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Environmental and Resource Management in the Nam Pong Basin, Thailand

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ABSTRACT

This paper is a brief and updated version of the findings of the NAM PONG ENVIRONMENTAL MANAGEMENT RESEARCH PROJECT, executed by the Mekong Secretariat in collaboration with scientists from various Thai institutions. Financial support for this project was provided by the Ford Foundation.

The objectives of this project featured initial identification and measurement of environmental and socio-cultural effects arising since the commencement in 1964 of the construction, and operation of the Nam Pong water resource development project. It is expected that the results will eventually help, through clarification of the management inputs required, to maximize the benefits already obtained and to solve environmental, socio-economic and resource management problems that have arisen.

The project study area covers the approximately 15,000 km^2 drainage basin of the Nam Pong, a river in northeastern Thailand. Within the scope of the water resource development project, this basin now contains watershed and lakeshore areas of some 12,000 km^2, a 410 km^2 reservoir and its hydroelectric plant, a low diversion dam downstream, with delivery canals planned to service a 500 km^2 irrigation zone, and the resettlement zones of 664 km^2 for the reservoir site evacuees. Most of the remaining area excluding that covered by the numerous villages and the city of Khon Kaen, was until forested recently, but much of it has now been cleared for rainfed farming.

The state of the principal components of the Nam Pong basin ecosystem-WATER, LAND, LIVING THINGS IN WATER AND LAND, MAN AND AIR- after nearly two decades of development is determined, evaluated and described in detail. A number of outstanding issues are identified. Possible management actions are pointed out in this document which may be implemented to arrest resources depletion and environmental degradation in the Nam Pong basin.

INTRODUCTION

A. Objectives

With a view to taking stock of the changes that have occurred and are still occurring in the Nam Pong basin, and to evaluate the overall performance of the development programme, this investigation was launched to improve understanding of these changes and their causes and effects. It is anticipated that the understanding derived from this information should provide the basis for better management of changes occurring in the Nam Pong watershed, and could be of value for other river basins as well, especially in the sense of avoiding environmental degradation through appropriate resource management

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measures. Therefore, the specific objectives of this study were :

(1) to define changes related to water resource development that have occurred and are occurring in the Nam Pong basin system

(2) to develop knowledge and understanding of the causative factors and the effects of these changes;

(3) to improve means for managing the system in an environmentally compatible manner so as to direct the changes toward desired ends ; and

(4) to evaluate the significance of the results for formulating planning and management procedures.

B. Study area

Most of the project study area is located northwesterly from the city of Khon Kaen in northeast Thailand (see Fig 1.) ; the urban and upland village area was not included in the investigation. The entire Nam Pong basin has a catchment area of some 15,000 km^2 spread over the provinces of Phetchaboon, Loei, Chaiyaphum, Udon Thani, and Khon Kaen.

The project area lies roughly between longtitudes 101° and 103°E, and between the latitudes 16° 15′ and 17° 30′ N. Elevations range from 225 m above mean sea level (MSL) in the northwest extremity to 150 m in the southern part. With the exception of a few patches of high hills, the land surface undulates only gently and slopes gradually towards the east and southeast. For ecological purposes, the study area can be regarded as having four subunits, as described in the following paragraphs.

(1) *Upland subunit* -This subunit comprises the watershed of the Nam Pong reservoir and the Nam Pong itself downstream to the Nong Wai irrigation diversion dam. The human population may approximate 100,000 families or 600,000 persons as extrapolated from the government census that gave 60 persons per $km.^2$

(2) *Reservoir and the fishing settlements* -The Nam Pong reservoir is located at about 50 km by road northwest of the city of Khon Kaen. Its maximum storage capacity at 182 m MSL is about 2,550 x 10^6 m^3 and its surface area is about 410 km^2 with a mean depth of 5.9 m. The lowest drawdown water level is 174 m MSL when the surface area is reduced to 130 km^2 and the mean depth, to 3.9 m. There are a large number of fishing settlements and camps around the reservoir, all of recent, unplanned, and uncontrolled origin. In 1980, the families numbered 8,000, or some 48,000 people, within a 2-km strip around the lake. This equals an estimated population density of 80 persons per km^2 in contrast to an estimated 60 persons per km^2 in the upland subunit.

(3) *Resettlement subunit* -Two sites compose this subunit, "Nam Pong" and "Non Sang" and involve 2,750 families or some 16,500 persons. The Nam Pong resettlement site is located at about 36 km north of the city of Khon Kaen. It was set up by the Public Welfare Department of the Ministry of Interior in 1964 for the benefit of the Nam Pong reservoir evacuees and landless farmers in the vicinity. The total area of some 60,000 ha set aside for this resettlement area is mostly upland and was previously reserved forest land. Of the entire area allocated for the Nam Pong resettlement, some 20 per cent is forest reserve, streams, and "mountains", 53 per cent land already occupied by the host population, 13 per cent area reserved for public utilities, and 11 per cent is for allocation to resettlers, of which about three quarters has now been claimed by some 2,000 occupant familites.

A second nearby smaller resettlement area is Non Sang with a total area of 6,400 ha, of which some 30 per cent are streams, ponds,

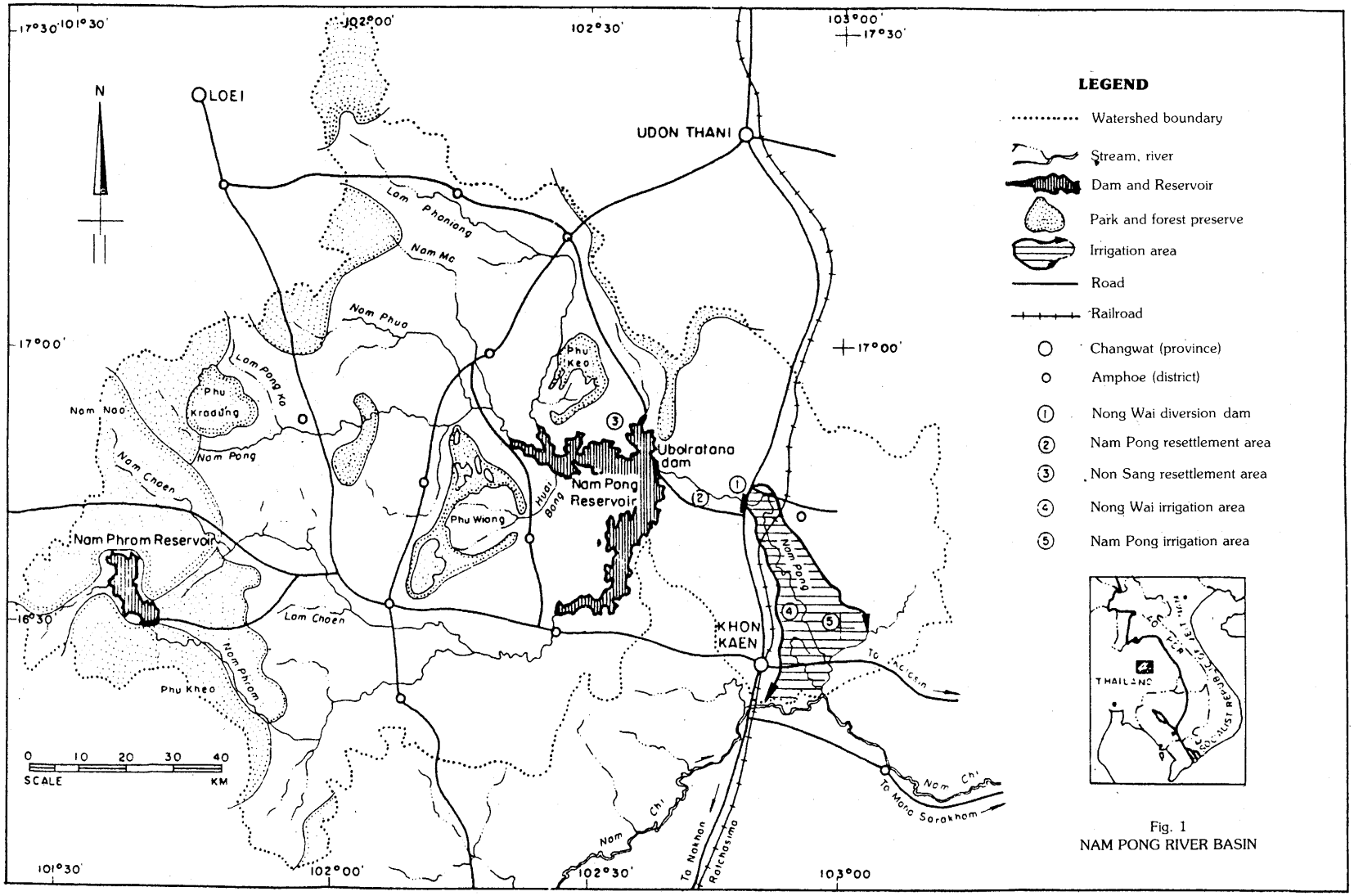

Fig. 1
NAM PONG RIVER BASIN

and lateritic soils, about 20 per cent are public land and forest reserve, and some 50 per cent (3,486 ha) allocable to the resettlers. Of the latter, an area of about 1,800 ha has been allocated to resettlers of which only 40 per cent (721 ha) has been cultivated by the some 750 family occupants. There was only a sparse host population in the Non Sang area.

(4) *Irrigation subunit* -This subunit is composed of two irrigation projects, "Nong Wai" and "Nam Pong". The Nong Wai portion of the irrigation subunit located on the right bank (facing downstream) of the Pong river, stretches for more than 30 km along the river and lies adjacent to Khon Kaen city. It has a target irrigable area of about 12,000 ha. The occupant families number 4,000 or some 24,000 persons. This area is at present under intensive development at the farm level.

The Nam Pong irrigation project of the left bank (facing downstream) was targeted at 33,900 ha, but this was recenty reduced to 29,400 ha. It is estimated that 9,800 families and 58,800 persons live in the potentially irrigable area of 29,400 ha.

METHOD

Given the previously described four subunits of the Nam Pong basin, and using knowledge and experience of the area, the project was organized (with twelve task forces) to study thirteen interrelated subjects currently considered to be of high significance from developmental and environmental management viewpoints (Fig. 2). These thirteen subjects deal broadly with : (1) quality of life, including income, health and nutrition of the human population, especially as concerns the resettled reservoir, and the farmers in the irrigation area ; (2) water supply and aquatic biota ; (3) land use, soils, and the plant canopy, (4) pests and diseases of crops and livestock ; and (5) water weeds in the reservoir and irrigation canals. Not all subjects were studied in all subunits ; only selected aspects judged to be of particular relevance in the respective subunit at this time, were investigated.

RESULTS

The state of the principal components of the Nam Pong basin ecosystem. WATER, LAND, LIVING THINGS IN WATER AND LAND, MAN AND AIR is paraphrased below.

WATER The basin *water supply* is greatly benefited by the reservoir storage. Desirable products of this storage are : the generation of 65 GWh of electricity per year , the provison of a flood control benefit of ฿ 21 million per annum, and the creation of an irrigation potential for 50,000 ha of which only 15,000 ha are currently utilized. Development to increase utilization of water potential is now progressing very rapidly. These obvious human benefits are offset by an annual loss due to evaporation and seepage of 830 x 10^6 m^3 of water from the reservoir, and loss to agriculture (and gain to fisheries) of about 50 per cent of nutrients in the water due to storage. This loss is eventually channeled into fish production through plankton production in the lake. Water quality is presently being deteriorated by storage, sediment transport, the quite large-scale kenaf (Thai jute) retting and by the as yet localized uses of pesticides. Extension, regulatory, and policing actions are called for to arrest further deterioration of water quality, and to improve it at identifiable point and non-point sources of pollution. To ensure usefulness of the water for many of its potential functions suitable quality has to be maintained.

AQUATIC BIOTA. Principally in terms of a *fish crop*, the gains in fish production of 2,000 tons per year greatly exceed the catch from the river channel that was submerged by impoundment. The *downstream fishery* suffered a modest loss of 240 tons per annum. Waterfowl benefited in the expansion of their habitat by the creation of the reservoir. However, without stringent management inputs, especially promotion of aquaculture of which at present

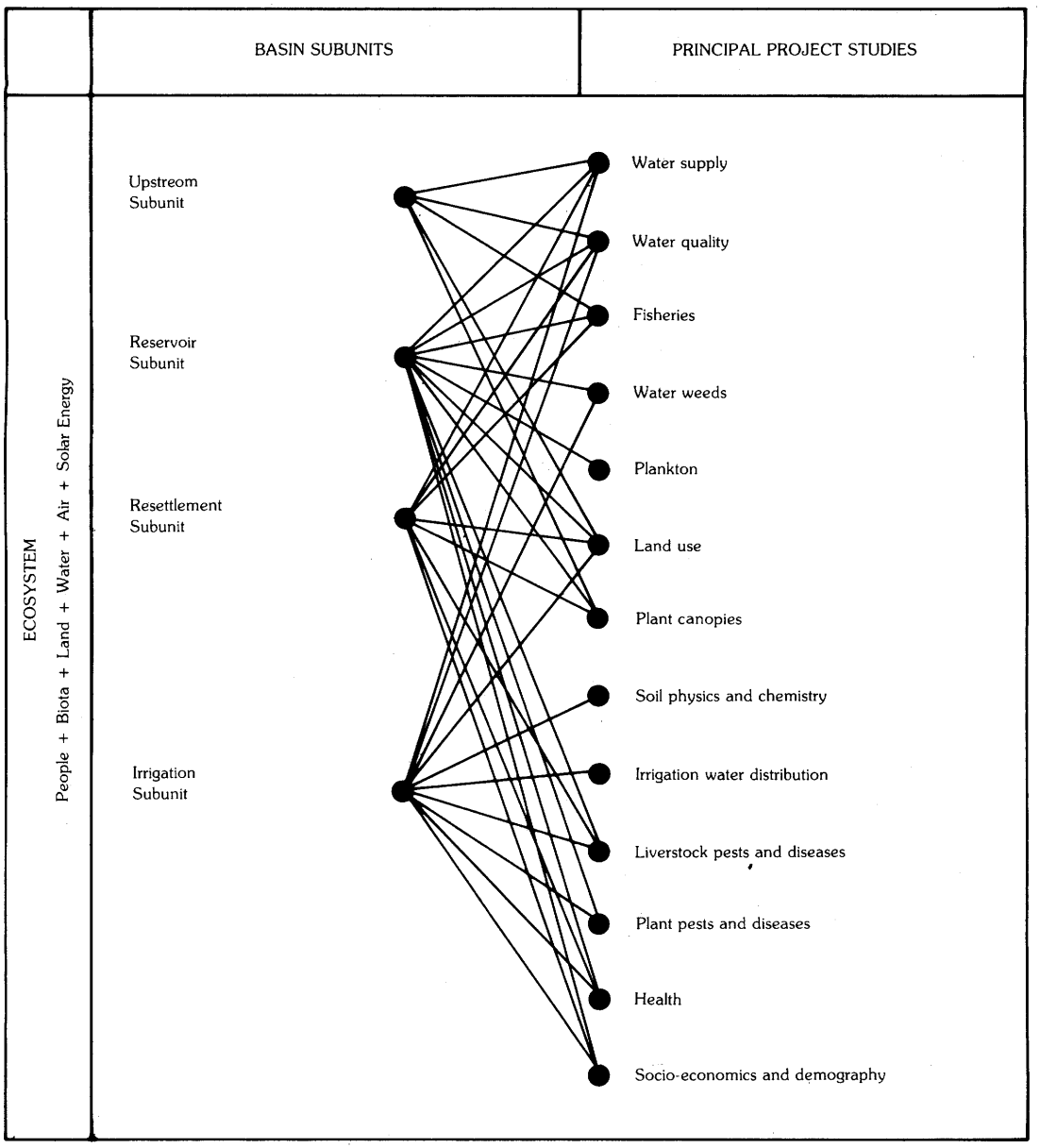

Figure 2 Relationships of project studies to ecological subunits of the Nam Pong basin

there is little in the rural basin, the reservoir and other fishery resources will ever more poorly serve the fisher-folks and the progressively burgeoning population of the basin. Anticipated deterioration of water quality through misuse of resources will impact negatively on fish production, careful monitoring and corrective actions are required as an insurance investment.

LAND. Traditional shifting agriculture that dominates the basin upstream has been destructive of forest cover, eliminating the merchantable timber (Fig. 3), and exposing the soil to wind and water erosion and continually over-extracting nutrients from it. Unless corrected, this recently aggravated soil deterioration can only worsen to the point of a virtual of biological desert in most of the rural basin. Soil deterioration has increased erosion which results in the annual deposition of 2.0×10^6 tons of sediments in the reservoir. If this rate of deposition increases considerably due to further destruction of forests, then the expected 200-year hydroelectrically functional life span of the reservoir may be gravely shortened.

LAND BIOTA. *Crop production* in the basin has increased in the two decades of project history. As the population has increased, forests have been cleared, and the drawdown zone of the reservoir has become available for cultivation and livestock production. An additional 15,000 tons per year of paddy in the irrigated area, and 16,000 tons per annum in the drawdown zone, are the major contributions of the development to food production in the basin. However, unless traditional agriculture is converted to environmentally sound practices in the extensive uplands, and brought completely to double cropping in the irrigation and drawdown zones, the outcome will change from BETTER at present as compared to 19 years ago, to WORSE in another 10 years or so.

Forests and upland wildlife habitat for birds and most mammals have been reduced by land clearing. Some open-ground species (including mammalian crop pests) have benefited, as have waterfowl in the reservoir. On balance, however, rural impacts on wildlife and has a more negative effect than was the case 19 years ago. Unlese this trend is reversed through stringent management, by the end of 1990 commercially valuable trees will essentially all be gone from the basin, and the touristic, biological, and food values of the wildlife resource will have been greatly reduced while there will be an over population of unwanted domestic-pests and crop and grain destroying small mammals.

AIR. Macroclimatic changes are not apparent in the basin. Micro-climatic changes, regarding which no studies have yet been made, are probable because of the large reservoir water area, the extensive, variously moist drawdown zone, the irrigated area (about equal to that of the reservoir), and the widely denuded upland extent of the basin.

MAN. Within the preceding macro-context, four major man-development-environment interactions stand out.

Resettled population : Resettled from homesites inundated by the reservoir were 2,750 families each of whom was allocated 2.5 ha (to absorb 6,875 ha of the total of the 66,400 ha in the area set aside for the resettlement zone). The land in the two resettlement areas is poor, causing ever outward destruction of forests in traditional slash-and-burn (swidden) agriculture. General improvement in socio-economic conditions of resettlers continues to be difficult to discern. Health and nutritional problems are common.

Lakeshore population, fishing and land use : The saturation of the lakeshore by 1980 with some 8,000 families, all of whom both fish and farm, is one of the clearest cause/effect relationships of the water resource development project. In the absence of a land ownership plan, carrying capacity is over-

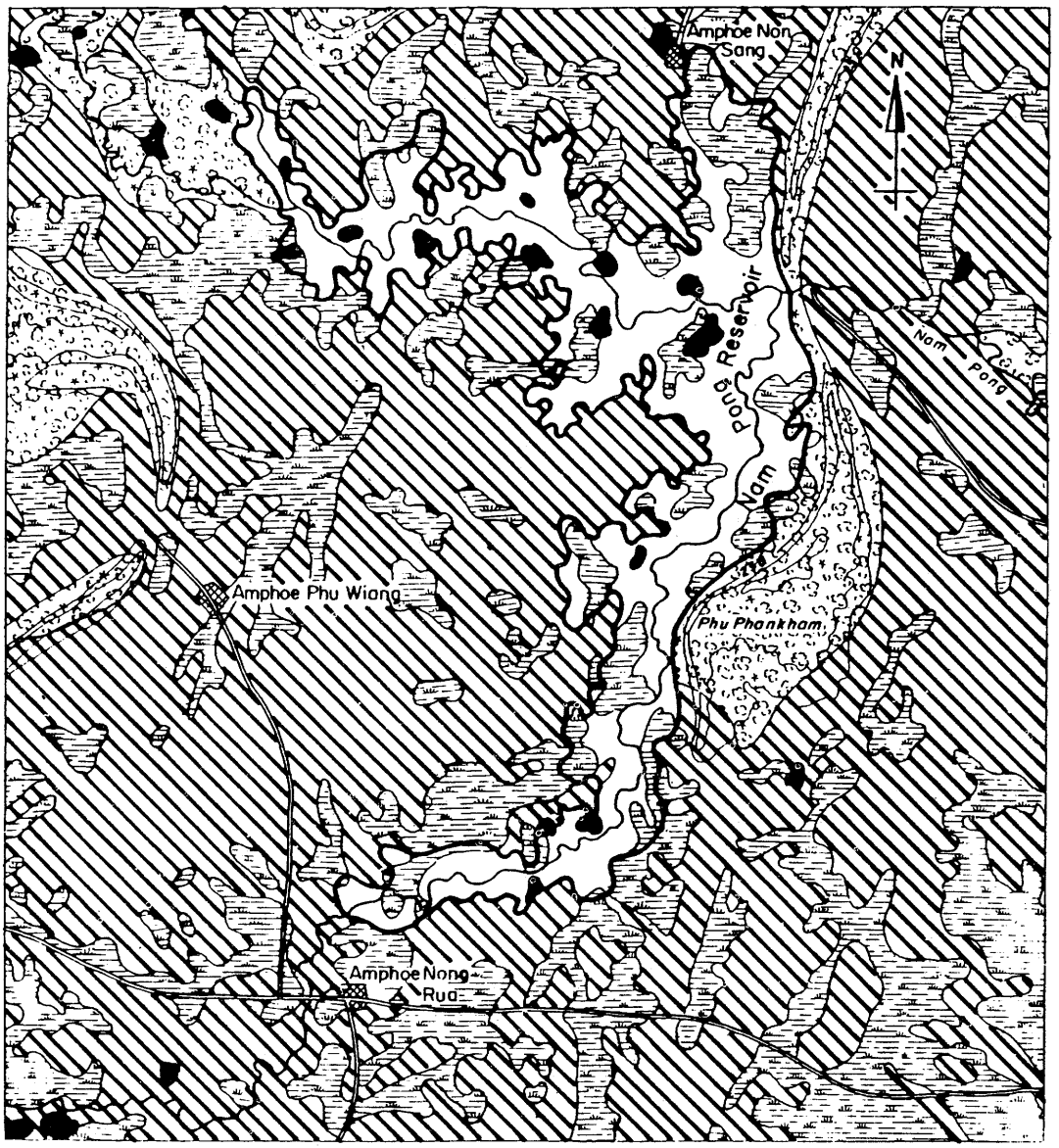

Figure 3 Sketch map of part of the Nam Pong basin, Thailand, showing major changes in land use. 1965 - 1975.

rapidly being reached, occupancy and exploitation are haphazard, unregulated, and environmentally degrading. The environmental degradation has been further aggravated by progressive expansion of agriculture onto adjacent marginal lands. Public services are generally wanting and the socio-economic situation is poor and worsening. Human health and nutritional problems prevail and livestock diseases are common.

Rural popalation and land use : Human occupancy of the extensive rural areas in the basin during the 19 years which have elapsed may already have exceeded an estimated carrying capacity based on traditional agriculture and an average family size of about 6 persons. Most of the forested land has been changed to farm land with only a few "islands" of upland forest remaining in "preserves". The face of the land has changed quite suddenly. The exposed land, when not in crop, is subject to erosion. The present estimated rate of erosion of 2×10^6 tons of soil that is washed annually into the reservoir is likely to be doubled if adequate erosion control measures are not instituted immediately.

Irrigation zone population : Water delivery to crops is only about 50 per cent complete in the two irrigation areas in the Nam Pong/ Nong Wai downstream perimeter of 500 km^2. Environmentally, prior to the irrigation scheme, the land was already stabilized in farm plots, mostly rice paddy. Where irrigation water has been supplied, it is still mostly used to benefit the traditional one-crop-per-year practice. However, the socio-economic status of the population in this area is the best in the rural basin. The use of irrigation water has not led to soil salinization or laterization. Human health, however, has deteriorated perceptably due to an inordinate increase in liver fluke *(Opisthorchis viverrini)* infestation which has an incidence as high as 33 to 51 per cent in the irrigated areas as opposed to 10 to 17 per cent in the rest of the basin.

IMPROVEMENT OF RESOURCE MANAGEMENT IN THE BASIN

A. Socio-economic and environmental issues

While, as stated earlier, the Nam Pong project has undoubtedly contributed to the economic development of the area and bettered the socio-economic status and 'quality of life' of a section of the population, this achievement has entailed some environmental costs. The outstanding issues are the following :

(1) *Within 19 years the rural area of the basin has been almost entirely deforested and 'overpopulated', and poorly supports the enlarged rural population who are near or below the poverty level* (approximately ฿ 2,000 per person per year), with an unsatisfactory quality of life regarding health, nutrition, education, communication, and in adequate provisions of amenities including electricity. All this now exists in a watershed that was formerly forested.

(2) *The some 2,000 tons of fish harvested from the reservoir each year are not generally available to the rural population.* Like hydroelectricity, most of the catch is shipped to urban centres of the region.

(3) *The fish population of the lake and the fishery thereof as presently managed could economically serve well only one-fourth of the present some 7,500 artisanal fishermen families.*

(4) *Unplanned and uncontrolled settlement of the lakeshore and incursions of the settlers into the adjacent forested lands have not only created a slum area around much of the lake but have also been environmentally very destructive in denuding the land.* Parasitic diseases, especially, liver flukes and intestinal helminth parasites in both humans and livestock are very common.

(5) *The land assigned for cultivation by the families resettled from the reservoir site is so poor and mostly rain dependent for crops, that the economic status of those involved has not been improved* (although the resettlement

intent was to improve it). The presumed advantage of providing costly village platforms has been essentially negated by the poor agricultural performance. In addition, there have been environmental costs, including health impovrishment, in the resettlements.

(6) *The environmental and monetary costs of irrigating the Nam Pond/Nong Wai perimeter have by far not yet been justified.* To date only about 50 per cent of the irrigation project has been completed, and, even where completed, the anticipated double cropping has not been invoked. Moreover only the few farmers who have adjusted to the opportunities for irrigated farming have shown any real socio-economic improvements among the entire rural population of the basin.

(7) *Flood control has had some negative effects on the fisheries* downstream in the Nam Pong and Nam Chithough admittedly this is more than compensated for by the flood protection benefits afforded by the dam and the increased production of fish in the reservoir.

(8) Generally the quality of rural life of the basin population has slightly improved

Having noted the above "symptoms" of major environmental and socio-economic woes in the Nam Pong basin, the question next arises as to the causes or causative factors---the etiology, in medical terms. The causes, needless to point out, are complex. But to generalize in the face of complexity a sweeping generalization would be : THE GLARINGLY OVER-RIDING CAUSE OF THE INTERACTING ENVIRONMENTAL AND SOCIO-ECONOMIC PROBLEMS THAT PREVAIL IN THE NAM PONG BASIN IS A SERIES OF FAILURES IN HUMAN RESOURCE MANAGEMENT. Underlying the over-riding cause in probably the great fragmentation of responsibility and authority for management of the Nam Pong basin resources, and servicing of its population by over-many agencies of national and local Government, coupled with the poorly educated condition of the inhabitants. Centralization of this fragmented authority and responsibility into a unified management programme for the basin might be the best solution.

The elements of such a unified programme can best be examined in two categories : (1) those macro-policy elements which for their structure and level of activity depend on national policy; and (2) those which are basin specific.

B. Macro-policy factors in management

It is well-known that provision of a wide range of facilities such as the supply of safe drinking water, health services, elementary education, rural electrification and adequate communication along with irrigation, agricultural and fishery extension, credits, promotion of cooperatives, regulation of water and land use and control of occupancy, and the awarding of property rights, would raise the quality of life of rural inhabitants in the basin and improve their capacity to use the natural resources. However, it would be unreasonable to expect that public agencies could concentrate on the Nam Pong basin alone in providing these facilities to the exclusion of other parts of the Northeast, particularly when the basin is even now in a markedly better condition than the neighbouring areas. Thus, any management programme for the basin must be adapted to what are believed to be viable levels of inputs in the macro-context.

C. Basin-specific management actions

The areas where a unified management programme would have greatest autonomy, i.e. where it would be conducted more within a micro-context, relate principally to construction and operation of the infrastructure for water resource regulation, fisheries, and promotion of secondary and tertiary economic activites. Specifically the plan would address ;

(1) Implementing management plans for harvesting, replacing and conserving forests in the basin.

(2) Regulating rural land occupancy, including that of the rich drawdown zone of the reservoir, and land use to assure both a good quality of life and environmental com-

patibility of the resource extractive processes.

(3) Regulating entries into the fishery to assure economically viable and biologically self-sustaining fishing enterprises as well as prevention of water-borne diseases.

(4) The presently 30-per-cent-operational irrigation project would have been completed and the still-prevalent single cropping would have been universally transformed into the double-cropping plus on which the feasibility of the project was initially based.

(5) Public and production services, including a tenfold increase in extension to agriculture, fisheries, health, and environmentally sound resource use, would have produced a healthier population better informed and sharing in resource use and management decisions, with better income, and versed in soil and water conservation practices. This population would be extracting the maximum of benefits from the biophysical system of the basin without degrading or irreparably disrupting its natural functions.

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