SECTION IV COASTAL BASINS OF II CORPS

The twelve provinces comprising the II Corps area have a population of about 2.5 million. Of this total population, roughly 700,000 live in the seven highland provinces (subject of the preceding section of this chapter), and the remaining 1.8 million live in the five coastal provinces - Binh Dinh, Phu Yen, Khanh Hoa, Ninh Thuan and Binh Thuan. This section of the report is confined to a general discussion of the coastal provinces followed by a more specific, but still preliminary, program for development of water and land resources.

In the context of regional development as presented in the other sections of this chapter it is difficult to identify problems and opportunities common to the whole within the five coastal provinces. The five northern provinces form a recognizable geographical unit characterized by a broad, nearly continuous coastal plain which will lend itself well to a coordinated regional program for developing water resources and improving agriculture. The Central Highlands is distinctive as a region in that it is less advanced than the rest of Vietnam, has difficult environmental conditions, presents numerous special problems, is sparsely inhabited, and has a population with racial origins different from the rest of the country. The five coastal provinces, unlike the two regions just mentioned, do not lend themselves well to an overall regional development plan since, physically, the coast does not form a near-continuous plain; rather, it is comprised of a series of relatively small deltaic areas at the mouths of the rivers, which suggest independent project development. It is important, however, that in program planning consideration be given to the possible advantages of interdependence both among the coastal basins and between the highlands and the lowlands.

All the coastal basins in II Corps are connected both by the National Railroad and National Highway No. 1. The center of activity of each province is usually located within the largest coastal basin in the province. Major towns are Qui Nhon, Tuy Hoa, Nha Trang, Phan Rang and Phan Thiet.

Areas presently under cultivation total roughly 200,000 hectares, of which about 150,000 hectares are planted to rice. It is reported that about one-half of the rice area is double cropped and yields are less than two tons per hectare per crop. Over half of the rice production is from the Qui Nhon area of Binh Dinh Province.

Fishing, too, is an important occupation in the coastal areas of II Corps, producing about one-third of the total national catch. Yields per fisherman and boat are well above the national average in Binh Thuan, equal to it in Ninh Thuan and Khanh Hoa and substantially below it in Phu Yen and Binh Dinh. Phan Thiet in Binh Thuan province is a large fish processing center accounting for almost half the national nuoc mam production and a sizeable portion of the total production of cured and dried fish.

Each coastal center also represents a center of trade, although port facilities are adequate only at Qui Nhon and Nha Trang. Cam Ranh is a special case in that it is an excellent natural harbor of far greater size than can apparently be supported by its hinterland. Development of Cam Ranh will probably occur as a result of special circumstances not necessarily related to the region.

Water Resources Development

The problems of the coastal basins of the Central Lowlands are similar to those of the coastal plain of the five northern provinces, as described in section I of this chapter. Average farm size (about 0.7 hectare) is uneconomical, resulting in a majority of the people living at subsistence level; rice yields are low; many areas are subject to frequent flooding; some areas are subject to salt water intrusion; insufficient rainfalls to permit year-round cultivation (especially in the south); most rivers have inadequate base flow to enable area-wide irrigation; and drainage conditions are poor, particularly on the flatter portions bordering the sea.

To ameliorate these conditions it is proposed that a development program be established with full control and utilization of the water and land resources of the five provinces as its eventual objective. This program should provide for comprehensive detailed

studies of the several potential coastal basin projects in the area; establishment of development priorities; and consideration of interdependence, particularly regarding crop diversification; i.e., each basin does not necessarily have to be entirely self-sufficient in its agricultural production. This report presents a general, tentative outline of such a program together with a rough order of magnitude of costs; however, detailed implementation plans and specific development priorities cannot be presented until much more detailed appraisal studies are made.

Many studies have been carried out, and various facilities, such as diversion dams, dikes and canals, have been constructed over about the past 30 years. These facilities have been both productive and beneficial, especially in the Qui Nhon, Tuy Hoa and Phan Rang areas; however, they can only be considered partial solutions to the problems of the coastal basins; more land (much presently unused) can be brought into intensive, year-round cultivation through provision of storage, flood and salinity control and drainage works by orderly and timely development of each basin.

There are ten major rivers serving the coastal areas of the five provinces. The estimated gross irrigable area within the coastal basins is 400,000 hectares; assuming there are at least 320,000 net cultivable hectares within this figure, eventual full development would bring at least an additional 120,000 hectares under cultivation. Irrigable areas and river basin drainage areas are presented in Figure 12-8; Table 12-4 lists the major rivers and drainage areas with rough estimates of average annual and minimum monthly discharges and gross irrigable areas served.

Of the ten basins only one, the Song Ba, serving the Tuy Hoa area, has sufficient runoff to meet irrigation water requirements without seasonal storage. There are several apparently suitable storage dam sites within the five provinces, including the Song Ba; alternative schemes should be studied for providing storage including the possibility of diversion from the Song Ba to neighboring basins. It is also noted that the natural runoff of the Song Cai (serving the Phan Rang area) is supplemented by tail water from the Da Nhim hydro-electric plant which,

TABLE 12-4

COASTAL BASINS - II CORPS

RIVERS AND IRRIGABLE AREAS

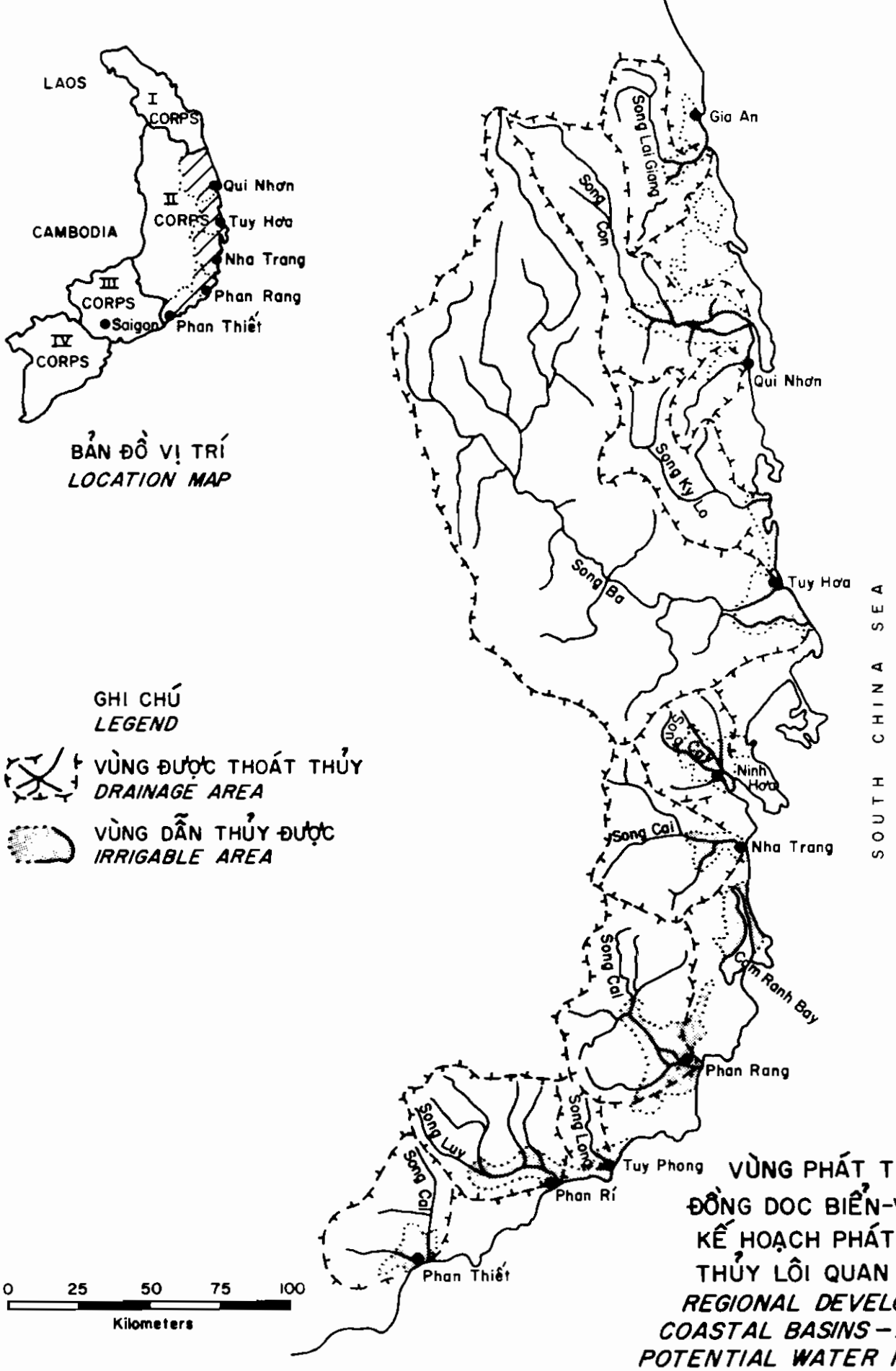
River	Estimated Drainage Area	Estimated Average Annual Discharge	Estimated Average Minimum Monthly Discharge	Estimated Gross Irrigable Area
	km^2	m^3/s	m^3/s	ha
Song Lai Giang	1,300	30	5	30,000
Song Con	3,000	75	15	100,000
Song Ky Lo	1,800	40	7	10,000
Song Ba	14,000	300	50	40,000
Song Cay	1,200	25	4	45,000
Song Cai (Nha Trang)	2,000	40	6	15,000
Song Cai (Phan Rang)	3,700	40	7	70,000
Song Long	700	10	2	10,000
Song Luy	2,000	20	3	35,000
Song Cai (Phan Thiet)	1,900	20	3	45,000
TOTAL				400,000

BẢN ĐỒ VỊ TRÍ
LOCATION MAP

GHI CHÚ
LEGEND

VÙNG ĐƯỢC THOÁT THỦY
DRAINAGE AREA

VÙNG DẪN THỦY ĐƯỢC
IRRIGABLE AREA



0 25 50 75 100
Kilometers

VÙNG PHÁT TRIỂN ĐỒNG DOC BIỂN-VÙNG II KẾ HOẠCH PHÁT TRIỂN THỦY LÔI QUAN TRỌNG

REGIONAL DEVELOPMENT COASTAL BASINS – II CORPS POTENTIAL WATER RESOURCES DEVELOPMENT PROJECTS

HÌNH *FIGURE* 12-8

with re-regulation, will enable year-round irrigation of nearly half of the irrigable area in the basin.

The incidence of flooding and saline intrusion varies considerably in the ten coastal basins. Generally, the most serious floods occur north of Tuy Hoa and they are most severe in the Qui Nhon area; the same general statement also applies to saline intrusion in the dry season. Some areas around Qui Nhon are subjected to frequent salt water flooding also. Flood and salinity control should form an integral part of project development through means of storage allocations, flood retention dams, dikes, and tide gates in various combinations to be determined by economic comparisons.

With the possible exception of providing power for irrigation and drainage pumping, installation of hydro-electric plants at storage dams is not considered feasible owing to relatively low streamflow and low available head. The Song Ba is an exception to this general statement; however, power developments on this river would probably be single purpose, unless implemented in conjunction with potential irrigation projects in the upper reaches in the Central Highlands.

To permit crop diversification, drainage facilities must be provided, particularly in the flatter areas adjacent to the sea; it is envisaged that some drainage pumping plants will be required to effect this.

In designing and implementing the coastal basin projects, fullest practicable utilization should be made of the many existing facilities; for example, at least 20,000 hectares are presently commanded by canals in the Phan Rang area. Some areas, such as Phan Rang, Tuy Hoa and Qui Nhon, will require less capital expenditure than others to develop because of considerable existing works in these particular localities. However, no attempt is made in this Report to estimate costs by project. Rather, an overall, average rough order of magnitude cost of equivalent US $1,300 per hectare is assumed as adequate to cover capital cost requirements to implement water control works. On this basis, capital costs for a total estimated 400,000 hectares would be in the order of the equivalent of US $520 millions.

Total development of the coastal basins will probably require at least 30 years to accomplish; a quarter of the total irrigable area, say 100,000 hectares, might be brought under development during the first ten years after peace, at a rough capital cost equivalent to about US $130 millions.

Construction of project works is only a beginning. To ensure success, 1) crop diversification on the basis of land capability and markets must be encouraged; 2) agricultural extension services, including instruction in irrigation methods, and farm credit must be provided; 3) improved seed varieties and fertilizers must be developed and made available; and 4) local associations must be organized to facilitate proper water use, distribution of seed and fertilizers, crop storage facilities, marketing, collection of water and drainage charges for loan repayments, and other such services. In connection with this last purpose, attempts are presently underway to establish associations in the Phan Rang area; to date results have been mixed, with some confusion and disagreements between villages.

If the projects are properly designed and organized, substantial benefits should result, including: 1) firm supplies of irrigation water for year-round cropping; 2) proper drainage; 3) effective flood and salinity intrusion control as applicable; 4) conditions in which improved cultural practices can be adopted by local development associations with the assistance of the agricultural extension services; 5) use of higher yielding rice varieties, thus releasing large areas now planted to rice to other higher value crops; 6) crop diversification; and 7) exploitation of considerable areas of land not now under cultivation. These will almost certainly result in favorable cost-benefit ratios.

More detailed project appraisal studies will lead to the establishment of priorities among the ten basin projects. At this time it is proposed that, in general, development should start in the two southernmost provinces of Ninh Thuan and Binh Thuan, since these comprise the areas of greatest need, having the lowest annual rainfall (only 600 to 1,000 millimeters). Orderly development could then proceed towards the north.

Overall Development Possibilities

The above discussion covers only a tentative program for developing the land and water resources of the coastal basins. Considerably more research and investigation are required before a more definite overall development plan can be drawn up. Also, there are other potentials besides water resource development which should be studied with a view to evolving a regional-type plan for post-war economic development of the five provinces; such a plan might comprise the following elements, in addition to water control and agricultural improvement:

1. Improvement of the fishing industry and establishment of fish-processing facilities;

2. Establishment of a forestry and wood products industry;

3. Improvement and diversification of agriculture in the river valleys;

4. Reconstruction of ports, railroads and highways as needed for commerce and transportation throughout the region; and

5. The development of Cam Ranh Bay.

SECTION V SAIGON AND THE SURROUNDING PROVINCES

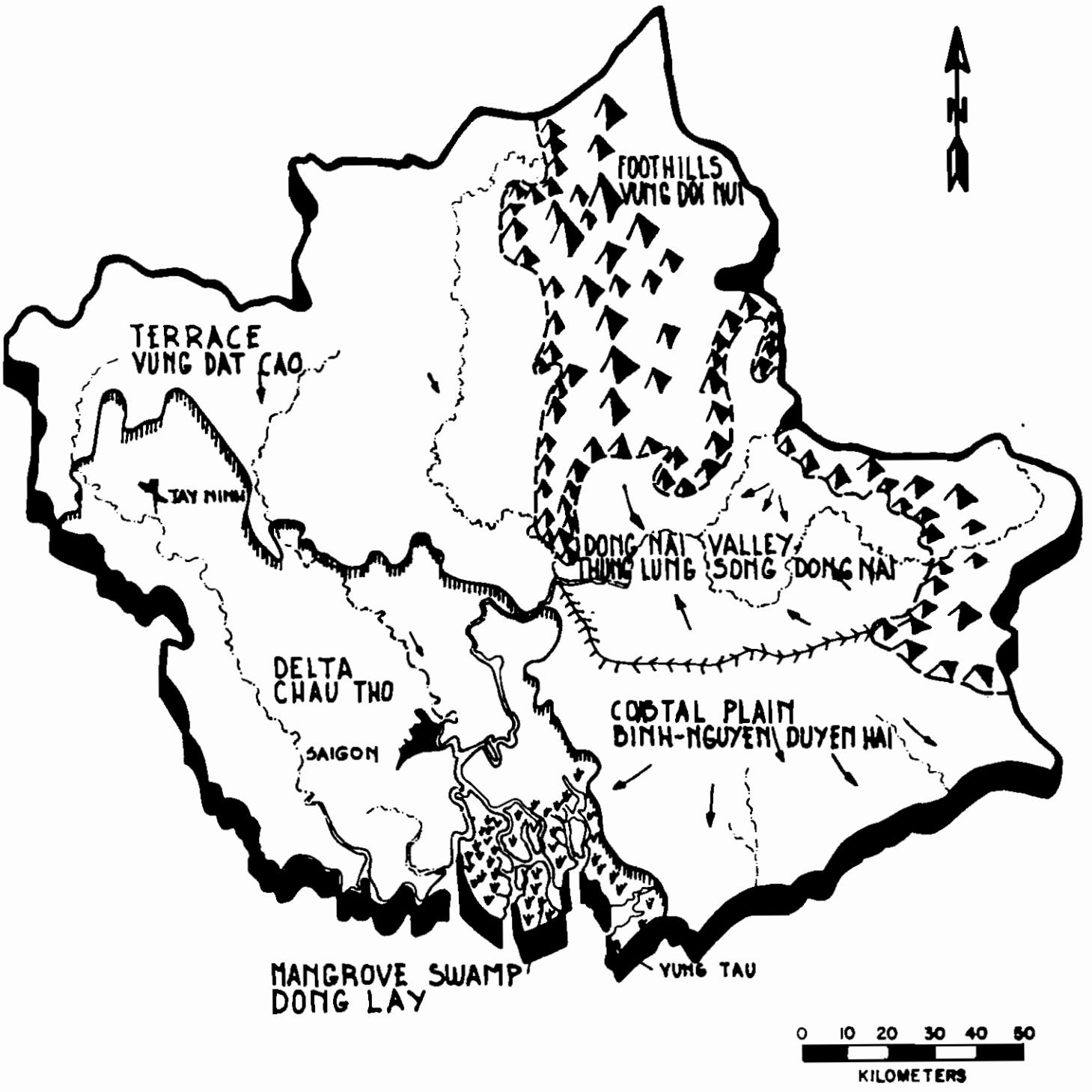
This section sets forth preliminary proposals on basic policies and objectives for the long-range development of Saigon and the surrounding provinces. The area concerned comprises Saigon, the special capital zone of Gia Dinh Province in which it is located, and the ten surrounding rural provinces. The whole coincides with the III Corps Tactical Zone.

Today the population of this area approaches 5,000,000 people (nearly one-third of the nation), 40 percent of whom live in the city of Saigon which with nearby centers accounts for nearly all of the nation's manufactured goods. The rural provinces themselves produce two-thirds of Vietnam's sugar, nearly all of its plantation grown rubber and 15 percent of its rice crop.

Saigon and the surrounding provinces occupy land of geographical transition between the Mekong Delta to the south and the Central Lowlands and Highlands to the north. The southwestern provinces are flat delta lands and contain the areas' two largest cities (Saigon and Tay Ninh), as well as a large mangrove swamp which penetrates some 30 kilometers inland (figure 12-9). The northern provinces include the so-called Mekong Terrace and contain areas of rougher terrain which fall away in the southeast to the Dong Nai valley and the coastal plain.

A variety of land uses occur. The coastal plain and uplands in the north support dense forest stands which contain many of Vietnam's most valuable trees. The Delta lands and the Dong Nai valley are generally rich rice lands which also produce tea and sugar cane. In a 30 kilometer wide belt west and north of Saigon is found most of the country's plantation rubber.

The center of the Cao Dai faith is in the city of Tay Ninh and the Brahmanist Chams are also active in Tay Ninh Province. The Stieng and other Montagnard peoples are found along the Cambodian border and in the rising hills to the northeast.


N
FOOTHILLS
VUNG DOI NUI
TERRACE
VUNG DAT CAO
TAY NINH
DONG NAI VALLEY
THUNG LUNG SONG DONG NAI
DELTA
CHAU THO
SAIGON
COASTAL PLAIN
DINH-NGUYEN DUYEN HAI
MANGROVE SWAMP
DONG LAY
VUNG TAU
0 10 20 30 40 50
KILOMETERS

HÌNH 12-9

The city of Saigon presents a complex cultural picture and contrasts greatly with its rural hinterlands. Because of the considerable topographic and socio-economic diversity, Saigon and the surrounding provinces do not now constitute a unified region. The grouping of provinces surrounding one of the great cities of Southeast Asia lacks internal identification and meaningful interrelationships. The disparities of the area were emphasized with the break-up of French Indochina and have been intensified by the present war. They have been accentuated by the military infrastructure that has been built largely in the vicinity of Saigon, which has altered the pattern of urban-rural relationships. Differences have also been accentuated by extensive migration to Saigon, not only of refugees, but also of rural people seeking the broader economic opportunities of the city.

For the area as a whole, the principal issues of further development planning are twofold; (1) a determination of the opportunities for production in the rural provinces and a definition of the relationships of those provinces to Saigon; and (2) an identification of the ways to satisfy the immediate and urgent requirements for support of the fast growing city of Saigon, and a definition of its longer term role with respect to the surrounding provinces and to Vietnam.

THE RURAL PROVINCES

The rural provinces present a variety of opportunities and challenges for future development. Generally, the provinces nearest Saigon are active agricultural areas with well-established practices and land-uses. There are potentials for agricultural improvement, however, in terms of the stimulation of higher production and new crops, the rehabilitation of the existing rubber plantations (or their renewal with high yielding clones), and the introduction of livestock, to name typical opportunities. Fairly broad studies of land capability and crop adaptation to the various ecological subdivisions within the area are required. Fish industries may be important and the possibility of establishing brackish water fish ponds along the fringes of the mangrove swamp should be investigated.

Settlement of presently unused land may afford exceptionally favorable development opportunities; attention should be focussed initially on two sections; the northern provinces, and the Dong Nai Basin, which affords irrigation possibilities in its lower reaches and hydroelectric possibilities in the highlands.

Land needed for other uses will no doubt ultimately decrease the total area under forest. The spread of urbanization implies intensive agriculture for market crops and the value of land for timber will become relatively less important in areas nearer Saigon. But the outer-most rural provinces include at least 1.5 million hectares of high dense forest, and smaller areas of forest which man's activities have modified to some extent. This area presents the best opportunity for exploiting and growing tropical hardwoods.

The large block of mangrove southeast of Saigon has been severely damaged by defoliation activities, but the mangrove tideland is important. Here the age-old process of land building is taking place. Mangroves, the forerunners of tomorrow's dried land, are the retainers of today's tidelands. Vietnam will need the land they are building some day and studies should be made to identify the real potential for preservation of this area.

Apart from Saigon, Tay Ninh and Vung Tau are the main possibilities for programs of urban amplification within the area. Their role in the possible future decentralization of Saigon, as discussed later, should be studied. Related studies are required to assess the possible postwar uses of such military infrastructure as airfields, bases and hospitals.

SAIGON

Saigon functions today as the seat of government, principal port, business and commercial center, transport hub and military headquarters for all of Vietnam. It is, in fact, Vietnam's only viable urban concentration.

Over the past twenty years, its dominant position over the rest of the nation, has been growing at an increasing rate. Its population has nearly tripled since 1950, and it is continuing to absorb people from rural and less developed areas throughout Vietnam. It has been estimated that the population of Saigon and Gia Dinh could approach 5,000,000 by 1980, and over 9,000,000 by the end of this century.

The present day Saigon dates from 1867 and is a French establishment. (The ancient citadel is in Gia Dinh). In 1954 Saigon was united with the Cholon, and in 1966 was further enlarged by the acquisition of the low lying area east of the Saigon river. Saigon's French roots are evidenced in its wide tree-lined boulevards, squares, arcades, and axes. Its downtown or core area is perhaps the best example of western influenced urban design in Southeast Asia. Cholon, on the other hand, reproduces in spirit and form its Chinese oriented urban counterparts elsewhere in Asia. It is a rich mixture of intermingling uses; small shop-houses, hotels, restaurants, industries, all close together in one totally urban complex.

In 1943, at what was probably the end of effective French rule in Vietnam, the population of the former independent city of Saigon stood at 500,000. Today, the consolidated city of Saigon and Cholon has over 1,640,000 inhabitants and another 1,000,000 live in Gia Dinh Province. Altogether, they contain some 2,700,000 persons, or slightly over 16 percent of Vietnam's total population, and 85 percent of the country's urban population.

Except for specialized military installations, virtually no new public works facilities and commercial buildings have been built in Saigon since 1950, and the increased population has continued to be served by the pre-war municipal infrastructure.

The architecture and general form of Saigon reflects the inherent physical deficiencies of its site. The delta soils on which it is built are deep, clayey-types, with bed rock well below the surface. Thus the construction of high-rise structures is especially expensive and difficult.

In recent years, a limited expansion of Saigon has occurred along two axes. One extends toward Tay Ninh on the north, and the other extends easterly along the highway to Bien Hoa. The northern expansion consists chiefly of indigenous houses arranged in clusters that approximate rural settlements. The expansion to the east and Bien Hoa is more sophisticated, consisted of more permanent houses, industrial buildings and various kinds of military facilities. This new growth has been taking place in the areas that are best suited for urbanization, since the terrain to the south and west of Saigon is technically and economically less fitted for this purpose.

Important today, and especially for tomorrow, are the military support facilities that have been built in and near Saigon. These installations, chiefly the ports and camps, are of permanent value and they will undoubtedly influence future growth patterns and land usage. The wharfs that have been built along the Saigon River, the New Port and Long Binh Camp and the airfield at Bien Hoa, will likely become important features of Saigon's landscape.

The Dominance of Saigon

In most developed countries there is a hierarchy of cities of population size and economic activity. Although the largest city may occupy the leading role in the economic life of the country, such as the case of New York, London, Paris and Rome, there are other cities that challenge the largest one in size and may surpass it in certain kinds of economic functions, such as Chicago, Los Angeles, Manchester, Lyon or Milan. In most underdeveloped countries the capital city is dominant in every respect and the city second in size is only a fraction of the size of the largest. Bangkok, Manila, Phnom Penh, and Rangoon, all neighboring capital cities are at least five times as large as the next biggest city in their respective countries. Saigon is six times larger than Da Nang, the next largest city in Vietnam.

The secondary cities of Southeast Asia, and Vietnam exist as extensions of the primary ones; they are immature and have little self determination. In Vietnam there are only six autonomous cities (Cam Ranh, Da Lat, Da Nang, Hue, Saigon and Vang Tau). Other important urban centers such as My Tho and Tay Ninh are formed as collections of villages grouped together.

In most cases, the rates of growth of the primary cities of Southeast Asia are almost one third faster than those of the secondary centers. The attractions of Saigon are of many kinds, only of one which is traceable to the greater security of life in the city. The other attractions of a more varied life and wider economic opportunities will persist and perhaps grow stronger in the post-war period.

The forecast of a Saigon population of 9,000,000 in the year 2000 (Saigon and Gia Dinh) is closely paralleled by current projections of 8,000,000 for Bangkok by the same year. Calcutta, with an estimated current population of 7,500,000 has already attained this range. These huge urban concentrations are hard to comprehend in the circumstances of Saigon which is struggling to provide the bare essentials of urban services based on an infrastructure built for a population of only 500,000.

The implications of the possible future growth of Saigon are significant. City building will drain natural resources; based on accepted costs per capita for urban infrastructure, it is estimated that as much as US $10 billion might be required in additional investment in Saigon to support a population of 9,000,000.

The following exercise in a variable range of future infrastructure costs illustrates the possible future load on the National budget this may create. It presupposes an adequately served population base for the metropolitan area for 2,840,000 persons at the end of 1968.

	Projected Population of Urban Area		Estimated Costs of New Infrastructure*			
			At $5,000/Capita		At $1,500/Capita	
Year	Incremented Increase	Cum. Total	Increased Amount	Cum. Total	Increased Amount	Cum. Total
1968	---	2,840,000	---		---	---
1969	133,000	3,073,000	66.5	66.5	199.8	199.8
1970	140,000	3,213,000	70.0	136.5	210.0	409.8
1975	804,000	4,017,000	402.0	538.5	1,206.0	1,615.8
1980	940,000	4,957,000	470.0	1,008.5	1,410.0	3,025.8
1990	2,163,000	7,120,000	1,081.5	2,090.0	3,244.5	6,270.3
2000	2,180,000	9,200,000	1,090.0	3,180.0	3,270.0	9,540.3

*Millions of US Dollars

Policies For Development

A long run problem is to make sensible adjustment to the attractions of Saigon while, at the same time, to supply incentives and specific programs to encourage growth outside the city. It is impossible, and probably undesirable, to stop the growth of Saigon, but it is reasonable to have as a target a rate of growth which is less than the rate for other cities in the country; that is, it is reasonable to adapt urban policies to encourage the more rapid growth of secondary cities.

We believe that there are two main criteria or objectives for policies affecting Saigon. The short run objective is to move or alleviate the worst of the pressures now bearing on the city, so that it can function more effectively and secure some breathing space in which to initiate longer run programs. Second, we believe that the long run development strategy for Saigon will be most economically attractive and politically feasible if it aims at decentralizing economic activities, building outward, rather than completely rebuilding the "core" city or the central business district and that steps to encourage the growth of other cities and of new satellite cities close by are some of the ways to move outward.

The Vietnamese text of this section presents a comprehensive assessment of Saigon's existing and probable immediate postwar needs for public work facilities and essential social services. In the short run Saigon is faced with a rescue operation for, in some essential respects, the city is breaking down in the performance of the functions of a major city, and the situation seems likely to continue to deteriorate in the immediate future. This deterioration is caused primarily by the unbelievable inflow of people into the city, with a consequent overburdening of municipal facilities and infrastructure built for a city of only one third the size. The problem is most starkly seen in traffic conditions and in housing. It is also apparent in all other municipal services but not to the same extent.

It is fruitless to speak of deliberate planning for the future development of the metropolitan area while these immediate problems threaten to break down the functions of the city. The Joint Development Group has suggested immediate measures to correct or at least to mitigate

the worst of the problems in transportation, housing, and utility supply. The time when palliatives or half-hearted measures could suffice has long passed. Nothing short of very strong, even draconic, measures will suffice. If at least some improvement in present conditions can be achieved, there are intermediate measures that may be taken to further improve the situation in the city. And if these in turn can be undertaken, it will then be time to turn to long-run planning on a considered basis.

We have not recommended comprehensive planning for Saigon now, primarily because the need to be comprehensive frequently leads to paralysis of action. If a few vigorous programs are undertaken, much of the remaining planning can follow in due course without any loss of time or efficiency. But we believe an immediate task of national planners is to consider the extraordinary problems facing Saigon in the future with a view to devising policies for diverting, checking or transferring some part of the anticipated growth. The future development of Saigon must be considered in relationship to the nation as a whole and not only to the city alone.

Saigon as the capital of the Republic has already established for itself what seems to be an appropriate national role. But this function as the nation's capital requires a highly specialized city. One of dignity and formality, with broad, landscaped streets, malls and buildings of high architectural quality. A city that reflects the image and aspirations of the nation. This is the primary role that should be emphasized for Saigon. A secondary, national role as financial center is already in being and will probably, and logically, continue.

Saigon's regional role, its relationship to the adjacent provinces, has been one of a port city and city large enough to supply adequate, higher echelon, urban services. The proper role for the port should be regional. The urban services required by the region, such as higher order medical and educational facilities, should not be developed in the area if these services or facilities could be placed elsewhere.

Saigon's real future lies with programs that are instituted now. At present there are no proven techniques to cope with growth on the scale that is occurring here. In the interest of the nation and the future of the city, a beginning must be made to de-emphasize its attraction and to decentralize some of its present functions. There are a number of techniques that might be investigated.

In the long term, programs of family planning may have impact on Saigon's growth; more direct results could flow from budget programming that re-oriented priorities for investment to other urban centers. Industrial development, expansion of government services, and provision of new educational and health services are example of the kinds of growth that might be directed toward outlying urban centers. Encouragement and planning of new satellite towns near the primary city is a technique used successfully elsewhere. At Saigon's present stage of development this may be premature, but it should not be ruled out for the future.

To consider these questions, we believe a high level group of citizens, possibly one composed of responsible local citizens, government officials from pertinent Ministries perhaps with interested persons from agencies of other governments or world organizations should be formed. This group may take the form of an ad hoc body or one with semi-government status. It may be formed to create on the part of the citizens, government officials, and others, an awareness of the scope of national urban problems. This group, if provided with a professional staff, could also be the coordinating and recommending agency for all urban proposals.

SECTION VI THE MEKONG DELTA

INTRODUCTION

Early in the JDG studies in 1967, it became apparent that increasing agricultural production in the Mekong Delta represents a major opportunity for the economic development of Vietnam. In October 1967, the JDG issued its Working Paper No. 3, A Program for Mekong Delta Development which described the potential of the Delta and outlined a long-term program of water control and agricultural improvements required to attain this potential. The paper recommended a continuing program of study which has been carried out by the JDG.

A preliminary appraisal of a proposed Mekong Delta Development Program has been prepared. The Delta as herein defined is that portion of the Mekong Delta lying within Vietnam comprising the sixteen southern provinces, lying south of the West Vaico River. The proposed program envisions a massive increase in agricultural production in the Delta through the application of water control and other inputs.

This presentation describes the region, analyzes existing and potential agricultural conditions, describes present water control problems and proposes solutions, examines the organizations proposed for Delta development, discusses a proposed development program and presents a preliminary appraisal of the program.

DESCRIPTION OF THE REGION

The Mekong Delta is a vast, flat alluvial plain located in the lower reaches of the Mekong River in Cambodia and Vietnam. The area in Vietnam is slightly over 3.7 million hectares. The Delta is very flat with elevations above five meters occurring only in a few places.

The population of the Delta is about six million people. Most of the population lives in towns, villages and hamlets located at intersections of or along the banks of the rivers and canals. Virtually all of the population is engaged in agriculture and related activities, with principal emphasis on rice. The major towns, which are usually provincial capitals, serve as commercial centers for the surrounding agricultural areas.

Waterways are the dominant mode of transportation in the Delta. Highways are few and in poor condition becoming more so as the distance from Saigon increases. The transport system is oriented toward connecting the hinterlands to the major river towns and connecting these towns to the Saigon region.

Climatic conditions in the Delta are dominated by the monsoons. Annual rainfall averages about 1,800 millimeters over the entire Delta, ranging from 1,000 millimeters in some interior areas to over 2,400 millimeters in the southern part. Much of the rain occurs in intense local showers and there is considerable year-to-year variation in rainfall. The rainy season extends from May to November, with only occasional rains during the rest of the year.

The annual flood of the Mekong is a major hydrological feature of the Delta. As the river rises during June and July, extensive overbank spill occurs from both the Mekong and Bassac, covering large land areas with up to three meters of water. The second major hydrological feature is the influence of tides during the low flow season. Tidal ranges of 3 meters in the South China Sea and over 1.5 meters in the Gulf of Thailand cause flow reversals in the rivers and many other small channels interlacing the Delta causing salinity intrusion in these channels throughout about one-third of the Delta. Due to the extreme flatness of the Delta, drainage is a problem during the rainy season when river stages are high. Tidal action also inhibits proper surface water drainage in the Lower Delta.

The Mekong Delta is alluvial, formed from deposition of sediments from the Mekong. These deltaic materials are generally fine-textured sediments with coarser grades found along the river banks and finer materials together with peat and muck formations found in more

poorly drained areas away from the river. In the lower Delta and along the coast soils have been subject to a marine environment.

The predominant economic activity in the Delta is the production of rice and related processing and commerce. Other agricultural crops are grown on a small scale and usually for local consumption. Livestock, principally chickens, ducks and hogs, is also raised and marine and river fishing are practiced throughout the Delta.

AGRICULTURE

Existing Conditions

Of a total land area in the Delta of slightly over 3.7 million hectares, about 2.1 million hectares, or 57%, is readily suitable for agricultural production from the standpoint of fertility. In 1967, just under 1.7 million hectares were under cultivation; 1.56 million hectares in rice and the balance in other crops.

Generally, rice cultivation consists of a single crop each year planted in May or June and harvested at the end of the rainy period in October or November. Three distinct systems of rice culture are used, each adapted to the natural conditions prevailing in different parts of the Delta. These are: single transplant, double transplant and direct sown floating rice. The introduction of new high-yielding varieties such as IR-8 is very recent and not yet extensive.

The three basic systems have been developed over the years to adapt to water conditions encountered in the Delta. In the upper part of the Delta annual flooding of vast areas requires the use of floating rice which is capable of growing at a rate and to a height such that the heads remain above water as the flood rises. In the middle part of the Delta, where flooding is not a serious problem but drainage of local rainfall is poor, double transplanted rice is grown in an effort to develop plants which are tall enough to survive under high water levels in the fields in which the final transplant is made. Single transplanted rice is grown in the lower Delta where flooding and poor drainage are a less serious problem.

Single transplanted rice is the most common in the Delta, being grown on 760,000 hectares. Maximum yields range between 2 and 3 tons of paddy per hectare. Floating rice is grown on 500,000 hectares of the upper Delta, where the land is subject to heavy annual flooding over a period of several months. Floating rice is a wonderfully adapted crop but yields are low, usually only about one ton of paddy per hectare.

Delta rice production in 1967 was about 3.3 million tons with average yields slightly over 2 tons of paddy per hectare cultivated. This was about 70% of the total Vietnam production.

About 31%, or one million tons, moved into the channels of trade. Half of this amount was sold in the Delta and the other half, or 500,000 tons, was exported to Saigon for consumption or redistribution to other parts of the country. The price of paddy at rice mills in the Delta averaged about US $114 per ton during 1967.

Other crops grown include manioc, mungo beans, peanuts, soybeans, sweet potatoes, corn, bananas, coconuts, tree fruits, pineapple, sugar cane, tobacco and vegetables. Except for areas located around the major towns, other crops are grown as a part of the rice farming operation, on river and canal bank lands close to the farmer's home. Livestock raising is also usually an adjunct to the basic farm operation. Fishing is often a commercial activity encompassing offshore and river boat fishing, fish trapping and fish raising in ponds.

In terms of value, the five other most important crops grown in the Delta are mungo beans, bananas, coconuts, tree fruits and vegetables. The Delta produces 70% of Vietnam's ducks and duck eggs, almost 60% of the chickens and chicken eggs and about one-half of the hogs and buffaloes. The fish catch in the Delta is 37% of Vietnam's total, over half being river fish.

Soils and Land Capability

Soil types in the Mekong Delta are based upon five different environments: coastal soils, highly acid estuarine soils, river alluvium, Mekong terrace soils, and mountain soils in the western end of the Delta.

The coastal soils and river alluvium comprise about 94% of the total and only a very small portion of the remaining soils has any agricultural significance.

The coastal soils are of marine origin and occur as sand bars, tidal flats and mangrove swamps. The sand bars cover 26,000 hectares in long strips parallel to rivers and shorelines and are presently moderately productive. The tidal flat soils encompass just over 900,000 hectares in the lower Delta representing former tidal flats, depressions and tidal creeks. They are moderately to highly productive. The soils of the mangrove swamps (225,000 hectares) are saline, poorly drained, silty clay mudflats.

The river alluvium soils are found in the so-called backswamp areas, along river banks and in alluvial plains. The backswamps are low-lying, poorly drained areas where acid and very acid alluvial soils exist. Acid soils are moderately productive after leaching, but highly acid soils are generally unproductive. Highly acid soils comprise some 1,170,000 hectares in the Plain of Reeds and in scattered areas of the Ca Mau peninsula. Their cultivation is limited and production is either low or impossible under present conditions. Among the less acid backswamp soils are 655,000 hectares which are only moderately acid and when adequately drained are highly productive. River bank soils cover some 102,000 hectares along the banks of the Mekong and Bassac in the upper Delta. Rice yields are fair but other crops grow well. Alluvial plain soils include 248,000 hectares and are moderately productive.

Hydrology and rainfall are the major factors affecting the exploitation of soils in the Delta. Soil fertility will become a significant factor only after water control is achieved and then mostly as related to crops other than rice. Under strict water control conditions, rice is adaptable to a wide variety of soil characteristics and, aside from those soils where toxicity is a problem, rice will be a highly productive crop in the Delta. With water control 2,135,300 hectares of Delta soils will support high yield double cropping in rice. In this same category, some soils are also particularly adaptable to other crops. Of the remaining low productivity soils, opportunities for improvement in the highly acid series are limited, but the peat soils, given special treatment, can be highly productive in vegetables and other high value crops.

Market Projections

The future of crop production in the Delta can be viewed in terms of projections of domestic and export requirements for crops, livestock and fish for the 1970-1990 period. The estimated demand for agricultural products from the Delta during this period are shown on Table 12-5 Domestic requirements are based upon population projections and the highest levels of per capita consumption for the 1962-1967 period. No changes in the consumption pattern are reflected. Export projections are tenuous due to rapid changes in production in various countries, particularly as related to rice and only 20% of the total 1990 rice demand was forecasted for export. The determination of the proportion of country requirements to be met from the Delta was established on the basis of historical trends and the best judgments available of future patterns. The Delta is the largest and most economical source of most of the products listed.

Production Potential

The basic requirements for realizing the full crop production potential of the Delta are: water control (protection from flooding, improved drainage, salinity control and wet and dry season irrigation), improvement in agricultural practices, utilization of high-yielding rice varieties, and use of improved strains of crops other than rice.

Water control is basic. Under existing conditions, the only possibilities for major expansion in rice production lie in the extension of cultivation into areas of suitable soils where rice is presently not grown. The resulting production increase would be about 1.25 million tons, which, although a major amount, is insufficient to meet more than short-term needs.

Improvements in agricultural practices under existing water conditions can also be undertaken. Delta-wide application of better seed, new fertilizers and improved cultural practices might increase yields by as much as 0.5 tons per hectare, a total production increment of 1.0 million tons. This would require a massive program of research and extension with only limited promise for increased production.

Table 12-5

ESTIMATED DEMAND FOR DELTA AGRICULTURAL PRODUCTS

Commodity	1967 Production	Tons 1970 Demand	1990 Demand
Rice (paddy)	3,287,000	4,350,000	9,963,800
Manioc	39,370	94,450	363,200
Mungo Beans	13,715	15,850	29,400
Peanuts	1,735	2,200	4,450
Soybeans	3,550	5,900	10,750
Sweet Potatoes	79,230	105,600	188,200
Corn	8,655	16,500	36,750
Bananas	131,360	220,000	390,550
Coconuts	117,235	160,100	267,500
Tree Fruits	126,900	220,750	289,800
Pineapples	20,900	42,100	75,350
Sugar Cane	148,180	505,250	844,200
Tobacco	3,155	4,600	5,450
Vegetables	54,005	72,500	173,100
Buffaloes	-	58,000	97,200
Cattle	-	21,100	35,250
Hogs	-	187,550	313,350
Poultry	-	71,600	119,650
Eggs	-	778,000	1,245,000
Fish	103,695	162,200	271,600

The introduction of the new, high-yielding rice varieties into the Delta must be handled with caution if provision for water control is excluded. While it is possible to provide proper water control at the farm level in scattered locations, the widespread cultivation of these new varieties will require water control.

Proper water control in the Delta will permit changes in the present system of rice production, extension of the growing season, a more intensive type of crop production and use of new and improved varieties.

Important changes in rice production systems will result from flood control and improved drainage. Protection against flooding in the upper Delta, together with partial improvement in drainage, would permit the growing of single transplant rice on the 500,000 hectares where floating rice is now grown. Improved drainage would also permit a change from double to single transplant on 300,000 hectares in the middle Delta. Introduction of improved agricultural practices at this stage would raise single transplant yields to 3.0 tons per hectare in these areas.

In the lower Delta, salinity control will permit a longer rice-growing season with higher yields and higher returns over present single transplant practices and provide the opportunity to grow a second short season crop.

The provision of irrigation in both wet and dry seasons will permit much more intensive use of Delta lands than the present one rice crop per year. The controlled, year-round application of water will allow not only the growing of two rice crops per year, but other cropping combinations involving rice and other crops of higher value. For example, it would be possible for a farmer to grow five rice crops in two years or two rice crops and a secondary crop per year or one rice crop and three vegetable crops per year. Grain or vegetable crops could be included, depending upon soil characteristics and markets. The potential is enormous.

All elements of water control (flood control, drainage, salinity control and irrigation) are required for the widespread utilization of new high yielding rice varieties in the Delta. However, yields of 4 to 6 tons per hectare per crop can be reasonably expected.

Delta production of rice is expected to grow from the present 3.3 million tons to almost 10 million tons in 1990 in order to meet projected demands. During this period, several transitions will occur: from floating rice to double or single transplant, from double to single transplant and ultimately to new high yielding varieties.

The production of about 8 million tons to meet estimated domestic requirements in 1990 could be accomplished by increasing yields to 4 tons per hectare on the 1.5 million hectares presently under cultivation through the use of improved varieties (6 million tons) and either increasing the area under cultivation by 500,000 hectares or double cropping 500,000 hectares (2 million tons). To supply the additional production of 2 million tons required for export by 1990, an additional 500,000 hectares could be double cropped.

Among other crops presently grown successfully in the Delta and for which experimental work indicates high yields from improved varieties are: peanuts, soybeans, mungo beans, corn sorghum, sweet potatoes, cassava, pineapples, sugar cane, tobacco, kenaf, vegetables, mangoes, oranges, coconuts and bananas. Analysis of farm income indicates that many of these, alone or in combination with rice, will provide a higher return to Delta farmers. Production of many of these crops will increase greatly while others may be more adaptable to other areas in Vietnam. Projections of demand indicate an increase of about 350 per cent in production in the Delta. Although part of this increase can be accomplished through increased yields, at least 300,000 hectares would be devoted to these other crops. This could be accomplished by several means. Some of these crops could be grown in rotation with rice. Some could be grown on lands now planted to rice, but more suited to other crops with rice production requirements maintained through further double cropping of rice. Some could be grown very well on the less productive soils not considered suitable for rice.

In any event, land does not represent a limiting factor in attaining estimated production targets for 1990. The theoretical potential of the Delta for rice production might be roughly defined as the production of two crops of high-yielding varieties per year, yielding 4 tons per hectare per crop, or 16 million tons.

Livestock raising, principally hogs and poultry, and the production of livestock feed show great promise in the Delta. Success will require improvement in the local breeds, greater attention to disease control and improvement in marketing facilities. High yielding varieties of sorghum appear particularly well suited for growth in the Delta as livestock feed.

Fishing conditions will need to be closely observed during the change in water conditions resulting from construction of the water control system. However, there is no reason to expect adverse effects on fishing if proper measures are taken. Production of fish should continue to be more than adequate to meet local needs and increases in river fish production for export from the Delta may also be anticipated.

Agricultural Program

An agricultural development program directed at realizing indicated production goals must reach directly the millions of Delta farmers who are hard-working and clever individuals who can and will adapt to new practices and new crops. Large and far-reaching programs will be required, however, to provide the Delta farmers with the opportunities to benefit from the proposed water control improvements and to obtain thereby the productivity and increased incomes which are potential to the region.

The device by which it is recommended agricultural, economic and social advantages of the Delta's proposed development program be brought to the farmers is the Local Development Association. These are conceived to be organizations of farmers, possibly grouped by village, and ranging in size from 2,000 to 5,000 hectares, with farm populations from 5,000 to 15,000 people. The Local Development Associations would provide a vehicle for accomplishing agricultural research and extension,

provision of physical inputs, provision of agricultural credit, improvements in the marketing process, and resolution of land tenure questions.

In order to take full advantage of water control in the Delta, many agricultural innovations and changes must be instituted. The best means of field preparation and water application to various crops, the best new rice varieties and new crops, the fertilizers and insecticides, the best means of improving livestock and fish culture, the best controls of plant and livestock diseases will all have to be anticipated and allowed for in the projection of new agricultural practices. These determinations will require a great research effort in the Delta. But more importantly, once these optimum solutions are arrived at, several million farmers will have to be educated in their use. A program of research and extension is therefore central to the Delta program.

Six large pilot areas in the Delta have been identified and recommended for early intensified development. These pilot areas are designed to be the forerunners of some 770 Local Development Associations which will provide the organizational framework for intensive agricultural development throughout the Delta. The six pilot areas are so located in various parts of the Delta as to be representative of the various conditions encountered. They are designed to provide fairly large-scale areas for testing and demonstrating the best technical and organizational ways to achieve the agricultural goals of the program for later widespread application throughout the Delta. They will be focal points for intensive agricultural investigation and study, not only in the context of research and trial, but also in the determination of the best ways of transferring the results of research to large groups of farmers.

A variety of scientific and technical talents will need to be applied intensively to these pilot areas. Research will be performed by a number of research teams which will service the six pilot areas. An extension team will be assigned to each pilot area, to assist the farmers in upgrading their production methods, utilizing the results of the concurrent adaptive research being conducted by the research teams.

The manpower needs for staffing the Delta agricultural program are very great. Ultimate development of some 770 Local Development Associations, each encompassing an average of 2,700 hectares

devoted to intensified agriculture will require large numbers of highly-trained and experienced research specialists, farm managers and operators, marketing experts, extension agents and engineers. Current estimates of the availability of such manpower indicate a serious shortfall. Heavy emphasis must therefore be placed upon improving education in agriculture at all levels.

Physical inputs include seed, fertilizer, insecticides and equipment and their ready availability at fair prices is an essential element in improved agriculture. Projecting requirements to over two million hectares under multiple cropping indicates the scale of the ultimately required supply and distribution system. At the present time, the distribution of these inputs in the Delta is primarily a function of private dealers and there is no conclusive evidence of unfair pricing. It appears that the simplest and most direct means of handling the increased demand for these products is to encourage the continued participation and expansion of private entrepreneurs in this field. Supply of equipment from commercial sources or by custom operation is projected with the Local Development Associations acting as agents for the farmers.

Credit in greatly increased amounts will need to be available to farmers, farmers' associations, dealers and others engaged in the marketing and supply of agricultural goods. Aside from widespread informal credit arrangements among families, friends and neighbors, the three principal sources of credit in the Delta at this time are the commercial banks, dealers and merchants, and the Government-sponsored Agricultural Development Bank.

It is estimated that by 1990 the total loan funds needed in support of the Delta agricultural program will total VN $25 billion. A reasonable share which might be contributed by the public sector through the Agricultural Development Bank might be one-half or VN $12.5 billion.

Care must be exercised in establishing credit procedures so tha they may remain simple while providing some degree of control over the use of loan funds.

The Local Development Associations will require large sources of credit, presumably governmental, in order to construct their water control facilities and perform land leveling operations. Within this credit structure it might be possible to devise a channel of loan funds to the farmers.

The Local Development Associations, in cooperation with

governmental and private channels, will provide an organizational framework within which to achieve the required improvements in the marketing process. Improvements in rice drying, warehousing and milling will be required to handle increased tonnages efficiently at minimal loss. The provision or improvement in these facilities can be accomplished on a large scale, either communally through the Local Development Associations or by arrangement with private commercial interests.

The transportation system in the Delta consists primarily of waterways. Such highways as do exist are in need of substantial rehabilitation. The Government has plans for rehabilitating both modes of transport to an extent that transportation will not be a limiting factor in handling Delta production for many years.

As the Delta moves into a more complex modern agriculture, there will be need for various marketing services and regulations will need to be established for quality control and grading, for warehousing, and for the sale of agricultural products. Reliable marketing information should be quickly disseminated. Cooperative marketing will have a distinct advantage to the farmer in obtaining a fair return from his crop and this will be a major function of the Local Development Associations.

The establishment of land tenure is basic to agricultural development. Unless a farmer is secure in the possession or use of his land, he will not make the efforts required to increase his production and improve his livelihood. The question of economic farm size must be accounted for. If land reform results in the continuation and intensification of farm poverty through the establishment of farms too small to provide a living, it will be a tragic failure. In the Delta, indications are that a farm family can derive a satisfactory income under improved conditions from two hectares of rice double-cropped. The same results can be obtained on lesser areas if part or all of the land is devoted to vegetables or other high-value crops or if a supplemental livestock operation is included. Average Delta land holdings are now just under two hectares. This average is close to an uneconomic farm unit and considerable attention will have to be devoted to farm size in the context of land productivity under various crops, family income levels, off-farm employment and other factors.

WATER CONTROL

Present Conditions

The basic problem inhibiting the growth of agricultural production in the Delta may be stated in very simple terms. The Delta farmer is unable to control the application of water to his crop. It is a tribute to his resourcefulness that he is able to wrest a livelihood from his land under the wide variations in water conditions which exist.

In the upper Delta over 500,000 hectares are flooded annually with depths up to three meters. In the middle Delta the intense rainfall during the growing season does not drain from the land because of its flatness and tidal action in drainage channels. In the lower Delta salinity intrusion during the low flow season seriously shortens the period in which crops can be grown. Virtually all rice is grown throughout the Delta during the rainy season and the farmer is at the mercy of too much or too little rainfall during critical periods of growth. There is insufficient flow in the river during the dry season to provide a fresh water supply for irrigation. Beyond these immediate factors, the effect of uncontrolled standing water on the land during much of the time results in soil toxicity in wide areas.

Water Control Schemes

The four needs for water control in the Delta are protection against floods, improved drainage, control of salinity intrusion and supply of irrigation water during both wet and dry seasons. To accomplish all of these purposes, some combination of water control systems in the Delta and upstream storage reservoirs will be needed. The function of the Delta water control system, simply put, would be to seal off the agricultural lands of the Delta from floods, from high river stage, from the tides and from the encroachment of salinity; and to control the ingress and egress of water to and from these sealed areas as required to provide for the four basic water control needs. The design of this system must take account of the extent to which it is technically and economically feasible to partially meet these basic needs through the multi-purpose operation of large reservoirs proposed for construction in the upstream riparian countries.

A study program was undertaken during the summer of 1968 to analyze the hydraulic response of the Mekong Delta to various schemes of water control. Two principal questions were addressed. The first dealt with the effectiveness of large upstream storage reservoirs in reducing floods to the extent required to prevent heavy and widespread overbank flooding in the Delta. The second dealt with the ability to construct levee and bypass systems in the Delta which would protect large areas against floods, but which would not adversely affect historical flooding conditions in unprotected areas.

The analytical tool used for these studies was the Mathematical Model of the Mekong Delta which had been prepared by SOGREAH for the Mekong Committee. This Model, installed on a computer in Bangkok, simulates hydraulic behavior in the Delta as it responds to various flow conditions in the river as it enters the Delta,and to rainfall conditions in the Delta itself.

In the analysis, the Delta (both the Cambodian and Vietnamese portions) was divided into thirteen large areas for which levee systems could be simulated singly and in various combinations. Representations of three possible flood bypass channels were also incorporated. The 1961 flood was used as the basic hydrologic input to the Model and the effect of Delta rainfall and evaporation was simulated. Studies were performed to determine the extent and depth of flooding in the Delta under natural conditions and with the flood control operation of the proposed Pa Mong and Stung Treng projects. Other studies determined the effect of levee protection of various individual areas and various combinations of areas in the Delta. The leveeing of all of the proposed development units in Vietnam was one of these combinations, as was the leveeing of the entire Delta, including Cambodia.

The analyses revealed that none of the assumed upstream reservoir capacities will result in full control of flooding in the Delta, although the larger amounts would theoretically permit a reduction in the magnitude of Delta flood protection works. These larger amounts, however, are probably at the upper limits of possible development at the two mainstream sites. A rough comparison of the relevant alternative costs indicates that flood protection works in the Delta are far less expensive than any reasonable allocation of the cost of upstream projects for this

purpose. Furthermore, the construction of reservoirs in the capacities needed to effect flood control to an extent permitting a significant reduction in magnitude of Delta flood protection works cannot be expected to take place for decades.

The analyses also demonstrated that the construction of levee systems for flood protection in the Delta is feasible without undue adverse effect in unprotected areas provided that proper attention is given to upstream levee alignments and flood bypasses are constructed. It has been concluded, therefore, that provision for full protection against natural floods should be incorporated in the Delta water control system.

The need for improved drainage is primarily due to the extreme flatness of the Delta. The problem becomes particularly acute during the wet season when river stages are high. This high stage also occurs in the numerous waterways which interlace the Delta and is further affected by high tidal fluctuations. It is not realistic to expect river stages to be significantly reduced by upstream flood control storage. Therefore, alleviation of drainage problems needs to be dealt with locally by provision of adequate conveyance channels and pumping facilities.

Salinity intrusion becomes serious during the dry season when the Delta river and waterways stages are low. In these circumstances, tidal action forces salt water into the various rivers and channels for various distances and at high tides causes substantial overbank spill in large areas. Again, it does not appear that upstream storage can significantly alleviate this problem and dikes and channel barriers will be required to protect the areas now subject to salinity intrusion.

Irrigation requires the construction of facilities in the Delta for conveyance of fresh water from the river to the lands to be irrigated. There are serious limitations on the source of fresh water for irrigation in the Delta during the dry season. Under natural low river flow conditions, salinity intrudes up the main river for about 40 kilometers to the vicinity of Can Tho. Further reductions in low flow could have serious consequences in allowing saline waters to intrude further upstream. Therefore, widespread dry season irrigation in the Delta will require augmentation of natural low flows from upstream storage reservoirs. Indications are that the amounts required will be within the capacities of multipurpose operation of either of the two major mainstream storage projects

under consideration by the Mekong Committee.

Proposed Water Control System

Provision of water control for the agricultural lands of the Delta requires facilities for the performance of four functions. A fifth, transportation, must also be accommodated. These facilities must be combined in various sequences into a scheme of water control that is multi-purpose in nature and adapted to the various conditions encountered in different parts of the Delta. The four basic functions are: flood protection, drainage, salinity control and irrigation. The facilities comprising a full water control system should be designed in the most effective and economical manner such that each function would be combined with and fully compatible with the other functions required at each stage of development. Water control implies that the beginning, duration, depth and quality of water on the farmers' fields will be controlled within certain limits. Some areas of the Delta may require two or more functions before a substantial increase in agricultural production may be realized and in others some functions do not apply.

Water control facilities have been further subdivided into principal and local works. The principal works such as: levees; dikes; main transportation, drainage and irrigation canals; principal pumping plants; and navigation locks will be developed as project facilities by a central organization called the Mekong Delta Development Authority. The local facilities such as : secondary and tertiary irrigation and drainage canals; farm or village dikes (bunds); small pumping stations and land preparation will be developed under the auspices of farmers' organizations called Local Development Associations.

Flood protection in the Delta will be provided by a levee and flood bypass system. The system will consist of levees placed adjacent to the major rivers, the Mekong and the Bassac, their distributaries and connecting links to the downstream limit of overbank flooding. The levees will also extend laterally from the right bank of the Bassac near the Cambodian border to the Gulf of Thailand to form the southern boundary of a flood bypass from the Bassac to the Gulf. A primary levee will also be constructed from the left bank of the Mekong near the Cambodian border

along the southern boundary of the Plain of Reeds to form the southern boundary of a flood bypass into the Plain of Reeds and the Vaico River.

Drainage of excess rainfall from the Delta lands will be provided through a system of collector laterals and major conveyance canals. The latter will dispose of the drainage either to the sea or the major river courses. The existing navigation canals will be used to the maximum extent possible. At locations where conveyance capacity of existing canals is insufficient, the canal will be enlarged or a new parallel canal will be constructed. Collector laterals will be provided so as to receive water by gravity from the Local Development Association lands and discharge by gravity to the major conveyance canals. The major conveyance canals will have low-lift pumping plants spaced at intervals to develop the necessary gradient for flow at the desired capacity. Terminal pumping plants will lift drainage water into the sea and river channels.

It is contemplated that drainage improvements be made in two stages, an initial stage sufficient to create conditions suitable for single-transplant rice culture and a final stage to improve drainage to the extent required for the cultivation of improved varieties under closely controlled water conditions at any time of the year.

Control of intruding surface salt waters will be provided by control structures or earth barriers in canals and sloughs, rehabilitation of existing dikes along the seacoast and rivers and construction of new dikes where required. The works required for salinity control will in part be provided by the drainage system.

The facilities to be provided for irrigation are those necessary to divert water from the main river channels and distribute it to the Local Development Association lands. Water will be diverted upstream from the intruding salt water in the river and conveyed in the major conveyance canals and laterals previously installed for the drainage system with modifications where required.

The pumping plants provided for drainage will be used with additional capacity provided where needed for irrigation. Pumping plants will be provided where necessary at the river diversion points. Small

pumping plants will lift water from the major conveyance canals into the local collector laterals previously provided for drainage.

The existing primary water transportation network in the Delta will be incorporated into the water control system and transportation will be maintained through the provision of navigation lock structures in those canals which will continue to serve as major transportation arteries as follows: 1) at intersections with primary levees; 2) to bypass pumping plants and control structures; and 3) at intersections with salinity dikes. Surface transport will be facilitated through construction and extension of bridges and causeways, incorporating roads on canal embankments and salinity dikes, and common use of rights-of-way.

Local Development Associations will consist of individual units composed of one or more villages encompassing an area of between 2,000 to 5,000 hectares. These organizations will serve individual farms and facilities to be constructed, operated, and maintained by the Associations will include any works needed to drain excess rainfall from or transport irrigation water to individual farms. These facilities will connect to the principal canal system of the Authority.

ORGANIZATION

Mekong Delta Development Authority

An inter-agency seminar was organized jointly by the National Committee for the Mekong and the Joint Development Group in November, 1967. At these proceedings, Delta development was discussed by representatives of the Ministries and the departments within them. The proceedings concluded with the unanimous passage of the following resolution:

> "For the full exploitation of the potential of the Mekong Delta, the proper coordination of departmental and extra-governmental agencies must be assured.

> "For this purpose the best solution, if it is possible, is to set up a separate Authority, provide it with the requisite duties, functions and powers, grant it financial independence, and place it above political influence. Such an Authority would both undertake projects in cooperation with other governmental agencies responsible for development planning in Vietnam, and support the Ministries and their departments in their investigational and project activities."

A proposal for establishment of a Mekong Delta Development Authority was made by the Joint Development Group to the Offices of the President and Prime Minister in March 1968. This has not yet been approved for two reasons. First, it was considered premature to establish such an Authority before the dimensions of the Delta development program had become clear. It is believed that the present Report removes this obstacle. Second, it was decided that creation of the Authority should be subject to debate and approval by the Legislature. Scrutiny and full discussion by this body is highly desirable since the Authority's ability to perform its functions will depend upon full public understanding of its program. It is recommended that a decree establishing the Mekong Delta Development Authority be submitted to the Legislature for action as soon as possible.

The Authority, as proposed, will be concerned with the management of the waters of the Mekong River in the Delta. It will be responsible for investigating, planning, promoting, designing, constructing and implementing projects and programs for the control and utilization of the water resources of the region for agriculture, transportation and other purposes. It will establish and enforce standards for the beneficial use of water. It will promote and assist the establishment of farmers' organizations for the local control and utilization of water and the development of agriculture.

The foregoing functions are limited in two respects. First, the Authority is concerned with water, and beyond encouraging and assisting in programs for its beneficial use, the Authority will not engage directly

in broad programs of economic and infrastructural development which are unrelated to the water resource and are properly the functions of other agencies. Second, the Authority is not considered a master agency which will deal directly with millions of Delta farmers. Instead, it will deal with the broad aspects of water control and will promote the organization of separate farmers' organizations responsible for development on the local level. These organizations, numbering in the hundreds, are termed here Local Development Associations.

To the extent feasible in the context of achieving program goals, the Authority may assign certain elements of the program by agreement with other agencies. Program control, however, must rest firmly with the Authority.

Initially, the Authority's operations will need to be financed through appropriations from the national budget and by loans from domestic and external sources. The Authority should also be empowered to levy and collect charges for water control services from the Local Development Associations and other customers, and to issue bonds.

It is not contemplated that the scale of water charges levied by the Authority be adequate to recover all costs of the water control program. They should certainly be sufficient to cover the costs of operating and maintaining the Authority's water control facilities and to recover some part of the interest and capital charges. The whole complex subject of Authority charges for water control in all its aspects merits careful investigation.

Local Development Associations

The principal responsibility of the proposed Mekong Delta Development Authority is to design, construct, and operate major facilities for the regional control of water. It would be unrealistic to imagine that the Authority can reach directly the millions of farmers who make their living in the Delta.

A new approach should be put forward and Local Development Associations, organizations of farmers, committed entirely

to the farmer's interest, are recommended. Their formation is likely to start with the Authority carefully explaining to the farmers in selected villages the overall Delta program and by specific offers of assistance to farmers in organizing to undertake development activities in their locality. A regular pattern should be applied throughout the Delta. The Authority should explain fully and honestly what a Local Development Association is expected to do, and what the Authority is prepared to do for it in return - and, having done this, to assist the farmers in organizing themselves. Local Development Associations will operate best if organized within the areas of existing villages and their component hamlets.

A Local Development Association must provide for the construction and maintenance of local water control works, provide its members with agricultural technical instruction and assistance, assist its members in securing adequate quantities of the most important supplies, provide storage and marketing facilities where private enterprise is not forthcoming, offer its guarantee for loans extended to its members, ensure that Laws and Regulations concerning water use are observed, and secure for each of its members rights-of-way, the right to use water and the facilities for water control as are necessary for the proper development of its members' farms.

The relationship between the Local Development Associations and the Authority will be a contractual one. The contract will define the functions and activities which the particular Association undertakes to perform, the assistance and services which the Authority undertakes to supply to the Association, and the regulations concerning the beneficial use of land and water which the Association agrees to observe.

The concept of the Local Development Association requires a great deal of further study and planning and, most important, testing under field conditions in the Delta. Immediate steps should be taken to select a few typical villages within the Delta in which studies in depth can be carried out. These villages will serve as pilots to the organizing of all villages in the Delta.

The four most important objectives of the Pilot Associations will be:

(a) A test of social and political practices to determine the practicality of introducing Local Development Associations within the village structure.

(b) A test of water control and agricultural production techniques to achieve maximum agricultural production.

(c) A test of the methods to educate farmers to change their agricultural practices as required to upgrade production.

Six areas have been selected as representative of the many conditions found in the Delta. Within each of these, an existing village should be chosen for detailed investigation and planning of a Local Development Association. Villages should be selected in the vicinity of My Tho, Can Tho, Long Xuyen, Soc Trang, Quan Long and Rach Gia to serve as the initial pilot Associations.

PROGRAM SCHEDULE

Factors Affecting Schedule

It has not been possible to establish a specific schedule for implementation of the Delta program at this time, although a general time frame can be foreseen from the projections of demand for the various crops. A number of important factors affecting program schedule are discussed below.

The market for Delta crops over the years will be a basic factor controlling the pace of development. The projections of demand for Delta products indicate the need for rapid improvements, particularly in rice production. A conservative indication of the Delta potential for rice production assumes that 2 million hectares could be double-cropped

with improved varieties yielding 4 tons per hectare per crop. Total production would be 16 million tons. Current market projections estimate a demand for Delta rice of 10 million tons by 1990. This indicates the need for substantial progress toward full development of the entire Delta in the next twenty years.

The Delta is an outstanding rice production area, and will continue to be so, but it also presents great opportunities for the production of other crops, many of which offer a better economic opportunity than rice to the farmer. On the other hand, the Delta is a vast area, and substantial areal expansion into other crops will necessarily be a gradual process due to market limitations and due to the need to introduce new cropping systems on a large scale. In the very long term, diversification is undoubtedly the major potential of the Delta. However, the prediction of the course and rate of diversification is extremely uncertain. It is largely due to this uncertainty that the economic analysis of the program presented in this report was based upon the production of rice alone. For this same reason, flexibility in land use must be a major factor in shaping the Delta development program.

Extension of the area under cultivation and improvements in agricultural practices under existing water conditions would produce fairly substantial short-term increases in total rice production. However, these factors alone will not be adequate to increase production to the extent required to meet the projected increases in demand. It is therefore proposed that these improvements not precede, but coincide with the implementation of the first step in water control development in each part of the Delta.

There will be certain requirements which will control the sequence of the various development steps in the Delta. In the large areas presently inundated by overbank flow, protection against floods must precede all other improvements. In areas now subject to salinity intrusion, control measures must be taken to permit the introduction of irrigation and double cropping. Initial drainage provisions must be made in present floating and double transplant rice areas before changing over to single transplant culture. Full drainage provisions are a prerequisite to the widespread introduction of improved varieties.

Rice is a crop which is very adaptable to water conditions. This factor permits flexibility in determining the various development steps in a particular area. As water control improves it is possible to increase productivity by shifting to the higher yielding types of rice. It is therefore not necessary, as it often is with other crops, to change the physical conditions affecting agriculture from the existing to the ultimate stage in a single discrete step. A more gradual shift is possible assuring reasonable continuity in the improvement process.

Delta farmers have been growing rice for decades, and with remarkable results considering the very adverse water conditions under which they are forced to operate. With this basic expertise, it is unlikely that the shifts in rice culture proposed in this report will result in a serious lag in increasing production. The shift from floating rice to double or single transplant in presently flooded areas will be the most difficult due to the major change in cultural practices and the increased labor requirements. Expansion into other crops, particularly those not grown extensively in the Delta, will have to be more gradual.

The Delta is a very large area and the physical facilities proposed for water control are large and extensive. Their financing and construction must be scheduled over a reasonable period of time. Similarly, organizations must be created to implement Delta development. Besides a central Mekong Delta Development Authority, this report contemplates the creation of some 770 Local Development Associations throughout the Delta. The formation of these organizations will be a long process. Finally, a program of this magnitude requires very large numbers of skilled manpower. It is estimated that the agricultural program alone will need several thousand highly trained professionals and technicians. A massive training effort will be required over a long period to meet these needs.

The need for upstream reservoir projects is of less importance to the Delta than was anticipated in earlier studies. Flood protection will be provided in the Delta itself and the principal need for upstream storage will be to provide supplemental water supply for dry-season irrigation. With the many other water control improvements possible, the need for dry-season irrigation is not of great importance in the early stages of the program. However, the 1990 demand projections indicate the need for a major upstream reservoir project in the 1980's.

Improvement Steps

In order to evaluate the economy of the Delta program in the absence of a specific program schedule, a series of improvement steps were postulated, each dealing with a particular improvement in water control and the resulting change in cultural practices leading to increases in rice production. These steps relate only to rice cultivation, although other crops will play an important part in the future of the Delta. Four consecutive water control improvement steps were defined and were applied to 24 different zones in the Delta to determine the effect of each step upon development in each zone. The development of each zone is likely to follow such a sequential course but application of such an analysis to the entire Delta will not be possible since the overall development process will represent some combination of individual steps taken in each zone or group of zones. The steps are as follows:

Step 1 - In those zones presently subject to inundation by the annual flood of the Mekong, flood protection facilities will be constructed and initial drainage provisions will be effected in sufficient degree to permit the cultivation of single transplant varieties of rice. Completion of this step will permit the growing of one crop of single transplant rice instead of floating rice throughout the areas now flooded each year. Expansion of single transplant cultivation into areas of suitable soils not presently cultivated in these zones was included in this step and the introduction of improved agricultural practices was also assured. Annual yields as a result of this step are estimated to be 3.0 tons per hectare.

Step 2 - This step encompasses the provision of salinity control and initial drainage improvements in the zones not covered under Step 1 and the initiation of irrigation throughout all parts of the Delta. These improvements will provide the capability for double-cropping of single transplant rice by careful scheduling of seedbed planting during the dry season to avoid excessive diversion from the dry season river flow. Improved agricultural practices will be introduced in zones not covered in Step 1. Firm agricultural

management and a strong Delta Authority are necessary in combination at this point to assure close control of water use during the dry season. Annual yields as a result of this step are estimated to be 5.5 tons per hectare (3.0 tons from the first crop and 2.5 tons from the second).

Step 3 - When upstream storage facilities are completed and the dry season river flow is augmented, irrigation water can be provided to cultivate one crop of a high-yielding rice variety during the dry season. It will be necessary to accomplish extensive land leveling so that water depths on the field can be strictly controlled, but the full drainage improvements required for wet season cultivation of improved varieties will not be needed. This step will permit the cultivation of one crop of an improved high-yielding rice variety during the dry season and one crop of a single transplant rice during the wet season. Annual yields as a result of this step are estimated to be 7.0 tons per hectare (4.0 tons from improved varieties and 3.0 tons from single transplant).

Step 4 - The last stage of development provides for complete drainage and irrigation capability. Under these conditions, it will be possible to cultivate at least two crops annually of the improved high-yielding rice varieties. The primary canal system will need to be extended and additional project pumping facilities will have to be constructed. Local Development Associations must increase the capacity of their internal conveyance systems above that provided for irrigation to handle increased drainage. Annual yields as a result of this step are estimated to be at least 8.0 tons per hectare. It should be emphasized strongly that at this stage, the Delta water control system is capable of supporting a highly intensive, multi-cropped agriculture to provide benefits far in excess of those justified by a continuing rice monoculture.

Economic Analysis

The preliminary economic analysis of the Delta program completed at this time was not structured to produce an overall benefit-cost ratio. Instead, it was designed to determine the economic viability of implementing the four sequential water control improvements steps in each of the 24 separate zones in the Delta. The reason for this approach was to evaluate the effect of each element of water control upon different parts of the Delta which exhibit widely varying water conditions and agricultural practices and which require different types and degrees of water control.

RECOMMENDATIONS

It is recommended that the first stage of the Delta water control system consist of flood protection, initial drainage facilities and agricultural improvement (Step 1 development) in the northern part of the Nam Phan unit. This area comprises a total of 425,000 hectares and represents an area currently subject to heavy flood and the least productive in terms of yields per hectare. The area is relatively secure. It is believed that starting the Delta program here will directly attack the worst physical problem in the Delta, that of flooding, and thereby will have a relatively greater initial impact on Delta development at reasonable cost. The costs of the levee system needed to protect this area from flood and the initial project drainage facilities required to permit the growing of single transplant rice are estimated to be US $70 million.

A second area which involves different water control elements and which merits early attention is the eastern portion of the Cao Lanh unit. Except for the upstream portion of the area, there are no flooding problems and it would be possible to go directly to Step 2 development. It is recommended that this area be accorded second priority for early development. The area comprises about 189,000 hectares some of which is presently being double cropped (rice with other crops). The provision of flood protection in the upstream portion, salinity control in the downstream portion and initial drainage improvements throughout would permit irrigation and a move towards crop

diversification. This is particularly important since the area is close to the Saigon market. Project costs are estimated at US $68 million.

At the time of compilation of this Report these analyses and findings were being subjected to review and decision. The final recommendations may not, therefore, be in the precise form in which they are offered here.