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THE USAID MISSION TO LAOS

EVALUATION STUDY

OF THE

NAM TAN IRRIGATION PROJECT

SAYABOURY PROVINCE

LAOS

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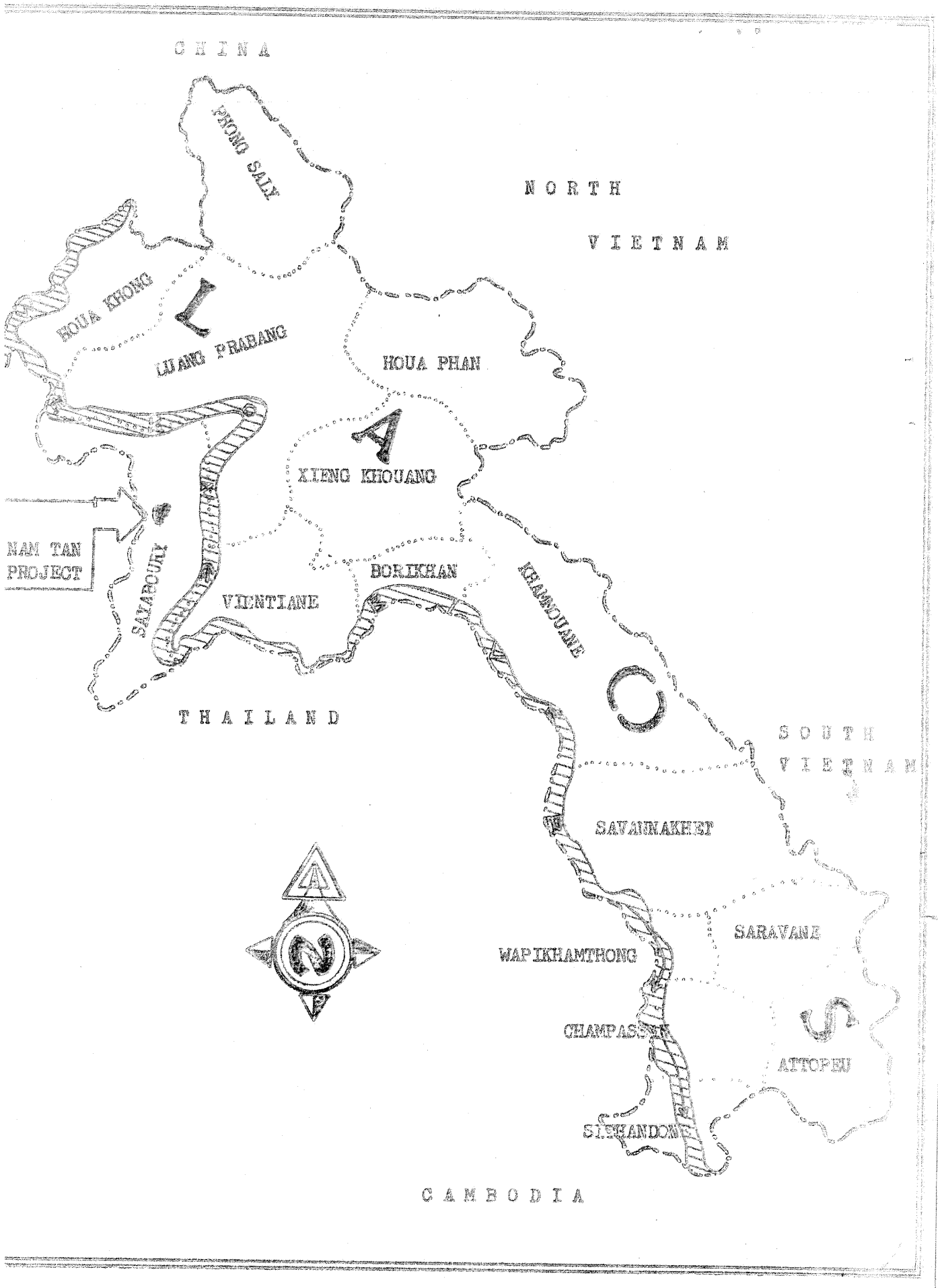
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CAMBODIA

The Evaluation Study of the Nam Tan Irrigation Project was conducted primarily to determine the potential, and the possibility of improving the efficiency and operation of the Project.

The Authors have compiled all available data concerning the technological aspects of the Project. They have conducted additional studies with a strong emphasis on socio-economic aspects. They have suggested operating guide lines based on Project experiences that will help to improve management of the Project.

The socio-economic analysis indicates further studies and evaluation of the Project need to be conducted periodically to realize its current potential and the course of advancement. This Report is the first step to supply such information that will illuminate the present aspects of the Project, and will help put it into the best technical condition and sound management.

The information compiled in the report will be helpful to all concerned in the development of the Nam Tan Irrigation Project.

Charles A. Mann
Director USAID
Mission - Laos

ACKNOWLEDGEMENTS

The Evaluation Study of the Nam Tan Irrigation Project represents the combined efforts of the USAID Mission Laos. The report was prepared at the direction of Mr. Charles A. Mann, Director, USAID Mission, Laos. Much of the work and information in the report has been produced through the efforts of several Divisions and individuals. This report summarizes the information available from all sources on the scope, purposes and plans as well as suggesting operating guidelines for the Project.

It would be difficult to properly express our appreciation to each individual whose contribution have made the report possible. We are especially appreciative of the following people without whose cooperation and effort the report would not be complete:

Messrs. Paul J. Maynard and Polachart Kraiboon who prepared an "Evaluation Study of the Muong Phieng Cluster Area, Laos" September 1969. Considerable social-economic and other historical data were taken from the Study which provided us with valuable bench line data for the Project Area.

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The Authors

P R E F A C E

A majority of the structural activity of the Nam Tan Irrigation Project had been completed by March 1972 and documented under 49 individual Activity Proposals (APs). The work authorized under the APs had developed the Project to a stage of maturity and complexity to justify a multidiscipline approach in planning and documentation. A field project proposal (FP-1-002) was prepared in March 1972, to collect for the record and for future planning within a single intergrated and comprehensive document, the past and current cost elements, activity objectives, the scope and nature of future inputs, for overall development of the Project.

Although the FP-1-002 was prepared in March 1972, the cost data included were tabulated in October 1970. The guide lines shown, were then valid. Subsequent data collected by USAID staff on the Project have shown that the FP should be up dated and revised to reflect recent operating experiences. Also a benefit-cost analysis is presented to indicate the feasibility of the Project.

The (FP-1-002) also included data from the nearby Muong Phieng and Hia Nakok Irrigation Development Projects. Since those projects were of considerably lessor magnitude in operation, and scope than the Nam Tan Project it was decided by USAID to concentrate its effort on putting the Nam Tan Project into its best economical and technical operating condition. The evaluation study addresses only those activities directly related to the Nam Tan Project. It pays close attention to the complex administrative and social organization needed for effective use and management of irrigation water on the Project.

For the Project irrigation system to be fully effective, the farmer must have a dependable supply of water when it is needed. This requires an administrative mechanism that can maintain physical structures for providing water - - the dam, canals and ditches. There must also be a

mechanism to insure fair allocation and efficient use of water among the farmers. Maintenance of the physical structures can be confused with management of the system, because the two tasks often merge in the hands of one individual (e.g. the village water master or ditch tender). The ways in which these tasks differ, and the different talents they require, must be distinguished so that the administrative body and the farmers acting jointly will be able to produce a viable Project.

A prerequisite for improved management of the Project is a set of procedures for keeping continuously informed about the farmer's situation, for making judgements, not only about his needs, but even about his preferences. Some administrative functions performed by RLG professional staff also require reciprocal cooperation and action from the farmer. These responses are essential to achieve effective water management.

Policies and mechanisms of the administrative body are being sought which would help to serve the farmers. To improve the "link" between the RLG administrative body and the Project farmer. Farmer/Water Users Associations groups which are served by a common water delivery lateral have been established. Village water masters have been selected and water fee collections have been initiated. The basic RLG administrative structural organization has been established. The primary step is to make the Project function and improve the operation of the administration structure.

The USAID staff in cooperation with the RLG staff have contacted and discussed water problems with individual water groups to get feed back of the farmer's felt needs and requirements. This step has proved instructive to both the farmer and the RLG-AID Staff and merits repetition.

Basic system management data are being indexed in a manner to coordinate closely with the lateral canal delivery system which are closely linked with farmer groups. By feeding additional data into the system from

both the system management and farmers, a mechanism is being created that will closely coordinate system management with farm requirements. The system is designed to be open ended and flexible so improvements, additions, and additional data may be readily incorporated.

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SUMMARY

LOCATION

The Nam Tan Irrigation Project lies in the southern half of the Muong Phieng Valley, about 16 kilometers southwest of the Muong Phieng Headquarters, Sayaboury Province.

PURPOSE

A program of work was prepared in March 1972 for the Project. Subsequent experiences in operating the Project have shown that the program of work should be updated and guide lines revised. The physical works are largely completed. Now the complex step of changing the traditional Lao method of operating an irrigation project must be addressed.

The purpose of this report is to provide an evaluation study of the irrigation development of 2,200 hectares of irrigable land and make recommendations for the best development possibility of the Project.

PROJECT FEATURES

Water Resources and Land Areas	Square Kilometers
Watershed - sq. km.	174
	Hectares
Minimum stream flow irrigates in dry season	300
Maximum stream flow irrigates in rainy season.	1,800

	Hectares
Improved water management can irrigate	2,200
Arable but non-irrigable	159
Total crop land	2,359

Irrigation System	
	1
Main diversion dam	Kilometers
Main canal	18.7
Laterals	62.9
Farm Service Ditches	130.0

Land Classification	Hectares
Wetland Rice - No limitations	1,021
Wetland Rice - Topographic limitations	287
Wetland Rice - Sandy topsoil	647
Diversified Crops - No limitations	354
Diversified Crops - Sandy topsoil	51
Sub-total	2,359
Not suitable for agriculture	711
Total	3,070

Other Appurtenant Features (New since Project was implemented)

	Kilometers
Road	82.0

Airfield	2.1
	Number
School	3.0
Classrooms	22.0

PROJECT ASPECTS

Before the Project was implemented, the area was relatively static under a subsistence paddy and upland rice agriculture. Lack of transportation and communication was also retarding development. After the Project was implemented, the area was opened up and exposed to improved agriculture techniques and commercial enterprizes. Due to frequent communication, villagers are more friendly and no longer need to carry weapons on journeys. The Project also provided three schools and public health centers in several villages which provide the younger generation a better education and health facilities for all the farmers.

Resident and refugee farmers have cooperated to establish the Nam Tan Farmer/Water Users Association which is divided into 12 sub-farmer groups (11 which are active) on the left bank, and 9 sub-farmer groups (8 which are active) on the right bank. This step has promoted a spirit of cooperativeness although there are differences in ethnic backgrounds.

There was a rice deficit from 1963 to 1972, and the break even point was achieved in early 1973. The remainder of 1973 and into 1974 experienced a rice surplus.

Inadequate water management has resulted in social constraints between farmers of two or more sub-farmer groups. Although land is uniformly distributed at the rate of about three hectares per family, about one third of them have inadequate irrigation water because of the uneven and inadequate water distribution. This has created another facet of rice paddy shortage for the farmers. The farmers

in this situation believe that the RLG Project officials should be more efficiently and effectively operating the Project. A gap exists in communication between officials and the farmers.

The rate of progress of land development was slow during the initial stages of the development period. The Project was actively started in 1970 and the area of production was increased from 687 hectares to 797 hectares. By 1973 the total area in production amounted to 1,283 hectares. The slow progress resulted from many families who did not have enough manpower to till and operate a three hectare paddy field and only a portion of the farm was developed. As the plows and harrows are handmade, only a water buffalo must be purchased to supply the power for the implements. Many refugee farmers do not have money to buy a buffalo and must rent one. A rental fee is paid either in cash ₭ 600 per buffalo per day or in kind 600 kg. of paddy rice (value at current price of 45 kip/kg. = ₭ 27,000) per buffalo per season.

The largest market for rice from the Project is the Royal Capital of Luang Prabang which has been a rice deficit area for a prolonged period.

The refugee and resident farmers lack adequate facilities to store rice after harvest in order to retain production for higher prices. The majority of farmers are below the level of basic requirement to maintain their families and farm inputs. These two factors usually force many farmers to sell their rice prior to harvesting, or borrow money and then pay back in kind resulting in financial losses. During the pre development period of the Project, it is reported that middlemen monopolized the purchasing of rice at prices ranging ₭ 18 per kg. for paddy from 1963 to 1966, ₭ 20 in 1967 and 1969, ₭ 25 in 1969 and 1970, and ₭ 30 in 1971.

In 1972 ADO established the rice mill and offered ₭ 30 per kg. and the middlemen offered ₭ 50 per/kg., and thus the monopolistic tendency continued but at a higher price. Subsequently, the RLG officials have attempted to

establish a monopoly by legislating that farmers can sell only to the rice mill at a price that appears less than that being offered by the middlemen. By the end of 1973 the farmers had received a net income, net profit less total rice requirement value in kip. At the official price ₭ 45/kg., ₭ 110,893,300 - ₭ 104,040,000 = ₭ 6,853,300, and at market price ₭ 70/kg., ₭ 215,553,300 - ₭ 161,840,000 = ₭ 53,713,300. By 2000 this net income will be reduced to zero. The farmers may then go back into the red and upland rice farming may be necessary again because of the population growth demanding a higher rice requirement.

ECONOMIC ANALYSIS

Construction

The construction costs through out the development period are computed to the present worth value for 1970. The interest rate for U.S. Dollar cost is 3½% and local cost is 6%.

Total U.S. Dollar cost 1970[1/]	$ 3,656,224
Total local cost 1970	$ 1,379,753
Annual O&M cost 1977 and forward	$ 31,406
Period of analysis - 50 years	
Total annual cost	$ 248,112

Benefits

The benefits through out the development period are computed to a present worth value for 1970, and amortized thereafter over a 50 year period at an interest rate of 6%. Benefits are computed on the basis of 1,800 ha. and

1/ Includes repayment of principal plus interest.

300 ha. of irrigated paddy in rainy and dry seasons respectively.

Average Annual Benefits — Period of analysis - 50 years with 6 year lag.

Primary Benefit - Official Price	$ 170,706
Primary Benefit - Market Price	$ 348,749
Secondary Benefit from Refugee Relief	$ 38,184
Minimum Secondary Benefit from schools	$ 164
Maximum Secondary Benefit from schools	$ 709

Benefit - Cost Ratio

Minimum - Excluding secondary benefits

Annual benefit	$ 170,706
Annual cost	$ 248,112
Ratio	(0.69:1)

Maximum - Excluding secondary benefits

Annual benefit	$ 348,749
Annual cost	$ 248,112
Ratio	(1.41:1)

Minimum - Including secondary benefits

Annual benefit $ 170,706 + $ 38,184 + $ 164 =	$ 209,054
Annual cost	$ 248,112
Ratio	(0.85:1)

Maximum - Including secondary benefits

Annual benefit $ 348,749 + $ 38,184 + $ 709 =	$ 387,642
Annual cost	$ 248,112
Ratio	(1.56:1)

CONCLUSIONS AND RECOMMENDED ACTIONS

The evaluation study embraces every aspect of the Project. The critical aspect is water supply, which concluded by the hydrologic study, can irrigate 1,800 ha. and 300 ha. in rainy and dry seasons respectively. The economic analysis is computed on these basic data for 30 year period of analysis with 6 year lag. The benefits have two different rates resulted from two different prices, the official price as set by the Provincial Governor and the free market price offered by the middlemen. The benefit cost analysis produced four ratios: 0.69:1 at official price excluding secondary benefits, 1.41:1 at free market price excluding secondary benefits, 0.85:1 at official price including secondary benefits, and 1.56:1 at free market price including secondary benefits.

Socially, the Project has made an achievement. It has provided a secure place for both residents and refugees to live and farm. Farmers from various ethnic groups and backgrounds mutually work and enjoy life as though there are no differences in culture, religion, and attitude. Social discrimination largely no longer exists

Economically, the Project is at a complex stage. Improvement of marketing policy is essential. The free market price should be permitted to give the Project a higher benefit - cost ratio and to give the farmers an incentive to make a viable Project. Otherwise the farmers may remain at a subsistence level and the Project may not achieve the intended objectives.

A major prerequisite for improved management of the

Project is a set of procedures for keeping the management continuously informed about the farmer's situation, for making judgements, not only about his needs, but even about his preferences. Representing the farmer's interests in water management operation calls for an ingenuity not yet fully developed in the management of the Project.

The key to the efficient and effective management of the irrigation system is the development of the Farmer/Water Users Association and incorporating the Association into the management staffing. It is yet to be fully realized by RLG officials that the "Operation and Maintenance" is a primary facet of the Project. All other activities should be incorporated into the O&M. To bring the Project to its full production potential of 1,800 hectares of paddy as rapidly as possible, USAID should continue to provide assistance to the construction of the farm service ditches and land preparation.

The RLG has been slow in developing the Farmer/Water Users Association and incorporating the farmers into the Project staffing. It will require a prolonged period to develop if it is not given high priority. The present number of RLG positions and staff are adequate. Many of the staff could use and benefit from additional training, particularly in water management.

RECOMMENDED ACTIONS

A. Project Management

1. Revise the staffing to incorporate the Farmer/Water Users Association into the Management of the Project.

2. Index the canals, align the sub-farmer water users groups more precisely to fit into the water management scheme.

3. Phase out USAID MGT (Tech Support).

B. Project Development (Technical)

1. Continue the accelerated effort to construct 22 km. of farm service ditches and help farmers to develop new land.

2. Reduce the size of the Nam Tan Demonstration Farm to manageable size.

C. Project Development (Social)

1. Give the Farmer/Water Users Association more responsibilities in Project management.

2. Finalize the lingering land distribution problems.

D. Project Development (Economic)

1. Incorporate the Farmer/Water Users Association into the operation of the Rice Mill. Requires higher level assistance.

2. Induce the farmers to higher production by removing the RLG controls on the price the farmer can receive for his paddy. Requires highest level assistance.

E. Production and Marketing

The RLG must assist the farmers by permitting and insuring the free flow of produce to the Sayabaury and Luang Prabang markets, any surpluses produced in the Project.

F. Credit

Promote and expand the existing Lao Savings and Loan Cooperative (LSLC).

UNITS OF MEASURE AND CONVERSION FACTORS

Units of measure in the report are in the metric system except in those cases where original data were expressed in other units or where, for purposes of comparison or illustration, other units are used. Local units, other than those of the metric system, are defined in the accompanying tabulation. Temperatures are expressed in degrees centigrade (°C). Monetary values are expressed in terms of United States dollars converted where necessary from Lao Kip.

UNITS OF MEASURE AND CONVERSION FACTORS

AVOIRDUOIS WEIGHT

1 Ounce	=	28.35 grams
1 Pound	=	453.59 grams
1 Hundred weight	=	45.36 kilograms
1 Ton (U.S.)	=	907.18 kilograms
1 Ton	=	1000 kilograms

LENGTH

	25.0 centimeters	=	9.84 inches
	50.0 centimeters	=	19.69 inches
1 Kueb	= 20.0 centimeters	=	7.87 inches
1 Sok or 2.0 kueb	= 45.0 centimeters	=	17.72 inches
1 Wah or 4.0 sok	= 1.80 meters	=	5.91 feet

1	Sen or 20 wah	= 36	meters	=	118.11 feet
1	Yot or 400 sen	= 14.4	kilometers	=	8.95 miles

VOLUME

1	Tang (gallong)	= 20	liters	= 5.2834 gallongs
1	Bung or 1.11 tang	= 22.2	liters	= 5.8652 gallongs
1	Kwian or 100 tangs	= 2,000	liters	= 528.34 gallongs

WEIGHT

1	Sang	= 600	grams	= 1.3224 pounds
1	Tang (gallong) of corn	= 15.0	kilograms	= 33.060 pounds
1	Tang (gallong) of mung bean	= 15.5	"	= 34.162 pounds
1	Tang (gallong) of castor bean	= 10.0	"	= 22.040 pounds
1	Tang (gallong) of rice (rough)	= 10.0 to 12 kg.		= 22.040 pounds
1	Tang (gallong) or rice (polished)	= 15.0 to 16 kg.		= 33.060 pounds
1	Tang (gallong) of rice (rough)	= 18 muen		
20	Nan of rice (rough)	= 1 muen		
1	Muen of rice (rough)	= 12.0 kilograms		= 26.455 pounds
1	Saleung	= 1/4 baht		
1	Baht	= 15 grams (gold)		= 0.5291 ounce

AREA

1 Rai	= 0.16 hectare	= 0.395 acre
1 Rai (1 by 1 sen)	= 40 x 40 meters	= 1,600 square meters
6.25 Rai	= 1 hectare	= 2.471 acres
2.53 Rai	= 0.41 hectare	= 1 acre

CURRENCY

1 U.S. Dollar	= 605 (₭)
1 kip (Official Rate) (₭)	= US $ 0.00165
605 kips (Official Rate) (₭)	= US $ 1.00

METRIC AND BRITISH SYSTEMS

TEMPERATURE

$^{o}C = 5/9\ (^{o}F - 32^{o})$ $^{o}F = 9/5^{o}\ C + 32^{o}$

LENGTH

1 Meter (m)	= 39.37 inches (in)	= 3.2808 feet (ft)	
2.54 Centimeters (cm)	= 1 inch (in)		
0.3048 Meter	= 1 foot (ft)		
1,000 Meter	= 1 kilometer(km)	= 0.6214 mile (mi)	
1.60935 Kilometer (km)	= 1 mile (mi)		

AREA

1 Square meter (sq m) or (m^2)	= 1.196 sq yards	= 10.764 sq ft
0.836 Sq. meter	= 1 sq yard	
0.0929 Sq. meter	= 1 sq foot	
1 Square kilometer	= 100 hectares	= 247.1 acres = 0.3861 sq m
2.59 Square kilometer	= 1 sq mile	
1 Hectare	= 2.471 acres	= 6.25 rai

VOLUME

1 Cubic meter (cu m) or (m^3)	= 1,000 liters	= 1.308 cu yd = 35.31 cu ft
1 Cubic meter	= 0.0008107 acre feet	
1 Liter	= 0.2642 gallongs	= 0.03531 cu ft.
1,233.5 Cubic meter	= 1 acre-foot	= 325,851 gallongs

WEIGHT

1 Kilogram (kg)	= 2,204.6 pounds (lb)	= 2,204.6 lbs
1 Metric ton	= 1,000 kg.	

MISCELLANEOUS

1 Cubic meter per second (cms) or m^3/sec	= 35.314 cu ft/sec (cfs)

1 Hectoliter = 2.828 bushels (bu) = 100 liters

0.3524 Hectoliter = 1 bu

GLOSSARY OF TERMS

Abbreviations

AGR	Agriculture.
AID	Agency for International Development, Department of State, U.S.A.
ADO	Agricultural Development Organization.
FP	Field Project.
RLG	Royal Lao Government.
LSLC	Lao Saving and Loan Cooperative.
USAID/L	United States Agency for International Development Laos, Department of State, U.S.A. in Laos.
O&M	Operation and Maintenance of Nam Tan Irrigation Project.

Terms

Ban	Lao equivalent of village in English.
Khoueng	A political subdivision of the Kingdom of Laos, the English equivalent is province.
Nam	Medium-sized river.
Muong	A political subdivision of a province (Khoueng). The English equivalent is district.

Nai Ban		Appointed head of Ban. (Village)
Ta Seng		A political sub-division of Muong (district)
Farm/Water Users Association	-	A cooperative association of farmer/water users organized in sub-groups to operate the Nam Tan Irrigation Project.
Farmer/Water Users Sub-Group	-	An area or cooperative group of farmers being served by one lateral and its sub-laterals. Organized cooperatively to operate a portion of the Nam Tan irrigation system composed of the lateral and sub-laterals through the village appointed water master.
Village Water Master or Ditch Tender or Farm Ditch Rider	-	Village appointed personnel that allocates and controls the irrigation water serving the area from one lateral and its sub-laterals.
Free Market Price	-	The price at which commodities are traded by buyers and sellers.
Official Price	-	Price of rice offered by the RLG rice mill to the Nam Tan farmers. Price of rice established by the Provincial authorities of Sayaboury Province.

Project	-	Nam Tan Irrigation Project.
Field Project	-	A multidiscipline unit of work management accomplished in the field under the direction of a Field Project Manager. The Field Project is made up of more than one activity and potentially many jobs.
Right Bank	-	Area of Project looking downstream served by the right bank main canal.
Left Bank	-	Area of Project looking downstream served by the left bank main canal.
Main Diversion Dam	-	Concrete dam constructed in the Nam Tan River to divert water into left and right bank canals.
Right Bank Canal (RB)	-	Main canal leading from diversion dam serving right bank area.
Left Bank Canal (LB)	-	Main canal leading from diversion dam serving left bank area.
Lateral	-	Canal leading from either left bank or right bank main canals into paddy areas.
Sub-lateral	-	Canal leading from laterals into paddy areas.
Farm Service Ditch	-	The terminal ditch that delivers irrigation water from lateral or sub-lateral to the paddy area.
Service Ditch	-	Terminal ditch.

Duty of Water	-	Volume and/or continuous flow of irrigation water required to produce one hectare of paddy rice, usually expressed in liter/second/hectare.
Lit/second/hectare	-	The volume and velocity of flow of the amount of water required to irrigate one hectare of paddy.
Evapotranspiration	-	Amount of moisture in centimeters or inches depth per day transpired and evaporated from the plants and the adjacent ground or water surface area.
Arable Land	-	The amount of land of quality suitable for cultivation.
Irrigable Area	-	The amount of land that can be serviced by the irrigation system.
pH of the Soil	-	The logarithum of the reciprocal of the H^+ ion activity. Commonly used in showing the acidity or alkalinity of soils. A soil with a pH of 7.0 is neutral; soils having pH values ranging lower and/or higher indicate degrees of acidity and/or alkalinity respectively.
Paddy	-	This term is used in several different senses. (1) It is commonly used to denote the area where wetland rice is grown.

(2) In the rice trade, it is defined as rice in the husk after threshing and without any portion of the stalk as it comes from the farm.

Rough Rice - Rice in the husk after threshing

Upland Rice - Commonly used to denote areas planted to rice where controlled water is not available. Usually on hilly, sharply undulating land.

Wetland Rice - Rice grown in paddies.

I. BACKGROUND

A. Project Origins

The villagers of Na Bouam can claim credit for having started the reconsideration of the Nam Tan River as the site for irrigation activities. A previous French dam at this site had been washed out. Early in 1965, they suggested to the Chao Khoueng that they would like a dam to divert water into their paddy area. In March 1965, the site was visited by the Chao Khoueng, in company with Tiao Somsavath, Chief of RLG Agriculture, Mr. Savady, Director of RLG Irrigation, and Mr. L.C. Mathews, USAID/AGR DIV/Irrigation Branch. On the basis of preliminary survey, USAID staff were authorized to evaluate the feasibility of building a dam on that location. The Project location and area is shown in Figure 2.

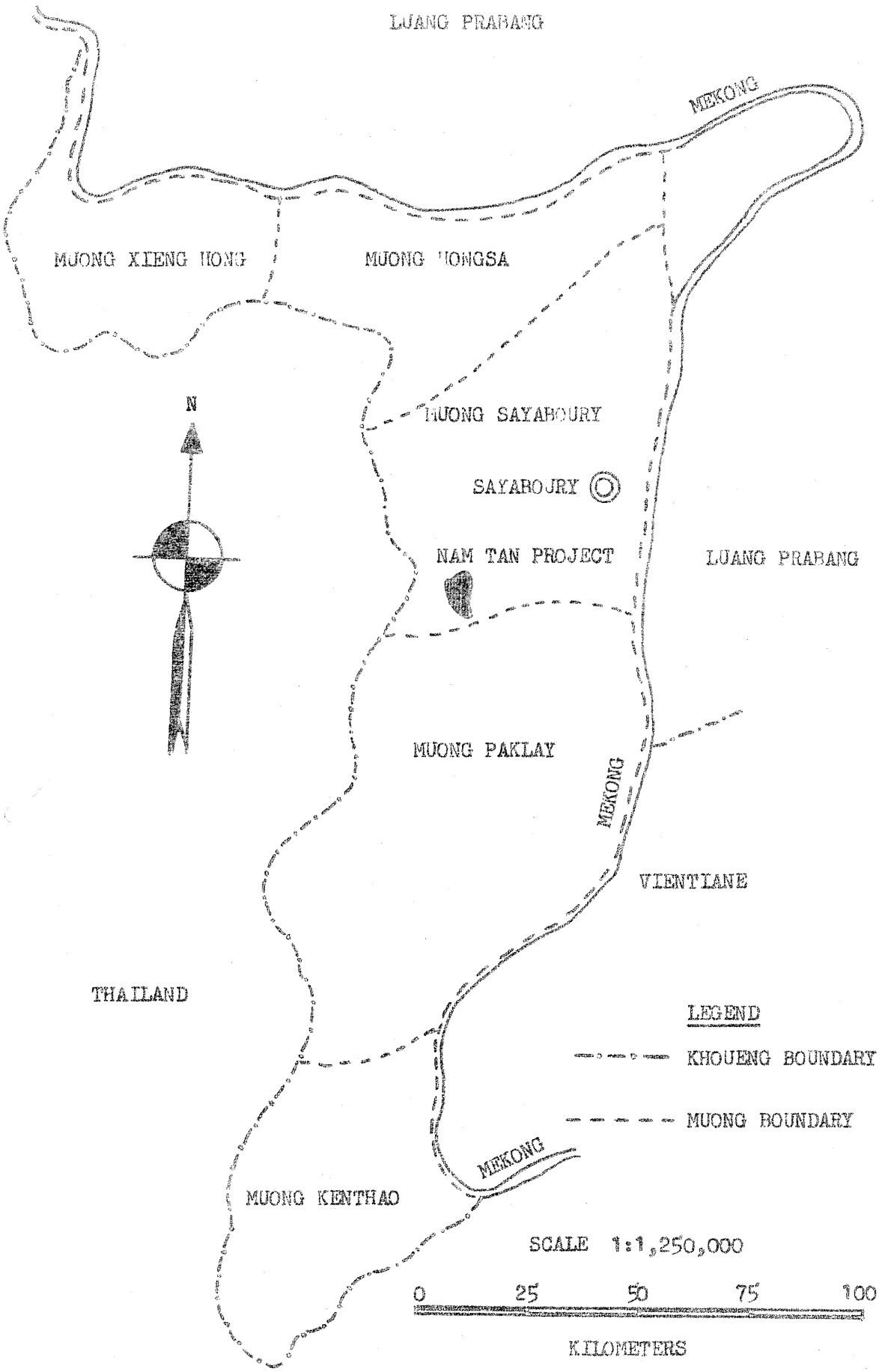
By August, 1967, the potential of the Nam Tan area had been evaluated by the AID-RLG Irrigation staff and a plan was prepared, which suggested maximum development of the irrigation potential on both banks of the Nam Tan River. Planned development of the area would require considerable construction effort.

At a meeting held by Mr. Mendenhall, USAID Director, on August 26, 1967 it was agreed that the Public Works Division would undertake the construction of the Project in a manner similar to a contractor relationship. The Irrigation Branch, Agriculture Division, would provide the investigations, designs, plans, cost estimates and specifications.

B. Project Area Definition

The geographic definition of the Nam Tan Irrigation

Figure 2 MAP OF SAYABOURY PROVINCE



Project is included in the Presidential Decree 543/PC shown in Appendix Section 1. The Decree issued by order of the Prime Minister, President of the Council of Ministers on August 20, 1970 defines the geographic area of the Nam Tan Muong Phieng Irrigation Development Project as being the irrigation service areas of the Nam Tan dam, Muong Phieng dam and Houei Hia dam as well as the watersheds located above those three dams. This evaluation study is limited to those activities associated only with the Nam Tan Irrigation Project.

C. Pre-Project Conditions

1. Topography

The Project is located in the heavily forested highlands of Laos as shown in Figure 2. p 2 It occupies the southern half of the Muong Phieng Valley and borders on the southern boundaries of the Hia Nakok and the older Muong Phieng Project.

The northern end of the Muong Phieng Valley is approximately 25 kilometers southwest of Sayaboury which is the provincial capital of Sayaboury Province. The Muong Phieng Valley is about 21 kilometers in length and about five kilometers wide at the widest point. The valley floor is generally flat with a fairly uniform elevation of about 350 meters above sea level. The mountains on the west rise to elevations from 750 to 2,000 meters and on the eastern edge of the valley to 1,500 meters.

The major streams draining into the valley are the Nam Phieng, Houei Hia and Nam Tan. The Nam Phieng enters at the extreme northwest corner of the valley, runs the full length from north to south, draining into the Nam Poui at the extreme southern corner. The Nam Poui drains into the Mekong. The Houei Hia and Nam Tan are tributaries of the Nam Phieng.

2. Geology

The Muong Phieng Valley is a mountain valley formed by the meanderings of the Nam Phieng River. Being a closed mountain valley of limited extent, the soils throughout the valley are very uniform. Basically they are reddish-brown latosols with light brown to grey silt to silty clay loam surface textures. The surrounding hills are mainly sedimentary in origin, although there are some igneous outcroppings.

3. Rainfall

Rainfall in the Muong Phieng Area, averaging about 130 centimeters per year, and is intermittent during the rainy season. Prolong dry periods occur in the rainy season and supplemental irrigation may be required to insure a good crop. Diversion of surface stream flow is necessary to assure good crops during the rainy season.

4. Agriculture

When construction of the Nam Tan dam began in 1968, the farmers in Muong Phieng Area were practising a subsistence agriculture, growing both upland and paddy rice as the main staple crop. A few plantings of vegetables were made either in the farm yard near a stream where water was available and some livestock raised for some protein needs. Paddy was a permanent means of rice cultivation, requiring ample rainfall to supply the rice field. Upland rice farming required slash and burn of forest every two to three years. The slash and burn method destroy the forest and reduces soil fertility.

Rainfall has always been the most critical factor in both upland and paddy rice production. Low rainfall resulted in low yields. High rainfall sometimes flooded the paddy too much and washed

out the upland crops. In the dry season no major crop could be grown. A few plots of vegetables were grown where water was available for hand irrigation. Farmers generally relied on rainy season cropping only. A poor crop year would result in the farmers going without sufficient food for three quarters of the year. Under subsistence agriculture farmers produce with family labor and animal drawn equipment enough products for their own needs ranging from livestock, fish, crops, tools and household utilities. Very little commercial business was transacted and agriculture supplies in the urban areas were scarce. The retail prices of these supplies were disproportionately higher than the prices of farm produce.

5. Baseline Data

1) Population	1963	1970	1973 *
Villages	10	16	16
Families	630	866	1,187
Male	1,694	2,474	3,248
Female	1,796	2,732	3,513
Total population	3,490	5,206	6,761
2) Sources of Potable Water (Useable Wells)			
Unlined wells, dug	2	110	86
Lined wells, dug	1	25	27
Drilled wells	0	5	5
3) Wats			
Number	11	11	12
Monks	9	10	9
Novices	25	51	21

* Current as of February 19, 1973

4)	School Locations	1963	1970	1973
	Primary	7	9	8
	Group scholar	0	2	3
	Number of rooms	8	38	45
	Teachers	7	24	38
	Pupils	233	916	1,176
5)	Medical Facilities			
	Clinics	1	2	2
	Trained medical personnel	1	2	2
6)	Police Stations			
	Number	1	1	0
	Policemen	2	5	0
7)	Cultivated Land			
	Paddy rainy season, Ha.	591	797	1,283
	Paddy dry season, Ha.	0	74	270
	Upland Rice, Ha.	Unknown	180	400
8)	Irrigated Land			
	Dams	0	1	1
	Hectares		797	1,283
9)	Rice Production (Rainy season, rough rice only)			
	Paddy MT (1.2, 1.8 and 2.8 Metric Ton/Ha.)	820	1,434	3,592
	Upland MT (Produce by farmers living in Project area but on land outside perimeter of Project)	Unknown	323	1,200

10)	Livestock Population	1963	1970	1973
	Buffalo	N/A	2,155	1,580
	Pigs	N/A	1,066	1,557
	Poultry	N/A	7,887	13,661
11)	Rice Mills			
	Number	0	9	12
	8 hours day capacity in kilos	0	25,000	34,600
12)	Retail Stores			
	Number	1	20	24
13)	Airfields			
	Length	0	2,100	Same
14)	Roads			
	Length kilometer	0	82	82
	Seasonal usability, all weather	N/A	35	35
15)	Vehicles			
	Taxis	0	0	10
	Trucks	0	1	3
	Motorcycles	0	8	23
	Private cars	0	0	1
16)	Volume of Traffic			
	Number of vehicles between main check points			
	Daily	N/A	42	
	Weekly		294	
	Monthly		1,260	

D. Objectives

1. The goals of the Nam Tan Irrigation Project are:

   1) To alleviate the uncertainly of a rainy season paddy by providing supplemental water for rice production during the rainy season in an area where there is a marginal supply of rainfall during all the months of the rice growing season.

   2) Bring new areas under cultivation for resettlement of refugees.

   3) To provide the means to orient farmers from subsistence to production farming, whereby the surpluses could be marketed to rice deficit areas such as Luang Prabang.

   4) To create an improved socio-economic-political atmosphere for the inhabitants of the Project area.

2. A diversion dam of reinforced concrete was completed in January 1970. Forty-six kilometers of distribution canals were completed on the Left Bank of the Nam Tan River by May 1970 and 35 kilometers of the canals were completed on the Right Bank in December 1970. Additional farm service ditches totaling about 130 kilometers were left for the farmers to construct by hand.

   The original Project planners envisioned 3,000 hectares would be irrigated in the rainy season and 1,000 in the dry season. It is now known the delivery system, when the farm service ditches are completed, could supply water to 2,200 hectares. Hydrologic studies conducted in 1973 have shown that about 1,800 of the 2,200 hectares in the rainy season and about 300 hectares in the dry season can be safely assured water supply.

3. A land committee of the RLG was established to

distribute land to old and new farmers. Each farmer was to receive up to three hectares of land. The indigenous farmers could claim the paddy fields they have been farming as their own. Farmers with less than that could receive additional new land. New farmers were to receive about three hectares. Farm sizes vary due to the layout of the land. Cadastral surveys of old and new farms were carried out to determine farm boundaries. Approximately 160 refugee families have been resettled on new lands opened up by the Project.

The dam and canal system not only insures supplemented water for the rainy season rice crop but permits a limited amount of dry season cropping. The first dry season crop in the Project area was grown in 1970. Also to help increase production a Research Demonstration Farm was established to introduce improved rice varieties and farming techniques. A modern rice mill donated to ADO by Government of Japan was erected and is operated by the RLG.

4. A Farmer/Water Users Association has been established to provide a cooperative effort by the farmers for the management, operation and maintenance of the Project.

5. Other USAID Divisions, offices of Rural and Refugee Affairs, Education, Public Health, Tech Support and Federal Highways Administration have made inputs to improve the socio-economic-political atmosphere of the Project. The proposed USAID inputs are listed below:

Sub-Activity/Areas of Responsibility

1) Agriculture Division

a. AGR Extension Branch

(1) Develop a Farmer/Water Users Association.

(2) Promote agriculture production of crops other than rice if economically and technically feasible.

(3) Provide training in agriculture related skills.

b. AGR Crops and Soils Branch

(1) Conduct research trials on production of rice and other crops.

(2) Promote and provide research data in processing of agricultural products.

(3) Provide training opportunities in crop improvement and seed multiplication.

c. AGR Irrigation Branch

(1) Provide engineering plans, designs and surveys for the construction of the irrigation system.

(2) Construct minor canal structures and farm service ditches.

(3) Assist in operation and maintenance of the project until turned over to the RLG and Farmer/Water Users Association.

(4) Provide training in irrigation management to RLG staff.

(5) Promote organization and development of Farmer/Water User Associations.

(6) Develop Project operation and maintenance capability in RLG and Farmer Water Users Association.

d. Agriculture Development Organization

(1) Provide credit sources for agriculture development and production loans.

(2) Promote the movement of modern agricultural chemicals and tools into the area as the market demands.

(3) Develop plans to facilitate marketing and to promote agriculture-related commerce as it is economically viable.

e. AGR/Fisheries Branch

(1) Develop the fishery potential of the area by producing fingerlings and technical guidance training to farmers.

(2) Construct fish hatching facilities.

(3) Assist and train RLG staff to operate the facilities.

2) Public Health Division

Provide to extent possible for the health needs of the villagers.

3) Office of Rural and Refugee Affairs

Provide support to refugees until properly

settled estimated to require one to one and half year.

4) Education Division

a. Provide to extent possible teachers and curriculum materials.

b. Support construction of primary and secondary schools as appropriate.

5) Federal Highway Administration

a. To assist Travaux Publique to improve & maintain the roads and port facilities serving the area.

b. Complete the road to Luang Prabang.

6) Air and General Tech. Support

a. Provide air service for the project site until no longer required and/or commercial air service is available.

b. Will provide a small motor maintenance facility.

c. Provide warehousing facilities for Project commodities.

d. Provide expertise in the operation of electrical equipment as needed by the Project.

e. Provide appropriate support for Mission personnel.

12

II. THE NAM TAN IRRIGATION SYSTEM

A. Introduction

The Nam Tan Irrigation system is the largest and most sophisticated in Laos. Its goals fits into the USAID/AGR overall objective to assist Laos to become self-sufficient in rice production. It is a very attractive program as it offers potential to bring a large area of non-cultivated land into production. The Project is unique as its implementation required the direct participation and close cooperation of three operating Divisions of USAID as well as various offices of the host government.

The Agriculture Division's Irrigation Branch provided the engineering for the project, i.e., the investigation, planning, and design for the irrigation system, and inspection of the construction. It also set up the operation and maintenance of the system and organized the Farmer/Water User Associations. Other Branches made appropriate inputs.

USAID additionally undertook through a private contractor to clear the forest land within the Project service area. Initially this work was under the supervision of ADO/AGR and in January 1970 was transferred to IRR/AGR.

The Public Works Division provided equipment, materials and constructed the irrigation system.

The Community Development Staff maintained liaison with the local Lao people and RLG officials, assisted in the settlement of the land and related community development activities.

The RLG provided the required land and right-of-way,

an information program to instruct the people, a self-help labor force, the required number of new settlers, and distributed the land.

B. Water Resources

1) The perennial Nam Tan River that serves the Nam Tan Irrigation system is the large visible natural resource.

2) The Nam Tan River flowing east out of the mountains enters the valley at its widest point and flows into the Nam Phieng. It has a watershed of 174 square kilometers. The minimum stream flow is about 0.60 cu.m/sec. and is capable of irrigating about 300 hectares in the dry season. Maximum flood flows have been recorded up to 60 cubic meters per second. The short term (6 years) hydrologic rainy season flow records indicate that about 1,800 hectares of paddy rice area may be predictably assured an adequate water supply.

C. Utilization History

Year	Paddy Rice Producing Area	
	Rainy Season Jun. - Dec.	Dry Season Jan. - Mar
1959 *	654	-
1967 *	667	-
1968	603	-
1969	687	-
1970	797	74
1971	685	218
1972	1,098	192
1973	1,283	270

* From Maynard report.

D. Diversion Dam

A request was made to USAID to construct the Nam Tan Irrigation Project as early as 1963. It was reported that a dam had been built across the river during the late fifties under sponsorship of the French and the excavation of a canal was started. The dam failed during the first flood. Portions of the old dam remained in the river.

Surveys of the river bed disclosed that the present site was the best dam location and was approved by Dr. Olsen early that year. The location is few meters upstream from the previous dam. Rock out-crops and test pits produced evidence of adequate foundation rock to encourage the acceptance of that location. The dam location is at a high enough elevation to enable it to serve most of the arable land in the vicinity. The dam site is not suitable for a significant amount of storage without considerable additional investment, which in view of the adequacy of the existing water supply did not seem warranted to the design engineers. A buttress type diversion dam was designed with enough height to divert the low flows of the river into the canals located at both ends of the structure, while allowing the flood flows to overflow and continue downstream.

The dam is a low, multi-buttress, reinforced concrete structure, having an overflow spillway with a crest length of 24 meters. Incorporated into the structure are two canal intakes, sometimes called regulators, one at each end of the dam, and also two double gated sluice-ways near each end of the dam to reduce sedimentation and facilitate clearing.

The design was based on the necessity for the structure to operate effectively at a low flow of 1.2 cubic meters per second, and also be able to pass a maximum flood of 180 cubic meters per second.

The dam consists of a concrete slab with both sides

vertical. Buttresses against this wall are spaced eight feet apart face to face. The original dam design was a wall 30 centimeters thick, which was considered adequate for stability but later was widened to 50 centimeters to provide easier access during construction. The maximum height of the wall is less than five meters. The wall as well as the buttresses are anchored with reinforcement steel into the foundation rock to absorb the shear pressures.

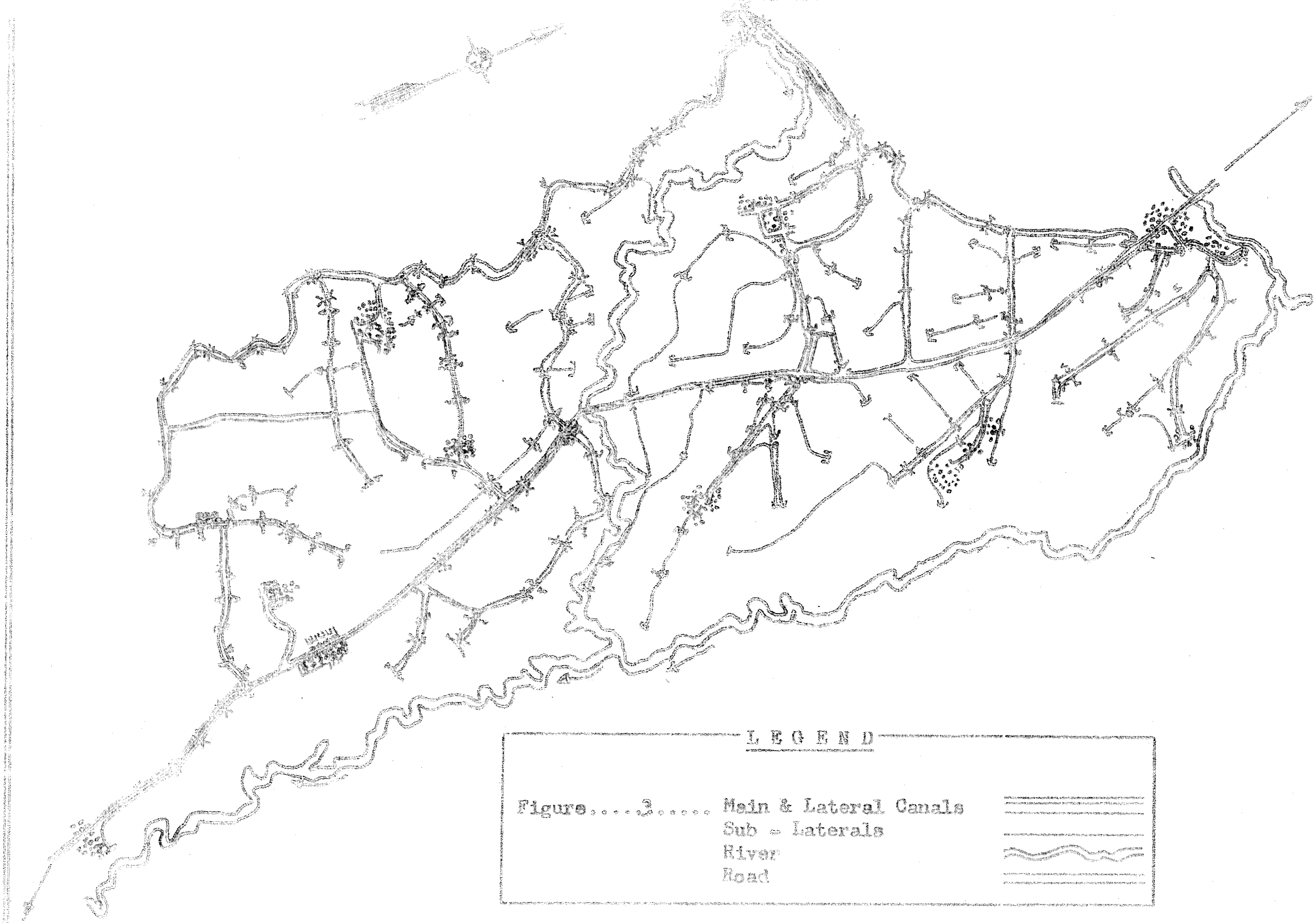
E. Distribution System

The distribution system as shown in Figure 3 is designed to ultimately supply water to about 2,200 hectares of irrigable land of which 1,800 hectares can be adequately served in the rainy season and 300 hectares in the dry season.

The system is designed to divide a flow of 1.2 cubic meters per second into two main canals. The canal intakes are gate controlled so that the diversion of any flow may be regulated in accordance with the demand. The distribution system consists of two separate systems; one on each side of the river. The left bank main canal is 5.9 kilometers long with 40.3 kilometers of main laterals having 159 regulating structures. This system provides irrigation for 1,201 hectares of land. The right bank canal is 12.8 kilometers long with 22.6 kilometers of laterals having 138 regulating structures. This system provides irrigation for 1,000 hectares of land. Canal control structures were built of reinforced concrete or corrugated metal pipe or combinations of both. There are also 50 small bridges crossing these canals.

F. Irrigation Method

The major production area of Nam Tan Project is devoted to paddy rice cultivation. The Nam Tan distribution system when complete will irrigate by gravity flow as many individual paddies as practical, directly from a


LEGEND
Figure....3.....
Main & Lateral Canals
Sub - Laterals
River
Road

farm service ditch. Paddy rice generally requires irrigation by flooding whereby water from a farm service ditch is allowed to flow under gravity into a paddy field surrounded by earthen levies. The water slowly runs across the field supersaturating the soil to flood the field up to a depth of 20 centimeters. When one paddy is sufficiently flooded the process is repeated again for the next field. Water can either be permitted to flow from the farm service ditch directly into each paddy field or flow from one paddy into the next. The latter is not recommended because it promotes the spread of disease and weed infestation and the application of fertilizer and other insect and weed control compounds may be diffused and lost.

III. HYDROLOGY

A. Conclusions

1. The river flow and rainfall records were collected from 1968 through 1973 which is too brief a period to assure closely definitive predictions of project irrigation requirements.

2. The flow records collected are believed to be accurate since January 1970, when a permanent stage recorder was installed. The flow records collected before 1970 were non-continuous and are thus questionable, as flow measurements may not have been conducted during periods of critical low flow.

3. Rainfall is being measured adjacent to the Nam Tan watershed and does not accurately show rainfall condition within the watershed area. It is believed that the river flow records accurately reflect, and are responsive to the watershed rainfall conditions. Only river flow data is utilized in predicting project irrigation requirements.

4. Project water management experience in dry season 1972 - 73 indicates a duty-of-water requirement of 2.54 liters/second per hectare required for irrigation of paddy rice. That duty-of-water may be too high but is used to forcast dry season water requirements. A lessor duty-of-water demand may be used when it can be demonstrated on the Project. The Japanse experience for 1972 - 73 dry season on the Tha Ngon Project near Vientiane indicates a duty-of-water of 1.50 lit/sec/ha. which they believe to be too low.

5. Rainy season Project water management experience is inadequate to show the required duty-of-water.

Frequent intermittent rains and lower evaptranspiration rates occur during the rainy season and would assist irrigation. It is believed that the duty-of-water should be more nearly 1.0 lit/sec/ha. customarily used in irrigation project design in the South East Asian region. This study uses a duty-of-water estimate of 1.27 lit/sec/ha. in predictions of rainy season Project paddy rice water demand.

6. About 300 ha. of paddy rice can be assured adequate water supply in the dry season. Even the restricted area can be predicted to experience a water shortage one year out of five.

7. About 2,200 ha. are proposed for irrigation development during the rainy season in the Project but the proposed irrigated area will need to be reduced to about 1,800 ha., until it can be demonstrated by improved Project water management that 2,200 ha. can be assured an adequate water supply. The remaining 400 ha. should be developed for non-irrigated crops. With the reduced irrigated area, water shortages could occur in 1 out of 9 years.

8. During portions of June, July and October about 500 ha. can be assured an adequate water supply. About 500 ha. of paddy rice should be planted earlier to a non photosensitive variety that would mature earlier in September and help assure the later, 1,300 ha. planted in July or August, an adequate water supply to reach maturity. With staggered planting using non-photosensitive varieties, water shortages could occur about 1 out of 9 years.

B. Water Supply

Data available for accurately estimating the flow in small rivers (under 1,000 square kilometers drainage area) in Laos are practically non-existent. Some short period records of the flow in the Mekong and its major tributaries are available. Such data is published

in the Lower Mekong Hydrologic Year Book.

The hydrographs for the Mekong are shown for Luang Prabang in 1962 & 64, see Figures 4 through 7. They indicate that the minimum flow occurs in March or April. The tributaries which feed the Mekong may have a somewhat similar pattern, but there could be wide divergence.

Hydrological experience in Laos under tropical rainfall conditions show that river flows from smaller watersheds are very erratic. High run-off flows occur during high rainfall and may decrease to very little or no flow during prolonged low, or no rainfall periods that occur during the dry season. The amount of runoff flow is responsive and more proportional to rainfall in the smaller watersheds. The drainage area above the Nam Tan damsite of about 174 square kilometers is a relatively small watershed. Erratic and unpredictable amounts of runoff can be expected.

The dam is designed as a diversion structure. No storage of water is provided. The amount of water for irrigation depends largely upon the amount of Nam Tan river flow which will be influenced by the condition of the watershed. During the rainy season the crop may be partially irrigated by rainfall. The paucity of hydrologic and rainfall data for the river and watershed area indicated a need for the collection of river flow and rainfall data which was first started in 1968.

Flow measurements were started in 1968 with individual and intermittent stream flow measurements. The earlier measurements were made at locations 1,000 meters above and below the dam. The amount of flow was calculated from measurements of the stream bed cross sectional area and the velocity of the stream.

Stream flow measurements were conducted intermittently until January 1970, when a permanent automatic stage recorder was established about three km. upstream from the dam. At that location the stream channel remains

Figure 4 MEKONG - LUANG PRABANG
1962

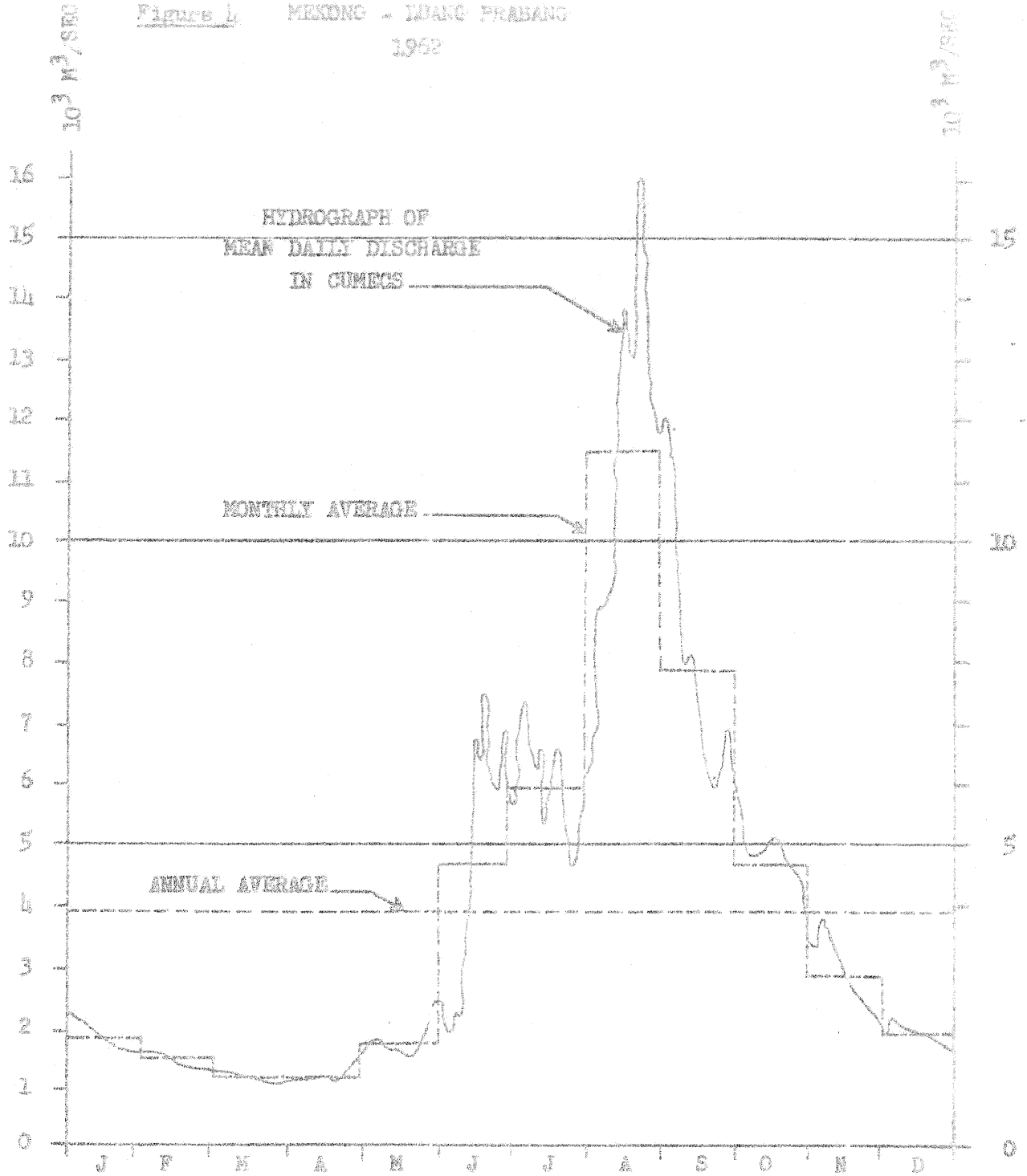


Figure 5 MEKONG LUANG PRABANG

1961

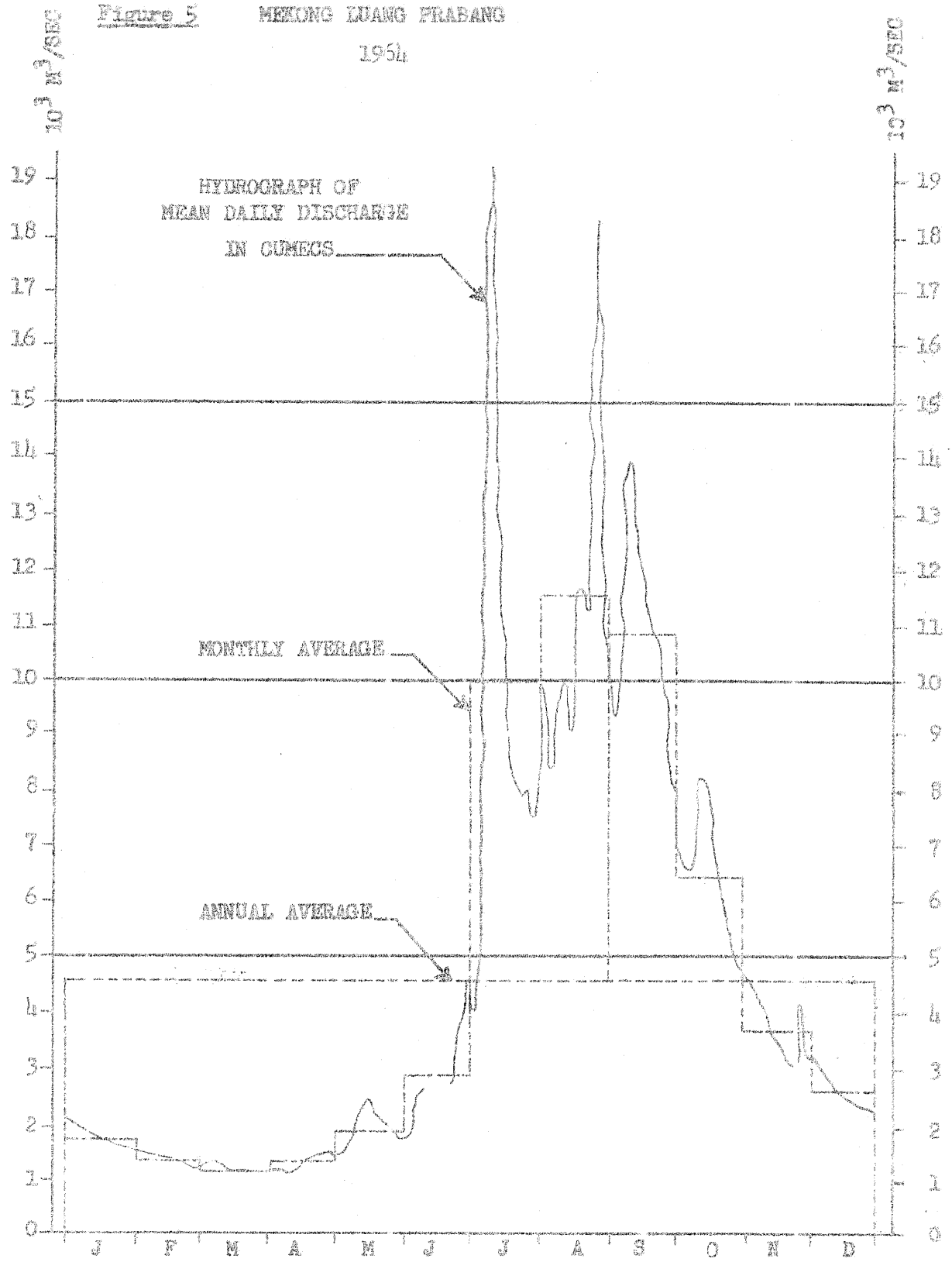


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Figure 6 MEKONG - VIENTIANE

1962

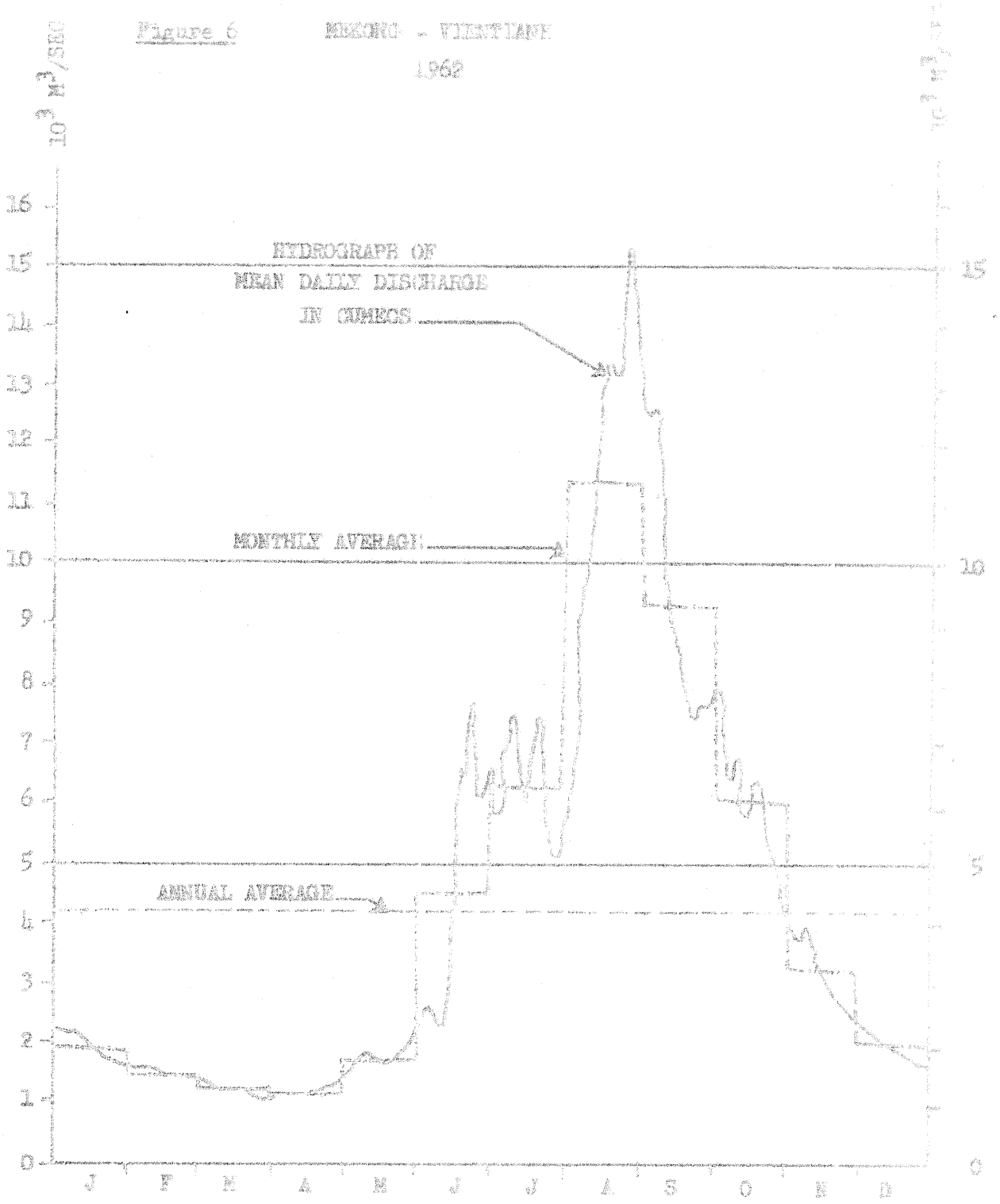
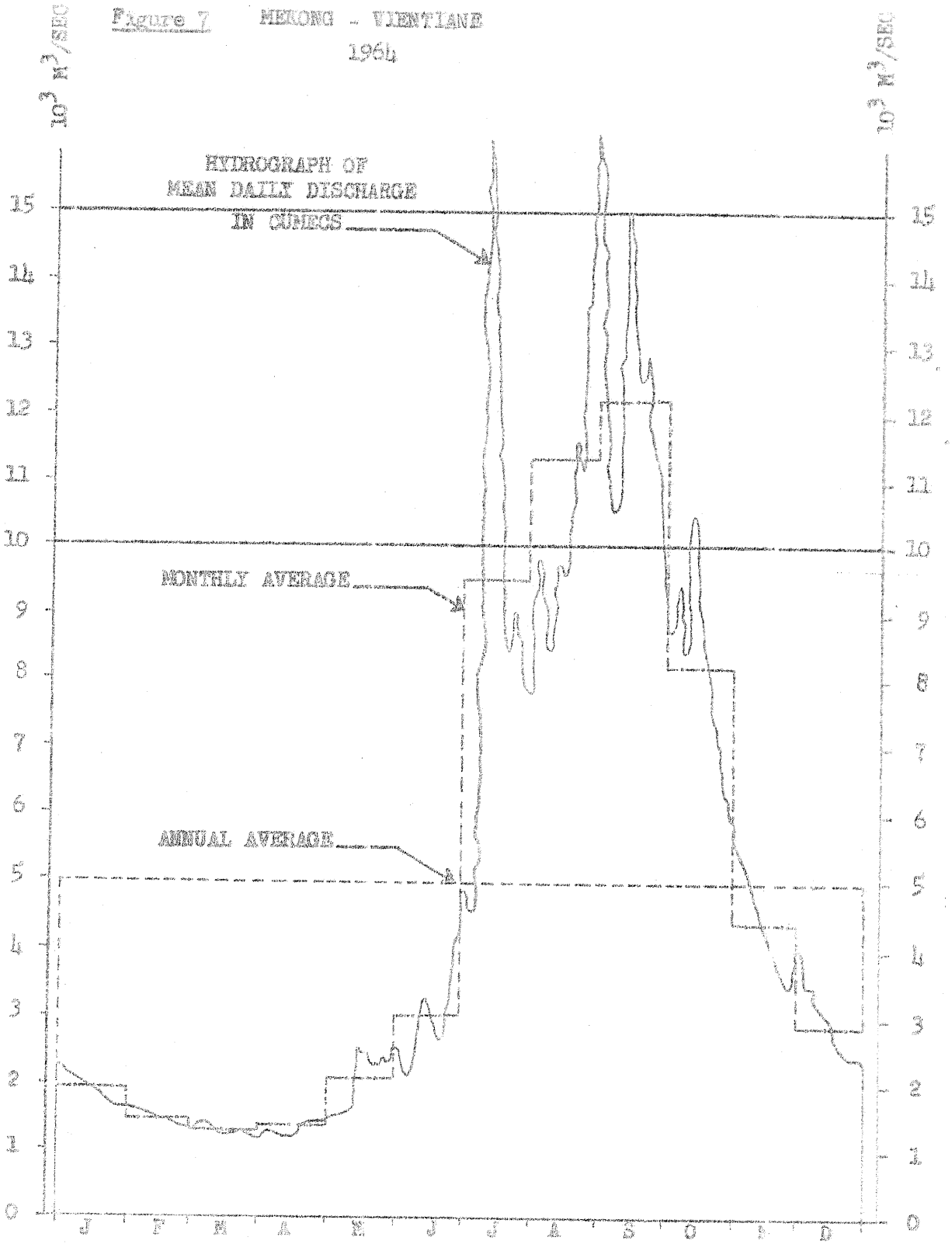


Figure 7 MEKONG - VIENTIANE

1964



stabilized and assures accurate results from the stage recorder. From that time, the stage records are continuous and daily flow data were obtained except for short periods when the stage recorder was inoperable. All the known flow data are tabulated in Appendix Tables 1 thru 12.

Although the stream flow records of the river made prior to 1970 were not continuous and reflect some inconsistencies as shown in the Tables, it is believed the individual measurements show the approximate amount of flow. From the time when the permanent stage recorder was established in January 1970, the flow measurements are believed to be fairly accurate.

Although all flow measurement prior to 1970 were at two sites made within 1,000 meters of the dam, there are unexplained differences in the amounts of flow as indicated in the Tables. The high and low flow periods in the simultaneous sets of measurements at the different locations indicates the trend of stream flow. Since the trends of flow volume are indictative and although actual measurements are inconsistant, it is believed that an average summary could be made for all individual measurements for the same period. It must be recognized that only approximate flow estimations can be made from the data and must be used cautiously when estimating amounts of flow.

C. Irrigation Requirements

Paddy rice is the principle crop grown on the Project. Experience with paddy rice in the Project indicates that to maintain optimum growing conditions water must be supplied about every 5 days in the dry season and 10 days in the rainy season. The figures are approximate and assumes normal evapotranspiration. The length of period could be altered by rainfall.

The paddy soils of the Project must be kept saturated to maintain optimum crop growth. If the paddy soils become dewatered and dried, the pH drops, causing an

excessive acid condition. This will bring about an aluminum toxicity in the soils. This results in crop damage proprotional to the extent that the soils are permitted to dry out.

The dam was designed to serve as a diversion structure. No water storage is provided. The 5 or 10 day period of flow is crucial to successful irrigation of paddy rice. A 5 and 10 day running average of river flows were calculated from the available flow data by months and presented in Appendix Table 13.

Project Operating Experience

Actual experience will indicate if the Project duty-of-water design criteria are applicable to Project operating conditions. In the dry season of 1972-73 about 300 ha. of paddy rice were planted and brought to full production. During that period, the Project water management staff working closely with water users showed that about 300 ha. was the maximum area that could be irrigated with the available amount of water from the river.

The dry season paddy rice was grown according to the following cultivation schedule:

	Dry Season Paddy Rice Cultural Practices.
25 December	Seed bed planting limited water required.
25 January	Plowing, field preparation, and transplanting of seed. Water required up to maximum flow until the end of January.
February	Growing. Maximum water supply required.
March	Panicle initiation (flower). Maximum water supply required.

April - May	Harvest. Water will be required until 2 to 3 weeks before harvest but not at maximum flow.

Full water supply is required starting about late December and continuing up to about the end of March. The most critical period is the growing and panicle initiation in February and March.

The average water flow during the period February and March was 763 lit per sec. The records show that the daily flow during the period was very close to that average except for a rainy period, March 24 to 27, 1973. Relating the average flow for the period to the area irrigated indicates that about 763/300 = 2.54 lit/sec/ha. duty of water was required to serve the crop area.

To serve the 300 ha. in the dry season it was necessary to maintain a river flow of about 2.54 lit/sec/ha. duty of water. There was a wide divergence between the Project design criteria for the duty of water and experience for that dry season. The Project was designed on the criteria that 1 lit/sec/ha. duty of water would be adequate to serve the paddy areas. That amount is the overall project delivery design flow commonly used by irrigation project designers in the South East Asian rice growing areas. During that period there was observable waste of water. Many of the paddy fields were widely separated so that a number of the fields were not contiguous. This promoted waste of water, since water runoff from one paddy could not be picked up and utilized by adjacent lower lying paddies. Excessive waste may have occurred within the delivery system. Water wastage may be reduced by improved water supply management and by grouping the paddy areas into larger contiguous units.

A Project design criteria of a duty of water of about

2.54 lit/sec/ha., will be used to forcast the area of paddy that can be served until it can be demonstrated and proved otherwise under dry season operating conditions.

The duty of water criteria for estimating the rainy season period water requirements for growing paddy will be less than 2.54 lit/sec/ha. During the rainy season, rainfall and reduced evapotranspiration is helpful to paddy irrigation. Examination of the rainfall and river flow records indicate that the flow increases rapidly within 24 hours after a rain and reduces rapidly when no further rain occurs. The rain will help to fill the paddies along with the river flow available immediately following the rain period. The flow will rapidly decline after a rain if a prolonged dry period occurs beyond 24-48 hours. These data also indicate that there is a rapid runoff of water with little retention or storage of rainfall within the watershed. The river flow correlates and is very proportional to the amount and timing of rainfall.

Numerous rains occur in the rainy season and infrequent prolonged dry periods may occur. Dry periods are usaully preceded by rains which produce enough water along with river flow so that the paddy areas will enter the period with full water supply. It is believed that the required irrigation frequency during the rainy season will be about 10 days. The duty of water of 2.54 lit/sec/ha. experienced in the 1973 dry season is believed to be too high to be used as design criteria for the rainy season water demands. The irrigation frequency is estimated to be increased from 5 day in the dry season to a 10 day period in the rainy season. It is similarly estimated that the duty of water demand can be reduced by about half or 1.27 lit/sec/ha. which is closer to the design criteria of 1 lit/sec/ha. commonly used for irrigation design in the region.

The Japanese experience in the Tha Ngon Project in the Vientiane Plain during the 72-73 dry season indicates a duty of water of about 1.50 lit/sec/ha. The Japanese

experts estimated that the figure may be low as they experienced difficulty serving the paddy lands. This indicates that the Project dry season experience of duty of water of 2.54 may be high and that the rainy season duty of water will be less than 1.50 lit/sec/ha. The figure of 1.27 lit/sec/ha. noted above is believed to be realistic for Project estimates of water demands during the rainy season and will be used in the following calculations.

Rainfall Correlation

An attempt could be made to correlate the rainfall to the river flow and irrigation water demands. However, that step would very likely not reveal any more information than is already known for the following reasons:

1) The rainfall is measured near the dam site and not within the central watershed area which is over 10 km. distant from the dam site. To relate rainfall data to the river flow and irrigation demands requires rainfall data collected by the RLG over a long period within the watershed area.

2) Rains in Laos are very erratic, spotty and many times occur in very concentrated areas.

3) The flow records generally reflect the rainfall pattern within the watershed.

Therefore only Nam Tan river flow data will be used in further discussions and predictions regarding the amount of the Project area that can be irrigated.

Dry Season Irrigation Requirements

The cropping schedule show that February and March is the period when a full supply of water must be provided to the paddy rice to maintain optimum growth and to prevent crop damage from the adverse effects of the drying out of the soils.

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Examination of the 5 day running averages presented in Appendix Table 14 show that the river flows during February and March is very uniform with only minor exceptions.

The 5 day moving average flows were calculated for the months of February and March. By utilizing a duty of water requirement of 2.54 lit/sec/ha. Table 1 shows the total possible area that can be irrigated with that flow.

TABLE 1 Average Stream Flow and Areas That Could be Irrigated (Dry Season)

Year	Month	Average Flow Lit/sec.	Estimated Area Served @ 2.54 lit/sec/ha. Duty of Water Ha.
1968	February	1,580	622
	March	1,750	688
1969	February	-	-
	March	-	-
1970	February	1,230	484
	March	700	276
1971	February	1,200	472
	March	970	381
1972	February	460	181
	March	930	366
1973	February	720	283
	March	810	319

Average Values Descending Order

	Ha.	
1	688	
2	622	
3	484	
4	472	
5	381	
6	366	Median
7	319	
8	283	
9	276	
10	181	

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In ten periods in February and March ranging from 1968 thru 1973 the amount of area that could be supplied water during the critical dry period varies from a low of 181 ha. to a high of 688 ha. The medium range is 373 ha. During the period 1968 - 1973 dry season about half of the time, less than about 373 ha. could be served adequate water for dry season paddy. The values range to a low of 181 ha. during one month, the next higher value was 276 ha. Based on those records and for the total time of six years, in which record of one year is missing or five records, it can be predicted that about 300 ha. of land area of paddy rice could be supplied adequate water 9 out of 10 months. There is a possibility that a water shortage would be experienced one out of five years, based upon the limited data on hand.

Rainy Season Irrigation Requirements

The rainy season is a different set of climatic, rainfall, and river flow conditions. The Project irrigation area has not been fully devloped. The experience factors are not complete enough to show the amount of the duty of water demand during the rainy season. The records show that the river flows are erratic. The amounts depend largely upon the frequency of rainfall The rainfall can be expected to supply a portion of the required irrigation water to the paddy fields. The flow records show prolonged periods of very low flow during the rainy season which is a reflection of the general rainfall pattern. Due to more frequent rains on the Project area during the rainy season it is believed that a 10 day irrigation period can be used for rotational water supply to paddy rice. This assumes that the rice could go for about 10 days without additional water supply or rainfall during the critical growth period and still maintain optimum production. The figure of 1.27 lit/sec/ha. duty of water demand noted above will be used to estimate irrigation requirements during the rainy season. If a prolonged low rainfall period occurred the estimated duty of water may not be sufficient.

Rainy Season Paddy Rice Cultural Practices

June	Sowing seed, plowing and field preparation. Water supply critical but full water supply not required.
July & August	Transplanting of seedling. Water supply brought to full amount by first of July.
September & October	Panicle initiation (flower). Full water supply required to end of October.
November	Harvest.

The cultural practices indicate that full water supply is required throughout the growing period from late July through an earlier portion of October.

The average 10 day flows from Appendix Table 15 were utilized in the analysis of water requirements for rainy season paddy rice. By using a duty of water of 1.27 lit/sec/ha. the areas were calculated that could be served by the average 10 day flows and are summarized by months and years in Table 2.

The data were resummarized into 18 periods in descending order of values in Table 3 and were plotted in Figure 8 as regression curves.

TABLE 2 Average Areas That Could be Irrigated (Rainy Season)

(Based on 10 day moving averages)

Year	10 day cycle	June Ha.	July Ha.	August Ha.	September Ha.	October Ha.
1968	1	2,315	1,913	4,228	2,606	3,189
	2	2,717	2,165	4,740	3,488	3,425
	3	1,898	3,015	3,512	4,189	2,787
1969	1	2,827	1,842	1,764	4,639 *	4,307
	2	2,055	1,606	6,984	4,639 *	1,087
	3	1,882	2,402	2,906	4,639 *	937
1970	1	1,945 *	4,535	8,063	10,260	3,803
	2	1,945 *	3,071	5,598	7,898	3,031
	3	1,945 *	2,811	6,315	6,331	2,094
1971	1	1,465	2,819	3,378	6,047	5,622
	2	1,173	5,819	8,843	4,488	1,756
	3	5,559	4,126	9,975	2,874	1,323
1972	1	740	575	2,724	969	1,102
	2	583	724	2,811	858	1,457
	3	449	1,969	3,984	2,291	976
1973	1	3,425	1,795	2,968	3,921	4,354
	2	1,331	3,953	1,323	4,850	1,079
	3	756	2,402	7,118	8,512	890

* Missing data, average of periods.

TABLE 2 Average Areas for Months Descending Order

(Based on 10 day moving averages)

	June Ha.	July Ha.	August Ha.	September Ha.	October Ha.	
1	5,559	5,819	9,975	10,260	5,622	
2	3,425	4,523	8,843	8,512	4,351	
3	2,827	4,126	8,063	7,898	4,307	
4	2,717	3,953	7,118	6,331	3,803	
5	2,315	3,071	6,984	6,047	3,425	
6	2,055	3,015	6,315	4,850	3,189	
7	1,945 *	2,819	5,598	4,639 *	3,031	
8	1,945 *	2,811	4,740	4,639 *	2,787	
9	1,945 *	2,402	4,228	4,639 *	2,094	
Median						Median
10	1,898	2,402	3,984	4,488	1,756	
11	1,882	2,165	3,512	4,189	1,457	
12	1,465	1,969	3,378	3,921	1,323	
13	1,331	1,913	2,968	3,488	1,102	
14	1,173	1,842	2,906	2,874	1,087	
15	756	1,795	2,811	2,606	1,079	
16	740	1,606	2,724	2,291	976	
17	583	724	1,764	969	937	
18	449	575	1,323	858	890	

* Missing data, average of known data.

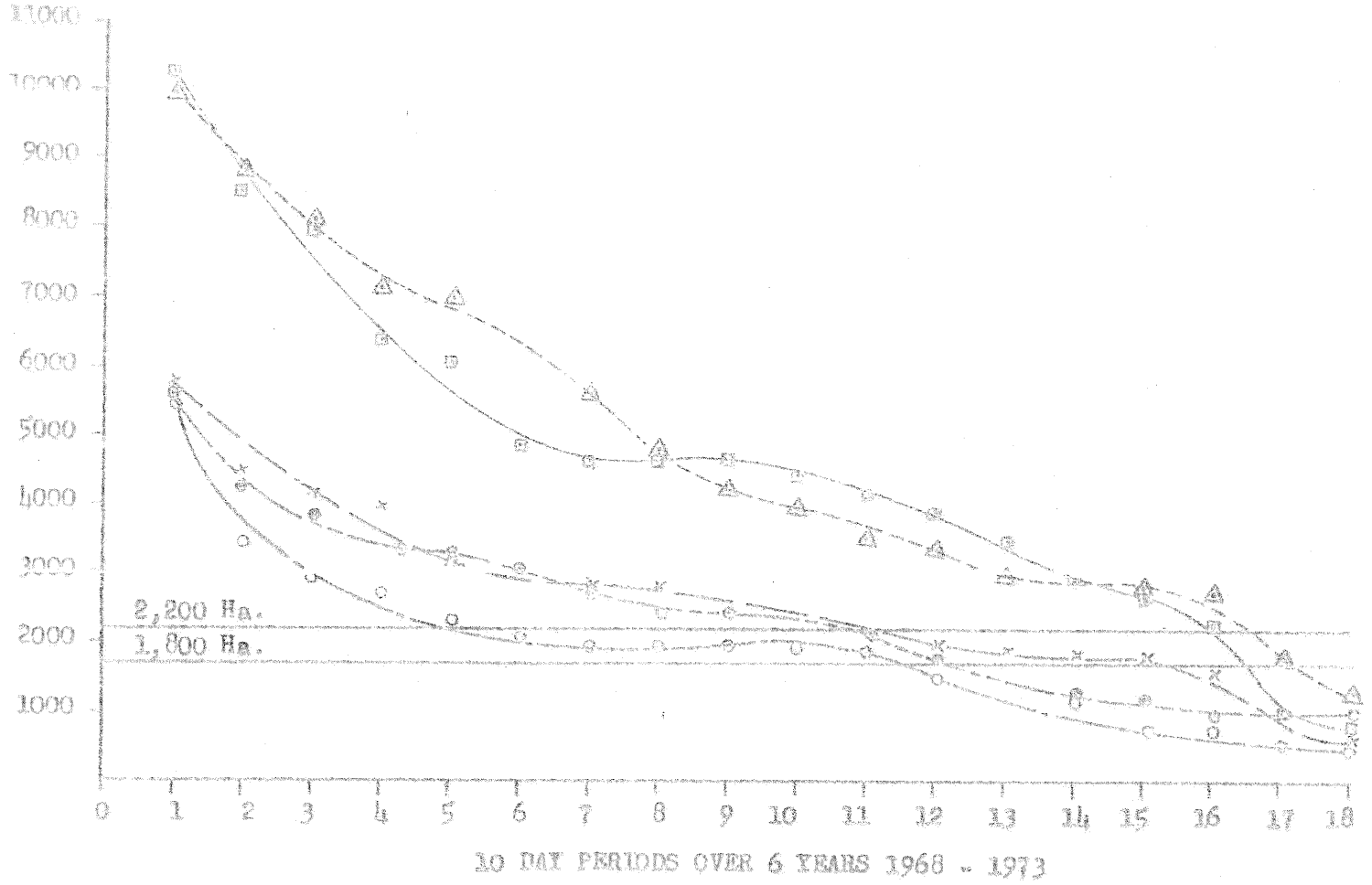


Figure 8 Median Regression - Probable Area of Irrigation (Ha.) Critical Growth Periods.

June
July
August
September
October

D. Monthly Notes on Water Requirements (Irrigable Areas)

From the 10 day moving averages shown in Table 3 p-18 and plotted in figure 8 p-19 the following is indicated:

1. June

The areas range from 449 to 5,559 ha. with a median of 1,898 to 1,945 ha. About half the time less than 1,900 ha. could be supplied water. The farmers do not like to plant in June. The high probability of a short water supply in June shows the accuracy of their experience. The data indicates that about 500 to 600 ha. could be safely planted in June and be assured an adequate water supply.

2. July

The areas range from 575 to 5,819 ha. with a median of 2,402 ha. The data show that in 15 periods out of 18, there will be an adequate supply water for 1,800 ha. or more. It can be predicted that one period in 6 years may experience a water shortage when serving 1,800 ha. In five out of 18 periods less than 1,800 ha. ranging down to 575 ha., could have been supplied adequate water. The flow records for 1972 indicate the first 20 days would be supplied only enough water to supply about 575 ha. to 724 ha. In 1972 there was 1,097 ha. of rice successfully produced and there were no complaints from the farmers of water shortage. The estimated design criteria of 1.27 lit/sec/ha. may be a bit conservative and might be lowered and/or the farmers may be delaying the planting of the crop so the maximum water demands does not come until a later period. These data also explain, in part, why the farmers of the Nam Tan area prefer to delay the rice planting to late July and early August. Long hard earned experience with the weather has taught the proper time to plant rice.

3. August

The areas range from 1,323 to 9,975 ha. with a median of 3,984 to 4,338 ha. The low values of 1,323 and 1,764 ha. occurred in the midle period 1973 and the first period of 1969 respectively. In 1973 there was about 1,283 ha. of paddy rice successfully planted. There were no significant complaints from the farmers of a water shortage during that period. All other periods could have been supplied water in excess of the 2,200 ha. of land planned to be developed in the Project. A very low river flow occurred two times. A water shortage could occur about 2 times in an 18 period frequency in 6 years. These data show that careful water management will have to be exercised, as the periods of low flow are unpredictable.

4. September

The areas range from 858 to 10,260 ha. with a median of 4,488 to 4,639 ha. The data show that two successive periods in first part of September 1972 were abnormally low flow periods of the river. The flow was adequate to irrigate only about 858 to 969 ha. In 1972 there was 1,097 ha. of paddy rice successfully produced and there were no significant water shortage complaints from the farmers. These data indicate that the estimated design criteria of 1.27 lit/sec/ha. may be a slightly low estimate for the rainy season duty of water. Some of the fields were planted earlier and are in the final stages of growth in September and water demands may be reduced for the earlier maturing crops. Planting practices will play an important role in correlation with water management to "stretch" short water supplies. Staggering the time of planting would reduce peak demands for water supply to within the available river flow, provided farmers will accept improved varieties of rice that are non-photosensitive.

5. October

The areas range from 890 to 5,622 ha. with a median of 1,756 to 2,094 ha. Crops are maturing, harvest is beginning and water demands are reduced. If water shortages have not occured in the previous months with the crop maturing, water shortages that might occur now would not effect the crop. There is inadequate production data to show how much of the crops are lost due to shortage of water in October. It is believed there were losses in the 1973 crop due to late planting and inadequate water supply through late October and early November.

The six year river flow record is too short to make definitive and reliable flow predication. Known flow data combined with three years of Nam Tan Project operating experience indicate the following broad conclusions:

E. Dry and Rainy Season Cropping

1. Dry Season Cropping

About 300 ha. of paddy rice can be reasonably assured adequate water supply. Even with that it can be predicted to experience a water shortage one year in five. Water management experience during the 72 - 73 dry season which is the criteria used to support the prediction, showed consierable wastage of water. Thus it is believed that 300 ha. is a conservative estimate. Even though the flow records indicate a water shortage could predictably occur, improved water management practices would alleviate the situation. When it can be demonstrated by practical Project operation that water management will be improved, the production area can be increased. the probability of growing alternate crops requiring less water on suitable soils areas could also be considered. A significant area of alternate crop production would be a substantial change for the cultivator from the long tradition of rice growing. The feasibility of alternate crops is yet to be

established. It is believed that in the forseeable future, rice will be the primary economic base. Thus water demands will need to be adjusted to the water requirements of rice cultivation.

2. Rainy Season Cropping

About 1,800 ha. of paddy rice can be assured an adequate water supply until it can be demonstrated by improved Project water management and shown by longer recorded river flow data that additional area can be assured an adequate water supply. With a 1,800 ha. of irrigable area, water shortages could occur one out of nine years. Water and crop management will exert a key role in attempting to increase the irrigable area to the maximum possible irrigable area of 2,200 ha.

The remaining 400 ha. of irrigable land should be developed for non-irrigated crops such as those recommended in Chapter IV Soil and Agronomy. Improvement of water management and cropping practices would permit development of paddy rice beyond the 1,800 ha. recommended for immediate development. But until these improved practices can be demonstrated and there is reasonable chance farmers will utilize them, i is recommended that irrigation development be limited to about 1,800 ha.

During portions of June about 500 ha. of paddy rice can be assured an adequate water supply. About 500 ha. of paddy rice should be planted in June to a non-photosensitive variety that would mature in September. This would assure the remaining 1,300 ha. planted in July or August an adequate water supply to reach maturity. Even with a staggered planting using non-photosensitive varieties, water shortage is predictable and would occur one out of nine years.

IV. SOILS AND AGRONOMY

A. Introduction

Water management and land classification are the integrated processes of intake, conveyance, regulation, measurement, distribution, application and use of irrigation water on farms, and with proper amounts and at the right time, for the purpose of securing maximum crop production and water economy. It is within this framework that the probable uses of land classification and its function -- not only in planning and assessing irrigation projects, but also in operational programs of water management are used as an operational tool in the Nam Tan Project. Land classification is the systematic appraisal of the physical, chemical and biological characteristics of land. Also included is the determination of irrigation suitability by categories or land classes having similar physical and economic aspects. Land classification is one of the fundamental activities involved in planning, constructing, and operating the Project.

B. Economic Correlation

In the Project, the physical factors of soils and crops are functionally related to an economic value. The arable lands of the Project were separated into the two main groups: a) those best suited for irrigated rice production, b) those best suited for irrigated diversified crops. The criteria which determine whether the land is better suited for rice or for diversified crops are the physical soil features. Wet-land rice thrives best on soil which can easily be puddled and which will maintain a perched water table under flooded conditions without excessive losses to deep percolation. Diversified crops on the other hand do best on medium-textured and well drained soils.

the technical probability of increasing the assured irrigation area to an amount greater than 1,800 ha. are very good. Given the need to improve water control and system management, much treining of water masters, altering traditional cropping practices and many other needed technical changes, it would be optimistic to believe that these changes can be achieved in a short time frame. Rather it is believed that further Project development to the maximum of 2,200 ha. should proceed at a pace commensurate with the experience gained as the changes and improvement in Project management are achieved.

C. Uses of Land Classification Information

The primary function of land classification on the Project is to delineate the areas suitable for irrigation development. It also serves as one of the basic elements in determining water requirements, evaluating land use and management requirements including estimating and determining good methods of land development. Also irrigation benefits and payment capacity are derived from farm returns. It provides the basis of the engineering layout for the distribution system, appraising land values, and for assessment of water charges. Most of these are relevant to water management and apply generally to irrigation planning, construction, operation and maintenance.

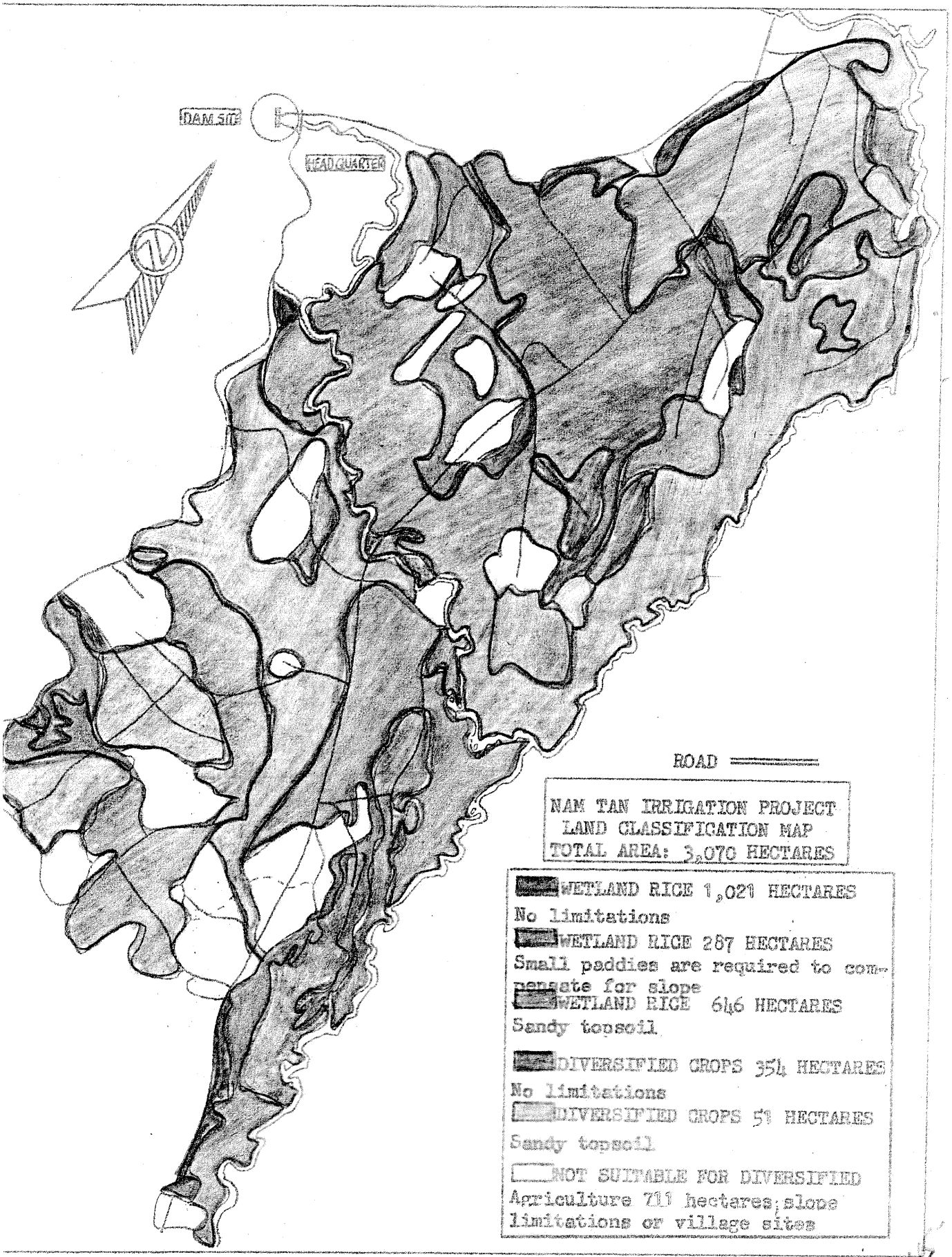
D. Land Classification Results

A reconnaisance land classification conducted in about 1969 indicated that the Project was physically feasible relative to the soils. Subsequent project operating experience both with water management and with the soils indicated that a detailed land classification would be required to assist and refine management of the Project. The detailed classification shown in Figure 9 was completed on October 1973 and the results are as follows:

a.	Wetland Rice	1,021 hectares
b.	" "	287 "
c.	" "	646 "
a.	Diversified Crops	354 "
b.	" "	51 "
	Total	2,359
Not suitable for cropping		711
	Grand Total	3,070

Of the total area of 2,359 ha. shown as suitable

Figure 9 LAND CLASSIFICATION PROJECT AREA JANUARY 1974



for cropping with only about 2,700 ha. supplied with water under the existing planned delivery system. Of this 2,200 hectares, 1,800 can be reasonably assured adequate water. (See Chapter III)

E. Recommended Uses of Classified Soils

Following are shown the recommended cropping use and location of the classified soils:

Paddy Rice

a) 1,021 hectares [redacted]

Existing paddy, clay loam with impervious sub-soil of clay, soil pH ranges from 4.5 when dry to 6.5 when wet, aluminum toxicity ranges from high when dry to low when wet, and having a high water holding capacity and low to moderate inherent fertility.

Suitable for paddy rice cultivation since rice is tolerant to flooding. Not suitable for diversified crops because these crops are not tolerant to:

a - Flooding
b - High level of aluminum toxicity when dry.

For recommended procedures see Sec. 2, Attachment #1 (Dry Season Rice Production).

b) 287 hectares [redacted]

Proposed for paddy - sandy loam with imperneable sub-soil, other conditions are the same as green colored area with the following exceptions: lower holding capacity, difficult to transplant, and low in soil nutrients.

Same procedures as above except the undulating topography requires small paddies to compensate for slope. This increases the amount of manpower needed to farm and maintain paddy dikes. The small paddies

also restrict the use of large tractors and there is a permanent limitation on cultural practices for economical production.

c) 646 hectares [redacted]

Has same conditions as green but uneven topography If paddy rice is to be grown, the paddies will be small in size, similar to terraces, and difficult to irrigate. Same procedures as above except the sandy topsoil requires more labor during transplanting and 25% more fertilizer to maintain optimum production.

During the wet season, the rice land that has not been developed into paddies can be planted to upland rice. See Appendix Sec. 3, Attachment #2. Severe weed problems are frequently created under this type of rice farming.

Diversified Crops

a) 354 hectares [redacted]

Loamy, well drained soil suitable for diversified crop. Fertilizer required for good production. For recommended procedures see Appendix Sec. 4, Attachment #3.

b) 51 hectares [redacted]

Loamy, well drained soil suitable for diversified crops. Sandy soil has low water holding capacity and requires fertilizer for good production.

Same procedures as recommended above except the sandy topsoil requires 25% more fertilizer to maintain optimum production.

Not suitable for diversified agriculture, 711 hectares. The land, in these areas, that is not

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occupied by roads, streams, villages and rock outcrops can be used for tree and forage crops.

F. Soils and Agronomic Factors

A total of 2,359 hectares of land within the Project area were classified as suitable for irrigated agriculture. Of this area about 1,954 hectares are suitable primarily for wetland rice and about 359 hectares could be utilized for diversified crops. A major portion of the Project area is thus classified as suitable only for wetland rice paddy. Recent experiences with the tropical paddy soils of Laos and on the Project have shown that due to the chemical and mineral nature of those soils, in order to achieve successful rice production will require careful water management and agronomic practices. Moreover if a rice yield of 2 to 3 tons per hectare is to be significantly increased, additional basic information about those soils is required.

Mr. Harold Rinnan, AID/Agric. Advisor, recently completed a paper "Soil Fertility Conditions in Laos" (See Appendix Sec. 5) which shows some of the basic information and suggested criteria for managing the paddy soils of Laos. It is believed the ideas and criteria shown in the paper will apply with minor exception to most of the paddy rice areas of the Project.

The paper is summarized as follows:

To effectively improve agricultural production in Laos, more knowledge is needed about the location and extent of potentially productive soils. To use these soils to their best advantage, more information is needed about their nutrient holding capacity and to determine a suitable fertility management program. In this paper, the effect of high soil acidity on the availability of plant nutrients is discussed.

Limited effort should be devoted to increasing rice

and upland crop production until a better understanding is gained about soil acidity and cation exchange capacity of Lao agricultural soils. Both of which provide an indication as to the availability of plant nutrients and the extent to which nutrients can be stored after fertilizer applications. In soils of high acinity, phosphates fixate with iron and aluminum, making them unavailable for plants. Highly acid and poorly drained soils provide conditions for the rapid reduction of nitrogenous compounds to nitrogen gases which escape into the air and are unavailable for plant growth.

The modification of the soil acidity can be temporarily achieved by flooding during the growth cycle of a crop. Rice is one of the few crops that can tolerate constant standing water above its root system. Flooding changes the soil conditions by excluding the oxygen supply causing important changes to take place in the soil that will shift the acidity from pH 4.5 to stabilize at or near a neutral pH 7.0. Under such conditions, denitrification cannot occur and the solubility of iron, aluminum and manganese no longer interfer with the availability of phosphate and potassium making them readily available for plant growth. If the anerobic conditions are lost, i.e., the paddy dried out, the phosphates and nitrates are no longer readily available.

The soil environment can be modified, but a basic knowledge of the soils is necessary if proper decisions are to be made regarding the best use of land resources and adequate soil fertility management.

G. Recommendations

1. The well equipped soils laboratory located at Salakham Station, should be put into operation as soon as possible. It will be the cornerstone of meaningful improvement in Lao agricultural development.

2. Leadership of a full time agronomist with a good

background in soil chemistry and laboratory operation is recommended. Because competent Lao staff must be trained to operate the different testing instruments, his tour should be a minimum of two years. This agronomist must know how to service and maintain the electronic testing machines and be prepared to make frequent trips to the different Provincial Agriculture Offices to help them administer and understand a dynamic soil testing program in their areas. There must be very close coordination between the laboratory staff and the field staffs at Provincial levels. The field staffs will need substantial help in understanding the laboratory data and learning how to apply this information to their areas.

3. Though several references have been made as to the need for correcting soil acidity, it would be inappropriate at this time to start construction of an agricultural limestone processing plant, until the laboratory is functioning and soil scientists and agronomists have been able to study the situation. The on-going agriculture limestone program in South Vietnam, which is enjoying USAID support, should be followed closely. The soils problems there may be very similar to those of Laos.

V. SOCIO-ECONOMIC ASPECTS *

Before the Project was implemented, Nam Tan Area was in a very basic subsistance agricultural environment and travelers either went on foot or rode on an elephant. Jungle was everywhere. About two days and one night were required to travel from Sayaboury to the area. Everybody when making the journey carried some kind of weapon. Only a few merchants had the courage to transact business between Sayaboury and the area and most of the villagers remained and lived where they farmed and hunted. There was little communication and movement between villages, unless the villages were close together. Life was ancient and static under a subsistence agriculture.

Money was seldom earned or circulated. The merchants usually exchanged some clothes and other goods for agricultural products with farmers. Pricing was not important to the farmers as long as they could barter for what they wanted. Marketing was unnecessary to the farmers as they only needed to feed their families.

Partly due to the lack of education the villagers had little want for a better life. There was no great inducement to work harder in order to improve their income and life.

Lack of transportation and communication were also retarded progress. This facet of the environment inhibited the development of urban areas, and hindered the villagers' adoption of new technology for modernizing their socio-economic life.

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* For more details concerning Socio-Economic Aspects, see Appendix Sec. 6, Project Evaluation and Appendix Sec. 7, Interviews with the Farmer Groups.

A. Transportation and Communication

Before the Project was started, a road was constructed from Muong Phieng to Na Khem transversing a portion of the Project area. After the Project had been implemented, a number of roads were constructed adjacent to the canals leading to the villages and this development induced considerable change in both environment and life. The communication network seemed to energize the area. Merchants, taxis, commercial trucks, soldiers, and people from all walks of life traveled to the villages. The entire area was suddenly opened up and exposed to civilization.

Merchants no longer carried goods, but cash to exchange for agricultural products. Farmers no longer remained at home to await merchants to bring industrial goods to exchange for their agricultural products, but took the cash to town and bought what they needed. Commercial life emerged from the ancient and non-business life. A number of villagers have opened up retail shops.

Villagers tend to pay visits to friends and relatives in other remote villages more frequently than before since there are taxi and trucks coming and going 3-5 times a day. The taxi fare is relatively cheap. Replacing the elephant, farmers can now take a heavier load of agricultural products to town for a relatively smaller cost on a truck.

Through intensive and frequent communication, villagers are more friendly. They no longer need to carry weapons on their journeys. News of events can disseminate over the entire area in a matter of hours rather than days or weeks as before. Lastly, people of different tribes and cultures are integrating into one farmer unit which is promoting changes in the Nam Tan community.

B. Social Transformation and Community Development

The long lasting Indochina war has generated pressure on the social security of the Lao people near the war front. Sick and hungry people of all ages have had to leave their homes, properties and land. The USAID cooperated with the RLG and has provided a few of them homes in the Nam Tan Area. But they must become productive and self-sufficient by exploiting local resources as much as possible. The Project has created not only a water distribution system but also a transportation and communication network. The Project has provided three new schools having 22 classrooms and public health centers in several villages to provide the young generation with a better education and health facilities for farmers.

Weak and unhealthy refugees from different environments slowly became strong and healthy. At Nam Tan they were transformed into a single community, a new society in a new land. The differences in religions, cultures, and traditions are kept alive but the philosophy of various tribes and societies is merged into a single form. They farm, trade, celebrate, and enjoy festival ceremonies together. Before they never gathered together to perform celebrations. Now at Meo New Year, Lao dance and popular dancing are performed by both Lao and Meo together. In the dining room they sit and eat together. This is a large social transformation of the refugees into the old, deep rooted resident society of the area, which has equally been transformed by the intrusion of the refugee culture. The old and the new are mutually fused into one by the development of the Project. The resident and refugee farmers have cooperated to form the Farmer/Water Users Association; another phase of community development integrating the old and the new. The Farmer/Water Users Association is divided into 12 sub-farmer groups on the left bank, and 9 sub-farmer groups on the right bank, (See Table 4). The main objective of the Association is operation and maintenance of the Project.

TABLE 4 LAND PRODUCTION AREAS (RIGHT AND LEFT BANKS)

A survey was done on each individual farmer group to determine the present potential of the project land in production in relation to the number of farmers.

The result of the survey is presented in tabulation for left and right banks herebelow.

LEFT BANK - 12 Farmer Groups (1 inactive)

Farmer Group	No. of Resident Farms	No. of Refugee Farms	Total Old Land	Old Land in Production	Total New Land	New Land in Production
			Ha.	Ha.	Ha.	Ha.
1	5	28	7.75	Full	76.40	38.20
2	6	39	10.79	"	116.29	87.22
3	5	24	10.68	"	67.27	Full
4	33	4	61.08	"	34.20	23.20
5	34	-	25.73	"	76.64	19.16
6	15	16	11.55	"	69.63	62.67
7	30	9	20.42	"	81.93	28.68
8	28	-	34.46	"	35.09	10.53
9	42	-	43.06	"	56.81	12.04
10	54	-	87.01	52.21	36.60	Full
11	55	-	71.35	Full	48.85	Nil
12	Inactive not yet formed			-	-	-
TOTAL	307	120	383.88	349.08	699.71	390.57

TABLE 4 (Con't) LAND PRODUCTION AREAS (RIGHT AND LEFT BANKS)

RIGHT BANK - 9 Farmer Groups (1 inactive)

Farmer Group	No. of Resident Farms	No. of Refugee Farms	Total Old Land	Old Land in Production	Total New Land	New Land in Production
			Ha.	Ha.	Ha.	Ha.
1	37	-	40.43	Full	40.48	-
2	57	-	70.76	"	41.81	12.54
3	60	2	30.93	"	96.39	48.20
4	67	-	24.93	"	151.46	75.73
5	36	13	7.87	"	129.89	Full
6	33	2	22.83	"	62.23	"
7	Inactive not yet formed					
8	75	-	83.98	Full	38.92	11.68
9	32	-	25.03	"	57.84	Full
TOTAL	360	17	306.76	306.76	619.02	398.11

Resident and refugee members work and enjoy life together as though there are no differences in ways of life.

C. Social Benefits and Constraints

The Project has provided a secure place for both residents and refugees to live and farm. Water is adequate for domestic use, livestock consumption, and irrigation. Both resident and refugee farmers are more confident that their families will not be hungry, because they can grow crops permanently on the same piece of land. Before the implementation of the Project the majority of resident farmers and all refugee farmers had to grow crops on hillsides by the slash and burn method. They had to move from place to place as frequently as every two years.

The Project provides up to three hectares of new land to each refugee family, and additional new land to each resident family to provide a total area up to three hectares. Land ownership certificates have also been issued to each family who have received new land. This is important to induce recipients of new land to feel confident of legal ownership, and to motivate farmers to put new land into production. This permits refugees to feel at home as residents.

However, problems have been created. The immigration of refugees has resulted in an increase of population growth, as shown Table 5 and Figure 10. The rate of development and crop production had not kept pace with the rice requirement. There was an increasing rice deficit from 1963 to 1969. During the deficit period many farmers were forced to grow upland rice as a supplemental supply. The annual deficit was narrowed down to a breakeven point in early 1973. The remainder of 1973 and early 1974 experienced a rice surplus, as shown in Table 5 and Figure 11.

TABLE 5 POPULATION REQUIREMENTS AND SURPLUS OR DEFICIT OF PADDY RICE

(300 Kg/Capita/Year)

Year	Population	Requirement	Production*	Surplus or Deficit	Remark
		Tons	Tons	Tons	
Table A					
1963	3490	1,047	887	(160)	No refugees
1968	4660	1,398	905	(493)	No refugees
1969	5884	1,765	1,013	(752)	1124 refugees
1973	7707	2,312	4,186	1,874	2572 refugees
Table B					
1963	3,490	1,047	887	(160)	It is assumed that the rate of population growth is linear from 1969 to 1973.
1964	3,700	1,110	887	(223)	
1965	3,917	1,175	887	(288)	
1966	4,167	1,250	887	(363)	
1967	4,430	1,329	905	(424)	The resident population has increased very little from 1968 to 1973. Population growth from 1969 to 1973 is mainly due to refugees.
1968	4,660	1,398	905	(493)	
1969	5,884	1,765	1,013	(752)	
1970	6,330	1,899	1,295	(604)	
1971	6,800	2,040	1,333	(707)	
1972	7,250	2,175	2,045	(130)	
1973	7,707	2,312	4,186	1,874	
1974	7,877	2,363	4,900	2,537	
1975	8,050	2,415	5,160	2,745	
1976	8,200	2,460	5,160	2,700	
1977	8,377	2,513	5,160	2,647	
1978	8,550	2,565	5,160	2,595	

* Figures obtained from Table 14.

Figure 10 - POPULATION GROWTH

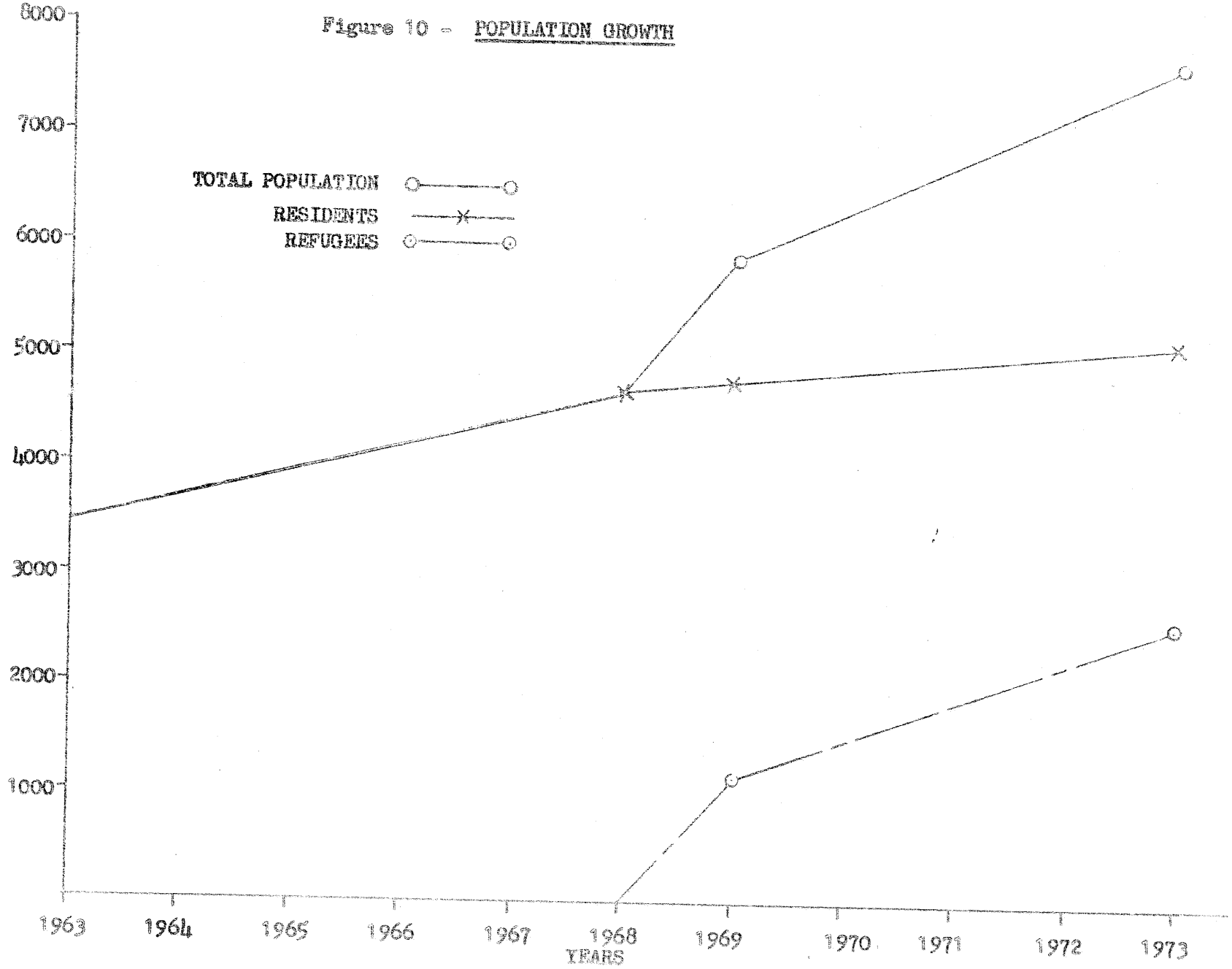
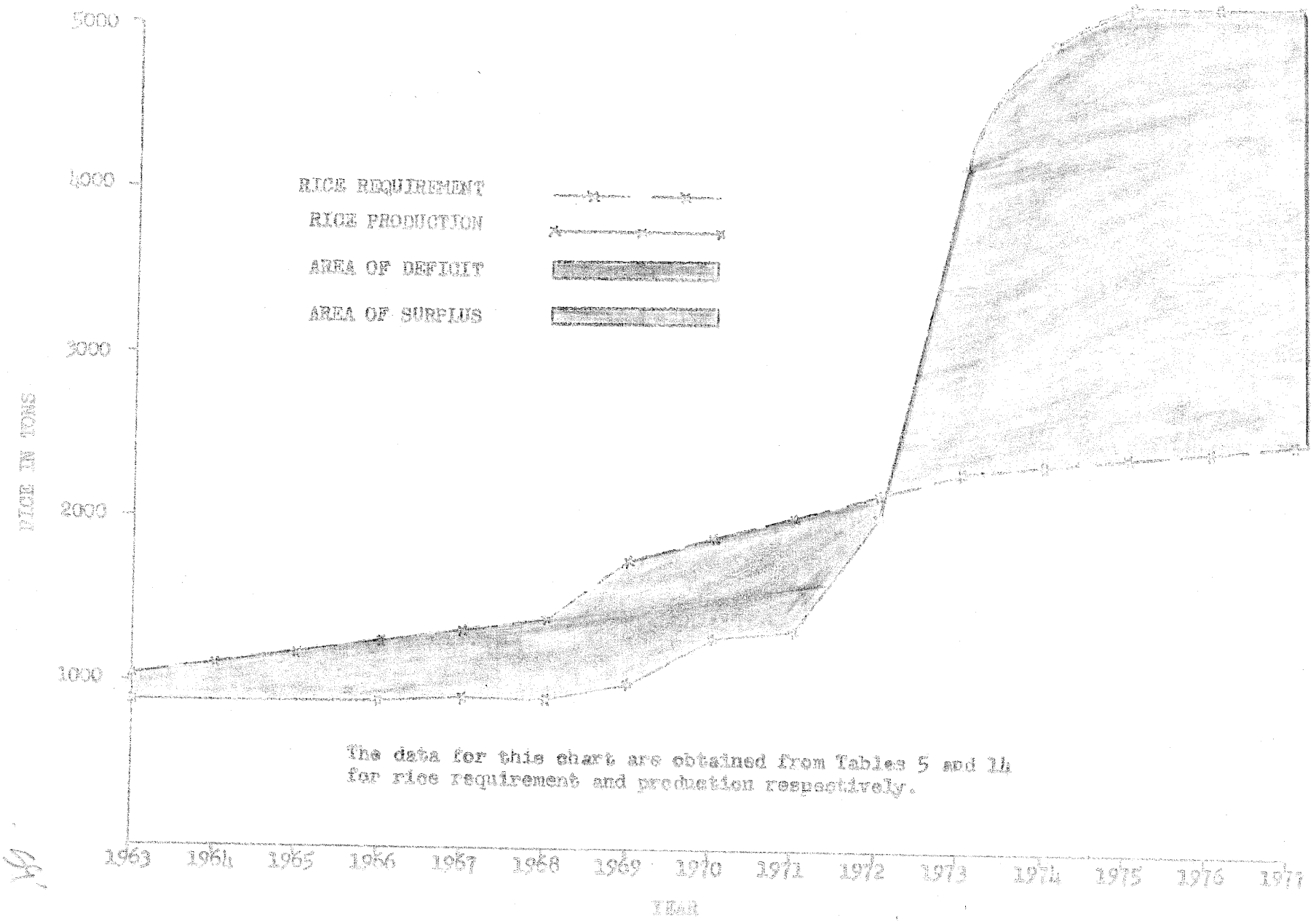


Figure 11 RICE PRODUCTION AND REQUIREMENT



The data for this chart are obtained from Tables 5 and 14 for rice requirement and production respectively.

After the Project was started, another factor influencing paddy rice shortage was due to insufficient irrigation water supply to some areas, which resulted in only portions of the new land being put into full production. Farmers remote from the delivery canals received less water, because farmers nearer the canals frequently obtained much more water than they needed. The inadequate water management has resulted in social constraints between farmers of two or more sub-farmer groups. Water dispute is now an aspect of the Project. Farmers who cannot put their new land into production because of the water shortage become depressed, poor and unhappy.

Although land is evenly distributed to each family the uneven and inadequate water distribution has placed one third of the farmers in a difficult position without an adequate water supply. The farmers in this situation believe that the RLG officials are not running the project as efficiently as possible. It appears that there is a gap in communication between officials and farmers, which needs be bridged in order to help operate the Project effectively. The officials seem to prefer a single downward communication line which retards feed-back from the farmers.

D. Production Factors

The principle factors in agricultural production are land, labor and capital. The most variable and the most easily substituted ones are labor and capital. This means that land is fixed and either labor intensive or capital intensive can be applied to produce the same volume of output. Since capital for the Project development is scarce, the labor intensive approach is necessary, particularly since a number of refugees have recently been resettled in the area. As more immigration occurs, irrigable land areas must also be increased and developed to meet the demand, up to the maximum level feasible.

1. Land

The rate or progress of land development from 1963 to 1969 was very slow with an average annual increase of 16 ha./yr., from 591 ha. to 687 ha. respectively. The development of the Project was actively started in 1970 and brought the area in production up to 797 ha. with an increase of 110 ha. By 1973 the total area in production amounted to 1,283 ha. as shown in Tables 6 through 8.

The land development trend is tabulated separately for left and right banks, and in Tables 6 through 8 and the bar charts, Figures 12 and 13. The total land development for both left and right banks is computed, forecasted, tabulated, and illustrated in bar chart, Figure 14.

Before the implementation of the Project, it was estimated that the water flow of Nam Tan River would irrigate about 3,000 ha. in the rainy season, and 1,000 ha. in the dry season. Recent hydrologic studies, stream flow and experience factors have shown that the river flow can irrigate only about 1,800 ha. and 300 ha. in the rainy and dry season respectively. The reduced area in the rainy season is largely attributed to the rainfall condition and inefficient water management. The water management can be improved by 1) Completion of the farm service ditches permitting controlled water into all irrigated farms. 2) Providing water measuring device on each inlet of lateral and sub-lateral canals, and farm service ditches. Permitting adjustment of the volume of flow to supply the optimum water requirement of a field and; 3) Training and organizing of the ditch tenders on programming the water supply schedule and controlling the supply to meet the water requirement of the crop in a field in relation to the frequency of irrigation.

TABLE 6 LAND DEVELOPMENT (LEFT BANK)

Year	Area Under Paddy	Cultivation not Planted	Area to be cleared	Area Cleared & to be developed	Total Irrigable Area
1963-66	244	154	-	-	398
1967	256	194	-	-	450
1968	256	194	-	-	450
1969	340	476	385	-	1,201*
1970	450	360	385	-	1,201
1971	455	746	-	-	1,201
1972	704	97	-	400	1,201
1973	788	35	-	378	1,201

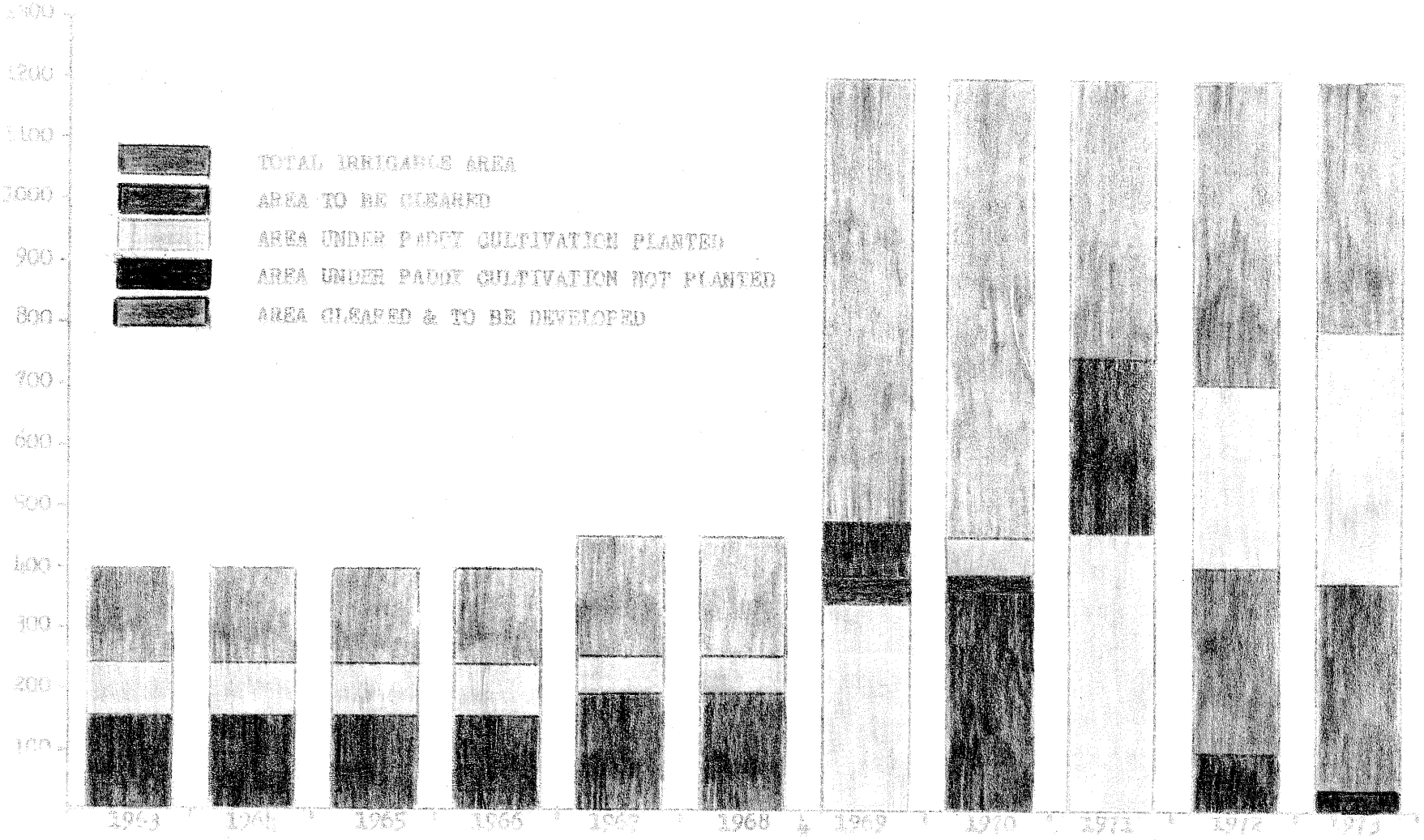
* As defined by cadastral survey at implementation of project

TABLE 7 LAND DEVELOPMENT (RIGHT BANK)

Year	Area Under Paddy	Cultivation not planted	Area to be cleared	Area Cleared & to be developed	Total Irrigable Area
1963-66	347	76	-	-	423
1967	347	86	-	-	433
1968	347	86	-	-	433
1969	347	94	559	-	1,000 *
1970	347	206	447	-	1,000
1971	230	170	100	500	1,000
1972	394	35	37	534	1,000
1973	495	-	37	468	1,000

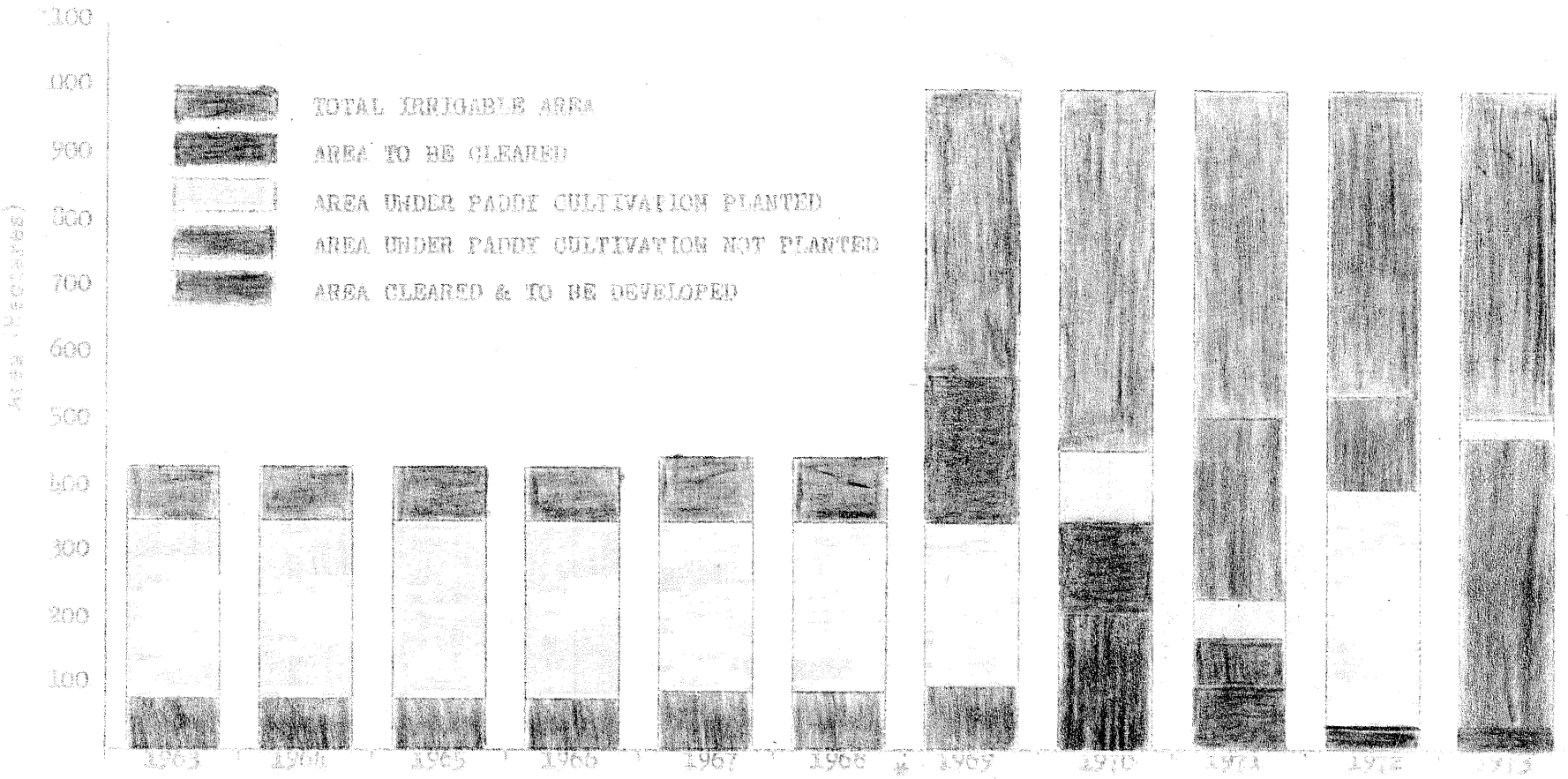
* As defined by cadastral survey at implementation of project

Figure 12 LAND DEVELOPMENT (Left Bank)



* As defined by cadastral survey at implementation of project.

Figure 13 LAND DEVELOPMENT (Right Bank)



* As defined by cadastral survey at implementation of project

TABLE 8 LAND DEVELOPMENT (Con't)

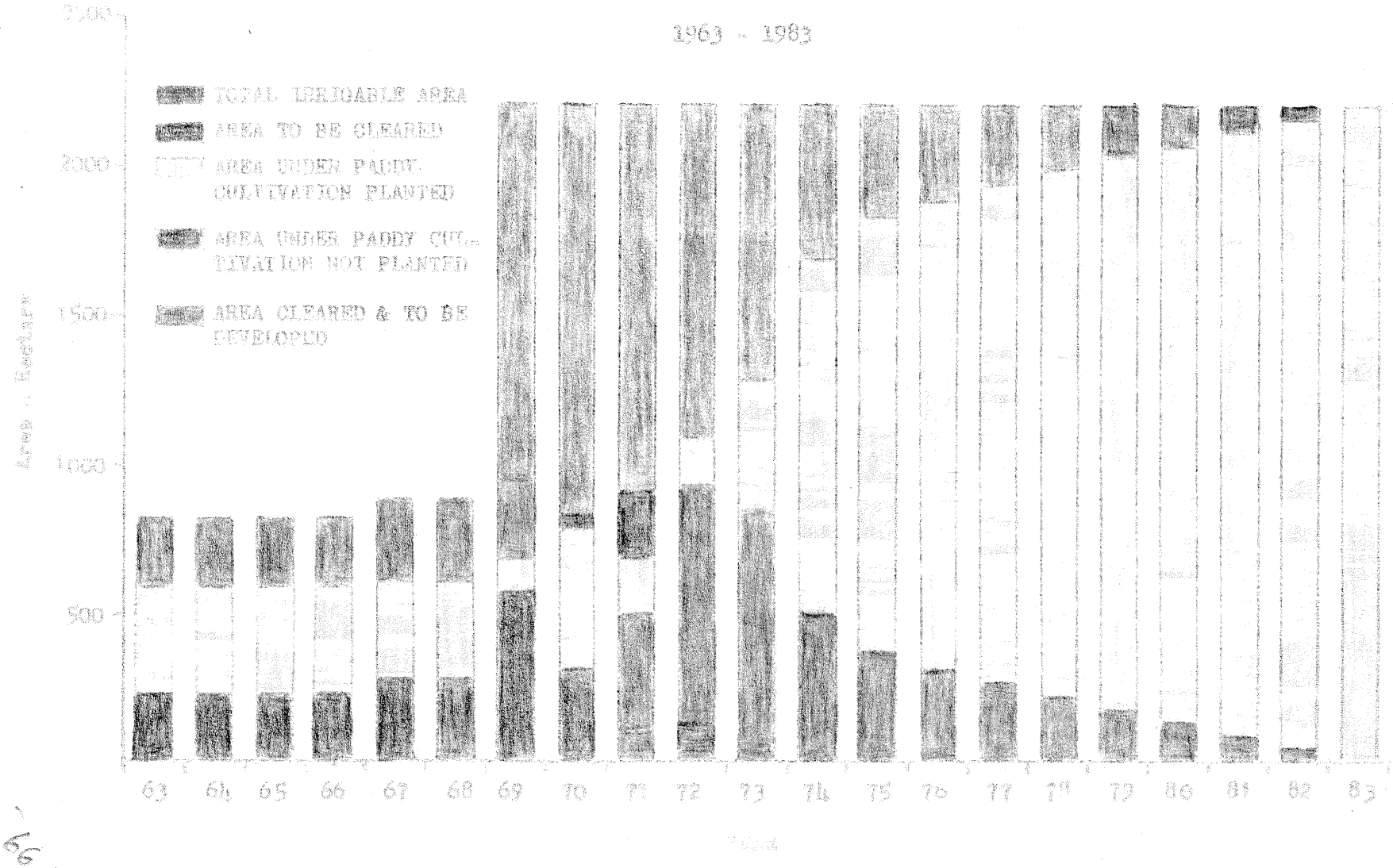
(LEFT AND RIGHT BANKS)

Year	Area Under Paddy	Cultivation not planted	Area to be cleared	Area Cleared & to be developed	Total Irrigable Area
1963-66	591	230	-	-	821
1967	603	280	-	-	883
1968	603	280	-	-	883
1969	687	570	944	-	2,201 *
1970	797	318	832	-	"
1971	685	916	100	500	"
1972	1,098	132	37	934	"
1973	1,283	-	37	846	"
1974	1,696	-	-	505	"
1975	1,835	-	-	366	"
1976	1,885	-	-	316	"
1977	1,935	-	-	266	"
1978	1,985	-	-	216	"
1983	2,201	-	-	0	"

* As defined by cadastral survey at beginning of project.

Figure 14 LAND DEVELOPMENT PROJECTION (Left and Right Banks)

1963 - 1983



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The former improvement is far more important than the latter. Without the proper water control and measuring devices the function and responsibility of the ditch tender, no matter how qualified and experienced he is, can contribute very little to the water management.

From a recent survey shown in Table 9, it can be noted that 1,283.00 hectares was planted in the 1973 rainy season. This is an increase of 185.00 hectares over 1972. Of the total hectares planted in 1973 nearly all the old land and about half of the new land on the left bank received water from the laterals and sub-laterals through the traditional irrigation method of water flowing from one paddy to another. With improved water management the 81 hectares on the left bank having service ditches but no water and 81 hectares of non-developed paddy having service ditches on the right bank can be put into production in 1974. This would result in a total of 1,446 hectares of developed paddy land, which is about the maximum amount of paddy that can be developed without additional service ditches.

An accelerated program is in progress to construct 22 kilometers of service ditches serving 355 hectares of which an estimated 250 hectares can be brought into production in 1974 for a total planting of 1,696 hectares. The remaining 105 hectares would be in production by 1975 bringing the total paddy lands to 1,800 hectares which is the estimated area that can be serviced by the available water supply in the rainy season. Due to water limitations the remaining 366 hectares of suitable arable land may be developed for non-irrigated diversified crops in the rainy season.

2. Labor

The Lao farmers traditionally work as a family

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TABLE 9 SURVEY DATA ACCORDING TO THE PROJECT MAP

DECEMBER 1973

	Left Bank	Right Bank	Total
Number of Farmers	464	453	917
Old Farm Land	Hectares	Hectares	Hectares
Planted	343.40	322.18	665.58
Not planted	0	9.49	9.49
Total	343.40	331.67	675.07
Service ditch	59.54	40.39	99.93
No Service ditch	283.86	291.28	575.14
Total	343.40	331.67	675.07
New Farm Land			
Planted	444.61	173.31	617.92
Not planted	379.77	422.61	802.38
Total	824.38	595.92	1,420.30
Service ditch, good water	204.26	173.31	377.57
Service ditch, good water not developed	0	81.31	81.31
Service ditch, no water	80.69	0	80.69
Sub-total	284.95	254.62	539.57
No service ditch	539.43	341.30	880.73
Total	824.38	595.92	1,420.30

TABLE 9 SURVEY DATA TO THE PROJECT MAP DECEMBER 1973
(Con't)

SUMMARY	Hectares	Hectares	Hectares
Total project land planted	788.01	495.49	1,283.50
Total project land not planted	379.77	432.10	811.87
Net project land for farming	1,167.78	927.59	2,095.37
Service ditch	344.49	295.01	639.50
No service ditch	823.29	632.58	1,455.87
TOTAL	1,167.78	927.59	2,095.37
Demonstration Farm	35.00	0	35.00
Undistributed & non-irrigable lands	0	70.86	70.86
Net project farm land	1,202.78	998.45	2,201.23

groups managing their own farm. Since they seldom hire farm laborers, their labor cost is not an out of pocket cost. It is only a cost of effort and energy. Traditionally farmers usually want to have large families. In the Project area many small families do not have enough manpower to supply the labor requirement to operate a three hectare paddy field. Thus they utilize only a portion of their total land. If they hire labor, they pay in kind about 300 kg. of paddy per hectare per season per man.

This is not an 8 hour-day work and 6 day week. It is a part time job which allows the laborer time to fish and hunt for his family's protein requirement.

In this analysis, farm labor cost were obtained from labor costs paid by RLG and other employers in the area. Labor cost in 1966, 1969, 1970, 1972 and 1973 is ₭ 180, ₭ 200, ₭ 250, ₭ 300, ₭ 350 per day respectively, and are shown in Table 10.

To cultivate one hectare generally requires 11 man-days to plow and harrow, 38 man-days to prepare the seed bed and transplant, 12 man-days to weed, 23 man-days to harvest, and 20 man-days to thresh.

3. Capital

Subsistence farmers need very little capital. The plow and harrow are homemade and the water buffalo is utilized for powering land tillage equipment. However, many refugee farmers on the Project do not have sufficient money to buy a buffalo, so they rent the buffalo for plowing and harrowing their land. The rental fee can be paid either in cash or in kind at about 600 kg. of paddy per buffalo per season.

Table 10 Production Cost of Paddy Rice
Kip Per Hectare

Year	1966	1968	1970	1972	1973
	Kip	Kip	Kip	Kip	Kip
Labor for plowing and harrowing 11 man days	1,980	2,200	2,750	3,300	3,850
Buffalo for plowing and harrowing 11 days	5,500	5,500	6,600	6,600	6,600
Labor for seed bed and transplanting 38 man days	6,840	7,600	9,500	11,400	13,300
Weeding 12 man days	2,160	2,400	3,000	3,600	4,200
Seeds 40 Kg	1,200	1,200	1,600	2,000	2,400
Harvesting 23 man days	4,140	4,600	5,750	6,900	8,050
Threshing 20 man days	3,600	4,000	5,000	6,000	7,000
Water charges 100 Kg of paddy	Nil	Nil	Nil	Nil	4,500
TOTAL	25,420	27,500	34,200	39,800	49,900

Note: Labor cost per day is K180, K200, K250, K300, and K350 in 1966, 1968, 1970, 1972 and 1973 respectively. Cost of seed per kilogram is K30, K30, K40, K50, and K60 in 1966, 1968, 1970, 1972 and 1973 respectively.

Buffalo cost per day is K500 in 1966 and 1968, and K600 in 1970, 1972 and 1973. Farmers at Nam Tan do not apply fertilizer and insecticides.

In this analysis costs in term of cash rather than kind are used. In 1966 - 1968, the rental fee was ₭ 500, and in 1970 - 1973 was ₭ 600 per day. A buffalo requires 11 days to plow and harrow one hectare. The Project will provide farm tractors to farmers for plowing and harrowing at a rental fee of ₭ 18,000 per hectare, which is ₭ 7,550 more than the cost of labor intensive plowing and harrowing with a buffalo. Mechanical tillage is indispensable for growing diversified crops on a production basis as the soil is too dry and hard to be worked with the buffalo. Mechanization also reduces cultivation time and can plow much deeper than the buffalo.

E. Marketing Factors*

1. General

Historical evidence has shown that the price of agricultural produce fluctuates in the seasonal cycle from the lowest price at harvest to the highest price just before and at the planting period when supply is usually scarce. The price fluctuating cycle can be smoothed out by an efficient marketing mechanism. The market network at Nam Tan is not well established. It is still at a rudimentary stage which needs to be improved. It is important that farmers be given an incentive to increase production and more economically for a higher profit and income in order to produce a viable project. An attractive market for their products would help provide the incentive needed. Without an efficient marketing system the prices will continue to fluctuate widely. The margin between purchasing and selling price will also be very wide. Consequently, the producer will receive relatively little for his product and the consumer pays a higher price for the product. This will certainly upset the supply and demand balance. Since the demand for rice is inelastic, as there are no other

*For further details see Appendix Sections 8 and 9

substitutions, the consumers have to pay for it at the going price. This situation places a heavy strain on the urban population, particularly those in Luang Prabang where rice is generally scarce. Therefore, the closest large market for rice from the Project is Luang Prabang. Thus Luang Prabang is an attractive market that can promote the producers on the Project to accelerate up to full production, provided the management can seize the opportunity. Otherwise the Project may never be viable and the producers will remain at the subsistence level.

The Project is still at the take-off stage. Certain facts concerning the current market conditions must be ascertained, analyzed, and examined. Both refugee and resident farmers do not have the storage facility for large quantities of surplus rice after the harvest and sell it when the situation is at the equilibrium point of intersection between supply and demand. Financially, the majority of farmers are below the level of the basic requirements to maintain their families and farm inputs. These two factors usually force farmers to sell their rice even before harvesting, or borrow money and then pay back in kind.

The middlemen in the past monopolized the purchasing of rice in the region. There was no formal competitive marketing establishment to protect farmers from the monopoly. The prices offered by the middlemen through out the period of pre-development were ₭ 18 per kg. for paddy from 1963 to 1966, ₭ 20 in 1967 & 1968, ₭ 25 in 1969 & 1970, and ₭ 30 in 1971.

In 1972, with USAID assistance and the RLG under the auspices of ADO constructed a rice mill donated by the Gov't of Japan in the Project under the name of the Farmer/Water Users Association. The objective of setting up the rice mill was primarily to provide the Association with rice milling services and storage facilities. It was a break through for

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farmers to escape from the monopolies here-to-for practiced. The objective was successfully targeted. The RLG officials established the price of paddy at ₭ 30/kg; the middlemen offered at ₭ 50/kg.

This competition broke the middlemen's monopoly and he subsequently offered higher prices. The rice mill closed since there was not enough rice to operate. It was a set back for the RLG officials and the middlemen, but benefited the farmers by raising the price of paddy from ₭ 30 to ₭ 50/kg without operating the rice mill. It would be interesting to ascertain at what level of price the rice mill would need to establish that the middlemen would refuse to compete.

After this the RLG officials established a new tactic by closing the routes, and imposed new legislation on the farmers so that no rice could be sold to the middlemen. No rice can be shipped out of the Nam Tan Muong Phieng Area without permission and taxation. Any rice surplus will be bought at the official price by the rice mill. It was reported that an official notice was issued that stated soldiers would be dispatched to search for rice surpluses in the villages, and would urge farmers to sell it at the official price. But no action was taken. It appears that the RLG is buying rice and operating the rice mill in a manner that may promote an adverse feeling toward the RLG among the farmers.

The 1973 harvest was excellent. The yield was about 2.8 ton/ha. formerly it was 1.5 ton/ha. There is a large amount of surplus rice this year of about 1,800 metric tons of paddy rice. The RLG officials are very busy collecting the rice and negotiating with farmers to buy the rice surplus at the official price so that they put irrigation water distribution at the lowest priority. The HIGHEST PRIORITY of the Nam Tan Project is water. Without

water the farmers will not experience good yields and produce a surplus.

The official price this year was ₭ 45/kg. but the middlemen offered ₭ 70/kg. So farmers refrained from selling their rice to the rice mill. Furthermore, farmers claimed that the rice mill should belong to the Farmer/Water Users Association, and why don't the officials let the farmers operate it? The RLG officials have employed manpower to operate the mill, but no single farmer can get near it. Evidently, nearly all the RLG irrigation staff have been put to work on the rice mill and the management of the irrigation distribution at the farmer level is being neglected.

2. Marketing

The marketing aspect of diversified crops highlights another development of the official formula. The officials will distribute corn seeds at ₭ 108/Kg., and prepare land, plow and harrow, and ₭ 18,000/ha. They will also supply fertilizer and insecticide at their price. Then the net profit, gross sale minus production cost excluding labor cost will be divided half and half between the producers and the officials. Most farmers do not understand this formula of production and marketing derived by the officials and refuse to invest in diversified crops. Furthermore most farmers are knowledgeable concerning the unsuitability of the largest portion of the Project soils for corn production.

The transportation and handling of rice and livestock by private enterprise from Sayaboury to Luang Prabang is expensive. Tiao Somsavath, Director of Agriculture/RLG, estimated the cost of transportation of rice from Nam Tan to Luang Prabang in as follows:

He stated it cost 8 kip/kilo from Nam Tan to Thadeua (Mekong River boat dock) and 12 kip/kilo from Thadeua to Luang Prabang. To this he added 10 kip/kilo for milling costs and 350 kip for each bag. Thus, based on Tiao Somsavath's estimates, for 100 kilos of rice to move from Nam Tan to Luang Prabang (where Nam Tan rice is planned to be marketed) the calculation would be about as follows:

RLG price at 45 kip/kilo in Nam Tan for 1,000 kilos paddy.	=	45,000 kip
Milling cost, 10 kip/kilo	=	10,000 kip
Transportation - Nam Tan to Luang Prabang.	=	12,000 kip
(600 kilos milled rice at 60% milling factor although Tiao Somsavath reported milling rate of close to 50% - 600 kilos x 20 = 12,000) 6 - 100 kilo bags = 350 kip each	=	2,100 kip
Total cost of purchasing, milling transporting 600 kilos milled rice from Nam Tan to Luang Prabang	=	69,100 kip or 11,517 kip per 100 kilos milled rice

At the RLG 55 kip official rate, the cost would be 12,517 kip per 100 kilos.

At the 70 kip rate for the middlemen the cost would be 14,017 kip per 100 kilos.

Tiao Somsavath stated that on February 1, 1974 the official price for milled rice in Sayaboury Province was 1,900 kip per gallong (equals 16 kilos milled rice or about 119 kip per kilo - 1,900 kip ÷ 16 kilos) or 11,900 kip per 100 kilos. He also

stated the price in Luang Prabang was 16,000 kip for 100 kilos of milled rice.

In conclusion, Tiao Somsavath stated that the RLG was trying to hold prices down to avoid undue inflation. He said Nam Tan farmers were now satisfied with the price of 53 kip/kilo for unmilled rice which they were paying kind for operation and maintenance costs for irrigation, water and facilities supplied them. He confirmed that farmers were selling small quantities of rice to middlemen at 65 - 70 kip per kilo when they needed cash but the majority were hoarding rice, hoping for higher prices.

In the case of livestock transaction between Sayaboury and Luang Prabang, studied by the Evaluation Branch of the Office of Refugee Affairs during the period of June - August 1973 *. An average purchase and shipping cost is outlined below for a 40 kg. hog. All buyers agreed that few animals raised in the area weigh much more than 40 kg. (The animal is never weighed at the farm and the middlemen buyers admit to buying as light as possible). The income statement is shown in Table II.

		Accumulative value of animal
Purchase from farmer (Approximately ₭ 300/kg)	₭ 12,000	₭ 12,000

* For detailed marketing study see Appendix Sec. 8, Market Study IV Nam Tan Area of Sayaboury Province and Appendix Sec. 9, Market Study II Luang Prabang.

		Accumulative value of animal
Military release from SBY	₭ 2,000*	₭ 14,000
Chao Muong release fee	1,500	15,500
Nong Khay checkpoint	335	15,835
Muong Liep "	165	16,000
Pak Houne "	100	16,100
Pak Lane "	200	16,300
Tha Deua "	500	16,800
Boat fare	700	17,500
Taxi fare (total)	600	18,100
Feed (3 days)	200	18,300
Luang Prabang Police	300	18,600
Veterans Association	100	18,700
Veterinarian fee	300	19,000
Prefecture fee	100	19,100
Buyer Profit	2,000	21,100
Patente Holder buys at Ministry of Finance	400	21,500
Prefecture fee	1,500	23,000
Butcher labor	435	23,435
Police	600	24,035
Veteran's Association	220	24,255
Miscellaneous loss	345	24,600
Patente Profit	1,000	25,600
Sold to retail vendors	-	25,600
Total retail sale value	-	27,600

(Since the animal was originally bought light. It is probably heavier than 40 kg. and the final retail value is 3 to 5 thousand kip higher. This added income profit takes care of the special unofficial fees).

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* The official procedure calls for the shipper to obtain a permit from the Khoueng office to ship each animal. The merchants prefer to save time and red tape by simply paying the somewhat higher military fee and ship the animals immediately.

TABLE 11 Income Statement

Total retail sale		₭ 27,600	
Purchase from farmer		₭ 12,000	
Gross Profit			₭ 15,600
Less Transport fare			
Boat	₭ 700		
Taxi	₭ 600		
Total		₭ 1,300	
Less cost of sale			
Feed (3 days)	₭ 200		
Butcher labor	₭ 435		
Misc. Labor	₭ 345		
Total		₭ 980	
Sub-Gross Profit			₭ 13,320
Less Official Fees			
Civil Servants	₭ 5,120		
Military	₭ 3,300		
Police	₭ 900		
Total		₭ 9,320	
Net Profit			₭ 4,000

This net profit is shared out equally to buyer and retailer, ₭ 2,000 each.

The official fees are computed to be 34% of the retail price or 78% of the purchase price. This high official fee will result in a low revenue to farmers and a high

living cost to consumers in Luang Prabang. Without this official fee the retail price could be down to ₭ 18,280 which would help depress the living cost to consumers; alternatively, the purchasing price could be raised up to ₭ 21,320 which would motivate farmers to increase their livestock production.

F. Economic Benefits and Constraints

Economics is defined as the science of the production and distribution; alternatively, it can be defined as the condition of a country as to material prosperity. The obvious material prosperity of the Project is land reclamation and development, water conservation and diversion for irrigation, refugee housing, schools, and health service centers. It is shown in the land development Tables 6, 7 & 8 p-12 and Figures 12 through 14 p-14 that total land reclamation and development since 1970 onwards is 2,201 ha. - 687 ha. = 1,514 ha. valued at K 141,514,992, discounting at 6 percent, the present worth value (1970) is $ 275,135.

The revenue of irrigation water fee has been tentatively set in 1973 on the basis of the area planted. That is, one hectare is charged 100 kg. or 10 gallongs of paddy value at K 4,500 or $ 7.44. The revenue in 1973 can be calculated at $ 9,546. By 1978 this revenue can amount to $ 14,880 per year for the remainder of the Project life estimated to be 42 years. It can be seen the water charges and land benefits noted above will not pay the construction cost of the project. The welfare of the resident and refugee population of the area will be the main ingredient of the development to be extracted as the social benefits of the project.

Under the social aspects, the benefits of health, education, transportation, communication, and social transformation were mentioned. The following deals with the economic aspects of these areas.

During the pre-development period the resident farmers were operating in the red with regard to paddy production and marketing. They were below the subsistence level. They had to grow upland rice to supplement their rice requirement.

Since the development started, land has been distributed to refugee and resident farmers. Paddy rice production has started to increase, and by mid-year 1973,

the total rice requirement trend valued in kip intersected the net profit upward path as shown in Figure 15. The point of intersection is the break-even point where farmers would no longer be required to produce upland rice. By the end of 1973, farmers had received a net income, net profit less total rice requirement value in kip. This is a large achievement. If the rice can be marketed to rice deficit areas, some foreign exchange can be saved. Without the Project the refugees would have to be fed by the RLG/USAID Refugee Office and the resident farmers would have to grow upland rice on slash-burn plots.

A conflict is developing between farmers and the officials on marketing rice. The balance of income characteristics of the Project plotted in Figure 16, shows a very small net income at the official price while it is larger at the market price. Thus, the farmers are reluctant to sell their rice to the rice mill. The projection on the chart further show that rice sold at the official price will put the farmers in the red again in 1984 and through out the remainder of the Project life. Rice sold at the market price will permit the farmers to receive a net income at the commercial agriculture level, though at a dimishing rate.

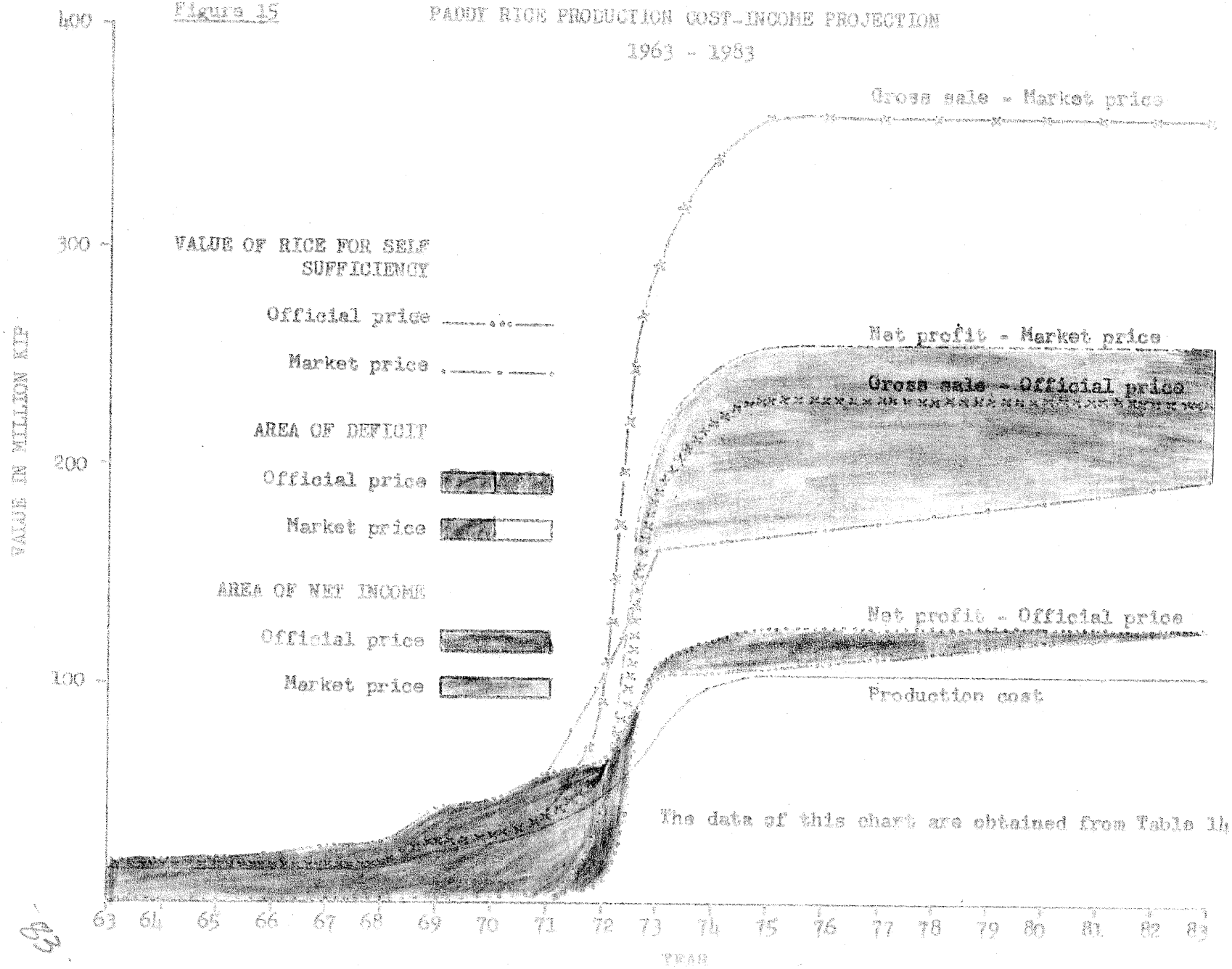
By 2000 this net income will be completely diminished, because of the population growth by 173 people annually and an increasing rice requirement rate by 53 tons per year accummulatively and the farmers will be back in the red. Upland rice farming may start again.

Unless improvement of production and marketing is achieved, the farmers may remain at the subsistence level without enjoying the benefits of the profit that could be realized. The project may not be viable and may be endangered from lack of support for proper operation and maintenance.

Defining economics as the science of production and distribution, the project has introduced a new form

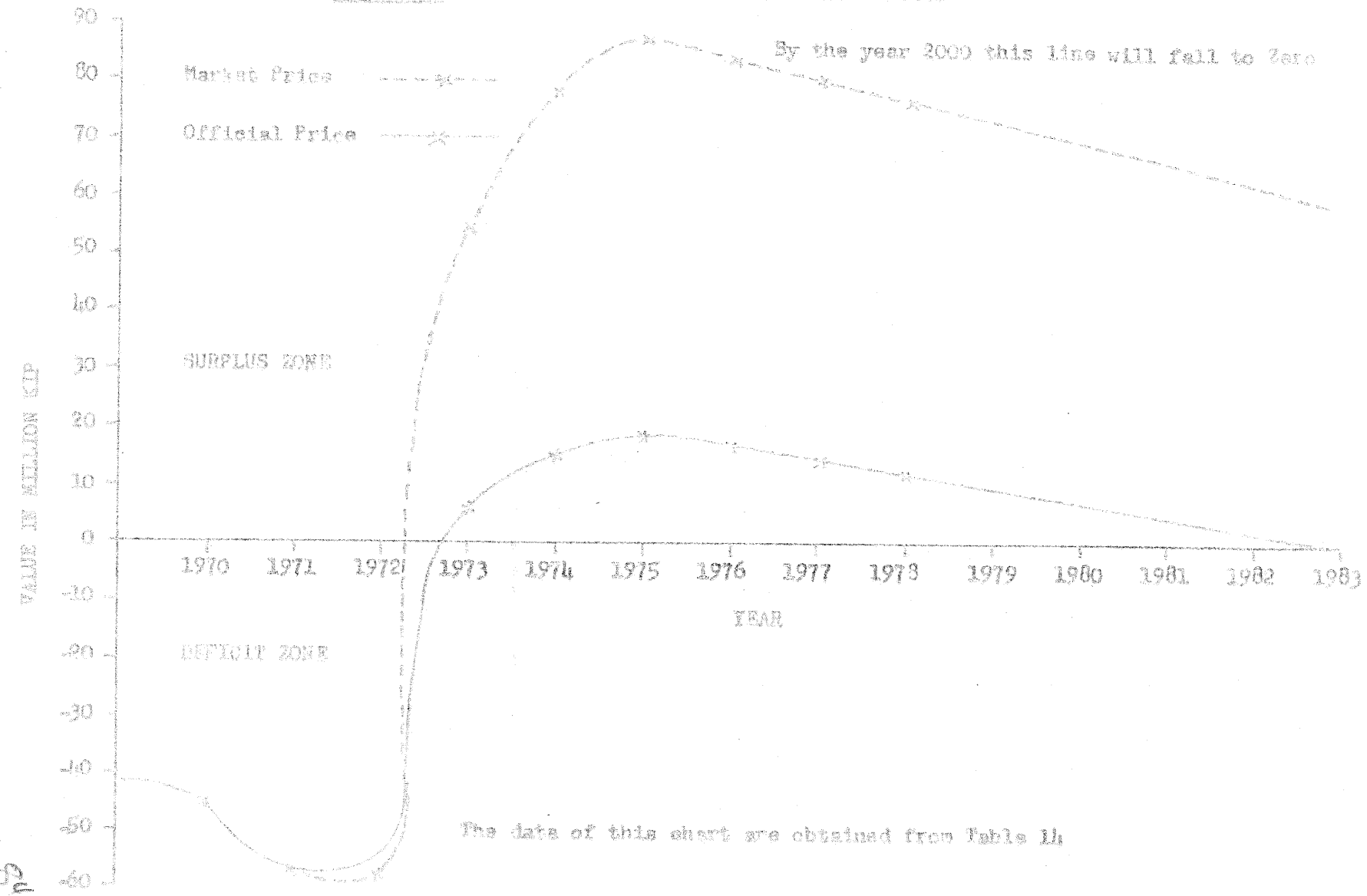
Figure 15

PADDY RICE PRODUCTION COST-INCOME PROJECTION
1963 - 1983



The data of this chart are obtained from Table 14

Figure 16 BALANCE OF INCOME CHARACTERISTICS



The data of this chart are obtained from Table 11

and technique of production. Irrigation and farm mechnization are the most recent. Farmers have learned how to grow rice and some diversified crops in the dry season with irrigation. It has been shown that with proper irrigation, the crop yield is much higher and the quality is improved. Since irrigation has proved worthwhile some farmers have invested in farm machinery. Others hire tractors from the Project to plow their land. A water buffalo with a wooden plow cannot plow in the dry season for a second crop. Mechanization is coming into the area via the development of the Project. The discussion under the Marketing Section, shows the distribution aspect of the afore mentioned definition of economics.

Referring to individual farmers, the uneven distribution of irrigation water permits farmers who can obtain an adequate supply of water to become richer while those who cannot get an adequate supply of water become poorer. This gives an uneven distribution of income requiring some farmers to return to upland cropping and others to being laborers for the more prosperous farmers.

G. Financial and Loan Factors

Many farmers, especially the refugees, do not have enough money to spend on farm inputs and on unforeseen requirements. They need money especially just before and during the rice growing period so they look for loans.

1. The middlemen provide loans just before the growing season and farmers have to pay back in rice valued at ₭ 20/kg., whereas the market price is ₭ 40/kg.

Middlemen Rate of Interest

Loan out valued at ₭ 20/kg.	In May
Pay in valued at ₭ 40/kg.	In November

Term of debt 6 months

Interest ₭ 40 - ₭ 20 = ₭ 20/kg.

Half yearly interest rate (₭ 20 ÷ ₭ 20) x 100 = 100%

Average monthly interest rate 100% ÷ 6 = 16.67%

2. The RLG Directorate has loaned money during 1973 to farmers before the growing season in the same manner as the middlemen and at the harvest they will collect their loan in rice valued at ₭ 45/kg. whereas the market price is ₭ 70/kg. A condition of the loan is that farmers must use it for farm inputs.

Nam Tan Official Rate of Interest

Advance money to be paid back in kind (rice at ₭ 45/kg.) In May

Pay in rice valued at ₭ 70 kg. on open market. In November

Term of debt 6 months

Interest ₭ 70 - ₭ 45 = ₭ 25/kg.

Half yearly interest rate (₭ 25 ÷ ₭ 45) x 100 = 56%.

Average monthly interest rate 56% ÷ 6 = 9.33%

3. Lao Savings and Loan Cooperative has set up a branch at Nam Tan in order to assist the farmers with production loans. The loan conditions are briefly stated below:

a) Borrower must register for membership, membership fee is ₭ 200.

b) Borrower must buy regular shares; each share is valued at ₭ 500.

c) Borrower must have at least 6 shares, with a total value of ₭ 3,000 before he is entitled to apply for a loan.

d) Borrower purchases additional share capital based on 10% of the amount of his loan, until his share account equals a ratio of 60% of his maximum loan amount. Share capital is withdrawable under the following conditions, and earns 6% interest.

1) When a member moves away from the area.

2) When he dies it is automatically redeemed to his heirs.

3) When he reaches 60 years of age.

e) Borrower must deposit collateral such as his land, house or other valuable items, as an insurance on the loan before his application for a loan can be considered.

f) The loan must be spent on crop and livestock production.

g) Interest rate is 1.5 percent per month or 18% per annun computed on the unpaid balance of the loan.

h) The term of payment can be made monthly quarterly, or semi-annually.

To date the LSLC has provided 139 loans valued at ₭ 11,381,000 for the farmers in the Nam Tan Project as follows.

Project/Activity	No. of Loan	Amount
1. Buffalo	89	₭ 8,005,000
2. Swine	24	2,040,000
3. Ducks	6	366,000
4. Broilers	4	180,000
5. Fish	3	100,000
6. Corn	2	100,000
7. Peanuts	1	90,000
8. Weaving	1	12,000
9. Tractor Rent	7	368,000
10. Buffalo Rent	2	120,000
TOTAL	139	₭ 11,381,000

The LSLC does not grant loans without considerable paper work and committee approval, and the loans are generally for livestock and crop production. The LSLC does not yet help the borrowers with marketing their livestock and crops in order to pay their debt. It does get the membership involved in the process. As the members become more knowledgeable of how a savings and loan cooperative functions; it should expand into the marketing area.

4. Mr. Avram, AID LSLC Advisor, visited the LSLC/ Nam Tan on January 29th and 30th, 1974, and noted the following:

a. Nam Tan farmers stated that prior to LSLC their only source for a cash loan was from the money lender who charged 10 percent per month interest. LSLC's rate is 1-1/2 percent per month.

b. Due to the increase in purchase price of buffalo from 80,000 kip one year ago to 130,000 kip at present, the LSLC is increasing loan limits at Nam Tan from 100,000 to 150,000 kip (buffalo loans only).

c. A loan of 130,000 kip from LSLC at 1-1/2 percent per month to buy a buffalo and payable over three crop seasons would cost as follows:

	Date	Payment	Principal	Interest
Loan Made	Jan. 1	-	130,000 K	
1st payment	July 1	43,500 K	86,500	11,700 K
2nd "	Dec. 31	43,250	43,250	7,785
3rd "	July 1	43,250	-	3,892
				23,377 K

As the above illustrates, a one and a half hectare farmer renting a buffalo over a three-crop period would pay 225,000 kip as rental, whereas a loan from LSLC would cost him 23,777 kip, and he would own the animal upon termination of payment.

In conclusion, it appears that Nam Tan farmers have more sources of credit than before and that the most profitable source would be in the following order:

(1) LSLC, (2) RLG Directorate, and (3) Middlemen money lenders. The LSLC role in the Nam Tan Project should be increased.

H. Intangible Financial Factors

Most of the resident and refugee farmers do not save much money. When a member of their family becomes seriously ill, they need money to pay for medical care. It is at this crucial moment that they have to borrow money as quickly as possible. The lender usually demands a very high interest rate. The borrower must deposit as collateral his land, house, or valuable items which is often three to four times the value of the loan.

Moreover, most farmers do not know how to project a

cash flow schedule for both inputs and outputs for the growing season. Therefore, they do not know exactly when, and how much money they need to borrow. When it comes to the point of borrowing money they may approach the Project administration or LSLC. The long period of waiting at the crucial moment of their urgent need impels them to the middlemen who will provide them a loan at any time with minimum paper work.

Although the interest rate from the middlemen is high, the farmer's need is met and his mind is at ease. There is a high risk placed on both parties. In the past, some borrowers could not pay their debt so their properties were possessed by the lenders. In other instances, the lenders never received any payment from their borrowers who fled away.

VI. ECONOMIC ANALYSIS

A. Funding History, Projected Estimates, and Contributions

The funding history was largely taken from the Field Project AP 1002 and refined by later cost data. The detailed funding history and estimates of future funding requirements are shown in Appendix Table 16.

Estimated funding of the construction, operation and maintenance and agro-development is given below in US dollars with the cost for each shown in five major categories of personnel, commodities, equipment, other and kip expenditure.

1. Construction Costs for FY-68 thru FY-73

	$ U.S.
Personnel	563,900
Commodities	1,618,800
Equipment	781,500
Other	280,000
Kip Expenditure in $ (Personnel & Other Costs)	858,714
TOTAL	4,102,914

2. Estimated Construction Costs for FY-74 thru FY-75

	$ U.S.
Personnel	35,100
Commodities	4,172
Equipment	22,987
Other	2,000
Kip Expenditure in $ (Personnel & Other Costs)	12,018
TOTAL	76,277

3. Operation and Maintenance Costs for FY-68 thru FY-73

	$ U.S.
Personnel	8,253
Commodities	90,950
Equipment	67,000
Other	11,000
Kip Expenditure in $ (Personnel & Other Costs)	51,051
TOTAL	228,254

4. Estimated Operation and Maintenance Costs Estimates for FY-74 thru FY-75

	$ U.S.
Personnel	41,100
Commodities	6,300
Equipment	47,987
Other	4,000
Kip Expenditure in $ (Personnel & Other Costs)	29,522
TOTAL	128,909

5. Agro-Development Activity Costs for FY-68 thru FY-73

	$ U.S.
Personnel	60,000
Commodities	68,658
Other	80,500
Kip Expenditure in $ (Personnel & Other Costs)	60,450
TOTAL	303,788

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6. Estimated Agro-Development Costs for FY-74 thru FY-75

	$ U.S.
Personnel	7,980
Commodities	3,220
Equipment	13,700
Kip Expenditure in $ (Personnel & Other Costs)	8,828
TOTAL	33,728

7. RLG Self-Help Contribution FY-68 thru FY-73 in Dollars

	$ U.S.
Construction	208,568
O&M	25,867
Agro-Development	66,052
TOTAL	300,487

8. RLG Self-Help Estimated Contribution FY-74 thru FY-75

	$ U.S.
Construction	1,418
O&M	43,656
Agro-Development	32,066
TOTAL	77,140

Funding estimates FY-68 thru FY-75 are summarized as follows:

	$ U.S.
Personnel	716,333

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Commodities	1,792,100
Equipment	967,354
Other	377,500
Kip Expenditure in $ (Personnel & Other Costs)	1,020,583
TOTAL	4,873,870

RLG-Self-Help Contributions FY-68 thru FY-75 are Summarized as follows:

	$ U.S.
Construction	209,986
O&M	69,523
Agro-Development	98,118
TOTAL	377,627

Grand Total Estimated Costs FY-68 thru FY-75

$ 5,251,497

The inter-subactivity funding for the Project is still on going. Additional programming or completion of unprogrammed but planned Project activities will depend on the economy of the nation and the availability of funds. Separate activity plans are written for each sub-activity.

B. Benefit Cost Analysis

Benefits and costs have been discussed in Chapter IV, Socio-Economic Aspects. This section shows the benefit and cost analysis used to determine the benefit-cost ratio.

For the purpose of the economic analysis the funding requirements are grouped into the three facets: 1) construction, 2) operation and maintenance, and 3) agro-development, giving only the total cost of the

various categories of personnel, commodities, equipment and other. The U.S. dollar and local currency costs are tabulated separately as the rate of interest on dollar cost is 3½% and on local currency it is 6%. Present Worth Value of the Project Annual Cost from 1970 shown in Table 12 gives the breakout of these costs by facet and fiscal year.

Table 13 through 16 present additional data used in the analysis. Further detailed funding estimates are shown in Appendix Table 16.

The value of paddy land is based on the general price of land that is sold in the Muong Phieng Area. The land value is expected to increase annually. The figures given in the Table 13 of present worth value of new land are forecasted estimates.

Although the 1973 yield was 2.8 ton/ha., it is thought to be an exceptional year due to favorable rains. The yield is forecasted to average 2.5 ton/ha. and 2.2 ton/ha. for rainy and dry seasons respectively for the duration of the project analytical life. If the yield can be increased to more than 2.5 ton/ha., the benefit-cost ratio will be proportionally higher.

The benefit-cost analysis is conducted in two sections; 1) consider the revenue at the official price, 2) revenue at the market price.

Table 12 Present Worth Value of the Project Annual Cost as of 1970

	1970		1971		1972		1973	
	U.S	LOCAL	U.S	LOCAL	U.S	LOCAL	U.S	LOCAL
Construction	2,519,600	702,415	486,700	278,496	238,531	189,531	29,400	8,839
O&M	-	-	90,235	24,522	30,125	21,821	77,758	30,757
Agro Development	-	-	82,637	46,827	33,021	40,838	90,755	38,837
TOTAL	2,519,600	702,415	659,572	349,845	301,646	252,190	203,913	78,251
Present Worth Factor	0.9662	0.9434	0.9335	0.8900	0.9019	0.8396	0.8714	0.7923
Present Worth Value	2,436,438	662,658	615,710	311,362	272,055	211,739	177,690	61,983

	1974		1975		1976		1977	
	U.S	LOCAL	U.S	LOCAL	U.S	LOCAL	U.S	LOCAL
Construction	36,000	5,609	28,200	5,678	-	2,975	-	-
O&M	52,687	35,919	46,700	37,289	-	28,100	-	28,100
Agro Development	14,720	32,113	10,180	8,781	-	3,306	-	3,306
TOTAL	103,466	73,641	85,080	51,748	-	34,381	-	31,406
Present Worth Factor	0.8420	0.7473	0.8135	0.7050	-	0.6651	-	0.6274
Present Worth Value	87,118	55,032	69,213	36,482	-	22,867	-	19,704

Present Worth Value of the Total Project Cost upto 1976 is: $ 5,035,977 = US$ 3,656,224 + Local $ 1,379,753 Equivalent.

Present Worth Factor US $ Cost is at 3½ and for Local Cost is at 6%

Table 13 Present Worth Value of New land as of 1970

Year	A	DA	VPL	△VPL	VUL	△VUL	LB	PWF at 6%	PWV	$ Equiv.
1969	687	-	-	-	-	-	-	-	-	-
1970	797	110	100,000	11,000,000	20,000	2,200,000	8,800,000	0.9434	8,301,920	16,439.45
1971	685	-	-	-	-	-	-	-	-	-
1972	1,098	301	130,000	39,130,000	25,000	7,525,000	31,605,000	0.8396	26,535,558	43,860.43
1973	1,283	185	150,000	27,750,000	30,000	5,550,000	22,200,000	0.7921	17,584,620	29,865.49
1974	1,696	413	160,000	66,080,000	30,000	12,390,000	53,690,000	0.7473	40,122,537	66,318.24
1975	1,835	139	165,000	22,935,000	35,000	4,865,000	18,070,000	0.7050	12,739,350	21,056.78
1976	1,885*	50*	170,000	8,500,000	40,000	2,000,000	6,500,000	0.6651	4,323,150	7,145.70
1977	1,935*	50*	180,000	9,000,000	40,000	2,000,000	7,000,000	0.6274	4,391,800	7,259.17
1978	1,985*	50*	200,000	10,000,000	45,000	2,250,000	7,750,000	0.5919	4,587,225	7,582.19
1983	2,201	216	300,000	64,800,000	60,000	12,960,000	51,840,000	0.4423	22,928,832	37,898.90
								TOTAL	141,514,992	236,626.35

* This additional increase may be developed for non-irrigated diversified crops

Note: Rate of Foreign Exchange is $ 1.00 = ₭ 505 until Nov. 1971 and $ 1.00 = ₭ 605 thereafter.

A = Area under paddy production rainy season
DA = Increased area A
VPL = Value of productive land kip per hectare
△VPL = Grand value of productive land in kip
VUL = Value of uncleared land kip per hectare
△VUL = Grand value of uncleared land in kip
LB = Land benefits in kip
PWF = Present worth factor
PWV = Present worth value

TABLE 3: PADDY FLOW PRODUCTION COST INCOME PROJECTION

Year	A Ha	Y Ton/Ha.	△P Ton	Fr K/Kg.	△C K	FC per Ha.	△nC K	SF K	△kR Ton	Vrr K	BGI K	BG K
1963	591	1.5	887	18	15,966,000	25,420	15,023,220	942,780	1,047	18,846,000	- 17,905,220	- 158
1964	"	"	"	"	"	"	"	"	1,110	19,980,000	- 19,037,220	- 168
1965	"	"	"	"	"	"	"	"	1,175	21,150,000	- 20,207,220	- 159
1966	"	"	"	"	"	"	"	"	1,250	22,500,000	- 21,557,220	- 17
1967	503	"	905	20	18,100,000	27,500	16,582,500	1,517,500	1,329	26,580,000	- 25,062,500	- 683
1968	"	"	"	"	"	"	"	"	1,398	27,960,000	- 26,442,500	- 624
1969	687R	"	1,031	25	25,775,000	34,200	23,495,400	2,279,600	1,765	44,125,000	- 41,845,400	- 132
1970	794R	"	1,191									
	74L	1.4	103.6									
	868T	-	1,294.6	25	32,365,000	34,200	29,685,600	2,679,400	1,899	47,475,000	- 44,795,600	- 077
1971	895R	1.5	1,027.5									
	218D	1.4	305.2									
	903T	-	1,332.7	30	39,981,000	39,800	35,939,400	4,041,600	2,040	61,200,000	- 57,158,400	- 430
1972	1,098R	1.6	1,756.8									
	192D	1.5	288.0									
	1,290T	-	2,044.8	30	61,344,000	39,800	51,342,000	10,002,000	2,175	65,250,000	- 55,248,000	- 620
				50	102,240,000	"	"	50,898,000	"	108,750,000	- 57,852,000	- 980
1973	1,282R	2.8	3,592.4									
	270D	2.2	594.0									
	1,552T	-	4,186.4	45	188,388,000	49,900	77,494,700	110,893,300	2,312	104,040,000	6,253,300	889
				70	293,048,000	"	"	215,553,300	"	161,840,000	53,713,300	7,959
1974	1,696R	2.5	4,240.0									
	300D	2.2	660.0									
	1,996T	-	4,900.0	45	220,500,000	49,900	99,600,400	120,899,600	2,363	105,335,000	14,564,600	2,149
				70	343,000,000	"	"	243,399,600	"	165,441,000	77,958,600	11,497
1975	1,800R	2.5	4,500.0									
	360D	2.2	660.0									
	2,160T	-	5,160.0	45	232,200,000	49,900	**104,790,000**	127,410,000	2,415	108,675,000	18,735,000	2,763
				70	361,200,000	"	"	250,410,000	"	169,050,000	87,360,000	12,882

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TABLE 14 (Con't) PADDY RICE PRODUCTION COST INCOME PROJECTIONS

Year	A Ha.	Y Ton/Ha	ΔP Ton	PR K/Kg.	ΔS K	PC Per Ha.	ΔPC K	NP K	ΔRR Ton	Vrr K	BOI K	BIC K
1976	1,800R	2.5	4,500									
	300D	2.2	660									
	2,100T	-	5,160	45	232,200,000	45,900	104,790,000	127,410,000	2,460	110,700,000	16,710,000	2,09
				70	361,200,000	"	"	256,410,000	"	172,200,000	84,210,000	10,27
1977	1,800R	2.5	4,500									
	300D	2.2	660									
	2,100T	-	5,160	45	232,200,000	49,900	104,790,000	127,410,000	2,513	113,085,000	14,325,000	1,71
				70	361,200,000	"	"	256,410,000	"	175,910,000	80,500,000	9,61
1978	1,800R	2.5	4,500									
	300D	2.2	660									
	2,100T	-	5,160	45	232,200,000	49,900	104,790,000	127,410,000	2,565	115,425,000	11,985,000	1,40
				70	361,200,000	"	"	256,410,000	"	179,550,000	76,860,000	8,98

R = Rainy season cropping
D = Dry season cropping
T = Total annual cropping
A = Area in paddy production
Y = Yield - tons/ha.
ΔP = Gross paddy production

Pr = Price of paddy

ΔS = Gross value of paddy

PC = Production cost/hectare

ΔPC = Gross production cost

NP = Net profit (ΔS-ΔPC)

ΔRR = Gross rice requirement for self-sufficiency

Vrr = Value of ΔRR in kyat

BOI = Balance of income (K) (NP=Vrr) from paddy

BIC = Balance of income (K) per capita.

Table 15 Incremental Benefits

Year	Net Profit	Inc. Benefit	$ Equiv.	PWF	PWV
1969	2,279,600	-	-	1.0000	-
1970	2,679,400	399,800	791,68*	0.9434	746.87*
1971	4,041,600	1,762,000	3,489.11*	0.8900	3,105.33*
1972	10,002,000	7,722,400	12,764.30	0.8396	10,716.91
	50,898,000	48,618,400	80,360.99	"	67,471.09
1973	110,893,300	108,613,700	179,526.78	0.7921	142,203.16
	215,553,300	213,273,700	352,516.51	"	279,229.91
1974	120,899,600	118,620,000	196,066.12	0.7473	146,520.21
	243,399,600	241,120,000	398,545.45	"	297,833.01
1975	127,410,000	125,130,400	206,827.11	0.7050	145,813.11
	256,410,000	254,130,400	420,050.25	"	296,135.43

PWF = Present worth factor
PWV = Present worth value

Total Incremental Benefits for 6 years

Official Price = $ 449,105.57 at Present Worth Value

Market Price = $ 944,521.62 at Present Worth Value

*Rate of exchange $ 1.00 = ₦ 505

Otherwise $ 1.00 = ₦ 605

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Table 16 Annual Benefit-Cost Statement

1. Annual Costs*

O&M		$ 19,704
Amortization of Investment Costs		
U.S Dollar Cost		
3,656,224, 50 yrs at 3-½% (0.04263)		$ 155,865
Gross Local Cost	1,379,753	
Land Benefit	236,262	
Difference	1,143,491	
Net Local Cost		
1,143,491, 50 yrs at 6% (0.06344)		$ 72,543
Net Annual Cost		$ 248,112

2. Benefits at Official Price

Total Incremental Benefits at Present Worth Value, 6 yrs lag	= $ 449,106	
Amortized for 50 yrs, $ 449,106 x 0.06344	=	$ 28,491
Present Worth at beginning of 7th year $ 206,827 x 15.374	= $ 3,179,758	
Present Worth at beginning of 1st year $ 3,179,758 x 0.7050	= $ 2,241,729	
Amortized for 50 yrs, $ 2,241,729 x 0.06344		$ 142,215
Net Annual Benefit		$ 170,706

Benefit-Cost Ratio

Annual Benefit	$ 170,706
Annual Cost	$ 248,112
Ratio	0.69 to 1

3. Benefits at Market Price

Total Incremental Benefits at Present Worth Value, 6 yrs lag	= $ 944,522	
Amortized for 50 yrs, $ 944,522 x 0.06344	=	$ 59,920
Present Worth at beginning of 7th year $ 420,050 x 15.374	= $ 6,457,849	
Present Worth at beginning of 1st year, $ 6,457,849 x 0.7050	= $ 4,552,784	
Amortized for 50 yrs, $ 4,552,784 x 0.06344	=	$ 288,829
Net Annual Benefit		$ 348,749

Benefit-Cost Ratio

Annual Benefit	$ 348,749
Annual Cost	$ 248,112
Ratio	1.41 to 1

*Present Worth Value Calculated to 1970

C. SECONDARY BENEFITS

1. Refugee Resettlement

In 1969, there were 1,124 refugees settled in the area. By 1973 the number of refugees amounted to 2,572. Assuming the Project was not implemented, the RLG/Social Welfare in cooperation with USAID/Refugee Affairs would have had to spend on rice relief, 337 tons in 1969 and 772 tons in 1973. The Project can save these rice relief expenses.

Benefits	$ Equiv.
Value of rice in 1969 = 337 x ₭ 35,000 = ₭ 11,795,000 = $ 23,356	
Value of rice in 1973 = 772 x ₭ 80,000 = ₭ 61,760,000 = $ 102,083	
Present worth in 1970 at 6% = $ 23,356 x 0.9434 = $ 24,757	
Amortized for 50 yrs. $ 24,757 x 0.06344	= $ 1,571
Full benefit $ 102,083 with 4 yrs lag, the annual increase $ 102,083 ÷ 4 = $ 25,521	
Present worth at beginning of 5th year $ 25,521 x 8.70 = $ 222,033	
Present worth at beginning of 1st year $ 222,033 x 0.791 = $ 175,872	
Amortized for 50 yrs. $ 175,872 x 0.06344	= $ 11,157
Annual benefit from rice relief	= $ 12,728
Annual benefit from other nutrients	= $ 25,456
Total benefit from refugee relief	= $ 38,184

II. School Benefits

Without education, a young man will become an unskilled labor who will earn about ₭ 350 per day. Completing the primary school, he can earn a minimum rate of ₭ 500 a day and the maximum rate of ₭ 1,000 a day. Therefore the benefit is ₭ 500 - ₭ 350 - ₭ 150 a day and ₭ 1,000 - ₭ 350 - ₭ 650 a day. There were two schools built under Agro-development fund:

1.	Phone Savanh	10	class rooms
2.	Phone Xieng	6	" "
3.	Other Schools	6	" "
	TOTAL	22	" "

Each class room is assumed to accommodate an average number of 30 pupils. So 22 x 30 = 660 pupils will finish primary school each year.

Annual benefit :	660 x ₭ 150	=	₭ 99,000	
		=	$ 164	Minimum
	660 x ₭ 650	=	₭ 429,000	
		=	$ 709	Maximum

III. Adult Education

This program is also under Agro-development fund. It involves farmer training, seminars, and farm demonstration. The revenue of this adult education is difficult to evaluate. It can be stated that farmers have in general significantly improved their technique of production and irrigation, especially the refugees who formerly grew upland crops by slash and burn method. Now they are good paddy farmers. Some of the refugee farmers own their own farm tractors and equipment. It is evidenced that through adult education that many upland farmers have been transformed into mechanized

low land farmers. Furthermore, the majority of farmers are more familiar with the marketing of their products.

IV. Nam Tan Demonstration/Research Farm

It is still too early to evaluate the benefit of the Farm. It is still under development. The Farm has provided a place for adult education and farmers' community development.

V. Rice Mill

Here again, it is still too early to evaluate the revenue from the rice mill as it has recently started to operate. There are many implications to be smoothed out between the RLG officials and the Farmer/Water Users Association. It was built under the agro-development fund and it is necessary to account its revenue to the benefit of the Project.

D. Intangible Benefits

There is a road to every village and over 100 taxi and commercial vehicles come from and go to the Project area each day. The movement of villagers and products to their destination is now much faster and cheaper. The benefit can be calculated if time is allowed to collect relevant data. Project road tax is not levied on these vehicles, thus the benefit in terms of cash are nil. The benefit of transforming the ancient society into a modern one is considerable.

Benefit-cost ratio taking all the accountable annual benefits into consideration is:

Official Price (45 kip per kilo for paddy rice)

Annual benefit:	$ 170,706 + 38,184 + 709	=	$ 209,599
Annual cost			$ 248,112
Ratio :-			(0.85:1) Max.

Market Price (70 kip per kilo for paddy rice)

Annual benefit:	$ 348,749 + 38,184 + 709	=	$ 387,642
Annual cost			$ 248,112
Ratio			(1.56:1) Max.

VII. RECOMMENDATIONS

A. Operation and Maintenance

1. General

It has been correctly stated but not fully recognized that the Nam Tan Irrigation Project is a much larger and more complex irrigation system than the usual Lao Irrigation project. Thus, without the benefits or a prior detailed soils classification and analysis hydrologic study, operating experience and other data presented in this report the Project has inherited some unrealistic goals.

That is, while the Project is basically an irrigation Project designed for the purpose of rice production and early emphasis was placed on diversified farming with rotational cropping. To augment this concept, 35 hectares of land was reserved near the center of the Project as a research and demonstration farm. The staffing was established to reflect a relatively complex government agricultural organization, shown as follows:

DIRECTORATE OF AGRICULTURE

PROJECT DIRECTOR - Field Project Manager USAID/LAOS

ASS'T PROJECT DIRECTOR

ADMINISTRATION

- Secretary
- Comptroller
- Personnel
- Supply

TECHNICAL SERVICE

- RURAL WORKS DIVISION
  - Construction
  - Survey
  - Land Distribution
  - Water Distribution
- PRODUCTION DIVISION
  - Seed Multiplication of field crops and fruit trees.
  - Pork Production
  - Fisheries
  - Training Rural Leaders and Technicians.
  - Demonstration Improved Cultural Practices, Uses of chemical fertilizers and Pesticides.
- COOPERATIVES
  - Organizing Farmer Groups
  - Training Farmer Groups
  - Membership & Operating Procedures.
  - Farmer Demonstrations and Visits.
- INDUSTRY AND COMMERCIALIZATION
  - Marketing
  - Rice Mill Operation
  - Credit Cooperative

The above staffing has tended to spread priorities over a wide spectrum. Thus, the needed emphasis to establish the complex administrative and social organizations required for effective use of irrigation water on the Project has not been realized. The key to the efficient management of the irrigation system is the development of the Farmer/Water Users Association and incorporating the Association into the management staffing. This is the next important step that needs to be taken.

To further complicate matters, it was envisioned the farmers would construct by hand the 130 kilometers of farm service ditches required to provide controlled water to all the farms. This has retarded development of new land into production.

A brief synopsis of the various roles carried out by USAID, the RLG and Farmer/Water Users Association is given:

a) USAID

During the construction of the dam and canals, nearly all USAID Divisions, PWD, AGR, ADFO, ORRA, PHD, MGT, were providing inputs. For purpose of coordination the Project was established as a USAID Field Project and a Project Manager appointed. As the construction phased down, the various branches of the Agriculture Division assisted in crop production, extension, fisheries and irrigation. However, USAID/MGT is still making important inputs which have been somewhat unnoticed and unincorporated into

the overall Operation and Maintenance (O&M). The O&M has nearly become a segregated section of the overall organization and thought to deal only with operating of water gates and maintenance of canals. It is yet to be realized that the "Operation and Maintenance" is the heart of the Project. All other activities should be incorporated into the revolve around the O&M.

USAID has been supporting and managing to a large extent the O&M of the canal network. Gradually this activity is being transferred to the RLG and Farmer/Water Users Association, but without the emphasis it should be receiving.

To bring the Project to its full production potential of 1,800 hectares of paddy, USAID is providing support to construct the farm service ditches and land preparation.

b) Royal Lao Government

The RLG has staffed the Project in line with the staffing pattern given above. They are relatively new in terms of managing a sophisticated irrigation development project and developing Farmer/Water Users Association. The latter will ultimately play the major role in both the management and support of the Project.

Several of the RLG Staff members have been trained at IRRI in rice production. No noticeable results of this training has been demonstrated on the Demonstration Farm in terms of rice production. Yet, it is believed to have been useful in terms of the overall management of the Project. But, for the most part their management of the Project is dependent upon their individual backgrounds, education and on the job experience gained since the Project was started. It can be said the RLG staff has done an admirable but limited job to date.

The weakest area has been the important development of the Farmer/Water Users Association and incorporation of the farmers into the Project staffing. This is also the most difficult area to develop. Admittedly, it will take time but it will require a much longer time if it is not given high priority.

Rather than tackle the complex problem of developing the administrative and social organization required to manage and maintain the Project efficiently the RLG tends to request and rely on its own resources too much. Thus, they want more RLG agents, when the present number of RLG positions and personnel are adequate. Many of the staff could use and merit additional training, particularly in water management.

c) Farmer/Water Users Association

One Central Committee has been established grouping the farmers into 21 sub-farmer groups having a present membership of 878 members. The sub-groupings have been established in relation to the canal network so as to fit into the water management scheme.

In June 1973 the first annual meeting of all the sub-groups was held to elect the Central Committee. The Constitution and By-Laws governing the Association was distributed and discussed. Since that time neither the sub-groups or the Central Committee have held independent meetings to discuss their group problems. Consequently, meaningful cooperative action is yet to be realized. The Association is still controlled exclusively by the RLG.

A water users fee was levied on the farmers and collected for the first time this year. This fee is to be utilized by the Project management for the operation and maintenance of the system. However, this is not fully understood by the farmers for several reasons; 1) the irrigation system is new to them 2) cooperative effort across village boundaries is very new 3) the Farmer/Water Users Association has not been incorporated into the overall management and 4) the procedures for continuously informing the farmer, and keeping informed about his needs and preferences has not been implemented.

To assist in the marketing of the anticipated surplus of rice, a rice mill was established within the Project. This mill is to be operated by the Project management staff which should be the Farmer/Water Users Association with necessary technical guidance from the RLG's Directorate of Agriculture. It is presently being operated as a government enterprise to the dismay and misunderstanding of the farmers.

2. Recommended Plan of Action

a) General

USAID has been significantly involved in the Project since 1966. The RLG has gained experience and assumed increasingly more responsibility. The USAID is working toward a phase down of its involvement in the Project.

The Project has progressed from a few scattered villages traditionally farming about 680 hectares of land into a highly sophisticated irrigation complex having a diversion dam, 19 kilometers of main, 63 kilometers of lateral and sub-lateral

and about 35 kilometers of completed farm service ditches. The system was designed to service about 2,200 hectares of irrigable land but this figure has been reduced to 1,800 hectares based on recent hydrologic studies. Of the 1,800 hectares, about 1,400 hectares had been developed.

An organizational structure has been set up to manage, operate and maintain the system. It is in the rudimentary stage in terms of the necessary development of the complex administrative and social organization required to effectively operate the Project.

The Nam Tan Farm and Rice Mill are being operated by the RLG although the Farm still receives limited USAID assistance.

b) Execution

The steps to be taken to achieve a phase down of USAID involvement over the next 15 months is given below. These steps are given in generalities. Some are being accomplished and others are proposed. The steps will be prepared in more detail as the plan of execution is more firmly established and jointly agreed upon by the USAID, RLG and Farmer/Water Users Association.

1. Project Management

a) Revise the staffing to incorporate the Farmer/Water Users Association into the management of the Project. A staffing using the present resources is being prepared.

b) Index the canals, align the sub-farmer/water users groups more precisely to fit into the water management scheme, establish a central card file on all farmers,

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and revise the present maps to show correct names of canals and land owners. This is being prepared with a completion date set for May 1, 1974.

c) Phase out USAID MGT (Tech Support). To be completed by June 30, 1974 by 1) Grant in aid of office and household furnishings supplied by USAID to the Project 2) Transfer Tech Support staff to USAID Irrigation, the RLG and/or Farmer/Water Users Association and 3) the Project (USAID Agriculture and the RLG) underwriting the POL formerly supplied by Tech Support.

2. Project Development (Technical)

a) Continue the accelerated efforts to construct 22 km. of farm service ditches. Lend tractor assistance to the farmers to help develop an additional 350 hectares of new paddies. Target completion date, July 1974.

b) Reduce the size of the Nam Tan Demonstration Farm to a manageable size, from 35 to 15 hectares, including one hectare for the Meterological Station and about three hectares for the fisheries station. The Farm should concentrate on improved rice production and the Fishery Station should demonstrate fish culture and supply fingerlings to fish farmers in the valley.

c) Concentrate production efforts on rice, fish and ducks.

3. Project Development (Social)

a) Give the Farmer/Water Users Association more responsibilities in Project management, extend more guidance and information to them on their role in the Project and make greater demands on their services. Encourage and permit them to hold meaningful regular sub-group and Central committee meetings.

b) Finalize the lingering land distribution problems. This will be more easily accomplished when item 2 under management is complete.

4. Project Development (Economic)

a) Incorporate the Farmer/Water Users Association into the operation of the rice mill. Requires higher level assistance.

b) Induce the farmers to higher production by removing the RLG controls on the price the farmer can receive for his paddy, i.e. put the rice purchased by the rice mill on a free market basis. Thus, orienting the profit motive toward increasing the income of the farmer. Requires highest level assistance.

c) Concentrate production efforts on selected crops, namely, rice fish and ducks. The latter two would be more for the improvement of local diet than for increased profits.

B. Production and Marketing

1. General

Aside from the steps outlined above the RLG must assist the farmers by permitting and insuring the free flow of produce to the Sayaboury and Luang Prabang markets, any surpluses produced in the Project. And if necessary, land assistance in the marketing by acting as a middleman for the farmers, i.e. purchasing the finished product (milled rice) at the prevailing market price for unrestricted movement to the market areas.

2. Credit

Promote the existing Lao Savings and Loan Cooperative (LSLC) organized in 1973, and which provides loans to farmers for production needs, and to mobilize savings. The LSLC Branch in Nam Tan plays the dual role of a miniature bank and a production credit association.

When the branch office was first opened it was designed to serve the 525 families living in the 10 villages served by the left bank irrigation canal. During the year 1973 almost 300 farmers joined as members of LSLC and 138 loans amounting to 11,318,000 kip were made to assist farmers to increase production. A breakdown of the loans shows that they were made for the following purpose. For purchase of buffalo 89, swine 24, ducks 6, broilers 4, fish 3, corn 2, peanuts 1, weaving 1, tractor rentals 7, and buffalo rental 2.

The members raised more than 2 million kip of their own capital through share purchases and voluntary savings. The branch is now in the process of expanding it's service to include the 398 families living in the six villages served by the right bank irrigation canal, and thus bringing into it's orbit of service 923 families living and being served by the Project.

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