied none of the raw product processed at this plant in 1965, but began to supply about half of the volume in the winter of 1966-67. Plant data has been used as a base for study of projected future secondary benefits.

Agribusiness. Agricultural business constitutes a very minor portion of the life of the Shamalan farmer. Because so small a portion of his business is monetized, he has little cash and can exert little demand for agricultural inputs. In the absence of machinery, parts, fertilizer and insecticide dealers, with little seed and feed sold, and with few labor wages paid in cash, only in dealings with Kochis or government cotton or tax agents does much cash change hands. Camel rental and livestock purchases are the only appreciable agricultural business transacted, and data were collected as required.

Purchased foods. The Shamalan farmer today spends a small part of his disposable income on rice, sugar, candy and tea. Data collected from farmers and general observation indicate that rice is served on festive occasions and when a farmer entertains, generally tea, sugar and candy are consumed. In general these luxuries are limited to landowners. The tenants have tea without sugar or candy, if at all. Farmers were asked to estimate the amount and prices of these products consumed in an ordinary year, and secondary income is calculated on marketing and hauling these products.

The calculations for processing, hauling, and marketing farm products, agribusiness, and purchased foods were collected from the sample survey and extrapolated to the project area. Adjustments were made as required for different rates of consumption by landlords and tenants. The income data relating to fishing, journeymen and artisans, and transporting people were collected for the entire project area.

Fishery. In the early winter of each year the Shamalan and other main canals in the various project areas are drained for inspection and occasional cleaning and stand empty for approximately 40 days. At this time the only remaining water is in pools below the canal bed where concrete drop structures have been built to divert water into laterals and to accomodate the force of falling water.

Fish collect in these pools and are netted, hauled, and sold. Some fishing persists in the summer months on a reduced scale. The fishermen operate shops in the Bost bazaar, where the figures on catch and price were collected. Some fish are known to be taken by Kandahar residents as well.

Journeymen and artisans. The benefits realized by journeymen, itinerant artisans, settled religious leaders and teachers, village shopkeepers, traveling peddlers, and musicians constitute an important part of project secondary income. To determine the benefits accruing to these people, it was necessary to conduct an intensive series of interviews at homes and shops to measure the share of their income realized on the West Shamalan lands, as well as convert the payments they receive in wheat into cash, and extrapolate the West Shamalan findings to the Shamalan Area.

In the West Shamalan area in 1965 there were 128 men who made all or part of their living providing services to local farmers. The greatest number of these were mullahs, followed by peddlers and shopkeepers, carpenters, water-masters, blacksmiths, barbers, and tailors. One of each category of copper-smith, cobbler, goldsmith, millwright, and musician was found. Since some of these people, particularly mullahs, supplement their income by farming, only the portion earned from their secondary activities was calculated.

In general a mullah will serve a number of farms, and most villages have one or more mullahs. The other service workers either travel through the area seeking work, or operate small shops in the village of Khalach. These workers receive the bulk of their income in wheat. In all cases the tools and equipment used by the artisans are of the simplest construction and represent a minimum of investment. The barbers, for example, operate with a pair of scissors and a small hand razor, with an average value of 50 afs. ($0.67). The cobbler has a small awl, scissors, a hammer and a small metal last with an average value of 250 afs. ($3.33). The blacksmith operates over a small charcoal-fed forge with hammers and a pair of tongs, with an average value of 150 afs. ($2.00). Some peddlers carry freshly slaughtered meat in sacks on their backs and walk from village to village. The same small scale of operations is true for the other occupations.

Transporting people. A bus service operates in the West Shamalan area on a semi-regular basis. The owner hauls an average of 70 men per week from Bost to Khalach at a charge of 10 afs. per man each way.

Total secondary income was calculated as $224,485, or 32.2% of the $697,694 or primary income for the area. This is equivalent to $17.67 per irrigable hectare ($7.15 per acre), compared to $54.91 of primary income per irrigable hectare ($22.22 per arable acre). Secondary income on the nonarable grazing land is negligible, for the population is sparse and poor.

Development Benefits.

Development benefits are the portion of the annual operation and maintenance expenses which remain in the country. These include wages paid to local employees, a part of the salaries paid to foreign personnel, and the hauling charges from Chaman and Meshed to the project.area. They exclude original cost of machinery, equipment, parts, fuel, motor and lubricating oil, or grease; hauling from offshore sources to Chaman or Meshed; and part of the salaries paid in dollars. About 25% of the expenses of operating and maintaining the system remain in the country, and the balance is spent abroad for foreign procurement and salaries. Development benefits total $19,200, or $1.51 per arable hectare ($0.61 per irrigable acre), equivalent to 2.8% of primary income for the area. Development benefits for the present situation are presented in Table 4 of this report and summarized in Table 38 of the appendix.

TABLE 4

Summary of Present Development Benefits

Shamalan Unit

	Labor $	Hauling $	Total $
Operation and Maintenance	18,340		19,200
TOTAL, Development Income	$18,340		$19,200

Projected Future Conditions

General.

The Shamalan area in the future will be approximately the same size as it is today, but with firmer water control, improved drainage, and a much higher percentage of good lands. Few if any new lands will be irrigated, but firm water control will allow water delivery to lands in the central portion and along the west side which now are irrigated on an intermittent basis. Many lands presently affected by high water tables, poor drainage, salinization, and adsorbed sodium will be improved through drains, leaching and soil amendments. The nonarable lands would continue to provide grazing and some portion could be in woodlot. Under anticipated future conditions, following land reclamation measures, 93.2% of the arable land will be land class 1; 4.4% land class 2; and 2.4% land class 3.

The future of the area depends upon effective land use, with all of the myriad factors that this involves, as well as upon improvement and correct utilization of project works. The mode and methods of farming must change drastically and farmers made aware of the improved agricultural inputs that are available, coupled with a great change in attitude if the land is to justify any new investment. The burden for this change rests not only upon the farmers, but also on the officials in the Helmand Arghandab Valley Authority. The proposals and recommendations for successful use of the area follow below as a series of twelve points, and future projections are based upon successful implementation of these points. If the program is pursued successfully, the project can be an economic success; without it, the project area is likely to continue with little change. The starting point will be the completion of the project works to make possible effective utilization of land; the conclusion will be a successful project brought about by years of effort by the farmers, businessmen, and government officials.

Primary Income.

The area has been analyzed in terms of its probable future development, bearing in mind that any factors more favorable than those projected would increase future returns, and any less favorable factors would reduce them. The future cropping pattern and types and density of livestock, as well as crop and livestock yields, are projected at levels that appear reasonably attained, subject to noted conditions. The natural resources of this area are favorable, and higher yields of adapted crops can be supported by the land, water and climatic resources. The social factors are less favorable, and on a strictly historical base, both pre- and post-construction of Kajakai Dam, little yield increase can be expected. Therefore a reasonable forecast must consider not only what is possible, but also what is probable.

The favorable natural resources of the Shamalan area include the climate, which is suitable for a broad range of commercial crops and livestock; the land, which can be made to produce well through reclamation and proper farming inputs and methods; and the water, which will be available in adequate quantity and satisfactory quality for irrigation and domestic use. The future drainage system will remove surplus water from the fields; no farm will be more than one kilometer from a road; and sanitary wells will provide safe drinking water at all times, including the canal shutdown period. In contrast to these favorable conditions are many social and procedural inhibitions. The area has had a long history of poor crops, weak response to innovations which were intended to augment production, and an apathy of most farmers to efforts intended to create a higher standard of living. To date, production has fallen considerably short of levels that should have been attained.

To project any significant improvement, many factors in the area must advance radically. An objective appraisal of this situation is forced to conclude that without assistance, improvement would be very slow and fragmentary. Considering these points, yields and double cropping have been projected higher, on condition that a great deal of pressure is brought to bear on lagging inputs.

A program of development, improvement, and dissemination is required on a systematic, timely, and orderly basis for future improvement. Project construction, land reclamation, and operation and maintenance will provide the infrastructure for successful development, and create a base for improved agricultural operations. The balance of the work must be done by the area residents in cooperation with the HAVA. Pertinent recommendations for agricultural development follow as the conclusion of this chapter, as a series of 12 points.

Agriculture cannot be transformed immediately, and complete and competent use of farm credit, new varieties, fertilizers, insecticides and disease control agents, machinery, and proper land management and crop rotations cannot be expected immediately after the project works are installed. Assuming that the improved inputs become available and are used in a reasonable time, yields are projected upward in stages, with the highest levels projected for the 50th year of project development. For the average year, which is used as the basis of analysis of anticipated future conditions in this report, the economic midpoint is used. This point is based on an expected rate of development of yields for each crop and livestock species, and on the anticipated cropping patterns. Tables 5-A and 5-B summarize the present level, the levels of achievement projected for the 15th, 25th, and 50th years of project development, and the anticipated 50-year average levels. Tables 6-A and 6-B depict the anticipated future situation, and details for the 15th, 25th, and 50th years are presented in the agricultural economics appendix. The factors used in determining the economic midpoint for each product are presented in Table 21 of the appendix.

Tables 6-A and 6-B show the anticipated average future conditions for 50 years of project development, predicated upon successful implementation of the agricultural recommendations at the conclusion of this chapter. Average returns are predicated upon low levels in the early years, rising to much higher levels by the end of fifty years, and include a grazing allowance for the nonarable land in the project.

In the future, as in the present, field crops are expected to continue as the mainstay of the Shamalan area. Horticultural crops should become more important as the area realizes more of its natural advantages in producing these crops. As livestock become more productive, the value of their products should exceed their slaughter value. Fuel should decrease in importance as customs and habits change and residents plow under manure, collect less brush and wood, and begin to utilize commercial cooking fuels.

	$ per Hectare	$ per Acre	Percentage
Field crops - wheat, barley, cotton, corn, mung beans and sunflower	179.55	72.67	72.3%
Horticultural crops - orchard, garden, and vineyard	30.21	12.23	12.1
Livestock products - milk, eggs, hides and skins	17.63	7.13	7.1
Livestock - annual value of cattle, donkeys, horses, sheep, goats and poultry	15.57	6.30	6.3
Fuel	5.36	2.17	2.2
TOTAL	$248.32	$100.50	100.0%

TABLE 5-A

Present and Projected Crop Acreages and Yields for Shamalan Unit
(Units in Metric System)

Crop	Present		15th Year		25th Year		50th Year		Anticipated Weighted Average for 50 Years	
	% of Land	Kg/Ha	% of Land	Kg/Ha	% of Land	Kg/Ha	% of Land	Kg/Ha	% of Land	Kg/Ha
Single crop										
Wheat	47.0	1,215	38.8	3,300	36.3	3,750	35.0	4,035	38.6	3,360
Barley	2.2	1,290	3.8	1,560	4.5	1,720	5.0	2,150	3.9	1,560
Seed cotton	27.4	660	22.0	1,670	21.0	1,920	20.0	2,410	21.9	1,695
Lint		230		585		675		840		595
Seed		430		1,085		1,245		1,570		1,100
Alfalfa	4.6	5,385	19.8	9,865	22.9	10,310	25.0	12,780	20.1	9,860
Orchard	2.2	8,080	3.0	20,120	3.2	22,710	3.3	26,900	3.0	20,380
Garden	1.5	6,430	2.8	16,890	3.1	18,910	3.3	23,650	2.8	17,090
Vineyard	3.2	2,075	3.3	12,080	3.4	13,880	3.4	17,370	3.3	12,260
	1/ 88.1%		93.5%		94.4%		95.0%		93.6%	
Double crop										
Wheat	-	-	11.0	2,665	10.5	3,000	10.0	3,230	11.0	2,690
Corn	12.8	620	14.3	3,920	14.7	4,580	15.0	5,020	14.3	4,020
Carrots	1.8	3,700	2.7	11,500	2.9	13,025	3.0	16,250	2.7	11,650
Mung beans	9.2	320	9.8	920	9.9	1,040	10.0	1,120	9.8	930
Sesame or sunflower	0.1	340	2.2	875	2.7	1,055	3.0	1,315	2.3	890
	23.9%		40.0%		40.7%		41.0%		40.1%	
Livestock products										
Milk per cow per year 2/		390 kg		900 kg		940 kg		995 kg		900 kg
Eggs per hen per year 3/		35		85		95		100		87

1/ Excluding minor crops not projected for future production. Yield figures are rounded.
2/ Excluding milk consumed by calves.
3/ Excluding eggs set under hens.

TABLE 5-B

Present and Projected Crop Acreages and Yields for Shamalan Unit
(Units in English System)

Crop	Present		15th Year		25th Year		50th Year		Anticipated Weighted Average for 50 Years	
	% of Land	Yield/Acre	% of Land	Yield/Acre	% of Land	Yield/Acre	% of Land	Yield/Acre	% of Land	Yield/Acre
Single crop										
Wheat	47.0	18 bu	38.8	50 bu	36.3	56 bu	35.0	60 bu	38.6	50 bu
Barley	2.2	24 bu	3.8	29 bu	4.5	32 bu	5.0	40 bu	3.9	29 bu
Seed cotton	27.4	590 lb	22.0	1,490 lb	21.0	1,710 lb	20.0	2,150 lb	21.9	1,510 lb
Lint		205 lb		520 lb		600 lb		750 lb		530 lb
Seed		385 lb		970 lb		1,110 lb		1,400 lb		980 lb
Alfalfa	4.6	2.4 ton	19.8	4.4 ton	22.9	4.6 ton	25.0	5.7 ton	20.1	4.4 ton
Orchard	2.2	7,200 lb	3.0	17,950 lb	3.2	20,260 lb	3.3	24,000 lb	3.0	18,180 lb
Garden	1.5	5,730 lb	2.8	15,070 lb	3.1	16,870 lb	3.3	21,100 lb	2.8	15,250 lb
Vineyard	3.2	2,650 lb	3.3	10,780 lb	3.4	12,380 lb	3.4	15,500 lb	3.3	10,940 lb
	1/ 88.1%		93.5%		94.4%		95.0%		93.6%	
Double crop										
Wheat	-	-	11.0	40 bu	10.5	45 bu	10.0	48 bu	11.0	40 bu
Corn	12.8	10 bu	14.3	62 bu	14.7	73 bu	15.0	80 bu	14.3	64 bu
Carrots	1.8	3,300 lb	2.7	10,260 lb	2.9	11,620 lb	3.0	14,500 lb	2.7	10,400 lb
Mung beans	9.2	285 lb	9.8	820 lb	9.9	930 lb	10.0	1,000 lb	9.8	830 lb
Sesame or Sunflower	0.1	305 lb	2.2	780 lb	2.7	940 lb	3.0	1,175 lb	2.3	795 lb
	23.9%		40.0%		40.7%		41.0%		40.1%	
Livestock products										
Milk per cow per year 2/		860 lb		1,980 lb		2,070 lb		2,200 lb		1,990 lb
Eggs per hen per year 3/		35		85		95		100		87

1/ Excluding minor land in crops not projected for future production. Yield figures are rounded.
2/ Excluding milk consumed by calves.
3/ Excluding eggs set under hen.

TABLE 6-A

Anticipated Future Conditions, Shamalan Unit - 50 Year Average
Units in Metric System and U.S. Dollars

	Land Use %	Hectares	Yield: Kg/Hectare	Yield: Total, Kg	Price $/Kg	Gross Income, $: Per Ha	Gross Income, $: Per Composite Ha	Gross Income, $: Total	Gross Costs $	Net Income $
Single Crop										
Wheat	38.6	4,905	3,373	16,544,565	0.060	194.42	75.05	953,630 1/		
Barley	3.9	496	1,575	781,200	0.026	40.10	1.56	19,890		
Cotton: Seed Cotton	21.9	2,783	1,695	4,717,185	0.157	264.89	58.01	737,175		
Lint			(593)	(1,650,319)	(0.392)	(232.43)	(50.90)	(646,850)		
Seed			(1,102)	(3,066,866)	(0.029)	(32.55)	(9.11)	(90,325)		
Alfalfa, Hay	20.1	2,554	9,908	25,305,032	0.001			- 1/		
Orchard	3.0	381	20,378	7,764,018	0.026	539.37	16.18	205,500		
Garden	2.8	356	17,093	6,085,108	0.009	150.62	4.21	53,620		
Vineyard	3.3	419	12,262	5,137,778	0.024	297.54	9.82	124,670		
Subtotal, Single Crop	93.6	11,894					164.83	2,094,485		
Double Crop										
Wheat	11.0	1,398	2,698	3,771,804	0.060	162.07	17.83	226,580		
Corn	14.3	1,817	3,988	7,246,196	0.039	128.71	18.40	233,860 1/		
Carrots	2.7	343	11,652	3,996,636	0.007	77.29	2.09	26,510		
Mung Beans	9.8	1,245	933	1,161,585	0.046	43.08	4.22	53,630		
Sunflower or other Oilseed	2.3	292	893	260,756	0.117	104.18	2.39	30,420		
Subtotal, Double Crop	(40.1)	(5,095)					44.93	571,000		
Crop Residue								- 1/		
Idle and Farmstead	6.4	813						-		
Subtotal, Crops	100.0	12,707					209.76	2,665,485		
Livestock and Products			No/Hectare	Number						
Oxen			0.13 Hd	1,570 Hd	6.35/Hd	0.78	0.78	9,970		
Milk Cows			0.50 "	6,280 "	2.89 "	1.43	1.43	18,150		
Other Cattle			0.45 "	5,650 "	2.31 "	1.03	1.03	13,050		
Donkeys and Horses			0.09 "	1,225 "	0.26 "	0.02	0.02	320		
Sheep and Goats			0.67 "	8,480 "	10.72 "	7.16	7.16	90,900		
Chickens and Other Poultry			14.33 "	182,000 "	0.36 "	5.15	5.15	65,520		
Milk			448.12 Kg	5,694,261 Kg	0.031/Kg	13.85	13.85	175,830		
Eggs			268.60 Eggs	3,453,900 Eggs	0.013/Egg	3.53	3.53	44,900		
Hides and Skins			1.87 Kg	23,762 Kg	0.135/Kg	0.25	0.25	3,200		
Subtotal, Livestock and Products							33.20	421,840		
Fuel Income							5.36	68,135		
Total Income							248.32	3,155,460	1,686,130	1,469,330
Average per Hectare								248.32	132.69	115.63
Grazing Income Nonarable Land										99,220
Grazing Income per Hectare 2/										7.81
Grand Total Income										1,568,550
Grand Total Income per Hectare										123.44

1/	Total Production/Kg	Livestock Feed	Surplus Over Livestock Feed
Wheat	16,544,565	686,134	15,858,431
Alfalfa	25,305,032	21,732,350	Balance Turned Under
Corn	7,246,196	1,411,890	5,834,306

Crop Residue Fed to Livestock

2/ Per Hectare of Nonarable Land (12,638 Hectares)

TABLE 6-B

Anticipated Future Conditions, Shamalan Unit - 50 Year Average
Units in English System and U.S. Dollars

	Land Use %	Acres	Yield Unit/Acre	Yield Total	Price/Unit $	Gross Income, $ Per Acre	Gross Income, $ Per Composite Acre	Gross Income, $ Total		Gross Costs $	Net Income $
Single Crop											
Wheat	38.6	12,120	50 bu	606,000 bu	1.640 bu	78.68	30.37	953,630	1/		
Barley	3.9	1,225	29 bu	35,525 bu	0.056 bu	16.24	0.63	19,890			
Cotton: Seed Cotton	21.9	6,876	1,510 lb	10,382,760 lb	0.071 lb	107.21	23.48	737,175			
Lint			(530 lb)	(3,633,970 lb)	(0.178 lb)	(94.07)	(20.60)	(646,850)			
			(1.1 bale)	(72,680 bale)	(89.000 bale)						
Seed			(980 lb)	(6,748,790 lb)	(0.013 lb)	(13.14)	(2.88)	(90,325)			
Alfalfa, Hay	20.1	6,311	4.4 ton	30,254 ton	6.840 ton		-	-	1/		
Orchard	3.0	942	18,180 lb	17,125,560 lb	0.012 lb	218.15	6.55	205,500			
Garden	2.8	879	15,250 lb	13,404,750 lb	0.004 lb	61.00	1.71	53,620			
Vineyard	3.3	1,036	10,940 lb	11,333,840 lb	0.011 lb	120.34	3.97	124,670			
Subtotal, Single Crop	93.6	29,389					66.71	2,094,485			
Double Crop											
Wheat	11.0	3,454	40 bu	138,160 bu	1.640 bu	65.60	7.22	226,580			
Corn	14.3	4,490	64 bu	287,360 bu	1.000 bu	52.08	7.45	233,860	1/		
Carrots	2.7	848	10,400 lb	8,836,160 lb	0.003 lb	31.26	0.84	26,510			
Mung Beans	9.8	3,077	830 lb	2,553,910 lb	0.021 lb	17.43	1.71	53,630			
Sunflower or Other Oilseed	2.3	722	795 lb	573,990 lb	0.053 lb	42.13	0.97	30,420			
Subtotal, Double Crop	(40.1)	(12,591)					18.19	571,000			
Crop Residue	-	-				0.15	-	-	1/		
Idle and Farmstead	6.4	2,010				-					
Subtotal, Crops	100.0	31,399					84.90	2,665,485			
Livestock and Products			No/Acre	Number							
Oxen			0.05 hd	1,570 hd	6.35 /hd	0.32	0.32	9,970			
Milk Cows			0.20 hd	6,280 hd	2.89 hd	0.58	0.58	18,150			
Other Cattle			0.18 hd	5,650 hd	2.31 hd	0.41	0.41	13,050			
Donkeys and Horses			0.04 hd	1,225 hd	0.26 hd	0.01	0.01	320			
Sheep and Goats			0.27 hd	8,480 hd	10.72 hd	2.90	2.90	90,900			
Chickens and Other Poultry			5.80 hd	182,000 hd	0.36 hd	2.09	2.02	65,520			
Milk			400.00 lb	12,559,600 lb	0.014 /lb	5.60	5.60	175,830			
Eggs			110.00 eggs	3,453,900 eggs	0.013 /egg	1.43	1.43	44,900			
Hides and Skins			1.67 lb	52,435 lb	0.061 /lb	0.10	0.10	3,200			
Subtotal, Livestock and Products							13.43	421,840			
Fuel Income							2.17	68,135			
Total Income							100.50	3,155,460		1,686,130	1,469,330
Average per Acre								100.50		53.70	46.80
Grazing Income, Nonarable Land											99,220
Grazing Income per Acre 2/											3.16
Grand Total Income											1,568,550
Grand Total Income per Acre											49.96

Note: Based on anticipated average conditions for 50 years of project development.

1/

	Total Production	Livestock Feed	Surplus Over Livestock Feed
Wheat	606,000 bu	24,516 bu	581,484 bu
Alfalfa	30,254 ton	29,245 ton	Balance Turned Under
Corn	287,360 bu	53,500 bu	233,860

Crop Residue Fed to Livestock or Plowed Under.

2/ Per Acre of Nonarable Land (31,229 Acres)

Future farming costs are projected upward, and are based on a mixture of traditional and modern inputs in the early years, with subsistence inputs gradually being replaced over time. Although total farm costs will rise per unit of land, unit costs will tend to be reduced as yields rise. Therefore, greater net income per unit of land is projected for each period in the future as the project progresses.

Future farm costs are the annual expenses incurred to realize the yields and gross farm income projected for future operation. These include the costs of seed, fertilizer, insecticides and disease control agents, operation, repair, interest, and depreciation of farm machinery and implements, crop payments and oxen feeding, storage, purchases of livestock, depreciation of farm buildings and improvements, interest on land, improvements, and borrowed capital, well operation and maintenance, the farm share of utilities, and taxes.

Some of these categories, such as seed, fertilizer, insect and disease control agents, and costs of depreciation and interest should rise sharply in the early period of project development as the inputs are made available and the value of the farm investment rises. Others, such as machine costs, will increase less quickly due to the major investment required to mechanize a given operation and the great change in attitude which must accompany this process. Concurrently with the projected increase in mechanization is a reduction in costs of crop payments to tenants and feeding oxen. Storage costs should decrease per unit as losses are reduced. Taxation and use of utilities should rise in the early period of development, and well operation and replacement, on an annual basis, would tend to be constant for each year of operation. Table 7 shows the expected average costs for the future, and Table 8 the anticipated farm costs for the 15th, 25th, and 50th years of project operation. Appendix Table 35 shows the factors used in arriving at the average cost figures for the 50-year period of analysis.

Seed costs are charges made against the farm enterprise for purchase of improved varieties of seed as these become available. This presumes that farmers will abandon much of their present practice of saving seed from each crop for next year's planting, but instead purchase improved, adapted seed as it is made available by the Extension Service or commercial seed houses.

Fertilizer costs are incurred to supply the annual plant requirements of nitrogen and phosphorus, plus some of the plant requirements for potassium. Soils in this area are generally deficient in both nitrogen and phosphorus, but contain enough potash so that the soil can be mined for the foreseeable future without return of more than 20% of the potash removed yearly by vegetative growth. Fertilizer costs include an allowance for the return to the soil of part of the annual production of farm manure.

Insecticide and disease control costs include the reagents necessary to control pests which now are common in this area, and an estimate of future control measures as cropping intensifies and pests multiply. The most useful general agents known at present are included, for these are effective for a

TABLE 7

Average Anticipated Farm Costs

Shamalan Unit

	50-Year Average		
	$ per Hectare	$ per Acre	Total $
Seed	4.15	1.68	52,750
Fertilizer	39.17	15.85	497,675
Insect and disease control	17.27	6.99	219,480
Machine operation, repair, depreciation and interest	21.40	8.66	271,915
Crop payment to tenants	5.56	2.25	70,650
Oxen feeding	2.57	1.04	32,655
Storage	2.25	0.91	28,575
Livestock purchases	4.72	1.91	59,970
Depreciation of improvements	10.63	4.30	135,015
Interest on investment and borrowed capital	17.79	7.20	226,075
Well operation and maintenance	0.44	0.18	5,650
Utilities	0.27	0.11	3,455
Taxation	8.25	2.62	82,265
TOTAL	$132.69	$53.70	$1,686,130

TABLE 8

Future Farm Costs

Shamalan Unit

	15th Year		25th Year		50th Year	
	$ per Hectare	$ per Acre	$ per Hectare	$ per Acre	$ per Hectare	$ per Acre
Seed	4.08	1.65	4.89	1.98	5.44	2.20
Fertilizer	38.40	15.54	46.09	18.65	51.20	20.72
Insect and disease control	16.93	6.85	20.31	8.22	23.10	9.35
Machine operation, repair depreciation, and interest	20.39	8.25	30.59	12.38	40.77	16.50
Crop payment to tenants	5.85	2.37	2.92	1.18	0.00	0.00
Oxen feeding	2.69	1.09	1.36	0.55	0.00	0.00
Storage	2.22	0.90	2.37	0.96	2.50	1.01
Livestock purchases	4.67	1.89	5.24	2.12	5.54	2.24
Depreciation of improvements	10.53	4.26	11.44	4.63	12.06	4.88
Interest on investment and borrowed capital	17.67	7.15	18.98	7.68	19.87	8.04
Well operation and maintenance	0.44	0.18	0.44	0.18	0.44	0.18
Utilities	0.25	0.10	0.37	0.15	0.49	0.20
Taxes	6.35	2.57	7.49	3.03	8.25	3.34
TOTAL	$130.47	$52.80	$152.49	$61.71	$169.66	$68.66

broad range of control and should be indicative of future costs. Pests of cotton, orchard, garden and vineyard crops are expected to be more virulent and expensive to check.

Machine costs are the annual expenses incurred to purchase, operate and repair the farm tractors and implements required to perform cultural operations in the future. This machinery includes enough tractors, plows, harrows, ditchers, ridgers, tillers, planters, drills, fertilizer spreaders, cultivators, hay rakes, mowers and balers, sprayers, combines, and trailers to perform farming operations cheaply and efficiently. One tractor is projected per 40 hectares (100 acres); one plow, harrow, ditcher, ridger, tiller, drill, planter, cultivator, hay mower, sprayer, rake and trailer per 80 hectares (200 acres); one hay baler per 160 hectares (400 acres), and one combine per 300 hectares (750 acres). This spread of equipment over farms that will range in size from 9 to 10 hectares (22 to 25 acres) will necessarily involve some pooling of capital or credit to make initial purchases, and possibly the evolution of rental and contractual patterns in the future. In the early years of operation some custom use by private owner-operators or government machine pools would be desirable. Hay baling and grain and bean combining would probably continue as custom operations for the period of analysis.

As mechanization increases, the use of tenants and oxen will decrease. These costs are carried on a diminishing basis, ultimately being dropped by the 50th year of project operations.

Storage costs are the value of crops lost in storage on the farm. They exclude the cost of the storage facilities, which are carried under depreciation, interest, and taxation. Under improved future conditions wheat and barley losses should be reduced from 5% at present to 2%, and corn and mung beans from 2% at present to 1% of total harvest. Fruit, vegetables, and other perishable crops will be consumed fresh on the farm, and losses after sale would be in the processing and marketing sectors. Alfalfa would be fed green as needed, or cut and cured. Cotton and oilseeds would be sold essentially without farm losses.

Harvest losses are deducted from crop yields, and hauling costs carried under machinery operation.

Livestock purchases are the costs of sheep and goats purchased in the fall from nomads, fattened on crop residues and stubble, and slaughtered in the winter. With larger future farms, more intensive cropping, and better vegetative growth there is every reason to expect this practice to continue and increase.

Depreciation of improvements, exclusive of depreciation charged against machinery and implements, is the annual cost of replacing farm buildings, wells, orchards and vineyards, and livestock as they wear out or become obsolete. These costs do not occur equally each year, but rather in lump sums as particular assets are replaced. For purpose of analysis, depreciation is treated on an annual equivalent basis.

Interest on the farm investment, which primarily is charged against land, improvements, orchards and vineyards, livestock, and on borrowed capital represents a cost of doing business. The greater portion of interest is an alternative earning that could be realized by placing the value of the farm investment in an enterprise where it would earn the current local interest rate. This is actually an investment foregone rather than an out-of-pocket cost, for it represents money that could have been earned elsewhere, rather than an actual expense. Some portion of this charge, however, represents a true cash cost, for in the future farm credit will be required to purchase commercial inputs. The full cost of interest, including earnings foregone and farm credit is calculated at 6% per annum on the farm investment.

Well Operation and Maintenance. This represents the annual equivalent cost of operating and maintaining the well each year after installation. The wells would be constructed as a project expense, but their care and upkeep should be a farmer responsibility and expense.

The cost of farm utilities estimates the farm share of electric power which is expected to come in use in the Shamalan area at some future date. At present the town at Bost and the surrounding area and several other towns are electrified, and both demand and service are spreading. For the future the typical Shamalan farm is expected to make modest use of electric power, and 33% of estimated farm usage is charged against the farm business.

The taxation cost is the future tax expected to be levied against farm land in the Shamalan area, exclusive of project amortization and operation and maintenance charges. In the past, the RGA has taxed both land and livestock, but in recent years the land tax has been increased and the livestock tax in part eliminated. The future tax cost is based on an expected continuation of this trend.

Total farm costs of $132.69 per hectare ($53.70 per acre) are computed for anticipated average future conditions or 53.4% of expected gross income. The relationship between present and future gross income, farm costs, and net income suggests that future farm costs, although considerably higher than present levels of $44.45 per hectare ($17.99 per acre), actually result in much greater net income. If these inputs are applied correctly and effectively over a 50-year period of operations, project gross and net income per unit of land and in total will be enhanced.

Secondary Income

The study of future secondary income is based on factors that exist in Afghanistan today only in fragmentary form. Judgment is required to calculate the type and size of future local, regional and national secondary income. Expected future primary income data provide information on crop and livestock production, livestock feed requirements, and cleaning and storage losses. Dietary projections, including allowances for food wastage and purchase of nonlocal food indicate the amount of farm produce that should be retained for home consumption, and the balance available for sale. Secondary income is computed for the portions sold, consumed locally, and fed to livestock.

Processing, Hauling, and Marketing Farm Products. In the future, the project area is expected to consume about 10 to 15% of its own food production, compared to 75% at present. Again it must be emphasized that no increase in salable farm product can automatically be assumed; the many agricultural and infrastructural weaknesses in the area must be corrected before sizable surpluses can be attained. The basic assumption made is that as agriculture develops, modern processing, hauling, and marketing facilities will follow; project farmers will demand services of seed, fertilizer, insecticide, machinery, and fuel dealers, repair shops, craftsmen services, and nonlocal foods; and transportation and export systems will be enlarged.

On the assumption of future development, information was collected as a base of production from the modern processing plants that exist today in Afghanistan. The flour mill and granary (silo) in Kabul, the fruit and grape cannery in Kandahar, the Bost cotton gin, and the Bost creamery were visited. Additional data were collected from the oilseed mill under construction in Bost, a textile mill and a proposed raisin and fruit drying plant near Kabul, and a hide and skin tannery proposed for Kandahar. Data were secured from the General Transport Department of the RGA for hauling costs in the country. Marketing and shopkeeping benefits are based on expected costs and profit margins. These data form the base upon which future wage, salary, interest, and profit figures are projected for future Shamalan processing and marketing benefits. If surpluses are produced, and industries develop to handle these as they are doing in other parts of Afghanistan, then it is reasonable to assume that secondary income of the type and amount shown will develop.

Wheat, Barley, Corn, and Mung Beans. A sophisticated milling process is expected to replace the crude grinding currently used to process small grain and dry beans in the Shamalan area. The Kabul silo produces several grades of flour, bakes bread, and acts as a granary, buying and selling grain to reduce price fluctuations. Figures collected from this facility were used as the base for future secondary benefits, and a similar operation is under consideration for the Bost area.

Cotton and Oilseeds. Three industries are expected to process Shamalan cotton and seed in the future, and each presently exists in Afghanistan. Cotton ginning, cottonseed crushing, and cotton fiber spinning and weaving are necessary to produce the finished project. The Bost gin processes and sells lint and seed, and an oilseed mill is scheduled for completion in 1967. Cotton textile mills are operated at Gulbuhar. The demand for cotton is growing, and a wider variety of fabrics is being produced and imported. The bulk of future cotton lint and seed produced in this area will probably be processed internally, rather than exported in the crude stage and re-imported as fiber and oil.

Data collected from the gin, with a margin added for future profit, are used as the base for future secondary benefits. Data made available by the Afghan Textile Company for 1338, 1339, and 1340 (1959-60, 1960-61, and 1961-62) and from projected estimates of the Bost Oil Company were used for fiber and oil production. Cotton textile weaving, however, is sufficiently far removed from the farm that only half of the secondary benefits are claimed; the remainder should be considered industrial benefits. Sunflower or other vegetable oil, if produced in volume, would be crushed and refined by the Bost Oil Company.

Horticultural Crops. Processing of garden, orchard, vineyard, and carrot crops can take divergent forms. Some portion of the surpluses of these crops would be sold fresh locally and regionally, and other portions canned, dried, or exported in various forms. The Kandahar Fruit Corporation and a raisin and dried fruit plant scheduled for Kabul supplied conversion figures for fresh and dry products, production figures for whole and half fruit, compotes, jellies, juices, and syrups, and cost and profit figures for the packs. Marketing and hauling figures complete the secondary benefit computations for these crops.

Forage. All alfalfa, clover, and other leguminous pasture crops are expected to be fed to livestock or plowed under for soil improvement. No secondary benefits can be claimed.

Livestock Products. A greater volume of animal products is expected from this area in the future, after making an allowance for adequate home consumption of animal proteins. Raw milk and hides will be processed in bulk, but most of the meat and egg production should be consumed at home, as dietary patterns improve and farmers demand a higher standard of living. A strong commercial livestock industry is not projected; farmers are expected to remain producers of field and horticultural crops, on a larger and more efficient scale.

The Bost dairy supplied basic data for this operation. The dairy currently pasteurizes and homogenizes whole milk and sells small quantities of butter, cheese, heavy and light cream, and ice cream. With greater supply from the Shamalan area and expanding demand, it could be the base upon which production and efficiency rise.

Several small tanneries in Kandahar tan hides and skins to produce leather, but these inefficient operations are expected to be replaced in time by larger plants. Projected benefits were abstracted from a tannery proposed in the Kandahar Industrial Park.

Agribusiness. Agribusiness, or agricultural business, is expected to show the greatest relative increases in income of all categories computed. Although camel rental would disappear and livestock purchases improve only moderately, the business in seed, fertilizer, pesticide, farm equipment and parts, and fuel, oil and grease should move from almost zero to a considerable volume over 50 years. At present the farmers use no factory-made equipment, with the exception of some iron plow points, tethers, chains, and sickles; do not use commercial fertilizer; are not aware of the existence of pesticides or herbicides; and save their own seed for planting. Future development is in part predicated upon the introduction and application of efficient inputs. It is axiomatic, therefore, that the use of modern inputs and the abandonment of traditional or subsistence inputs is required if agricultural business is to develop.

Commercial seed costs furnish the data from which secondary benefit factors are determined. Improved seed must exist if higher yields are to emerge, and the local experimental and demonstration farms should lead the way, followed in time by a network of private seed dealers. These costs include an allowance for propagation, multiplication, and marketing.

The quantities required of commercial fertilizer and insecticides are estimated from acreage and plant needs, but only a small portion of the expenses can be considered secondary benefits. The costs of internal hauling and handling furnish secondary benefits, but construction of a nitrogenous fertilizer plant at Mazar-i-Sherif, in northern Afghanistan, would materially increase secondary benefits of fertilizer use.

Tractors, implements, parts, fuel, oil, and lubricants originate outside Afghanistan and will continue to do so for many years. Only the cost of hauling the equipment from Chaman, West Pakistan; the petroleum products from the border near Meshed, Iran; of internal distribution and handling; and of maintaining the equipment on the farm are claimable as sources of secondary benefits.

Purchased Foods. With a rising living standard, a wider variety of foodstuffs, and a greater knowledge of diet and nonlocal food, the project residents are expected to spend more for purchased foods, including tea, sugar, candy, rice, fats and oils, subtropical fruit, and other non-project foods. The consumption of tea, sugar, candy, and rice; of secondary dairy products processed from milk; of shortening from cottonseed; and of oranges, lemons, limes, and other citrus fruit from Jalalabad is expected to increase. Processing, hauling and marketing these products form the base of secondary benefits.

Fishery. There is no basis for assuming that the future take of fish from the distribution and drainage system will vary significantly from the present. The primary use of the system is to supply and remove irrigation water, and proper operation dictates that the canals must be drained and cleaned each year. Down time would be increased when a domestic well system exists and this would prevent any significant increase in fish population.

Journeymen and Artisans. The income realized by journeymen, craftsmen, artisans, and religious leaders is expected to rise with project development. Calculations of this type are highly subjective, but an increase is predicted on the basis of a higher living standard and an increased demand for many occupations. The number and income of barbers, carpenters, mullahs, musicians, shopkeepers and peddlers, and tailors should increase if the project area develops, wealth increases, and the demand for goods and services is augmented. On the other hand, the itinerant or village blacksmith and millwright will probably fall victim to the machine shop and consolidated flour mill; and the number of coppersmiths and goldsmiths may increase less rapidly, for example, than the number of general shopkeepers. Such local work as wandering shoe and pot repair would tend to be replaced by shop work, and shoes manufactures from old tires will be replaced by superior products from specialized factories. The position of local watermaster could become a project function and benefits carried under operation and maintenance.

Secondary benefits from these sources are estimated by comparing the future expected population of the Shamalan area with the present, and by judgment factors that attempt to measure future demand for each service. Studies elsewhere indicate a direct relationship between area development and the demand for services. As an agricultural area becomes more specialized and efficient, the farming population tends to decline in relation to the manufacturing and service population. Increases occur in retail and wholesale trade, business, professional and governmental services and manufacturing, coupled with decreases in handicraft and cottage industry employment. All of these factors are included in estimating future secondary benefits for journeymen and artisans.

Transporting People. Transporting people to, from, and within the project area is expected to increase sharply with development. The greater secondary and tertiary population and the greater affluence of the farmers and general public will increase local traffic. Secondary benefits are estimated from cost and profit figures collected from local haulers, increased population, and a factor for increased travel per person.

Exports. At present a negligible quantity of goods is exported from the Shamalan area. Although a small quantity of local fruit or grapes eventually reaches West Pakistan or India, the small production and the extremely poor packing and handling make this insignificant. The Bost and Girishk markets are traditionally supplied with fruit, grapes, and vegetables that originate not in the Shamalan or other nearby areas, but in the Kandahar region.

If the project develops, this trend could be reversed. It is assumed that half of the fruit, grapes, vegetables, and carrots that are surplus to the needs of project inhabitants will be exported as fresh, dried, or canned pack. Construction of the proposed rail spur from Chaman, West Pakistan to Spin Baldak, Afghanistan would reduce rough handling and facilitate the export of perishable products. Benefits are calculated for hauling a large volume of products from the Shamalan area to Bost, and for lesser quantities to Kandahar and Spin Baldak.

Table 9 summarizes expected future secondary income. Appendix Tables 37 and 37-A through 37-O present the material in greater detail. All secondary benefit figures are computed for full 50th year production and reduced to an

TABLE 9

Summary of Secondary Benefits, Future Situation
Shamalan Unit

	Milling $	Ginning, Spinning & Weaving $	Oilseed Crushing $	Canning $	Drying $	Dairying $	Tanning $	Shopkeeping and Butchering $	Hauling $	Total $
Processing, hauling and marketing farm products										
Wheat	161,900	-	-	-	-	-	-	37,320	18,230	217,450
Barley	5,570	-	-	-	-	-	-	565	645	6,780
Cotton, raw	-	96,370	-	-	-	-	-	-	-	96,370
Lint	-	241,760	-	-	-	-	-	9,100	1,575	252,435
Seed	-	-	55,105	-	-	-	-	2,540	2,185	59,830
Orchard	-	-	-	159,455	13,085	-	-	5,520	7,005	185,065
Garden	-	-	-	114,725	-	-	-	660	2,445	117,830
Vineyard	-	-	-	108,070	15,770	-	-	3,225	4,505	131,770
Corn	55,510	-	-	-	-	-	-	8,895	6,680	71,085
Carrots	-	-	-	144,975	-	-	-	640	3,060	148,675
Mung beans	4,005	-	-	-	-	-	-	1,535	980	6,520
Sunflower	-	-	4,200	-	..	-	-	825	180	5,425
Subtotal, Crops	226,985	338,130	59,525	527,425	28,855	-	-	70,825	47,490	1,299,235
Milk	-	-	-	-	-	82,140	-	4,710	4,600	91,450
Meat	-	-	-	-	-	-	-	400	15	415
Eggs	-	-	-	-	-	-	-	20	5	25
Hides and skins	-	-	-	-	-	-	3,480	140	40	3,660
Subtotal, Livestock	-	-	-	-	-	82,140	3,480	5,270	4,660	95,550
Secondary Benefits, Processing, Hauling, and Marketing Farm Products	$226,985	$338,130	$59,525	$527,425	$28,855	$82,140	$3,480	$76,095	$52,150	$1,394,785

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TABLE 9 continued

	Processing or Production $	Handling and Shopkeeping $	Hauling $	Total $
Agribusiness				
Livestock purchase	21,580	-	-	21,580
Tractor and implement purchase	-	70,070	4,675	74,745
Tractor and implement repair	-	81,565	-	81,565
Fuel, oil, and lubrication purchase	-	2,255	4,040	6,295
Seed purchase	-	2,585	55	2,640
Fertilizer purchase	38,825	21,035	15,960	75,820
Insecticide purchase	-	9,285	890	10,175
Secondary Benefits, Agribusiness	60,405	186,795	25,620	272,820
Purchased foods				
Rice, sugar, tea, candy, fats and oils, fruit	1,430	12,445	950	14,825
Secondary Benefits, Purchased Foods	1,430	12,445	950	14,825
Fishery				
Winter	850	-	10	860
Summer	40	-	5	45
Secondary Benefits, Fishery	890		15	905
Subtotal, Secondary Benefits, Agribusiness, Purchased Foods, and Fishery	$62,725	$199,240	$26,585	$288,550

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TABLE 9 continued

	Handling and Shopkeeping $	Hauling $	Labor $	Total $
Journeymen and Artisans				
Barber	-	-	545	545
Carpenter	-	-	12,050	12,050
Cobbler	-	-	140	140
Coppersmith	-	-	700	700
Goldsmith	-	-	505	505
Mullah	-	-	24,575	24,575
Musician	-	-	585	585
Shopkeeper, peddler	26,795	-	-	26,795
Tailor	-	-	4,020	4,020
Subtotal, Journeymen and Artisans	26,795	-	43,120	69,915
Transporting people	-	1,280	-	1,280
Secondary Benefits, Transporting People	-	1,280	-	1,280
Exports				
Orchard	3,685	2,465	-	6,150
Vineyard	335	940	-	1,275
Garden	1,880	1,770	-	3,650
Carrots	420	1,190	-	1,610
Secondary Benefits, Exports	6,320	6,365	-	12,685
Subtotal, Secondary Benefits, Journeymen and Artisans, Transporting People, and Exports	33,115	7,645	43,120	83,880
TOTAL, Secondary Benefits				$1,767,215

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average of 50 years of project development. The factors used to determine averages for each secondary crop and livestock enterprise are identical to those employed for primary production of that product in the Shamalan area.

Development Benefits

Development benefits arise when resources that otherwise would be unemployed or underemployed are utilized to construct, operate, and maintain a water resource or other capital project. Future secondary development benefits here can include only the portion of the expenses incurred within the country, and must exclude all off-shore expenses to the Afghan border. Only the wages paid to local employees, a portion of the dollar salaries paid, and hauling from the frontiers to the project area are used as the basis of development benefits, plus income accruing from mining, processing, and handling local gypsum.

Future development benefits derived from operation and maintenance are expected to be higher than present levels. Present construction costs are nil, but future construction and land reclamation costs will be high. All capital costs are amortized over the period of analysis to derive their annual equivalent cost. A portion of this figure, plus a portion of operation and maintenance costs, can be claimed as secondary benefits. Table 10 summarizes expected future development benefits, and Appendix Table 39 presents these in greater detail.

TABLE 10

Summary of Future Development Benefits

Shamalan Unit

	Processing $	Handling $	Labor $	Hauling $	Total $
Construction	-	-	56,700	30,530	87,230
Soil amendments	3,440	1,270	6,055	3,080	13,845
Operation and maintenance	-	-	24,365	13,310	37,675
TOTAL	$3,440	$1,270	$87,120	$46,920	$138,750

Intangible Benefits

Intangible benefits are improvements expected from project development which are not measurable in monetary terms, but which nevertheless are important in overall project formulation. They should be considered a partial basis of justification, even though they form no part of a financial analysis. These benefits are intangible only in a financial sense, for physically they exist and are real. They occur in several distinct categories, including community services and facilities, project population, rural employment, level of living, land values and farm equities, development of commercial agriculture, and the affect of the project on the national economy. Intangible benefits are discussed for both the present situation and the expected future condition, assuming that agricultural production in the area increases and the project develops.

Community Services and Facilities. The economic growth expected with project development, and the greater social interest and broader horizons which emerge with development and change form the basis for presuming that community services and facilities will improve. Overall demand for services offered by schools, hospitals and dressing stations, libraries, mosques, sports and meeting halls, and other amenities will increase. The stimulation offered by easier transportation, more farm sales and greater demand for outside products, and particularly more extensive contact with the world, will increase the desire for amenities. A rising standard of living and greater cash income will provide the means to bring improved community services and facilities to the area.

Project Population. Overall regional population, including the secondary and manufacturing population that will emerge with development of the agricultural resource base, is expected to increase with development. The work force supported by the oil, flour, and textile mills, cotton gin, dairy, canneries and packing sheds; distributors of seed, fertilizer, insecticides, farm equipment, and petroleum products; and by trade, banking, commercial transportation and government institutions should grow as the agricultural base develops. Increased non-agricultural employment should absorb the decrease in farm employment. Displaced sharecroppers should be integrated into the non-agricultural economy as farms enlarge, mechanize, and require less labor. Over time the problem of displaced rural population should be solved by growing labor requirements in the industrial and service sectors.

Rural Employment. In the Shamalan area rural underemployment, or "hidden" unemployment, is prevalent today. Land farmed per man-equivalent, including the field work done by women and children, is a low 1.2 hectares (3.0 acres). The low level of crop and animal yields indicates that much of this high usage of labor is not productive. Gross and net product per man-equivalent was $139 and $78 respectively in 1965, and this further indicates a great lack of productivity. Project development should alleviate this condition in two ways - by providing more productive work on the land and by creating a base of surplus production upon which an urban, processing and service segment can be built.

Level of Living. A change in projected levels of living should occur in two categories - diet and income. Although the change will come gradually, by the end of the 50-year period of analysis the improvement should be marked. Study of the local diet indicates that the farm family and tenants are not receiving their full nutritional requirements, either in total food intake or on balance. The diet for the farm family probably does not exceed 2,500 calories per adult per day; for the tenant families, not above 2,200 calories.

Based on production figures, the consumption of whole grains, mainly wheat but including some corn and barley, constitutes about 75% of the total diet, somewhat less for the owners but more for the tenants. Fruit, grapes, carrots, and other vegetables constitute 9 to 10% of the total intake, beans 4%, and food from animal sources, including milk, eggs, beef, lamb, mutton, goat, and poultry, 6%. The remaining 5 to 6% originates outside the area. The manifestly poor health of the project residents, the high death rate among the children, and the thinness and weakness of many adults bear this out in observation. Although other factors, including lack of sanitary facilities and general nonavailability of drugs and medicines in the rural areas contribute, the diet is at least partially responsible. A more adequate diet is projected for the future, and if the project develops there is no reason why higher levels of food consumption should not be realized. The health and education programs should include demonstrations on balanced diet, new foods, and improved cooking methods.

A future diet of 2,800 calories per adult-equivalent, in correct balance, will support good health and enable residents to work productively. The percentage of whole grains should diminish to roughly 40% of the diet; beans should increase to 6%; fruit, grapes, carrots, and other vegetables to 15%; and milk, eggs, and meat to a level comprising 15 to 20% of the total caloric intake. The higher intake of food from animal sources would also correct a longstanding protein deficiency. The balance of consumption would come from such purchased foods as sugar, tea, candy, rice, fats and oils, and fruit.

The level of living on the project, expressed in terms of money and kind retained by the family, is another important segment of the benefits of project development. The present family living allowance, or amount retained by the family in cash or kind, expressed in this context is $332 per farm, or roughly $17 to $21 per person. 1/ This is the cash equivalent of the product available per person after paying farm costs and after receiving a portion of the true value of cotton from the government. In real terms in 1965, at local prices and in local markets, this was equivalent to 266 kilograms (918 bushels) of wheat per year for every man, woman, and child in landowning families. The average tenant receives less than the equivalent of $9 per year, or 144 kilograms (5.3 bushels) of wheat per capita per year.

In the future this situation should be improved. By 50 years after project completion, the family living allowance should approximate $600 per farm per year. This could be $100 per person, depending upon the trend toward the

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1/ Depending upon inclusion of true operation and maintenance cost as a project or farm expense, and including the full value of cotton as a farm return.

nuclear family pattern and away from the extended family system. This sum should be adequate to purchase the outside food, school books, uniforms, and supplies, medical and dental services and medicines, basic housing, furniture, clothing, and cooking and eating utensils that are so sparse and poor today, the electricity that will come into the area, some transportation, professional and business services, some bicycles, radios, shotguns and other luxuries; and provide a monetary incentive to keep the farmer producing at a high level. An adequate family living allowance, as much as any other single factor, will be a key to enable the area to move from subsistence to commercial farming, with an attendant thriving agricultural economy, sizable farm surpluses, and effective demand for manufactured products.

Land Values and Farm Equities.

At present there is no true real estate market in the Shamalan area. Occasionally a parcel of land changes hands, but when it does the property is unmarked, frequently unrecorded, and generally neither the buyer nor the seller can determine the actual amount of land involved. Once the land is surveyed and recorded 1/, and assuming that agricultural development occurs, a legitimate market for land should develop. This would facilitate sales, and provide an easier procedure for progressive farmers who wish to move into the area.

The price of real estate should rise as the area develops, and the value of farm buildings, ditches, orchards, vineyards, and other permanent installations also increases. This would constitute an important benefit to project farmers.

Commercial Agriculture. A final point of considerable value, but one very difficult to assess financially, is the transformation of subsistence to commercial farming. Subsistence farming refers to a situation wherein peasants consume the bulk of their production, produce the bulk of their own consumption, supply little to the urban market, purchase few manufactured goods originating in the urban sector, and operate perpetually at a low standard of living. Commercial farming in this context indicates a condition wherein the farmer produces primarily for market and produces those commodities which he is best qualified to grow, purchases from off the farm the goods and family requirements other rural areas and cities produce at lower cost, sells his products and purchases his inputs with cash, produces a surplus for an expanding urban sector and provides labor for that sector. The commercial farmer, distinct from the peasant, views farming as a business as well as a traditional way of life. This is the route along which all developed countries have traveled, and which will be necessary for Afghanistan to travel if she is to develop.

National Economy. Another benefit generated by increased production relates to the overall national economy. All products exported will create badly

1/ A Cadastral Survey was under way in 1967.

needed foreign exchange. Conversely, any domestic increase of products now imported will lessen needs for imports and reduce expenditure of foreign currencies. More impelling is the increased production of foodstuffs in a country that operates continually on the brink of deficient food supplies.

Sound agricultural policies, geared to producing surpluses for sale, will be essential if internal progress is to occur. External capital and assistance have their place, but in the final analysis it will be through the domestic agricultural sector that Afghanistan achieves self-sufficiency and advances to industrialization. Only when the Shamalan area contributes its share to development of the entire nation will its project works and investment be fully justified.

Agricultural Recommendations.

To implement the plan of development and to bring the project to a point at which it can be said to be successful, it is necessary for agriculture to develop. Based upon a sound foundation of an adequate distribution and drainage system, a network of farm roads and a domestic water service, and reclamation of much land from saline and alkaline conditions, agricultural development must be made to follow. This work will be neither quick nor easy, but it must be carried out if the project is to achieve its potential. Without project works, the area cannot reach its full competency; without agricultural development following project development, the project works will be so much wasted effort and capital. The following recommendations outline what must be done in the Shamalan area for full project success.

1. Farm Size and Farm Development. The farms must be laid out rationally, of sufficient size to enable the owner to work his land with family labor and avoid consumption of his surplus production by tenants and to provide adequate gross income to permit the farmer to pay for his inputs, cover his operation and maintenance charges and a share of capital costs if assessed, and retain sufficient family income to permit an adequate standard of living and provide incentive. The recommended farm size is eight to ten hectares (20 to 25 acres) for land class 1, 10 to 11 hectares (24 to 27 acres) for land class 2, and 11 to 12 hectares (27 to 30 acres) for land class 3. Most land in the area will be class 1, so farm size should be not less than 8 to 10 hectares. Land class 6 is nonarable and should be included in farm units only for grazing, as an addition to the basic unit, and not as a portion of the 8 to 10 hectares.

Each farm unit should be established on land properly consolidated, leveled, smoothed, drained, and well located with regard to a secondary road, irrigation turnout, and deep well. Where exchangeable sodium and salts will inhibit yields, gypsum applications and leaching are required in combination with green manures and proper crop rotations.

Land leveling should be considered a project function, for the present motive power cannot level fields of sufficient size to permit efficient use of machinery. Leveling and smoothing in this context will allow efficient water distribution on fields large enough for machinery, with no post-irrigation development of high and low spots through settling. Without firm water control, small irrigation basins must be used, machinery will be slow to replace oxen and tenants, and land is wasted by numerous irrigation basin banks.

The farms should be consolidated into single tracts with boundary lines conforming to the irrigation and drainage systems. All farms should be of economic size so that one man, using family labor, can operate his farm without tenants. Tenancy would spread the net returns, lower the living allowance per family, consume a surplus that should be feeding a developing urban sector, and inhibit the use of purchased inputs. Tenancy would also hinder introduction of machinery, perpetuate the employment of oxen, force a larger portion of the land into lower value forage crops, prepare a poor seedbed, and delay achievement of projected yield levels. Sharing a smaller crop with a tenant could perpetuate a class of rural poor, with little purchasing power and less participation in the national economy, and could reduce incentive on the part of the landowner.

With a farm of sufficient size, the farmer should maintain a sound business without tenants and oxen. Continued use of these archaic factors can only perpetuate the present subsistence system and retard development. Proper farm size and sound operation will permit the farmer to emerge from his subsistence standard of living and develop a commercial enterprise that will pay its costs and provide his family a standard of living commensurate with its efforts.

To permit land development in an orderly and efficient manner, it will be necessary for farmers to move off the land by blocks, ahead of construction. When the land is resettled, the farms should be laid out to conform to sound economic and engineering principles. In the absence of land reform legislation, it is not possible for farms of optimum size to be established immediately after project construction is completed. The sample survey indicated that the average farm is 7.4 hectares (18.3 acres), and that many farmers own additional land in the intermittently irrigated portions where full water supply will become available, which would bring average total farm size approximately to the recommended figures. However, some farmers today own several hundred acres, while many own fewer than 10 acres, and some exchange of land for water rights may occur. The change to ownership of economic-sized units must occur gradually, as machinery replaces oxen and tenants, and as the less efficient farmers sell their holdings. This process is common in developing countries, and continues in areas with high agricultural income, as part of the continuing process of commercialization of agriculture. However, sound engineering practices dictate that roads, wells, and irrigation structures be laid out and constructed in view of economic farm size, although this goal will be attained only gradually.

In the future farmers should have title to surveyed lands, recorded on plats in a local government office. Accessible public records should be maintained to reduce litigation and a water right should accompany the land title to prevent curtailment of water service during the irrigation season. The Cadastral Survey of Afghanistan is working on Shamalan land ownership and measurement, and should complete work before construction.

When the project works are constructed and the land resettled, land and water rights should be clarified to the owners, including any land lost due to laterals, drains, and roads. The mechanics of farm consolidation, land allocation, and resettlement should be prepared in advance of construction.

2. Improved Varieties of Seed and Livestock. Adapted, high-yielding varieties of seed and stock, rust-resistant wheat, increased production of industrial crops, and introduction of new cash crops are necessary. A program of research, experimentation, selection, propagation, seed multiplication, and distribution of improved, adapted varieties is essential to bring farmers the crops which will respond to better fertilizer and cultural practices and produce greater returns. The present Helmand Valley crops have largely developed here over centuries, and have been grown with little fertilizer or organic matter returned to the soil. The seeds are mixed and the plants have little inherited potential to produce high yields, and may not respond well to higher levels of fertility and better practices. Varieties which will produce good yields under improved conditions and are adapted locally are necessary to achieve any significant higher level of yields and returns. These varieties, however, must be properly fertilized and tended before they can produce their potential yields, and introduction of superior varieties without proper treatment will return little to the farmer. The same general statements are true of livestock. The local cattle have constantly been selected downward by castrating the strongest bull calves for oxen. The remaining specimens have not been selected for ability to transmit high milk production, nor has any breeding program been followed to increase beef yields. The cattle are stunted; an ox is not ready for plowing until its fourth year, and oxen and cows grow very slowly during their juvenile period and attain a weight of approximately 360 kilograms (800 pounds) and 270 kilograms (600 pounds) respectively. Poultry are scrawny and poor meat and egg producers. Sheep and goats are fair size, running about 45 and 36 kilograms (almost 100 and 80 pounds) at slaughter, but this stock is produced by nomads off the farm. Donkeys and horses are very small, and should be replaced by tractors, trailers, and trucks in time. Improved livestock species must be fed properly and protected against disease before they can perform effectively. As in improved crops, introduction of superior livestock without a full feeding and health program will accomplish little.

Several seed and improvement programs have started in the Helmand Valley. Brown Swiss dairy cattle and New Hampshire chickens have been imported, and the Bolan Research Farm has propagated and distributed some superior vegetables. A valley-wide program was initiated in 1966 to test Mexican-Pakistan wheat, which closely follows a successful program in West Pakistan. Surecropper, a high yielding open-pollinated field corn, also has been introduced. These and many other programs in cotton, fruit, vegetables, legumes, oilseeds, and livestock must be initiated and perpetuated, and improved seed and progeny made available to the farmers on a continuing basis. To date the distribution of new varieties to the farmers by extension workers has been quite limited.

Such new crops as sunflowers will be in demand. This crop is seldom seen by project farmers, and introduction and propagation is necessary by the development farm and extension service.

3. Fertility, Pest Control, and Disease Control. Chemical fertilizers in sufficient quantity are an absolute necessity if the projected yields are to be realized. Although use of livestock manure is projected, chemical elements must provide the bulk of the fertilizer required in the Shamalan area. It is calculated that an average of 77 pounds per acre of elemental nitrogen, 100 pounds of phosphorus, and 3 of potash will be needed per year under project development. At present commercial fertilizers in bulk are not available in the Helmand Valley.

Green manures are essential in view of the anticipated crop rotation and the present low level of organic matter. About 3 percent of the land is in alfalfa and clover; in the future 20 percent of the land should be in leguminous forage. Some of this would provide green feed for livestock, and the remainder, together with wheat and bean straw and corn stalks, should be turned under. Green manuring to improve soil tilth is especially required to reduce crusting and cloddiness.

Insecticides, fungicides, and other pathogen control agents will be necessary. At present insects and diseases are entirely uncontrolled, and occasional epidemics ravage crop and animal populations. In 1965-66 Newcastle disease destroyed a large part of the chicken population, rust was endemic in wheat, and aphids, fleahoppers, bollworms and cutworms were numerous in cotton. Control programs must be effected as required, and the responsibility for making the agents available to the farmers should rest initially with the HAVA, until private distribution facilities have been built up. The necessary fertilizer drills, dusters, and sprayers should be introduced by the HAVA, and credit made available for purchase by farmers.

4. Farm Equipment. Farm equipment, which should include training programs in operation and upkeep, includes as many tractors, implements, and trailers as required to properly plow the ground, prepare the seedbed, sow, fertilize, cultivate, and spray the crop, and harvest and haul the product economically and efficiently. Proper mechanization, which is dependent upon adequate farm size, is less costly per unit of physical yield than present yields coupled with feeding oxen and sharing the crop with tenants. Introduction of machinery must be accompanied by driver and operator instruction, an effective organization of machinery dealers, spare parts depots, repair shops, and fuel and service stations, and establishment of credit institutions to allow farmers and custom operators to purchase machinery singly or through associations. Tractors of different sizes should be imported and tested until a good balance is achieved between size of farm, field, and machine. At present a program to sell 200 45-hp diesel tractors is under way at Kandahar, and this could be the beginning of mechanization in this area.

Comparison of fields plowed and disced with these tractors and those done with the oxen teams reveals that the tractors produce a deeper, smoother seedbed with much better weed control than is possible with oxen. Government custom operation in conjunction with arrangements for farmers to pay at harvest time may be an effective first step in mechanization.

5. Farm Credit. Farm credit is essential for the successful development of the Shamalan area. At present credit is unavailable to the residents, except on a private basis. Tenants borrow and repay wheat from landlords, and landowners borrow from friends and relatives, but no private or governmental banking system exists here. Yet credit is necessary, considering the small amount of available local cash, for any meaningful purchases of improved seed, fertilizer, insecticide, and farm equipment.

The Shamalan area requires a source of readily available improved seed and livestock, fertilizer, insecticide, and farm tractors and implements, on site, plus an available local source of credit so the farmers may purchase these inputs. The credit may be extended in cash, certificates repayable at harvest time, or carried as a debit against a farmer's account at the bank, but however the mechanics are implemented the result should be access to a source of locally available improved inputs. Thereby the means of increasing production can be brought directly to the farmer, and he will be responsible, with the assistance of the Extension Service, for their successful implementation.

In the first years of project operation it may be necessary for groups of farmers to purchase inputs on a cooperative basis. As income advances, farmers may gradually shift toward single ownership of machinery and make larger applications of commercial fertilizer. A ready source of quick credit for emergency applications of insecticide or herbicides should be available.

There has been a tendency for farmers in Afghanistan to misconstrue the purpose of credit. Money which was loaned ostensibly for productive purchases has been spent on weddings and other familial uses, and in many cases farmers have been reluctant to meet interest charges or even to repay principal. The future credit program must be soundly backed, supervised, and administered and loans tailored for specific farming purposes at fair interest rates and repayment periods.

A satisfactory credit program was instituted in 1966-67 in connection with the new tractor program. Farmers pay 25% down, and the balance over five years at 6% interest on the unpaid balance. This system could establish a pattern for a larger credit program in the future.

6. Land Use and Management. Sound patterns of land use, double cropping, and crop rotations are essential. A balanced cropping pattern, based on commercial crops, nutritional requirements and dietary preferences of humans and livestock, and increases of organic material levels in the soils is necessary. The grains, fruit, vegetables, grapes, beans and carrots

projected will produce food for local consumption with a balance for sale. The cotton and oil crops are intended for commercial sale, and the alfalfa for livestock feed and green manure. The proportion of crop residues sold off the farm and used for fuel, including stalks and straw, should gradually decrease, and the cellulose returned to the soil.

Shamalan soils are extremely deficient in organic matter, a condition which contributes to poor tilth, poor soil-moisture and soil-air relationships, reduced biological activity, and difficulty in maintaining fertility levels. Sound farming practices, including the use of more leguminous forage and plowing under a portion of this forage for green manure, and the use of animal manure will increase and maintain favorable organic matter levels.

Double cropping should be followed as much as feasible. About three-fifths of the land that can be double cropped is actually projected for two crops. Any additional double cropping, if supported by fertilizers and performed in a timely manner, would raise future net farm income.

The corn, carrots, mung beans, and sunflowers projected as second crops are expected to follow wheat and barley in the rotation, on the same field. These are being grown at present to a lesser extent than projected for the future. However, the concept of wheat following cotton on the same field is new and will be possible only under mechanized conditions. Cotton is harvested in this area in October and November (final picking) and wheat should be planted no later than November. With a tractor plowing 8 to 10 acres per day, compared to oxen at the rate of 0.5 acre per day, only machinery can make this second crop possible. Yields for second crop wheat must be projected lower, for November wheat cannot make the same growth before cold weather as October wheat, but inclusion of this crop causes significant increase in projected net income for the area.

7. Transportation and Roads. At present a network of canal and drainage bank roads provides limited access to and within the Shamalan area, but tertiary roads do not extend to the farms. Few farms are accessible by more than a camel or donkey, and many farms are isolated by irrigation ditches and rows of mulberry trees. Farm roads and access roads should be developed and maintained as a project function and cost to permit vehicular traffic to reach farms from both the Shamalan Canal and the desert. At present the small farm surpluses are carried by camel, donkey, oxen, several private truck operators, and HAVA trucks, but if the project develops and appreciable surpluses are produced, the need for modern transport systems will enlarge.

8. Markets and Marketing Facilities. Adequate markets and facilities are essential if the project is to succeed and the region to advance. No area can rise above subsistence if its products are not sold, for a cash market provides farm income, enables farmers to purchase the inputs upon which increased yields are predicated, and assists the sociological change of peasants into commercial farmers. It is assumed that a larger market economy will develop, and products will be marketed locally, trucked to Bost, Girishk, Kandahar, and Kabul for sale or processing, and some portion of the processed

or fresh product sold in West Pakistan and northern India.

Individual farmers can market small volumes of produce, but large scale marketing may require farm cooperatives. The local, regional, national and export markets, Bost gin, oil mill, and dairy and the Kandahar cannery are expected to function as outlets for surplus Shamalan production.

Included in this recommendation is the need for improved storage facilities. Present storage losses are high, but proper facilities can reduce this in the future. With adequate drainage high water tables will be less of a problem, but the depredation of insects and rodents will require control measures.

9. Education, Demonstration, Training and Health Programs. Programs are needed to bring the concepts and procedures of modern, successful farming and living to the farmers. A schedule of regular farm visits should insure that the improved practices, water application, and use of new inputs are understood by the residents, and that they are working with reasonable efficiency. Programs to teach farmers the fundamentals of organization and cooperation are required.

10. Settlement. Little, if any, outside recruitment and settlement appears necessary in the Shamalan area. The land is almost entirely privately owned, has a surplus population in relation to its production, has many farms that logically should be enlarged to improve farming efficiency, and is cultivated annually with the exception of certain water-short areas. If surplus lands exist after farms are consolidated and brought to rational size, any displaced farmers should certainly be given first consideration, followed by landless tenants.

If new settlement is considered to replace present farmers, the new farmers should have a background of successful farming elsewhere. The policy of settling pastoral nomads on farms can only hinder progress, for their background in no way prepares them for successful farm management, or even for a sedentary life. The primary consideration in any settlement scheme is correct farm size and rational settler selection to enable the area to emerge from its subsistence base.

11. Operation and Maintenance. Project facilities, including the main canal, the distribution and drainage systems, and the roads must be properly operated and maintained. Operation and maintenance work has been carried out since the area came under water control, but many cleaning operations, notably on drains and waterways, have not been performed on schedule. The O & M operations have been hampered by lack of funds and equipment; water use by farmers is not regulated or measured; and farmers at the head of ditches have a tendency to overuse their supply, creating a seasonal shortage for farms at the end of the same ditches.

Future water delivery should be under strict administration and control, regulated by a central office in Bost. Well qualified watermasters and ditchriders should deliver water on schedule, in accordance with regulations.

A set of rules should be given each water user, stipulating the conditions under which he may receive irrigation water. The regulations should state that water will be delivered for irrigation use only, will not be delivered for domestic use during the nongrowing season, and that delivery will be made to farms on a demand, rather than a continuing basis. The volume of water delivered to each farm should be strictly controlled by the Operation and Maintenance Division, and farm units and blocks provided a turnout equipped with a measuring device. Water should be under control of the project ditchrider, who will turn water on and off and maintain water records.

No obstructions should be permitted on the rights-of-way, and all portions of the delivery, drainage, and road systems should be maintained free and clear of trees, brush, low vegetative growth, and trash.

The RGA presently charges water users only a small portion of the actual O & M costs, and none of the capital costs. Although real present O & M costs are computed at $5.99 per arable hectare ($2.42 per arable acre), farmers pay from $0.10 to $0.15 per arable hectare ($0.04 to $0.06 per arable acre) as part of their land tax. In the future, with an enlarged water distribution system designed to serve the area equitably, an adequate drainage system, an expanded and improved road program, but with more efficient management, O & M is estimated to cost $7.41 per irrigable hectare ($3.00 per irrigable acre).

12. Repayment. The HAVA should have a repayment plan or schedule in readiness when construction of the Shamalan Project is complete. The government now recognizes the need to collect operation and maintenance costs, and possibly part of capital costs, from the farmers. An early decision should be made on assessment and collection of water charges, and mechanics to accomplish this efficiently should be enacted. Charges can be made as a flat rate per unit of land, a water toll based on volume, or a base rate for all farmers in the area, plus a rate per cubic foot of water used. Once the rate and amount of payment have been established, collection should be administered properly on a systematic basis.

It would be unfair to expect the water users to pay the entire capital cost of the project, for the secondary beneficiaries will also profit by project operation. Therefore a suggested repayment table charges the water users with the operation and maintenance costs and the principal, but not the interest portion of capital costs. Interest on capital costs would be collected from secondary business, as a general business or income tax. Tables 11-A and 11-B illustrate a suggested repayment plan for water users in the Shamalan area.

TABLE 11-A

Suggested Repayment Schedule - Shamalan Unit

Units in Metric System and U. S. Dollars

Year	Net Farm Income per Hectare $	Family Living Allowance per Hectare $	Net Disposable Farm Income per Hectare $	Operation and Maintenance per Hectare $	Capital Cost[1/] Principal per Hectare $	Total Repayment per Hectare $	Disposable Income after Repayment per Hectare $
Present	52.97	41.27	11.70				
1	57.04	42.27	14.77	4.62		4.62	10.15
2	61.11	43.27	17.84	6.56		6.56	11.28
3	65.18	44.27	20.91	7.41	1.62	9.03	11.88
4	69.25	45.27	23.98	"	4.45	11.86	12.12
5	73.32	46.27	27.05	"	6.54	13.95	13.10
6	77.38	47.27	30.11	"	7.37	14.78	15.33
7	81.45	48.27	33.18	"	8.96	16.37	16.81
8	85.52	49.27	36.25	"	10.54	17.95	18.30
9	89.59	50.27	39.32	"	12.13	19.54	19.78
10	93.66	51.27	42.39	"	13.71	21.12	21.27
11	97.73	52.27	45.46	"	15.37	22.78	22.68
12	101.79	53.27	48.52	"	15.50	22.91	25.61
13	105.86	54.27	51.59	"	"	"	28.68
14	109.93	55.27	54.66	"	"	"	31.75
15	114.11	56.27	57.84	"	15.50	22.91	34.93
16	115.63	57.28	58.35	"	16.65	24.06	34.29
17	115.98	57.58	58.40	"	"	"	34.34
18	116.33	57.88	58.45	"	"	"	34.39
19	116.69	58.18	58.51	"	"	"	34.45
20	117.04	58.48	58.56	"	16.65	24.06	34.50
21	117.39	58.79	58.60	"	17.81	25.22	33.38
22	117.75	59.09	58.66	"	"	"	33.44
23	118.10	59.39	58.71	"	"	"	33.49
24	118.45	59.69	58.76	"	"	"	33.54
25	118.81	60.00	58.81	7.41	17.81	25.22	33.59

Page 1 of 2 pages.

TABLE 11-A - continued

Year	Net Farm Income per Hectare $	Family Living Allowance per Hectare $	Net Disposable Farm Income per Hectare $	Operation and Maintenance per Hectare $	Capital Cost[1/] Principal per Hectare $	Total Repayment per Hectare $	Disposable Income after Repayment per Hectare $
26	119.34	60.26	59.04	7.41	18.86	26.27	32.77
27	119.87	60.53	59.34	7.41	"	"	33.07
28	120.40	60.80	59.60	"	"	"	33.33
29	120.93	61.06	59.87	"	"	"	33.60
30	121.46	61.33	60.13	"	18.86	26.27	33.86
31	121.99	61.60	60.39	"	19.81	27.22	33.17
32	122.52	61.86	60.66	"	"	"	33.44
33	123.05	62.13	60.92	"	"	"	33.70
34	123.58	62.40	61.18	"	"	"	33.96
35	124.12	62.66	61.46	"	19.81	27.22	34.24
36	124.65	62.93	61.72	"	20.81	28.22	33.50
37	125.18	63.20	61.98	"	"	"	33.76
38	125.71	63.46	62.25	"	"	"	34.03
39	126.24	63.73	62.51	"	"	"	34.29
40	126.77	64.00	62.77	"	20.81	28.22	34.55
41	127.30	64.26	63.04	"	21.81	29.22	33.82
42	127.83	64.53	63.30	"	"	"	34.08
43	128.36	64.80	63.56	"	"	"	34.34
44	128.89	65.06	63.83	"	"	"	34.61
45	129.43	65.33	64.10	"	21.81	29.22	34.88
46	129.96	65.60	64.36	"	22.94	30.35	34.01
47	130.49	65.86	64.63	7.41	22.94	"	34.28
48	131.02	66.13	64.89	8.62	21.73	"	34.54
49	131.55	66.40	65.15	"	"	"	34.80
50	132.08	66.67	65.41	8.63	21.72	30.35	35.06
TOTAL			2,685.77	370.50	832.50	1,203.00	1,482.77

1/ Principal only. Annual interest cost of $18.86 per hectare is not charged to farmers.

TABLE 11-B

Suggested Repayment Schedule - Shamalan Unit

Units in English System and U.S. Dollars

Year	Net Farm Income per Acre $	Family Living Allowance per Acre $	Net Disposable Farm Income per Acre $	Operation and Maintenance per Acre $	Capital Cost[1/] Principal per Acre $	Total Repayment per Acre $	Disposable Income after Repayment per Acre $
Present	21.43	16.70	4.73				
1	23.08	17.11	5.97	1.87		1.87	4.10
2	24.73	17.51	7.22	2.65		2.65	4.56
3	26.38	17.91	8.46	2.98	.66	3.65	4.81
4	28.02	18.32	9.70	3.00	1.80	4.80	4.90
5	29.67	18.72	10.95	"	2.65	5.65	5.30
6	31.31	19.13	12.19	"	2.98	5.98	6.20
7	32.96	19.53	13.43	"	3.62	6.62	6.80
8	34.61	19.94	14.67	"	4.27	7.26	7.41
9	36.25	20.34	15.91	"	4.91	7.91	8.00
10	37.90	20.75	17.15	"	5.55	8.55	8.61
11	39.55	21.15	18.40	"	6.22	9.22	9.18
12	41.19	21.56	19.64	"	6.27	9.27	10.36
13	42.84	21.96	20.88	"	"	"	11.61
14	44.49	22.37	22.12	"	"	"	12.85
15	46.18	22.77	23.41	"	6.28	9.27	14.14
16	46.80	23.18	23.62	"	6.74	9.74	13.88
17	46.93	23.30	23.63	"	"	"	13.90
18	47.08	23.42	23.65	"	"	"	13.92
19	47.22	23.54	23.68	"	"	"	13.94
20	47.36	23.67	23.70	"	6.74	9.74	13.96
21	47.51	23.79	23.71	"	7.21	10.21	13.51
22	47.65	23.91	23.74	"	"	"	13.53
23	47.79	24.03	23.76	"	"	"	13.55
24	47.93	24.15	23.78	"	7.21	"	13.57
25	48.08	24.28	23.80	3.00	7.22	10.21	13.59

TABLE 11-B - continued

Year	Net Farm Income per Acre $	Family Living Allowance per Acre $	Net Disposable Farm Income per Acre $	Operation and Maintenance per Acre $	Capital Cost[1/] Principal per Acre $	Total Repayment per Acre $	Disposable Income after Repayment per Acre $
26	48.29	24.39	23.89	3.00	7.63	10.63	13.26
27	48.51	24.49	24.01	"	"	"	13.38
28	48.72	24.60	24.12	"	"	"	13.49
29	48.94	24.71	24.23	"	"	"	13.60
30	49.15	24.82	24.33	"	7.63	10.63	13.70
31	49.37	24.93	24.44	"	8.01	11.02	13.42
32	49.58	25.03	24.55	"	"	"	13.53
33	49.80	25.14	24.65	"	8.01	"	13.64
34	50.01	25.25	24.76	"	8.02	"	13.75
35	50.23	25.36	24.87	"	8.03	11.02	13.86
36	50.44	25.47	24.98	"	8.42	11.42	13.56
37	50.66	25.58	25.08	"	"	"	13.66
38	50.87	25.68	25.19	"	"	"	13.77
39	51.09	25.79	25.30	"	8.42	"	13.88
40	51.30	25.90	25.40	"	8.43	11.42	13.99
41	51.52	26.00	25.51	"	8.32	11.82	13.69
42	51.73	26.11	25.62	"	"	"	13.79
43	51.94	26.22	25.72	"	"	"	13.90
44	52.16	26.33	25.83	"	8.82	"	14.01
45	52.38	26.44	25.94	"	8.83	11.82	14.12
46	52.59	26.55	26.05	"	9.28	12.28	13.76
47	52.81	26.65	26.15	3.00	9.28	"	13.87
48	53.02	26.76	26.26	3.48	8.79	"	13.98
49	53.24	26.87	26.37	3.48	8.79	"	14.08
50	53.45	26.98	26.48	3.48	8.80	12.28	14.19
TOTAL			1,086.90	149.94	336.90	486.84	600.06

1/ Principal only. Annual interest cost of $7.63 per acre is not charged to farmers.

CHAPTER VI

Project Lands

CHAPTER VI

Project Lands

General

A detailed land classification of the Shamalan Unit was made during the two year period, March 1965 to March 1967. The purpose was to determine the extent and character of the lands and their suitability for irrigation farming. The field classification was based on the factors of soils, topography and drainage, considering their individual and combined effects on productive capacity of the lands under present conditions. This classification was also interpreted in terms of final land classes following project development with all correctable deficiencies removed. These are the final, or economic land classes, and are the basis for determination of the irrigable area.

The Unit is located on the west side of the Helmand River, extending northward and southward from the confluence of the Helmand and Arghandab Rivers. It is 64 kilometers (40 miles) in length, ranging from approximately one to seven kilometers(0.6 to 4.3 miles) in width, with an approximate average width of four kilometers (2.5 miles), and comprises a gross area of approximately 259 square kilometers (100 square miles).

Soils and Topography

The project lands of the Shamalan Unit are located on relatively young river terraces of the Quaternary geologic period along the west side of the Helmand River. Nearly all of the irrigable lands are located on the second terrace level where they are not subject to flooding. The soils have developed under very arid conditions,largely from relatively recent alluvial materials, and are virtually devoid of organic matter. They are predominantly light brown to light grayish brown in color, typical of soils developing under arid climatic conditions. Sandy aeolian deposits, varying from low hummocks to medium light sand dunes, occur as overburden in a narrow strip along the western edge of the area where the terrace on which the project lands are located is bordered by a nearly continuous scarp forming the edge of a vast desert. The alluvial soils, in general, have profiles quite uniform in texture, varying from light silty clay loams to sandy loams, with loams and silt loams predominating. Sandy, stratified alluviums are found in strips bordering the river on the first terrace level, but these and the sandy aeolian soils are largely included in the lands classed as nonarable. The moderately fine to moderately sandy textured soils of the Unit are typically two to three meters (6 to 10 feet) deep and frequently exceed four meters (13 feet) in depth. The entire area is underlain by open, unconsolidated gravel and occasional gravel exposures occur on the surface. Typical depth to gravel is two to four meters (6 to 13 feet).

Topographically the Shamalan Unit consists primarily of relatively uniform 1st and 2nd terrace levels, ranging from approximately one to four meters above the water surface with the great majority of them, as previously stated, occurring on the second terrace level. Slope from north to south averages approximately 1.3 meters per kilometer (6.9 feet per mile) and east-west slopes are nearly level within terrace segments. Topographic variations consist largely of short slopes into intermittent river channels and some nearly flat backwater areas, or oxbows.

Land surfaces in the area are generally uniform with minor undulations caused by weeds and shrubs collecting windblown materials in uncultivated areas. Sand dunes have invaded the western edge of the area along a narrow strip but are confined to lands classed as nonarable. Surfaces of most of the arable lands are sufficiently level to achieve reasonably effective irrigation under the present system of small level fields surrounded by low dikes or borders. These fields have been leveled by hand or by the use of oxen and crude implements over the centuries, with small segments of each cultivator's holdings being leveled each year. Conversion to mechanized farming with modern methods of irrigation would require broad scale land leveling or grading, but Unit leveling requirements will be moderate due to the general uniform, relatively smooth surface features.

Drainage

The majority of the lands in the Shamalan Unit are at present subject to drainage problems of varying degrees. Contributory to drainage problems are the irrigation systems, over-irrigation in certain areas, movement of ground water into the area, and lack of an effective and well maintained drainage system.

Investigation work in the Unit shows that the lands classed as arable have favorable natural drainage characteristics. Borings and exposed profiles indicate that the entire area is underlain by gravel strata at or near the depths that deep drains would intercept. The areas where the gravel occurs at the deepest depths are least subject to drainage problems under present conditions, probably because the gravel strata are thicker in these areas.

With the increased water supply planned for the Shamalan Unit, accretions to the ground water table will be considerably increased, and drainage problems will become correspondingly more severe. Thus, it is imperative that an adequate drainage system be provided.

Adequate drainage protection to the arable lands can be provided at reasonable cost. This will require improvement of existing drains and the distribution system, construction of additional drains as required, good irrigation practices, satisfactory irrigation system management and maintenance of the drainage and distribution systems.

Salinity and Alkalinity

Salinity and excessive exchangeable sodium constitute moderately serious problems in the majority of the Shamalan Unit lands. Approximately 80 percent of the presently irrigated lands of the Shamalan Unit are affected in some degree by limiting concentrations of salt and/or exchangeable sodium. Of the total irrigated lands approximately 30 percent are affected by moderate salt concentrations; approximately 10 percent are affected to a moderate degree by combinations of salinity and exchangeable sodium; approximately 15 percent are affected by relatively high salt and exchangeable sodium concentrations, but can be reclaimed by moderate applications of gypsum, leaching, and provision of adequate drainage; and approximately 25 percent of the irrigated lands are so highly saline and sodic that reclamation is not considered feasible. In the majority of the affected lands salt and exchangeable sodium excesses are associated with seasonal or constant high water table conditions, but there are sizable areas of saline and/or sodic soils where water table is not a problem.

Salt and exchangeable sodium concentrations occur in sporadic and highly variable patterns throughout the affected areas, with wide variations in concentrations of both. The moderately to severely affected areas are typically interspersed with areas virtually free of salts and with very low exchangeable sodium percentages. Many of the unaffected areas are too small and irregular in shape to be mapped out from the affected lands.

Land classed as arable, where soluble salt excesses are the only inhibiting factor, can be reclaimed by leaching.

The great majority of the soils having moderate exchangeable sodium concentrations (subclass 2sa lands) can be reclaimed by use of green manures, crop residues, animal manures, and leaching, if adequate drainage is provided. The more severely affected (sodic) lands included in the arable lands as land subclass 3sa, measuring approximately 2,900 hectares or 7,140 acres, in addition to these treatments, will require moderate gypsum applications to achieve full reclamation. On the basis of available information it is estimated that the equivalent of 12.5 to 17.5 tons per hectare (5 to 7 tons/acre) of "gotch" containing 70% gypsum will be required to meet the calcium amendment requirements of these lands.

In the future, it may be feasible to reclaim part of the lands now classed as nonarable due to excessive exchangeable sodium concentrations. Feasibility of reclamation of these lands will depend upon the amount of gypsum necessary to reduce sodium concentrations to safe levels, costs of drainage installation and other reclamation measures required, and the response of the soils to treatment. Feasibility of reclaiming these lands can only be ascertained by appropriate research trials.

Land Classification

A detailed land classification was made to determine the extent and character of the lands and to classify them according to their degrees of suitability for irrigation farming. The field classification was based on the physical factors, soils, topography and drainage, and involved the determination of arable and nonarable lands on the basis of present conditions. The arable lands were separated into three classes on the basis of productive capacity. The data from the field classification was interpreted in terms of final economic land classes as they would be following full project development, assuming correction of all remediable deficiencies. The final or "Following Project Development" classification is the basis of the irrigable land classes. The irrigable lands were segregated into three classes on the basis of productive capacity anticipated under continued irrigation farming. These are described as follows:

Class 1 lands constitute 11,843 hectares (29,265 acres), or 93.2 percent of the irrigable lands. They are highly suited in every respect for irrigation farming assuming that necessary reclamation and other development measures are effected. Approximately 80 percent of these lands are presently affected by limiting concentrations of salts, and/or exchangeable sodium concentrations and the majority of the lands with saline and saline-sodic soils are also affected to varying degrees by water table conditions. These, however, can be fully corrected by appropriate reclamation measures. Class 1 lands are capable of sustained production of high yields of a wide variety of climatically adapted crops at reasonable costs; are nearly level to gently sloping and have smooth surfaces; have deep, moderately fine to moderately sandy textured soils; and have favorable drainage characteristics. Development costs will be low, and, although additional drainage installations will be needed with use of a full water supply, costs for meeting drainage requirements will be relatively low. Class 1 lands have a relatively high potential income.

Class 2 lands comprising 559 hectares (1,380 acres), or 4.4 percent of the Unit irrigable lands, are moderately well suited to irrigation farming, but are of measurably lower productive capacity than class 1 lands because of moderate deficiencies in one or more of the factors considered in the classification. The class 2 lands of the Shamalan Unit have shallower soils with minimum depths of 60 cm (24 inches) of moderately fine to medium textured soils, or 75 cm (30 inches) of moderately sandy soils over sand or gravel, coarser textures than are permitted in class 1 lands, or uncorrectable topographic deficiencies limiting field sizes and shapes. They also include lands having nonreclaimable sodic spots too small to separate out, which will limit their overall productivity to class 2 levels. Class 2 lands have intermediate potential income.

Class 3 lands constituting 305 hectares (754 acres), or 2.4 percent of the irrigable area, have the lowest productive capacities of the Unit irrigable lands and are of marginal quality for irrigation farming due to more severe limitations in soils and topography than those of class 2 lands. They have shallower or coarser textured soils, or greater topographic limitations or combinations of class 2 soil and topographic deficiencies.

Class 6 lands constitute 12,638 hectares (31,229 acres) and include all lands which for one or more reasons do not meet the minimum requirements of irrigable lands. Of these, 4,497 hectares (11,113 acres) of class 6W land now receive irrigation water. Capacity will be provided in the project system to continue present level irrigation water supplies to the now irrigated class 6 lands. They will not, however, be provided with other project facilities.

Land Classification Summary

The detailed land classification of the Shamalan Unit covered a gross area of 25,875 hectares (63,936 acres), of which 12,707 hectares (31,399 acres) were classed as irrigable, and 12,638 hectares (31,229 acres) were classed as nonirrigable. The remaining 529 hectares (1,308 acres) will be taken up by rights-of-way, etc. Table 1 presents a summary of the irrigable area by land classes and subclasses following project development. The detailed land classification showing land classes under present conditions is shown on Drawings 501-123 to 501-127, inclusive, at the beginning of this report.

TABLE 1

Summary of Irrigable Area Following Project Development

Shamalan Unit

Land Class or Subclass	Irrigable Hectares	Irrigable Acres	Percent of Irrigable Area
Class 1	11,843.0	29,264.4	93.2
2sa	383.1	946.7	3.0
2sk	99.1	244.9	0.8
2st	16.0	39.5	0.1
2sv	60.4	149.3	0.5
Subtotal Class 2	558.6	1,380.4	4.4
3sk	107.4	265.4	0.8
3st	113.0	279.3	0.9
3sv	84.9	209.8	0.7
Subtotal Class 3	305.3	754.5	2.4
TOTAL	12,706.9	31,399.3	100.0

Suitability of Water for Irrigation

The Helmand River water, which will be the major source of supply for the Shamalan Unit, is of good to excellent quality for irrigation purposes.

This conclusion was stated in the International Engineering Company, Inc. report "Soil and Water Resources - Southwest Afghanistan", 1959, and is further substantiated by analysis of water samples from the Boghra and Shamalan Canals during 1966 and the first six months of 1967. The water is low in soluble salts and has a low sodium content. Although the proportion of bicarbonates is relatively high there will be no residual sodium carbonate, assuming precipitation of all carbonates and bicarbonates as insoluble calcium and magnesium carbonates, and the sodium-adsorption-ratio (SAR) will be very low.

The plan of development includes using the Nad-i-Ali Wasteway to carry water from the Boghra Canal to the West Shamalan lateral to supply West Shamalan Division lands. This water, using the planned rate of mix, will be satisfactory for irrigation purposes for the types of crops planned to be grown, and will not pose a hazard with regard to buildup of salts or exchangeable sodium in the soil if adequate drainage facilities are provided to permit a moderate amount of leaching and to control water tables at safe levels. The proposed allocation of 0.87 cubic meter per second for 500 hectares (1 cfs for 40 acres) will provide ample water to accomplish the necessary leaching. Water quality is discussed in detail in Chapter VII "Water Supply".

Conclusions

The Shamalan Unit Project lands are well suited to irrigation development. The lands are capable of sustaining good to high production levels under irrigation, providing the necessary improvements are effected, to the extent that they can pay operation and maintenance charges and part of the capital costs, and that additional construction and rehabilitation costs can be justified by increased returns from the land.

CHAPTER VII

Water Supply

CHAPTER VII

Water Supply

Availability of Surface Water

The Helmand River is the source of irrigation water for the Shamalan Unit and for other irrigated lands of the Helmand Valley with minor exceptions where some small areas are irrigated by kareezes. The main stem of the Helmand River rises west of Kabul on the southern slope of Koh-i-Baba and Hazara ranges which form part of the Hindu Kush range and reach elevations as high as 4,400 meters (14,440 feet) above mean sea level. The river flows are stored and regulated in the Kajakai Reservoir for irrigation and flood control purposes. River elevation at Kajakai is approximately 960 meters (3,150 feet). Most of the streamflow in the Helmand River originates either from rainfall in the winter and spring at intermediate elevations or from snow melt in the higher elevations during the late spring and early summer.

The lower elevations in the basin are comprised chiefly of desert areas providing little or no runoff, except for flash floods resulting from relatively intense, but usually local rainstorms. Inflow from desert areas does not firm up or increase irrigation water supply since it occurs during the early spring months at a time when releases are usually being made from Kajakai Reservoir for flood control.

Irrigation water for the Shamalan, Marja, and Nad-i-Ali Units is initially diverted into the Boghra Canal at a point near Girishk, approximately 75 kilometers (46 miles) below Kajakai Dam. The bifurcation point into the Shamalan Canal, which serves the Shamalan Unit lands, is approximately 30 kilometers (18 miles) below the Boghra Diversion near Chah-i-Anjir.

Analysis of streamflow records obtained at critical points shows that there is enough water, with the present storage and regulation, to furnish a full irrigation water supply for the estimated 101,500 hectares (251,000 acres) presently irrigated, or which could reasonably be irrigated within the foreseeable future.

The Helmand River now receives a fairly high degree of regulation by Kajakai Reservoir located about 125 kilometers (78 miles) above the mouth of the Arghandab River. This reservoir is formed by a large earth and rock fill dam on the main stem of the Helmand River. The reservoir when constructed had a total storage capacity of 184,000 hectare-meters (1,495,000 acre-feet). Irrigation and normal reservoir releases are made through three valves which have a combined discharge capacity of 217 cubic meters per second (7,660 cfs) when the reservoir level is at spillway crest, at elevation 1,033.5 meters (3,390.7 feet). The reservoir was constructed primarily for irrigation, although it has managed with late winter and early spring drawdown to provide considerable flood control benefits to downstream area. The reservoir spills through an offstream spillway cut in the right abutment. This spillway with a capacity of 9,910 cubic meters per second (350,000 cfs) is a broad weir with no control gates. After the reservoir fills, the only reduction of flood flows results from reservoir surcharge.

A penstock has been provided for future installation of hydroelectric power facilities, and plans are now being made for an initial stage of power installation at an early date. It is contemplated that gates will be installed on the spillway, possibly increasing the controlled capacity of the reservoir to more than 250,000 hectare-meters (approximately 2,030,000 acre-feet). Streamflow records have been obtained on the Helmand River at several points above and below Kajakai Reservoir, at Girishk, Bost, and Darweshan, and in the lower Helmand in the Chakhansur region. Records have also been obtained on the Arghandab River at its confluence with the Helmand at Qala Bist, and on some canal diversion and tributary streams.

To study and illustrate how flow of Helmand River has been historically affected by project irrigation diversions and operation of Kajakai Reservoir, selected stream gage records were tabulated in Tables 1-A and 1-B. Runoff of Musa Qala River represents nonregulated tributary inflow between Kajakai Dam and Boghra Diversion Dam, and there is considerable inflow from Sangin wash. Runoff of Arghandab River at Qala Bist is inflow from the only regulated tributary of the Helmand River. Estimated diversion requirements for Shamalan Project are included for comparison with historical stream flow.

Estimates of irrigated areas along the Helmand River indicate that about 74,500 hectares (184,000 acres) between Kajakai Reservoir and the Darweshan gate receive irrigation water supply from the river. Streamflow records show that streamflow volume at Darweshan is almost equal to releases from Kajakai reservoir, indicating that accretions to natural flow and return flows from irrigation are almost equal to depletions by irrigation. It is apparent that the available water supply is ample to meet the requirements of any further irrigation development work that may be carried out in the Shamalan Unit, even though such work may result in a slight overall increase in water requirement and consumptive use. It is also apparent that other lands along the river above Darweshan of suitable quality for irrigation can be provided with ample water.

It is now planned to install a hydroelectric power plant at Kajakai Dam, and water releases for power generation will doubtlessly supply a major part of irrigation demands. However, it is imperative that operation of the power facilities at the reservoir be coordinated with irrigation demands to insure that ample irrigation water will be available when needed.

Effect of Reservoir Sedimentation

Reconnaissance surveys by the United States Geological Survey, made in May 1967, indicate that the storage capacity of both Arghandab and Kajakai Reservoirs is rapidly filling with sediment. In time, sediment deposition will

TABLE 1-A

Historical Flow at Selected Stations

Unit: 1000 hectare-meters

	Helmand River			Arghandab River at Qala Bist	Musa Qala River at Musa Qala	Shamalan Project Diversion Requirements
	Inflow to Kajakai Reservoir	Below Kajakai Reservoir	Darweshan			
Oct 1956	21.2	28.9	29.3	3.2	0.1	2.81
Nov	22.8	34.6	36.9	2.9	0.2	1.17
Dec	22.0	35.9	42.1	3.2	0.2	0.33
Jan 1957	29.4	46.2	83.5	18.6	2.7	0.23
Feb	32.8	38.4	75.2	19.7	4.2	0.78
Mar	139.8	51.6	148.5	42.7	41.4	1.38
Apr	300.7	255.4	413.1	77.7	36.6	2.54
May	315.5	317.3	389.0	52.2	20.7	3.73
Jun	128.5	138.9	159.8	18.3	2.8	3.07
Jul	53.0	63.6	63.1	7.2	0.8	3.75
Aug	29.1	47.0	39.3	0.9	0.2	2.85
Sept	23.0	51.7	49.2	0.2	0.3	2.77
TOTAL	1,117.8	1,109.5	1,529.0	246.8	110.2	25.41
Oct 1957	29.7	55.4	51.4	1.5	0.3	2.81
Nov	38.5	26.3	35.6	5.0	2.8	1.17
Dec	45.8	49.7	93.6	53.3	4.1	0.33
Jan 1958	44.6	55.3	75.0	16.9	2.1	0.23
Feb	47.7	49.2	61.2	13.6	4.1	0.78
Mar	99.0	56.7	57.1	9.2	3.5	1.38
Apr	158.5	103.3	97.6	16.2	2.1	2.54
May	100.4	106.9	106.8	6.9	0.4	3.73
Jun	52.0	63.0	55.1	3.8	0.2	3.07
Jul	28.1	58.9	47.2	2.8	0.2	3.75
Aug	20.6	57.8	45.3	2.3	0.1	2.85
Sept	19.7	52.4	42.2	1.4	0.1	2.77
TOTAL	684.6	734.9	768.1	132.9	20.0	25.41
Oct 1958	22.1	50.2	40.6	0.2	0.1	2.81
Nov	22.6	35.5	28.1	2.0	0.1	1.17
Dec	27.5	31.6	28.6	4.8	0.9	0.33
Jan 1959	27.5	31.5	33.9	5.5	1.3	0.23
Feb	29.1	28.3	32.8	9.6	3.0	0.78
Mar	121.5	37.9	78.5	26.4	14.8	1.38
Apr	158.7	96.0	118.8	28.8	10.2	2.54
May	100.1	100.6	106.4	10.2	2.8	3.73
Jun	43.2	60.7	56.0	6.1	0.9	3.07
Jul	26.0	57.4	47.0	5.2	0.5	3.75
Aug	20.2	54.0	38.7	0.5	0.2	2.85
Sept	18.7	42.4	32.4	1.3	0.1	2.77
TOTAL	617.2	626.1	641.8	100.6	34.9	25.41

TABLE 1-A- continued

Unit: 1000 hectare-meters

	Helmand River			Arghandab River at Qala Bist	Musa Qala River at Musa Qala	Shamalan Project Diversion Requirements
	Inflow to Kajakai Reservoir	Below Kajakai Reservoir	Darweshan			
Oct 1959	19.8	32.5	23.8	1.7	0.2	2.81
Nov	24.8	27.3	22.0	2.8	0.2	1.17
Dec	30.9	41.5	42.1	5.1	2.1	0.33
Jan 1960	26.1	34.1	37.4	2.8	1.2	0.23
Feb	29.3	26.3	21.4	1.7	1.2	0.78
Mar	53.3	28.7	26.3	4.1	3.9	1.38
Apr	122.6	25.9	49.0	10.7	11.3	2.54
May	157.2	108.6	112.5	18.7	3.0	3.73
Jun	59.2	68.6	63.9	3.3	1.0	3.07
Jul	26.4	34.4	20.5	0.1	0.6	3.75
Aug	18.0	33.2	15.4	0.1	0.4	2.85
Sept	16.7	31.2	16.7	0.4	0.3	2.77
TOTAL	584.3	492.3	451.0	51.5	25.4	25.41
Oct 1960	19.7	31.6	20.4	0.9		2.81
Nov	21.8	53.6	46.2	1.5		1.17
Dec	21.8	53.1	53.4	2.2		0.33
Jan 1961	21.5	49.5	52.2	2.9		0.23
Feb	20.4	39.1	40.9	6.6		0.78
Mar	55.3	28.3	34.1	12.0		1.38
Apr	194.1	46.8	130.7	50.7		2.54
May	163.8	168.7	183.6	30.8		3.73
Jun	52.9	60.8	56.1	6.3		3.07
Jul	25.6	35.4	24.6	2.4		3.75
Aug	18.9	35.0	20.9	1.0		2.85
Sept	17.7	27.5	18.5	1.6		2.77
TOTAL	633.5	629.4	681.6	118.9		25.41
Oct 1961	19.4	34.5	24.5	1.8		2.81
Nov	22.5	19.3	31.0	2.7		1.17
Dec	23.8	54.4	52.3	2.9		0.33
Jan 1962	22.5	51.0	52.5	4.6		0.23
Feb	23.1	38.7	36.0	2.8		0.78
Mar	43.7	37.4	39.6	3.7		1.38
Apr	88.8	30.6	25.0	5.1		2.54
May	73.8	41.0	26.6	0.1		3.73
Jun	30.7	40.4	27.0	.0		3.07
Jul	16.1	27.3	14.5	.0		3.75
Aug	13.7	18.9	7.5	.0		2.85
Sept	13.8	15.2	5.7	.0		2.77
TOTAL	391.9	408.7	342.2	23.7		25.41

TABLE 1-A- continued

Unit: 1000 hectare-meters

	Helmand River					
	Inflow to Kajakai Reservoir	Below Kajakai Reservoir	Darweshan	Arghandab River at Qala Bist	Musa Qala River at Musa Qala	Shamalan Project Diversion Requirements
Oct 1962	16.2	14.8	6.9	.0		2.81
Nov	17.3	21.4	13.1	.0		1.17
Dec	18.2	24.2	21.7	0.3		0.33
Jan 1963	17.6	35.4	33.4	.0		0.23
Feb	19.0	41.5	34.2	0.3		0.78
Mar	33.8	43.6	36.2	1.0		1.38
Apr	57.6	30.6	24.5	4.0		2.54
May	124.3	34.4	45.3	9.6		3.73
Jun	54.0	45.5	33.5	1.0		3.07
Jul	21.1	40.8	23.9	.0		3.75
Aug	15.4	38.0	23.3	.0		2.85
Sept	12.8	29.2	18.9	.0		2.77
TOTAL	407.3	399.4	314.9	16.2		25.41
Oct 1963	16.7	19.8	13.0	0.3		2.81
Nov	21.8	19.2	14.7	1.2		1.17
Dec	22.1	51.1	49.2	1.5		0.33
Jan 1964	21.3	47.2	61.9	12.2		0.23
Feb	32.8	40.7	68.1	11.1		0.78
Mar	96.7	46.3	67.4	14.4		1.38
Apr	195.7	78.7	102.5	20.6		2.54
May	127.4	132.9	139.9	7.1		3.73
Jun	46.8	59.5	44.1	0.1		3.07
Jul	24.0	56.6	46.2	0.0		3.75
Aug	15.9	50.2	36.8	.0		2.85
Sept	14.7	23.6	14.9	0.3		2.77
TOTAL	635.9	625.8	658.7	68.8		25.41

TABLE 1-B

Historical Flow at Selected Stations

Unit: 1000 acre-feet

	Helmand River			Arghandab River at Qala Bist	Musa Qala River at Musa Qala	Shamalan Project Diversion Requirements
	Inflow to Kajakai Reservoir	Below Kajakai Reservoir	Darweshan			
Oct 1956	171.8	234.2	237.5	26.2	0.7	22.8
Nov	184.9	280.2	299.3	23.1	1.4	9.5
Dec	178.5	290.9	341.6	25.6	2.0	2.7
Jan 1957	238.5	374.6	676.7	150.9	21.5	1.9
Feb	265.8	311.3	609.6	159.6	34.2	6.3
Mar	1,133.0	418.1	1,204.0	346.4	335.3	11.2
Apr	2,436.9	2,070.0	3,348.0	630.0	296.7	20.6
May	2,557.0	2,572.0	3,153.0	422.7	168.1	30.2
Jun	1,041.3	1,126.0	1,295.0	148.1	22.8	24.9
Jul	429.8	515.8	511.2	58.2	6.3	30.4
Aug	235.7	380.6	318.8	6.9	1.9	23.1
Sept	186.5	419.1	398.8	1.3	2.2	22.5
TOTAL	9,059.7	8,992.8	12,393.5	1,999.0	893.1	206.1
Oct 1957	240.5	448.8	416.9	12.5	2.4	22.8
Nov	312.0	212.9	288.7	40.3	22.4	9.5
Dec	371.6	402.6	758.9	432.0	33.4	2.7
Jan 1958	361.8	447.9	608.0	137.1	17.1	1.9
Feb	386.5	399.0	496.3	110.2	33.2	6.3
Mar	802.7	459.9	462.7	74.3	28.6	11.2
Apr	1,284.7	837.0	791.4	131.3	16.7	20.6
May	813.7	866.4	865.6	55.9	3.6	30.2
Jun	421.6	510.9	446.4	31.0	1.9	24.9
Jul	227.7	477.6	382.9	22.9	1.5	30.4
Aug	167.1	468.1	367.2	18.4	1.2	23.1
Sept	159.7	425.0	342.2	11.5	1.2	22.5
TOTAL	5,549.6	5,956.1	6,227.2	1,077.4	163.2	206.1
Oct 1958	179.3	406.8	328.8	1.8	0.9	22.8
Nov	183.0	287.9	227.9	16.0	0.6	9.5
Dec	222.8	256.0	231.5	38.9	7.3	2.7
Jan 1959	223.2	255.5	275.0	44.8	10.9	1.9
Feb	235.9	229.6	266.1	78.2	24.7	6.3
Mar	985.1	307.2	636.3	214.3	120.3	11.2
Apr	1,286.0	778.9	963.0	233.6	82.6	20.6
May	811.1	815.2	862.3	82.8	22.6	30.2
Jun	350.2	491.7	454.2	49.8	7.6	24.9
Jul	210.8	465.4	380.6	42.2	3.9	30.4
Aug	164.0	437.8	313.6	4.2	1.3	23.1
Sept	151.6	343.9	263.0	10.4	1.2	22.5
TOTAL	5,003.0	5,075.9	5,202.3	817.0	283.9	206.1

TABLE 1-B - continued

Unit: 1000 acre-feet

	Helmand River			Arghandab River at Qala Bist	Musa Qala River at Musa Qala	Shamalan Project Diversion Requirements
	Inflow to Kajakai Reservoir	Below Kajakai Reservoir	Darweshan			
Oct 1959	160.3	263.6	192.7	13.6	1.6	22.8
Nov	200.9	221.0	178.6	23.0	1.8	9.5
Dec	250.6	336.7	341.0	41.1	17.0	2.7
Jan 1960	211.4	276.2	302.8	22.4	9.5	1.9
Feb	237.5	213.3	173.7	14.0	9.4	6.3
Mar	432.1	232.7	213.0	33.0	31.6	11.2
Apr	993.3	210.2	397.2	86.4	91.3	20.6
May	1,274.5	880.3	912.2	151.8	24.0	30.2
Jun	479.6	555.8	518.3	26.9	7.8	24.9
Jul	213.9	278.7	165.8	.3	5.1	30.4
Aug	145.8	269.3	124.6	.3	2.9	23.1
Sept	135.0	253.0	135.3	2.9	2.8	22.5
TOTAL	4,734.9	3,990.8	3,655.2	415.7	204.8	206.1
Oct 1960	159.5	255.9	165.5	7.0		22.8
Nov	176.4	434.1	374.4	12.0		9.5
Dec	176.7	430.2	433.1	17.9		2.7
Jan 1961	174.4	401.6	423.0	23.6		1.9
Feb	165.6	317.0	331.3	53.5		6.3
Mar	448.3	229.3	276.5	97.2		11.2
Apr	1,572.9	379.3	1,059.6	410.9		20.6
May	1,328.0	1,367.3	1,488.2	249.8		30.2
Jun	429.1	493.0	454.6	51.1		24.9
Jul	207.8	287.2	199.0	19.6		30.4
Aug	153.2	283.9	169.1	8.2		23.1
Sept	143.2	222.8	150.2	12.6		22.5
TOTAL	5,135.1	5,101.6	5,524.5	963.4		206.1
Oct 1961	157.1	279.4	198.7	14.3		22.8
Nov	182.6	156.6	251.1	21.8		9.5
Dec	193.1	441.1	423.5	23.2		2.7
Jan 1962	182.3	413.4	425.9	37.4		1.9
Feb	186.9	314.0	292.1	22.4		6.3
Mar	353.9	303.0	320.8	29.7		11.2
Apr	719.7	248.1	202.9	41.5		20.6
May	598.3	332.7	215.8	.4		30.2
Jun	248.7	327.7	219.1	.0		24.9
Jul	130.7	221.6	117.5	.0		30.4
Aug	110.9	153.2	60.6	.0		23.1
Sept	111.6	122.8	46.0	.0		22.5
TOTAL	3,175.8	3,313.6	2,774.0	190.7		206.1

TABLE 1-B - continued

Unit: 1000 acre-feet

	Helmand River			Arghandab River at Qala Bist	Musa Qala River at Musa Qala	Shamalan Project Diversion Requirements
	Inflow to Kajakai Reservoir	Below Kajakai Reservoir	Darweshan			
Oct 1962	131.2	119.8	56.2	.0		22.8
Nov	140.1	173.1	106.3	0.1		9.5
Dec	147.3	195.9	176.2	2.8		2.7
Jan 1963	143.0	287.3	270.7	0.1		1.9
Feb	153.9	336.4	277.4	1.9		6.3
Mar	274.1	353.0	293.1	7.8		11.2
Apr	467.2	247.7	198.8	32.4		20.6
May	1,007.7	278.5	367.0	77.8		30.2
Jun	437.8	368.7	271.4	8.3		24.9
Jul	170.7	330.5	193.7	.0		30.4
Aug	124.6	307.7	188.7	.0		23.1
Sept	103.5	236.4	152.9	.0		22.5
TOTAL	3,301.1	3,235.0	2,552.4	131.2		206.1
Oct 1963	135.4	160.1	105.4	2.4		22.8
Nov	176.9	155.5	118.9	9.4		9.5
Dec	179.4	414.0	399.0	11.8		2.7
Jan 1964	173.0	382.8	502.0	98.5		1.9
Feb	266.0	330.2	552.3	89.6		6.3
Mar	783.8	375.5	546.1	116.8		11.2
Apr	1,586.4	637.7	831.0	167.0		20.6
May	1,032.8	1,077.4	1,134.0	57.8		30.2
Jun	379.1	482.6	357.3	1.2		24.9
Jul	194.5	458.5	374.1	.0		30.4
Aug	128.5	406.8	298.0	.0		23.1
Sept	119.4	191.1	120.4	2.4		22.5
TOTAL	5,155.2	5,072.2	5,338.5	556.9		206.1

seriously affect the operation of the reservoirs for flood control and irrigation water supply. Drainage of agricultural lands in the river valley and protection and maintenance of project works will become increasingly more difficult and expensive because river flow below Kajakai Dam will be at higher stages for longer periods.

A memorandum prepared by the U. S. Geological Survey relative to the reconnaissance sediment survey is made a part of this report and is quoted in its entirety.

"RECONNAISSANCE SEDIMENT SURVEY
OF KAJAKAI AND ARGHANDAB RESERVOIRS

"A reconnaissance survey of Kajakai and Arghandab Reservoirs was made May 26-28, 1967 to observe the present extent of silting and to determine the optimum method to be used for detailed sediment studies at each reservoir. This preliminary report is not complete. It is only intended to alert the Mission to the magnitude of sedimentation observed during this survey. The optimum methods for detailed studies will be given in a later report.

"Soundings of water depth at various points in the lake were made with a sonic depth recorder, and an attempt was made to measure sediment thickness at several points with a steel rod.

"ARGHANDAB RESERVOIR

"Storage began in Arghandab Reservoir on February 24, 1952 and the initial storage capacity was 388,000 acre-feet. The daily mean inflow to the reservoir for the 17-year period, 1948-64, was 1,398 cubic feet per second (cfs). The annual runoff has varied from a maximum of 2,168,000 acre-feet in 1957 to a minimum of 464,100 acre-feet in 1955. The average annual runoff for the period was 1,012,000 acre-feet. The maximum discharge recorded was 35,700 cfs on March 17, 1957 and the minimum recorded was 44 cfs on September 7-8, 1948.

"The only major source of the sediment deposited in Arghandab Reservoir is that which is transported by the Arghandab River. Deposited sediment now fills the upper three miles of the reservoir where water depths were originally as much as 32 feet. Soundings also indicate sediment deposits up to 30 feet thick for an additional two miles of reservoir and up to 20 feet thick for one more mile. Although soundings were not taken in the lower part of the reservoir (the reservoir is approximately 10 miles long) silting has undoubtedly occurred.

"A rough estimate based on the above observations indicates that up to 25 percent of the reservoir capacity has been lost to sedimentation in the last 15 years and that the present storage capacity of the reservoir is less than 300,000 acre-feet. If the past rate of sediment accumulation continues, the reservoir will probably be filled by sediment in another 45 years.

"KAJAKAI RESERVOIR

"Storage began in Kajakai Reservoir on January 28, 1953 and the initial capacity was 1,495,000 acre-feet. The daily mean inflow to the reservoir for the 17-year period, 1948-1964, was 6,977 cfs. The annual runoff has varied from a maximum of 9,059,000 acre-feet in 1957 to a minimum of 3,175,000 acre-feet in 1962. The average annual runoff for the period was 5,051,000 acre-feet. The maximum peak discharge is unknown. The maximum mean daily discharge recorded was 66,200 cfs on May 3, 1957. The minimum discharge recorded was 1,100 cfs on October 1, 1947 (start of record - it may have been lower prior to that date).

"The only major source of the sediment deposited in Kajakai Reservoir is that which is transported by the Helmand River. In the upper arm of the reservoir soundings indicate sediment deposits of up to 50 feet in thickness. Because of the size, shape, and operational pattern of the reservoir the distribution of sediment is not as readily determined as it is in Arghandab Reservoir. The narrow upper part of Kajakai Reservoir is not as completely filled as the upper part of Arghandab Reservoir because of the large volumes and high velocities of the water entering while the lake is filling. This moves sediment previously deposited much farther into the reservoir. The large upper arm of the lake will trap much of the sediment while lake levels are high, but at the start of the storm season when lake levels are low the sediment will pass through the upper arm and into the main body of the lake.

"Although the silting of Kajakai Reservoir is not as obvious to the eye as that of Arghandab Reservoir the facts point to a rate of silt accumulation that may be equal to that of Arghandab Reservoir.

"RECOMMENDATIONS

"This preliminary survey indicates a loss of storage from the two reservoirs of about 470,000 acre-feet at the present time, more than the total initial storage of Arghandab Reservoir. At the present rate of silt accumulation, the reservoirs will probably be half filled with sediment in another 15 years. This will seriously affect the flood-storage capacity of the reservoirs and cause increasing problems for the proposed hydro-power installation at Kajakai Reservoir and for the continued expansion of irrigated lands, especially in the Arghandab-Tarnak area.

"It is recommended that a complete survey be made of both reservoirs to more accurately determine the present amount and location of sediment deposits, and to establish a system whereby periodic checks can be made to observe the silt-accumulation rate." (End of quotes)

A review of streamflow records presented in Tables 2-A and 2-B shows that irrigation water supply requirements of Shamalan Unit lands could be met even with serious encroachment of sediment in Kajakai Reservoir.

TABLE 2-A

Natural and Historical Inflow to Kajakai Reservoir Compared to Shamalan Project Diversion Requirement

Unit: 1000 Hectare meters

Water-year	1948	1949	1950	1951	1952	1953	1954	1955	Shamalan Project Diversion Requirement 1/ 1000 Hectare-Meters	Meters per Hectare
Oct	11.0	14.9	19.3	18.8	19.4	19.8	17.7	22.4	2.81	0.221
Nov	14.0	17.7	21.7	19.8	22.1	21.4	18.8	24.3	1.17	0.092
Dec	16.5	19.2	23.1	20.3	23.3	21.9	20.4	23.5	0.33	0.026
Jan	16.2	19.3	27.5	21.1	24.3	20.9	26.5	21.9	0.23	0.018
Feb	18.1	27.6	28.0	21.9	37.1	29.6	39.5	20.3	0.78	0.061
Mar	74.0	88.3	59.6	83.0	93.0	96.3	103.2	72.9	1.38	0.109
Apr	156.7	226.0	126.3	165.0	168.7	117.4	178.0	80.5	2.54	0.200
May	101.6	126.1	210.1	246.4	113.4	91.3	147.2	103.7	3.73	0.294
Jun	33.4	46.1	74.9	94.0	42.9	47.9	57.9	50.3	3.07	0.242
Jul	17.0	24.0	27.7	35.2	21.6	16.8	34.0	22.0	3.75	0.295
Aug	10.4	16.7	15.5	19.0	14.3	14.8	20.0	13.7	2.85	0.224
Sept	11.0	14.9	14.7	17.0	15.4	14.4	18.3	13.0	2.77	0.218
TOTAL	479.9	640.8	648.4	761.5	595.5	512.5	681.5	468.5	25.41	2.000

Water-year	1956	1957	1958	1959	1960	1961	1962	1963	1000 Hectare-Meters	Meters per Hectare
Oct	17.0	21.2	29.7	22.1	19.8	19.7	19.4	16.2	2.81	0.221
Nov	17.6	22.8	38.5	22.6	24.8	21.8	22.5	17.3	1.17	0.092
Dec	22.5	22.0	45.8	27.5	30.9	21.8	23.8	18.2	0.33	0.026
Jan	24.2	29.4	44.6	27.5	26.1	21.5	22.5	17.6	0.23	0.018
Feb	27.1	32.8	47.7	29.1	29.3	20.4	23.1	19.0	0.78	0.061
Mar	111.0	139.8	99.0	121.5	53.3	55.3	43.7	33.8	1.38	0.109
Apr	266.8	300.7	158.5	158.7	122.6	194.1	88.8	57.6	2.54	0.200
May	122.4	315.5	100.4	100.1	157.2	163.8	73.8	124.3	3.73	0.294
Jun	38.9	128.5	52.0	43.2	59.2	52.9	30.7	54.0	3.07	0.242
Jul	48.6	53.0	28.1	26.0	26.4	25.6	16.1	21.1	3.75	0.295
Aug	20.1	29.1	20.6	20.2	18.0	18.9	13.7	15.4	2.85	0.224
Sept	18.2	23.0	19.7	18.7	16.7	17.7	13.8	12.8	2.77	0.218
TOTAL	734.4	1,117.8	684.6	617.2	584.3	633.5	391.9	407.3	25.41	2.000

1/ Diversion requirement at Boghra Diversion Dam for 12,707 hectares.

TABLE 2-B

Unit: 1000 acre feet

Natural and Historical Inflow to Kajakai Reservoir Compared to Shamalan Project Diversion Requirement

Water-year	1948	1949	1950	1951	1952	1953	1954	1955	Shamalan Project Diversion Requirement 1/ 1,000 AcFt	AcFt per Ac.
Oct	89.0	120.5	156.4	152.0	157.0	160.5	143.2	181.6	22.8	0.725
Nov	113.8	143.3	176.2	160.2	179.3	173.7	152.0	196.6	9.5	0.302
Dec	134.1	155.7	187.5	164.7	188.8	177.3	165.5	190.3	2.7	0.087
Jan	130.9	156.8	222.9	170.7	197.0	169.6	214.5	177.6	1.9	0.061
Feb	146.6	223.8	226.7	177.3	300.7	240.3	319.9	164.2	6.3	0.200
Mar	599.6	715.3	483.4	672.5	753.6	780.7	836.5	591.0	11.2	0.357
Apr	1,269.0	1,832.0	1,024.0	1,337.0	1,367.0	951.9	1,442.9	652.8	20.6	0.656
May	823.2	1,022.0	1,703.0	1,997.0	919.5	740.3	1,193.2	840.1	30.2	0.963
Jun	271.1	373.9	607.1	762.0	347.8	388.6	468.9	407.4	24.9	0.793
Jul	134.5	194.3	224.3	285.3	175.4	136.0	275.5	178.1	30.4	0.969
Aug	84.3	135.1	125.4	154.3	116.1	119.6	162.1	110.8	23.1	0.736
Sept	89.1	120.8	119.1	138.1	125.1	116.6	148.6	105.4	22.5	0.715
TOTAL	3,885.2	5,193.5	5,256.0	6,171.1	4,827.3	4,155.1	5,522.8	3,795.9	206.1	6.564

Water-year	1956	1957	1958	1959	1960	1961	1962	1963	1,000 AcFt	AcFt per Ac.
Oct	137.7	171.8	240.5	179.3	160.3	159.5	157.1	131.2	22.8	0.725
Nov	142.4	184.9	312.0	183.0	200.9	176.4	182.6	140.1	9.5	0.302
Dec	182.6	178.5	371.6	222.8	250.6	176.7	193.1	147.3	2.7	0.087
Jan	196.5	238.5	361.8	223.2	211.4	174.4	182.3	143.0	1.9	0.061
Feb	219.6	265.8	386.5	235.9	237.5	165.6	186.9	153.9	6.3	0.200
Mar	899.4	1,133.0	802.7	985.1	432.1	448.3	353.9	274.1	11.2	0.357
Apr	2,162.4	2,436.9	1,284.7	1,286.0	993.3	1,572.9	719.7	467.2	20.6	0.656
May	992.1	2,557.0	813.7	811.1	1,274.5	1,328.0	598.3	1,007.7	30.2	0.963
Jun	315.3	1,041.3	421.6	350.2	479.6	429.1	248.7	437.8	24.9	0.793
Jul	393.7	429.8	227.7	210.8	213.9	207.8	130.7	170.7	30.4	0.969
Aug	162.7	235.7	167.1	164.0	145.8	153.2	110.9	124.6	23.1	0.736
Sept	147.9	186.5	159.7	151.6	135.0	143.2	111.6	103.5	22.5	0.715
TOTAL	5,952.3	9,059.7	5,549.6	5,003.0	4,734.9	5,135.1	3,175.8	3,301.1	206.1	6.564

1/ Diversion requirement at Boghra Diversion Dam for 31,399 acres.

Completion of recommended sediment surveys on Kajakai Reservoir would permit making a detailed study of the effect of sedimentation in the reservoir on the water supply for the Shamalan Unit lands as well as for other areas served by the reservoir. A program for carrying out such surveys is now under way by HAVA and AID. The target date for completion of field surveys is December 1968.

Suitability of Water for Irrigation

Analyses of water samples from the Boghra and Shamalan Canal show: Moderately low soluble salts, with an average electrical conductivity of 336 micromhos/cm (215 ppm total dissolved solids); low sodium content, with an average of 0.50 milliequivalent/liter, or 15% of the total cations; and a very low boron content with an average concentration of 0.21 ppm. The highest boron content found was 0.28 ppm.

Nad-i-Ali Wasteway-Boghra Canal mixed water will have an electrical conductivity of 731 micromhos/cm (468 ppm).

The Shamalan Canal waters and the mixed waters can be used on most soils and all but the most sensitive crops with little danger of salt accumulation if a moderate amount of leaching occurs.

A detailed discussion on suitability of water for irrigation is in the Project Lands Appendix.

Irrigation and Farm Delivery Requirements

The Shamalan Unit is located in a desert region where practically all the crop consumptive use requirement must be supplied by irrigation. The overall availability of water supply is not a critical problem. In the Shamalan Unit, the primary problem is one of distribution and to provide ample canal and lateral capacity to fully meet farm delivery requirements on time throughout the periods of maximum demand.

Estimates of monthly farm delivery requirements were arrived at through a review of consumptive use studies made by International Engineering Company, Inc., "Soil and Water Resources of Afghanistan"; review of data furnished by the Director of Bolan Experimental Farm on frequency and amount of irrigation application for various crops; and by observations of irrigation throughout the project. Consideration was also given to leaching requirement, irrigation efficiency, and preirrigations to condition land for seedbed preparation.

Table 3 presents estimated crop consumptive use requirements and Table 4 shows farm delivery requirements with allowances for leaching and deep percolation losses indicated.

TABLE 3

Shamalan Unit
Crop Consumptive Use1/

Units: Inches

Crop	Land Use Percent	*Jan	*Feb	*Mar	*Apr	May	June	July	Aug	Sep	Oct	*Nov	*Dec	Total
Effective Precip. @ 80% average		1.05	0.23	0.78	0.51							0.29	0.95	
Wheat	38.0	0.28	1.23	2.80	3.63	5.54	-	-	-	-	4.08 2/	2.11	0.43	20.10
Cotton	21.9	-	-	-	3.53 2/	3.27	4.32	5.94	5.20	4.28	1.84	-	-	28.38
Alfalfa	23.9	0.79	2.20	3.07	4.54	6.54	7.56	8.10	3.15 3/	5.14	4.34	2.60	0.97	49.00
Orchard	3.0	-	-	0.29	2.77	4.90	5.18	5.40	4.72	3.74	2.04	0.76	-	29.80
Vineyard	3.3	-	-	0.29	0.70	3.87	4.43	4.97	3.68	1.28	1.02	0.23	-	20.47
Garden	2.8	0.53	1.93	1.90	3.03	4.63	4.32	4.32	4.72	3.75	3.06	1.81	0.70	34.70
Corn	14.3	-	-	-	-	1.50 2/	4.32	4.86	6.72	4.92	3.57	-	-	25.89
Carrots	2.7	-	-	-	-	-	-	-	-	4.55	3.57	2.55	1.53	12.20
Mung Beans	9.8	-	-	-	-	-	2.16	5.40	4.72	3.74	-	-	-	16.02
Sunflower	2.3	-	-	-	-	-	5.40	5.83	5.15	4.28	-	-	-	20.66
Wt. Total (Inches)		0.31	1.04	1.86	3.41	5.00	4.13	5.04	3.83	3.72	3.78	1.57	0.45	34.14
Wt. Total (Feet)		0.026	0.087	0.155	0.284	0.417	0.344	0.420	0.319	0.310	0.315	0.131	0.038	2.846
Percentage of land irrigated during month		68.0	68.0	71.0	92.9	107.2	81.3	81.3	81.3	84.0	109.9	73.7	70.7	

1/ Monthly consumptive use from International Engineering Company (MKA) Report, 1959, based on Blaney-Criddle method.

2/ Includes irrigation for land preparation for seeding.

3/ Alfalfa dormant during most of August.

* Crop consumptive use less effective precipitation.

TABLE 4

Shamalan Unit
Farm Delivery and Canal Diversion Requirements

Units: Acre-Feet/Acre

Month	Weighted Consumptive Use	Leaching and Deep Percolation Loss 15%	Weighted Net Input for Consumptive Use	Farm Irrigation Waste 20%	Weighted Farm Delivery Requirement	Lateral Loss 15%	Weighted Lateral Diversion Requirement	Canal Loss 25%	Weighted Canal Diversion Requirement
Jan	0.026	0.005	0.031	0.007	0.038	0.007	0.046	0.015	0.061
Feb	0.087	0.015	0.102	0.026	0.128	0.022	0.150	0.050	0.200
Mar	0.155	0.027	0.182	0.046	0.228	0.040	0.268	0.089	0.357
Apr	0.284	0.050	0.334	0.084	0.418	0.074	0.492	0.164	0.656
May	0.417	0.074	0.491	0.123	0.614	0.108	0.722	0.241	0.963
June	0.344	0.061	0.405	0.101	0.506	0.089	0.595	0.198	0.793
July	0.420	0.074	0.494	0.123	0.617	0.109	0.726	0.243	0.969
Aug	0.319	0.056	0.375	0.094	0.469	0.083	0.552	0.184	0.736
Sept	0.310	0.055	0.365	0.091	0.456	0.080	0.536	0.179	0.715
Oct	0.315	0.055	0.370	0.092	0.462	0.082	0.544	0.181	0.725
Nov	0.131	0.023	0.154	0.039	0.193	0.033	0.226	0.076	0.302
Dec	0.038	0.007	0.045	0.011	0.056	0.010	0.066	0.021	0.087
TOTAL	2.846	0.502	3.348	0.837	4.185	0.737	4.923	1.641	6.564

	Meters per Year	Feet per Year
Farm delivery requirement	1.275	4.185
Surface water from irrigation 20%	0.255	0.837
Net Input	1.020	3.348
Deep percolation loss 15%	0.153	0.502
Estimated consumptive use requirement	0.867	2.846

Distribution System Requirements

It is assumed that in the early years of project operation the irrigation efficiency, as adopted to formulate Table 4, will not be attained. Until irrigators can be trained in proper irrigation management, the traditional ways of operation will result in excessive losses through deep percolation and surface waste.

Lateral design capacities and canal diversion requirement are based upon the adoption of the maximum monthly consumptive use (July) shown in Table 3 as 0.420 Ft/acre, and applying slightly higher percentages for loss by deep percolation and farm waste than indicated in Table 4.

Maximum weighted consumptive requirement	0.420
Deep percolation loss: 20%	0.105
Weighted net input	0.525
Farm irrigation waste: 25%	0.175
Weighted farm delivery requirement	0.700
Lateral losses: 15%	0.124
Lateral diversion requirement	0.824
Supply canal losses: 25%	0.275
Supply canal diversion requirement	1.099

Average Q for 30-day month would be

$$\frac{1,099}{59.5} = .01847 \text{ cfs per acre}$$

Total maximum diversion requirement for 31,399 irrigable acres would be 580 cfs.

In the early years of project life it is assumed that irrigation of class 6 W lands will be continued, at least until such time as a reform toward establishment of water charges is brought about and the farmers realize that continued irrigation of these lands is no longer economical. Land classification surveys have determined that there are 11,113 acres of class 6 W land. Total estimated maximum diversion requirement, including the 6 W lands, would be:

(31,399 irrigable acres plus 11,113 6 W acres)
42,512 X .01847 cfs/acre = 785 cfs

Availability of Ground Water

Little information is available concerning the ground water resources of the Helmand Valley region. Through the drainage investigation program it has been determined that a relatively shallow aquifer consisting mainly of highly permeable gravelly material underlies the project area. This gravelly material stratum is 6-8 meters (20-26 feet) thick and overlies a sandstone stratum generally encountered at depths of 8-12 meters (26-39 feet). The gravelly material stratum constitutes the drainage aquifer of the project since the sandstone forms an effective horizontal barrier to the vertical movement of water.

Most of the water in the drainage aquifer originates from deep percolation resulting from irrigation of project lands and canal seepage losses. There is some ground water inflow to the project area from the Marja and Nad-i-Ali project areas and lands adjacent to the river probably receive ground water inflow from the river.

From analysis of water samples taken from observation wells and drains in the Shamalan Project area, it is concluded that careful study is necessary before water from the drainage aquifer is considered to be used for either irrigation or domestic use. Drain flows reflect the amount and quality of water in the drainage aquifer. A detailed discussion of the suitability of this water for irrigation is contained in the Project Lands Appendix.

Detailed investigations were not made to determine if suitable aquifers in the project area exist under the drainage aquifer. Municipal wells have been developed at Bost and Chah-i-Anjir which yield potable water in ample amounts to supply town needs. The wells are about 75 meters (246 feet) deep with a static head of 6 meters (20 feet) and yield about 11 liters per second (175 gallons per minute). No information is available on drawdown during pumping.

In the drainage investigation program some holes were dug to a depth of 40 meters (131 feet) in the central part of the project area without encountering any material other than sandstone below the gravel stratum. Piezometer permeability tests made in the sandstone stratum showed it to have very low permeability. Due to lack of control and accuracy of measurements, data from the tests cannot be used to determine potential water yield from the sandstone stratum. Also, quality of water determinations could not be made since method of drilling required pumping water into the holes. A detailed description of the drilling and tests is in the Drainage Appendix.

No conclusions can be drawn regarding availability and quality of water from possible aquifers below depths of 10-12 meters (33-39 feet). Detailed investigations through deep well drilling and pumping tests should be made to determine supply potential of deep strata.

English Units

	Feet per Month	Cubic Feet per Second per Acre	One Cubic Foot per Second for	Total[1/] Demand Cubic Feet per Second
Supply canal requirement	1.863	0.312	32 acres	980
Supply canal losses 20%	0.375	0.062		
Lateral canal requirement	1.488	0.250	40 acres	785
Lateral canal losses 25%	0.375	0.062		
Farm delivery requirement	1.113	0.188	53 acres	590

Canals designed to above specifications will have capacity to deliver sufficient water to farm turnouts, after distribution system losses, to provide one 10 cm (4 inch) irrigation application per week on 85% of the irrigable lands. It is estimated that a maximum of about 85% of the irrigable lands will require irrigation at any one time. With reasonable distribution system operation and farm irrigation efficiency, canals designed as recommended will have sufficient capacity to deliver a full and adequate irrigation water supply to all irrigable lands included for project development.

Nonirrigable lands with a water right should be provided with irrigation water limited to the fall, winter, and early spring months as they are now.

Availability of Ground Water

Little information is available concerning the ground water resources of the Helmand Valley region. Through the drainage investigation program it has been determined that a relatively shallow aquifer consisting mainly of highly permeable gravelly material underlies the project area. This gravelly material stratum is 6-8 meters (20-26 feet) thick and overlies a sandstone stratum generally encountered at depths of 8-12 meters (26-39 feet). The gravelly material stratum constitutes the drainage aquifer of the project since the sandstone forms an effective horizontal barrier to the vertical movement of water.

Most of the water in the drainage aquifer originates from deep percolation resulting from irrigation of project lands and canal seepage losses. There is some ground water inflow to the project area from the Marja and Nad-i-Ali project areas and lands adjacent to the river probably receive ground water inflow from the river.

1/ Total demand based on supplying irrigation water to 12,707 hectares (31,399 acres) of irrigable land.

From analysis of water samples taken from observation wells and drains in the Shamalan Project area, it is concluded that careful study is necessary before water from the drainage aquifer is considered to be used for either irrigation or domestic use. Drain flows reflect the amount and quality of water in the drainage aquifer. A detailed discussion of the suitability of this water for irrigation is contained in the Project Lands Appendix.

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CHAPTER VIII

Drainage

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Drainage

General

In general, lands classified as irrigable in the Shamalan Project area have good to excellent drainage characteristics.

An excellent drainage aquifer underlies practically all of the project area; there is little indication of vertical drainage barriers within the drainage aquifer, and shallow horizontal drainage barriers apparently do not affect extensive areas of irrigable land. Over practically all of the project area there should be no critical resistance of ground water movement downward and toward existing and proposed drains. Effective open drains can easily be constructed to depth of 2-4 meters (6.6-13.1 feet) in stable material with bottoms of drains in and over strata that offers noncritical resistance to movement of ground water upward into drains. On irrigable lands the soil infiltration rates are low to moderate and with reasonably good irrigation and water management, leaching can be accomplished without excessive additions to the ground water table. Because of the good to excellent quality of the irrigation water, leaching requirement is only about 10-15% of irrigation input. The project area has a relatively uniform and gentle slope with few excessive irregularities to cause accumulation of surface and ground water. Most project lands are situated relatively high above the drain outlets to the river, and the general slope of the land permits orderly layout and construction of adequate distribution and drainage systems with gravity flow. Due to low rainfall intensities and gentle slope of lands, providing surface drainage for storm runoff is not a significant problem.

Some undesirable characteristics of the Shamalan Project area which create drainage problems and increase drainage costs include the requirement for long outlet drains because of the shortage of suitable outlets to the river, the gentle slope of the lands, and the existing relationship of the lands to the Shamalan Canal and the river. Some potentially good areas have such location, slope and elevation that adequate drainage relief by gravity flow is not possible. Operation of the Marja and Nad-i-Ali Projects on higher lands to the west creates drainage problems in parts of the Shamalan Project area. High runoff of the Helmand River during the early spring significantly affects drainage of lands near the river and restricts flow of outlet drains where they empty into the river.

Present operation of Kajakai Reservoir for flood control substantially reduces duration of high level flows below the reservoir, but high rate of sediment deposition in the reservoir will greatly reduce its effectiveness for flood control in the future.

The high transmissibility of the excellent drainage aquifer underlying practically all irrigable lands accounts for most of the good drainability qualities of the project area. The drainage aquifer is the zone through which most subsurface drainwater movement occurs. In the Shamalan area this zone extends from the top of the ground water table down to the effective horizontal drainage barrier 8-12 meters (26-29 feet) below the ground surface. A detailed description of the drainage aquifer and tests made to define it is included in the drainage portion of Appendix B.

Existing Drainage System

The existing drainage system consists mostly of outlet drains constructed in topographic lows that meander along the river valley. They were apparently planned to conform to the existing jui distribution system and to provide drainage protection to lands adjacent to the Shamalan Canal which receive adequate water. Few effective lateral drains to intercept the ground water slope have been constructed. Location of all existing drains are shown on the Project Map, Drawing Nos. 501-130 through 501-134.

Most of the outlet drains collect and dispose of considerable quantities of ground water to give fairly adequate drainage protection to lands adjacent to the Shamalan Canal, but they provide little drainage relief to lands more distant from the canal.

Total outflow of subsurface drainwater from the existing drainage system varies from 1.27 to 3.54 cubic meters per second (45-125 cfs). This compares to 15.58 cms (550 cfs) of irrigation water delivered to the project area on a sustained basis.

The drain outflow is relatively high considering that most drains do not intercept the ground water slope and are in a poor state of maintenance. The main accountability for it is the high transmissibility of the drainage aquifer and position of drains in topographic lows. Another reason could be excessive additions to the ground water table through deep percolation from irrigation of lands adjacent to the canal and seepage from the Shamalan Canal. Most lands near the canal are irrigated heavily and the juis run almost continuously during most of the irrigation season.

Drainage Requirements

Most lands classified as irrigable experience few periods of damaging high water tables. Where such high water tables do occur it is usually the result of ground water inflow from other areas or excessive deep percolation from over-irrigation. Some irrigable land areas have excessively high ground water levels only because they lie at too great a distance from existing drains. Rapid drop of the water table over practically all of the project area during the drain-out periods showed the area to have good drainability.

Improved operation and maintenance of a rehabilitated existing drainage system, together with better irrigation practices, would greatly aid drainage of irrigable lands adjacent to the Shamalan Canal and existing drains.

Even with rehabilitation, the existing drainage system would not provide adequate drainage protection to all project lands. With development of a full and adequate irrigation water supply to the project, there will be a significant increase in additions to the ground water table. Provisions must be made to collect this ground water and carry it out of the area, or a damaging rise in the ground water table will occur over much of the project area. Additional drains are needed, especially on lands more distant from the Shamalan Canal and the existing outlet drains. Lateral drains to intercept the ground water slope must be constructed over the entire project area.

Determination of drainage requirements is discussed in detail in the drainage portion of Appendix B.

The plan of development for drainage requirements in the Shamalan Unit includes: rehabilitation of 118 kilometers (73.4 miles) of existing drains; construction of 28.5 kilometers (17.7 miles) of new outlet drains; and construction of 91 kilometers (56.5 miles) of new lateral drains.

CHAPTER IX

Plan of Development

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Plan of Development

General

In the overall plan for development of the Shamalan Unit, consideration is given to construction of a water distribution system to provide ample water at peak demands to all portions of the project. This includes not only lands classified as irrigable, but also lands classified as 6W which are eliminated from the irrigable land classes,but which have a history of irrigation and probably hold prior water rights.

Main outlet drains and subsequent lateral and field drains must be added to the present main drainage system to lower high water tables in localized areas and to insure proper future drainage of the project area when adequate irrigation water is applied.

Good land preparation must be a part of the plan of development. This will entail some clearing, perhaps some deep plowing or ripping, leveling, and grading and shaping of fields as required, to permit efficient application of irrigation water on bodies of land of adequate sized units.

Development of a new, potable source of domestic water supply must also be a part of the plan of development. Existing sources of supply carried by the canals, juis and drains are not only unsafe but create the necessity of continued operation of the irrigation conveyance system which aggravates drainage problems and limits performance of adequate operation and maintenance. np

Access roads are planned at frequent intervals throughout the farm areas to provide better transportation facilities and accessibility.

Consideration for providing protection, during periods of high river flows, for the erosion control of river banks and adjacent project lands in localized reaches is a part of the plan of development.

Distribution System

Present plans include the following major considerations: introduction of an additional water supply from the Boghra Canal into the Shamalan system via the use of Nad-i-Ali Wasteway and through rehabilitation of the Shamalan Canal; construction of a new lateral diverting from the Shamalan Canal near drop structure at Station 22+610 to serve and supply adequate quantities of water to the "water short" West Shamalan area; and redesign and realinement of the remaining jui lateral and sublateral system presently serving the major land segments of the Shamalan Unit.

Nad-i-Ali Wasteway is considered to be the best means of adding substantial quantities of additional water into the Shamalan system. Water would be diverted from the Boghra Canal at Wasteway structure #56 and would flow through the rehabilitated channel of Nad-i-Ali Wasteway for a distance of about 10.7 kilometers to its junction with Nad-i-Ali Drain. From this point water would flow through the combined Nad-i-Ali Wasteway and Drain channel a distance of about 9.7 kilometers to a point where it could be diverted through a new structure into the West Shamalan Lateral.

The channel of Nad-i-Ali Wasteway to its junction with Nad-i-Ali Drain would be rehabilitated to provide for capacity of about 5.92 cubic meters per second (209 cfs). From this point on to the point of diversion into West Shamalan Lateral the channel capacity requirements would be about 7.67 cubic meters per second (271 cfs) which would not be difficult or expensive to attain due to the existing slope and cross section of the combined Nad-i-Ali Wasteway and Drain channel. At the West Shamalan Lateral diversion point, the amount of water available for use in the project area after deductions for canal losses would be about 6.15 cubic meters per second (217 cfs).

The capacity of Boghra Canal between the Shamalan Canal diversion point and the proposed diversion into Nad-i-Ali Wasteway is more than sufficient to meet the added requirements of the Shamalan area and provide the water supply to present irrigated lands at Nad-i-Ali and Marja.

The Boghra Canal presently provides the water supply for an estimated gross irrigated acreage of 73,000 acres. The canal was designed for a substantially larger acreage but much of the proposed area proved uneconomically suited for development.

Present Conditions

Boghra Canal Design Capacity (Cubic feet per second)	Estimated Gross Irrigated Acres	Acres per cfs
Above Sta 31+680 - Shamalan Diversion Pt. - 2,340 cfs	73,000	31.0
Below Sta 31+680 - 1,600 cfs	33,000	20.6
Below WW structure 56+500 - 940 cfs	20,000	21.3
Future Conditions		
Above Sta 31+680 - 2,350 cfs	1/ 60,700	26.0
Below Sta 31+680 - 1,600 cfs	2/ 45,300	28.3
Below WW structure 56+500 - 940 cfs	20,000	21.3

1/ Gross irrigated acreage to be served from this reach of canal reduced by the area in the West Shamalan Division (12,300 acres).
2/ Gross irrigated acreage to be served from this section of canal increased by the area in the West Shamalan Division.

Estimated project capital cost for the rehabilitation of Nad-i-Ali Wasteway and Drain including 25% contingencies is $50,000.

The proposed location of the new West Shamalan Lateral is shown on the Project Map. It would have capacity for irrigating approximately 5,170 hectares (12,775 acres) in the West Shamalan Division, including some 850 hectares (2,100 acres) of class 6W lands. At Station 6+548, where the proposed lateral would cross the Nad-i-Ali Wasteway, provision would be made to divert the flows which are released into the Nad-i-Ali Wasteway from the Boghra Canal into this West Shamalan Lateral to supplement or replace the water diverted from the present Shamalan Canal.

The West Shamalan Lateral is reduced from its initial capacity of 6.1 cubic meters per second (215 cfs) at the point of crossing the Nad-i-Ali Wasteway to 4.7 cubic meters per second (165 cfs). From Nad-i-Ali Wasteway to approximately Station 13+820 the lateral would be located along the toe of the valley escarpment. From Station 13+820 to its end the lateral would follow generally the location of an old existing jui in the valley proper.

Plans for the provision of laterals to serve the remaining segments of the Shamalan Unit consist essentially of redesigning and realining the existing juis which now serve the present land patterns formed by the existing drains and the main Shamalan Canal to insure a fully controlled distribution system and provide an adequate irrigation water supply.

The Project Map, Drawings No's. 501-130 through 134, shows the location of the major proposed laterals and Table 1 shows initial design capacities and estimated capital costs, including contingencies.

Estimated costs for the sublateral distribution system were based upon a representative layout of recommended sized farm units and a distribution system to fit with the proposed new laterals and the existing and proposed drainage system. Estimated project capital cost for the sublateral distribution system is $2,826,000 including 25 percent contingencies.

Drainage System

Ultimate development of a drainage system for the Shamalan Unit is based upon improvement of most of the existing drains, construction of new Outlet Drains "J" and "K" for the West Shamalan Division with tentative locations as shown on the Project Map, construction of new Outlet Drain "L" for the East Shamalan Division, construction of new Outlet Drain "M" for the South Shamalan Division, and the construction of additional lateral drains as needed.

TABLE 1

Initial Design Capacity and Estimated Capital Costs
for Main Laterals

	Initial Capacity		Length		Cost
	Cubic Meters per Second	Cubic Feet per Second	Kilometers	Miles	$
West Shamalan Division					
West Shamalan Lateral	6.09	215	24.7	15.4	535,200
Lateral 43.43	0.57	20	5.2	3.25	25,600
Sublateral 13.82	0.57	20	6.0	3.75	25,600
Lateral 39.745	1.84	65	7.2	4.50	74,500
					660,900
East Shamalan Division					
Sublateral 3.226	0.34	12	7.7	4.81	17,100
Sublateral 4.02	0.34	12	3.2	2.00	10,300
Lateral 38.145	0.42	15	3.8	2.38	20,200
Zarest Sublateral	1.27	45	6.6	4.13	54,000
Lateral 48.48	3.12	110	15.6	9.75	107,100
Lateral 30.1	2.41	85	7.9	4.94	43,300
Sublateral 3.7	0.34	12	4.8	3.00	15,200
Lateral 42.00	2.27	80	9.6	6.00	42,800
Sublateral 0.73	0.34	55	6.4	4.00	25,100
					335,100
South Shamalan Division					
Lateral 63.6	3.40	120	16.3	10.19	125,700
Lateral 57.060	0.42	15	2.7	1.68	10,400
Lateral 58.790	0.42	15	2.1	1.31	9,000
Lateral 62.220	0.42	15	2.5	1.56	6,900
					152,000

Page 1 of 2 pages

TABLE 1 - continued

	Initial Capacity		Length		Cost
	Cubic Meters per Second	Cubic Feet per Second	Kilometers	Miles	$
North Shamalan Division					
Lateral 9.827	0.71	25	6.9	4.31	38,100
Lateral 25.395	0.85	30	4.9	3.06	28,900
					67,000
TOTAL					$1,215,000

Page 2 of 2 pages.

Rehabilitation of existing drains includes reshaping the invert cross section to uniform widths and grade, removing constrictions, installing adequate sized culverts and the construction of road crossings about every two kilometers (1.2 miles).

Because of the many variable and indeterminate factors affecting lateral drain spacing, the most critical of which is the transmissibility of the drainage aquifer, it is not possible at this time to predict accurately drain spacing requirements. Land distribution and farm unit boundaries will determine to a large extent the final location of the lateral drains and the sublateral distribution system.

For the purpose of estimating costs on the drainage and distribution lateral systems for the report, a representative layout of the project works was made considering the distribution of land to form recommended sized farm units. Project roads, laterals and drains were planned parallel and adjacent to each other where possible to provide for better conformation of farm areas, lower construction costs, minimum land requirements for rights-of-way, and more efficient operation and maintenance.

Estimated project capital costs for drainage construction are as follows:

Rehabilitation of existing drains	402,000
New outlet drains	284,000
New lateral drains	564,000
TOTAL	$1,250,000

Land Development

Land preparation requirements for the Shamalan Unit are generally low to moderate in intensity, and costs should be correspondingly low to moderate. Sufficient leveling has been done by hand and with oxen over the many years of irrigation by individual farmers to achieve a relatively high degree of efficiency of water use under the present oxen and tenant system, wherein the fields are farmed in small level basins bounded by low dikes. The present irrigation system consists of a convoluted network of juis which cut the lands into small irregular shaped tracts. Trees, principally mulberry, grow along the banks of the juis.

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

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

Total clearing costs are estimated to be relatively low as trees occur on only a small percentage of the lands. Actual earth moving requirements per unit of area over the bulk of the lands should also be low due to the existing generally uniform, smooth land surfaces. The principal exception would be the requirement for leveling the old jui system. Estimated capital cost for land preparation is $1,570,000 including 25 percent for contingencies.

Roads

Tentative locations of the main project roads proposed for access and maintenance to serve the project lands are shown on the Project Map, Drawings No's. 501-130 through 134.

Roads are planned to fit with the proposed drainage and distribution system and farm unit boundaries where practicable to obtain the advantage of minimum land requirements for rights-of-way, lower construction costs, and easier establishment of farm units.

Access roads which may be needed in addition to those that are planned in connection with the irrigation and drainage facilities can be incorporated in the plan on an alinement conforming to farm unit boundaries and other engineering works. Farm access roads should be built to conform to farm unit boundaries, farm ditches and lateral drains where possible.

Six meter wide (20 feet) roadways are planned for both banks of the existing and proposed outlet drains, and on one bank of the proposed lateral canals and lateral drains. The base material for nearly all the roads can come from material excavated from the drains during their construction. In some areas materials excavated from the drains can be used for road surfacing. However, most gravel surface material will probably have to be hauled from outside areas.

About 396 kilometers (246 miles) of gravel surfaced roadway are planned for construction at a total estimated cost of $314,000 including 25 percent for contingencies.

Domestic Water Supply

At present most of the villages and farms in the Shamalan Project area depend upon water supplied through the irrigation distribution system for domestic water. Others obtain domestic water from drains and shallow hand-dug wells. These sources provide neither pure nor palatable drinking water. Irrigation distribution system water supplied through the Shamalan Canal is impure, and most drain and shallow well water is impure and also unpalatable due to high dissolved salt content, and seepage of human and animal wastes from the fields.

Since most of the population depends upon the distribution system for its domestic water supply, it is difficult to schedule sufficient "down-time" to shut off the Shamalan Canal, main laterals, and sublaterals for needed maintenance and improvement. Present operating practice is to allow continuous flow, with little or no control, to all laterals and most sublaterals during the irrigation season.

Water is shut off from the Shamalan Canal for about 45 days during December and January at which time maintenance work and improvement are carried out. If adequate pure and palatable domestic water could be supplied from wells it would be possible to shut water off from the Shamalan Canal and other proposed supply canals for a longer period of time. Such a longer shutdown period would greatly benefit drainage as well as operation and maintenance.

The best possible dependable source for a pure and palatable water supply in the Shamalan area would be wells drilled to potable water. Investigations made for drainage indicate there are probably no shallow ground water aquifers in the Shamalan area with potential to yield an adequate and economical water supply suitable for domestic use.

There may be deep ground water aquifers in the Shamalan area in which wells could be developed and maintained to provide an adequate and economical water supply suitable for domestic use, and investigation of this possibility should be given top priority.

For costing purposes it is assumed that wells can be economically installed and maintained in deep aquifers over most of the project area. It is estimated that 100 wells installed about 45 meters (150 feet) deep at a cost of $2,300 each should provide an adequate domestic water supply. This would be a total capital cost for domestic water supply of $230,000 including contingencies.

If investigations indicate that adequate water for domestic use cannot be supplied from underground sources, the alternative source would be through the irrigation distribution system, with facilities provided to collect, filter, and store the water in sufficient quantities to carry over the irrigation system shut-down period.

Soil Amendments

A sizable part of the Shamalan Unit land is adversely affected in varying degrees by exchangeable, or adsorbed, sodium excesses which will require correction in order to achieve the potential productivity of these lands. High exchangeable sodium causes soils to become deflocculated, or puddled, making them plastic and sticky, slowly permeable to water and poorly aerated.

High exchangeable sodium is also toxic to crop plants. In the exchangeable or adsorbed state, sodium is not readily soluble in water and usually cannot be effectively removed by leaching alone.

To correct exchangeable sodium excesses it is necessary to effect replacement of the adsorbed sodium ions with calcium ions. When excesses are low to moderate the necessary correction can usually be accomplished by use of green manures, animal manures and crop residues accompanied by leaching and necessary drainage. Where high exchangeable sodium excesses occur, the use of calcium supplying amendments will be required, plus leaching and required drainage. Gypsum is the most commonly used amendment for this purpose. It is available in the Helmand Valley in ample quantities to meet project needs in the form of "gotch" which occurs in deposits ranging from 40 to more than 80 percent gypsum. Extensive deposits have been found ranging from 60 to 80 percent gypsum content.

In the Shamalan Unit approximately ten percent of the irrigated lands are affected to a moderate degree by exchangeable sodium and can be reclaimed by use of manures, leaching and provision of adequate drainage. Approximately 2,900 hectares (7,163 acres), constituting 17 percent of the irrigated lands, have relatively high concentrations of exchangeable sodium and in addition to leaching and adequate drainage, will require moderate applications of gypsum, ranging from 12.5 to 17.5 tons per hectare(5 to 7 tons per acre) of gotch containing 70 percent gypsum. Total requirements for these lands will be the equivalent of approximately 43,000 tons of gotch containing 70 percent gypsum. (Note: These estimates are based on calculated gypsum requirements for typical soil profiles, assuming 1.7 tons of gypsum/acre-foot to replace 1 milliequivalent of sodium per 100 grams of soil.) The total estimated cost of the gotch required for the affected lands, including mining, gravel removal, crushing, screening, delivery to farm and spreading is $432,000. Use of manures and crop residues in conjunction with gypsum application will facilitate reclamation of these lands.

Approximately 25 percent of the total irrigated lands have such high concentrations of exchangeable sodium that reclamation is not at this time considered feasible. Further study may show that part of these lands can be reclaimed. Feasibility of their reclamation is dependent upon the amount of gypsum required to reduce exchangeable sodium concentrations to safe levels, costs of required drainage facilities, other reclamation requirements, and response of the soils to treatment. Feasibility of reclaiming these lands, which are classed as nonarable, can only be ascertained by appropriate research studies and field trials.

Cost Summary

Project capital costs include the water distribution and drainage systems, the domestic water supply, the road system, land development, and soil amendments. The following tabulation summarizes estimated capital costs of the proposed Shamalan Unit.

Summary of Estimated Costs

Distribution system	$4,091,000
Drainage system	1,250,000
Land development	1,570,000
Roads	314,000
Domestic water system	230,000
Soil amendments	432,000
Resettlement costs	153,000
	$8,040,000
Engineering and overhead @ 25%	2,010,000
Interest during construction	528,000
TOTAL	$10,578,000

Operation and Maintenance

An important factor in the successful development of the project lands of the Shamalan Unit is good maintenance of the irrigation and drainage facilities, and proper control and administration of water use.

Under project development the irrigation system should be operated on a demand rather than the present continuous flow method which contributes substantially to many of the drainage problems and water shortages.

At the beginning of each irrigation season enough water should be allocated to each farm to meet annual crop requirements. A set of regulations should be prepared stipulating the rules and conditions under which irrigation water would be delivered. The canals, laterals, sublaterals, farm turnouts, and the volume of water delivered to each farmer must be controlled by the Operation and Maintenance Division.

A detailed discussion is presented in Appendix B of this report on the regulation, method of operation, and the basis for estimating costs for project operation and maintenance.

Operation and maintenance costs for the Shamalan Unit are estimated at $7.44 per hectare ($3.00 per acre) per year.

CHAPTER X

Economic and Financial Analysis

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Economic and Financial Analysis

General

The economic and financial analysis of the Shamalan Unit is based upon a determination of expected project benefits and project costs, concluding with a ratio of project benefits to cost. According to law[1], proposed water and land resource projects must be analyzed so that expected benefits and costs can be compared. In the Shamalan Unit, the average anticipated primary or irrigation benefits are compared to the annual equivalent cost of installing project facilities and the annual cost of operating and maintaining the project. For purposes of further evaluation, and to consider in full perspective the effect that the project will have on the local, regional, and national economy, two supplemental benefit to cost ratios are included. These measure respectively the sum of primary plus secondary benefits to project costs; and the sum of primary, secondary, plus development benefits to costs. Finally, a financial analysis statement shows the proper relationship between project costs, primary benefits, the farm family living allowance, and farm size.

Although economic justification rests upon the relationship between expected project primary benefits and expected project costs, further analysis demonstrates the importance of the project from a national standpoint, and measures the expected effect that the project will have on the manufacturing, transport and marketing sectors of the economy. This enables a more meaningful comparison of the project with other proposed projects, and thereby enables the government to concentrate on those projects which are expected to produce the maximum returns.

Economic justification measures the benefits which can reasonably be expected to arise after the project is constructed, and compares these with the expected costs of installing, operating, and maintaining the project facilities on a common time basis. Benefits are expected in increasing amounts annually, and operation and maintenance costs occur yearly, but capital costs are

1/ Section 101 of the 1963 Foreign Aid Appropriations Act requires that none of the funds therein appropriated (other than funds appropriated under the authorization for "International Organizations and Programs") shall be used to finance the construction of any new flood control, reclamation, or other water or related land resource project or program which has not met the standards and criteria used in determining the feasibility of flood control, reclamation and other water and related land resource programs proposed for construction within the United States of America. Quoted from Supplement No. 1 to Feasibility Studies, Economic and Technical Soundness Analysis, Capital Projects, Department of State, Agency for International Development, Office of Engineering, Washington, D.C. 20523, A.I.D. M.O. 1221.3, May 31, 1963, pg. 1.

incurred in lump sums prior to the realization of benefits. The capital costs must be reduced to their annual equivalents for comparison with annual benefits. Analysis must include any anticipated adverse effects of the project. In the Shamalan area the arable land is almost completely cultivated, and construction of distribution and drainage systems would curtail production in any given area for an average of one year. Assuming that production loss is equal to one year's value at present yields and returns, the annual equivalent of a year's return is subtracted from the expected future returns as an adverse effect, or induced cost.

Benefits are divided into primary, secondary, and development categories, and measure the difference in net income with and without the project. Primary benefits are received by project farmers and their families as a result of project development. Secondary benefits are received by users who do not farm but whose income is enhanced as a result of project development. These persons may live on or off the project lands, and typically comprise the manufacturing and service population, and their wages, salaries, interest, or profits have been generated or increased as a result of project development. Development benefits are the sums retained by the national economy as a result of project construction, operation, and maintenance.

Project costs are the expenditures for goods and services required to construct, operate, and maintain the project. The capital cost, which is the sum of installation cost, resettlement cost, engineering and overhead cost, and interest during construction, is amortized or converted to an annual equivalent basis by use of a $3\frac{1}{2}\%$ interest factor and a 50-year period of analysis. The annual operation and maintenance costs are incurred to keep the capital structures functioning in an efficient manner throughout the life of the project. The sum of the annual capital cost and operation and maintenance cost is the total annual project cost.

Annual project benefits, less induced costs, are compared to annual project costs by a benefit to cost ratio. A related method, also presented, is the difference between expected project benefits and costs. In any capital-short country, including Afghanistan, it is important to know with reasonable probability not only if project benefits will exceed costs, but also to know by what annual margin, for comparison with other proposed development projects. Scarce capital and other resources can then be allocated with maximum efficiency.

Primary project benefits in the Shamalan Unit are measured by projecting yield levels expected for 15, 25, and 50 years after construction, projecting the rate of attainment of these yields, and by discounting the future yields to obtain the averages over the 50-year period of analysis. This extended period of growth considers the divergence between present yields and those which may reasonably be expected in the future. Commencing with low present levels, targets for 50 years are predicated on progressive strong increases in individual crop and livestock yields, ranging up to 250% of present levels by the 50th year, and averaging less for each crop and animal product over 50 years. An average or discounted yield for the 50-year period represents the economic midpoint for each product and is used to measure average annual crop and livestock income. Yield increases are predicated upon a massive improvement in agriculture as well as project betterment, for without a concerted and sustained impetus to the agricultural sector the project works will be of little use. Yield increases of this magnitude require both a sound base, in the form of project works and facilities, and an improvement of farming methods and inputs. This level of attainment demands an intensive improvement and distribution program for each crop and livestock species.

The rate of development, or the achievement of yields projected after project construction will necessarily be gradual, and will require increased effort by the farmer plus assistance by the HAVA. In the first 15 years the basic physical requirements should be met. Farm consolidation and layout, clearing, leveling and smoothing, reclamation of sodic and saline land where required, an efficient system of water distribution and drainage, an adequate network of farm and service roads, and a domestic water system should be installed and functioning. In this same period, improved plant and animal varieties should become available, disease and insect control agents will be in short supply but increasingly more common, and some mechanization, with better prepared seedbeds, sowing and cultivation will have an effect. Between the 15th and 25th years the farm input situation should be greatly improved. Better varieties of crops, fruit trees, and livestock, firmer insect and disease control, effective use of machinery, increased use of fertilizers and rational crop rotations coupled with a buildup of organic levels in the soil will be producing greater returns. Finally, between the 25th and 50th years the cessation of employment of oxen and tenant sharecroppers, the liberal use of credit and agricultural extension, the formation of effective marketing and purchasing cooperatives, the emergency of a class of educated, trained, and experienced farmers, and the final dropping away of the concepts of subsistence or traditional farming should bring yields and returns to their 50th year level. It is assumed that markets and agricultural processing industries will improve concurrently with agriculture. The average yield level anticipated for 50 years of project operation reflects this extended period of development. This average level is the anticipated annual primary benefit used in project financial analysis.

When analyzing the Shamalan or other irrigation project, the vital criterion to consider is the purpose of the project. The Shamalan Unit is currently almost completely utilized, on a low productivity basis. Most of the lands receive water, although considerable areas are subject to an inadequate supply. Drainage also is a serious limiting factor on some lands while other lands are damaged by high and rising water tables, salinity, or adsorbed sodium. In the Shamalan Area, however, these conditions are only partial limiting factors upon production. Widely prevalent poor farming techniques and weak farming inputs have an important bearing upon low levels of production and the universal rural poverty. The level of agriculture is low, is capable of producing and sustaining a subsistence economy indefinitely, and has done so for millenia. This must change if the area is to develop and become a surplus producer. Economic justification of the Shamalan Unit depends as much upon improvement of basic agriculture as upon construction of improved physical facilities.

Project construction will provide the base upon which sound agriculture can be built. Furthermore, the stimulus to the RGA of another massive investment in this area, after many millions of dollars have already been spent and many years have elapsed without significant returns, indicates that HAVA will be required to make a determined effort to develop the area after the project works are installed. It is felt that in the absence of the completed project little progress will be forthcoming and will proceed very slowly and in a fragmentary fashion. Therefore, future conditions without the project are expected to be little improved over present conditions. If the investment is made and an adequate physical base provided for improved agriculture, then the government should take strong measures to develop farming.

The complex of limiting factors, which includes small and fragmented farm units; incomplete land preparation; poor sowing, cultivation, and harvest methods; poor seed and stock; low levels of fertility and organic matter; lack of pest and disease control; lack of farm credit; underdeveloped markets and transport facilities, and poorly oriented and trained farmers, are important reasons for poor performance but are not the complete picture. Water distribution and drainage, including proper farm unit location in regard to location of laterals and drains; land clearing, leveling, and smoothing; reclamation of saline and alkaline lands, and construction of an adequate access road network and a domestic water system is the other side of water resource development in this area. The entire picture of project development, which in this context signifies creation of a thriving agricultural economy capable of producing food surpluses in excess of farm requirements, producing raw materials for industrial processing, providing a market for manufactured goods and services, and of releasing labor to the urban segment without loss of production on the farm, is created by a complex of project and land development, agricultural development, and farmer development. Economic justification, or a demonstrated ability of the project to produce benefits in excess of its costs, is possible only if the farmers make full use of the project physical facilities and works.

Economic Analysis

Economic analysis of the Shamalan Project consists of computation and comparison of expected benefits and costs. Strictly interpreted, analysis requires only calculation and comparison of anticipated primary benefits and costs on a common time basis. For full analysis and consideration, however, the secondary and development benefits have also been considered.

Primary Benefits. Primary benefits are the incremental agricultural income for the area, or the difference between net farm income with and without project development, including incremental grazing income and an allowance for induced project costs. Table 1 summarizes expected incremental primary benefits.

TABLE 1

Shamalan Unit Primary Benefits

	$ per Hectare	$ per Acre	Total $
Present Primary Income			
Gross farm returns	97.42	39.42	1,237,893
Farm costs	44.45	17.99	564,870
Net farm returns	52.97	21.43	673,023
Net grazing returns	1.94	0.79	24,671
Present primary income	54.91	22.22	697,694
Future Primary Income			
Gross farm returns	248.32	100.50	3,155,460
Farm costs	132.69	53.70	1,686,130
Net farm returns	115.63	46.80	1,469,330
Net grazing returns	7.81	3.16	99,220
Future primary income	123.44	49.96	1,568,550
Incremental Primary Benefits			
Future primary income	123.44	49.96	1,568,550
Present primary income	54.91	22.22	697,694
Subtotal, incremental primary income	68.53	27.74	870,856
- Induced costs	- 2.25	- 0.91	- 28,573
TOTAL, Incremental Primary Benefits	$66.28	$26.83	$842,283

The incremental primary benefits of $842,283 (say $842,000) for the Unit must be compared to the expected costs of the project. Project costs include the value of all goods and services required to construct, operate, and maintain the project. The portion spent to construct the facilities, or the installation cost, includes the water distribution and drainage systems, land development, reclamation of sodic and saline lands, a road network and a domestic water system. A cost is added for resettlement of farmers displaced by construction. Added to the sum of installation and resettlement costs is a 25% contingency for engineering and overhead. The total of installation costs and contingency, plus interest during construction, is called the capital cost. Interest during construction is the cost of borrowed money during the construction period prior to realization of benefits. Capital costs are amortized or converted to an annual equivalent by use of an appropriate interest rate and period of analysis.

The project costs which occur annually and which are necessary to keep project structures functioning in an efficient manner for the life of the project are called operation and maintenance costs (O & M). The expected annual O & M cost is added to the annual equivalent of the capital cost to determine total annual project cost. The capital costs which have been previously incurred for the Shamalan Unit are not included in this analysis. These are considered "sunk", and project costs in this report are only the incremental costs which will be incurred to complete irrigation and drainage systems, prepare the land for improved irrigation farming, and provide the infrastructure for a productive farm economy. There are two reasons for excluding the previous capital costs. The development work on the Shamalan Unit has never been completed, and significant surplus production is not expected here until the correct physical base is installed. The other point is the legal requirement, per memorandum of the President, May 15, 1962, which requires: "Where a new project consists of additions to an existing project or system the determination of a benefit-cost ratio is based on benefits and economic costs of the new projects only." 1/ The question in this analysis is whether the RGA should embark on a future expenditure of roughly $337 per acre in the Shamalan Area and the economic feasibility of such an investment.

Distribution System. The distribution system is a conveyance facility which brings irrigation water to irrigable project lands in sufficient quantity as needed. Work will include new construction or rehabilitation of the main Shamalan Canal, the Nad-i-Ali Wasteway, the main lateral distribution system, the proposed West Shamalan Lateral, and a system of sublaterals and farm ditches.

Drainage System. This is the network of main, outlet, and lateral drains required to remove surplus surface and subsurface water from project lands and to prevent the creation of high or rising water tables. Future development will include rehabilitation and construction of outlet and lateral drains, including reshaping, deepening, cleaning, grading, removal of obstructions, and installation of adequately sized culverts at crossings.

Land Development. Land development in the Shamalan Area includes clearing, leveling, and smoothing or grading. Deep plowing or ripping are not considered necessary, for the soils appear mellow and no plow sole 2/ is in evidence. The present irrigation system consists of a convoluted network of ditches which cut up the lands into small, irregular tracts, frequently enclosed by rows of mulberry trees. Within these tracts the fields are further subdivided by low dikes which enclose irrigation basins no larger than garden tracts. The farmers perceive the relation between level land and successful irrigation, and have done sufficient leveling with oxen power to shape these

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1/ Quoted from Benefit-Cost Evaluations as Applied to AID-Financed Water or Related Land Use Projects, Supplement No. 1 to Feasibility Studies, Economic and Technical Soundness Analysis, Capital Projects, Department of State, Agency for International Development, Office of Engineering, Washington, D.C. 20523, A.I.D. M.O. 1221.3, May 31, 1963, pages 1-2.

2/ Plow sole -- a layer of earth at the bottom of a furrow compacted by repeated plowing to the same depth.

basins. Continuation of this practice, however, would preclude the use of modern irrigation, mechanical cultivation or harvest, or indeed any tractor-powered implement after the basins are installed. Small tracts and basins would decrease the efficiency of farm machinery and would tend to perpetuate the use of oxen and the continued employment of tenants. Rough or partial leveling would have the effect of forming topographical highs and lows in the fields when land is irrigated in the early years of project use.

Land development, which in sequence in this area refers to clearing trees from ditchbanks, leveling the superfluous portions of the existing farm ditch systems for replacement with an improved system, and overall leveling, smoothing, and grading of farm units, is carried as a project function and cost. Clearing costs will be low, for trees occur only along some juis and in villages. Grading costs also will be low due to generally uniform, relatively level, and smooth surfaces, except where old juis will be filled in. Smoothing and grading will be the final stages before land is returned to private ownership. All phases of this work should be completed before the land is resettled to provide the base for commercial farming and higher returns.

Soil Amendments. Certain project lands, including the majority of subclasses 2sa and 3sa are characterized by excesses of adsorbed or exchangeable sodium. Lands in this condition are plastic, slowly permeable to water, poorly aerated, and in extreme cases toxic to plants. In the adsorbed state sodium is not water soluble and cannot be reclaimed by leaching alone.

In the Shamalan Area approximately 41.6% of the irrigable lands are affected to a moderate degree by exchangeable sodium and can be reclaimed by green and animal manuring, plowing in crop residues, leaching and drainage. Costs of these operations, except drainage, would be carried by the project farmers. Another 22.8% of the lands have relatively high concentrations of adsorbed sodium and can be reclaimed only by the replacement of the sodium ions with calcium, followed by the above treatments. Gypsum, or "gotch", is a calcium supplying amendment that is available in the Helmand Valley in deposits which range in purity from 40% to 80% or more of hydrous calcium sulfate, $CaSO_4 \cdot 2H_2O$. This material should be mined, screened, hauled to the farms, and spread at the rate of 13.5 metric tons per hectare (6.0 short tons per acre) as a project function and cost.

Leaching the soil would be a farmer cost. The depressing effect that adsorbed sodium has upon crop yields, until the reclamation process is completed after several years of work, has been included in computations of crop yields and returns.

Another 31.5% of the land in the Shamalan Area has concentrations of adsorbed sodium so high that reclamation is not now considered feasible, and these lands are classified as class 6 after project development.

Road System. Project roads are planned so that each project farm will be no more than one kilometer from a surfaced road, with access to the Shamalan Canal and desert roads. Roads will be constructed at roughly two kilometer intervals, either on or along the banks of existing or proposed canals, drains, laterals, or sublaterals. If a main access road is required where no suitable irrigation or drainage facility exists or is planned this road should be built on an alinement parallel to or in conformance with farm unit boundaries. Ditchbank roads should serve both for access and maintenance.

Domestic Water System. At present the domestic water supply for the Shamalan population is provided by the Shamalan Canal, other features of the irrigation or drainage system, or shallow hand-dug wells. None of the water from these sources is pure, and much of it has a high salt content and is contaminated by seepage of human and animal wastes from fields and farmsteads.

Since the Shamalan Canal provides much of the drinking water for the populace, it is difficult to schedule more "down time" than 45 days during December and January. If adequate, pure, and palatable domestic water could be supplied from wells, it would be possible to close the canal for as much as 75 to 90 days per year. This extended period would greatly benefit drainage as well as operation and maintenance.

In some Shamalan areas relatively shallow wells can be drilled to potable water depths, while in other areas wells may have to be deeper to reach a potable aquifer. Wells should be drilled and the casing installed and sealed to prevent contamination from surface flows.

The domestic water system includes the cost of establishing wells in villages and on farmsteads. Many of the wells would be relatively inexpensive and could be pumped by hand. Only the first cost of this system is included; the costs of operating, maintaining, and rehabilitating these installations are considered farmer costs.

Total installation costs include the distribution system, drainage system, land development, soil amendments, road system, and the domestic water system. Capital costs are the sum of installation costs, resettlement costs, a 25% contingency for engineering and overhead, and interest during construction.

Resettlement Costs. Resettlement costs are incurred as project expenses to move farmers back to the land after project work is completed. The cost of new houses built for farmers, farm credit, and food and seed wheat for the first year would be charged against farmer accounts and repaid, but the administrative expenses incurred would be project costs.

Fertility Restoration. The Shamalan lands have been farmed for millenia, and are among the older irrigated lands in Asia. During this period no artificial fertilizers have been applied, only the small areas around villages have received significant quantities of animal and human manures, and the practice of plowing under soil-building crops has not developed. The result is that the great majority of the soils are seriously depleted in fertility, have a very low organic matter content, and probably cannot support crop yields much in excess of present levels. Heavy applications of chemical fertilizers, coupled with greater use of green manures, will be required to restore adequate fertility and organic matter levels to these lands.

On the basis of findings in old irrigated areas elsewhere in the world, it is believed that serious phosphate deficiencies are likely and that nitrogen, zinc and iron deficiencies are possible on certain soils. Based on research in the western United States, the initial application necessary to make up these deficiencies may be equivalent to 340 kilograms per hectare (300 pounds per acre) of P_2O_5. Actual deficiencies are not known and can be determined only by a comprehensive field research program involving several years of tests. The 25% engineering and overhead contingency should be high enough to cover the cost of correcting the deficiency if it exists.

The capital cost is amortized to derive its annual equivalent by multiplying it by the 0.042634 factor. This yields the average annual equivalent of the sum over 50 years at 3½% interest, which is added to annual operation and maintenance costs to derive the total annual project cost.

Operation, maintenance, and replacement costs are incurred yearly to keep the system of project canals, laterals, and drains functioning in an adequate manner, to deliver water on schedule and in the correct volume, to remove excess water from fields, and to keep the road network in good condition for vehicular traffic. Although in practice O & M costs will not be identical for each year of water delivery, an average annual O & M cost is computed and used in the analysis.

The annual cost of the project operation and maintenance, plus the annual equivalent of project capital costs, is the total annual project cost. It is this cost which is measured against annual project benefits to derive the ratio of benefits to costs. For the Shamalan Project the anticipated annual incremental primary benefits are $842,000 or $66.28 per hectare ($26.83 per acre), and the annual project costs are $471,000 or $37.06 per hectare ($15.00 per acre). The ratio of benefits to costs is 1.79 to 1.00 and the difference between annual benefits and costs is $371,000 for the project. This indicates that the proposed expenditure in the Shamalan Project Area is feasible, subject to conditions stated in the Agricultural Economics chapter of this report. Table 2 summarizes project costs and the relationship between primary benefits and costs.

TABLE 2

Shamalan Project
Costs and Primary Benefits

	$ per Hectare	$ per Acre	$ Total
Installation costs			
Distribution system	321.95	130.29	4,091,000
Drainage system	98.37	39.81	1,250,000
Land development	123.56	50.00	1,570,000
Soil amendments	34.00	13.76	432,000
Road system	24.71	10.00	314,000
Domestic water system	18.11	7.33	230,000
Subtotal, Installation Costs	620.70	251.19	7,887,000
Resettlement costs	12.03	4.87	153,000
Subtotal, Installation and Resettlement Costs	632.73	256.06	8,040,000
Engineering and overhead costs	158.18	64.01	2,010,000
Subtotal, Installation, Resettlement, and Engineering and Overhead costs	790.91	320.07	10,050,000
Interest during construction	41.54	16.81	528,000
TOTAL, Future Capital Costs	832.45	336.88	10,578,000
Present capital costs 1/	(-)	(-)	(-)
Total Incremental Capital Costs	832.45	336.88	10,578,000
Annual incremental capital costs 2/	35.51	14.37	451,000
Annual future O & M costs	7.41	3.00	94,000
Annual present O & M costs	(5.86)	(2.37)	(74,000)
Total Annual Incremental O & M Costs	1.55	0.63	20,000
Total Annual Incremental Project Costs	37.06	15.00	471,000
Total Annual Incremental Primary Project Benefits	66.31	26.83	842,000
Ratio of primary benefits to costs			1.79 to 1.00
Difference between annual primary benefits and costs			$371,000

1/ Previously incurred capital costs, estimated at $1,235 per hectare ($500 per acre) are excluded from this analysis.
2/ Amortized over 50 years @ 3½% interest by use of the 0.042634 factor

Secondary Income. Secondary income is the sum expected to arise from future processing, hauling, and marketing farm products, agricultural businesses, purchases of food originating outside the project area, fishing, income of journeymen and artisans, transporting people, and exporting farm products to foreign markets. Large increases are projected for processing, hauling, and marketing farm products, since a higher proportion of a greater volume of produce is expected to be sold and processed off the farm in the future than at present. Agricultural business will expand if the project develops, for a large proportion of commercial inputs are expected to be purchased in the future. At present most inputs are produced on the farm. Demand for services of journeymen, shopkeepers, and mechanized transport will increase with development. Finally, the export of products from Afghanistan will be wholly or almost entirely new for the Shamalan Area. The prime reason for the expected expansion of secondary benefits is the expected conversion of a subsistence to a commercial economy. Projected future secondary income is high only in relation to the very low level of secondary income realized at present, and is predicated entirely on development of primary income. Incremental secondary income, summarized below as $1,542,730 (say $1,543,000) is examined in detail in the Agricultural Economics appendix.

	$ per Hectare	$ per Acre	Total $
Future secondary income	139.07	56.28	1,767,215
Present secondary income	17.67	7.15	224,485
Incremental secondary benefits	121.40	49.13	1,542,730

Table 3 summarizes project primary and secondary benefits and the relationship between these benefits and project costs.

TABLE 3

Shamalan Project
Primary Plus Secondary Benefits and Costs

	$ per Hectare	$ per Acre	Total $
Annual incremental primary benefits	66.31	26.83	842,000
Annual incremental secondary benefits	121.40	49.13	1,543,000
Sum of incremental primary, plus secondary benefits	187.71	75.96	2,385,000
Annual incremental project costs	37.06	15.00	471,000
Ratio of primary plus secondary benefits to costs			5.06 to 1.00
Difference between annual primary plus secondary benefit costs			$1,914,000

Development Benefits. Project development benefits are the portions of project capital, operation, and maintenance expenses that remain in the country when monies are paid for domestic labor, materials, handling, and internal hauling. They include project expenditures for construction, soil amendments, and operation and maintenance. If these expenditures occur prior to project operation, they are amortized over the period of project analysis to derive an average annual equivalent. The project operation and maintenance expenses occur annually and portions of these costs remain in the national economy. Incremental development benefits, which amount to $119,550 (say $120,000) are summarized below and listed in detail in the Agricultural Economics appendix.

	$ per Hectare	$ per Acre	Total $
Future development benefits	10.92	4.42	138,750
Present development benefits	1.51	0.61	19,200
Incremental development benefits	9.41	3.81	119,550

Table 4 summarizes project primary, secondary plus development benefits and the relationship between these benefits and project costs.

TABLE 4

Shamalan Project
Primary, Secondary, Plus Development Benefits and Costs

	$ per Hectare	$ per Acre	Total $
Annual incremental primary benefits	66.31	26.83	842,000
Annual incremental secondary benefits	121.40	49.13	1,543,000
Annual incremental development benefits	9.41	3.81	120,000
Sum of primary, secondary, plus development benefits	197.12	79.77	2,505,000
Annual incremental project costs	37.06	15.00	471,000
Ratio of primary, secondary, plus development benefits and costs			5.32 to 1.00
Difference between annual primary, secondary, plus development benefits and costs			$2,034,000

Financial Analysis

The Shamalan Project, in common with any other proposed water resource development project, should meet the test of financial feasibility. In this context "financial feasibility" is taken to mean the ability of the project area to produce sufficient gross farm revenue to pay farming costs, allow the farmer a fair sum for his family living, cover the costs of operating and maintaining the project, and possibly to repay a portion of project capital costs. After the farmer has paid for his inputs, his net revenue should provide an adequate family living allowance and the difference, or net disposable income, should permit the project to collect a sum from him which would cover yearly average operation and maintenance costs. If a repayment policy is established and enforced by the HAVA, part of the balance, after deducting the actual cost of operation and maintenance, could be collected from the farmer to cover some portion of project capital costs (see "Suggested Repayment Schedule, Shamalan Unit", Tables 11A and 11B, Agricultural Economics chapter). This method of analysis measures the ability of the project to pay its costs after providing a reasonable standard of living for the farm family. Since the project is the sum of the farm units, financial feasibility of the project ultimately rests upon the financial ability of the individual farm.

When the basis of an adequate living standard is considered, certain fundamental facts emerge. One of these is that demand tends to increase as living standards improve, expectations rise, and recipients become increasingly aware of the availability and usage of goods. Another is that farmers tend to respond to a higher level of demand for consumer goods with efforts designed to create greater production. Higher farm production is the only manner in which the farmer can earn the funds to purchase his nonfarm requirements. The farm family must retain a fair and reasonable living allowance. Although farmers will respond to many different levels of income, there is probably a minimum sum or its equivalent in purchasing power below which little family satisfaction will be forthcoming and incentive will be lacking. This sum will certainly rise as years pass and the project develops and farmers become increasingly more aware of consumer goods and equate these with familial satisfaction. The family living allowance, however, should not be so high that the general taxpayer is asked to pay for project costs if the farmer is able to do so.

Farm Size. The proper size of the farm unit is an important factor in determining the probable success or failure of a farm and of the irrigation unit. A feasible farm unit must be able to meet the same criteria as the irrigation project, since the unit is a composite of the individual farms. Farm size is seen as a crucial determinant of the ability of the farmer to succeed.

The farm unit should pay for its inputs without subsidy, provide an adequate family living allowance, provide sufficient returns after meeting the family living allowance to cover operation and maintenance costs, and amortize some portion of the capital investment if a repayment policy is enacted by the HAVA. If the farm unit, and the project, can meet these standards the project will be financially feasible.

Determination of farm size involves the correlation of land quality, water supply, cropping patterns, availability of credit and commercial inputs, anticipated yields and prices, and farming practices and costs. The competency and motivation of the farm owner must be considered. Farm size is intimately related to farm mechanization and to family living allowance. The farm should be of sufficient size so that the owner can work efficiently, replacing oxen with machinery and tenant labor with operator and family labor in time, and spreading his costs over a large gross income. It should not be so large that one man and his family cannot operate the unit, nor so small that the farmer is forced to use oxen and tenants indefinitely. It must support a business base broad enough to enable the owner to borrow money for seed, fertilizer, insecticide, machinery, and other commercial inputs necessary for high yields, based on the pattern of extensive agriculture expected to prevail in this area.

In the West Shamalan Area today, the average farmer has 7.4 cultivated hectares (18.3 acres) and additional intermittently cultivated and grazed land. He keeps one tenant per 3.9 to 4.0 hectares (9.6 to 10.0 acres) and one oxen team per 6.7 hectares (16.5 acres). As he adds increments of this hectarage, at present levels of intensity and work habits, he adds to his working capital of tenants and oxen. He feeds his extended family, two tenants and their families, his work stock and other domestic animals from this land, all at low levels of consumption. The surplus available for the urban sector, considering his poor yield level, is very small. This is the situation from which the farmer must emerge if the project is to prove successful.

Including the water-short desert fringe areas which receive some irrigation runoff and are planted on a wheat/fallow or wheat/fallow/fallow rotation, the Shamalan farmer owns somewhat more than 8 hectares scattered over several fields and areas. Considering present ownership, the economics of farm production using commercial inputs, and the working patterns of the population, the recommended farm size for the future Shamalan Unit, after farmers are resettled and farm units consolidated rationally, is not less than 9 hectares (22.2 acres) for land class 1, 10 hectares (24.7 acres) for class 2, and 11 hectares (27.2 acres) for class 3. Since the irrigable area after draining, leaching and reclamation of sodic lands is classified as 93.2%, class 1; 4.4%, class 2; and 2.4%, class 3, the average farm should be 9 to 10 hectares (22-25 acres). No farms in the long run should be smaller than the average size prevailing today, including lands presently water-short but which will be irrigated in the future. Nonarable or class 6 lands form 49.9% of the gross Shamalan Area, equal in area to 99.5% of the irrigable lands, so the farm unit should include 9 to 10 hectares of dry grazing land where location permits. Grazing lands, however, should be included only as an adjunct to irrigable lands, and no amount should form the basis of a farm unit.

Farm size is related directly to expected benefits. Adequate farm size is the base of a sound business which will produce the primary benefits needed to justify the project. Repayment ability, if recognized as a project responsibility by the HAVA, is dependent upon the prior realization of primary benefits on the farm, and is not the specific objective of a policy of adequate farm size.

There are sound physical and economic grounds for supporting a farm size no smaller than present consolidated Shamalan size. An adequate size of business is essential to provide a base for farm credit which in turn is necessary to introduce and sustain such commercial inputs as fertilizer, pest and disease control agents, and farm machinery. These inputs are preconditions for the increased yields projected for the future. Mechanization is the only feasible means in this area to adequately plow and disc, turn under alfalfa and clover, control camelthorn and other woody shrubs, make full utilization of land (present methods require many small banks to enclose numerous small irrigation basins), drill and seed in rows, cultivate, and to effect timeliness of operations. This last point, for example, permits the projection of wheat after cotton the same year, for a 45-hp. diesel tractor requires 7.0 hours to plow, disc, ditch, and drill one hectare (2.8 hours per acre) of wheat, and does a superior job than present methods, with deeper and more arable seedbeds, better germination, fuller stands, good initial weed control, and higher yields. Under present methods, a man and oxen team require 7.7 working days to plow, border, and plant one hectare of wheat (3.1 working days per acre). Since cotton is harvested until November in this area, and wheat should be planted no later than November, only with machine operation can a second crop be projected.

Mechanization is expensive as a first cost, although not in terms of units of output, when used in conjunction with other improved practices. A small farm with an inadequate business base could not expect to mechanize in the same time and to the same degree as a larger farm. The larger farmer will be the innovator in this field, and in some Shamalan farms in 1966 this already has started with the purchase of Massey-Ferguson field tractors and implements.

In the Shamalan Area the concept of cooperative purchase is presently unknown, and custom operation almost unheard of. If many small farmers purchased a single machine, dilution of ownership would tend to decrease efficiency of operation. Although theoretically the only criterion should be the amount of land operated per machine, in practice the greater the number of owners of a piece of equipment the poorer the probable results. This is particularly true for maintenance and repair. Therefore the larger farmer should be more easily able to purchase these inputs, which include not only equipment but also volumes of fertilizers and insect and disease control agents, all initially furnished with government credit. The low borrowing capacity of the small farmer would result in limited accessibility to fertilizers, spray and dust materials, and superior livestock, and the probable effect on yield of lessened availability of these inputs is obvious.

If tenants and oxen continue as major factors of production, gross farm income is expected to remain low per unit of land, but the number of persons per unit of land would remain high to include tenants and their families. This would divide lower production over more people, with a resultant smaller share per individual. In practice this would yield a major share to the landlord and a minor share to the tenant, a situation little different than exists today. Adequate farm size, volume of farm business and access to commercial inputs, replacement of tenants and oxen with machinery, and adequate family living allowance and financial incentive are all important criteria in future farm success.

The question of intensity of operations as a substitute for mechanization is important. At present in the Shamalan Area fields are commonly unhoed, uncultivated, and full of clods, weeds, and camelthorn during the growing season, and are plowed once by oxen teams when four or five times would be better. Generally no dragging or discing of clods follows plowing, and a minimum of weeding, hoeing, or other arduous hand operations is effected. The 1965 sample survey, based on size of holdings and time required per operation, revealed that farmers work an average of only 75 full days per year on their wheat, alfalfa, cotton, corn, and mung beans, plus some additional work on minor crops and livestock.

If large urban markets were to develop quickly in this area and to exert a strong demand for agricultural commodities, and this demand in turn was satisfied by Shamalan lands, more intensive agriculture with higher income per acre on small farms could be projected. This type of development, if it occurred, would necessarily emanate from a strong urban sector. If such a market were to develop in southern Afghanistan in response to a presently unforeseen stimulus, in all probability it would be supported by agriculture in the Kandahar Area which has a natural transportation, processing, and marketing advantage over the Shamalan Area, and which is presently much more intensively farmed than the Shamalan.

The question then revolves on expecting a group of extensive farmers to mechanize, or to expect the same group to become intensive workers within a stated period of time. The trend now in Afghanistan is toward mechanization, with 100 Byelarus (U.S.S.R.) and 200 Massey-Ferguson tractors and sets of implements already in Afghanistan, and 350 more tractors scheduled for import in the third Five-Year Plan. Little change is noted toward intensification of operations, and a frequently stated reason for opposition to the cotton program is the farmer's complaint that this crop requires too much work. Both mechanization and intensification call for a revolution in tradition and thinking, but of the two, mechanization appears more likely to occur.

Family Living Allowance. There is also a direct relationship between farm size and family living allowance. At present in the West Shamalan Division of the Shamalan Unit, the farm family spends roughly $305 per year on items which are considered components of a family living allowance. Since general conditions for the Unit are very similar, this figure is considered the present family living allowance for the area. As collected in 1965 in the field, the components are:

Item	Annual Expense $
Cloth and clothing	80.10
Tea, candy, sugar, rice	49.30
Ghee	48.76
Salt	47.03
Medicine	26.64
Mullah, journeymen and artisan services	13.30
Radios, bicycles, watches, saddles, jewelry	10.80
Utensils	10.37
Tobacco	10.08
Grain grinding	8.00
Personal transportation	1.00
TOTAL	$305.38

Future farm family living allowances must provide the family a return commensurate with its efforts and create an incentive for higher production. Considering that the family in the future will consume a larger and more varied diet; will demand more cooking and eating utensils, a greater variety and quantity of imported foods, a larger volume of such locally processed foods as butter and cheese, and more cloth and clothing; will incur greater school expenses; desire more medicine, doctor visits and hospital treatment; will exert stronger claims for such luxuries as radios, furniture, shotguns, motorbicycles, motorcycles, jewelry and tobacco; will travel more within the area and to Kandahar and Kabul; and will have some personal savings; then an allowance of $600 per farm family appears reasonable. This is the level that should be attained by the end of the 50-year period of analysis, and would be double the present allowance. The expenditure for the average year of project operations would approximate $515 per family, based on the growth curve expected for farm income as the project develops. It is anticipated that demand for consumer goods, education, transportation, and many other goods and services will be augmented and become part of the ordinary farm standard of living. This has social as well as economic significance, for a rising standard of living will produce incentive for the farmer to provide even more for his family. This is part of the process of commercialization of agriculture, as opposed to subsistence or traditional farming.

The effect of too small a farm, with its restrictions on use of machinery and its permanent reliance on oxen and tenants, would maintain the division of product between landowner and sharecropper and in effect reduce farm income.

Subject to these limitations and conditions, a budget for the future typical farm and a summary of repayment based on this budget are presented in Tables 5 and 6. They are based on average anticipated conditions for 50 years and depend upon fulfillment of the stated conditions of project, farmer, and farm development.

TABLE 5

Anticipated Average Conditions for 50 Years of Project Operations
Shamalan Unit 9.0 Hectare (22.2 Acre) Farm

	Hectares	Yield Kg/Ha	Yield Total	Price/Kg $	Gross Income $	Gross Costs $	Net Income $
Single Crop							
Wheat	3.4	3,373	11,470	0.060	660 1/		
Barley	0.4	1,575	630	0.026	16		
Cotton: Seed Cotton	2.0	1,695	3,390	0.157	532		
Lint		(593)	(1,185)	(0.392)	(468)		
Seed		(1,102)	(2,205)	(0.029)	(64)		
Alfalfa	1.8	9,908	20,000	0.001	- 1/		
Orchard	0.3	20,378	6,115	0.026	159		
Garden	0.2	17,093	3,420	0.009	31		
Vineyard	0.3	12,262	3,680	0.024	88		
Subtotal, Single Crop	8.4				1,486		
Double Crop							
Wheat	1.0	2,698	2,700	0.060	162		
Corn	1.3	3,988	5,185	0.039	163 1/		
Carrots	0.2	11,652	2,330	0.007	16		
Mung beans	0.9	933	840	0.046	39		
Sunflower	0.2	893	180	0.117	21		
Subtotal, Double Crop	(3.6)				401		
Crop Residue	-				- 1/		
Idle and Farmstead	0.6						
Subtotal, Crops	9.0				1,887		
Livestock and Products		No./Ha	Number				
Oxen		0.13	1.17	6.35 hd	7		
Milk cows		0.50	4.50	2.89 hd	13		
Other cattle		0.45	4.05	2.31 hd	9		
Donkeys and horses		0.09	0.81	0.26 hd	-		
Sheep and goats		0.67	6.03	10.72 hd	64		
Chickens		14.33	129	0.36 hd	46		
Milk, kg		448	4,030	0.031 kg	125		
Eggs, no/		268	2,410	0.013 egg	31		
Hides and skins, kg		1.9	17.1	0.135 kg	2		
Subtotal, Livestock and Products					298		
Fuel Income				6.67 ha	60		
Total, Gross Farm Income					2,245	1,194	1,051
Average per Hectare					249.44	132.69	116.75
Average per Acre					100.95	53.70	47.25
Grazing Income, Nonarable Land 2/							70
Average per Hectare							7.81
Average per Acre							3.16
Grand Total Income							1,121
Average per Hectare							124.56
Average per Acre							50.41

1/	Total Production, Kg	Livestock Feed, Kg	Surplus Over Livestock Feed
Wheat	11,470	475	10,995
Alfalfa	20,000	15,685	Balance Turned Under 4,180
Corn	5,185	1,005	

Crop residue fed to livestock

2/Per hectare of nonarable land (9.0 hectares).