PROCEEDINGS

SEMINAR ON

DEVELOPMENT RESEARCH AND NATIONAL DEVELOPMENT, Bangkok, 1984

DECEMBER 1 - 2, 1984

Volume 2

Position Paper 5 - 8

THAILAND DEVELOPMENT RESEARCH INSTITUTE
RAJAPARK BUILDING 163 ASOKE ROAD BANGKOK 10110 THAILAND
TEL. 258-9027-29, 258-9013 TELEX 20666 RAJAPBS TH

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PREFACE

Thailand is accelerating its rate of change in all spheres, economic as well as cultural, political as well as social. The traditional Thai value structure and mode of behaviour, long accustomed to gradual adaptive changes, is under growing pressure to increase its rate of change in response to rapidly changing circumstances both within the country and in the world at large. New phenomena come into play, giving rise to new patterns of behaviour, and leading the country in unforeseen directions.

Amidst these evolving patterns of economic, political and cultural forces, the Government of Thailand finds itself in new and unexpected roles. Government action itself has become bound in complexity. Decision makers in the public sector, as well as leaders in the private sector, are finding it increasingly difficult to grasp the changing circumstances and to apply the limited energies available to precise and well-aimed responses to crises as well as to rapidly emerging new opportunities.

In spite of the traditional Thai adaptive spirit, there has been a growing awareness in Government central planning and decision-making circles, as well as among business leaders, of the need to strengthen the research and monitoring capacities which are the basis for informed decisions. The last decade has seen a considerable growth of research activities in the country, with a number of minor attempts to carry out research with a direct bearing on policy-making. Focussed policy research is still, however, in its infancy. Many important policies, both in the public sector and implicitly in the private sector, are rarely analyzed in sufficient depth. Many serious problems which are properly articulated fail to generate adequate policy responses, while many other problems remain largely intractable and ill-understood. Public agencies in charge of planning and policy-making, as well as line agencies charged with policy implementation, lack the resources,

both financial and human, for carrying out effective policy research. There are serious needs for new creative solutions to new problems, as well as for critical monitoring and evaluation of existing responses to changing circumstances.

What is needed is seen,therefore,as a sequence of research activities providing sufficient in depth data for informed decision, recommending efficient mechanisms for the conversion of the researched information into policy and the implementation of such policy, to be followed by well researched monitoring systems to study the effect of the policy on the people. The effect may well indicate a need for a modification of the policy due to various conditional changes, and at th point more research is required. And so the sequence is repeated until acceptable benefits to the country is obtained.

This is to be done through the conduct of research projects, commisioned by government central planning agencies, implementing agencies, as well as private sector institutions, international financial institutions and donor countries providing bilateral and multilateral assistance to Thailand.

These perceptions have been gradually translated into a decision to establish a national policy research institute in Thailand. The pivotal role envisioned for such an institute goes well beyond the conduct of research. It must function to create an atmosphere of credibility and trust in the ability of policy research to provide sensible and effective results. As such, it must promote closer relationships between researchers and decision-makers, and insure that research is of the highest possible standard. Such an institute must be a focus of intellectual activity, able to attract the best of minds into the policy research arena. It must promote respect for independent and non-partisan thinking and action, and remain free of bias and partiality. It must balance the need to remain close to decision-makers with the equally important need to remain uninvolved in the conduct of political affairs.

These considerations have been long in the minds of many, but have only very recently born fruit. The National Economic and Social Development Board (NESDB), the central planning and monitoring agency of the country, acted to establish an independent foundation, to be named the Thailand Development Research Institute (TDRI), to perform the central role of a national policy research institution. Following a Cabinet approval of the Board's initiative on April 24, 1984, the Government has demonstrated its strong support of this initiative in securing a substantial financial base for commencing the operation of the Institute. His Excellency, Prime Minister Prem Tinsulanonda, was instrumental in promoting the establishment of the Institute during his recent tour to Canada, and witnessed the signing of an agreement between Thailand and Canada, ensuring an operating fund for the Institute during its first five years.

The initial small working group for the institute selected seven priority areas and a Development Information Center deemed to be necessary for the development of the country. These are Macroeconomic Policy, Agriculture and Rural Development, Industry, Trade and International Economic Relations, Natural Resources and Environment, Human Resources and Social Development, Energy Infrastructure and Urban Development, Science and Technology, and a Development Information Center. However, with its small number of staff and as yet without a firm stand as to the research directions, TDRI felt a need to have an airing of possible directions to guide the Institute even in the simple task of recruitment. TDRI must shop around for the content of the big frame of policy research we have set out to do: good high-quality researchers and research agenda. Consequently, this seminar on "Development Research and National Development" was launched.

We have been very fortunate to have such a large number of experts to come and give their versions of directions of research in their particular fields for TDRI. Ideas and viewpoints were subjected to fruitful debates and discussions, and TDRI has already begun to digest the wealth of

information obtained from the seminar. It is hoped that with the digested information and the technical assistance TDRI is getting from consultants, a good framework of research activities can be drawn up for TDRI's first five-year operation.

The seminar has not only provided TDRI with substantive to-date development scenarios, but has also provided valuable viewpoints on policy research in general and thoughts and perceptions about TDRI in particular. Participants have been more than sincere in their offering of recommendations and warnings, and all in all TDRI could not have had a more whole-hearted support of all concerned. May I once again say "thank you very much".

Dr. Anat Arbhabhirama
President

Bangkok
June 1985

REPORT

Seminar on "Development Research and National Development"
convened by Thailand Development Research Institute

Dr. Snoh Unakul
Chairman, TDRI Foundation

Your Excellency,

On behalf of the Thailand Development Research Institute please allow me to express our deep appreciation to Your Excellency's kind consent to preside over the opening of the Seminar this morning.

In view of its very recent formation as a new institute, and being the first of its kind in the country to concentrate on policy research for national development, may I have this opportunity to describe briefly the events that lead towards the establishment of TDRI.

Through the past decade, Thailand has been keenly aware of the need to utilize policy research for her national development, and consequently, centers and institutes dealing with economic and social development have been established. Yet, the fact remains that none of these centers and institutes have been able to conduct policy study on an integrated basis, encompassing essential aspects of development such as agriculture, industry, social, science and technology. It has been difficult for any single center or institute to pool multidisciplinary research resources together from both the public and the private sectors to provide much needed recommendations for the resolutions of development problems.

Thailand is currently entering a critical transitory threshold from an agrarian society into a semi-industrial society. For Thailand to develop and attain her noble goals, much will depend on appropriately practical policies. Development policy decision-making will be more

critical than it has ever been before. In order to meet this challenge, it was generally agreed that a special kind of institute is required — an institute that will be a center for development policy studies, endowed with the ability to draw upon varied resources.

In 1981, the National Economic and Social Development Board (NESDB) commissioned the Thailand University Research Association (TURA) to undertake a feasibility study for an establishment of a policy research institute. The concurring expenses were kindly provided by the Ford Foundation.

In 1983, the Canadian International Development Agency (CIDA) provided experts to review and analyse the findings and recommendations put forth by the TURA feasibility study, for consideration by the Canadian Government. Their findings revealed a strong support for an establishment of such an institute. Subsequently, on April 11, 1984, an aid agreement between Canada and Thailand to support the TDRI Foundation was signed during the state visit to Canada by H.E. the Prime Minister.

With that support, TDRI has been established under the TDRI Foundation as a non-profit organization. The principal officers are Dr. Snoh Unakul, as Chairman of the Board of Directors, and Dr. Anat Arbhabhirama, as President of the Institute.

To support the operating cost of the institute during the initial five-year period, the government of Canada gave a grant sum of Canadian $4.48 million. The Institute has also approached the Government of Japan for a grant-in-aid for the construction of its permanent headquarters plus other appropriate assistance. The Government of the United States has also been requested to assist through it's fund on "Emerging Problems of Development" that would help strengthen the institute's research capability, both in the main policy research and other necessary related activities.

TDRI has planned its activities with a goal that within this initial five-year period, the Institute will serve the planning staff as a "think-tank" for development policy, and hopes that the work to be conducted will be of value for the policy decision-making process.

The objective of this seminar is to bring together research workers, technologists and development workers with different experitise, to help pave TDRI's research directions in the chosen priority fields of: marco-economics; agriculture and rural development; industry, trade and international economic relations; energy, infrastructure and urban development; science and technology; natural resources and environment; human resources and social development; and the development information center.

This seminar is made possible through the excellent cooperation of all concerned, both from the public and the private sectors, and through the financial support from the USAID. TDRI wishes to record its thanks and gratitude to all these helpful people on this occasion.

The time is indeed auspicious, may I now ask for your kindness, Your Excellency, to declare open the Seminar, so that all of us assembled here would be so honored.

Thank you, Your Excellency

OPENING ADDRESS

Seminar on "Development Research and National Development"

convened by Thailand Development Research Institute

H.E. Sanya Dharmasakdi

Chairman, Privy Council

Mr. Chairman of the TDRI Foundation,
Your Excellencies the Ambassadors,
Ladies and Gentlemen,

I am very pleased and honored to preside over this important seminar.

I agree with Mr. Chairman of the Foundation that appropriate policy is truly needed to keep the country's development on course. It requires meticulous studies on all aspects of development, and therefore, the establishment of The Thailand Development Research Institute, as reported by Mr. Chairman is very appropriate and timely to meet the needs of our country.

However, the founding of TDRI may not have been realized if Thailand did not have cooperation and support from our friends -- especially from the Governments of Canada, the United States and Japan. I wish to express my appreciation to the three countries on this significant occasion.

The gathering of so many researchers, technologists, and experienced development experts here today is indeed special for the instit te, and I would like to entertain the hope that the outcome of your deliberations will be valuable for the ensuing work of the Institute.

It is now an auspicious moment for TDRI and I declare the Seminar open

Best wishes to all of you and to the success of the Seminar.

ADDRESS

Seminar on "Development Research and National Development"
convened by Thailand Development Research Institute

H.E. John L. Paynter
The Ambassador of Canada

It is a particular honour and pleasure for me to have the opportunity to participate in this important and even historic meeting. Indeed, it was just two and a half years ago that Canada participated with Thailand in another seminar here in Pattaya to begin to plan the project that ultimately resulted in the Thailand Development Research Institute.

It was a privilege and a pleasure for us to work with our Thai friends and partners on that project: a privilege because Canada was able to share in an historic occasion in shaping Thailand's development future; and a pleasure because of the spirit of openness and cooperation that characterized the dialogue. It is therefore particularly gratifying to see that spirit of consultation and frankness which characterized the planning of TDRI will also be a hallmark of its actual operations.

And, since those days, the TDRI team has grown-- and I am delighted that our American friends and other donors are also joining the TDRI experience. We are also very pleased to see so many eminent Thai as well as international experts and scholars here today to share the exciting task of working with TDRI and make some contribution to the solution of those critical issues which will shape Thailand's development.

We are only 15 years away from the year 2000 and the end of a century that has seen extraordinary technical advances. Mankind now has powerful technical resources at its disposal -- but how those resources are used depends not on the technocrats, but the policy makers. We need now to ensure that the advanced technologies serve humanity if we, as a society, are to solve the human problems.

There has been extensive investment in the research and scientific institutions advancing modern technologies. However, the enormous potential of these technical breakthroughs has not been harnessed to solve the critical human problems of this century.

Mankind is being confronted with problems of gigantic proportions -- poverty, population growth, environmental deterioration, resource depletion, unmanageable urban centres, land limitations. But these problems not only require technical solutions, they require human solutions -- leadership, commitment, imaginative policy measures and the spirit of international cooperation. If we do nothing to address these problems, we are denying our responsibilities to our future generations. TDRI is an institution that accepts this responsibility -- to search for ways in which our modern technologies can be the servant of innovative, forward thinking.

Canada and Thailand share many interests. As trading nations with considerable natural and human resources, our development is intricately woven into the international community of nations. More than any time in the past history of the world, nations are inter-knit in a global system by trade and investment, communication and transport networks, tourism, sport, music, entertainment, by common problems such as atmospheric and oceanic pollution, and the threat of war.

We share a common destiny and must work together, both as friends and as partners, to ensure that it is a future worth sharing. It is in everyone's interest to address our problems on a national scale and then to look beyond our borders to the regional and global realm. Human survival depends on the capacity of human initiative and commitment to create the policies, strategies and institutions necessary to be prepared for and deal with the challenges of the year 2000.

Mankind needs foreward thinkers to plan for the colossal changes that lie ahead in such vast fields as population, food, energy and the environment. These thinkers must have the capacity to plan across extended time horizons, since the real impact of their decisions will come not today but in the world of tomorrow, and even of the next century.

These global issues -- rural development, international trade, natural resources, human and social development, science and technology, energy and urban development -- are part of the TDRI workplan being discussed this week-end. They are also part of the international agenda. The work that goes on under TDRI will not only serve Thailand; the search for breakthroughs and measures to address these issues can also be transferred to serve the regional and global community as it struggles with the same problems.

For the agenda of the seminar here this week-end, it could be an agenda for any country in the world. The issues identified are those being faced by industrialized and developing countries alike, and those that require national and international cooperation for their resolution. It is thus most appropriate that TDRI seeks to bring together the best thinkers in Thailand and the international community to serve on its Council of Trustees and to participate in this important seminar to formulate a workplan for the future.

Those of us that are fortunate enough to be involved in this experience may perhaps be able to make some contribution, however small, to Thailand's future. However, the benefits which we receive from our participation will also undoubtedly serve our <u>own</u> nations as well in their search for solutions to these problems.

Too often policy research is done on specific topics in isolation from other issues, or practical realities. In the complex world of today, there is no isolation - of issues or peoples. We no longer take the simplistic view that the key to development is only economic growth or "getting the price right" as some economists used to tell us. But we

do believe that "getting the policy right" is essential to successful achievement of development goals that reflect not only quantitative achievement, but look closely at qualitative considerations.

Thailand has experienced exceptional growth over the past two decades. But, as the TDRI agenda indicates, the nature of development itself is the critical issue for Thai policy makers, not only growth per se. Economic issues, social issues, environmental issues, urban and rural issues have equal time in the discussions for this week-end.

The imagination and foresight which marked the founding of TDRI promises to put Thailand in the forefront of innovation in development. TDRI can be an example for Asia, indeed for the entire world -- a model for development research, a model that recognizes the holistic nature of development, the need to address the crises of tomorrow by foresight and action today, the need for national and international cooperation, and the mobilization of the community of mankind to address these issues.

The longterm success of a new institution is usually determined by its performance in the initial five years. The innovative and ambitious program that TDRI has set for itself, the commitment and dedication of Dr. Snoh and his Board of Directors, and the talented resources brought together here today to address that challenge, augurs well for the long term success of TDRI.

I personally am very grateful for the opportunity to be involved in this exciting venture. Although it is with a sense of both responsibility and modesty that I look forward to participating in the deliberations, I know I will come away stimulated and enriched by the experience.

Indeed, as someone once remarked about the founding of another organization, it is a real honour both for myself and my country to be "present at the creation" -- and to have been privileged to make some contribution to the birth.

Thank you very much.

DISCUSSION ON GENERAL ISSUES

- Thoughts and perceptions about TDRI as a policy research institute

Issue 1 TDRI's non-partisan nature

Comment 1: It is very important for TDRI to be free from any form of control by the government, donors or foreign organizations. TDRI as a policy research institute must maintain clear objectives and a willingness to obtain and give cooperation with a non-partisan view. The services of TDRI should be charged sufficiently to enable the operation on an independent basis but at the same time as a non-profit institute.

Comment 2: TDRI needs the support and cooperation of the NESDB, but TDRI's work must not be confused with the work of the NESDB. Although the work done at TDRI does have some association with some aspects of the Sixth Five-Year Plan, TDRI will not be involved in the decisions of the plan. TDRI and NESDB will have to work together for a common interest of the country's development.

Comment 3: TDRI must keep a good balanced relation between the public sector, the private sector and foreign organizations.

Comment 4: By working as a coordinator for the 'data bank' system, TDRI must avoid multiplicity and overlapping work. TDRI should be conscious of producing good quality research work by maintaining its non-alignment strategy and insisting on utmost academic freedom.

Issue 2 TDRI as the pivot for policy research and dissemination

Comment 1: Thailand does not lack experts to do research in development when compared with other countries in the region. What is lacking is the capability to have all the experts working together for the development of the country. TDRI should concentrate on how to mobilize all these manpower resources to produce good work, both at the personal and at the institutes' level since a large number of them have already engaged in research work of various development fields.

The question is how does everyone come together. Usually people come together to work for a common goal, and it is hoped that TDRI's goal will be that of quality research. We must not come together at the expense of quality, the common goal must be quality.

Comment 2: TDRI's role should be to support and promote policy research in all institutions and organizations particularly universities. It should act as a coordinator coordinating and integrating the research activities of the country.

Comment 3: The research at TDRI should be in-depth attempting to identify problems, policy solutions and effective measures for the implementation of the policy. TDRI must make clear to all agencies concerned that TDRI's roles are those of a catalyst, a coordinator and not of an investigator nor just another new research agency.

Comment 4: TDRI's part in the country's policy making can be summarized as having to engage in promoting research for development, conducting the studies, and disseminating the results. Through dissemination, reactions on the findings will be triggered and at least there will be some mental involvement

among the people concerned which may lead to an acceptance or a non-acceptance of the findings. An acceptance will bring about a process of change inducing many people to believe in the same thing, and finally to making them work for the same objective. TDRI can play an important role in that process of change through the dissemination process.

Comment 5: TDRI should be the disseminating center of policy research. Through publications and seminars, policies can be disseminated, knowledge can be propagated and ideas of the experienced can be shared.

Issue 3 TDRI's clients and marketing strategy

Comment: It is important to consider the marketing aspects starting at the identification of TDRI's clients. TDRI must then establish a framework whereby the taste and preference of the customers are considered in designing various project activities; but always with the basic neutral attitude. TDRI must be aware of various prejudices and decide from the very beginning whether such prejudices are acceptable and whether the project should be undertaken.

Issue 4 Whether the donation to TDRI is tax deductible

Comment: Only donations to some foundations are tax deductible. At present there are only forty organizations to which the donations are tax deductible. Therefore for the assistance of TDRI it was suggested that the Government be requested to put TDRI on the list of tax-deductible-donation organizations.

Issue 5 TDRI's communication

Comment: TDRI should establish a communication linkage, perhaps through a liaison officer, with various government units, so that both TDRI and the government units know the demand, supply of policy research.

TDRI should not only let the public know what is on its agenda, but should also ask for the market's needs for research. Some of the needs may be satisfied by TDRI's capacity but some may require the cooperation of other institutes.

The same type of communication is just as important for the private sector.

- Policy research in general

Issue 1 The multidisciplinary nature of policy research

Comment 1: There is a strong need for policy research to have an integrated approach. All or as many of the development factors whether they be social, economic, or technical, should be kept in mind when addressing a development policy issue. It should be carried out with a multidisciplinary nature. Goals must be set, and research projects should be carefully structured and aimed towards the same goals.

Comment 2: The planning of any research project should incorporate the concept of "balance of development" maintaining a good relationship between social, political, administrative and economic development parameters.

Comment 3: In defining various research projects, TDRI must make an effort to maximize the interrelated nature of the projects. In this way there will be less redundancy, more sharing of data, facilities and cost.

Issue 2 The human element (especially rural)

Comment: In undertaking any type of development research work it is very important to identify all potential resources. A good example is the potential of the people in the rural areas. In the past, the rural people have been somewhat inhibited in their development role. This was probably due to lack of support, encouragement and incentive for their involvement in development planning. It is generally recognized that if the culture, the traditions and the mental state of the people are duly considered in development planning, the ensuing policies are likely to be more practicable and successful.

Issue 3 The negative approach to research

Comment: The affirmative approach to research i.e., what the government should do, should now take an opposite turn by researching on what the government should not do, especially in the provision of educational and public health facilities in the rural areas.

Issue 4 Involvement of policy makers

Comment: Too little attention has been devoted to development agenda-setting i.e., the process of deciding which questions are important for research. If policy makers consider the results of research to be useful tools for policy decisions, they must be more involved in deciding the issues for research.

- Comments and Recommendations about the seven research programs at TDRI

Comment 1: Experts have a tendency to concentrate on their own specialized fields which is primarily the reason why the inter-relatedness and transectoral nature of different fields have been neglected in the past. It is important that the research areas at TDRI be treated in a related manner at least in the long run.

Comment 2: To have an overall research program that addresses the major questions of Thailand's development instead of undertaking a series of ad hoc studies will dictate that individual research studies be related to each other. But the mechanism to achieve this goal is not easily designed given the ad hoc nature of research in the past and the existing resource constraints. Nevertheless TDRI must strive to achieve the overall related approach to policy research.

Comment 3: For each of the programs, TDRI must safeguard against being bogged down in a multitude of detailed research proposals, otherwise deciding on priority becomes an added burden.

Comment 4: It is important to know how the research priorities of TDRI are related to the needs of the NESDB, the sectoral ministries, the private sector and the Thai population as a whole.

Comment 5: Any policy research must identify the manner in which the results can be utilized, can help improve policy-making and development planning, can evaluate existing or proposed policies and programs and can benefit the people of Thailand.

Comment 6: The human factor has to be well considered when designing each research study because policies will have repercussions and direct bearing on the people.

Issue 5 Development Research vs. Policy Research

Comment: The difference between development research and policy research is that development research is normally conducted by institutions and government agencies with the objective of improving technical know-how, efficiency and improving commodity-productivity; whereas in policy research, the objective is to take the results of these technical know-how, including other factors, both social and economic and integrate them with the policy environment so that recommendations could be presented to the government. By scope, policy research is wider than development research.

"Development Research and National Development"

Position Paper No. 5

HUMAN RESOURCE AND SOCIAL DEVELOPMENT

by

Kosit Panpiemras and Associates

I ABSTRACT

The period between 1940-1960 witnessed a natural rapid increase in population which became one of the determining factors in the country's human resource and development policy environment e.g., increased basic facilities as population increased and increased supply of technical manpower for the fast-growing government and commercial sectors. This trend was reversed after ten years when the first national policy to limit the population size was drawn up. Aside from the size of the population, the structure and the distribution of the population are also equally important for planners. The paper reviews the past trends in population, human resources and social development during the past 20-25 years and provides a critical appraisal of these as a basis for policy-issue debates. The dynamic fertility and mortality rates have brought about a change in the population age-structure which implied a wide range of socioeconomic implications, i.e. reduced population in the 0-14 age-groups will affect consumption, savings and production patterns, the fertility decline will affect the school-age population within the range 5-7 years, immigration to urban areas will affect urban population growth, etc. Since the human resource of the country is one of the valuable economic assets, the paper recognizes that the quality and quantity of the country's manpower and, their social, economic and political roles must be clearly defined and assessed. As reflected in the past five year plans, this sector in the economy failed to gain the importance it deserved until the topics on human resources and employment emerged as issues of national importance in recent years. With a basically agrarian-based economy, the employment of a large segment of the labor force in agriculture is very important. However, due to the approaching limits to the land utilization, the labor employment in this sector will also decline. The quality of education at all levels needs a big improvement in order to match with the demand in the labor market and the advancing technology. As a factor that contributed to the decline of the death rate, the provision of public services as it affects the health of the people and their productivity, warrant empirical analysis. On the social development front, literally implying "promotion of self-reliance among people to enable them to take more active participation in national development," the starting process took-off under a scheme to merely reduce population growth and

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to better distribute social services. After this, the scheme switched over towards quantitative rather than qualitative attitude over the improvement in the country's supply of manpower. The paper cites the mode of action that has been taken by the government as reflected in the fifth plan and its changed attitude towards seriously improving the flexibility through the concepts of rural poverty alleviation, public health development and education development. A discussion on the medium and long-term global changes and national economic development are also presented with an accompanying cross-sectional analysis of the effect of these changes on social development. The last section, or, the conclusion part of the paper is laid out in the form of questions for researchers to contemplate and roughly centers on the dynamic aspects of population e.g. demographic changes, distribution, urbanization, industrialization, etc., and their interaction with the socioeconomic changes taking place in the economic growth process.

II THE PAPER: HUMAN RESOURCE AND SOCIAL DEVELOPMENT

1. Introduction

During the 1940's to the 1960's, it has been the policy of the Thai government to encourage the growth of the population. In this period, relatively high birthrates and falling death-rates resulted in rather high-rate of natural growth. Thus, throughout the 60s and the 70s, the rapid expansion of the population size became one of the main factors which determined the policies on human resource and social development. In these early periods, the main thrust of the social programs was, in fact, an attempt to increase the basic facilities in line with increased population and, in the realm of human resource development, to increase the supplies of selected technical manpower for the fast-growing government sector and, for satisfying the demand of the small but growing commercial sector.

When the government adopted an official national population policy for the first time in 1970, the aim was to limit the size of the population. This policy, together with the rather impressive GNP growth rates in the 60's and 70's, proved to be very successful. The natural rate of growth was reduced from over three percent per annum in the 60's and the 70's to just over two percent in 1981. This recent history

of rapid population growth, followed by a successful restraint has given the planner many implications. It means that, not only should the size be taken into account in planning, but also, the distribution of the population in terms of age and location.

Planners have only recently come to realize that, as a matter of policy, the structure of the population is as important as the growth of the population. This was made explicit for the first time by the planners at the Pattaya Conference on Employment Policy and Direction, organized by the NESDB, the DOL and the ILO-ARTEP in June last year.[1] The rapidly-increasing population in the working age-groups (15-60) and, more especially, the unprecedented numbers of new entrants to the labor force were cited as evidence of an urgent need to create more employment for them in the Sixth Plan.

The structure of the population is especially more important in a country like Thailand whose labor is a vital economic resource. In fact, the structure of the population impinges on the planning process in several different ways.

First and foremost, the productive capacity of the economy is affected by the number and, the attributes of the population in the working age. Second, the allocation of resources and social development policies need to be undertaken with reference to the distribution of population among sub-groups. Different sub-groups require special facilities and assistance such as, education for younger age-groups, health-care among the aged, and particular types of infrastructure for urban and rural settings.

In addition, many factors such as, shifts in the age-structure, increased migration rates and the growth of towns may lead to a decline in the importance of traditional institutions which have been necessary for social harmony. In designing social development policies in the face of rapid socioeconomic changes, planners will have to consider what types of new institutions need to be developed or, which old ones

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[1] See page 5-67

need to be modified to enable people to adjust themselves to changes and to bring about social harmony in the process of economic and social transformation.

Development is for the people and is dependent to a large extent on the people. Human resource and social development policies should be able to augment the talents and the attributes of the people both for the good of the individual and, for furthering social and economic progress. The key variables which planners must deal with are the different dimensions of population in terms of its size, attributes and distribution. The size of the population and its distribution dictate the need to look at the human resource and its social development and related constraints. Planners must also take account of the dynamic aspects of the population as they interact with the socioeconomic changes taking place in the economic-growth process.

2. The "Population" Issue

2.1 The Growth

Population is the starting point of human resource and social development policies. This part, thus, describes the past, the present and the future trends in population, its size and its components of growth.

The first population census of Thailand in 1911 reported a population size of 8.3 million. In 1960, this figure increased to 26.3 million which is equivalent to an increase of 317 percent during the 49-year period. The latest census of 1980 enumerated a total population of 44.8 million. After adjusting the figure under enumeration, the 1980 figures was raised to 46.3 million. Under a low fertility assumption, in which Thailand seeks to attain the population growth-rate target of 1.5 percent per annum by the end of the Fifth Plan, it is estimated that the population size will reach 51.3 million in 1985, 55.3 million in 1990 and 63.7 million in the year 2000 (see table 1). In the early

years (from 1911-1947) the population grew rather slowly because both the birth and the death-rates figures were high. The period after 1947 saw a rather rapid rate of population growth due to the natural increase rather than,to the net increase of immigrants over emigrants. This rapid natural increase was made possible by the decline in the mortality rate in the face of continued high birth-rates due to improvements in medicine, health services and standard of living. Between 1947 and 1960, the population growth-rate averaged 3.2 percent per annum, which was one of the highest in the world. The growth-rate dropped to about 3 percent per annum during the 1960's. But during the 70's and the early half of the 80's, the population growth-rates declined consistently to 2.1 percent in 1981 and at present,the estimated rate ranges between 1.6-1.7 percent per annum.

2.1.1 Fertility Levels and Trends

The 1970's was a turning point in lowering the fertility level in Thailand, as the government began to actively support the family planning programs in order to reduce the population growth-rates. Before that, Thai politicians supported a high rate of population growth as it was felt that this was necessary for defence purposes. It was said that,one of the major reasons for setting up the public health service in the early part of the century was,to increase the rate of population growth.[2] The National Family Planning Programme was introduced throughout the country beginning in 1972. Soon after this, fertility began to decline, and this decline was accelerated during the second-half of the 1970's and during the 1980's . Within a decade of the programme, fertility dropped by 20 percent. This fertility reduction was largely caused by the success of the family planning program. This can be seen from the rapid increase in the number of women practising birth control after 1972. During 1966-1970 a survey reported that only 50% of the married women aged 15-44 were practising birth control, by 1978 the percentage increased to 53 and in 1981 to 59%.

There is evidence that fertility will decline further after 1981, although this decline may not be as rapid as in the 1970's. Expected further fertility reduction may be gauged from the change in the number of children expected by currently-married women. A study has shown a decline in the number of children expected by currently-married women from 3.8-3.5 between 1978 and 1981 or, a decline in the expected numbers of 8 percent (see table 2). It will be useful, however, to know the trends in the future fertility of women in different socioeconomic groups and in different regions in order to identify the target groups for future policies on population.

2.1.2 Mortality-Levels and Trends

The major source of data on death is the vital registration system. In Thailand, this source of death data is known to be an underestimate due to under-registration. The Survey of Population Change (SPC) conducted by the National Statistical Office revealed that, the data from death registration represented only 64 percent of the actual total event in 1964-1965. The long-term trend in the crude death-rate or, the number of death per 1000 population shows a steady reduction from 31.5 per thousand in 1920 to 8.8 per thousand in 1970. However, there was an increase in the crude death-rate during the Second World War. This rate declined steadily again after the War.[3] The NSO's SPC reported the crude death-rate at about 8.6 per thousand during 1974-1976 while the rate was estimated to be 8.2 in 1983 as compared to 5.1 computed from the registration data.[4] The steady decline in the death-rates during 1920-1983 has indicated an increase in life expectancy at birth of the Thai population. A study indicated that, during 1965 and 1975, the life expectancy at birth was high for both men and women; but with the figure for women being slightly higher than for men. Between 1965 and 1975, the life expectancy increased from 56.3 years to 58.0 years for men. For women, the increase was from 60.6 years to 63.8 years over the same period. It is expected that the figures will rise to 60.8 for male and 64.8 for females during the early half of the 80's.

2.2 Migration

Data on migration from population censuses have shown a pattern of inter-regional movement for a five-year period prior to each census year. Table 3 shows the pattern of inter-regional migrants aged 5 and above during the three five-year periods before each census date. The inter-regional total migration rose from about 335,497 persons during 1955-1960 to about 669,629 persons during 1965-1970 and to about 948,197 persons during the period 1975-1980. As compared to the total population in each census, the total migrants accounted for 1.3 percent for 1955-1960; 1.8 percent for 1965-1970, and 2.1 percent for 1975-1980.

The pattern of inter-regional migration has changed during the last 10 years. Bangkok-Thonburi is the only area with net gain in migration throughout the three periods-- 1955-1960, 1965-1970 and 1975-1980. The Bangkok Metropolitan area's gain has also increased over these periods (Table 3). But the Northern Region which used to gain people for the first two periods, encountered some loss of 17,032 people in the period of 1975-1980. The Northeast Region faced a bigger loss of population during these three periods,while the Central Region reversed the migration stream from sending to receiving people in the period of 1975-1980. For the last two periods, the number of people going out in the southern region exceeded the number coming in.

2.3 The Distribution of Population

The age and locational (regional, urban and rural) distribution of the population will be discussed in this sub-section,as both have important implications for planners.

2.3.1 The Age-Structure of the Population

Figure 1 shows the age and sex structure of the population in 1960, 1970,

and the projected structure for the year 2000. The most noticeable features of the figure are the following:

(a) Between 1960 and 1970, the age-structure did not change very much. In both years, the age-structure resembles that, typical of any developing country undergoing a rather high rate of population growth. The population pyramids for both years have similar flat bases and pointed tops. This indicates a very high proportion of those in the young age-group (below 15), which were 45-46 percent in both years (see details in Table 4), but a low share of those 60 and above (4.8-4.9 percent). The high-proportion of the young indicates a high-dependency ratio of the young in these years.

(b) By 1980, the effects of the decline in the birth-rates have begun to be felt on the age-structure. The shape of the population pyramid in 1980 became more bell-shaped rather than the triangular ones in 1960 and 1970. As the detailed figures in Table 4 shows, the proportion of those in the young age-group decreased by 40 percent of the total. While for those in the age-group 60 and above, the proportion rose to 5 percent. The proportion of those in the working-age went up from 49.7 percent to 55 percent between 1970 and 1980.

(c) Dramatic changes could be expected by the year 2000 when the gradation of the pyramid becomes less steep, as those in the age above 15 continues to bulge out. The share of those in the working-age would have risen from 55 percent in 1980 to 66 percent in 2000, while that of those below 15 would have been reduced to 27 percent of the total, and those 60 and above would have gone up to 7 percent.

(d) Following the changes in the age-distribution between 1970 and 1980, the dependency ratio declined from 87 in 1970 to 72 in 1980. However, regional data (which does not appear

in this figure) shows the Northeast having the highest dependency ratio which is, incidentally, the poorest region in the country. This is rather high when compared to the low-dependency ratio of 47 in the Bangkok Metropolis in 1980. The high-rate of dependency ratio in the Northeast reflects a rather high fertility-levels as compared with other regions.

2.3.2 Locational Distribution of the Population

The data in Table 5 shows the regional distribution of population to be unchanged between 1960, 1970 and 1980. The Northeast remains the largest in terms of population size. This is also consistent with the rather high-fertility in the region. Of all the regions, the average family-size in the Northeast is still high because this region is relatively poorer compared to the other parts, and the farming households tend to have large, but infertile land on the average. Thus, for economic and survival reasons, the farming families still prefer a rather large family size.

The overall density of the population per square kilometer has increased from 67 in 1979, to 87 in 1980. A dramatic increase can be seen in the case of the Northeast, possibly due to the high-rate of fertility, and in the North, which is due more to the favorable rate of immigration.

2.3.3 Urban/Rural Distribution

The rate of increase of urban population (defined as those living in municipal areas) has been quite low in Thailand compared with the other developing countries. The urban population grew at the rate of only 5 percent per annum during the 70's and the early half of the 80's, (see Table 6) while in other countries, the rate could be as high as 10-15 percent. By 1980 the proportion of the urban population in total was only 17.3 percent. This ratio is expected to become 25-26 percent during the Sixth Plan. In the future, however, it may be expected that

the rate of increase of the urban population will be accelerated. It is difficult to predict the success of the rural industrialization and the rural development policies as the rate of urban investments may slow down, due to the movement from the rural to the urban centres.

Majority of the urban population is, at present, concentrated in the Bangkok Metropolis (61.5%). The rate of increase of the urban population in the Bangkok Metropolis has also been the highest due to immigrants. Other urban centers which have grown (in declining order) in recent years are in the Northeast, the South, the Central and the North. The high population density in the North may explain the lower rate of urban growth there. In terms of immigration, the Bangkok Metropolis, also, had the highest rate of immigrants during the last decade, followed by the Central Region, the North, the South and the Northeast. Similar trends may be expected in the future.

2.4 Conclusions on the "Population" Issue

Thailand has been achieving a descending growth of population and rate of fertility. The population growth-rate of about 3.1 percent a year at the beginning of the 1970's declined to about 1.6 or 1.7 percent at present. The fertility rate measured by the number of children born dropped from 4.1 in 1969/1970 to 3.3 in 1981. The mortality levels have declined steadily since 1920 and reached a low-level of about 8.2 in 1983. The dynamics of fertility and mortality have brought about a favorable change in the population age-structure. The broad age-structure would be dominated less by the population age 0-14 and greater by those in the productive age. By the year 2000, among the projected total of 63.8 million population, about 27 percent would constitute the population age under 15 years, whereas, about 66 percent would constitute the productive population age 15-60 years. The aging population, 60 years and above, would share about 7 percent.

The change in such an age-structure implies a wide range of economic and social implications. The reduction in the young dependency ratio or, the proportion of the population aged 0-14 years to those aged 15-60 years would, for example, have an important impact over consumption, savings and production patterns. An investment to cope with a rapid growth of new entrants to the labor force could be alleviated after some time-lag on the impact of fertility decline. The fertility decline will have some impact on the school age population, at least within the 5-7 years group. The impact of migration can be seen in both the sending and the receiving areas. Migration to urban areas has a major contribution to the urban population growth. So far, however, the impact of the decline of fertility and the population growth have not been intensively studied yet. The impact studies can provide a significant basis for the formulation of related policies.

3. The "Human Resource" Issue

The previous section discussed the basis of the human resource, which is the population,its size and distribution. This section is about the quality and the utilization of the human resource.

Human resource can be broadly-defined as the 'sum total of the knowledge, skills and aptitudes of the people, inhabiting the country'. In a broad sense, it includes the initiative, resourcefulness, capacity for sustained work, right values, interest, attitudes, and other human qualities conducive to higher output and accelerated economic growth. Human resource,with both the quantitative and the qualitative dimensions,[5] is essential in the production of goods and services. The GNP would be much lower without a healthy,trained, educated, as well as, an informal labor force.[6]

Because the human resource is one of the most valuable assets of the economy, the most valuable use of capital resource would be that portion invested in the human being.[7] The pace of economic growth in a country is largely determined by the quality and the quantity of its human resource. It is vitally important, therefore, that the

country's manpower be developed along with the stock of the physical capital. In addition to this economic importance, the development of human resource has social, political and cultural significance. All these dimensions of human resource development are important and none can be neglected. They assume special significance in the context of the national development plan which entails social, as well as, economic development. Human resource planning must be closely integrated with national development planning at all stages since, the human element constitutes, not only, an important factor of production, but also, a major force in the economic growth.[8] In addition, human capital is an economic resource which will contribute to income and growth, either more or less, according to the ways it is being utilized.[9]

3.1 Size and Characteristics of Human Resource in Thailand

The Thai economic planners have not given attention to the human resource problems as much as, to the growth and the stability problems. Until recently, human resource and employment have emerged as important issues worth national attention.[10] The first three National Economic and Social Development Plans (1961 - 1976) acclaimed the acceleration of economic growth as first priority. The Fourth Plan (1977 - 1981) has put, more or less, equal emphasis on growth and stability. Employment in the Fifth Plan is, again, treated as a by-product of other objectives.[11] The plan contains no clear guidelines for employment policy.

Other factors have also contributed to the lack of clear planning in human resource. For such planning and development to be effective, it is necessary to have sufficient, consistent, reliable and up-to-date labor market information and data. It should be noted here that such information and data are not available in Thailand.

Historical data on the economically-active population of the country are generally lacking but, several efforts have been made during the last 30 to 40 years, to collect such data mainly as part of the national censuses and surveys. In the 1937 census, the first attempt at collecting data on the economically-active population was made by recording the activities of persons aged 11 years and over.[12]

The overall picture of Table 7 is one of relatively high participation rates, particularly for females, as compared with many other countries in the ESCAP region.[13] The high-rate of participation for Thai women could partly be explained by a liberal definition which includes the unpaid family workers.

The decline in the crude activity rate and the participation rate between 1960 to 1980 might be attributed to a number of factors. Firstly, there was a decline in the proportion of the working-age population (11 years and over) to the total population from about 53 percent in 1960 to about 56 percent in 1980 and this, in itself, would have had the effect of depressing the participation rate. Secondly, during the period of the Second Plan (1967-1971) through the Fourth Plan, vigorous efforts were made to develop and expand educational services throughout the country that resulted in increased school enrollment. Children now tend to stay in school longer and enter the labor market later than before. Thirdly, in developing countries like Thailand where employment does not grow as fast as the population of working age, the labor force participation rates tend to be lower than those in countries where jobs are plentiful.[14]

The age-sex participation rates for 1960, 1970 and 1980 are shown in Table 8. It will be observed that for both males and females, the participation-rate rises precipitously from a low figure of around 30 percent for those under the age of 15 years to around 65 in the 15-19 age-group, then gradually increasing to a peak in the ages

30-49 years and declining thereafter. The peak rate for males is around 95 percent, while for females, it is about 77 percent. In the case of males, between 1960-1980, there was a slight increase in the rates for ages below 15 years, no real change for ages 15 to 50, a slight drop in the rate for the 50-59 age group and a more pronounced drop in the rates for the age-group 60 and over. The overall picture is a slight fall in the male participation rates for all ages due presumably, to a growing practice of a slightly earlier retirement. The greatest percentage reduction in the female rates occurred for age-groups 15-19 and 50-59, reflecting presumably a growing tendency among young females to prolong their schooling and earlier retirement for women at the upper end of the age schedule. It may also be pointed out that the subtle difference in the definition employed in the censuses may explain part of the apparent decline in female participatic though there is no firm evidence,yet,of any such biases.

As is known, Thailand's population is predominantly rural and consequently agrarian. About 72 percent of the employed persons are engaged in agriculture. This particularly high percentage reflects the level of the economic development achieved in Thailand. There has been a shift in the occupational composition from agriculture to non-agriculture, because the share of those engaged in agriculture has fallen from 81.9 percent in 1960 to 72.3 percent in 1980 (Table 9). The major occupation of males in non-agriculture in descending order of importance are crafts, sales work and service while those for females are sales work, crafts and services. More males work in the 'professional' field than females.[15]

As mentioned earlier, the Thai planners have not given much attention to human resource development. The past neglect of the employment

dimension in the macroeconomic plan is partly related to the assumption that, growth equals employment. An additional reason is that the planners have regarded other problems to be more urgent and important.

Methodologically, human resource and manpower planning in Thailand concentrated mainly on the quantitative forecasting of the demand for, and the supply of, the various categories of technical manpower for a projected period of expansion in the economy. This manpower projection was then translated into educational requirement for the education sector. In the Fifth Plan, the manpower projection method was employed again to project requirement of a few key manpower. It was estimated that in 1981, there will be 23.8 million persons in the labor force and 23.5 million persons will be employed. By 1986, there will be 27.6 labor force and 27.0 million employed persons. However, it is recognized that there is indeed a serious lack of sufficient, reliable and up-to-date information and data base for manpower projection. The practice of manpower planning in the past years tended to be overoccupied with the quantitative aspect and little attention was paid to the qualitative side.[16]

3.2 The Utilization of the Human Resource

3.2.1 The Labor Force

Based on the Labor Force Survey of the National Statistical Office, the total employment in 1982 was 24.7 million persons. Over the last decade, the total employment increased rapidly from 16.6 million persons in 1971 to 24.7 million persons in 1982 as shown in Table 10. On the average, the total employment increased by nearly 4% per annum, which is one of the highest rates in the world. The rapid increase in the total employment was in line with the increase in the labor force which has resulted in the baby-boom during the 1950's and 1960's as discussed in section 2. The increased labor force was concentrated in the agricultural sector where self-employment predo-

minated. Thus,when labor force expands, the employment levels of the self-employed in the agricultural sector also increases. Additional working persons in agriculture are thus, automatically counted as employed persons. On the demand side, expansion of agricultural production through an increase in planted areas during the 1960's and 1970's could absorb more labor in agriculture. However, it is obvious that an ability of labor-absorption in agriculture has tended to decline due to the limitation of new arable land. The problem of labor-absorption in the economy will become more serious if the increase in the labor-force continues at the present high-rate.

A large majority of employment is concentrated in the non-municipal areas. In 1982, about 87 percent of the total employed persons worked in non-municipal areas. Over the last two decades, the proportion of employed persons in municipal areas slowly increased even with the appearance of rural-to-urban migration.

Since, majority of the population live in the Northeast, more than one-third of the total employed persons work in the Northeast. The Central Plain and the South, whose natural resource endowment and investment are relatively high, shared only 20.0 percent and 11.7 percent of the total employment, respectively. Although one-third of the total employed persons were in the Northeast, the value of Gross Regional Product of this region shared only 12.8 percent (estimated at current prices) of the total GDP in 1982, resulting in a very low per-capita income in this region. Poverty and low standard-of-living of the people in the Northeast have stimulated out-migration from this region but,share in food and output per head have slowly increased.

Agriculture is a dominant sector in the economy. In 1981, this sector employed about 72 percent of the total labor employment. However, the share of agriculture in total employment experienced a gradual decline from 82.4 percent in 1960 to 79.3 percent and 72 percent in 1970 and 1981, respectively. The share of employment in

the non-agricultural sector, particularly manufacturing and services increased from 3.4 percent in 1960 to 4.1 percent in 1970 for manufacturing and, 4.7 percent in 1960 to 7.1 percent in 1970 for services. In 1982, manufacturing, commerce and service, shared about 8 percent of the total employment in the whole kingdom. In the rural or non-municipal areas, more than 80 percent of the total employment were in agriculture whereby manufacturing, commerce and service, shared an equal 5 percent of the rural employment in 1982. In the urban areas, services, commerce and manufacturing have played the important role in employment with shares of 32 percent, 31 percent and 21 percent of the total urban employment, respectively.

The declining share of agriculture in the total employment indicates that, the demand for labor in the agricultural sector is relatively growing slower compared with the non-agricultural sectors. This phenomenon has been experienced by many countries during their process of economic development. In the case of Thailand, not only has the agricultural sector's share in employment declined but also its share in the GDP. The share of agriculture in the GDP has declined at a rate faster than that of employment which resulted in a sluggish increase in the per-capita income of employed persons in agriculture. In the non-agricultural sectors, particularly in manufacturing, the share in GDP increased at a rate faster than that of employment. Because of this, a gap of income differential between the people in the agricultural and non-agricultural sectors became wider.

Thus, it follows that the increase in employment in agriculture without a corresponding increase in productivity is not preferable. Furthermore, whenever income distribution is taken into consideration, it seems that a transfer of the labor force from agriculture to the other sectors should also be stimulated. However, a question of where and how agricultural labor could be transferred to, requires an investigation.

Seasonality in employment is one of the striking features of employment in Thailand. On the average, the employment in the dry season

declines by 25 percent of the total employment in the rainy season as shown in Table 10. This is due to the decrease in the demand for labor in agricultural production in the dry season. However, seasonal changes in employment vary among areas and regions. Large fluctuations in seasonal employment are found in the rural areas, particularly in the Northeast and the North,where rainfed agriculture predominates. In the Central Plain where irrigation for crop production and non-farm activities exist, the difference in seasonal employment is relatively small. This indicates that,the people in the poverty areas are faced with the problem of unstable employment. This problem may be related to their poverty and their low-standard of living.

3.2.2 Labor Utilization Problems

The labor force is the human resource of the nation. If well-developed and fully-utilized, an increase in the labor force can be benefi - cial to production and output-growth. However, the problems of labor utilization were not seriously taken into consideration in the previous economic development plans until recently, when unemployment became of interest for discussion among scholars, policy makers and planners. Among various discussions, the National Seminar on Employment Policies and Direction which was organized by the NESDB, the DOL and the ILO-ARTEP in June, 1983, classified employment problems into 5 categories; open unemployment, unemployment of educated persons, underemployment, seasonal unemployment and problems of child and women labor.

- Open Unemployment: The data of the Labor Force Survey indicated that the open unemployment rates for the whole Kingdom never exceeded 3 percent during the last decade. Even in municipal areas where a relatively high proportion of hired labor exists, the rate of open unemployment is still low. Also,when the demand for labor in agriculture declines during the dry season, the rate of open unempolyment remains low

and does not differ from the rate during the rainy season. The apparently low rate of unemployment is due to the definition of unemployment commonly used in a modern labor market.

In Thailand, where self-employment is dominant, the definition of unemployment used in the Labor Force Survey may not reflect the real unemployment situation. If there was to be a system of unemployment registration and unemployment benefit system, the rates of the unemployed and the open unemployment in Thailand would probably be higher than those reflected in the present data.

Among the unemployed persons, about 31 percent and 25 percent are those in the age-groups of 15-19 years old and 20-24 years old, respectively. Such high-proportions are mainly due to the fast increase in the number of the new entrants into the labor force in recent years. A crucial problem of open unemployment is the rapid increase in the absolute number of unemployed persons in the last few years, when the unemployed persons increased from 35,280 in 1971 to 459,000 persons in 1982.

- Unemployment of Educated Persons: Only 10 percent of the persons in the labor force completed an education higher than elementary-level (see Table 11). Their education is mainly paid for, either by their families or, by the Government. Unemployment among these educated persons means unproductive investment in the human resources. The data from the Labor Force Surveys indicate that the rates of open unemployment of educated persons were quite high, particularly among university graduates and vocational graduates who have been given higher human resources investment. The open unemployment rates of educated persons also vary among sex and areas. On the average, the educated female labor force has a higher unemployment rate than the male labor force. In absolute terms, the number of educated

unemployed persons increased rapidly. It is expected that, the number will increase sharply in the next decade due to the increasing number of students (see details in Tables 12 and 13).

- Underemployment: Underemployment refers to a situation in which the employed persons work less than a certain minimum level of income, or where there is a mismatch of occupation and education. Based on the definition used in the labor force surveys, about 16-38 percent of the total labor force in the non-municipal areas and 13-31 percent of the total labor force in municipal areas were underemployed during 1977-1981. Underemployment in terms of income was a major component of this problem. Underemployment in terms of the number of work hours was relatively low, except during the dry season in rural areas. The patterns of underemployment did not change much during the period 1977-1981, except that, the rates of underemployment in the municipal areas increased as a result of the increase in the minimum-wage rates.

Among the underemployed persons under the work-hours category, almost nine-tenths live in non-municipal areas (see Table 14). The majority are farmers who come from the Northeast. In the non-municipal areas, the underemployment seemed to decline during 1977-1981. In absolute terms, the number of underemployed persons declined from 6.76 million in 1977 to 3.59 million in 1981 and, in relative terms this number declined from 5.4 to 3.5 percent over the same period. One can hypothesize that, the decline of underemployment in terms of work-hours could be attributed to development activities or public work programs. However, there is no empirical evidence available to support this hypothesis. On the other hand, the rates of underemployment by income were high, which suggests that the earnings gained by the

rural people from their work are relatively low. Even in 1981, 3.2 million persons in the rural areas had an average income-level of less than 3,000 baht per annum per employed person. Most of these underemployed persons come from region where more attention on economic and social development should be given such as, the Northeast and the North.

- Seasonal Unemployment: Seasonal unemployment refers to a situation wherein people who usually work on the farm without pay do not actually work during the survey week because it was not the agricultural season. Based on this definition, the Labor Force Survey reported that 3 to 6 million persons did not work during the dry season in 1975-1981. Serious seasonal unemployment exists in the Northeast and in the North where rainfed agriculture is predominant. In the South, where monsoon seasons and cropping patterns are different, seasonal unemployment is relatively low. In the Central Plain, where agricultural production is dependent on the water supply from irrigation, the rates of seasonal unemployment were lower than those in the North and the Northeast. The irrigation system and the cropping patterns seem to influence the degree of seasonal unemployment.

Despite the fact that rural job-creation projects have been undertaken for several years, seasonal unemployment still increases both, in absolute and relative terms. In absolute terms, seasonal unemployment increased from 3.1 million in 1975 to 5.6 million in 1981. In the Northeast, where serious problems exist, seasonal unemployment increased from 18.1 percent in 1975 to 19.8 percent and 24.0 percent in 1977 and 1981, respectively. Furthermore, questions concerning the length and nature of seasonal unemployment, and the preference to work by the people who are waiting for the agricultural season, still persist.

- Problems of Child and Woman Labor: In 1981, the Labor Force Survey revealed that, 1.2 million children (11-14) years of age, and 10.97 million women were in the labor force. The majority of children and women in the labor force live in the non-municipal areas, particularly in the Northeast where the people are poor and where the children and women have to work to help with the family's income. In agriculture, child labor accounted for a substantial portion of the agricultural labor force. The poverty of farm families and the lack of opportunity in education of young rural people have forced children to enter the labor force. Some rural children and young women migrate to the urban areas for jobs. Nevertheless, the problems of child and women labor still persist in towns. They face the problems of both unemployment and low-income. Open unemployment rates appear to be the highest among the young workforce. More than 60% of those who are qualified to get jobs are paid lower than the minimum wage rate because the majority of them work in informal sectors, where labor laws and labor protection are not very effective. There are no official statistics on the number of children and women with problems, but newspapers often report on the problems of child and woman labor in big cities. Since the child is a valuable human resource of any country, the society and the policy-makers should pay more attention to the problems of child labor.

3.3 Other Human Resource Problems

3.3.1 Wage and Other Labor Market Mechanisms

Besides the five employment problems mentioned, attention should also be paid on the wage-structure and on the other labor market mechanisms. Wage rates vary among location, employment status,

industries, occupation, sex and skills of the work. However, information about the structure of wage and determination of wage is not clear. The minimum-wage enforcement, which aims at raising the income of unskilled workers, may create a negative effect on unemployment. Effects of the minimum wage have been widely discussed, although more base data are still needed. Labor market information and a career guidance system could facilitate adjustments in the labor market. However, information about labor markets and its mechanisms is not readily available to planners.

3.3.2 Education

An educational system that improves the quality and the productivity of the labor force is a form of investment for the human resource. Empirical studies by many countries indicate that, there is a high correlation between the level of investment in education and economic growth.[17] In Thailand, the availability of empirical studies in this area is rather scanty. However, one can observe that, an output per head in the agricultural sector where, on an average an employed person has lower education is much lower than, the output per head in the manufacturing and services sectors.

In terms of expenditures for education, about 3.4 percent of the GDP in Thailand has been spent on education at all levels. The proportion of the GDP spent on education did not change much over the last decade. However, the Government budget for education increased sharply from 5,135 million baht in 1972 to 27,746 million baht in 1981. The rapid increase in the education expenditure was due to the increasing demand for education. Of course, the increasing demand for education is related to the rapid increase in the number of children and the social needs.

Due to the increasing demand for education and, the emphasis on education during the previous economic and social development plans, the number of students increased sharply at all educational levels

as shown in Table 15. However, during the Fourth Plan, the number of students at the primary-school level increased at a lower rate than during the previous plans, while in the case for high school and vocational levels,the rate was faster.

Though investment in education in terms of quantity has increased in pace, still, the majority of the labor force completed only the primary-level of education. For example, in 1979, 73.6 percent, 6.8 percent and 1.2 percent of the total labor force completed the primary school, secondary school, vocational and university levels, respectively. The rest had an education lower than the primary school level. During the Fifth Plan, the proportional distribution of the labor force by education has only slightly changed. This indicated a very little change in the structure of the labor supply despite a vigorous policy of restructuring the economy by the government during the Fifth Plan. Though investment in education has increased at a high-rate, the investment for skill development required for transforming into a modern economy has been rather low. Furthermore, the quality of education at various levels is also questionable. Much is still to be done to improve the quality of the elementary, secondary and higher education levels in order to match the demand in the labor market and to match the needs in advanced technologies. Informal education has been provided for a large number of people. However, the emphasis of informal education has been placed on basic education for life improvement, which is quite general. Upgrading and skill development of the work force covers only a small proportion of the labor force.

3.3.3 Health

Expenditure on public health is another form of human investment. A relatively small proportion of the fiscal budget was spent on public-health services. However, expenditure on public-health in absolute terms has increased from 449 million baht in 1966 to 9,079 million baht in 1983. Because of the increase in public health investment and the improvement of medical services, the death rates declined

sharply. The death rate from malaria declined from 3.2 percent in 1961 to 2.4 percent in 1975, and 4.0 percent to 2.8 percent for tuberculosis over the same period. It is believed that health improvement would affect labor productivity, but so far, there has been no substantial empirical studies about such effects in Thailand.

3.3.4 Conclusions on the "Human Resource" Issue

A majority of the people in Thailand completed the primary school level. However, for higher levels, the education and skills acquired do not seem to be appropriate for the modern technology being used in production. Normally, improved educational and skills qualifications are required as the economy undergoes restructuring to a more advanced stage. The proportion of skilled to non-skilled labor force in Thailand is relatively small. However, there is still an increase in the number of unemployed among educated persons in Thailand and this has raised questions about the educational system and the manpower development in Thailand. Further to which, this problem worsened as more investment was given to higher level education. And though rural development has been attempted for many years, underemployment and seasonal unemployment do not seem to have declined. These serious problems exist among the poor and in the poorest regions of the country. These problems should receive more attention in the next economic and social development plan.

The above discussion on the human resource situation reveals that, there is an urgent need to restructure the previous practice of human resource development in Thailand. The planner can no longer concern himself with only the improvement of the prediction capacity on the demand side. The quantity, quality and the structure of the labor force should all be considered. There is a need to develop a data base for employment and human resource in order to have more efficient tools for

planning and implementation. There is also a need to influence development strategies so that human resource and employment growth can become one of the major goals in development, not just education as previously emphasized.

4. Social Development

Social development is the process of promoting self-reliance among the people so that, they may be able to solve problems by themselves and participate more actively in national development. In this process of promoting self-reliance, the society has to go through various types of changes. Thus, social development has to be aimed towards strengthening the capacity of the people in the society to enable them to adjust to changing conditions and circumstances. Keeping the above-mentioned social development concepts in mind, the necessary approach has to take into account the major medium and long-term changes expected in the society and to identify development issues and the necessary mechanisms to facilitate the process of adjustment.

4.1 Review of Past Social Development Efforts

During the past 2 decades of economic and social development in Thailand starting from the First to the Fourth Plans, the emphasis on social development was heavily placed on the reduction of the population growth-rate and the distribution of social services. The reduction of population growth was aimed to facilitate the distribution of economic and social services to reach more population and to alleviate the economic burden shouldered by low-income families. The distribution of social services was also considered as a means to increase the availability and to ensure more equitable distribution of these services to reach more people, particularly in the

remote areas. In 1970, the Government formally adopted a policy of slowing the population growth and openly supported a national family planning program. Since then, satisfactory progress was made in implementing the family planning programs as has been witnessed by the decrease of the population growth-rate from 2.7 percent in 1966 to 2.2 percent in the final year of the Fourth Plan in 1981.

The major emphasis on education development during the past two decades was, to provide greater opportunity for the people to receive education, particularly, through the expansion of compulsory education in conformity with the increasing number of school-age children and the improvement and expansion of secondary education in the province. During the Second and Third Plans, attention was shifted to the production of middle and high-level manpower for the growing sectors of the economy e.g. agriculture and manufacturing. In 1970's, the government bowed to the social pressure of a demand for higher educational institutions by adopting a liberal policy toward the establishment of new universities. Private initiatives to establish diploma and degree-granting colleges were endorsed: eleven private colleges mushroomed during 1970 and 1974; six new state universities, including two "open universities" were added to the existing eight. Consequently, the enrollment growth-rate, which was kept at approximately 6% in 1960's, accelerated to 14.5% in the 1970's. By 1975, for every 100 persons of university age, 3.4 were enrolled in a higher-education institution; in 1979, the figure became 9.1. Among the private colleges, the increase in enrollment in the 1970's was paralleled by a decline in quality of the support structure such as : inadequate facilities, underqualified faculty members and limited time and opportunity for conducting research.

Investment on education during the past 2 decades of development resulted in the increase of enrollments in every level of education. By the end of 1981, the compulsory education was expanded to cover 97.8 percent of all tambons. Impressive expansion in the secondary education was also achieved, as witnessed by the increase in the

number of classrooms and schools at the tambon level. Also, in the vocational and higher-education there had been a rapid increase in the growth-rate of enrollments particularly at various teacher's training and vocational institutes and universities. The expansion, in terms of the quantity in the supply of manpower, had contributed to the increased pressure on the problem of educated unemployed which became more visible at the beginning of the Fifth Plan.

Satisfactory progress had also been achieved in the expansion of health services as shown by the improvements in the proportion of physicians and nurses to the total population and the expansion of health centres to cover about 83.7% of the total tambons in the Kingdom by the end of the Fourth Plan. Despite the remarkable improvement of the standard of health-care delivery system and the considerable expansion of coverage, a large proportion of the Thai people during the Fourth Plan still remained without access to health services and continued to suffer from the pressing problems on health related to poor living conditions, inadequate sanitary facilities, malnutrition and preventable diseases. It was realized that reliance on a clinically-oriented health system was costly and unresponsive to the needs of the majority of the population, especially to those living in the rural areas. In an attempt to solve these problems, the Primary Health Care approach was adopted in 1979. One of the most important aspects of the PHC was the mobilization of the individuals and the communities to take active part in the planning and implementation of activities and programs that will have an impact on their health. Community participation was encouraged through the process of selecting the village health-volunteers and initiating and operating village revolving funds for health activities under the PHC program which include basic medical care, health education, endemic disease control, maternal and child-care, family planning, sanitation and water supply, immunization, food and nutrition etc., (see Table 16)

Despite this impressive achievement of social development in terms of reducing the rate of population growth and the distribution of various social services, to date, there has been very little knowledge and lack of understanding on the extent to which these improvements contribute to the promotion of self-reliance among the people. The economic and social impact arising from the reduction of population rate of growth has, not yet, been studied and fully understood. Likewise, the extent to which the expansion of social services contribute to the improvement of the capacity of the people to adjust themselves to changes and to participate in the process of development, still, cannot be clearly demonstrated. In the light of the rapid changes of the situation both internationally and domestically during the first two years of the Fifth Plan, there has been some evidence gathered indicating that, people in the society are encountering more and more difficulties in order to adjust themselves to these changes. This can be seen by the emergence of many social problems such as rising urban crime, juvenile delinquency, rising accidents, deterioration of mental health, and rising numbers of educated unemployed etc.

Since social development should be aimed at strengthening the capacity of the people in the society to adjust themselves to changing conditions and circumstances, the emphasis of its development on the quantity side may not be adequate. The people who are the end-target of social development cannot be viewed only as the recipient of development efforts, but, has to be treated as human resources who can also contribute and participate in national development through the process of adjustment. Hence, we can see that more attention in the future has to be shifted to the "quality" issue.

During the Fifth Plan period, many strategies and policies have been implemented in order to improve the quality of the human resources so that they can be more self-reliant and can be more adjustable to changing situations. They can be described as follows:

- Rural Poverty Alleviation: The preparation of rural development programs in the Fifth Plan is based on an entirely different concept compared with the past Plans. The Fifth Plan no longer attaches major emphasis to overall output and national income. The Fifth Plan is more people-oriented, and aims at making the rural poor more capable to help themselves. The government will have to allocate enough resources to them. A correct understanding of the causes of the problems of poverty should first be acquired if effective remedies are to be recommended. The new rural development policy-guidelines consist of five main salient features:

    - It is area-specific and gives top priority to the high-poverty concentration areas.
    - It develops high-poverty concentration areas to help the people raise enough food to eat and to clothe themselves. Basic public services will be made available in sufficient supplies.
    - It initiates self-help programs for the people.
    - It solves the poverty problems in all localities by emphasizing low-cost and self-help techniques.
    - It encourages maximum participation by the people in solving their problems.

- Development of Public Health: The Ministry of Public Health has adjusted the public-health programs for the remaining two years of the Fifth Plan by shifting more attention to increasing the people's capacity in preventing diseases rather than,the mere gesture of providing medical-care services. The main instrument to implement this strategy would be through the primary health-care system which mobilizes individuals and communities to

take active part in planning and implementing activities and programs bearing impact on their health. The development of public-health under the primary health-care approach is considered one important mechanism to improve the self-reliant capacity of the people, the capacity to solve their own problems and the ability to adjust themselves better to changes.

- Education Development: To enable the education system to supply manpower in the quality which corresponds to the requirements of the market, support was given to the development of vocational guidance system within various educational institutions and to the strengthening of information about the labor market. Various educational institutions were required to monitor the employment status of their graduates and used this information for vocational guidance at the secondary-level, as well as, for the adjustment of the annual enrollments. The information on the demand gathered from the labor markets was also used for the adjustment of the curricula and the teaching processes so as to improve the quality of graduates in accordance with the changing market requirements.

4.2 The Future Approach to Social Development

The review of past social development in the previous sections shows that, there has been a recent growing awareness to pay more attention to the issue on the improvement in the quality of the human resources in order to cope more efficiently with changes. In considering the approach for future social development, the questions to be asked concerns the future expected changes that will face the society and the characteristics of the quality required for desirable adjustments. The answers to these questions have to be thoroughly explored in order that development strategy and policy guidelines, as well as, adjustment mechanism can be clearly set up.

4.3 Medium and Long-terms Changes and Social Development Implications

Social development has to take into account both, the external and the domestic changes. With an open economy, Thailand cannot avoid the impact of changes in the worldwide development situation. During the next decade, it is expected that competition in the world market will become more intense. Economically, the country has to improve its export-capacity to meet this reality. In the social field, the development of skills or, the management ability of human resources in producing goods and services to compete more efficiently in the world market, is considered to be one of the major issues which has a lot of implications for the development of education and training programs in the future.

In considering the medium and the long-term domestic changes, past social development efforts paid much attention to the change in the size or quantity of the population. However, since a change in the structure and distribution of the population will have a lot of implications for the future economic and social development, these new aspects on the structural change and distribution have to be taken more seriously into consideration.

The outline of the present and the future structure and distribution of population has been presented earlier. A summary is given here to refresh the reader. The important points which were made earlier were:

- By the year 2000 and 1991, the proportion of the population in the age-group lower than 15 will decline to 27 percent and 32 percent of the total respectively, as compared to 40 percent in 1980.
- The proportion of active adults (15-59 years old) will increase quite dramatically from 55 percent in 1980 to 66 percent in 1991, and 62 percent in the year 2000.

- The proportion of the old-age population will increase from 5 percent of the total population in 1980, to 6 and 7 percent in 1991 and 2000 respectively.
- It is very likely that the rate of increase of the urban population will be higher than the average rate of 5 percent in the 70s. Although it is difficult to predict how high this would be.

Taking into account the long-term and the medium-term demographic changes in Thailand, issues which have social development implications can be briefly analysed as follows:

- In terms of quantity, the pressure from mothers and children for health services will decline during the next decade due to the increase in the number of the population in the 0-5 age group. There will be more opportunity to extend health services to cover more children in this age-group in order to improve their quality. The health standard for children in this age-group should be set up so that health-care such as immunization, nutrition and feeding services can be promoted for both their physical and mental development.
- The pressure to expand primary education will also gradually decrease during the next decade due to the reduction in the number of population in the age-group of 6-11. More economic and practical ways and means to improve the quality of education at this level still, however, remain to be an important issue to be tackled. More attention may have to be focussed on the improvement of textbooks, examination and screening processes, as well as, on the quality of teachers.
- The number of children in the 12-21 years old age-group will continue to increase and cause more pressure on the provision of education services at the secondary,

vocational and higher-education levels. The increased social demand for education at these levels will make it much more difficult to adjust the quality of education in the light of changing labor market conditions. Hence, proper educational financing, promoting private sector participation in the provision of education, and allowing flexibility in the educational system, both in and out-of-school in responding to the changing situations, are all important issues that need to be tackled in the future.

- The number of active adults 15-59 years old will increase. This increased share in the working-group can be considered an asset. But, if they are not adequately utilized in line with changes in investment pattern or demand for labor then, underemployment and unemployment will result that will further lead to increased frustration and economic waste. In the light of the expected increase in the demand for jobs and the limited opportunity for the expansion of employment in the public sector, the education and training system in terms of the teaching and learning process has to be reoriented towards self-employment in order to generate enough jobs in the government and the private sector.

- The proportion of old-age population over 60 years old will increase from 5 percent of the population in 1980 to 6 percent and 7 percent of the population by 1991 and 2000 respectively. Hence, there is a need to begin a more serious study of the economic and social impacts of this rising trend of old-age population so that a proper social welfare policy for this age-group can be developed in the future.

4.4 Population Distribution and Urbanization

Although the pace of urbanization is dependent on many factors, it is expected that, during the next decades, urban population will expand. During the Sixth Plan period, it is estimated that about 25-26 percent of the total population or, about 14-15 million will be living in urban areas. With increased urbanization, the urban areas will have a higher proportion of those in the working-age group (16-65 years old), while in the rural areas, the proportion of the aged will tend to rise.

Rapid urbanization and industrialization usually brings about more social problems such as, congestion and housing shortage , crime, juvenile delinquency, deterioration of the social environment which affects both the mental and the physical well-being of the people. Increased urbanization also weakens the family institutions as a result of the emergence of more nuclear families. Hence, more serious attention should be paid to seeking ways and means to strengthen family institutions to relieve these social problems. In addition, urban communities have to be encouraged to participate in the solution and prevention of problems in a more systematic and organized manner.

5. Conclusion: Implications to Planners

In the past, the rapid growth of the population has been one of the major factors that have influenced the scope and the direction of population, human resource and social development policies. The national population policy adopted in 1970 was aimed at lowering the natural rate of growth in order to reduce the pressure on the existing resources. In the areas of human resource and social development policies, the planners projected the needs according to the projected increase in population and tried to expand public facilities in line with the projected increase in demand for these facilities. This approach had its merit at the time when population

was growing rather rapidly and when there was a time lag in the effects of the family planning program on the size of the population. During the 60's and the 70's the age structure hardly changed and even the pace of urbanization was rather slow. The most noticeable change was, of course, the increase in the size of the population.

As the birth rates began to decline towards the end of the 1970's, the effects of this decline on the population distribution, especially on the age-distribution became very obvious. The most noticeable impact was, the decline in the proportion of children age 0-14 and, the bulging of those in the working-age (15-60) and those above 60. Locationwise, the share of those living in the urban areas has also increased due to the rise in investment in urban centres which raises urban employment and attracts rural migrants. It is expected that, the pace of the urban expansion will be accelerated in the future. What do these changes in the age-structure of the population and the locational-distribution mean to planners?

(1) The demand for elementary education and medical services for mothers and very young children will absolutely decline. Part of the resources which used to be allocated for these two purposes can be released for other uses.

(2) The number of people in the working-age group who will need higher education and training for skills will increase. This will have a direct bearing on the changes in the allocation of investment in education, both in the formal and informal systems.

(3) As the country's labor force is weighed more towards the higher age-groups of retirement or near-retirement ages, the dependency ratio of the old-age groups will rise even with the decline of the dependency ratio of the young. Thus, while the demand for elementary education and medical services for mothers and young children will

be reduced, the demand for social welfare for the aged will increase. This phenomenon is quite new to Thailand. The likely increase in the incidence of nuclear families following the urbanization trend further means that, it will be difficult to expect the extended family system to take care of this problem of the aged adequately. On this, the following questions can be raised. How serious is this problem going to be and, when will this be felt? If the problem is considered serious, what types of social welfare will be appropriate? Who should pay for the costs?

(4) As far as regional distribution of population is concerned, it is fairly clear that the Northeast will continue to be the largest in terms of population size. It will also continue to have the most serious problems in terms of poverty and high-fertility rate. In the future, planners will have to continue to allocate resources for solving the problems of poverty and more attention will have to be given to family planning there, in order to reduce the overall natural rate of growth.

(5) It is, as yet, difficult to predict the rate of change of the urban population and the pattern of change among the different urban centres. A lot will depend on the rate of migration and the investment in different urban centres. It is still, not too late to try to control the pace of urbanization and its pattern. The questions which should be asked are: Is there a need to control the rate of urbanization, and to determine the pattern of urbanization? Certainly, given the past trend of the dominance of Bangkok Metropolis, there is a need to reduce migration into this urban centre. How could this be achieved? The government policies with regard to employment generation between urban and rural areas can affect the pace and the pattern of urbanization.

What should be the policies of the government in this regard?

Given that the urban population will continue to expand, this will pose several implications for planners. The urban areas will have a higher proportion of population in the working-age groups, and there will be higher incidence of nuclear families. All these changes will affect the consumption pattern. There will be more demand for urban public utilities.

A related question concerning the question of urbanization is the increased social tension in urban areas as the population density increases. In the past, the government policies concentrated on expanding physical public utilities in order to cope with urbanization. While this will still be important in the future, another issue that arises is on, whether or not, more attention should also be given to facilities which help reduce social tensions, stress and strain of urban living. This is a direct social question. Should there be more public parks, community recreational facilities and other social services? If yes, who should pay for the cost? What should be the role of the public and the private sectors in this regard? What is the government's stand on this? Is there enough resources to provide more of these facilities? Who should take the initiatives? Where would the fund come from?

(6) In the realm of human resource development policies, the present and the future structure of the population have important implications to planners.

- The high-rates of population growth in recent decades are now creating large numbers of new entrants to the labor force. The rapid decline of the population growth

rate in recent years will not cause an increase in the number of people among the working age to level-off for some time to come. Thus, despite further reduction in the rate of population growth at 1.5 percent expected in 1986, the people in the working-age will still expand at the rate higher than 3 percent beyond 1986. This large size of the working population is an asset; and as put by Harbison, 'the skills, knowledge and capacities of the labor force are capable of limitless growth'. The questions are: is this plentiful human resource sufficiently developed to realise its full potential in terms of skills, talents and knowledge? Is it being utilized fully?

The above review of the current state of human resource development and its utilization has shown that,the majority of the labor force only receives four years of elementary education. The majority of the labor force is working in unskilled types of occupations. While the objective of imparting literacy to the population may have been achieved, this level of formal education is inadequate to prepare the people for further skill development. If we are to modernize our industries and our agriculture and develop new technologies in line with what happens elsewhere, the labor force must likewise be given higher basic education. Have we tried our best to educate the labor force up to 6 years of compulsory education as stated in the national policy? What are the obstacles, what

should be done to speed the enrollment up to this compulsory education? Even after reaching this educational level, people are still not equipped with occupational skills for productive employment. Should the compulsory education be raised to secondary level? What are the problems involved? What are the alternative policies? A related question concerns the quality or, the content of compulsory education.

At the moment, the capacity for producing middle and high-level manpower is limited. But even so, many of those who attain higher education face unemployment problems. This state-of-affairs suggests that, there is a problem in the development of human resource. We have too many people who are inadequately educated. At the same time, many of those who are educated do not even get jobs. How much of this can be explained by the mismatch between the training and demand in the labor markets? How much of this can be explained by inappropriate economic policies? How much of this can be explained by inappropriate training? Is formal education adequate as a means to train people for the labor markets? What should be the role of the informal training, such as on-the-job and apprenticeship schemes? What should be the role of the private sector in this regard? How could there be more co-operation between the private and the public sectors?

Among those who receive low education only, many are not fully utilized in the labor

force, as can be seen from the high rate of underemployment in agriculture. Yet, for the past 20-25 years, the government has been putting a lot of emphasis on rural development. The rural development has not yet been able to solve underemployment problems. Should the future strategies of rural development be reoriented goals? Are these problems appreciated by planners? If we are going to reorient our policies, do we know exactly where the problems lie? Do we have enough information in detail at the local level to identify the size, the specific socioeconomic groups with problems, and the duration of the period of underemployment, in order to design appropriate policy measures? If we are to continue with the past policies of economic growth, what will be the cost in terms of un- and underemployment?

- On the demand side, we have a situation where the economic structure is undergoing quite rapid changes. According to the Fifth Plan, Thailand aims to restructure and modernize the industrial sector by 1986. Several issues regarding human resource development policies warrant attention, accordingly.
    - In what way will the country's human resources be developed in order to satisfy the increased demand of the modern sector.
    - The modernization of industries may not lead to an increase in the labor-absorption rate high enough to employ all those who

are underemployed in the rural sector. If this is the case, what should planners do to accommodate this problem?

- There is also the question about the development of technology and employment. Is technological development concomitant with the goal of generating employment? It is inevitable that, as the economy develops, technical change will have to take place. But now, is this going to affect the employment generation goal? Further technological development requires people with proper skills, knowledge and particular training. What kinds of skills are consistent with the country's technological development?

(7) In the area of population, the Fifth Plan aims to reduce the natural rate of growth to 1.5 percent per annum. One of the policy options is to adopt a two-child family policy. Is this desirable? If it is adopted and results in a dramatic decline in the natural rate of growth, the next generation will bear the heavy burden of high-dependency ratio of the aged. What will be the implications of this on the other aspects of economic and social development? What will be the result of the continuance of voluntary family planning program which has been pursued in the past? The natural rate of growth will not decline drastically, and the dependency burden of the old-age will not rise so drastically. Another relevant issue is, what is the impact of socioeconomic change

on family size or on fertility? This is the question which has not received sufficient attention in the past.

(8) A crucial question concerns the link between economic development and human resource development policies. The two are interrelated. Economic development requires appropriate human resource policies to complement it. At the same time, economic development changes the pattern and the pace of the labor force utilization. Once the economic goals are set, planners must design human resource policies to complement them. At the same time, however, planners must also try to influence the direction of economic change in order to result in greater development and fuller utilization of human resources. Planners must integrate human resource development goals into the overall economic planning. Two other areas of concern in this respect are:

- The methodological question of how to integrate the issue of human resource into economic development planning and
- The need to develop the data base on the different aspects of employment and human resources for planners.

6. Tables

Table 1: Enumerated and projected population rate in Thailand for 1911-2000

Date of census	Population	Intercensal increase	Intercensal interval (years)	Average annual intercensal growth-rate (percentage)
	Enumerated			
1 April 1911[1]	8,266,408	-	-	-
1 April 1919[1]	9,207,355	940,947	8.0	1.36
15 July 1929[1]	11,506,207	2,298,852	10.3	2.19
23 May 1937[1]	14,464,105	2,957,898	7.8	2.96
23 May 1947[1]	17,442,689	2,978,584	10.0	1.89
25 April 1960[1]	26,257,916	8,815,227	12.9	3.22
1 April 1970[1]	34,397,374	8,139,458	9.9	2.76
1 April 1980[1]	44,824,540	10,427,166	10.0	3.02
	Projected			
1 July 1985[2]	51,301,000	6,476,460	5.0	1.99
11 July 1990[2]	55,345,000	4,044,000	5.0	1.52
1 July 1995[2]	59,580,000	4,235,000	5.0	1.47
1 July 2000[2]	63,772,000	4,192,000	5.0	1.36

Source [1] Government of Thailand, Statistical Yearbook of Thailand, 1983, 1939, 1945, 1955; ibid., 1960 Thailand Population Census, Whole Kingdom (Bangkok, Central Statistical Office, 1962); ibid., 1970 Population and Housing Census, Whole Kingdom (Bangkok, National Statistical Office, 1973); 1980 Population and Housing Census, Whole Kingdom (Bangkok, National Statistical Office, 1982)

[2] Working Group on Population Projection, Sub-Committee on Population Policy and Planning, NESDB

Table 2: Average number of children ever born to ever-married women by age-group and average number of children expected from several sources, Thailand, 1969-70, 1972-73, 1975, 1974-76, 1978 and 1981

Age-Group	LS 1[1] 1969/70	LS 2[1] 1972/73	SOFT[1] 1975	SPC[2] 1974/76	CPS 1[3] 1978	CPS 2 1981
	Number of Children Ever Born					
15-19	0.7	0.8	0.7	0.6	0.7	0.7
20-24	1.5	1.4	1.5	1.3	1.4	1.4
25-19	2.8	2.8	2.6	2.5	2.4	2.1
30-34	4.0	4.1	3.9	3.8	3.4	3.1
35-39	5.8	5.2	4.9	5.9	4.6	4.2
40-44	6.5	6.9	6.1	5.8	5.7	5.3
45-49	6.9	6.9	6.7	6.4	6.5	6.1
15-49	4.5	4.4	3.9	3.5	3.7	3.3
15-49*	4.1	4.1	3.9	3.7	3.6	3.3
Av. Number of Children Expected**	-	-	-	-	3.8	3.5

Source: Peerasit Kamnuansilpa and Aphichat Chamratrithirong, "A New Decade of Fertility and Family Planning in Thailand", 1981

Remarks: * Standardized directly for age, using the distribution of ever-married women from the 1970 census as a standard.

** Number of children expected is equal to the number of living children plus the number of additional children wanted.

1. Knodel, John and Nibhon Dehavalya, 1978. Thailand's Reproductive Revolution. International Family Planning Perspectives and Digest 4:34-39.

2. National Statistical Office, 1978, Report of the Survey of Population Change, 1974-1976. Bangkok.

3. These figures were recalculated from CPS1 raw data.

Table 3: Number of migrants by region of previous residence and region of present residence, 1955-1960, 1965-1970 and 1975-1980

Region of residence	Region of previous residence					Total
	Northern	Central	Bangkok-Thon Buri	Northeast	Southern	
			1955 - 1960			
Northern	-	30,270	8,900	26,002	847	66,019
Central	15,560	-	40,006	25,860	5,023	86,449
Bangkok-Thon Buri	13,947	81,214	-	26,745	9,464	131,370
Northeast	4,896	10,758	8,890	-	1,252	25,796
Southern	1,482	10,850	6,529	6,998	-	25,859
Total	35,885	133,092	64,325	85,605	16,586	335,493
			Net gain and loss			
Northern	-	+14,710	-5,047	+21,106	-635	+30,134
Central	-14,710	-	-43,341	+15,102	-5,827	-48,776
Bangkok-Thon Buri	+5,047	+43,341	-	+17,855	+2,935	+69,178
Northeast	-21,106	-15,102	-17,855	-	-5,746	-59,809
Southern	+635	+5,827	-2,935	+5,746	-	+9,273
Total	-30,134	+48,776	-69,178	+59,809	-9,273	-
			1965 - 1970			
Northern	-	58,035	14,646	43,920	3,430	120,031
Central	47,231	-	82,823	62,936	14,988	207,978
Bangkok-Thon Buri	36,555	166,181	-	66,813	29,242	298,791
Northeast	26,130	45,646	23,592	-	4,814	100,182
Southern	3,775	18,486	8,867	11,519	-	42,647
Total	113,691	288,348	129,928	185,188	52,474	769,629
			Net gain and loss			
Northern	-	+10,804	-21,909	+17,790	-345	+6,340
Central	-10,804	-	-83,358	+17,290	-3,498	-80,370
Bangkok-Thon Buri	+21,909	+83,358	-	+43,221	+20,375	+168,863
Northeast	-17,790	-17,290	-43,221	-	-6,705	-85,006
Southern	+345	+3,498	-20,375	+6,705	-	-9,827
Total	-6,340	+80,370	-168,863	+85,006	+9,827	-

Table 3: (Continued)

Region of residence	Region of previous residence					Total
	Northern	Central	Bangkok-Thon Buri	Northeast	Southern	
			1975 - 1980			
Northern	-	43,357	24,373	45,630	4,123	117,483
Central	58,578	-	123,670	103,727	21,211	307,186
Bangkok-Thon Buri	47,895	161,246	-	131,819	36,978	377,938
Northeast	20,164	37,497	23,729	-	4,959	86,349
Southern	7,878	22,086	15,546	13,731	-	59,241
Total	134,515	246,186	187,318	294,907	67,271	948,197
			Net gain and loss			
Northern	-	-15,221	-23,522	+25,466	-3,755	-17,032
Central	+15,221	-	-37,576	+66,230	-875	+43,000
Bangkok-Thon Buri	+23,522	+37,576	-	+108,090	+21,432	+190,620
Northeast	-25,466	-66,230	-108,090	-	-8,772	-208,558
Southern	+3,755	+875	-21,432	+8,772	-	-8,030
Total	+17,032	-43,000	-190,620	+208,558	+8,030	-

Source: Population and Manpower Planning Division, NESDB

Table 4: Percentage of Population Classified by Age-Group, 1960, 1970, 1980, 1986, 1991, 2000

Age - Groups	1960	1970	1980	1986	1991	2000
0 - 4	17.7	16.6	13.8	11.9	10.0	9.6
5 - 9	15.4	15.4	13.1	12.2	10.9	9.2
10 - 14	12.8	13.4	13.3	11.7	11.2	8.6
15 - 19	9.8	10.8	11.4	11.7	10.9	9.6
20 - 24	7.9	7.8	9.6	10.2	10.7	9.7
25 - 29	7.1	6.4	8.2	8.7	9.6	9.2
30 - 34	6.4	6.1	6.9	7.4	8.0	9.3
35 - 39	5.3	5.5	5.2	6.3	6.7	7.9
40 - 44	4.1	4.4	4.1	4.9	5.7	6.6
45 - 49	3.4	3.5	3.7	3.7	4.4	5.5
50 - 54	3.0	2.9	3.1	3.1	3.3	4.5
55 - 59	2.6	2.3	2.5	2.7	2.7	3.3
60 - 64	1.9	1.7	1.9	2.1	2.2	2.4
65 - 69	1.1	1.5	1.4	1.5	1.6	1.9
70^{+}	1.5	1.7	1.8	1.9	2.1	2.7
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Working Group on Population Forecasting,
Sub-Committee on Population Policy and Programs

Table 5: Regional Distribution of Population and Density

Region	Regional Distribution %			Population Density Persons per Square Km.	
	1960	1970	1980	1970	1980
Central	32.2	30.8	32.2	102.5	95
Northeast	35.0	35.0	35.0	70.6	93
North	20.2	21.8	20.2	44.0	80
South	12.6	12.4	12.6	60.9	53

Sources: Population Census 1960, 1970, 1980

Table 6: Urban and Rural Growth-Rate

Region	Average Annual Growth-Rates			
	1960-1970		1970-1980	
	Rural	Urban	Rural	Urban
Bangkok	-	3.7	-	4.3
North	2.8	1.8	1.6	4.2
Northeast	2.9	3.6	2.5	3.3
Central	2.1	3.5	1.5	5.7
Central, excl. Bangkok	2.0	2.4	2.4	2.8
South	2.6	3.2	2.5	4.3
Whole Kingdom	2.6	3.4	2.1	5.3

Source: United Nations, "Migration, Urbanization and Development in Thailand", Country Report, 1982

Table 7: Economically-active population of Thailand, the crude activity rates and labor force participation rate by sex, 1937, 1947, 1954, 1960, 1970 and 1980

Sources of data	Total population	Population aged 11 or 15 years and over	Economically-active population	Crude activity rate	Labor force participation rate
1937 Census[a/]					
Both sexes	14,464,105	9,640,851	6,823,556	47.2	70.8
Males	7,313,584	4,877,002	3,598,247	49.2	73.8
Females	7,150,521	4,763,849	3,225,309	45.1	67.7
1947 Census[b/]					
Both sexes	17,442,689	11,860,968	8,992,098	51.6	75.8
Males	8,722,155	5,910,495	4,682,293	53.7	79.2
Females	8,720,534	5,950,473	4,309,805	49.4	72.4
1954 Survey[b/]					
Both sexes	20,095,139	11,937,028	10,249,085	51.0	85.9
Males	10,021,805	5,852,734	5,243,188	52.3	89.6
Females	10,073,334	6,084,294	5,005,897	49.7	82.3
1960 Census[a/]					
Both sexes	26,257,860	17,311,096	13,836,984	52.7	79.9
Males	13,154,121	8,641,766	7,144,796	54.3	82.7
Females	13,103,739	8,669,330	6,692,188	51.1	77.2
1970 Census[a/]					
Both sexes	34,397,734	22,461,602	16,850,136	49.0	75.0
Males	17,123,862	11,080,013	8,910,760	52.0	80.4
Females	17,273,512	11,381,589	7,939,376	46.0	69.8
1980 Census[a/]					
Both sexes	44,824,540	32,357,502	21,790,924	48.6	68.9
Males	22,328,607	15,961,538	11,814,637	52.9	75.8
Females	22,495,933	16,395,964	9,976,287	44.3	62.1

Sources: Population censuses for 1937, 1947, 1960, 1970 and 1980
Government of Thailand, Demographic and Economic Survey 1954 (Bangkok, National Economic and Social Development Board, 1955)

Note: a/ Age 11 years and over

b/ Age 15 years and over

Table 8: Economically-active population and participation rates by age and sex, 1960 and 1970

Age-group	Economically-active (in thousands)					Participation rate (percentage)		
	1960	1970	1980	Increment 1960-1970	Increment 1970-1980	1960	1970	1980
Both sexes	13,837.0	16,850.2	21,790.9	3,013.2	4,940.7	79.9	75.0	68.9
- 15	1,079.5	1,688.3	1,349.9	608.8	-338.4	48.2	47.3	30.5
15 - 19	2,017.1	2,874.3	3,425.8	857.2	551.5	80.7	77.3	65.0
20 - 24	2,112.4	2,253.7	3,487.1	141.3	1,233.4	87.4	84.0	78.7
25 - 29	1,873.2	1,944.6	2,938.3	71.4	993.7	90.4	86.8	83.9
30 - 49	4,822.4	5,958.3	7,678.7	1,135.9	1,720.4	92.1	88.0	84.4
50 - 59	1,282.2	1,414.9	1,996.1	132.7	581.2	87.7	80.8	76.1
60 +	618.6	710.8	915.0	92.2	204.2	51.2	42.3	37.4
Unknown	31.6	5.3		-26.3		68.6	12.2	52.9
Males	7,144.8	8,910.8	11,814.6	1,766.0	2,903.8	82.7	80.4	75.8
- 15	486.3	790.8	648.8	304.5	-142.0	42.9	43.7	28.8
15 - 19	970.5	1,418.8	1,738.9	448.3	320.1	76.9	77.4	66.2
20 - 24	1,069.2	1,178.3	1,876.6	109.1	698.3	88.2	89.2	85.8
25 - 29	984.1	1,047.1	1,620.8	63.6	573.1	96.0	95.4	94.6
30 - 49	2,575.4	3,252.7	4,240.2	677.3	987.5	97.6	96.4	94.6
50 - 59	683.7	788.3	1,133.5	104.6	345.2	94.5	91.6	88.0
60 +	357.2	431.3	555.8	74.1	124.5	64.4	56.4	49.8
Unknown	18.5	2.9	-1	-15.6		72.1	13.4	
Females	6,692.2	7,939.4	9,976.3	1,247.2	2,036.9	77.2	69.8	62.1
- 15	593.2	897.5	701.1	304.3	-196.4	51.1	50.9	32.2
15 - 19	1,046.6	1,455.5	1,686.9	408.9	231.4	84.7	77.2	63.8
20 - 24	1,043.2	1,075.4	1,610.4	32.2	535.0	86.6	79.0	71.8
25 - 29	889.1	896.9	1,317.4	7.8	420.5	85.0	78.4	73.6
30 - 49	2,247.0	2,705.6	3,438.6	458.6	733.0	86.5	79.6	74.5
50 - 59	598.5	626.6	862.6	28.1	236.0	80.9	70.3	64.6
60 +	261.4	279.5	359.3	18.1	79.8	40.0	30.5	27.0
Unknown	13.1	2.4		-10.7		64.2	11.0	

Sources: Government of Thailand, 1960 Population Census, Whole Kingdom (Bangkok, Central Statistical Office, 1962, 1970 and 1980); Population and Housing Census, Whole Kingdom (Bangkok, National Statistical Office, 1973 and 1983)

Table 9: Employment* in Thailand: 1960, 1970 and 1980

	1960	1970	1980
Total	13,836,984	16,850,136	23,281,442
Agriculture	81.9	78.4	72.3
Non-agriculture	18.1	21.6	27.7
Male	7,144,796	8,910,760	12,041,317
Agriculture	78.0	74.6	69.4
Non-agriculture	22.0	25.4	30.6
Female	6,692,188	7,939,376	11,240,125
Agriculture	86.0	82.8	75.4
Non-agriculture	14.0	17.2	24.6

* 11 years and over

Source: National Statistical Office, Thailand Population and Housing Census (Whole Kingdom); 1960, 1970 and 1980

Table 10: Number of Employed Persons in the Whole Kingdom, Municipal Areas, and Non-Municipal Areas, Classified by Season; 1971-1981

(Unit: 1000 persons)

Year	Whole Kingdom		Municipal Area		Non-Municipal Area	
	Dry season	Rainy season	Dry season	Rainy season	Dry season	Rainy season
1971	16,590	16,619	1,752	1,779	14,838	14,840
1972	15,986	16,129	1,926	1,930	14,060	14,199
1973	16,466	17,043	2,021	2,026	14,445	15,017
1974	13,644	17,159	2,009	2,047	11,635	15,112
1975	14,171	18,182	2,029	2,056	12,142	16,125
1976	13,815	18,411	2,083	2,144	11,732	16,227
1977	15,905	20,218	2,477	2,591	13,428	17,627
1978	16,626	21,669	2,633	2,801	13,993	18,868
1979	16,788	21,180	2,799	2,869	13,989	18,311
1980	n.a.	22,463	n.a.	3,098	n.a.	19,365
1981	17,348	24,366	2,881	3,096	14,446	21,270
1982	18,347	24,681	3,078	3,162	15,269	21,519

n.a. = not available

Sources: National Statistical Office, Report of the Labor Force Survey: Whole Kingdom (Round 1) January-March, and (Round 2) July-September, 1971-1982

Table 11: The number and the percentage of the labor force in 1971 and 1982

Theme	1971		1982	
	Number in thousand	% of total L.F.	Number in thousand	% of total L.F.
Area				
Municipal	1,795.2	10.8	3,398.1	13.2
Non-municipal	14,858.7	89.2	22,347.7	86.8
Region				
Bangkok Metropolis	1,242.5	7.5	2,614.3	10.2
Central (excluding BKK)	3,310.1	19.9	5,132.3	19.9
Northern	3,971.5	23.8	5,689.9	22.1
Northeastern	6,187.9	37.2	9,284.1	36.1
Southern	1,939.0	11.6	3,028.7	11.7
Sex				
Male	8,960.2	53.8	13,498.2	52.4
Female	7,693.7	46.2	12,247.6	47.6
Education				
None	2,397.5	14.4	1,962.7	7.6
Elementary and less	13,430.3	80.6	21,020.4	81.6
Secondary and High School	564.1	3.4	1,354.3	5.3
Vocational and Technical	85.1	0.5	573.2	2.2
Teacher Training	64.2	0.4	523.3	2.0
University Graduate	105.8	0.6	233.6	1.0
Others	5.9	0.1	78.3	0.3

Source: Computed from Report of the Labor Force Survey: Whole Kingdom (Round 2), National Statistical Office 1971-1982

Table 12: The Unemployment Rates by Level of Education and Sex in 1981

Level of Education	Municipal Area		Non-Municipal Area	
	Male	Female	Male	Female
Total	3.0	3.0	0.6	0.4
Non-education	0.8	0.8	0.0	0.1
Less than Pratom 4	2.6	1.7	0.5	0.3
Lower Elementary	2.3	1.7	0.4	0.2
Upper Elementary	4.7	3.8	1.0	3.0
Lower Secondary	3.1	4.2	2.7	3.8
Upper Secondary	2.9	4.7	8.5	4.9
Vocational	4.9	7.6	9.3	11.5
Technical Vocational	4.9	9.4	1.8	19.8
Academic University	5.0	6.9	7.7	19.9
Teacher Training	2.7	2.9	1.3	2.6
Short-course Vocational and Others	0.0	2.8	0.0	0.0

Source: National Statistical Office, Report of the Labor Force Survey: Whole Kingdom (Round 2), July - September, 1981 Table 4

Table 13: Trends of Unemployed Persons by Level of Education in 1971-1981

(Unit: Person)

Year	Secondary	Vocational	Technical	Teacher Training	University
1971	12,500	6,840	1,460	490	1,200
1972	23,590	8,340	770	650	1,880
1973	15,170	11,980	5,050	5,160	3,410
1974	20,790	10,780	2,100	4,830	2,210
1975	22,330	10,560	1,220	13,540	1,910
1976	29,430	8,830	1,740	12,590	2,650
1977	37,700	14,900	2,600	13,300	6,200
1978	41,300	15,700	2,800	16,100	6,900
1979	44,600	23,600	3,800	15,800	5,900
1980	41,100	23,800	4,300	12,500	6,900
1981	42,000	28,400	5,800	8,800	15,200

Notes: The number includes family members who work in the economic activities of household 1-19 hour per week and desire to work more.

Source: The National Statistical Office, Report of the Labor Force Survey, Whole Kingdom. Round 2, 1971-1981

Table 14: Average Proportions of Underemployment Over the Period of 1977-1982, Classified by Aspect of Underemployment

	Aspect of Underemployment		
	Hours Worked	Income	Mismatch
Total (%)	100.0	100.0	100.0
Area			
Municipal	9.97	12.74	69.10
Non-municipal	90.03	87.26	30.90
Region			
Bangkok	6.58	11.79	60.47
Central	19.13	14.74	18.79
North	11.55	21.40	8.06
Northeast	35.39	44.01	4.23
South	22.35	8.06	8.45
Sex			
Male	53.05	49.64	74.77
Female	46.95	50.36	25.23
Age			
11 - 19 years	15.80	27.62	0.46
20 - 29 years	24.96	27.98	67.82
30 - 59 years	53.66	40.96	31.26
60 + years	5.58	4.49	0.46
Education			
Non-Elementary	95.44	96.36	-
Secondary	3.06	2.73	-
Vocational + Tech.	0.49	0.47	46.0
Teacher Training	0.73	0.14	3.5
University	0.07	0.08	49.3
Unknown	0.21	0.22	0.2
Industry			
Agriculture	72.55	77.96	1.67
Commerce	7.72	7.15	27.07
Manufacturing	7.86	7.63	20.67
Others	11.87	7.26	50.59

Source: Calculated from Report of the Labor Force Survey, Whole Kingdom (Round 2), July - September, 1971-1982

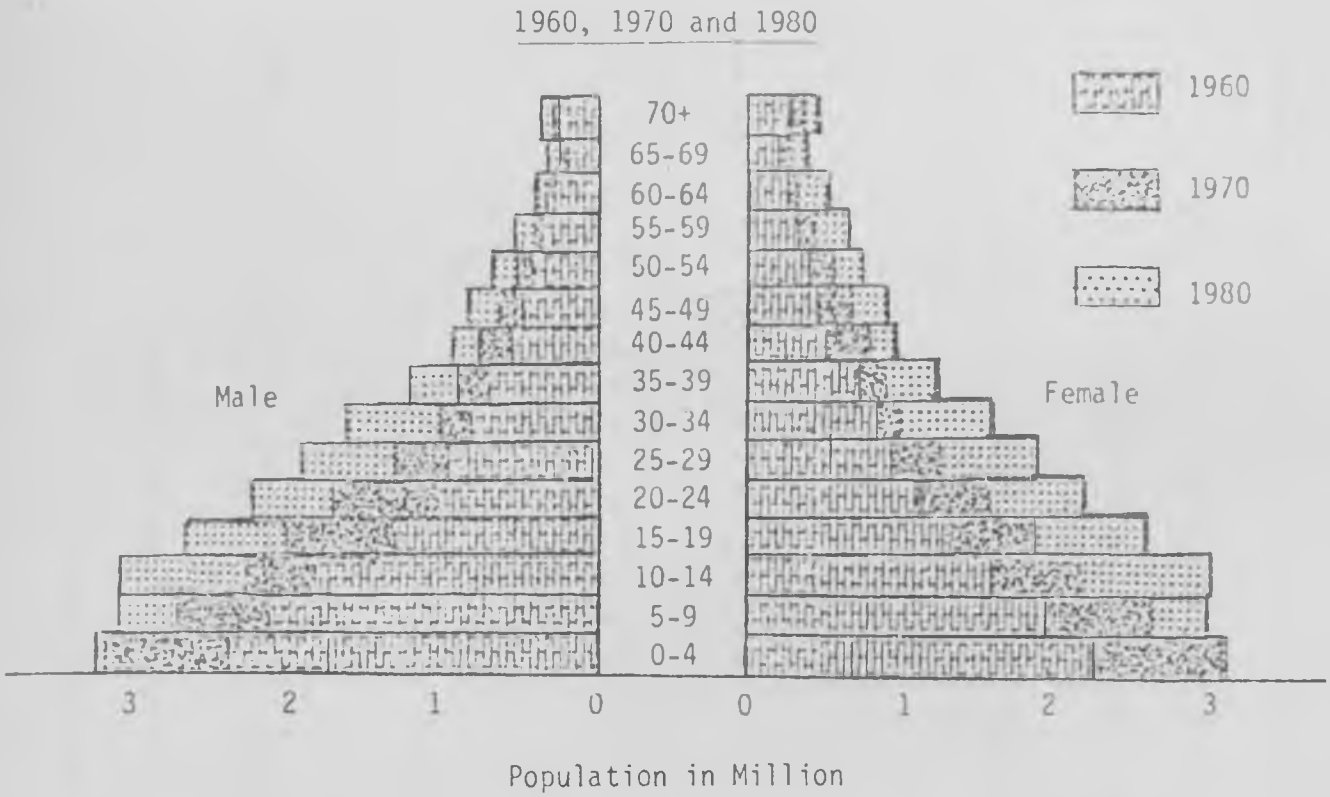
Table 15: Number and Average Growth-Rates of Students in Selected Years

Level of Education	Number (thousand persons)				Average Growth-Rates (%)	
	1972	1976	1977	1981	1972-76	1977-81
1. Pre-primary	153.7	227.3	301.5	481.5	15.9	12.3
2. Primary	6,146.4	6,810.7	7,052.9	7,308.4	2.6	0.9
3. Secondary						
3.1 Junior	598.9	899.3	929.0	1,098.4	10.7	4.3
3.2 High School	274.0	145.6	440.8	908.5	-17.0	19.9
Academic	69.4	154.9	189.9	466.2	22.0	25.0
Vocational	107.4	169.3	197.0	417.2	12.0	22.0
Teacher	80.6	72.6	33.4	4.9	-2.6	-
Nurse	3.7	4.9	3.8	2.0	7.8	-17.0
Others	12.9	13.9	16.6	18.1	1.8	2.3
4. Technical and University	172.3	285.8	293.1	848.0	13.5	30.0
4.1 Vocat. Tech.	15.6	24.8	32.6	68.3	12.4	20.0
4.2 Teacher	27.2	54.3	35.1	46.2	18.8	7.0
4.3 Nurse	1.9	3.7	5.5	8.2	17.7	10.6
4.4 Others	2.7	3.7	4.6	6.2	7.9	7.7
4.5 Bachelor	75.9	88.0	89.5	135.2	3.8	10.8
4.6 Open University	43.6	103.2	117.4	571.7	27.0	49.0
4.7 Master & Higher	5.3	8.1	8.3	12.2	10.9	10.0
Total	7,345.1	8,418.7	9,017.3	10,644.8	3.5	4.3

Source: Division of Education Planning, Commission of National Education, Education Sector Survey, September 1983, p. 6

Table 16: Reduction of Population Growth and Distribution of Economic and Social Services

Activities		
1. REDUCTION OF POPULATION GROWTH		
1.1 POPULATION GROWTH-RATE	2.5%	2.1%
1.2 NUMBER OF FAMILY PLANNING ACCEPTORS (NEW ACCEPTORS)	664,895 thousands	1,125,816 millions
2. DISTRIBUTION OF SOCIAL SERVICES		
2.1 NUMBER OF STUDENTS		
- PRIMARY EDUCATION	8,525,220 millions	7,828,619 millions
- SECONDARY EDUCATION	1,622,638 millions	1,990,866 millions
- HIGHER EDUCATION	136,723 thousands	246,397 thousands
2.2 DOCTOR : POPULATION RATIO	1 : 8,141.8	1 : 6,851.5
2.3 NURSE : POPULATION RATIO	1 : 3,096.3	1 : 2,422.9
2.4 HEALTH CENTRES	4,033	5,939
2.5 HEALTH VOLUNTEERS	-	23,286



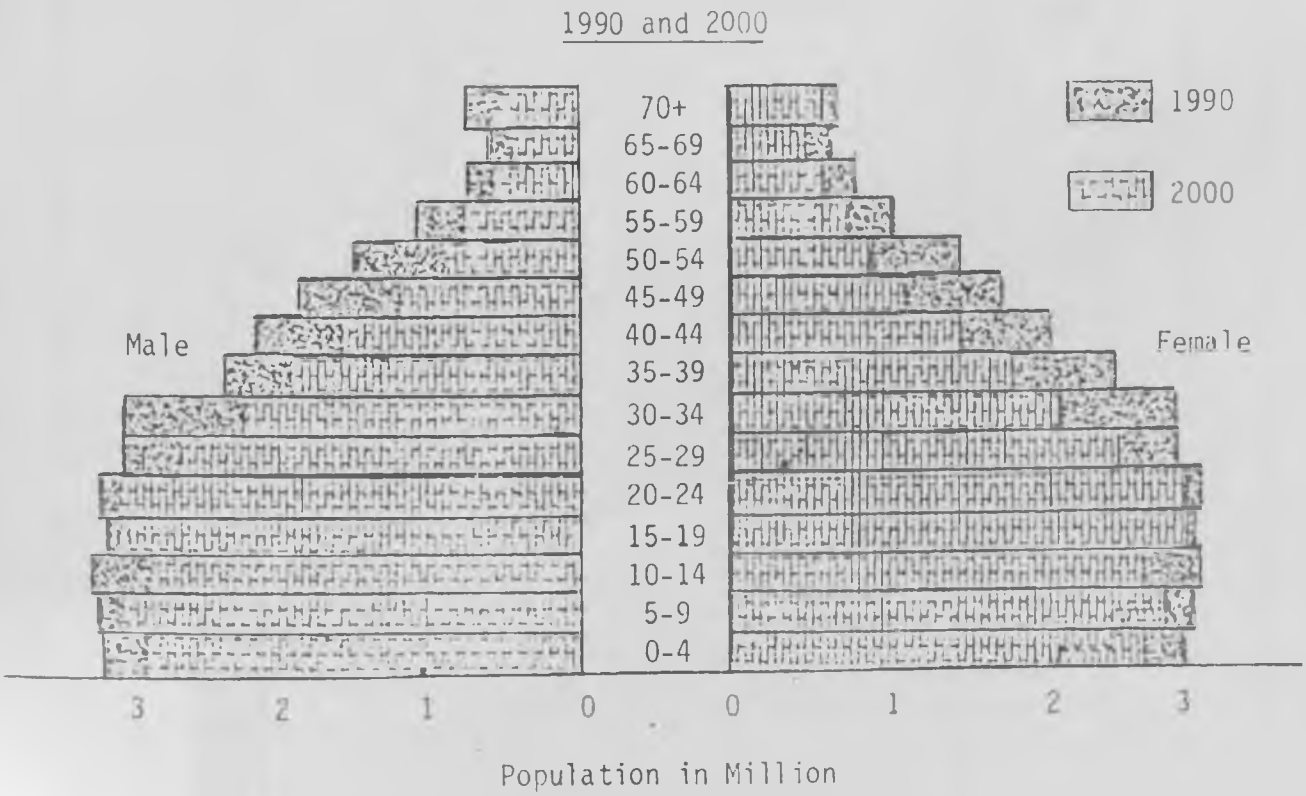


Figure 1 Thai Population Pyramid: 1960-2000

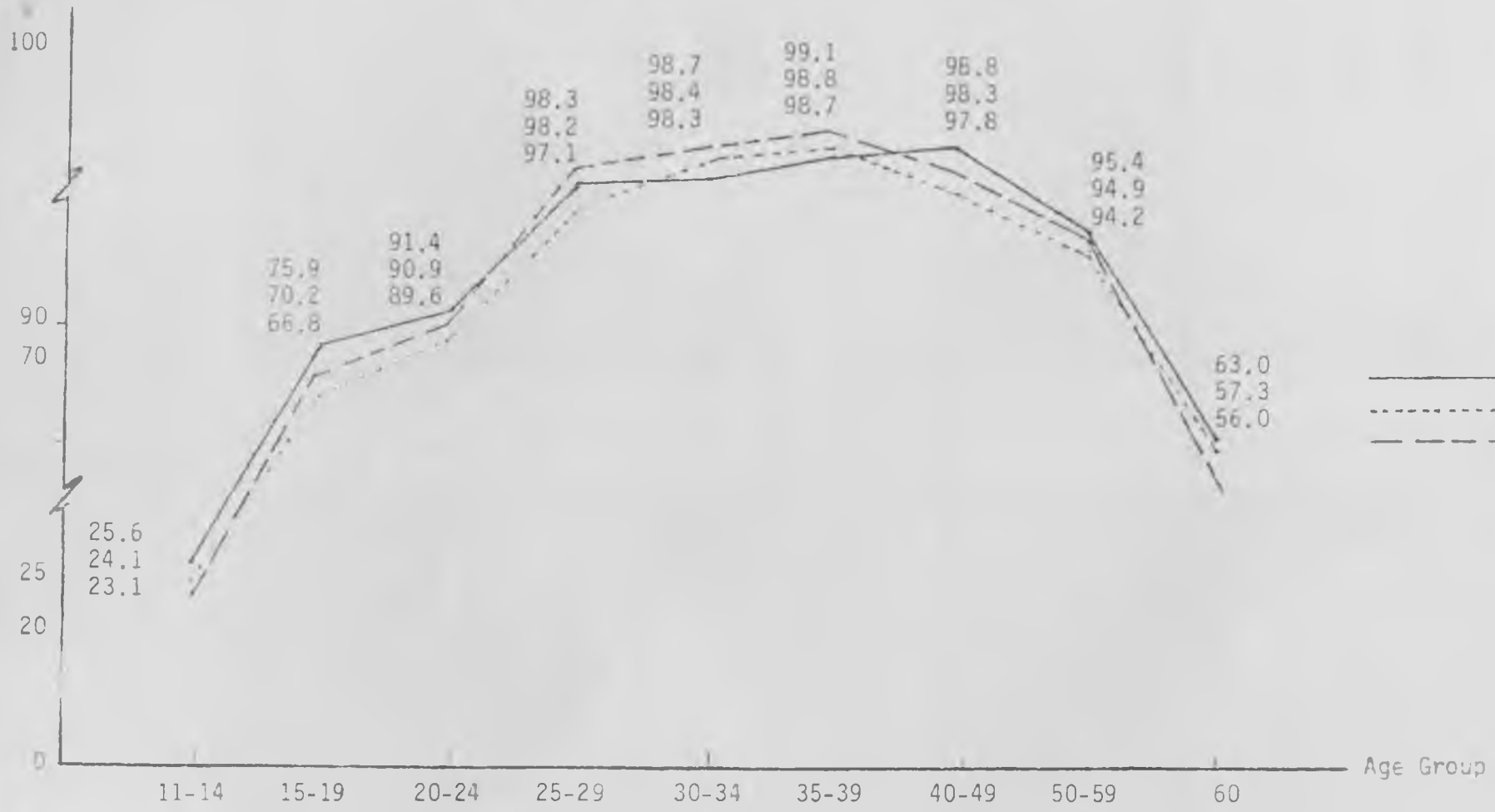


Figure 2: Labour Force Participation Rates For Male by Sex 1971, 1976 and 1981

Source: Labour Force Survey Round 2, National Statistical Office

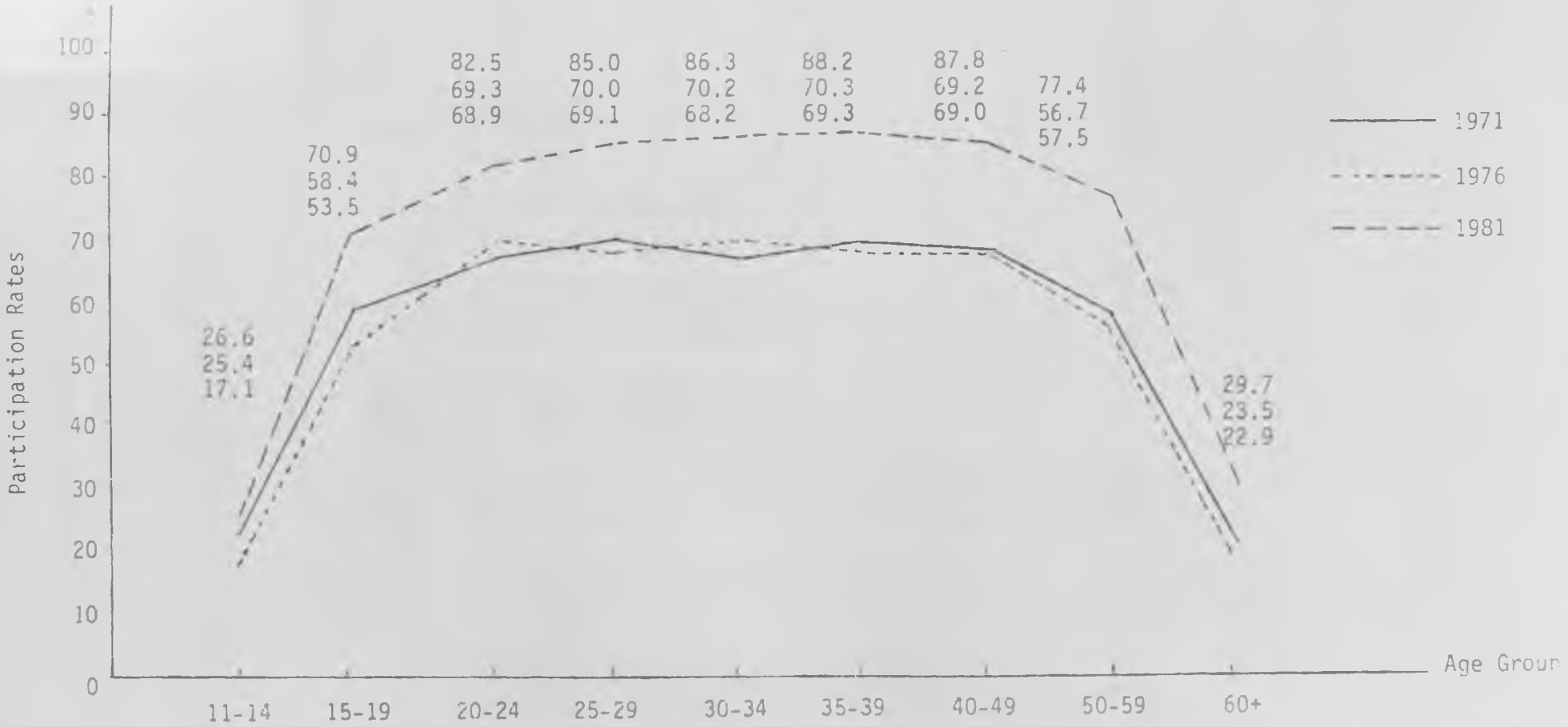


Figure 3: Labour Force Participation Rates for Female by Sex 1971, 1976 and 1981

Source: Labour Force Survey Round 2, National Statistical Office

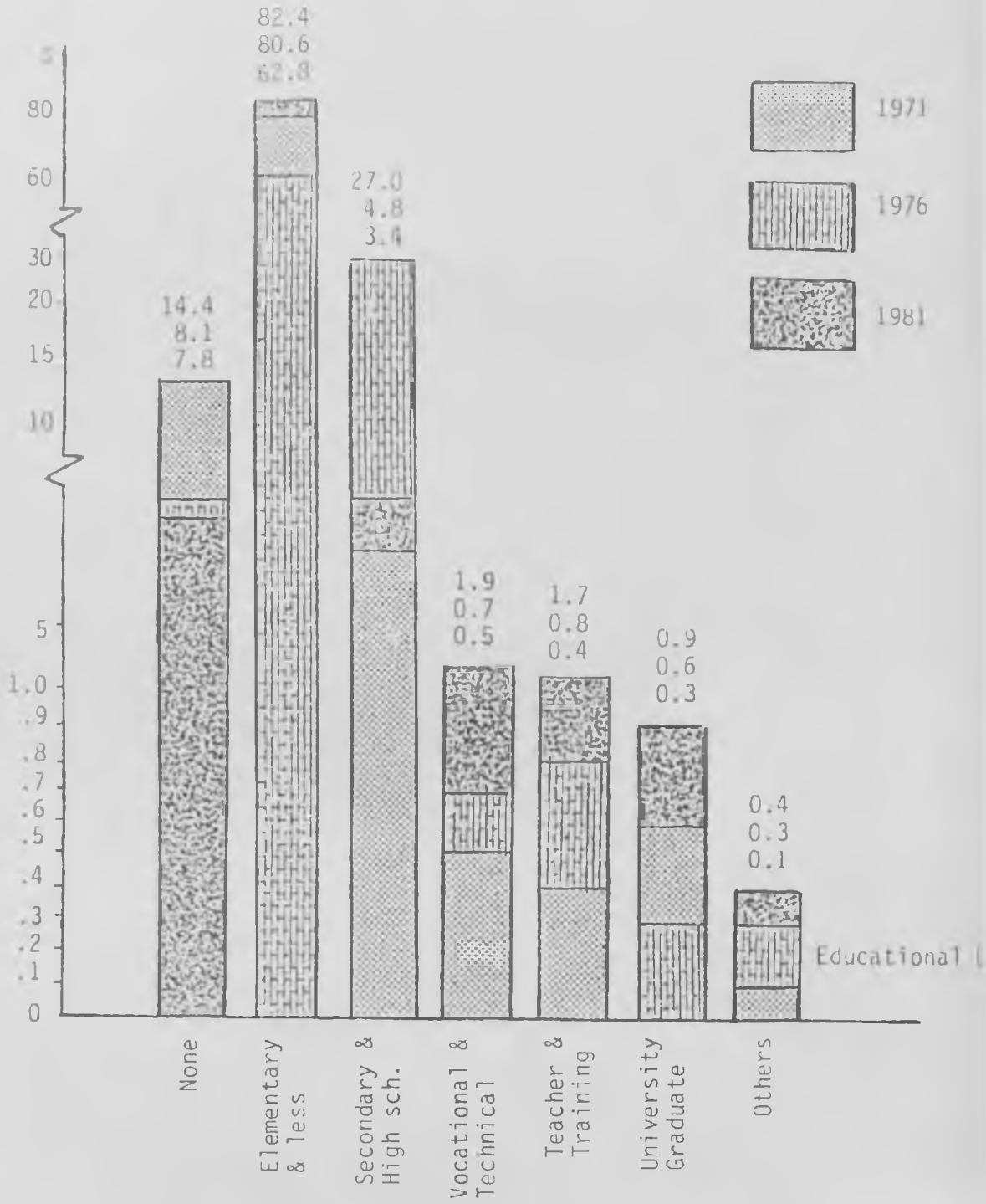


Figure 4: Educational Attainment of the Thai Labour Force in 1971, 1976 and 1981

Source: Labour Force Survey Round 2, National Statistical Office

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12 B. Leoprapai and J. Rachapaetayakom, "Economic Activity of the Population" in Population of Thailand, Country Monograph Series No. 3, United Nations, 1976.

13 See United Nations, Interrelation Between Population and Manpower Problems, Asian Population Studies Series No. 7, Bangkok, 1971.

14 J. Rachapaetayakom, "Demographic and Labor-Force Growth in Thailand" Unpublished M.A. thesis, Brown University, 1974.

15 K. Panpiemras and S. Pitayanon "Institutional and Policy Measures for Effective Manpower and Employment Planning in Thailand", March 1984.

16 Psacharopoulos, G.," Returns to Education: An International Comparison," Jossey-Bass Inc., Publishers, Washington, 1973.

III ISSUES OF DISCUSSION

1. Age-structure of the population and its impact on national development

Comment 1: The age-structure of a population will affect the economic policy of the country. For instance, in a country with a lot of old-age pensioners, the focus will be on how to maximize pensions or, in the case where the majority of the population are potential workers, then the focus will have to shift to employment strategies.

Comment 2: TDRI should consider research on the impact of the demographic structure on national development and, on the social structure.

2. Changes and socioeconomic implications

Comment 1: Previously, the approach to social development of the human resource was to look at various issues at the micro-level such as problems on women, children, homosexuals etc. This approach is now changed somewhat. It is now being suggested that when considering social development, it is important to trace back to the origins of the problems. It is recognized that these problems arise because of the changing environment, socially and economically. The changes in the socioeconomic environment are the bases from which various social problems spring. Therefore, one must look at the social problems in the light of, and in relation to, changes in the environment surrounding the society itself.

Comment 2: Population (Demography), human resource, and society are all interrelated. TDRI, in its approach to policy research in this area, should understand the relationship of these three factors. One must be aware of the interactions of the various changes among these factors such as, the repercussions

of demographic structure on the national development plan, repercussions of changes in social structure on social problems, etc. For example, if our society is going to be industrialized, what will be the repercussions and implications? Will we be able to solve the accompanying social and economic problems?

Comment 3: Strategies in solving social problems cannot be planned without the participation of the various institutions and organizations: the government, the society and the family. The society and the family play important roles in supporting the government in social development. The government should not just provide services but should only intervene when certain social organizations cannot function properly. For instance, should the government invest in preschool children? It would be advisable to be more practical and realistic. The government does not have to intervene all the time.

It was suggested that the role of each organization be carefully observed. If the government did not have too strict a control over the schools, they would probably be able to look after themselves and develop along the proper way.

Comment 4: On reinforcing the social issue, there is the question on how social-aid planning can be effectively undertaken. Should it be a process where the people's preference is considered an important parameter in designing and implementing the plan? There is a voiced contention that, if the government consults the people beforehand on matters that concern them such as their needs, then there would be no reason for complaints and grievances later on once the plans have been implemented. Besides, how could one undertake a national social planning without properly distributing the power and authority to the local level?

Comment 5: Populationists will have a bigger role to play in the national economic development, because of the pivotting characteristic of population/human resource in an economy. It needs to be stressed that, this field of study would require quantitative and qualitative research at both the macro and the micro-levels.

Comment 6: TDRI could include studies on social attitudes in relation to macroeconomics and the various aspects of development.

3. Labor and employment

Comment 1: The quality of labor in the country is, at present, questionable. There is much to think about appropriate educational background and skills. Universities have conducted a number of researches in this field, and it seems that these results should be used to plan for appropriately qualified labor that will respond to the needs of the economy and the society.

Comment 2: The program on Human Resource at TDRI should conduct a study on the quality of unemployed graduates as a guide in planning for employment.

Comment 3: TDRI may consider an analytical study of the role of the informal sector in employment and income-generation.

Comment 4: Research in the Human Resource program should include a study of the impact of foreign investment on employment and income-distribution during the past 2 decades.

Comment 5: The impact of utilizing agricultural machinery on the decreasing use of human and animal labor must be a part of the research program.

Comment 6: The significance of child-labor problem cannot be relegated. At present, accurate figures concerning child-labor do not exist with particular reference to child-labor under age 13 which is prohibited by law. This situation has to change.

4. The lack of data and statistics to make appropriate decision

Comment: Data and statistics for planning are vital. TDRI should help the government in providing the necessary information and background to help with planning and decision-making.

5. Policies, integration and implementation

Comment 1: TDRI should look at the importance of consolidating various research results into realistic policy recommendations. That is, to have the policy makers realize and understand the total picture of the various interrelations of activities before making policy decisions. Once the policy is out, then effort must be made to ensure the implementation to have activities carried out as planned. This will certainly lead to an improved utilization of manpower in the country as a whole.

Comment 2: There is a need to coordinate manpower development with educational and economic development. This need was taken seriously when the Education Council was established, and a plan for education based on a population forecast came out as a result. However, the plan was never implemented. It is critical to look for a mechanism to ensure the implementation of the plan and to monitor its progress. Otherwise, the resources that have been put into the preparation of the plan would be wasted, and the expected outcome will not be made available to fit in with the economic plan.

What happened was, an immediate problem of budget allocation at that time. Many educational institutes required financial support and the fund was pressured to be diverted towards these unplanned institutes. The result was, a growth in the number of people with unsuitable educational background and skill that was not responsive to the demands of the economy. The problem with not having plans implemented had been generally the result of lack of correlated planning. TDRI should undertake research to identify ways and means of solving past problems.

Comment 3: TDRI may consider undertaking detailed studies on the human resource and the educational plan for better integration and implementation.

Comment 4: There is a perceived recognition that the problem of inadequate personnel and educational planning and inappropriate economic planning should be overcome by involving more people to take more interest in undertaking research and studies to solve past problems and arrive at future solutions. To realize a well-coordinated plan, positive concepts must be imbued on the future leaders and politicians with a budget, properly allocated.

Comment 5: Research in this program should aim at clearly focussing on realistic policy formulation; developing the ability to provide adequate forecasts for improvement measures; developing an effective evaluation to determine the practicality of the implemented plan and, to assess proper organization.

"Development Research and National Development"

Position Paper No. 6

URBAN, ENERGY DEVELOPMENT AND INFRASTRUCTURE REQUIREMENTS

By

Phisit Pakkasem
Savit Bhotiwihok
Piyasvasti Amranand
Praipol Koomsup
Nibhon Debavalya
Sumet Jumsai

• URBAN AND INFRASTRUCTURE REQUIREMENTS

I ABSTRACT

The good economic performance of Thailand is proven by the country's overall economic growth rate, the rate of inflation, the strength of exchange rate, the balance of payment performance and the low-interest rate financing. This standing has given Thailand the fifth rank in the category of the world's best economic performance. The two papers (urbanization and energy) identify three main issues that will challenge this good economic standing viz., the economic transformation from a traditional agricultural to semi-industrialized economy, the new era for urban/energy development policies and R & D activities and, higher demand for energy and infrastructure as a result of economic transformation and urbanization. The first paper on urbanization starts by tracing the factors contributory to the "primacy" phenomenon of the urbanization pattern experienced by Thailand, i.e., the overwhelming primacy of Bangkok. The major reason cited is Bangkok's role as an educational, industrial and commercial center that offers both educational and employment opportunities and which, induces continuous rural-to-urban migration. With the surge of the rural population to Bangkok and the metropolitan areas in order to avail of these various opportunities, severe urban problems such as traffic jam , pollution, pockets of urban slums, flooding and land subsidence surfaced and continue to plague Bangkok and the environs to be further aggravated by the lack of an alternative to the city. The second section points out that economic factors and agricultural development policies favor increasing concentration and growth of this region in a haphazard way. In answer to the serious urban problems created by this urban concentration, a major Bangkok Metropolitan Regional Study is being launched in cooperation with the World Bank to set out alternatives to the slum problem, the transport problem, and the financing schemes involved. The 3rd section is devoted to explaining why decentralizing urbanization is the answer to the primacy of Bangkok and how this decentralization scheme will be carried out in three phases, namely, the creation of polycentric Bangkok, the development of the Eastern Seaboard and the development of regional growth centers or poles. And if, in spite of these attempts to decentralize the capital city based on creating self-contained satellites and the combined pulls of the

Eastern Seaboard and the regional cities, the primacy problem still persists and the Bangkok population continues an upward trend, the paper proposes another set of alternatives discussed in the 4th section consisting of the polder development, slum conversion and mass transportation. And as a final section, the paper briefly outlines four major research issues which TDRI can fill in coping with Bangkok metropolitan and urban problems.

II THE PAPER: URBAN AND INFRASTRUCTURE REQUIREMENTS

1. Introduction

Thailand ranks 5th in the category of the world's best economic performances of more than 85 developed and developing countries. This ranking was based on the country's overall economic growth-rate, rate of inflation, strength of exchange-rate and balance of payments performance. This is further complemented by an international financing at a very low-interest rate which demonstrates Thailand's topnotch credit rating. This bright economic standing of the country will, however, soon be challenged by key development issues such as:

- The economic and spatial transformation from traditional and Rural Agricultural to Semi-Industrialization as it joins the ranks of Newly-Industrialized Countries or, the NIC group.
- The demand for more energy as a result of the economic and industrial transformation and high-level of urbanization.
- The opening up of a new era for urban and energy development policies and,R & D activities as a consequent effect of the above.
- The increase and expansion of all types of infrastructural investments as a result of this economic and spatial transformation.

To support the economic and spatial transformation will definitely require a more efficient mobilization of capital, technology and management transfers from abroad.

The recent discovery and development of the natural gas in the Gulf of Thailand and oil from the onshore field at Lan Kra Bue will, not only change the resource picture of the country but will also, open up new opportunities for the creation of viable "basic industries" for Thailand. These basic industries will be supported by urban townships, infrastructures, two deep-sea ports, as well as, an industrial and a commercial complex. This development will open up an entirely new era for urban and energy development policies and research and development activities to come up with a comprehensive industrial restructuring program to make the country's industries more competitive, outward-looking and less-dependent on foreign inputs. Moreover, the industrial activities are intended to be decentralized away from the Bangkok metropolitan area to the new industrial zone at the Eastern Seaboard. This comprehensive industrial restructuring program is also reflected in the current 5th National Development Plan.

This economic and industrial transformation together with the projected increase in rate and higher level of urbanization will also "push up" the demand for energy, as well as, increase the average per-capita consumption in energy. The economic shift will have a direct bearing on the composition of the country's energy production, energy demand, external trade, employment patterns, future technology and energy requirements.

While the current substitution of imported oil by our newly-discovered gas and oil will reduce our dependence on energy - import during the rest of the 1980's, projections on energy requirement show that imported energy, both oil and possibly coal, will begin to climb again in the 1990's and this has caused some real concern to energy planners.

The New Industrial Zone or, the so-called Eastern Seaboard Development Program is part of the very comprehensive industrial restructuring program in order to disperse industrial activities away from the already-congested peripheries in Bangkok. In this program, new basic industries will be established using the newly-developed natural gas resource either for their energy supply or, for their raw materials.

The structural transformation will generate the boom of medium and large-scale industries as a result of which, employment opportunities will be opened up and will naturally attract more rural migrants. The need for social and infrastructural services will, as a consequence of all these changes, also increase energy supply requirements, e.g., the number of schools, hospitals, markets, transportation, electricity, etc., the provision of which also requires an increased demand for supply of energy. There will be a definite relationship between the two sectoral areas in energy and urban and infrastructure development under the economic transformation in the 1980's and the 1990's because infrastructure investments of all kinds will have to expand in step with this transformation.

2. Thailand's Urbanization Pattern

The urbanization pattern experienced by Thailand can be characterized as that of being moderate but very unbalanced and overwhelmingly skewed in favor of Bangkok. The urban population accounted for only 17.3% of the total 40 million in 1979 and has been consistently growing at 5% per annum during the past two decades compared to a rural growth rate of 2.5% a year and, to a total annual population growth of less than 3%. The moderate rate of urbanization in Thailand has been due to several factors such as, the good economic performance, low rural densities and the availability of new farm land in the past.

In the 1980's this urban growth is, however, expected to accelerate as a result of the diminishing supply of unoccupied agricultural land. An increase of only 20-25% of agricultural land use will be allowed after 1980's which implies that the means of absorbing population growth is likely to be used up in about a decade.

The phenomenon of the primate city, according to a well-known authority in Urban Development, Arthur Linsky, can be partly explained by the general social factors such as the country's low per-capita

income, high-dependency on export, agricultural economy and population growth. These social factors, while working interrelatedly, contribute to the manner of growth of the primate cities. The growth of Thailand's cities reflects their attractiveness to migrants from the rural areas which explains the natural increase of the population as they flock to these urban centers. Based on surveys conducted, it was shown that Bangkok is most often the frequent destination of migrants from the South, the North or, the Northeast. There are, of course, reasons cited for this migratory movement from the rural areas to the city of Bangkok. The 1970 survey on urban residents showed Bangkok as an educational center, possessing superior infrastructure and services and offering better employment opportunities.[1]

The Bangkok residents undoubtedly enjoy substantially better urban infrastructure facilities and services than those offered by other regional cities. But these infrastructural disparities have reinforced the imbalances in urbanization as a result of which, serious urban problems during the last five years namely traffic jam , pollution, pockets of urban slums, flooding and land subsidence have resulted. This is further aggravated by the lack of alternative to Bangkok to disperse activities away from the already-congested city.

The shift towards semi-industrialization seems to offer, not only an alternative to this problem but it also seems to offer a strong competition to the primate city of Bangkok with the hope that, new activities may take place and, a new pattern of urbanization may emerge following, or, close to the development taking place at the Eastern Seaboard.

3. Coping with Bangkok Metropolitan Problems

The haphazard growth of Bangkok Metropolitan has been largely influenced by economic factors and the government has also exerted a great

influence to this growth through its industrial and agricultural development policies, infrastructural investment pattern and policies, regional development policies and strategies for decentralizing urban growth, and other related national development policies. In attending to the problem of industrial concentration in Bangkok, the Board of Investment in 1972 expanded the BOI mandate to include locational objective by providing incentives to firms which coincided with designated regional urban centers.[2]

But an analysis of industries promoted in the past under these locational incentive scheme has shown that, not much success has been achieved as to effectively channel industries away from Bangkok. About 85% of the firms granted BOI incentives in 1960-1977 were located in Bangkok and the central region. Several opinions have been brought up to explain this, such as:

- The current size and structure of incentives are insufficient to compensate for the extra costs often associated with locating industries outside of Bangkok.
- The tax benefits for development zones often cannot compare with the short-term profit margins expected from operating in Bangkok.

This simple analysis indicates that, a variety of taxation instruments could be altered to introduce differentiation between Bangkok and other locations in the fiscal incentive system.

Another policy instrument used by the Government to promote industrial activities away from Bangkok is industrial finance. Two government agencies namely, the Industrial Finance Corporation of Thailand (IFCT) and the Small Industries Finance Office (SIFO) provide credit to potential industrialists. A not-so-encouraging study made by the Bank of Thailand indicated that commercial banks outside Bangkok tend to operate as deposit institutions rather than as fell-service banks and oftentimes required that permission be secured from Bangkok's

headquarters.[3] More than half of IFCT investments made during the period 1972-1976 was concentrated in the Bangkok area. SIFO's impact in terms of industrial promotion was minimal[4] and, although the geographical distribution of SIFO loans has been largely outside Bangkok, still, Bangkok's share in these investments has been increasing from 13% to 35% respectively, in 1970 and 1975. It can be deduced that, by itself, industrial incentives and finance still favor increasing concentration and more effort is necessary to redistribute economic and industrial activities away from Bangkok.

There are substantially better infrastructure services in Bangkok than in other cities. However, the efficiency of servicing these infrastructural requirements remains low. Safe water supply service in Bangkok and the nearby cities reaches only 73% of the population to the extent that, low-income households are forced to resort to secondary sources of water such as, rain water and rivers. About 84% of the population in Bangkok is served with electricity and the absence of a consistently adequate power supply is considered, both a deterrer and a serious constraint to improve urban development. Also, as reflected by the increasing traffic volume in Bangkok, the present road system will become inadequate if not properly maintained and improved. These disparities in basic infrastructural and transport facilities will provide planners a serious problem to think about.

For a fact, these imbalances have reinforced serious urban problems that currently plague Bangkok residents. In answer to these key issues, the government is launching a major Bangkok Metropolitan Regional Study in cooperation with the World Bank which will provide key inputs to the forthcoming 6th Five-Year Plan. The study aims to find answers to the following questions:

- In about five to fifteen years, what will be the magnitude and composition of the growth of the BMR in terms of population and economic activity?
- Within the BMR, where is the growth likely to occur? How

will the new growth of population be distributed? How will employment in manufacturing, commerce, and services be distributed? How will development cost vary by location within the BMR?

- Given the magnitude and distribution of growth, what sectoral investments should have priority with particular reference to transport, housing, water supply and infrastructure?
- How will it be possible to pay for the priority investments and for other urban services? How should institutions be designed to coordinate the investments and the provision of services?

The above issues have been selected as the minimum key inputs necessary to decide on the type of urban projects during the next Plan. They have also been drawn-up in consideration to the limited time and data constraints. Whatever the outcome of the above, a number of issues might well force the Government to implement certain projects, or they might partly force themselves into certain physical parameters without comprehensive implementation plans. These issues will be discussed in Section 2.4.

4. Future Urban Development Strategies

In a mixed and open economic system characterized by strong market forces, the national development plans should not be regarded as binding in the conduct of the day-to-day economic affairs. The basic development strategies in most sectors, the expansion of social overhead capitals have been fairly well-accomplished. Infrastructural investments of all types have expanded in step with production and exports.

The capacity to enforce extensive regulation over land use is limited and the government has avoided the social friction which their strict enforcement could cause.

Land utilization pattern and land development policies have not been very efficient, and any effort to strengthen land development planning will face obstacles because of the numerous bodies involved in land use planning and the Thai attitude towards land being essentially "a free good". In 1980's the land frontier will be ended because of the diminishing supply of unoccupied agricultural lands and the corresponding increase of the urbanization growth-rate. The concept to decentralize urbanization away from the primate city of Bangkok seems the most likely alternative.

This concept of decentralizing urbanization away from the primate city of Bangkok will have to come in three phases namely:

Phase I: The creation of a polycentric Bangkok and the decentralization of economic and industrial activities to the outer suburbs of Bangkok

Phase II: The development of the Eastern Seaboard

Phase III: The development of Regional Growth-Centers or Growth-Poles

Phase I: Polycentric Bangkok

The polycentric development is in line with the existing urban structure. In effect, Bangkok does not have any single center. Instead it has a series of centers or growth-poles that are scattered: However, these poles contain specialised (rather than self-contained) activities which tend to generate unnecessary traffic or cause cross-traffic. The polycentric development therefore means that the existing-growth poles should be made more self-contained. Moreover, new urban development in the greater Bangkok area should also be formulated around the concept of self-contained or balanced communities even if, certain types of activities prevail. The government's industrial and housing estates at Ladkrabang and the new town with its industrial zone at Bang Plee can be seen as an attempt towards this end.

In the short and medium-term, it is hoped that the polycentric development strategy may help alleviate the concentration of urban and industrial activities in central Bangkok, but, this hope will be more assured if the essential factors of development are also present in these areas, e.g. infrastructural and social amenities, housing, sufficient work force and of course, sufficient employment opportunities.

There are potential pitfalls of polycentric development, or rather, of developing satellites around Bangkok with the prevailing weakness of land use controls in Thailand and the difficulty of preserving low-density belt between the satellites and the core. The anticipated tendency is for satellites to leap-frog and subsequently, to join with the already existing urban periphery. A question arises as to how to strike a balance between maintaining access to the facilities and services that Bangkok can offer and at the same time, dispersing new developments as far from the core as possible.

Phase II: The Development of the Eastern Seaboard

The Eastern Seaboard Development of Thailand, otherwise called the New Industrial Zone, is the 2nd phase of the decentralization program. This development consists of an integrated seaboard development program that offers a wide and diverse range of engineering works and investment opportunities. The program aims to develop two different types of industries viz., the Map-Ta-Put Industrial Complex and the Laem Chabang Complex. The Map-Ta-Put project will involve capital and technology-intensive projects consisting of gas-related and heavy industries such as:

- gas-separation plant
- fertilizer plant
- ethylene craker unit with four downstream units producing HDPE, LDPE, VCM and PP

The Map-Ta-Put Industrial Complex will host capital-intensive and technology-intensive industries that are, in turn, anticipated to give rise to a number of supporting industries and other downstream projects. This complex will be served by an industrial deep-sea port capable of handling 100,000 ton vessels and providing the industrial estate with all the necessary utilities.

The Laem Chabang Complex on the other hand,will house small-scale, labor-intensive and non-polluting industries. It will have a deep-sea port capable of handling 120,000-ton vessels, Export Processing Zone and an Industrial Estate backed with a complete urban center with essential infrastructure.

Both industrial complexes at the Eastern Seaboard are being developed simultaneously and transport infrastructures in the form of highway network and railway line are also being constructed. Once the industrial program is in full-scale operation,it is anticipated that the expected 300,000 jobs that will be generated by this new economic zone should be able to provide a strong alternative to counter Bangkok's pulling effects. Considerable growth is already occurring along this corridor. The deep-sea port facilities would facilitate access to both imported materials and exports. Although the area is far enough from Bangkok to maintain ifself as a separate urban system, still,it is close enough to permit relatively easy access to Bangkok's commercial and administrative facilities. Since many agencies are,and will be involved in the area's development, the institutional means by which these activities could be integrated with the various other activities will have to be devised.

Phase III: Development of Regional Growth Centers or New Growth-Poles

The 3rd phase of the decentralization scheme would be to develop secondary cities or regional growth-centers, emphasizing the provision of better urban infrastructure and services in order to generate new economic opportunities and,to attract new industries to the regions. This regional urbanization and industrial decentralization are thus,

being considered complementary development instruments in order to redress existing regional income-disparities consisting of two types of infrastructure viz:

- communal and urban infrastructure to improve the standard of living in these centers such as roads, housing, water supply, sanitation and health.
- economic infrastructure to support expansion and diversification of economic production such as industrial estates and transport.

There were originally nine regional urban growth-centers identified in the 4th plan, namely: Khon Kaen, Korat, Ubon and Udon in the Northeast; Chiengmai and Phitsanulok in the North; Songkhla-Had Yai and Phuket in the South; and Chonburi in the Eastern Seaboard of the Central region. The need to distribute the growth poles in the country was the main factor considered by the Government in selecting these locations. These nine cities were, however, found to be excessive granting the available financial and technical resources of the government. The number of cities was ultimately reduced to five viz. Chiengmai in the North, Korat and Khon Kaen in the Northeast, Songkhla and Had Yai in the South, the selection of which was based on four factors:

- The strength of the economic base of the cities
- The ability to attract foreign investment
- The capacity of the cities to absorb migrants
- The relationship of the cities to rural development in the surrounding areas

The five cities selected have been identified as being capable of playing regional economic, as well as, administrative roles and having growth prospects in agro-industries, regional services and production, to satisfy regional-consumer needs met by goods made or imported through

Bangkok. As a project that came up with the assistance from the World Bank, the government's strategy for accelerating the development of these secondary cities consisted of:

- improvement of infrastructure and other services conducive to the expansion of economic activities and improvement of environmental conditions in the slum communities.
- creation of job opportunities by encouraging small industries, agro-industries, natural-resource based industries.
- strengthening the municipal governments through improved management and increased revenues.

With the view to alleviating the pressures from Bangkok through the development of the secondary cities, it has also been recognized that these projects could be successfully implemented by strengthening coordination among many agencies and improving the presently fragmented institutional framework.

5. Alternative Scenarios for Bangkok

In coping with the BMR problems, the previous section expounded on the three basic concepts of decentralization of the capital city based on the creation of self-contained satellites away from Bangkok, the pull of the Eastern Seaboard Project and the pull of the regional cities.

But, in order to cope with the net annual increase in the city's population alone, two satellites, each designed for about 100,000 people will have to be completely implemented every year. This is clearly something which will not happen at the rate referred to. And, as to the combined pull of the Eastern Seaboard and the regional cities, the extent with which this may happen in the remaining years of this century cannot, as yet, be gauged.

Up to this point, decentralization has been based on the economic, financial and physical strategies. Since decentralization means, first of all, decentralization of the government, and since no planner is in a position to make structural changes at such a level, the effort to decentralize the capital,based on the above strategies, has been proven to be in vain.

It might therefore be useful at this point to see what would happen if, in spite of the strategies described in the previous Chapter, Bangkok's population still reaches 12 million as projected by the World Bank for A.D. 2000.

A number of issues by that time will have forced Bangkok into a particular structure, some with and some without comprehensive implementation programs. This statement might well raise fury with planners who logically stress that projects should proceed from both the institutional and the financial plans. However, things are not always that neat. Indecision and the over-prolonged project studies and re-studies (often caused by too many "experts" on the same job) in the past have shown that, a number of infrastructure simply could not wait. They have to be implemented at the expense of their incomprehensibility which causes the need to systemize the financial and institutional aspects.

At least 3 basic issues will emerge to force the government into implementing far-reaching programs on the physical front. These are:

- The Polder Development
- Slum-Conversion
- Mass Transportation

5.1 The Polder Development

Due to huge damage and losses in the flooding of 1983, the government started the work on the polder development. At present, the program

is only partially implemented, i.e. only certain sections of the dykes and a number of pumping stations have been built. They, however, conform, or can easily become a part of a comprehensive polder program. With the prospect of the city and its environs going under the sea-level by the end of the century (mainly due to subsidence) and, of more flooding, the polder development could be the only solution.

Since no government will write-off the capital city, the polder development will have to be implemented. Bangkok, by the turn of the century, will consist of a mosaic of polder units with their accompanying canals or open-drainage channels and pumping stations. Urban-consolidation will automatically take place in the sense that, land inside the polders will be built up and utilized more efficiently, and areas outside will be left for agricultural purposes. The government can take advantage of this consolidation process to create a relatively efficient metropolis for 12 million inhabitants through the following measures:

- Rationalising the polder mosaic in terms of population distribution, activities, transportation and utility network
- Making each polder unit a self-contained center as much as possible
- Instituting legislations to regulate the different building types inside and outside the polder
- Instituting taxes and rates for the polder and for areas outside in such a way that, there would be incentives to utilise the polder land efficiently

Besides polders for urban development, those for agriculture and farm land, as well as, for infrastructure including highways will also have to be built in the city's environs.

5.2 Slum Conversion

Between 20% to 25% of the urban population will continue to live in

the slum areas well, into the foreseeable future. This picture might be somewhat optimistic if, the fact that, the population increase in the city, mainly in the poor sector, is taken into account. Given a future population of 12 million, some 2.4 - 3 million people will be living in slum areas in, and around, the city.

Since the government will not be able to afford to house nor, to provide utilities for the poor in the conventional manner, the following options are thus, left open:

- Acceptance of the urban poor reality. This means acceptance of self-built, low-rise, high-density areas as an integral part of the city
- Accepting the urban poor's "right to live" by instituting the process of land tenure. Only with the sense of security built up within the slum dwellers can slum areas be improved and converted to become a viable part of the city
- Providing seed funds through a savings and loan scheme by the government because slum conversion needs a minimum provision of utilities and building materials
- Exploiting the resourcefulness of the urban poor. Besides the self-built scheme this also includes self-management or self-reliance in the areas of community development, utilities management, garbage disposal, fire-fighting, etc.

With the acceptance of the above realities and the implementation of the accompanying measures, huge slum areas can be expected to give way to acceptable low-rise, high-density areas in Bangkok by AD 2000.

5.3 Mass Transportation

There is a simple rule of the thumb that 75% of urbanites have to be on the move daily. By AD 2000 some 8 to 9 million people will have to

be on the move every day for their work in,and around,the metropolis. Within the "urban core", commuters in the order of perhaps 6 to 7 million can be expected. The present bus lanes and roadways will not be able to sustain the load and a clear-cut decision on a totally new mass transit system will have to be made. The decision will not be based on,whether this transport option can be afforded, but,on whether the government can afford not to implement it.

Of the many factors involved in making such a decision, the following seem to play decisive roles:

(1) The imminent "urban standstill"

(2) The capacity of the system. The capacity must be able to expand to meet at least half the number of the total commuters within the "core area" projected for AD 2000

(3) Huge energy and other wastages involved in an inefficient public transport system

5.4 Conclusion Based on the Above Assumptions

Bangkok's scenario for AD 2000 might be that of a mosaic of polders containing a population of 10-20 million or more. Slums will give way to viable low-rise,high-density areas. A new public transport system will have been implemented. The new metropolis will be consolidated and partially restructured by the polder development and the mass transportation.

6. Agenda for Research at TDRI

(1) Bangkok Metropolitan Urbanization, Magnitude and Composition

(2) Trends of National and Regional Urbanization -- Towards a more Balanced Urban System or even a more concentrated growth of Bangkok Metropolitan Area

(3) Infrastructure Requirements, Affordability and Urban Finance:

- Bangkok Urban Traffic and Transport Management Strategies
- Urban Housing Policy Directions
- Bangkok Metropolitan Region, Flood and Water Resource Development Strategies.
- Subsidies vs. Self-Financing
- Privatization of Urban Infrastructure Services
- Strengthening Urban Development Finance

(4) Selected Target Groups -- The Urban Poor and the Slum Areas. It requires more positive treatments of the 'Urban Poor' and 'slum' issues.

Footnote Reference

1 Includes short-term opportunities which happens during the off-farm season. Unskilled jobs in the non-agriculture sectors are the largest source of urban employment accounting for 73% of the total municipal employment in the 1970's.

2 The locational incentives include:

- exemption of one-half of corporate income tax for a period of five years, in addition to the basic 3-8 years
- an investment allowance comprising deduction from taxable income of up to 25% of the cost of infrastructure construction and installation, which may be taken in any one of the first 10 years of trading, in addition to normal depreciation
- deduction from taxable corporate income of which the costs of transport, electricity and water supply
- exemption of up to 90% of business taxes on sales and up to 50% of import duties and business taxes on imported, raw or essential materials up to 5 years from the start of operation and trading

3 60% of deposits made in the province were being channelled back to Bangkok.

4 Only 34% of the total amount of loans applied from 82.6 million Baht or, about US$ 4 million were approved.

III. ISSUES OF DISCUSSION

1. Review of past urban planning attempts

While the 1st plan vis-a-vis urban development stressed more on economic matters, the 2nd and 3rd plans slightly emphasized on social aspects.

Comment 1: Recognizing that urban development is basically a matter of physical development, and urban planning, a matter of complex human ideas, too much concentration on the social aspect of the problem does not necessarily indicate a positive development. Instead, TDRI research must stress on filling in gaps and loopholes of past national planning attempts.

2. Coping with Bangkok Metropolitan Problems

With an approaching population of 12 million in the next 15 years, the floods, the slums and the subsidence problems in this 7,000 sq. km. city are being highlighted.

Comment 1: The concept of "city-size growth" must be transformed into the concepts of "orderly growth" and "management growth."

Responses to comment:

- It is not possible to restrict or, slow down the growth of the city because of the accepted reality that the growth of any city is always a response to demand. But even if such a fact exists, the situation is not a hopeless one because by adopting proper planning concepts, e.g. land use, service networks, etc., an orderly management of growth can be effected.

- These two new concepts are very well applicable to managing the land use in cities which are about to grow and also, to managing the urban infrastructure. And

since these concepts have already been widely adopted in cities worldwide, it would be very useful to spread the concept across all 21st urban planning experts.

Comment 2: The type of organization and administrative arrangement suitable for the Bangkok Metropolis of 8 million people must be identified since, the presently-existing Bangkok Metropolitan Administration is not capable enough to undertake such a big responsibility.

Response to comment:

- The Bangkok Metropolitan Administration has to be more active in seeking for solutions to national problems which are not within the capability of the local government. The BMR's responsibility on this aspect rests on alerting and effectively mobilizing the people concerning these problems. TDRI research could involve studies looking into organizations within government units not concerned with undertaking comprehensive research. With limited resources both human and financial, the BMR's present responsibilities are considered too large, i.e., the flood problems of Bangkok which is presently taken cared by only 29 people. A theme for TDRI research could include improving the administration of the urban metropolis. Moreover, solutions to technical problems should be the responsibility of the government.

Comment 3. On Urban Finance

The problem concerning urban administration is not an engineering problem but more of a financial problem especially with the anticipated surge of 12 million people in search for more needs and bringing in more conflicts and social pressures within the city and eventually, on the government.

Response to comment:

- The government, in seeking to provide for the services to the people, will be plagued the most with the problem of finance. Because of the subsidies available, the urban residents tend to demand for the best services while at the same time paying less for these. In facing this problem, the government has been making use of the income derived from taxes, i.e. rural income, to subsidize for the livelihood of the urban people. This practice has to stop. There should be a study on the overlapping relationship and coordination of urban with rural development affecting the rural economic structure, decentralization of power and the rural infrastructure, its financial aspect and its relationship with industrial and community development.

Comment 4: The rural-financing system relies heavily on government funds for local administration and worse still, projects seem to concentrate on solving the problems but, leaving the issue on financing out. Therefore, solutions to earlier urban problems were made possible through pressures under a central budget. A conflict arises as to who should really finance these projects, the central, local, private, or public sector because each party believes that the other party is more responsible. How do we improve the bases of the local-financing system to make them more autonomous? Besides the taxation system, one solution would be to reassess the value of land within these areas, 40% of which is government or public-enterprise-owned, and to reorganize the new land tax system.

Comment 5: Due attention must be paid to the sharing of the burden within the different administrative levels in the government: the national, local, private and public sectors in administering the basic services. Certainly, these projects which are aimed at resolving the city's problems will

require a lot of funds in the future. Since these projects definitely require huge investments, the government would be plagued with the two very basic questions of: whether or not,the project is worth investing and, if it is, finding out where and how to seek for funds to finance these projects.

Response to comment:

- It is important that urban development projects have been properly researched on, especially those that require importation of technology, because projects which did not have an adequate study will turn out to be much more expensive than thoroughly-studied projects.

Comment 6: The concepts of "users'-pay," "local-finance" and "self-finance" must be adopted into the system of financing the urban infrastructure, e.g. privatization of certain services and urban self-finance system.

Response to comment:

- People who expect to receive benefits from taxation should bear some responsibility in return. This underlying principle in urban self-finance is, however, hindered by the prevailing customary preference of the Thais of receiving rather than contributing. This is illustrated in the peoples preference to sit in the traffic jam and waste time and petrol than having to pay ten baht by using the expressway, and saving time and petrol.

Comment 7: Privatization of Service

Within the infrastructure development work, there is a growing probability that, by privatizing certain aspects of government activities such as, transport and sewage system, a considerable burden could be relieved from the government.

By way of research, the feasibility of such a hypothesis could be assessed.

Response to comment:

- A good example to explain the above is the present transport system. Every day, millions of people have to be transported and until now, the mass transit system in the city is in disarray because the services being provided by the government are too costly due, perhaps, to the pricing system being adopted. In the end, the private sector has to bear the consequences of such an inefficient management. Privatization, improving coordination and possible reorganization of the mass transit system, the sewage system, the telephone system and the power/electricity system are areas where TDRI could undertake serious research in relation to the role and responsibility of the public and private sector at the national level.

3. Strategy to Decentralize Bangkok Metropolis (Phase 1)
(Polycentric Bangkok)

Comment 1: The previous plan to decentralize Bangkok by establishing economic centers outside Bangkok was not quite successful because in dispersing the economic centers, political centers had to be dispersed too, and so were employment possibilities. As a natural course people had to follow the direction of employment opportunities. Decentralization normally tends to focus on the economic and infrastructural aspects and less on administration, power, employment and finance aspects.

Response to comment:

- It is difficult to decentralize Bangkok because the government has a very centralized system particularly the state enterprises which are all located in Bangkok.

A conceptual framework for decentralization should involve avoiding long-distance travels by locating sectors who need to work together, closely together. Decentralizing the institutional arrangement of the government into a polycentric development may also help alleviate the urban density problem.

Comment 2: Since we do not aspire to build new towns, we should aim to "deconcentrate" rather than to "decentralize," i.e. Chiang mai where such a scheme is being adopted.

Strategy to Decentralize Bangkok (Phase 2)
(Developing New Economic Zones)

Comment 3: In newly-developed areas such as the cities of Pattaya, Phuket, Chiang mai and the Eastern Seaboard, the attitude of the local people and their possible contributions to development must be carefully studied. For instance, in the cities of Chiang mai and Pattaya where no such studies have been conducted, the people who have benefitted most were not the local residents but the Bangkok migrants. In future developments, the local residents should be given the top priority.

Response to comment:

- In such cases, it is highly-important to know whether the local residents are prepared to accept the new development, growth and progress that are likely to take place in their locality. And, in order to assess the capability of urban management and organization, the program of research at TDRI should include restudying and reorganizing the role of Pattaya and the Eastern Seaboard.

4. Alternative Scenarios for Bangkok (Polder Development)

Comment 1: Mainly as a countermeasure to flood, the success of the polder development would depend, a great deal, on the massive support of the public and the members of the lawmaking body.

Response to comment:

- How should we maximize the utilization of the land within these polders? The government must be prepared for laws in preparation for the worst situation to arise.

Comment 2: Alternative Scenario for Bangkok (Slum Conversion)

With the belief that the urban poor, composed of slum dwellers, vendors and hawkers who are self-employed in the informal sector, will become the majority in the metropolitan area, this program should consider continuous conduct of research on positive measures to resolve the problems of the urban poor and for policy inputs. Not only that, the urban poor have to be properly integrated into any form of policy or plan.

Comment 3: It is true that the slums have economic power. Aside from being politically-conscious, resourceful and inclined to self-reliance in solving their problems, they are the people who labor hard but, earn the least. Neither have these people gained the importance that they rightfully deserved, nor has the government listened to their views and opinions about slum improvement in general.

Response to comment:

- It is high-time that the necessary assistance be given to these people in the form of education, funding, etc. in their self-help attempts. But first, the role of

"slums" in self-development,vocational development, residential and other services for improvement must be carefully studied.

Comment 4: With an anticipated housing shortage as a result of 3 million slum population in the future, the government may opt to augment some of the housing needs by constructing low-rise buildings, and to improve the people's sense of security through laws and regulations. To attempt at converting slums into non-slum areas, the government can assist in organizing the suppliers of construction materials and the firms that provide basic services.

ENERGY DEVELOPMENT

ABSTRACT

One area that will be very much affected with Thailand's intense urban industrialization process in the coming 5-6 years would be the overall energy supply and demand situation. Furthermore, the energy situation will depend on domestic uncertainty, world economic recovery, oil price, domestic production and additional gas/oil discoveries. In 1978, eighty-one percent of the country's primary energy needs was met through imported oil. This importation has cost Thailand a huge amount which was roughly equivalent to 30% of the country's total import bills and, almost equal to the trade deficit incurred during that year. The fact is that, Thailand will not become self-sufficient in energy and will continue to import oil in the foreseeable future. The paper predicts a worsening situation in the coming years and calls for strategies to intensify domestic energy production and diversification to better manage the energy resource and, to improve the present institutional framework. The structural transformation will create enormous demands for energy in virtually all economic sectors, particularly the industry power-generation, agriculture and commerce that will require the utilization of both imported and indigenous sources of energy. Indigenous sources of energy for Thailand consist of fossil fuel resources, e.g. lignite, oil-shale, petroleum, natural gas, hydropower, nuclear energy, etc. The need to find the best energy supply mix among domestically-available sources of fuel is highlighted in order to gradually stabilize and eventually reduce oil imports. On the issue of managing and conserving energy resources, schemes to improve the efficiency of the transport and the industrial sectors and improve upon the presently-adopted pricing policies should be taken. An active private sector participation strongly characterized the energy management and planning in Thailand in the past. As discussed in the third section, the realization that a more intense government control over energy matters in exploration, production and marketing was just a recent phenomenon following the oil shock of the 1970's. This was to be complemented by the need to bring about a more favorable environment in the energy supply in the form of policy measures, incentives and institutionalized procedures in energy decision-making. It is recognized that, above all, the presently fragmented political set-up in the energy sector must first be looked into. A summary of research issues is given in Section 3 whereas Section 4 outlines these issues into major topics for research by TDRI.

II THE PAPER: ENERGY DEVELOPMENT

1. Introduction

Thailand ranks 5th in the category of the world's best economic performances of more than 85 developed and developing countries. This ranking was based on the country's overall economic growth rate, rate of inflation, strength of exchange rate and balance of payments performance. This is further complemented by an international financing at a very low interest rate which demonstrates Thailand's top-notch credit rating. This bright economic standing of the country will, however, soon be challenged by key development issues such as:

- The economic and spatial transformation from traditional and Rural Agricultural to Semi—Industrialization as it joins the ranks of Newly-Industrialized Countries or, the NIC group.
- The demand for more energy as a result of the economic and industrial transformation and high-level urbanization.
- The opening up of a new era for urban and energy development policies and R & D activities as a consequent effect of the above.
- The increase and expansion of all types of infrastructural investments as a result of this economic and spatial transformation.

To support the economic and spatial transformation will definitely require a more efficient mobilization of capital, technology and management transfers from abroad. The recent discovery and development of the natural gas in the Gulf of Thailand and oil from the onshore field at Lan Kra Bue will, not only, change the resource picture of the country but will also, open up new opportunities for the creation of viable "basic industries" for Thailand. These basic industries will be supported by urban townships, infrastructures, two deep-sea ports, as well as, an industrial and a commercial complex. This development will open up an entirely new era for urban and energy development policies and, research and development activities to come up with a comprehensive industrial

restructuring program to make the country's industries more competitive, outward-looking and less dependent on foreign inputs. Moreover, the industrial activities are intended to be decentralized away from the Bangkok metropolitan area to the new industrial zone at the Eastern Seaboard. This comprehensive industrial restructuring program is also reflected in the current 5th National Development Plan.

This economic and industrial transformation together with the projected increase in rate and higher level of urbanization will also "push up" the demand for energy as well as increase the average per-capita consumption in energy. The economic shift will have a direct bearing on the composition of the country's energy production, energy demand, external trade, employment pattern , future technology and energy requirements.

While the current substitution of imported oil by our newly-discovered gas and oil will reduce our dependence on energy-import during the rest of the 1980's, projections on energy requirement show that imported energy, both oil and possibly coal, will begin to climb again in the 1990's and this has caused some real concern to energy planners.

The New Industrial Zone or the so-called Eastern Seaboard Development Program is part of the very comprehensive industrial restructuring program in order to disperse our industrial activities away from the already-congested peripheries in Bangkok. In this program, new basic industries will be established using the newly-developed natural gas resource either for their energy supply or, for their raw materials.

The structural transformation will generate the boom of medium and large-scale industries as a result of which, employment opportunities will be opened up and will naturally attract more rural migrants. The need for social and infrastructural services will, as a consequence of all these changes, also increase energy supply requirements, e.g., the number of schools, hospitals, markets, transportation, electricity, etc., the provision of which also requires an increased demand for

supply of energy. There will be a definite relationship between the two sectoral areas in energy and urban and infrastructure development under the economic transformation in the 1980's and the 1990's because infrastructure investments of all kinds will have to expand in step with this transformation.

2. The Energy Picture

Thailand's economic growth and transformation is generally characterized by a reliance on its own physical and human resources with private sector initiatives, prudent fiscal/monetary/debt management policies, and incentives for domestic saving and foreign investment as well as, reliance on trade. However, as stated earlier in Section 2 of this paper, the next 5 to 6 years will be a crucial turning point in Thailand's development planning and implementation because of the economic transformation from traditional agriculture-rural resource base to more modern and complex forms of urban-industrial activities.

The economic transformation will change the composition of the country's external trade, employment patterns, future technology and technological requirements and, will consequently affect the country's energy production, demand and requirements. The overall direction of the energy situation as a result of this structural transformation will also depend on world environment trends, a few domestic uncertainties, world economic recovery, oil price, domestic production and, additional discovery of gas and crude oil in the immediate future. Such that, though the heavy dependence on imported oil lessens as a result of these discoveries and explorations, the quantity of imported crude oil is still expected to rise in the 1990's because of the transforming economy. The anticipated production of natural gas supply is 450-500 mcfd. in 1985 and the 20,000 b/d of oil from the onshore field of Lan Krabue will altogether reduce the country's dependence on imported oil by 30% in 1985.

3. Energy Demand/Supply

A medium-term outlook of the Thai economy according to a simulation by NESDB shows that Thailand will have an average growth per annum of 6.5% until 1991, with the outputs in the non-agriculture, industry, energy, construction and service sectors expanding at 6.1%, 7.5%, 3.9% and 6.5% respectively. This economic picture, the shift towards semi-industrialization together with faster urbanization, will certainly create an enormous demand for energy for household/domestic, transport, industry and power sectors.

Energy consumption in Thailand has been growing at an average annual increase of about 9% since 1977. Imported oil now accounts for about 80% of energy demand. 41% of all petroleum products are being used in the transport sector. Diesel accounts for over half of this amount, 21% of oil products is used for electric power generation, 18% in the industrial sector, 11% in the agricultural sector and 9% in the domestic and commercial sectors. A significant 64% of all the energy consumed in Thailand is being supplied to the Bangkok area.

Thailand is critically dependent on imported oil which, in 1978, supplied about 81% of the primary energy needs. In 1980, indigenous production of oil accounted for only 0.1% of the 31.8 million liters of oil consumed in Thailand daily during that year. In that same year, Thailand's oil import cost 58 billion baht or 30% of the total import bill equal to the value of the trade deficit. It is expected that the demand for imported oil will double in the coming years and worse still, with increased prices. The cost of oil imports would certainly be an increasingly large item in the country's balance of payments. More importantly, the average level of per-capita consumption of commercial energy will definitely increase because of an intensified agricultural production, increased industrialization and higher level of urbanization as the economy shifts towards industrialization. Reducing the country's dependence on imported energy while at the same time diversifying the supply sources, are seen as crucial measures in

the energy supply picture. With particular reference to the contribution of the natural gas, the best energy supply mix must be devised because Thailand is not, and will not be, an energy-surplus country.

The present energy development strategy aims to maximize the production of domestic sources and diversify the supply structure of energy. Under the so-called supply issue, current attempts to meeting the present and the future energy requirements is amply displayed in the current spending on energy exploration and development[1] and the government's public investment target of US$7 billion. Projections show that the country's requirement for imported energy, both oil and coal, will soar again to about 45% share by year 2001. This picture has caused concern to energy planners and has, in fact, led to formulating some policy measures that need to be adopted. One of these policy measures was the flexible attitude taken by the Thai Government to meeting the uncertainties of the reliability in estimating reserves, quantifying oil and gas potential and quantifying new and additional discoveries. Another policy mesure adopted was to oversee the economics of oil and gas exploration and development in line with the goal of stabilizing oil imports in the 1990's. It is generally recognized that more oil and gas exploration will have to be carried out from now on, so that both domestic and possible export needs could be met. In effect, the proper incentives for continuous energy exploration should first be created.

4. The Pricing Policy

The basic principles[3] of energy pricing are economic effieiency, social equity and financial viability. The principle of efficiency seeks to ensure the regulation of prices in a manner that the allocation of resources to the energy sector reflects fully their values in alternative uses. The equity principle relates to the welfare and the income distribution considerations which may call for charging differential prices to different users on the grounds of basic needs. The financial principle suggests that energy supply systems should be able to raise sufficient revenues to remain financially viable and, by using taxation of energy resources, to raise sufficient government revenues.

The energy pricing policy is so critical to both the demand and the supply of energy. Thailand's desire to maintain high growth-rates in the 1970's led the country to adopting low domestic retail oil pricing policies. The government during that period then decided to absorb a substantial part of the increase in the price of imported fuel. After 1978, this picture changed considerably when drastic changes were made on domestic energy prices. At present, the country's domestic petroleum prices are roughly comparable to other ASEAN countries. The average level of taxation on petroleum products is even comparable to other oil-importing countries and subsidies on most petroleum products have been eliminated. However, disparities in taxation rates between the different types of petroleum products still exist and still need to be urgently corrected.

Thailand's approach to pricing domestically-produced oil and gas[4] has been based on production costs which has led to slow and time-consuming negotiations. A worthwhile alternative to consider is to establish a reference to international parity and to reduce the reference price by a small discount for users' incentives. This could substantially simplify and shorten the negotiating time-frame considerably and provide an added incentive for oil and gas exploration.

5. Towards a Better Energy Management Program

The successful economic development of Thailand in the 1970's was characterized by a rapid growth in commercial energy consumption that resulted in a very high-degree of dependence on energy import making the Thai economy vulnerable to external changes in the energy situation.[5] In 1977, the sectoral shares of commercial[6] energy demand were industry, 37.3%, transportation 31.9%, commercial and domestic 15.1%, agriculture 8.5% and others 7.2%. The continued growth and the transformation of the economy will lead to a substantial increase in energy demand and a sharp increase in dependence on imports for commercial energy could recur during the 1990's. The total commercial energy demand[7] is expected to increase from 127×10^{12} Kcal in 1978 to 274×10^{12} Kcal in 1985, at an average annual growth[8] rate of 10.1%. Energy needs[9] in Thailand have been increasing at the rate of 7% per

year, and petroleum products accounted for 74%. Thailand uses about 78 million barrels of crude oil equivalent or 1.7 barrels per capita. An ESCAP working group in 1982 stressed the fact that the most fundamental of all of Thailand's energy development problems is the rising price of crude oil and its products which had resulted in more trade deficits at a great portion of foreign exchange. A five-year projection presented by Thailand in that same working group meeting revealed that for 1982-1984, the energy consumption would have increased at a rate of 4.9% with petroleum products accounting for 16% in 1956. ADB projection shows that the overall share of imported petroleum products in total commercial energy consumption is projected to decline from 97% to 59% in 1990. To prevent a recurrence of such recent energy crisis, Thailand will require the stepping-up of demand management measures as concluded in the joint World Bank/NESDB/UNDP, 1984 Energy Assessment Report for 6th Plan preparation.

Both the Asian Development Bank and the World Bank definition of Energy Demand Management Strategies present similar policy instruments to effectively restrain the growth of demand for energy. However, a word of advice from the two largest money-lending institutions suggests that these instruments or measures are closely related and hence, their close coordination must be properly ensured for maximum effect. These major measures are: efficiency improvement of energy use in the transport and industrial sectors, conservation policies and appropriate pricing policies.

On the basis that energy will continue to constitute the national welfare and that shortage may result in the collapse of the national economic system, the following basic principles must be given priority attention and action.

(1) To effectively secure diversified stable energy supply

(2) To utilize energy in the most effective and efficient manner by taking into account the availability and the value of the supply service via consumption measures in the transport and industry sectors, and

(3) To recognize the need to use pricing as an instrument for energy demand management.

5.1 Energy Efficiency in the Transport Sector

The transport sector is usually one of the major consumers of energy. In Thailand, the transport sector accounts for nearly half of the total consumption of petroleum products with road transport accounting for about 95% of the sector's fuel use. Thailand has, in the past, adopted short and long-term measures to contribute to the energy conservation program in the transport sector. The measures/regulations[10] that are in-effect at present are as follows:

(1) Speed limits reduced for vehicles, i.e. 100 km for cars and 80 km for other transport on highways.

(2) Bus lanes provided in certain Bangkok streets.

(3) Parking banned in certain major areas in Bangkok.

(4) Heavy vehicles prohibited in Bangkok during rush hours.

(5) Strict traffic laws and heavier penalties imposed for violating these laws.

With comprehensive regulation for traffic control already existing, the condition seems to indicate that strengthening the present regulations in making a speedy decision on the development of mass transit system dictates that the government should provide the necessary financial encouragement for the improvement of the existing systems, and also the improvement of services of the different transport sectors. Another measure to consider in easing the traffic problem in Bangkok is by staggering the working hours in Bangkok.

In a memorandum submitted to NESDB on 3rd August, 1984 regarding the justification for a Comprehensive Transport Options through a study made by John F. Kain, a critical assessment was made of the present studies for possible transport investments and the desirability for such investments. In an ensuing memorandum of 31st August, 1984 on the same subject, more concrete findings were presented regarding the options for programs of transport investment that would be most

beneficial for Bangkok. These programs are herein enumerated:

(1) Measures to improve, modernize and rationalize bus services e.g. regulatory environment, traffic engineering measures to facilitate bus operations, or choice between the expensive MRT Systems or improvement of the existing bus system.

(2) A more reliable data base for projecting future travel and for assessing the benefits and costs of these alternative investments

(3) The upgrading and enlargement of Bangkok arterial and local street networks to increase the existing capacity at a cost relative to the expense of obtaining comparable increase in capacity in other ways

(4) Elevating the State Railways right-of-ways in Bangkok to reduce congestion.

(5) The choice between the Expressway-Based Bus Metropolitan Rail-Transport (MRT) Transport System and the Separate and Independent Rail MRT and Expressway Networks.

Fuel consumption can reach as high as 20% for an inefficient vehicle and the pinch of this problem is much more felt by the large freight transport section. The following recommendations are drawn to improve the efficiency of these vehicles.

- fuel efficiency testing and spot-checking;
- reducing the model or sales weighted average fuel consumption for all new cars sold in Thailand.[11]

For controlling freight transport, establishing control points in Bangkok for freight vehicles will assure optimum loading of vehicles leaving the city and will also serve as a center carrying out efficiency test on these vehicles. A study of the driving habits of freight vehicle drivers as an input to setting up targetting

and monitoring schemes as a part of a program to encourage optimum fuel consumption is also one recommendation. Setting up fuel efficiency targets for its own fleets is another step and also developing the most energy efficient combination of the road, rail and river transport resources.

5.2 Energy Efficiency in the Industrial Sector[12]

In a move towards saving energy in Thailand's industrial sector, a measure was drawn up in April, 1980 to prohibit industries which consume major intensive power in excess of 800 KW and those industries which did not run continuous operation from 6:00-9:00 p.m. This move has resulted to a reduction of 120 MW of power and a shift in the peak period (20% using their own diesel generation).

Another move being considered by the government is the mandatory reporting of energy consumption by factories consuming more than 500 KW/1000 liter of oil/2000 tons of coal per year. This is seen as important to ensure that realistic and achievable targets are acquired based on this detailed audit.

To complement the previously-mentioned realistic audit for monitoring and for setting targets, another step being considered by the government is the investigation of energy use in the energy-intensive industries.

Utilizing energy from agricultural waste through a more efficient burning of this waste and extending this resource for other industries as well is still another energy conservation proposal. This is hoped to lead to the encouragement of rural industrial estates to utilize surplus agricultural waste for generating heat and power or, for absorbing the surplus power and waste heat from the adjacent industries. There are, already, studies available in support of the potentials of heat recovery in some industries.

In times of serious fuel shortages, a requirement for demand-restraint

is seen as necessary. In this type of conservation plan, it is important that the targetting/monitoring system is made efficient enough to assure that cuts could be aimed selectively at the least efficient sectors.

5.3 Pricing[13]

Oil price increase bear particularly heavily on the energy consumption in Bangkok. The government has sought to alleviate the consequence of such rises by cross-subsidies between the different types of products. More recently, the effects of OPEC oil price rises are being passed on to the consumer, but energy price, both in terms of petroleum products and electricity tariff, still fail to reflect the true value of the resource or the long-term marginal costs.[14] Energy prices are sensitive issues in Thailand but, there is a need to come to terms with realistic energy prices; otherwise, the difficulties now faced in promoting efficient use of energy and ensuring balance of payments due to high oil import price will return with the decline of Thailand's indigenous resources.[15] As an indispensable instrument in achieving the goals of enhancing conservation, the substitution away from oil and increased production and trade[16], economic pricing or realistic pricing for domestic oil should reflect their long-term replacement cost.[17] It is important that all costs be taken into account and that, they should be valued in terms of the full resource costs.

Also, careful consideration should be given to the pricing levels for fuel in the transport sector to ensure that the price to the consumer properly reflects the changing price of oil in the world market and that national fuel and vehicle taxes are set at levels which encourage the consumer to use energy efficiently. In Bangkok especially, consideration must be given to mitigating the effect of price rises on the more disadvantaged section of the community. The possibility of using the extra revenue accruing from higher fuel prices to increase subsidies on the existing mass transit system and to provide funding for improvement on the mass transit system need to be carefully studied.[18]

In the power industry, although the margin for savings is small compared to the industrial and the transport sectors, the possibility for conservation through pricing policy should not be ignored. Price increases in electricity should be made so as to set tariffs at a level which take into account the full cost of incremental capacity.[19]

In the case of indigenous energy resources, an appropriate pricing policy for gas and lignite becomes a critical aspect to ensure its optimal utilization. With potential demand for gas and lignite likely to exceed availabilities, prices may have to be above costs to give appropriate signals to encourage optimal utilization of resources. While gas supplies are limited and gas is replacing fuel oil, gas prices need to reflect its opportunity cost (i.e. fuel oil). In this case, the opportunity cost of gas exceeds its long-run marginal cost (which includes price paid to the concessionnaire and delivery costs). When gas supplies increase and are substituted for cheaper fuels (e.g. coal) gas opportunity costs and prices may decline towards the economic cost of coal and may eventually decline below so that the opportunity cost of gas would then be equal to its long-run marginal cost. Because pricing also needs to allow for uncertainty in supplies, prices should be set in accordance with conservative estimates of gas availabilities.

While the current average levels of retail petroleum prices and power tariff are satisfactory, an important issue is the structure of petroleum prices and electricity tariffs. Differential tax rates on petroleum products have caused the structure of domestic petroleum price to differ substantially from that of international prices which encourage an inefficient shift of fuel use in transport from gasoline to LPG and diesel, and the adulteration of diesel with kerosene.

The World Bank/NESDB 1984 Report has recommended the following measures for revising the present pricing structure.

- Examine the structure of petroleum prices
- Estimate costs of present price distortions

- Review the options for revising the price structure
- Recommend a revised structure

5.4 Option to Reduce Dependence on Imported Oil Through Domestic Production

The planning of energy production in Thailand's energy management plan[20] for the period 1978-1989 was prompted by the dramatic increase in the price of oil in the 1970's, and for which in 1978, satisfied 75% of the country's total energy demand. Though dependence on oil after 1980's will lessen as a result of the country's transition to a different energy economy through the discovery of natural gas, projections insist that this dependency will once again rise in the 1990's from 10 million tons in 1978 to 13 million tons in 1989 because of continued growth and transformation of the Thai economy that leads to an increased demand for commercial energy. Thus, the planning of energy production of domestically-available sources of fuel should be oriented towards gradual replacement of oil and stabilization of oil imports.

Thailand's known fossil fuel resource[21] consists of several large deposits of lignite, oil-shale deposits, and a small amount of petroleum. An account of these reserves showed that Thailand has 441 million tons of lignite, 7.1×10^{12} cu. ft. of natural gas, 18 billion tons of oil-shale and 10,000 MW of hydro potential. Recent oil and gas exploration have been generally disappointing due to the long-lead times required to bring a gas discovery onstream. In Thailand's case, exploration and development must continue to be strong for there to have the hope of stabilizing the country's oil imports.[22] The choice between gas, lignite and coal for future base-load power generation facilities depends, also, on the relative costs of alternative fuels. The costs of domestic fuels need to be calculated and compared to the costs of imported coal. To make sure that discovery and exploration continue, the right incentives in the form of reasonable economic prospects must be given to the interested parties.

5.5 Option to Reduce Dependence on Imported Oil Through Energy Supply Mix

Through the mid-1990's it is anticipated that the fuel options for the power expansion program are domestic lignite, natural gas, hydro-electric power, imported coal, fuel oil and nuclear power. A rough estimate of the potential of Thailand's indigenous resources indicates that, a substantial amount of imported oil can be substituted once these options are properly developed. ADB energy studies revealed that deposits of lignite[23] at 441 million tons is equivalent to 160 million tons of oil; the natural gas reserves of 7 trillion cubic feet is equivalent to 175 million tons of oil; and the hydro-electric power potential of 10,000 MW is equivalent to 4.5 million tons of oil per year. The commercial value of oil-shale in the Mae Sod area for instance, indicated an oil content of 6,000 million barrels. The program to develop the oil-shale in Mae Sod in 1980 consisted of two pilot projects. These projects sought to develop low-grade shale to generate 20 MW power by 1986 and to develop an oil-extraction plant for high-grade shale.

In natural gas production, the program to develop the natural gas in the Gulf of Thailand involves replacing bunker and diesel oil for power generation[24], replacing bunker oil as fuel for the industrial sector and finally setting up the gas-extraction plant to produce propane, butane and ethane gases for use as household gas and as feedstock for chemical industries. 26% of the country's total commercial energy demand by 1990 is expected to be met by the supply of natural gas.[25]

Lignite will displace fuel oil in the power generation. LPG has begun to substitute for gasoline and transport and for kerosene in the household sector. This substitution is expected to continue the shift away from fuel oil and gasoline and, towards diesel. And by 1990, coal (lignite) is expected to account for about 12% of the total commercial energy consumption.[26]

The choice between gas, lignite and coal for future base load power

generation facilities will, however, depend on the relative costs of alternative fuels. Gas and lignite costs normally include exploration, development and delivery costs as well as appropriate depletion premiums. In order to maximize the overall benefits of domestic fuels, the value of the particular use of gas or lignite must exceed the fuel's economic costs and the resources must be used in the most valuable way. In terms of domestic energy production, all available information and World Bank/NESDB/UNDP report conclude that gas and lignite supplies would be insufficient to meet all projected incremental costs after the year 2000. The next best options revealed are those of continued oil-importation, hydro-power and nuclear energy.

There has, in fact, been an envisioned government project to construct a 600 MW nuclear power plant. And at present, the government, the International Atomic Energy Agency (IAEA), the NESDB and the World Bank are currently reviewing nuclear power issues in its joint NESDB/ World Bank/UNDP Energy Assesment for Sixth Plan Preparations Report expected to be completed in early January, 1985. Although there are indications that Uranium and Thorium are available in the country, the pros and cons of utilizing nuclear energy are still under debate.

6. Institutional Aspects of Energy Management and Planning in Thailand

The early stage of energy development in Thailand witnessed a more active private sector involvement in managing this valuable resource , viz. exploration, production, marketing, etc. The only participation by the government centered on the taxation aspect. It was not until after the first oil shock in the 1970's that the government awoke to the fact that,not only should it have full control over energy matters but also, must look up to the examples of nation-alizing the management of energy as shown by countries like Korea.

Within the context of energy supply and demand, the responsibility for energy-related matters in Thailand is spread across six[29] ministries and the Office of the Prime Minister. This fragmentation makes co-

ordination of a coherent energy policy difficult to the extent that even the responsibility for particular resources, e.g. mines and refineries, is split within these ministries. The responsibility for energy conservation matters rests primarily with the Regulatory Division of the National Energy Administration (NEA), and this regulatory division is further divided to provide separate branches responsible for pricing measures and energy efficiency. However, the overall guidance on energy conservation matters is provided by the Deputy Prime Minister's Energy Conservation Committee. This political structure in the energy sector accounts for the scattering of information on energy-related matters.

In managing the country's energy supply, a new arrangement must evolve to suit the Thai economy in the form of policy measures, incentives, political support and institutionalized energy decision procedures. In attempting to evolve towards a more favorable environment in energy, the following policy issues are worth a closer investigation:

- On the economics of oil and gas exploration and development. Since hydrocarbon exploration and development is both high-risk and high-gain in nature, the industry becomes politically-sensitive towards the government policies.

- To maintain private sector investment, the Petroleum Act must be preserved. In order to encourage vigorous oil and gas exploration, Thailand's energy policies should aim at maintaining a conducive environment that will allow producers some access to both the domestic and the foreign markets that may even transform a seemingly uneconomic scheme into a viable one.

- On the Natural Gas and on other Additional Energy Reserves. The accuracy and reliability of reserve estimates are highly important because these estimates will have a direct bearing on the future import-oil substitution, on the industrialization program of the Eastern Seaboard and on the

future of the Lignite Natural Gas (LNG) scheme.

- On Joint Ventures. Thailand must solely determine the basic rights and terms of joint ventures and not by the concessionnaire.
- On Pricing Policy. An alternative to the present pricing practice based on forecast[30] costs towards establishing a reference price to international parity and possibly reducing the reference price by small for user's incentives should be considered.
- On International Cooperation. The huge cost, size and complexity of public investment projects in the Energy and Petrochemical projects reinforces the importance of international cooperation. The projects are bigger and usually amounts to US$100 million; the projects are sponsored by international development entities and by the international financial market; the construction period is 3-4 years on the average; materials, technical inputs, equipment are often procured from international biddings or sponsorship; project costs and foreign currencies are relatively predictable with certain rates of inflation and interest rates.

7. Agenda for Research at TDRI in Energy

- Formulation and Establishment of an Information Center on Energy by starting to inventorize all available Research and Development on Energy.
- Installation of an Energy Model (Used in the Energy Masterplan) to link with the SIAM II Macroeconomic Planning Model SIAM II Model.
- Research on the various Demand/Supply Issues as well as the Pricing Policy as they relate to the Future Transformation of the Energy Sector in Thailand.
- Research on the Role of Multinationals and Multinational Cooperation on Oil and Gas Development in Thailand.

Footnote Reference

1 The requirements to accelerate exploration and development efforts include:

- clarification and modernization of the institutional and legislative frame for exploration and development as well as for improving the commercial environment of the oil industry.
- the possibility of direct participation by Thailand in exploration and development in order to improve the country's benefits from oil and gas resources.
- improved understanding by Thailand of its petroleum potential in order to both stimulate oil company interest and to permit the government to improve its interaction with foreign companies.

2 The lead time, or gestation-period of energy projects is usually very long. The exploration of an energy resource, the investigation to determine its technical feasibility and economic viability and, its development may take 5 to 15 years. Many energy supply plants have a useful life of over 20 years. It would be necessary to ascertain the likely demand and possible supply options for at least 20 years to develop long-term and internally and sequentially-consistent strategies for the energy section. (Regional Energy Survey, Asian Energy Problems, Asian Development Bank, 23 Feb. 1985, pp. 4-5)

3 Asian Development Bank, "Regional Energy Survey, Asian Energy Problems," ADB, Manila, 23 Feb. 1985

4 Thailand is a producer of natural gas. Gas prices in Thailand are based on contract prices with producers. To this must be added the cost of the publicly-owned gas pipeline transmission network to ultimate consumers, in this case EGAT, the publicly-owned electric generating utility company. Ibid., pp. 139

5 Terms of Reference for Joint NESDB/World Bank/UNDP Energy Assessment for Sixth Plan Preparations, Jul. 30, 1984.

6 ESCAP Proceedings of the Working Group Meeting on Energy Planning and Programming of the Committee on Natural Resources, Energy Resources Development Series No. 20, U.N., N.Y., 1979.

7 -8 Ibid.

9 ESCAP, Proceedings of the Committee on Natural Resources, Eight Session of the Regional Expert Group Meeting on the follow-up of the Nairobi Program of Action on New and Renewable Sources of Energy, Energy Resources Development Series No. 25, U.N., N.Y., 1982, pp. 6-7

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22 World Bank - NESDB Report 1984

23 Higher figure of 740 million tons is quoted by a 1981 ADB survey which includes indicated and inferred, as well as, hypothetical and speculative coal resources.

24 1580 MW Capacity by 1986

25 See 3 p. 58

26 Ibid.

27 The project to construct the nuclear power plant did not gain approval due to escalating costs and some degree of unpopularity particularly with the environmentalists.

28 See 6.

29 Ministry of Industry, Ministry of Science, Technology and Energy, Ministry of Defense, Ministry of Interior, Office of the Prime Minister, Ministry of Commerce.

30 The common techniques for forecasting on the basis of past funds are open to serious consideration because of the drastic changes in the energy supply of most countries.

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III ISSUES OF DISCUSSION

1. The Energy Demand/Supply

Comment 1: Energy consumption will always follow an upward trend especially with the foreseeable economic changes and the anticipated expansion of cities and industrial communities. This change will require consumption of more energy and more importation of oil. Thailand cannot depend on locally-produced natural sources, e.g. natural gas, because the supply is considered too low for long-term utilization. Therefore, even with the discovery of petroleum and natural gas, supported with energy conservation measures, Thailand would still have to depend on other countries for its long-term requirement in energy.

2. Towards a Better Energy Management Program

Comment 1: Conscious that the country will always be an energy-deficient and an energy-importing country, the subject of energy management is being highlighted that will serve the objective of obtaining sufficient energy for self-development.

Comment 2: The pricing system is criticized as distorted which tends to favor a group of people due to the available subsidies. Should the users themselves pay for the products or should they be favored by subsidies? Because of this pricing system, the country is forced to export a lot of products once it imports a huge amount of energy.

Comment 3: The present taxation system is inappropriate. And because changes in this field occur very rapidly, there is a need to create a system that is fair to both producers and consumers. Apart from taxation, there is also this problem of vesting royalty on oil and natural gas but not on lignite. To ensure fairness to both importers and users, the structure

of the cost of energy distorted by heavy subsidy, the tax and the royalty systems must be studied.

Response to comment:

Besides the above, research in the energy program should include studies on taxation and benefit-sharing systems in the oil or LPG exploration projects, and a comparison of the government's concession policy with the protection policy.

3. Options to Reduce Dependence on Imported Oil

Comment 1: To reduce dependence on oil, various energy options especially solar and nuclear energy must be properly and thoroughly explored through research. The United States and Australia provide good examples of research on alternative energy especially on solar energy. At the moment, there is no better alternative to reducing dependence on imported oil than to diversify the sources of energy, to seriously consider nuclear energy options, and to accelerate the exploration of various alternative domestic energy such as lignite, coal or oil-shale. This proposition must be supported by research studies.

4. Institutional Aspects of Energy Management in Thailand

Comment 1: Several issues in the energy sector such as pricing and international bargaining are politicised, and these issues seem to boil down into the main issue of organization.

Response to comment:

Too much politicizing on these issues lengthens the negotiating time and oftentimes results in endless bargaining. For instance, bargaining with the Texas Pacific has been

going on for 7 - 8 years and until now, no conclusion has yet, been reached. There should be an established formula for international bargaining. If this particular formula exists, then even investment in energy development could be made more attractive.

Unless energy issues are depoliticized, it would be very difficult for improvements to take place.

Comment 2: Research on energy infrastructure are dispersed among different government units, even with the Interior Ministry. There is, as yet, no single government unit that can undertake research in the field of energy exploration nor assess the government's role in refining and retailing.

Response to comment:

The energy program should include studies on the role of the government agencies and enterprises concerning production, processing and distribution of energy in order to propose an appropriate model on management policies and cooperation.

Comment 3: Responsible organizations and institutions have to be reorganized. To pursue this objective, research to explore the possibilities of consolidating these fragmented energy organizations must be proposed.

Comment 4: There should be a proper research conducted on export policies to govern refining, transporting and retailing energy and the role, cooperation and joint venture with transnational corporations.

Response to comment:

Rules must be established concerning the involvement of

multinationals in energy development because the country does not have a strong bargaining power especially in the field of exploration, compared with a country like Indonesia.

Comment 5: Carrying out activities in energy infrastructure, in refining, for example, is hindered by the lack of funds, to the extent that the decision to undertake any activity becomes a matter of priority.

5. Agenda for Research in Energy

Comment 1: There is a felt priority to establish a data bank that will build-up and compile information and studies related to energy.

Response to comment:

Inventorizing all energy-related information and studies would be an initial attempt and TDRI could act as the center to collect all these information.

Comment 2: Evolution in the field of information on energy is very rapid. As such, it becomes necessary to be aware of the repercussions of certain events and, to be able to respond properly to this evolutionary process. Because of this, a futuristic scenario describing probable events in the future will provide a useful framework for drawing up necessary measures. Such a scenario will be closely affiliated with the macroeconomic model/project.

Response to comment:

Energy policy has a great effect on the macroeconomics of the country with energy being an important production input. Therefore, policy studies on energy and on macroeconomics should be conducted simultaneously. Modelling on the oil pricing policy should be done together with the macroeconomics

policy so that demand-forecast could be made, future supply sources could be planned for and, possible effects on other policies could be studied. An energy scenario outlining the rapid change of the economy that will fit into the macroeconomic model must be drawn up.

Comment 3: Research on the energy model which includes updating, revising and synthesizing results properly linked up with the SIAM II - Macroeconomic Planning model should be able to assist the government in its energy policy-planning and decision-making.

6. The Energy Policy

Comment 1: An energy policy is most needed and an outline of the energy policy has been proposed by the NESDB to responsible authorities. Similarly, the private sector has also submitted a proposal for a national energy policy.

Comment 2: The economists and the industrialists should assist in drawing up a national energy plan. On the part of the industrialists, such a plan will be helpful in making appropriate investments on energy exploration if oil, gas and coal were included in the plan.

Comment 3: The energy policy/plan should be developed to aid the private sector draw up its investment plans.

Comment 4: The energy policy/plan should contain demand management measures such as energy conservation and taxation incentives as a means to encourage the use of locally-produced energy supply. And on the supply management, measures should include diversifying oil-buying sources to increase supply security and, encouraging more oil-exploration and lignite utilization as a means to achieve better self-sufficiency.

"Development Research and National Development"

Position Paper No. 7

SCIENCE AND TECHNOLOGY

by

Yongyuth Yuthavong
Chatri Sripaipan
Krissanapong Kirtikara

I ABSTRACT

The realization of the important role of science and technology in national development came at the right time for Thailand whose economy is undergoing a transition towards industrialization. But aside from the crucial role that it plays in the industrial sector, science and technology will exert significant influence over all other sectors of the economy: agriculture; natural resources and environment; human resources and social development; and energy, infrastructure and urban development. The introductory part of the paper briefly explains the reciprocal relationship of science and technology with development whereby science and technology could either be regarded as the forerunner that should influence the kind and level of development, or vice-versa, the development in the different sectors becomes the force that influences the type and level of development in science and technology. Along these two principles, the discussion goes further to building a framework for development of the various sectors hand-in-hand with science and technology and developing science and technology itself, by presenting a set of S & T input/output indicators, utilization and impact indicators and outlining components of the S & T system that requires special consideration in development. The paper highlights budget and manpower as key input indicators, whereas no single good indicator exists to measure the output of science and technology. 1,656 million baht which is 0.9% of the total government budget or 0.2% of the GNP is spent on R & D activities for science and technology. This is a low figure compared with the 2% GNP figure for developed countries and the 0.5%-0.6% figure for other developing countries. In terms of scientific and technical manpower, the shortage of degree-level engineers, an oversupply of technical manpower at a lower level, and the decline of natural science as a career constitute the main problems. There is a need to reverse these trends by increasing the supply of engineers, increasing the attractiveness of science as a career and upgrading the quality of technicians and craftsmen.

The succeeding section calls for a thorough understanding of the role of science and technology in agriculture and rural development, industry, natural resources and environment, human resources and social development and, energy, infrastructure and urban development and

stresses the integration of Science and Technology as a component in each sector's development plan. For S & T to be integrated in all the development plans it is necessary to strengthen the basic infrastructure of science and technology itself; to upgrade the quality of manpower; to build up R & D capability; to increase technology transfer; to increase scientific and technical services; to uphold and encourage basic science as a career and; to formulate general policies and strategies at the national level. This integration is achievable if a National Council for Science and Technology (NCST) had been created as was targeted in the Fifth Plan. The NCST will be an important body to forge badly-needed links between the government and the private sector to facilitate appropriate and effective technology transfer and to commercialize R & D efforts. Issues recommended for research by TDRI and the NCST and some issues dealing with developing a system for assessing S & T are outlined in a section before the conclusion of the paper.

II THE PAPER: SCIENCE AND TECHNOLOGY

1. Introduction

It is being increasingly realized that science and technology play a role of vital importance to national development, especially in developing countries. For Thailand, this realization comes at a particularly crucial period, when her economy is undergoing transition towards industrial orientation while, at the same time, the agricultural and other sectors need to become much more effectively modernized.[1] At the same time, the developed world is rapidly moving through an important post-industrial phase marked by many as the "Third Wave," a revolution of no less potential importance than the Agricultural and Industrial Revolution.[2] Both internal and external factors demand a new approach to national development based, not only on traditional economic and social considerations, but also on considerations involving science and technology.

Science and technology are defined here as a body of systematic knowledge about nature and its application in the production and distribution of goods and services. Development is defined as a process of change resulting in the continuous improvement of life and society. In this paper, we will be concerned mainly with development in various areas in the socio-economic spectrum. It is clear that science and

technology have a unique trans-sectoral role in development: development in all sectors critically depends on their scientific and technological components. These components include scientific and technical services and systems for generation and acquisition of new technologies and scientific knowledge. In general, the development pattern of any given sector in the country will dictate the pattern of science and technology development but vice-versa, science and technology are also major determining forces for the general development in that sector. The realization of this reciprocal relationship is crucial for a new and a more effective development planning. With this realization, two general approaches can be adopted in development planning. Science and technology can be considered as separate essential components in development plans for various sectors, or they can be considered as constituting a unique system or sector, intimately linked with the other sectors of the economy. The first approach will encourage development in various sectors through science and technology, while the second approach will favor development of science and technology, and their applications in various sectors. A suitable combination of both approaches should be found for optimum effect.

The major purpose of this paper is to offer a framework for developing the various sectors using science and technology as integral components, and/or developing science and technology in order to provide an infrastructure for the former process. In order to build this framework, the indicators of the status of science and technology in Thailand have to be first considered. Once the status is assessed, the role of science and technology in the various sectors can then be considered. This role is considered here only in brief outline, leaving specific details for further consideration and elaboration by appropriate planning bodies. Important components of the science and technology system requiring special effort in development are also outlined. Some of the concepts proposed have been considered on recent occasions.[3-5] Strategies are then proposed in order to build this framework, relying mainly on the integration of science and technology with development planning and, the organization of the science and technology system.

Finally, the role of Thailand Development Research Institute in the development of this proposed framework is discussed.

2. Status of Science and Technology in Thailand

In this section, the present status of science and technology in Thailand will be briefly reviewed in order to establish a baseline for further discussion on the role of science and technology in the various sectors. However, although some data are already available for the assessment of the science and technology status in general, there is still a great need for developing a set of indicators detailing input, output, utilization and impact of the various areas of science and technology and, their applications. An outline of suggestion for further development in the Assessment System is given in Appendix 1.

The scientific and technological status of Thailand has been periodically analysed.[6-11] With the exception of a recent analysis[12] however, the data mainly concerned the public sector by far, the major sector of the country. Since Thailand is on the inevitable path to industrialization, the need to monitor the status of the private sector in the future will become more pressing. The present data are compared, wherever possible, with the quantitative policy targets of the Fifth National Economic and Social Development Plan,[13] and guidelines are suggested for further planning.

2.1 Input Indicators

There are two main input indicators for science and technology, namely, budget and expenditure for R & D and scientific and technical manpower.

The annual budgets for research and development, and survey activities of government agencies since 1973, compiled by the National Research Council,[14] are shown in Table 1. To a certain extent, these figures roughly reflect the budget for R & D, although they are an overestimation because the survey activity, which accounts for about a quarter of the total budgets has been included. Presently, inspite of the

above-mentioned overestimation, the 1983 budget represents only about 0.2% of the GNP, far lower than the figures of more than 2% for the R & D activities in developed countries like those in the EEC, Japan and the U.S.A.[15] Developing countries like South Korea, Philippines and India are spending 0.5-0.6% of their GNP for R & D activities.[16] A target of 0.5% of the GNP has been set for R & D expenditure in science and technology for Thailand at the end of the Fifth Plan.[13]

Very few data are available on the contribution of the private sector to R & D activities in Thailand. A recent survey [12] however, for the first time gave a glimpse of the picture which turned out, as might be expected, to be an almost empty one. A survey of 105 companies which are members of the Association of Thai Industries representing a major fraction of large and medium-sized companies concerned with a wide cross-section of industry in Thailand, showed that their annual expenditure for R & D amounted to 65.5 million baht, while the annual sale amounted to 58,790 million baht. The percentage of the annual sale spent on R & D is therefore, only 0.11%.

In order to promote R & D activities in the private sector, the Ministry of Science, Technology and Energy has in 1982, drafted a law which will give tax and other financial incentives for the companies which will set up expenditure specifically for indigenous R & D for improvement and innovation in their products and processes. However, this law draft still awaits further negotiation with the Ministry of Finance.

Data given by the National Economic and Social Development Board[7] indicate that as of 1980, Thailand had a total of 55,790 scientists and engineers excluding medical science (with university degrees), 68,500 technicians (below-degree level) and 161,500 craftsmen (below-degree level). With a total population of 46 million, ratios of 12 scientists and engineers, 15 technicians and 35 craftsmen per 10,000 population were obtained. The figure for scientists and engineers may be compared with those of Japan (36) and USSR (51) for 1979,[16] with the conclusion that Thailand is still weak with regard to her

scientific and technical manpower. However, since many developing countries have fewer than 10 scientists and engineers per 10,000 population, Thailand can be classified, with respect to scientific and technical manpower, as a country in the middle stage of development.

The manpower production of universities and public colleges are shown in Table 2. There is no other existing system in Thailand at present to make reliable prediction of demand for scientific and technical manpower other than just compiling projections from various other institutions. A survey of the government sector by the Ministry of Science, Technology and Energy in 1981[17] indicated a shortage of degree-level engineers but an oversupply of technicians and craftsmen (Table 3). The demand figures represented the projections of individual government agencies which had to be approved by the Civil Service Commission, and take little account of the private sector.

Table 4 shows the number and distribution of scientific and technical manpower in 105 private companies that have been recently surveyed.[12] It also shows the approximate demand for additional manpower in the next five years. The total number of employees in these companies is approximately 66,000. The percentage of scientific and technical personnel are therefore 2.2% (degree level), and 5.9% (below-degree level). It is obvious from Table 4 that there is very little demand for personnel of high qualification, indicating weakness in the scientific and technological capacity in the private sector.

The number of scientists and engineers active in R & D in Thailand is not known with certainty. From a survey of the government sector by the National Research Council in 1979,[18] a figure of 2,010 was gathered with the following distribution: natural sciences, 341; engineering and technology, 222; agricultural sciences, 901; medical sciences, 546. These numbers are almost certainly underestimated since they are based on postal survey only. However, it can perhaps be reliably assumed that no more than 10% of the total scientists and engineers in the government sector are active in R & D. A survey of the private sector[12]

gave a figure of 5.6% of the scientific and technical personnel engaged in R & D. However, taking into account the fact that the personnel spend on the average only 46% of their time in R & D, it can be estimated that only 2.6% of the scientific and technical personnel, or 0.22% of total employees in full-time equivalent are engaged in R & D.

The Fifth Plan[13] has envisaged that the production of scientific and technical manpower is increased at an annual rate of not less than 10%, in anticipation to the rapid growth in the manufacturing sector. It seems, however, that more accurate demand figures are needed, in various fields and at various levels of qualification, in order to arrive at suitable supply-levels and growth-rates. Of no less importance, though this cannot be quantitatively measured, is upgrading the quality of manpower. There has recently been an alarming decline in the preference for natural science as a career by university entrants. This decline needs to be reversed by increasing the attractiveness of science as a career, and through other measures. The quality of technicians and craftsmen also need to be urgently promoted, since the present low status does not encourage suitable persons to take up the profession.

2.2 Output Indicators

There is no single good indicator to measure the output of science and technology. Each indicator will only give a limited amount of information on some aspects requiring even then, a very cautious interpretation. For scientific output, indicators may be chosen with justification from the number of publications in journals of acceptable standards, the number of scientific authors, etc. For Thailand and other developing countries, there are difficulties in counting such publications or authors since the local abstracting and indexing services are weak to the point of being almost non-existent. It is therefore necessary to rely on international indexing services such as those given by the Institute for Scientific Information (ISI) in the U.S.A. Although much criticism may be made against the ISI system, it is still the only international

yardstick at present. An exhaustive analysis of scientific output in the Third World during the period between 1971 and 1976[19] yielded some general conclusions which are summarized only for the ASEAN countries as in Table 5.

It can be seen that in the developing world, the ASEAN countries besides possessing the capability to produce considerable scientific output, are also moderate or fast-growers.

The distribution of output from various institutions in Thailand, based on ISI data, has been monitored for the past few years.[10-11] Table 6 shows the number of publications from various institutions in Thailand in international journals since 1977 based on ISI data.[20] It is important to point out that measuring the scientific output through counts of authors and publications ignores the output from scientific services, which is by far, the major function of science especially in developing countries. Here, an acceptable yardstick is needed and it should be a major task for science policy people to devise one.

If scientific output is difficult to assess, technological output is even more so. All the indicators that might be devised suffer from their dependence on non-technological factors as well as technological ones. The number and types of patents, the amount of royalty obtained from the export of technology, the income from export of technology-intensive products, the total value-added in the manufacturing sector, all these parameters measure in some sense or the other, the output of technology of a given country, but also do a complex of economic and other parameters. For Thailand, the difficulty is compounded by the fact that there is still a very young patent system. The Patent Act was promulgated in 1979, and only 146 patents have been granted up to March 1984 out of over 2,400 applications. There is little information on export of technology and technology-intensive products. One may, however, glean some information in this respect from data on imports and exports of engineering goods.[21] In 1980, imports of engineering goods totalled 70,043 million baht, while exports of engineering goods only amounted

to 24,375 million baht, out of which, most was for integrated circuits and basic metal. These figures indicate a weak status of the engineering industry in Thailand, which may in turn reflect a weak technological output.

3. The Trans-sectoral Role of Science and Technology and Policy Implications

Science and technology permeate all major spheres of development activities. This character spells both strength and weakness for science and technology. The strength lies in their universal applications to development activities: the weakness lies in the fact that they do not constitute the whole picture of any sector of development, but merely forming the integral components. Yet, the unique trans-sectoral role of science and technology is of enough importance to warrant the consideration of science and technology as forming a special system or sector. Therefore, science and technology deserves a special role in policy studies. Before such policy studies can be made however, it is important to have basic information on the role of science and technology in various sectors, including needs for R & D and other technical studies.

The role of science and technology in various sectors in Thailand are discussed in detail in Appendix 2. In order to correspond to the various development areas of particular interest to TDRI, the discussion centers respectively on the role of science and technology in agriculture and rural development, in industrial development, in the development of natural resources and environment, in human resources and social development and, in energy, infrastructure and urban development. Important topics for further R & D and technical studies are pointed out, as also issues for which the applications of known science and technology will lead to development. These specific topics and issues-ranging from "appropriate technology" for rural development to advanced technology for industrial development, from techniques in the conservation of the natural environment to those in the development of human resources, from the use of science and technology for economic returns

to their use for social benefits--form an essential background from which policy studies can germinate.

From a macroscopic viewpoint, the trans-sectoral role of science and technology gives rise to a number of policy implications. Should science and technology be included in sectoral policy considerations? If so, how? In Thailand, where the infrastructure for science and technology is relatively weak, there is a danger, if this approach is taken, of having only lip service without any substantive outcome. For example, while the importance of science and technology in a given sector is admitted, the relevance in terms of budget and personnel input may be easily forgotten in the light of other issues of more immediate concern to that particular sector.

The alternative approach, of considering science and technology as a special sector or system, has both advantages and drawbacks. The advantages include the prominence given as a sector, which at least guarantees specific policy considerations, and the positive interactions between various areas of science and technology, which would have otherwise been lost had they been considered separately as merely of service function in the various sectors. The drawbacks include the danger that science and technology may become isolated from the other important issues of development.

Both approaches are not mutually-exclusive, and it should be possible to obtain maximum benefit from a balanced policy. The recent fast pace of development in various sectors of development in Thailand, combined with an even faster pace of development in science and technology in the international scene, indeed calls for a balanced policy approach, which should be broad and flexible enough to allow science and technology to be called to the service of the various sectors and also, at the same time to favour the development of science and technology themselves.

The relationship between science and technology and the various sectors of development also leads to another major policy issue. What is the proper

balance between the "supply-push" and the "demand-pull" activities in science and technology? The former, which still constitutes by far the majority of the present activities in Thailand, is considered as promoting development in the long-term but may yield little immediate benefit and, worse still, may be incapable of solving immediate problems in development. The latter has recently captured the interest of policy makers as being immediately relevant to the problems at hand. However, the mechanisms to generate both the demand and the supply have still not been adequately studied.

4. Development of Science and Technology

To be capable of integrating science and technology with development in various areas, Thailand has to strengthen the basic infrastructure of science and technology themselves. In this strengthening of infrastructure, emphasis must be made on building up both the quality and the number of personnel engaged in the various areas of science and technology at all levels. These personnel and other support structures should be geared towards building up the capability in research and development (R & D), technology transfer, and general scientific and technical services. The importance of basic science as the foundation for science and technology should not be overlooked. Furthermore, science and technology education, both in schools and through non-formal channels, need to be improved and greatly widened in scope, in order that a public climate is established, favoring scientific and technological approach to solving problems in development. Finally, in order that these efforts become more successful, a general policy with accompanying strategies are needed at the national level. Science and technology policy and management, including the systems for assessing the present status and forecasting future trends, are crucial tools in making decisions concerning the future development of S & T required for the development of the country.

4.1 Development of Manpower and Supporting Structure

The development of scientific and technical manpower is costly and time-consuming, requiring careful planning and long-term commitment. Projections of manpower supply and requirement are presently fraught with gross assumptions and uncertainties. The need for making these projections to the best accuracy and the need for alternative models for policy decision, are yet to be fulfilled. The action plan for scientific and technical manpower development can then be elaborated. The development of manpower and institutions depends critically on the demand for science and technology in the public and the private sectors. The universities in Thailand are potentially capable of increasing their graduate outputs. While market demands in engineering and medicine remain high, the job prospects for science and agriculture graduates remain poor. The situation will certainly improve once the industry picks up more momentum. It is essential to anticipate this kind of development, since manpower and institution-building takes a long time.

Building up scientific and technological support structure should consist of strengthening both the education and the research and development aspects. The support can range from giving grants-in-aid to specific research proposals to strengthening infrastructural support such as sponsoring graduate programs in specific fields, workshops, symposia and other activities that will contribute to the "atmosphere" of the institutions. Great care should be taken however, so that support is not spread out over too many areas or, over too many institutions in a way that the momentum gets lost by the sheer scope of the program. The most important criterion would be to develop a core group of capable personnel who can successfully carry out the program.

4.2 Research and Development (R & D) and Technology Transfer

R & D comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge, and to use this stock of knowledge to devise new applications. Technology transfer means the process whereby technology is acquired, mainly from abroad, through various

means including the purchase of processes and equipment, and the training of manpower. The two activities are, to a large extent, interdependent: R & D can be meaningfully undertaken only in the presence of some prior and ongoing technology transfer activity, and technology can be meaningfully transferred only when there is significant capability generated to a large extent through R & D, to accept and to adapt the technology. Both R & D and technology transfer are essential in strengthening the science and technology system and, in utilizing them for other developmental purposes. In Thailand, these activities are still weak at present, especially in the private sector. Furthermore, there is very little linkage between the public and the private sector, so that what small capability generated remains static and untapped. There is urgent need therefore, to mobilize and enlarge the capability in R & D and technology transfer in both the public and private sectors and, to form links between the two sectors in order to enhance the flow of technology and knowledge. In this respect, it is essential to have measures to increase the demand for R & D in science and technology in the private sector, in addition to measures which will only increase their supply. The stimulation of demand should include fiscal and financial measures, giving incentives to industry to do R & D and to have meaningful technology transfer. Encouragement in terms of tax incentives, etc., should be given to companies so that they can either perform these activities themselves, or give contracts to the R & D institutes in the public sector.

4.3 Scientific and Technical Services

Adequate supporting services are essential for the success of any scientific and technological activities. These range from routine maintenance of instruments, to analytical services and supply of scientific and technological information. At present, the importance of these supporting services is not adequately realized by those with budgetary control. These services are essential for the maintenance of standards and quality control of industrial and other products. There is an urgent need to upgrade these services in Thailand so that both the status of science and technology in general and, the quality of industrial products in particular, can be significantly improved.

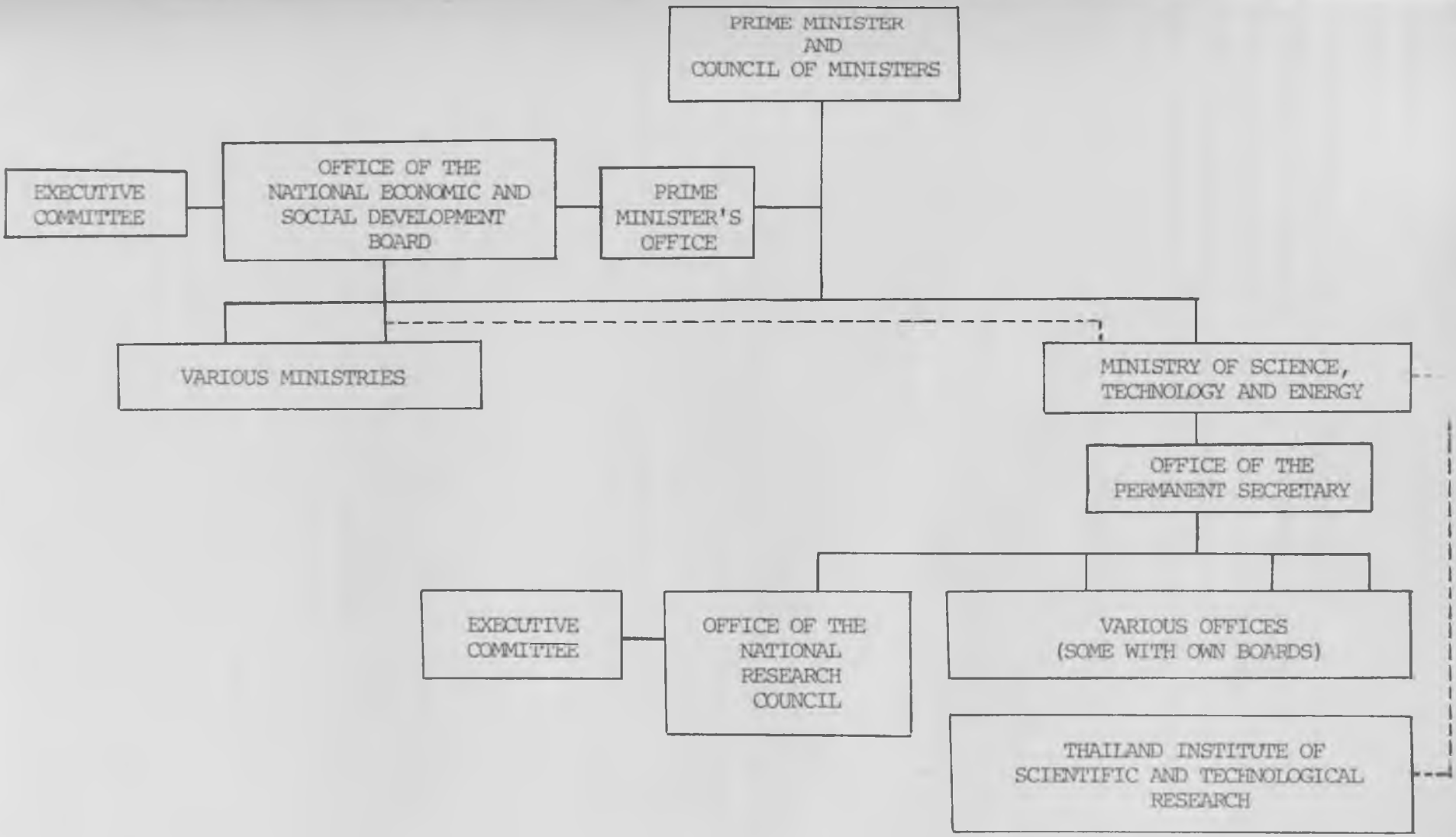
4.4 Basic Science and Science Education

No single area of science and technology can advance significantly in Thailand unless it has a sound base in fundamental sciences and in science education system. The current drop in interest to pursue basic science as a career is a problem of major concern. The best strategy for tackling this problem is to attract a small number of highly-motivated and gifted individuals with good scholarships and fellowships and, good job guarantees. In the past, the Ministry of Education and other government and international agencies were responsible for producing many good basic scientists by giving scholarships to top graduates to study abroad with an obligation to come back and work in government agencies and universities. These scholarships have been drying up recently, due to increased endogenous capability in science education in Thailand. However, there is a need for a small number of scholarships to study science abroad for two main reasons. First, there is need to prevent complete in-breeding; secondly, at least a fraction of our scientists should receive education from the world's centers of science. Precaution should be taken however, to ensure that these selected people come back and be absorbed into the local science and technology system.

The main thrust of the effort in the long run must however, be aimed at upgrading the local capacity for basic science and science education. This can be achieved only if the upgrading occurs at all levels, from school up to post-graduate. The competence of teachers appears to be the most crucial factor.

4.5 Science and Technology Policy and Management

Policy and management are the key to the promotion and application of science and technology in a broad framework. They are very important for Thailand, whose limited resources in science and technology inhibits the country's affordability to build and use them in a haphazard fashion. Presently, both the Ministry of Science, Technology and Energy and the



INFRASTRUCTURE FOR THE PLANNING AND MANAGEMENT OF SCIENCE AND TECHNOLOGY

National Economic and Social Development Board have responsibilities in these areas, the former concentrating more on the project and program levels, and the latter, more on broad policy issues in relation to socio-economic development. The main problem for both agencies is the lack of qualified manpower to deal with such important issues as budgets for R & D, running science and technology information systems, regulating technology transfer, forecasting and assessing technology, and planning of scientific and technical manpower. Training in policy and management for administrators, officials and others concerned is very important in ensuring that resources for science and technology are appropriately allocated and used, and the development of science and technology proceeds in appropriate directions. These issues will be further discussed in section 5.

5. Infrastructure for Planning and Management of Science and Technology

In this chapter, the present status of agencies dealing with science and technology for development will be briefly reviewed. An outline of future action will then be provided based on the tasks at hand that have been discussed in the previous chapters. It is proposed that the present structure for planning and management in science and technology be improved substantially, through the establishment of the National Council for Science and Technology. The role of Thailand Development Research Institute in research on planning and management of science and technology for development is further discussed in section 6.

.1 Present Status of Agencies Dealing with Science and Technology for Development

At present, Thailand already has some infrastructure for the planning and management of science and technology in relation with development (see Figure 1). However, this infrastructure is still weak and there is much room for further improvement. The National Economic and Social Development Board (NESDB) holds responsibility for the overall planning,

and therefore, for the integration of science and technology with development planning. In the Fifth Plan for example, the NESDB devoted a special chapter on science and technology. Due to its broad function in planning, NESDB necessarily deals mainly with major development program and broad concepts.

Planning in science and technology including energy, at a more detailed technical level is the task of the Ministry of Science, Technology and Energy (MOSTE). Major development projects with large science and technology components fall under MOSTE's responsibility, and so do also regular projects and operations in science and technology services, environmental monitoring, R & D support, etc. Although MOSTE is charged with a horizontal function in the planning of science and technology, its status as a ministry impedes its role in monitoring the progress of its plans in relation to the operations in other ministries. This dichotomy exists even in the Ministry's agencies, e.g., the National Environment Board, National Energy Authority and the National Research Council. These agencies, though under the bureaucratic control of the MOSTE, have their own boards chaired by the Prime Minister or the Deputy Prime Minister. Hence, a possible conflict of authority can be foreseen, although in practice this has been mostly circumvented.

The other agencies playing major roles in science and technology for development include the Ministry of Industry, Ministry of Agriculture and Cooperatives, Ministry of Public Health, Ministry of Education and Ministry of University Affairs. The first three ministries are involved as "consumers" of science and technology, i.e. in the utilization for their specific developmental purposes. The last two ministries are involved as "suppliers" of science and technology, i.e. making available the science and technology personnel. Needless to say, both the 'consumers' and the 'suppliers' of science and technology depend critically on the financial resources allocated by the Ministry of Finance and the Budget Bureau.

There is presently no agency dealing with the linkage between the public and the private sector in terms of promoting science and technology. The Board of Investment has been mentioned as the possible point for the regulation and promotion of technology transfer, but so far, no concrete action has been taken.

5.2 Integration of Science and Technology with Development Planning: The Role of the National Economic and Social Development Board

The National Economic and Social Development Board (NESDB) should continue to pay special interest to the integration of science and technology with development planning. Two major categories of development may be discerned for the purpose of planning: development through science and technology, and development of science and technology. Both are interdependent and should go hand-in-hand.

The essence of integrating science and technology with development planning is to define development goals, in quantifiable terms, which can be achieved through major inputs from science and technology, and to outline the courses of action that should be taken in order to achieve these goals. A number of crucial parameters may be agreed upon to serve as indicators of, and factors for, developmental change. These parameters need not, and should not, only be those of economic concern, but should also be reflective of development in a wide sense, spiritual as well as material, embracing also cultural, educational, health and environmental factors.

In science and technology as well as in other broad areas, three stages of planning are usually encountered according to three different levels of consideration: macro-level, sectoral level and project level. At the macro-level, overall priorities and broad strategies are considered, bearing in mind the present status and potential of science and technology, the social and economic background and the political commitment for future directions. The NESDB should be mainly concerned with this level of planning, since it is the central planning authority with over-

all responsibility for all sectors. At the sectoral level, specific targets are determined and guidelines for action and broad programs are formulated. At this important level, cooperative planning is required between the NESDB and the Ministry of Science, Technology and Energy (MOSTE), with direct responsibility in the areas of science and technology. Since science and technology has a trans-sectoral function, it is also necessary to have the participation of other government agencies. The project level of planning mainly involves specific technical considerations and the NESDB's role would be to ascertain its relevance to the overall program rather than to be entangled in the matters of narrow, technical concern.

5.3 Organization of Science and Technology: The Role of the Ministry of Science, Technology and Energy and the Proposed National Council for Science and Technology

The Ministry of Science, Technology and Energy (MOSTE) plays a crucial role in the organization of science and technology in order to serve developmental purposes as indicated in the Development Plans and, to formulate plans with technical details at the program and the project levels. MOSTE should therefore serve as the vital link between NESDB and various agencies both within and outside MOSTE with regard to science and technology. MOSTE should concentrate on both the development of science and technology and, their utilization for other developmental purposes. Using the various specialized agencies under its control, MOSTE can, in addition to planning, undertake implementation towards the targeted development goals. An Institute of Science Policy is being proposed to identify policies and implementation needed to achieve these goals.

In view of its status as a ministry, however, MOSTE cannot promote the program with major science and technology components in other ministries and agencies. Hence, its role in the horizontal promotion of science and technology is limited by its own status. In order to solve this

problem, which was foreseen before the establishment of MOSTE, it was proposed that the National Council for Science and Technology (NCST) be established as an inter-ministerial council chaired by the Prime Minister with the overall responsibility in the planning and promotion of science and technology in all agencies. The structure and function of the Council is similar to those of the Republic of Korea, Japan and other countries, where the problem of inter-agency integration of science and technology with development has been a common experience. Similar to these countries, it has been proposed that MOSTE act as the secretariat to NCST.

The establishment of NCST has been targeted in the Fifth Plan as a step to strengthen science and technology policy instruments. However, progress towards the target has been slow. After the Cabinet approved the draft law for the establishment of NCST in 1982, the law and related issues had to await deliberation in detail by the Committee for Reform of the Administrative Regulation and System, where the matter now, still rests.

If and when the NCST is established, science and technology can then be integrated with national development at the inter-ministerial level. The horizontal role of science and technology in various developmental issues has been stressed throughout this report, pointing to an integral, inter-agency approach to their planning and implementation. Furthermore, the NCST will be essential not only for a better integral approach to science and technology in the government sector, but also for a more effective linkage between the government and the private sector. The private sector is a very important user of science and technology, but so far, very little contact with the indigenous sources has been made and attempts have been mainly concentrated in the government sector, whose preference lies in the purchase of complete packages of technology from abroad. The NCST will be an important body to forge the badly-needed links, to facilitate appropriate and effective technology transfer, as well as, to commercialize indigenous R & D efforts.

An agenda of important issues which can be considered by the NCST is shown in Appendix 3.

6. The Role of Thailand Development Research Institute (TDRI)

Thailand Development Research Institute (TDRI) can contribute to development efforts involving science and technology in novel ways. As an independent institute, TDRI can make policy studies at depth, arriving at conclusions and recommendations without prior constraints and biases. The lack of constraints from a bureaucratic structure is an important asset and so is the fact that TDRI aims at research involving various aspects of development, hence having potential impact on various government agencies. The private sector can also be given special consideration owing to the non-governmental nature of TDRI.

With regard to specific issues, TDRI can concentrate on in-depth research on the various related aspects and the roles of science and technology in development. The independent status of TDRI is specially suited to the trans-sectoral nature of science, technology and development, and enables it to deal effectively with both the government and private agencies. Appendix 4 gives a list of research studies which might be effectively pursued by TDRI. This list is by no means exhaustive, and only serves to illustrate examples of important issues to which TDRI can make research contribution.

In order that the research results obtained by TDRI can be utilized to the maximum benefit, a mechanism of linkage is needed with important agencies dealing with science and technology in development, namely, NESDB, MOSTE and, in the future, NCST. Linkage should be forged at both formal joint projects, committees, seminars, etc. and informal levels. The aim is to optimize the complementarity between TDRI and these agencies.

International linkage is another important aspect to which TDRI can make important contributions. Science and technology, in addition to their trans-sectoral role in national development, are international in nature and cannot be done in isolation. In contrast to other projects of direct political, social or economic nature, bilateral or

international projects in science and technology are relatively easy to establish and should form an important part of bilateral and international cooperation. The recent US-Thai agreement on science and technology cooperation is a good illustrative example. The international interest of TDRI is suited to the international character of science and technology, and should serve to strengthen linkage between Thailand and other countries in the efforts to promote and utilize them for development.

7. Conclusion

This paper has attempted to paint a broad picture of how, depending on their own development, science and technology can make important contributions to improving the performance of the different economic sectors. It has briefly outlined the policy and planning aspects involved. It has pointed out specific aspects which require detailed research in order to obtain pertinent data and conclusions to be used as basis for further action. It has also pointed out the importance of linkages between the various agencies involved. It is foreseen that further development will involve positive action and cooperation among these various agencies. Science and technology are powerful tools in furthering development, but it takes time, resources and patient efforts to grow them to the state where they can be utilized optimally for developmental purposes. In making science and technology an important area for research in development, TDRI is adopting an appropriate approach which will yield rich benefits not only for science and technology themselves, but also more importantly, for the whole spectrum of development activities.

8. Acknowledgement

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9. Tables

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TABLE 1

GOVERNMENT BUDGET
for
RESEARCH, DEVELOPMENT AND SURVEY (RDS)

Year	RDS Budget (million baht)	Percent of Total Government Budget	Percent of GNP
1973	1,079	3.4	0.50
1975	1,191	2.5	0.40
1976	1,166	1.9	0.35
1977	1,277	1.9	0.35
1978	1,468	1.8	0.29
1979	1,331	1.5	0.24
1980	1,507	1.4	0.23
1981	2,549	1.8	0.36
1982	3,271	2.0	0.39
1983	1,656	0.9	0.18

Data are based on Ref. 14.

TABLE 2

SCIENCE AND TECHNOLOGY GRADUATES
PRODUCED IN THAILAND IN 1979

	Below-Degree Level	Bachelor's Degree	Master's Degree	Doctoral Degree	All Degree Levels
Natural Science	176	1,056	243	5	1,304
Agriculture	6,913	1,195	76	-	1,271
Engineering	28,513	1,400	51	-	1,451
Total	35,602	3,651	370	5	4,026

Source: Ministry of Science, Technology and Energy

TABLE 3

A. SUPPLY AND DEMAND OF SCIENTISTS AND ENGINEERS IN THAILAND

	Total	Natural Science	Agricultural Science	Engineering
Demand	42,991*	7,604*	9,487*	25,900*
Supply	40,109	8,280	9,429	22,400
Now employed (1981)	33,209	6,380	7,429	19,400
Now in science & engineering colleges (1981)	6,900	1,900	2,000	3,000
Balance	- 2,882	+ 676	- 58	- 3,500

B. SUPPLY AND DEMAND OF TECHNICIANS AND CRAFTSMEN IN THAILAND

	Natural Science	Agricultural Science	Engineering
Demand	5,055*	15,510*	68,564*
Supply		28,868	104,646
Now employed (1981)	4,689	13,258	61,646
Now in vocational colleges (1981)		15,610	41,000
Balance		+ 13,358	+ 36,082

* Government sector only

Data from Ref. 17

TABLE 4

MANPOWER FOR SCIENCE AND TECHNOLOGY
IN THE PRIVATE SECTOR IN THAILAND

Total number of companies surveyed: 105

	Below-Degree Level	Bachelor's Degree	Master's Degree	Doctoral Degree	All Degree Levels
PRESENT STOCK					
Natural Science	395	197	9	3	207
Agricultural Science	167	70	6	1	77
Engineering	3,353	967	140	6	1,113
Medical	10	75	7	2	84
Total	3,925	1,309	162	12	1,483
ADDITIONAL REQUIREMENT DURING THE NEXT 5 YEARS					
Natural Science	2	25	2	0	27
Agricultural Science	0	19	0	0	19
Engineering	429	226	11	2	239
Medical Science	0	0	0	0	0
Total	431	270	13	2	285

Source Ref. 12

TABLE 5

ASEAN COUNTRIES AS PRODUCERS OF SCIENTIFIC OUTPUT

Country	Classification by		
	No. of Authors	Growth	Authors/Capita
Indonesia	Moderate	Fast	Low
Malaysia	Large	Moderate	High
Philippines	Large	Moderate	Middle
Singapore	Large	Moderate	High
Thailand	Large	Moderate	Middle

Data are based on Ref. 19.

TABLE 6

INTERNATIONAL PUBLICATIONS

ON

SCIENCE AND TECHNOLOGY IN THAILAND

Institution	Number of Publications		
	1977	1979	1981
Mahidol University	86	102	106
Chulalongkorn University	21	33	42
Chiang Mai University	15	8	17
Kasetsart University	2	6	7
Silpakorn University	-	5	1
Khon Kaen University	3	4	7
Prince of Songkla University	1	4	5
King Mongkut Institute of Technology	6	15	4
Thailand Institute of Scientific and Technological Research	2	1	3
Ministry of Science, Technology and Energy	-	-	3
Ministry of Agriculture	1	5	9
Ministry of Health	1	4	9
Asian Institute of Technology	12	17	27
Others	3	34	27
Grand Total	153	238	269

Source: Institute for Scientific Information, U.S.A.

10. Appendices

APPENDIX 1

An approach to assessment of science and technology in Thailand through development of appropriate indicators

1. General S & T indicators

- Stock of S & T personnel (both quantitative and qualitative aspects)
- S & T institutions (R & D service, educational)
- Funds for S & T activities
- S & T communication
  - Number & quality of local journals
  - Professional societies & their activities
- Outputs of S & T (including conceptual problems)
  - R & D outputs
  - Outputs for scientific and technical service
  - Contributions to GNP and to export from technology-intensive products (and processes) and/or the manufacturing sector
  - Educational outputs

2. R & D indicators

- R & D personnel
- Funds for R & D
- Functional and institutional linkages of R & D system (with education & production systems; university-government-industry linkage). Indicators for linkage.
- Local-international linkage of R & D
  - Availability of information (journals, workshops)
  - Joint projects

- Outputs of R & D
  - Publications and patents (including extent of use)
  - Know-hows
  - Outputs in the three main sectors (government, university, private)

3. S & T education indicators

- Stock of graduates in S & T and production capacity
- Educational institute (universities and technical colleges)
  - Staff & staff/students ratio
  - Budget
  - Facilities & mode of operation
- Quality of S & T education

4. Technology transfer indicators

- Import of technology
  - Expenditures for technology import
  - "Free" import of technology (through available information)
- Diffusion of technology
  - Extension service
  - Training (formal and informal)
- Linkage between technology transfer and R & D
  - Local vs. local
  - Local vs. international

5. Indicators of selected areas in science and technology

- Biotechnology and agro-industry
- Microelectronics and microcomputers
- Engineering industry

- Chemistry and chemical industry

6. Indicators of public awareness and attitudes towards S & T

- Popular S & T publications
- Percentage of space given to S & T in leading newspapers; percentage of time allocated to S & T program on TV and radio
- Percentage of politicians and policy makers with S & T education
- Qualitative aspects
- Awareness and attitudes towards specific issues
  - Use of S & T in agriculture and other livelihoods
  - Environmental pollution
  - Energy

7. Use of indicators in S & T policy and management

- Targets of S & T policy: macro vs. micro-level indicators
- Use of appropriate indicators for policy and management purposes

8. Conclusions and further development

- A synthesis of indicators towards measuring S & T macro-system
- Comparison with international indicators (countries, ASEAN, OECD)
  - Assessment of "validity" of Thai indicators
  - Towards a scheme of indicators for developing countries
  - Where does Thailand stand in S & T?
- Suggestions for further development of
  - Indicators for S & T
  - S & T in general, based on indicators

APPENDIX 2

1. The Role of Science and Technology in Agriculture and Rural Development

Agriculture will, and should, remain to be a very important sector of the Thai economy for a considerable period in the future. The development of agriculture needs to take place hand-in-hand with rural development, in order to raise the living standard of the majority of the Thai population, who live in the rural areas and are involved in agricultural production. Science and technology inputs into agriculture and rural development span from simple, so-called "appropriate" or "intermediate" technology which can be mastered at the personal or village level, to development of new crop varieties through new methods of biotechnology. These inputs should be incorporated into agriculture and rural development activities through multiple mechanisms, both already available and yet to be devised.

1.1 Production of Food and Industrial Crops

Inspite of recent improvements, the yields per area of various crops in Thailand are still generally very low, and increase in productivity was brought about mainly through expansion of cultivated areas. Due to population pressure and the need to conserve the dwindling forest areas however, it is imperative that productivity increase in the future be brought about through improved yields per area, implying introduction of new technologies from seed improvement through improvement of farming techniques, to introduction of post-harvest technology. The so-called "Green Revolution" resulting from research on new varieties of cereals and other crops has been quite beneficial to Thailand as well as to other agricultural countries. However, the increase in productivity

in the past has relied heavily on energy-intensive inputs, i.e. chemical fertilizer, pesticides, water supply, farming machinery. The majority of the farmers in Thailand can ill afford the cost of these energy-intensive inputs, especially with the steep rise of energy cost in the past decade. New research approaches are therefore needed in order to place more importance on the question of reducing the cost of energy-intensive inputs as well as increasing the productivity. Important areas of science and technology relevant to these include the genetic improvement of crops.

New advances in research on tissue culture and other aspects of bio-technology should result in the genetic improvement of such food crops as legumes, cereals and tubers, and such industrial crops as rubber, oil palm and fibre plants. The search for high productivity and improvement in product quality, by increasing the nutritional value of crops is expected to remain dependent on classical approaches in agricultural research. However, the improvement of other characteristics, such as resistance to salinity, plant diseases and pesticides can be effectively achieved through genetic selection from tissue culture.

In the attempt to improve tropical agriculture of food and industrial crops, the main criterion would be to minimize the requirement for energy. Dependence of crops on artificial fertilizer can be minimized through genetic improvement and also through development of organic fertilizer from waste and by-products. Multi-cropping techniques can yield beneficial results and should be further explored, and so should soil enrichment through naturally-occurring microorganisms. Dependence on chemical pesticides and herbicides which, besides being expensive for small farmers, poses a hazard to the environment and a risk to health, can be minimized through integrated methods of pest and weed control and through more effective biological control. The reduction of environmental and health hazard of pesticides and herbicides is a matter of great concern and should be studied. The introduction of new and more efficient post-harvest technology should contribute substantially to reduction in loss and deterioration in the quality of

the product, on the way from the farm to the market place or, to the processing plant.

To ensure that the farmers actually obtain the benefit from the development of improved crops, an efficient system is required for the distribution of seeds and fertilizer and, for the extension of new farming techniques involved. Research is needed to define the optimum methods, the role of the government and the private sector, the pricing policy, and other mechanisms to achieve this aim.

1.2 Production of Livestock

The potential of animal husbandry in generating better and more food and income for Thailand is being witnessed by the recent rapid development in commercializing animal products, both for internal consumption and for export. This development arose through the use of new advances in science and technology combined with effective management. The use of feeds with balanced nutritional quality, of antibiotics to combat infectious diseases, and of improved genetic stocks all add tremendously to the increase in productivity. There are however, outstanding problems remaining in many areas.

Chief among these problems are the utilization of local sources for feedstuffs, and the prevention and removal of toxic contaminants. Materials abundantly available such as cassava, constitute important local sources, but appropriate protein and vitamin supplements are needed. Other potential sources which should be more adequately explored are those excess and waste materials from agro-industries.

Among the new technologies which will yield great benefits in the production of livestock are the technologies involved in the transfer of embryos and in-vitro fertilization. These technologies are superior to artificial insemination, and can supersede the old technologies in many cases. As with the other new technologies, their effective transfer to the producers of the livestock will be the main determining factor

for success.

1.3 Aquaculture and Mariculture

Inland aquaculture (raising of fresh-water fish, prawns, etc.) has long been practised with skill by the Thai farmers. Although traditional technology has been quite effective, its trial-and-error nature inhibits offering solutions to many problems. For example, an outstanding problem in recent years and still presently unsolved is the periodic outbreaks of ulceration in snakehead fish, sand gobies, etc. Problems in lobster-farming, eel-farming etc. have, on the other hand, been effectively tackled through the introduction of new technology. It is obvious that aquaculture as a science should be greatly developed in Thailand. With appropriate technology and management, inland aquaculture and mariculture (shoreline aquaculture) should become a very important source of food and income in the future.

Thailand depends greatly on deep-sea fishery for her export income. However, the present approach of simply gathering and hunting in the waters is akin to the pre-agricultural age on land more than ten thousand years ago. The finite resources of the sea are fast dwindling, and the problem of conservation and development of existing resources will become increasingly pressing. Optimum methods for harvesting, optimum use of catches, definition of zones and periods for conservation, etc., are topics which need to be addressed in the development of living marine resources. In addition to fresh and seawater animals, new aquaculture techniques should be developed for sea weeds and other edible aquatic plants.

1.4 Rural Development and "Appropriate" Technology

Agricultural development and rural development have to go hand-in-hand, since by far, most of the rural employment is in the agricultural sector. The main problem however, is in the diversification of the rural employment, so that not only agriculture but also agro-industry and the

other sectors of the economy can have a greater share than before. This diversification is necessary in order to lessen the problem of underemployment and mass migration to urban areas where the industries are located, especially during the off-planting season. Therefore, in addition to agricultural development, it is necessary to plan for the development of small and medium-scale industries, agro-based and otherwise. Given the present weak infrastructure of the rural areas, a plausible strategy in the short-term might be to encourage the growth of industries in selected centers outside Bangkok, well-placed in terms of communication and other components of infrastructure. In the long-term, strategies may be needed for self-development of villages based on low-cost agricultural and cottage technologies. Prerequisites for this would include the existence of a healthier infrastructure than at present.

The application of "appropriate" technology, employing relatively simpler, smaller-scale and self-help approaches, has been advocated as a key to alternative development style which in the long run, could be of more value than conventional approaches. In the absence of a strong infrastructure in the rural areas, simple forms of technology seem to be the only available choices and hence, "appropriate" technology should be seriously considered for promotion. Improvement of traditional technology and introduction of new, simple technology can contribute greatly to the occupational status and livelihood of the rural population. Examples range from technologies contributing to rural employment projects presently undertaken through government support, to technologies for the procurement of amenities and health-care at the family and individual level. Small-scale irrigation systems, biogas digesters, and improvement of traditional health-care through the aid of new medical knowledge are some of the specific examples which illustrate the value of "appropriate" technology. As development proceeds, the complexity of technology may increase to an intermediate level and hence, the term "intermediate" technology is sometimes used synonymously. The key feature is however, always based on maximum employment and community participation, as distinct

from large-scale technology usually based on capital and often leading to alienation of the community.

It is clear that "appropriate" technology as discussed above has a large role to play in rural development. However, development needs of various rural communities are not the same and therefore, the technology cannot be rigidly prescribed. What is appropriate to some communities may not be relevant to others, or may even retard the development in yet, others. Another complication may arise out of the misconception of "intermediate" technology as that belonging to a mediocre level, which in the long run can lead to a blind alley. A judicious choice of technology determined by community needs is therefore essential for technology-based rural development.

2. The Role of Science and Technology in the Development of the Industry

Many have predicted that Thailand will become "semi-industrialized" and almost completely self-sufficient in energy in the 1990s. Because of its natural advantages and traditional base in agriculture, agro-industry is expected to become the largest foreign-exchange earner. The resource-based industries should be developed to increase the value of ores and the limitation of market. Light industrial manufactures may prove to be competitive in export though there will be little heavy industries in the near future. As the provinces prosper, there will be great demand for modern infrastructure such as roads, electricity, water supply, telecommunication, etc. and commodities such as buildings, vehicles, consumer goods, etc. In this regard, science and technology will have a vital role to play in selecting the right industry at the right level of technology, in optimizing indigenous resources for the development of these industries and, in providing us with a better environment to live in. Below, we shall discuss the role of science and technology in the development of some selected industries.

2.1 Agro-industry

Thailand is blessed with an abundant supply of agricultural products,

the excess of which has, and should continue to earn substantial income from export. The two most important issues to which science and technology can make substantial contribution are the processing of agricultural products to achieve high value-added, and the quality-control and improvement of both fresh and processed products. For both issues, post-harvest technology should be a very important factor for the success of retaining, both the quality and the quantity of farm output right to the processing plants or, to the market. Biotechnology, including genetic engineering, is still at the beginning stage in Thailand at present, but should soon provide crucial tools in the processing and the improvement of quality as well as the improvement in agricultural yields.

Illustrative examples should suffice to indicate the value of improvements in science and technology in agro-industry. Improvement in the value of cassava starch can be made, not only in minimizing the toxic cyanide content, but also in upgrading the nutritional quality, pelletizing process, etc. Furthermore, the starch can be utilized as raw material for production of such chemicals as glucose, ethanol and pharmaceutical products through fermentation and enzyme industries.

Food industry will continue to be an important industry for Thailand, gaining in strength as the relevant science and technology improves. It is important to emphasize that both the large and small-scale industries will require science and technology inputs. In the small-scale fermentation industry for example, traditional practices can be considerably improved by blending with new technologies. The present production of fish sauce, soy sauce and other fermentation products in terms of fermentation time and other aspects can be greatly improved to produce better-quality product. Relatively large-scale industries, for example, those for production of amino acids will at first, require imported technology, which should be indigenized in the long run.

Another important contribution of science and technology in agro-industry which should not be neglected is the utilization of waste and by-products.

This serves, not only to economize the process, but also to lessen environmental pollution. However, the profit incentive is often not strong enough, and this, combined with the weakness of environmental regulations and monitoring leads to the entrepreneur's neglect of adequate treatment of waste and utilization of by-products. Relatively simple and efficient technologies are available and should be developed further to help strengthen this aspect of agro-industry in Thailand.

2.2 Chemical and Resource-Based Industry

This important group of industry is still in a stage of infancy in Thailand. Aggressive planning and investment in this area, both by the public and the private sectors will however, likely result in a fast growth and maturity of this industry in the near future. Because of the present weak infrastructure, and because of the intense competition from abroad, Thailand needs to be very careful in the choice of areas for development in this industry. For strategic and other reasons, it is advantageous to consider links with the agriculture and the other industries, especially agro-industry, which are relatively stronger and therefore may help to nurture the budding chemical industry. For example, the demand for fertilizer and pesticides for improved agricultural yields, presently met mainly by imports, represents a stimulus for local development. Processing of rubber represents an example of downstream technology which can be beneficially developed. Development of pharmaceuticals is another area which can serve the purposes both for import substitution and for export. Other areas for consideration depend on the concurrent development of other industries. Hence, if the resource-based industries and engineering industries are to grow substantially in the future, the demand for chemicals for processing and product components will also grow and should be planned for, at an early stage.

In addition to hydrocarbon resources on which the chemical industry is based, Thailand has rich deposits of many minerals which can form raw materials for resource-based industries. At present however, the

level of technological sophistication and local demand in Thailand is not yet very high. These resources are simply mainly exported as raw materials for industrial processing and use of the developed countries. The prices of these commodities are relatively lower compared with the finished products, and the market continuously fluctuates. It makes sense, therefore, for Thailand to acquire the capability for processing her own mineral resources in the future. However, even if such capability is achieved, it is uncertain whether these products will find use in the local industry or, will be competitive in the world market for at least a considerable time. A recent failure of the soda-ash project to get started in Thailand is an example to demonstrate this point. It is worthwhile to make case studies and feasibility studies on processing various types of resources, in order to make the correct policy decisions concerning their development.

2.3 Engineering Industry

The engineering industries include iron and steel, metal products, general industrial machinery, electrical machinery, and transportation vehicles. Their value-added increased from 12,100 million baht in 1975 to 33,700 million baht in 1980 or grew at an average annual growth rate of 22.8 percent. They remain a small part of the manufacturing sector. Their share of the manufacturing value-added is 18.5 percent and that of the GDP is merely 5 percent. However, the engineering industries have strong backward and forward linkages among the products and tend to be the "carriers" of technological change that affects, not only the engineering industries, but all the other industries as well. Therefore, it is important that the local engineering capital goods sector be developed to manufacture machineries for the other sectors.

The engineering industries in Thailand can be broadly divided into small and large firms. The large firms mostly assemble imported parts to become consumer goods intended for either the domestic or the international market. They possess good engineering capability and have access to foreign technology. The small firms usually concentrate on

the production of machinery and parts mainly for agricultural processing and for repair works. They usually have little or insignificant management and technological know-how. Science and technology can be employed in these small firms by raising the standard of their product so that they may serve as suppliers of parts to the large firms.

The technologies in the engineering industries may be classified into hardware and software. The software refers to the management systems which include forecasting, production planning and control, inventory control, management information systems, finance and marketing. The hardware technology is embedded in processes such as casting, forging, heat-treatment, welding, machining, metal-forming and plating. Each process has its own variation and levels of sophistication. Both the hardware and the software technology listed above are applicable for all manufacturing industries and are not product-sensitive.

The above-mentioned technologies need constant updating and upgrading so that the products remain competitive. Automation technologies such as computer-aided design (CAD) and computer-aided manufacturing (CAM) need to be introduced. CAD can substantially shorten product development time. CAM reduces the skill requirement of the machinist although there is an additional requirement for computer programming.

2.4 Electronics Industry

Although electronics is classified as one of the engineering industries, electronics industry deserves special mention as the main technology that will carry us into the "Third Wave " or, the Information Age[2]. The information-related industries which invariably uses electronics already accounts for more than 50 percent of GNP of the United States. This new technology offers us an opportunity to leap-frog into the new age without treading into the paths of other developed nations. However, to take up this challenge, political will, imagination and determination are needed.

The world production of electronics in 1983 was 5,244 billion baht and it has a rate of expansion of over 10 percent a year even throughout the recession. In particular, microprocessor-based products have been growing at over 50 percent a year and electronic office equipment at over 35 percent a year. Seeing the success of newly-industrialized countries (NIC) in exporting electronic products, there is no reason why Thailand should not join the club.

In 1982, the electronic industry in Thailand had an annual production worth 10 billion baht and employed about 15,000 workers. The integrated circuit (IC) assembly which accounted for about 6 billion baht was destined wholly for export. The radio and television industry took care of about 3.5 billion baht leaving another 1.5 billion baht to be shared among consumer products such as audio-amplifier tapes, professional products such as radio transceivers and components such as electrolytic capacitors. As the income of the population increased, the demand for electronic products followed. Apart from these consumer products, two areas of fast expansion are the telecommunications and the computer industries. The Master Plan of Telecommunication (1982-1991) envisaged an expenditure of 36 billion baht in the Fifth Plan and 93 billion baht in the Sixth Plan totalling 130 billion baht in telecommunications by the government sector alone. In Asia, Thailand probably has one of the fastest rates of increase in computer usage at the moment. The market should reach a billion baht in the next few years.

Although the industry is capable of manufacturing a number of products including some non-standard components such as inductors and printed circuit boards and a number of mechanical parts, still the industry needs better tools and dies, plastic moulding, aluminum die-casting and some chemical technologies to produce higher-quality products. The design and development activities in electronic circuits are, at present, not extensive, but will certainly become so, as the products diversify and become microprocessor-based. As for the production of components requiring specialized technologies both for materials and chemical processes, the technology would most likely have to be imported. Some

key technologies that we should look into are:

(1) Telecommunications

Since Thailand is presenting a huge market for telecommunications products, the know-how for the system design of communication networks needs to be developed to decrease external dependency in subsequent projects. Products that should be locally-manufactured are PABX, PBX, transmission and reception equipment, etc.

(2) Computers

Thai engineers have successfully designed a personal computer that is being marketed. Technologies to manufacture computer peripherals for local use and export should be obtained through joint ventures. Software technologies need to be developed by training the necessary manpower. Software engineers are in great demand for servicing the computer industry as well as the other industries. Computer software can also be a source of foreign exchange.

(3) Integrated Circuits

The heart of an electronic equipment is usually an IC. Although there is a huge number of standard IC's available, the "cutting-edge" of competition sometimes lies in custom IC's and special IC's. Modern technologies have made small batch production economically feasible. Therefore, it is necessary to be able to design and fabricate IC's in the long run.

IC's can be designed by using a computer. The software package has to be bought and its usage has to be learnt. Our universities already possess some silicon technology. With proper assistance, production technologies may be acquired in a few years.

3. The Role of Science and Technology in the Development of Natural Resources and Environment

Although Thailand is rich in natural resources, these resources are finite and the uncontrolled exploitation could soon result in their depletion. Moreover, reckless exploitation of natural resources inevitably leads to complex problems of the environment: depletion of forests leads to problems in maintenance of soil quality and control of water flow, mining in the sea leads to marine pollution of dangerous consequence to living marine organisms, etc. Other problems of the environment stem from increased industrialization, leading to waste-disposal problems and industrial pollution. Science and technology are needed to solve these problems, and therefore need to be integrated into the development plan for natural resources and environment.

3.1 Natural Resources Information and Management

Important natural resources in Thailand include forests, soils, minerals and water. There is a need for an accurate and continuously updated inventory of existing resources, in order to plan for future utilization and conservation, and to monitor the trend of their exploitation. Mapping of areas in terms of resources is still very inadequate in Thailand and should be improved by various new techniques such as remote sensing and other means. Thailand has recently made significant investments in remote sensing technology by setting up the Landsat/Metsat Station in 1982. This technology should contribute greatly towards the objective of keeping an active inventory of important resources. Other more conventional techniques should also still be employed in order to gain information on specific areas in detail.

The management of natural resources is greatly and urgently needed. The activity involves macro and micro-level planning, and development of programs for resources management. The approach initiated in Thailand so far has been devised in the form of integrated programs for specific geographic areas, for example, the Eastern Seaboard and

the Songkhla Lake. This approach should be expanded to cover other important areas, both inland and coastal. Science and technology can contribute greatly to the many aspects of these programs, such as in gathering preliminary baseline data and continuous monitoring, in compiling inventories of resources, and in conducting the necessary ecological studies.

3.2 Conservation of Forest Resources and Afforestation

Rapid deforestation is an alarming problem in Thailand, requiring urgent and substantial measures covering law-enforcement, human settlements and agricultural reform. Integrated approaches are needed for the control of deforestation, management of existing forests, afforestation and optimum utilization of forest products. The contribution of science and technology to these approaches range from issues of soil erosion and climatic change to mass planting of fast-growing trees, use of mycorhiza for soil enrichment and preservation of the genetic pool of the forests. The specialized ecosystem of mangrove forests deserves a special mention, in view of its importance in the extended shoreline areas in Thailand.

3.3 Preservation and Improvement of Soil Quality

With increasing intensity of agriculture, the problem of preserving and improving the soil quality becomes even more urgent than in the past. While there has been a steady progress in the development of technology for prevention of soil erosion and improvement of soil quality, the same cannot be said of the management of land use. Roughly, the same situation exists on the problem of controlling deforestation and in managing the existing forests. Preservation and improvement of soil quality, including protection of soil from desertification should be emphasized both in the technological aspects, and in the aspects involving the management of land use. Regarding the former aspects, agricultural techniques which do not deplete the quality of the top soil, especially the content of trace minerals,

should be carefully examined and balanced carefully with those techniques which may well yield greater productivity but may leave the soil exhausted. An area of great importance for further work concerns the optimal utilization of marginal lands, including semi-arid lands and lands with inappropriate acidity, salinity, etc.

3.4 Development of Mineral Resources

Although Thailand has substantial mineral resources, there has been little research on the utilization of these resources in addition to survey work. The major problem with R & D on mineral resources is that, a number of important aspects require high technology which is presently beyond the control of Thailand. Development of these resources are largely tied to the production system of the developed world through transnational corporations, international market and consultancy and major capital. With the Thai economy and the science and technology system undergoing a process of maturity, this situation should change significantly. Thailand should acquire much better capability for processing her mineral resources. However, this development should take into account market demands, economic feasibility and linkage with downstream technologies.

3.5 Development of Water Resources

In view of the importance of water, both as a natural resource and as a hazard, there has been too little attention on the many aspects of its development in Thailand. While relatively large-scale projects, such as the construction of large dams for hydroelectric power or irrigation have been given prominence in the past decades, the small-scale projects for water management have been given serious consideration only recently. Furthermore, the one-dimensional outlook given by those responsible for the large-scale projects have often created negative impacts which could otherwise have been avoided or minimized. By now however, the Government is already aware of the adverse environmental impacts that unavoidably accompany such large-scale projects,

including deforestation, ecological disturbances and consequences on the public health due to the increase in water-borne diseases, etc. From the bitter lessons of actual experiences, the problems of human resettlement and its effect on the livelihood of those directly or indirectly depending on a water resource which has been modified are also, now becoming more clearly understood. These lessons should be valuable for planning future projects, so that the benefits and drawbacks are carefully balanced against each other, enabling selection of the best option available.

It is convenient to classify development works on water under two different but related aspects: water as an economic resource, and water as a basic human need. The former includes work on large-scale irrigation systems, transportation, industrial utilization and harnessing of hydropower. The latter aspect includes works on procurements, and the use and conservation of water in rural communities. Understandably, because of the lack of immediate economic effect of the latter, there has been relatively little research on this aspect except under the realm of "appropriate technology." Recent trends have, however, been encouraging with greater emphasis being put on small-scale self-help systems for water management. Some new technologies and systems developed for use in the desert areas can also be transferred and adapted for appropriate use in some regions in Thailand.

Development of water resources should be stressed on both the quality and the quantity aspects. For water as an economic resource, emphasis should be made on operations research in water management, in order to increase the efficiency of water usage. For example, the present low-efficiency of water usage for irrigation (13%) could be greatly improved. In order to obtain optimum benefit from the large-scale irrigation or hydroelectric schemes as well as to minimize the adverse effects of flooding and salinization, research is needed, not only in the construction aspect of dams and channels, but also on the optimum methods of their management and maintenance. Small-scale schemes may be more appropriate, or even the only alternative, under many circum-

stances. For water as a human need, research is needed for the development of self-help systems in rural communities, including the organization of water management in the farm. Appropriate technology for the procurement of groundwater or water from other sources needs to be developed. The water needs to be free from pathogens and pollutants. Efficiency in usage and conservation techniques are important in areas where water is a scarce resource. Both endogenous research and adaptation of transferred technology should be encouraged, in order to contribute to the development of water resources in both aspects.

Attention needs to be paid also to water as a hazard. Hence the problems of flood control and management deserve mention, and so do the problems of wastewater treatment, both from household and industrial use. Although the technologies are known for the solution of most of these problems, they are not always appropriate and in many cases, they require adaptation.

3.6 Pollution Control and Waste Utilization

Waste from either household, industrial or agricultural sources causes pollution problems if it is not properly treated. The economic ways of waste treatment can be found by using it as a resource, albeit of low-value. Specific problems in waste utilization in Thailand are not very different from elsewhere, and much can be gained from technology transfer. There are however, local differences which may require special investigation.

In Thailand, serious problems from pollution of organochlorines, paraquat and other harmful agents are end-results of the unrestricted use of chemical pesticides. The extent of these problems is not clear and requires detailed studies. The dumping of industrial chemicals, including heavy metals in some areas has also been periodically reported to cause severe health and environmental problems. The scale of this problem should also be assessed. Appropriate measures to control these pollution problems will require contribution from science and technology.

4. The Role of Science and Technology in Human Resources and Social Development

Science and technology have a potential major contribution towards human resources and social development in Thailand. Major areas of contribution are in health, population and education. Human resources should by far, provide the major asset for any country and, for a rapidly-developing country like Thailand, special efforts should be devoted towards their development. Although the investment cost may be high and the return slow, this investment needs to be made in order to ensure the long-term progress of the society.

4.1 Health

Thailand has committed herself to the goal of "Health for All by the Year 2000" set forth by WHO and should, by all means try to achieve it. In order to achieve this aim, a community-based system for providing health services or, primary health care, need to be established. This system relies, not on the improvement of the professional capacity of doctors and nurses, etc., the supply of which is very limited, but on the improvement of trained village-level health communicators and volunteers, backed up by a professional personnel. However, as Thailand develops further, the need for professional personnel will greatly increase which must be satisfied to a considerable extent.

Where science and technology serves to provide support measures both in the provision of primary health care and medical services at more professional levels, Thailand must be capable of sustaining the required resources however and wherever needed. Infectious, debilitating diseases such as malaria, diarrhea and liver fluke diseases need to be controlled through the use of new information from biomedical science. Since most of these diseases do not occur in industrialized, developed countries, they do not attract the attention of the research community there and it remains for researchers in endemic countries like Thailand to do the utmost in order to become self-reliant as far as possible. The

problem of drug resistance for example, chloroquine resistance of falciparum malaria in Thailand, need research both in the laboratory and in the field. Some local remedies for parasitic and other diseases are worth investigating in a systematic manner. Results from this research might refute, support or suggest means for further improvement of these remedies. The research will often involve identification, isolation, purification and study of pharmacological properties of natural products, and require a combination of efforts in the various sciences.

Protein-calorie malnutrition and vitamin deficiencies are paradoxically prevalent in Thailand, which is an exporter of food and other agricultural commodities. There is lack of much basic information on the pathophysiology of malnutrition, and on the interaction between malnutrition and infection. Priority should be given to research in these areas.

4.2 Population

Although the success of family planning programs in Thailand has considerably reduced the scale of the population problem in recent years, the problem is still important and full attention must be paid to it in relation to the development of human resources and the society. Many aspects of the problem require input from science and technology for their solution.

One major problem that is yet to be solved in this area is the reduction of the male fertility. In the past, the control of population growth has been achieved mainly through the use of contraceptives and other devices for women. Although vasectomy and the use of condom are contributing substantially to the control effort for men, convenient methods based on chemical agents are still lacking. The apparent success in the use of gossypol for controlling male fertility in China represents an interesting development. However, much further work needs to be done on the safety and on other aspects as well, if this and

other new methods are to be seriously considered for use in Thailand. It is also worthwhile to research for other natural products in Thailand with similar anti-fertility effects.

In recent years, the issue of population control has evolved to become one of population development, implying that the former is dependent upon the latter. Therefore, it will not be sufficient to simply supply the people with the means to reduce their fertility, but an integral approach to population development is required, including the utilization of science and technology to further their means of livelihood.

4.3 Education

There are two main aspects of relation between science, technology and education: education as a tool for the development of science and technology, and science and technology as a tool for the development of education. The first aspect will be dealt with in 4.4. The second aspect is important in view of the magnitude of the problems in the development of education ranging from non-formal to formal education at various levels. These problems are greatly alleviated through advances in science and technology. Various means of modern communication ranging from audio-visual aids to radio and television are very important in both formal and non-formal education. Computer and information technology can make very important contributions to the development of education through self-instruction packages, and other means of education depending on active interaction between man and machine. Moreover, not only the products of science and technology are relevant to the development of education, but also their techniques and content as well. For example, the use of psychological techniques is very important in the learning process. Knowledge on children's growth and development is essential for effective education in this level. Science and technology therefore, should be incorporated into the plans for educational development.

4.4 Science and Technology for the People: The Popularization of Science and Technology

Science and technology are common properties of mankind, and should form a substantial part of the culture and the way of life of the people in any society. The products of science and technology should be naturally adapted to suit the indigenous culture and way of life of the society and to enhance social development. In order to achieve this objective, there must be some understanding and appreciation of the value of science and technology among the public. Without this understanding and appreciation, the public will be exposed only to the products of science and technology that originate from outside the society leading to their ineffective and wasteful use, alienation and conflict within the society. It is therefore, necessary that a national program for popularizing science and technology be instituted so that the public will become aware of the value of science and technology, and be able to use them for their means of livelihood in their everyday life.

The targets of this program should comprise such important groups as the youth, the housewives, the people of various professions in both the rural and the urban areas, etc. The messages delivered must be selected, so that the contribution of science and technology to matters of their interest can be better appreciated. Moreover, practical benefits should be gained by the various groups of people from the programs for popularizing science and technology. For example, housewives should gain knowledge in family health and nutrition, farmers should gain knowledge in the use of fertilizers, motorcyclists should gain practical experience about fixing their motorcycles, etc. The mass media and various non-formal means of communication should be actively used to promote the popularization efforts. Many radio and television programs, newspaper columns and magazines already in existence can be adapted to provide more inputs from science and technology. Others can be created to provide explicit or implicit messages relevant to the popularization of science and technology.

In order to implement the popularization program effectively, regular contacts, formal or otherwise, are required between mass communicators, scientists and technologists, so that simplified yet accurate messages can be delivered to the public. Because of the technical complexities of some issues in science and technology, attempts to simplify them for public consumption can result in oversimplification and subsequently in confusion. In recognizing the importance of the art and science of public communication concerning science and technology, full support must be given to the program of popularizing the true potentials of science and technology to the public.

5. The Role of Science and Technology in Energy, Infrastructure and Urban Development

In attempting to delineate the possible role of science and technology in energy, infrastructure and urban development, one must bear in mind the non-mutually exclusive nature of these 3 key development issues. For example, a fast rate of urban development entails a high increase of energy consumption. To describe the scientific and technical contribution to energy development or urban development may represent the same input viewed from two different perspectives.

5.1 Towards Self-Reliance in the Development of Energy Resources

Since the inception of the Fifth Plan, it has been recognized that certain key energy policy guidelines of Thailand in the 1980's and 1990's require indispensible science and technology inputs for them to eventuate and be effectively implemented. Notable among these are the promotion and enforcement of energy conservation measures, maximization of domestic resources utilization and development of alternative energy.

(1) Energy Conservation

In the light of the uncertainties inherent in the future world energy supply situation coupled with the past

tendency of indiscriminate use of energy resources, the present glut and relatively stable oil prices should not obscure the importance of long-term energy-saving opportunity. Thailand must develop substantial long-term energy conservation strategies applicable to the industrial and the commercial sectors.

For industries, it is evident that a reduction in the energy component of the unit cost of a product is to be achieved through the implementation of energy management programs. In commercial and residential buildings, efficient energy use will lead to substantial reductions in electricity consumption.

Presently, there is insufficient data on the consumption pattern of various industry types. Comprehensive management program must begin with systematic data collection and analysis, followed by the identification of energy conservation opportunities and appropriate technologies. Emphasis should be made on mastering technologies pertaining to instrumentation for process monitoring and control, and the development of energy-saving equipment.

For commercial and residential sectors, about half of the total electricity consumption goes into maintaining a comfortable environment. The demand for more sophisticated building services is expected to grow with rising living standards. The need to minimize energy usage in order to save on the ever-increasing cost of energy is obvious. Research should therefore be carried out on buildings, energy modelling and analysis through computer simulation, determination of energy demand factors for diverse types of building as well as their functions, daylighting, natural ventilation and thermal characteristics of building materials.

(2) Development of Alternative Energy

Newly-discovered gas and oil will reduce the dependence on imported petroleum products, perhaps until mid-1990's. Increased coal utilization, indigenous as well as imported coal and lignite for industry and power-generation is expected. However, due consideration on environmental conservation must be accorded priority. Studies on large-scale coal storage, handling and transportation should ensure that siting of coal-fired power plants will take into account the necessary port facilities and adequate coal-ash disposal options. Novel combustion techniques leading to substantial reduction of corrosive oxides such as fluidized-bed combustion and catalytic combustion should be thoroughly mastered.

Nuclear energy will be the most economical method of base-load electricity generation. It is imperative to make the public aware of the indispensable role of nuclear energy in the long-term energy supply of Thailand. A firm decision to proceed must be made within the Fifth Plan, should Thailand wish to bring the nuclear-powered electricity generating plants into the energy supply picture in the 1990's. Examples of scientific and technological capabilities that need to be developed are production of yellow cake from uranium-bearing minerals and thorium from monazite, nuclear reactor operation techniques, R & D for fuel cycles and fuel-management technology, development of reactor safety engineering, development of special alloys using indigenous rare earth resources and fuel-fabrication technology.

To develop renewable nonconventional energy such as direct and indirect solar energy into energy sources of importance within the 1990's is not possible. However, technological

development of these new energy forms must be monitored through selective R & D activities. Those considered as having high potential are industrial process heat and electricity generation from solar thermal processes, photovoltaic power generation, gasification, liquefaction and fermentation of woods and agricultural residues.

5.2 Infrastructure and Urban Development

As the process of development continues, urban centers normally become focal points that attract people from rural areas. In order to stem the tide of mass urban migration, it is necessary to strengthen the infrastructure of rural areas, and to accelerate rural development. In anticipation of the rapid growth of these urban centers, their infrastructure also need to be strengthened. Furthermore, plans for urban development in all aspects need to be formulated in advance. In general, these plans will involve expanding the economic and social bases in anticipation to supporting the increasing urban population. These plans must therefore be carefully linked with the plans for industrial development, human resources, social infrastructure and various other areas of development.

Science and technology play a prominent role in the provision of basic urban and rural infrastructural facilities. Major problems in the urban areas involve flood prevention and control systems, provision of water for human consumption and industries, provision of adequate energy and material resources, provision of social services, namely education, health and cultural recreational activities. Problems on infrastructure in the rural areas, although less immediate, require similar consideration. Major engineering services are required for these facilities. In addition, the telecommunication system, particularly the telephone and the telex services necessary for modern industries, trade and services is far from satisfactory. The transportation network is another major issue that can either help or hinder a planned land use system. In dealing effectively with all these issues, science and technology are very much needed.

APPENDIX 3

Examples of issues which should be considered by the National Council for Science and Technology

1. Policy and plans for

   - Expenditure in R & D as a ratio of the Gross National Product (GNP)
   - Expenditure in basic and applied research and technological development
   - Linkage between the public and private sectors
   - Manpower development in science and technology
   - Popularization of science and technology
   - Structural adjustment and reform in science and technology system
   - Capability-building through, e.g., setting up of program for specific areas, setting up of specialized institutions, strengthening of professional societies

2. Measures through laws and regulations

   - Laws to promote technological development in the private industries through fiscal and financial incentives
   - Laws to promote the status of technicians
   - Laws for establishment of R & D institutions, promotion of science and technology information system, etc.
   - Civil service regulations concerning science and technology

3. Coordination of policies

4. Advice to the Council of Ministers on important issues concerning science and technology

APPENDIX 4

An illustrative list of research topics for TDRI on science, technology and development

1. General issues

- Assessment of the present status, utilization and impact of specific areas of science and technology through development of appropriate indicators (details in Appendix 1)
- Medium and long-term forecast of status, potential utilization and impact of specific areas of science and technology
- Use of science and technology in development of linkage among the private, university and government sectors
- Improvement of the R & D system in science and technology for development
- Promotion and regulation of technology transfer
- Restructuring of the science and technology education system to meet developmental needs
- Restructuring of the science and technology policy/management system to meet developmental needs
- Restructuring of the legal/financial system to promote science and technology for development

2. Issues concerning sectoral development

- Generation and diffusion of science and technology for the improvement of agricultural productivity
- Appropriate technology for a self-reliant rural development
- Development of science and technology-based industries in Thailand (e.g., engineering industries, electrical products and electronics industries, food and biotechnology-related industries)

- Generation of demand for science and technology in the industrial sector
- Science and technology for conservation and development of natural resources
- Environmental conservation and control of industrial and household pollution
- Science and technology in the development of the health-care delivery system
- Science and technology in the development of the educational system
- Popularization of science and technology

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III ISSUES OF DISCUSSION

1. Status of science and technology (S&T) in Thailand

Comment 1: Science and technology has been developed locally but only to a limited extent because of inadequate resources and an improper use of raw materials.

Comment 2: The transformation of the Thai economy from an agrarian society to a semi-industrialized society requires considerable effort to take place. The degree of industrialization should not be measured by a simple indicator. Several indicators such as the level of technology employed in production, the standard of living and the technological base, should be simultaneously considered. The last indicator is a very important factor in the process of development because of its role in increasing the domestic value-added of raw materials. At present, the level of technology in Thailand is deficient.

2. The trans-sectoral nature of S&T in development

Comment 1: S&T are important, but the linkage with the various sectors is still a problem. Besides, S&T institutions in Thailand are few in number and play a low-key role.

Comment 2: S&T have played an important role in agricultural development especially in the food production and the green revolution through the use of fertilization. But the future sees a narrowing margin to the age of fertilizers and therefore, other S&T knowledge and technique must come into play. However, in looking at issues to be studied to improve agricultural production, the infrastructure required should be carefully thought-out because funding could be made more feasible if the project is well-structured. Potentially useful programs

are in the areas where Thailand possesses comparative advantage in domestic resources i.e., herbs for the pharmaceutical industry.

3. Concept of development

Comment 1: The concept of development is varied. Some have considered development as a problem-solving process. However, if development is taken to mean helping people to be self-reliant, helping villagers to be able to help themselves, and therefore helping Thailand to be self-sufficient, then development will have a lot of economic and social implications.

In achieving self-sufficiency, it is important to first, do research on the basic structure of the country, the urban and rural areas and their problems. It is critical to understand the problems from the rural people's point of view. To insist on understanding the rural people from our point of view and forcing our ideas on them would be tantamount to failing in our development effort from the very start.

Comment 2: In defining the word "development," one can consider the 'people' from two different points of view, either as a subject or as an object. A system that regards the people as a 'subject' is, democratically-oriented and that which looks at the people as an 'object' is dictatorially-oriented.

Comment 3: People have different perceptions about development. For instance, when one perceives the rural population as the 'object' then the provision of services for these people could be seen as an obligation and therefore, participation in the decision-making process would not be given to the rural people. But if the rural people is viewed as a 'subject', then the perception of development changes into a process by which the people become active participants in decision-making which strengthens and improves their capabilities for

self-reliance.

Comment 4: The conceptual framework of S&T for development is not clear, which is a common problem among many developing countries. A comparative study on their conceptual framework must be conducted.

4. Development of S&T

Comment 1: The program of studies for S&T is not precise. It should be developed through the following stages:

Stage 1: compile available technology
Stage 2: screen suitable technology
Stage 3: apply technology in production
Stage 4: design and develop new technology research in new areas.

Comment 2: There seems to be a real emphasis on upgrading the quality of the human resource in the development of S&T. This is, however, not the complete picture since other components necessary for the development of S&T must be dealt with simultaneously.

Comment 3: People with low education should learn more about S&T and S&T application to their lives. In promoting this idea, it is essential to reorient research programs to respond to the people's level of understanding and need.

Comment 4: TDRI should take real interest in integrating the capabilities of engineers, scientists and economists on appropriate technology, so that research and development (R&D) can best serve the country within available limited budget.

5. The use of S&T for development and priority

Comment 1: It is necessary to have an understanding that technological

development is important and necessary for Thailand. In as far as exports are concerned, one may take into consideration the appropriate technology for export promotion and the necessary technology for production to induce such exports and to undertake research for such and such technology. That is to say one should establish a technological structure that will help us envisage our national development. For example, should we be concerned with increasing our productivity? If so, should we concentrate only on fertilizer? A work plan should be established which is acceptable to all concerned after which, projects can be formulated and executed accordingly. Or for industrialization, issues on the type of industry, factory, and the appropriate infrastructure to develop these industries must be considered. Therefore, it is essential that a work plan be established to help us clarify our needs, and seek for sources of funds in response to these needs. One must set the right priorities in these development efforts.

Comment 2: In planning to use S&T for development, priority must first be set as to what needs to be developed first. Should priority be given to the alleviation of the poverty of the poor? If yes, then it is essential to attach priority to short-term research which will bring about immediate result for the poor farmers who are waiting for help.

Comment 3: TDRI's first duty should be to make people comprehend that science and technology is not something far-fetched, but that it can be incorporated into their everyday lives.

6. S&T policy and management

Comment 1: Thailand should try to set a policy that will improve the country's basic structure with the help of suitable S&T and sensible management. In the past, Thailand has concentrated more on the construction of infrastructure such as roads, bridges and dams. We should now turn towards maximizing and

optimizing the use of our natural resources. This can be achieved without the use of very high technology, and too much research. We should plan to undertake effective researches in the short, medium and long-term to see what Thailand can do to promote industries that will best utilize local resources. TDRI can play a very useful role by undertaking research that will set the right priority in this area.

Thailand has large quantities of resources and these should be used wisely to help in solving some of the country's economic problems. We must therefore try to create an atmosphere conducive to solving these problems otherwise we will never be able to improve anything.

Comment 2: Research on S&T should take the two-pronged approach which includes high-technology and appropriate intermediate technology since both the industrial and agricultural sectors are very important.

In response to the issues:

To choose between adopting appropriate technology or medium-level technology is easy because Thailand is essentially an agricultural society. At the same time however, we have to follow certain directives for our national development. Even then, it is still possible to undertake development in both types of technology without having to sacrifice anything. Thailand is sufficiently big and endowed with sufficient resources to have the freedom and leverage to choose or opt for alternatives.

"Development Research and National Development"

Position Paper No. 8

DEVELOPMENT INFORMATION CENTER

by

Krisorn Jittorntrum
Anumongkol Sirivedhin
Kanchit Malaivongs
Vichit Pounnavatar
Thanet Norabhoompipat

I ABSTRACT

The introduction to the paper summarizes the importance of information with reference to the evolutionary process which society has undergone from agricultural to industrial and, from industrial to the so-called information age where information becomes the central resource. In the sequel, the interrelationship of information services with development research and its complexity are discussed alongside the need to have a development information center at TDRI. In fact, the paper asserts that, this need for a development information center becomes more apparent if TDRI hopes to emerge as a leading research institute in the future. On the basis that an information center must be capable of acquiring information, classifying, storing, repackaging and disseminating this information to suit the needs and specifications of users, the fourth section presents a review of existing and emerging technologies. It also discusses the presently-available data bases, on-line services, and the national, regional and international information/library services available in order to service various types of information requirements. Constraints do exist in such a highly sophisticated undertaking as the setting up of an information center. These constraints are each discussed in detail in the fifth section with due consideration to the institute's characteristics, its program of operation and activities in research and, the resources involved. The funding issue brings to light the fact that a development information center requires a long-term and continuous source of funds and, the time-scale factor highlights the long length of time required for an information/document center to be fully operational. The strategies and the plan to implement the information center at TDRI will follow the underlying concept of service, application-specific, complementarity and coordination as against collection and storage, integration, competition and centralization. For the TDRI Information Center to successfully spearhead the age of information, it must be able to provide all forms of information and data services to every customer, e.g., government agency, private individual, etc. Possible difficult areas are also discussed. Likely ones are acquiring data/information, breaking in and integrating into the existing community of library/

information services, the success of bibliographic system, moving towards an efficient link-up, adopting a standard for data specification, adopting a standard for Thai encoding, developing the appropriate software for computerized bibliographic information system, keeping abreast with the latest advancement in the telecommunication industry and dealing with the paucity and limited reliability of existing data. Given these numerous constraints and other technical obstacles, the paper concludes that, the tasks to set up the Information Center at TDRI would definitely be a complex and challenging one but, worth pursuing.

II THE PAPER : DEVELOPMENT INFORMATION CENTER

1. Introduction

Central to any form of development planning is information. In fact, the "right" information is indispensible if any form of development planning and policy formulation is to proceed at all. Information services free researchers and policy makers from the dreaded situation of "reinventing the wheel" and of unnecessarily duplicating efforts. More importantly, the benefit of information services is in the multiplier effect--the cross breeding of ideas and in the awareness that others are dedicated to solving pressing problems.

Information/document systems are the mechanics for accumulating the wealth of knowledge and experience. Developed countries in contrast to developing and less-developed countries have invested more in the development of information systems. In fact, a strong characteristic which distinguishes the developed from the less well-developed countries is in the status of development of information systems/services whether it is for trade, consumer, science and technology, natural resources planning and development, etc.

The importance of information is best summarized by referring to the very notion and the various implications of the "Information Society." Civilization has come a long way from the "Agriculture Society" where land is the central resource, through the "Industrial Society" and now to the "Information Society" where the central resource is information.

2. Information Services and Development Research

As already mentioned above, information is the very basis for any planning. In fact, information is deeply rooted in the essence of development planning so that scarcity and deficiency in information could seriously affect development planning. In the conduct of development and policy research, sharing of information is essential for the success of such research endeavours. Proper information services could lead researchers to pursue fresher challenges, avoid duplicating effort, and also, obtain a multiplied effect, sometimes called "a cross-fertilization of ideas."

Note however, that in the development process, information is, not only the most significant single ingredient but, all too often the least well-husbanded. The success on the extent of exploitation of the information base depends on many factors. Some of these factors are the following:

- the role and interaction of the development specialist and the information specialist;
- the degree of importance accorded to information and degree of use of information;
- methodological issues;
- supply of information;
- resource limitations.

Most organizations, either government or private agencies, have their own document centers, libraries or computerized information systems. Thanks to, or perhaps blame it to, the fever of interest in computer technology and its applications, most or almost every organization are now giving more resources for the development of a computerized information system. It may seem that the degree of importance accorded to information and the degree of using information has somewhat improved. But the 'real' reasons may be pointed to the lure of computer technology,

or just the simple reason of joining the crowd having a computerized information system.

In the development planning process, the problems of acquiring data/information is as much a problem of defining data/information. Data/information requirements depend, to a large extent, on the concept of planning in use. Development objectives and priorities, it was observed, keep changing in accordance with the stage of progress achieved, and the continuous unfolding of new problems and challenges. The diversity and complexity of information requirements may be accorded to the interplay of the following factors:

- changing development objectives and priorities and the changing urgency of problems;
- increasing sophistication in the planning techniques;
- nature of planning activities;
- decision-making environment.

For Thailand, since the formulation of the First National Development Plan (1961-66), the continuing process of economic growth, social transformation, political integration and modernization of the economy has constantly triggered new data and information needs in the planning and policy formulation. The increased sophistication in planning techniques and changes in development objectives and priorities have, in recent years, resulted in new data/information requirements and planning tools such as: the National Accounts, Input-Output Tables, econometric models, data base on rural development, data base on energy, and energy planning model, etc.

An observation made is that the fulfillment of data and information requirements for development planning and policy research is an onerous and complex undertaking. The development of information services means long-term cost-intensive investment, which yields the result--"information" only after a comparatively long starting period.

3. The Complex Nature of Information Requirements for Development Planning

As mentioned earlier, the information /document problem is very much the same as the problem of defining the information needed. Ideally, information services should be timely, reliable, up-to-date, appropriate, accessible and useful. But, it is surprising that information services are often totally divorced from research activities. If researchers have sometimes been criticized for creating "ivory towers," perhaps librarians and documentalists are also guilty of creating "paper towers." The amount of statistical returns, reports and other information gathering dust in government offices is unimaginable. A great deal of information tends to be collected. This consumes the scarce resources which perhaps could be used elsewhere. Much of this information is rarely used, and in many cases, even its existence may not be known except to those immediately concerned with its collection. It costs to obtain information. Thus, it is vital to know the exact specification of the information requirements: the type of information, the amount of information, its reliability and the format in which it is required. If the information about the required information is made available, the cost of providing the information is then reduced and the value of the information, enhanced.

If the information system is to be mission-oriented for the pursuit of goals in development planning and policy-making, the information must then be properly delivered to the development researchers and the government officials, who will use this information to perform their functions. And this can best be assured if researchers and government agencies are, in fact, the members of the community who are in cooperative relationship towards building the system.

Another related issue is that the exact specification of the information requirement is very much the function of the state of development of the economy, changes in development objectives and priorities, the levels of sophistication in planning techniques, and the nature of planning activities. Successive waves of information have been and

are being generated, in response to the expressed new needs. But often, both the generated and the available information fails to match the rapid changes in needs, that creates a perpetual state of inadequacy and dissatisfaction among information service users. Broad implications to strategies are the following:

- The critical issue is information on information requirements. The first phase towards the establishment of a development information center should concentrate on determining the specification of the information requirement. This phase is expected to take about one to two years--accidentally in agreement with the above implied strategy for postponement of the implementation phase for another year or two.
- The symbiotic process of information services, in order to function, requires researchers/development planners and information experts to understand each other's work. The development of the information system must be users'-oriented and services-driven. Thus, besides the obvious requirements in financial resource, equipment, technical expertise, etc., there is also the requirement for the rare ability in communications/human interaction to assure the needed cooperation between various researchers, government officials and technical eccentrics.
- As a total turnabout from the usual "taken for granted" recommendation to an integrated approach; because of the complexity and diversity of information requirements in development research, taking into account the various sectoral requirements such as: rural development, regional planning, science and technology, agriculture, natural resource planning, urban planning, industry, etc.; taking into account the continually-evolving and changing development priorities and the upgrading for necessary planning techniques; the recommended approach here would be that of

a "non-integrated" approach. The recommended approach, at least for the initial years, would be to service TDRI's research program which is unlikely to cover the overall spectrum of development issues. The concept of a comprehensive and integrated information system should not be overstressed. The underlying principle implied here is that of "service" as against being "central."

4. The Present State of Information/Document Center

An information center normally performs the following five functions:

1. acquisition of information/documents covering published and unpublished materials
2. classification of information/documents through cataloguing and indexing
3. storage of information/documents
4. repackaging of information to suit the needs of users
5. dissemination of information

The dissemination of information are mostly and traditionally done through specialized publications, selected dissemination of information (SDI) services, and also through computer-readable magnetic tape.

In the area of computer and information technology, there has been a continued dramatic progress with increase in storage capacity and processing power. The processing capacity of the computer has increased steadily around to 45% per year while the cost has decreased by 25% per year for the past two decades. And the trend is likely to continue well int the next decade. The use of computer in information systems applications is, thus, now taken for granted even for a developing country like Thailand. In more developed countries, the term "information center" is now being replaced by "information industry" and "information society." At present day (November 1984), there are more than 2,400 on-line data bases, and more than 345 on-line service companies worldwide and most developed

countries are having one or several experimental videotex/view data services in operation.

With the already existing and rapidly emerging technologies such as satellite communication, fibre optic, packet switched network, cellular radio, digital phone, the merging of communication and computer technology, optical disk technology for mass storage, and the onslaught of microcomputer, the ways for which information are captured, processed and disseminated will be changed somewhat. Any proposal for the development of an information system operating into the next decade should at least be aware of the possibilities opened up by new technologies.

4.1 International and Regional Information Systems

The two organizations primarily responsible for most of the international and regional information systems are the United Nations (UN) and UN affiliated agencies, and the International Development Research Center (IDRC). Most or almost all UN agencies have developed some kind of information system. A listing and a brief description of a selection of these information systems is included in Appendix 1. For a specific example, (INRES) the Reference System on Information for Technical Cooperation among Developing Countries, is a system developed and maintained by UNDP. This system collects and disseminates information on the technical resources that the institutions in developing countries can exchange with each other. The manner of collecting data is done by reporting salient information on the forms provided by UNDP. The system processes the information. The service provides an institutional directory, a question and answer service and a separate computer printouts for each country.

IDRC also involves substantially in the development of many information systems. Of special interest is that IDRC has the information science as one of its five major areas of interest. An information system promoted by IDRC together with several other international organizations which is of special relevance to TDRI's development information system

is the DEVSIS system. DEVSIS (Development Sciences Information System) was conceived to respond to the needs of organizations with cross-sectoral responsibilities (such as ministries of planning, development banks) and to those of the research community engaged in socioeconomic development studies. The system is essentially bibliographic and decentralized. Each country will contribute its own information and will receive information from all the other countries in periodic publications. DEVSIS as a global system has not been implemented, but IDRC has already operated an experimental DEVSIS program since 1976.

Note that, though a few worldwide information systems such as the AGRIS (for agriculture) system have become truly operational, many such networks devised by international organizations especially UN agencies, have remained wishful thinking.

4.2 Information/Document Center in Thailand

Every organization/institution has some mechanism for servicing its information requirements. Each university and research institute has its own library, and has access to inter-library services. Most or almost all government organizations have their own information systems. With the inroad made by the computer into the government agencies, the information systems developed over the past several years have all become computerized-based systems. Non-computerized information systems in agencies having access to computing facilities are either being converted or, are planning conversion.

A listing of organizations/institutions in Thailand with information/document services that could be of relevance to TDRI's development information center is provided in Appendix 2. Note that this list is not intended in any way, to be inclusive.

By its very nature, a large-scale information service is only possible through the cooperation among a number of organizations. The development of such a system as an information center on development research would

certainly need the economy of scale of a large user-base significantly larger than TDRI itself. This entails the need for a good network of communication link and good cooperative relationship with other institutes/ information centers.

There are many information/document centers that already exist to serve the needs of their respective host organizations. Particularly, with the awakening fever to computerization cutting across almost every government agencies, the most obvious applications would be that of information systems. The trend for setting-up (computerized) information system by almost every organization/government agency will continue, with the proposed development information center of TDRI serving as a clear example.

5. Development Information Center at TDRI

The broad strategy for the information center program has to be formulated taking into consideration the many characteristics of the host organization, TDRI. The characteristics of TDRI could be the major determining factors in the future establishment and operation of the development information center which include the following:

- TDRI's status as a non-governmental and non-profit organization: This will give TDRI a good leverage in terms of administrative flexibility, personnel policy, i.e. recruitment of technical staff and, the continued operation of the information center. TDRI by its virtue, is also likely to benefit from the goodwill and the cooperative attitude of the government and non-government agencies as well.

- A baby organization: As a newly-started institute, there are the marked problems of lack of space, equipment, funding, etc. which could pose the following possible implications:

  . The information services for inhouse use will have to be planned to include components such as computing facilities

for general administration, information/data/time-series/ storage and retrieval in support of research program, model-simulation and computation facilities.

- As a newly-started organization, TDRI does not have a comprehensive library yet, meaning, the information center would lack the support of a strong host library, and that the establishment of a research library would have a higher priority.
- With the still-evolving research program and possibly the continued dynamic changes, the task of pinning down information on information requirement will be that much more difficult.
- The temptation of priority is to first establish TDRI on the development research scene. It is therefore unlikely for the information center program to have priority for funding.

- Funding sources: TDRI does not enjoy a "permanent" source of funding as most universities, research institutes or government agencies do. And any information/document center or library is very much unlikely to be self-financed from service and subscription fee. Further, the nature of information/document service is such that it requires substantial long-term investment. Thus, the financial side of establishing such an information center should first be carefully worked out.

- Close relationship with policy makers, donors and government agencies, particularly the NESDB: Even as a non-governmental organization, TDRI can enjoy the special close link with the government agencies and donor agencies. Thus, the role of an inter-agency linkage, operating without government bureaucracy is inherent in TDRI's inception. Also, with the special linkage it has with NESDB, a real possibility exists for TDRI to computerize and to provide information

services for NESDB. The rationale behind this is that, it would be difficult and inconvenient for NESDB to establish and maintain a well-managed computerized information system for planning, and yet with the state of complexity and increased sophistication of economic/development planning, NESDB cannot afford not to have one.

TDRI is an institute set-up for the conduct and promotion of development research and development activities. The aim of TDRI is to assume leadership in the field of development and policy research in Thailand. Towards the aim to assume the leadership status, the foresight to incorporate a development information center component must be a part in the formulation of the initial plan of operations and the organizational set-up of the institute.

5.1 Scope of Operation

Information is the very basis for development planning and policy research. The need to pool, retrieve and disseminate information in development research are the essential reasons towards the establishment of an information center at TDRI. The broad scope of operation in such an establishment includes the following:

- Set up of a comprehensive library on development research and inventory of information and R & D reports on development activities, the emphasis is on development research activities in Thailand.

- Facilitate the collection and dissemination of development information to government agencies and continue updating of development information.

- Create an efficient network to link as well as to facilitate the transfer of information within the government and the private agencies.

- Coordinate and catalyze promotion and development of information services activities, in its capacity as a national level information center on national development research.

For activities outside Thailand, TDRI's role in facilitating the exchange and updating of information is one of the primary goals. The aim is also to establish an information linkage between various research and academic institutes both within and outside Thailand--as a means to expand the resources for development and policy research.

TDRI is set up to become 'the' authority on development and policy research. First of all, a research institute could be accorded leadership status by looking at its research resources. And a vital research resource is the accumulated data/information or otherwise termed as the document/information service.

A viable research institute without a comprehensive library is just unthinkable. And in the present day, in the age of computer/information technology and the trend toward a more quantitative research approach, the concept of a modern research institute without a computerized information system and computing facilities is simply absurd. TDRI is,at present,just in the formative stage and,to move into the status of a fully operational research institute alongside further advanced, effective and efficient information technology would perhaps take a few years.

The need for establishing a development information center within TDRI is more apparent and in fact is the precondition for TDRI to become a leading viable research institute on Thailand development and policy research. It would be extremely difficult and unlikely to attain and retain the leading status without an inhouse development information/document center. TDRI could not be that leading if it had to depend on the information/document center of other institute(s). In the long-term, to be the authority on development issues, would mean having access to the best facilities and to the

most comprehensive information in coming up with various policy options. The information document service will also serve as the key element in attracting development researchers, policy-planners, potential clients, etc., to associate with TDRI.

5.2 Constraints

The intended development information centre has the broad aim of collecting and disseminating information to government agencies and researchers and,for inhouse usage. The mission to fulfill the needs of the information/document service is a complex undertaking involving substantial investment of resources and time. Thus, in this section, it is only appropriate to look at the factors and constraints which could pose strategic implications on TDRI's information center.

The establishment and the continued upkeeping of a comprehensive library and a document/information center require long-term and heavy investment of resources. Most,or all library and information centers would rely heavily on subsidy from the host-organization/institute. A library operating on fee from users is unheard of. An information/ document service operating from fee for services and subscriptions is only possible for a large market/user base. In the development research setting, the possibility of financing the entire operation of information centre from fee for services and subscription is very unlikely-- considering the possible market/user base. Furthermore, the nature of a document/information service is such that, for a start-up information/ document center, the time-scale for full-operational status-- for the acquisition and accumulation of data/information to reach the stage of a comprehensive coverage (for the specific mission)-- will normally take several years and more so,without the support of a well-established host library.

Thus, the establishment of the development information center requires as a precondition, adequate-long-term funding. Also, the very fact that the research institute itself is just being established, would mean

that the information center program would be competing for funds from the same sources of funds of the other programs at TDRI. Considering the several years time-scale needed for the information center to become operational at the intended level of services, TDRI's present limitation of space, computing facilities and funds, and high-priority attached to research program activity, a likely scenario would be to attach a secondary priority to the establishment of the Development Information Center. For these reasons, the full program may have to be postponed for at least one or two years.

5.3 Strategies to Implement the Information Center

Appropriate strategies for TDRI's information center are as follows:

- The aim should be to complement rather than to compete with the already-existing information/document centers. This non-competition must be emphasized in the area of data-collection. Many, or most government agencies that collect data have formal direct authority to do so and have developed strong infrastructure for data capture and data entry. Moreover, these data normally serve some operational purpose vs. the research need, and that the financial support is there. TDRI, at least for the initial years, with the lack of resources is not in a position for any large-scale data collection.

The key concept here is that of being a "coordinator" and a "catalyst" in information services.

- By "complement" strategy, TDRI must be able to capitalize on its organizational/administrative flexibility in order to create an efficient network to link, as well as, facilitate the transfer of information within the various government and private agencies. The envisaged role is that of a clearing-house for information, at the same time, performing

the marketing/dissemination/promotion function for information/data collected by other agencies. If the information/data collected can be commercialized, this marketing function could be a source of fund for TDRI (information center) and the data/information collecting agencies.

- Based on its user/service-oriented approach, TDRI (information center) could provide a feed-back of user's requirement and initiate program with government/data generating agencies for improvement and adjustment which will lead to more appropriate and more useful information in the form more suitable for "general" use rather than for the data collecting agency's own use.
- TDRI could play the role of an initiator and a coordinator to promote and improve information services among potential donors and funding agencies and among the various government and private organizations. TDRI could provide the forum/venue for its coordinating effort in such issues as data specification, information interchange, standard, format for record preparation, etc.

In establishing the development information center for TDRI, in consideration of the various factors involved, and the issues discussed above, the guiding concepts recommended are summarized as:

"Service orientation," "application-specific approach," and "complementarity and coordination"

as against that of

"collection and storage center," "total integration," and "competition and centralization".

5.4 Two-Phased Action Plan

The recommended plan for implementation is scheduled into two phases.

Phase 1 (Initial 1-2 year phase)

This is the initial phase which should last about one to two years, and is composed of three components: minimum system for TDRI's operation, systems analysis of development information system, and specific applications supporting research program.

Phase 2 (Post-feasibility study or implementation phase)

This comes after Phase 1 when a detailed feasibility study and systems analysis would have been made available and an implementation plan laid out that would likely cover the components of having a clearing house, a bibliographic information system and a specific data base system at TDRI.

1.1 Phase 1 - Minimum System for TDRI's Operation

The initial CIDA grant for TDRI operation has set aside some fund for the acquisition of a few microcomputers and for the start-up of a research library. Assuming a minimum funding with the fund allocated in the initial CIDA grant and other fund from TDRI's research program, the proposed minimum system for supporting TDRI's in-house requirements should have the following sub-components:

- Library and document center: setting up a library and a document center with a comprehensive collection of information and research/study on Thailand development with emphasis on supporting TDRI research program. It should be noted here that the setting up of a proper research library is not such a simple matter, it requires devoting proper attention to the initial one to two years, the library/document center could concentrate on the comprehensive inventory of information and R&D reports on a few key research areas such as macroeconomic planning, agriculture, natural resource development, and energy.

- Computing facilities: with the acquisition of two to three microcomputer systems with appropriate peripherals, software and communication linkage, the computer system set-up should be just capable to support the following functions:

  . General administrative function i.e., accounting, word processing etc.

  . Research facilities for storage and computation and running small to medium-scale computational models.

  . Serve in emulation mode as terminal to some large computer system: (Propose that before having its own sufficient computing capacity, TDRI should, possibly through NESDB's assistance or as joint program, rely on computing power of computer center such as that of NSO, ONCB, Chulalongkorn University, NIDA, etc. The computing capability could include remote access from TDRI's building by linkage through leased telephone line and utilizing one of the microcomputers as a computer terminal).

- Access to international information services: the microcomputer hardware with telecommunication facilities can be used to access various data base services, particularly those online data base services in North America. The facility can also be used for sending/receiving electronic message with other institutes/organizations. (Note that the technical issue does not present any major difficulty, the only likely constraint is that of financing).
- Establish an information system/data base on development-related organizations/agencies and research institutes: a comprehensive listing (directory) of research institutes, donor agencies, foundations, universities, government agencies, research centers, private agencies, researchers, and other relevant agencies and individuals-- to facilitate the establishment of 'the' research network on Thailand development and policy research.
- Electronic catalogue or possibly a simple bibliographic information system on TDRI library's holding.

4.2 Systems Analysis of Development Information System

With the source of funding yet to be identified, the first task before the implementation of any information system is to conduct a feasibility study and a proper systems analysis. The feasibility study on the establishment of a development information center and the systems analysis of development information system are expected to take about one to two years. Besides the normal estimate for software, hardware and personnel requirements, some of the issues which should receive proper attention include the following:

- Identification of information requirement with their corresponding level of priority for each research/development area.
- Identification of the possible source of data/information, method of collecting and entering data and precise definition of each item of information .
- Estimate likely volume of data, cost of set-up and cost of operation.
- Identification of the likely user-groups for each type of information. For the development information services itself, the potential user-group should be identified. It is a likely turnout that such narrow and specific subject as Thailand development may only have a small user-base. This gives some indication on the likely mode of financing or the redesign/expansion required in information services in order to include data/information having a larger user-base.
- There should be a detailed survey of the existing information/data centers in Thailand. The details would go down to the definition of data collected, specification of information produced, method of data-collection, mode of operation, etc. This study component should also include possible means for link-up and joint cooperative program with TDRI.

The importance and the difficulties of the systems analysis phase should not be underestimated. It is almost certain that the specification of information requirements will be played by the problems of lack of inconsistency of data, inconsistency in the methods of classifying/grouping of data, lack of agreeable standard, etc.

1.3 Specific Applications Supporting Research Program

It is almost certain that some of the research programs conducted by TDRI in the next one to two years will possess the requirements of a tailor-made information system and computing support. The applications could take the form of setting up a small but a well-specialized data base for a narrow line of research, the collection of alternative simulation/computation models, etc.

Besides the above-mentioned activities, other activities likely covered within the time-frame of Phase 1, include, providing information service such as access to international data base to users outside TDRI (possibly with some charge of membership fee) and playing the role of "coordinator" and "catalyst" on information-related activities.

.4 Phase 2 (Post-feasibility study or implementation phase)

After one to two years of activities and a detailed feasibility study and systems analysis, a clearer strategy, having a more appropriate scope and a detailed and concrete implementation plan would be available. Depending very much on the long-term funding secured for the information system program, some likely specific components of the overall implementation plan are the following:

- A clearing-house: many of the specific information systems already exist and they are being operated and maintained by appropriate government/private agencies. An information clearing-house should be set up to enable TDRI to establish linkage to these information base (preferably an on-line electronic linkage) and to disseminate information to other users. Sophisticated techniques may be employed here to certain restricted data for internal research use, some class of data to be accessible by a particular group of

government agencies, and other classes of data for access by private public agencies, etc. TDRI's system may also be designed in such a way as to capture and to accumulate a particular group of data for use in future research study.

- Bibliographic information system on development research: the establishment of a bibliographic information system on the subject of Thailand development and policy research. TDRI may attempt to persuade other organization/government agency to implement this system, probably as a subsystem of a larger bibliographic information system. But the recommendation is that, if adequate space, equipment, and long-term funding can be secured and assured for TDRI to assume the lead role in development and policy research, then this system should be implemented by TDRI.
- Specific data base/information systems: such as an information base for supporting macroeconomic modelling, or possibly as a joint program with NESDB, and an information base for development planning, etc.

5.5 Possible Alternative Scenarios

It is very difficult and sometimes non-ethical to attempt to predict how the proposed development information center will flare four to five years from now where past data are practically non-existent. To be able to do so will be a paradox and a contradiction to the very foundation of the development information center itself: that of having development without a supporting information base. What we will attempt here is to project five possible scenarios for the information center. How the information will actually flare will depend on the combined interaction of many factors that include staff, equipment, long-term financial support, cooperative relationship with other institutes/information centers, priority attached to the information center program within TDRI, the development of TDRI itself and the development of Thailand.

- Low-low Scenario: With minimum equipment, funding and staffing, the following infrastructural support are expected to be generated:

  . a research library/document center for supporting research program mainly for inhouse use.
  . computer facilities (microcomputer) for supporting general administration, accounting, word processing function and some simple office automation applications.
  . computing facilities such as low-cost microcomputers for some simple programming tasks, data tabulation and statistical computation.
  . link access to international data base services.

- Low Scenario: Building over Scenario (1), possibly with high-quality technical staff plus other forms of support, the following seems to be the likely characteristics of the scenario:

  . a comprehensive library/document center with inventory of information and R&D reports on Thailand development with a special extensive holding for the few special research strengths of TDRI.
  . simple cataloging/bibliographic system on holding in TDRI's library/document center.
  . data-storage and computational capability from small to medium-scale computational models for support of specific research program.
  . linkage to other mainframe computer system with remote terminal access from TDRI (location), for medium to large-scale data base and computational models.
  . services to users outside TDRI for the research library/document center and for accessing international on-line data base.

- Medium Scenario: Assuming that a substantial long-term funding could be secured, possibly with the installation of a medium to large mainframe computer system and possibly with a separate minicomputer system for bibliographic applications, space allocation (new building for TDRI, perhaps) and proper staffing, the following components are seen as the most likely characteristics of this scenario:

  . information system/data base for development planning; the system could be that of a support information system for NESDB with data on various socioeconomic indicators, national accounts, etc.
  . specific data bases and associated computational models for quantitative research in various areas such as macroeconomic planning, natural resources, energy and agricultural planning, etc.
  . computing capacity for in-house use (linkage with other computer system is mainly for communications and data-transfer, no longer for accessing computing power)
  . linkage with other information centers for data-capture, data-interchange and communications.
  . bibliographic information system on Thailand development

- High Scenario: Probably with the need for appropriate investment in hardware, software, and communication facilities, and with the assumption that the public communication facility (telephone system) will have improved somewhat, TDRI's information center can , with its unique organizational set-up, take on the role of an "information clearing-house".
The picture is that of the information center becoming a market and a reprocessing plant for information. The information and the data captured, reprocessed and repackaged by

TDRI's system would then be electronically-disseminated (and possibly also in document form) to various government and private agencies, individual researchers, traders, consumers, and the public. In this scenario, the raw material (information) processed and marketed by the clearing-house will no longer be only information for development planning. Most of the information going through the clearing-house are likely to be operational data such as daily price movement, etc. TDRI would also have to obtain agreement with the various agencies supplying data/information on the issues of financing, restriction of dissemination, type of reprocessing and repackaging of information, etc.

- High-high Scenario: In this scenario, the information center will probably overshadow the research institute itself. The scenario can be referred to as "Information Utilities", with the information center of TDRI spearheading development of the country in the "Information Age". The utilities will provide all forms of information/data services to every customer be it a government agency or a private individual. Possible products may include shopping information, electronic mail, electronic bulletin board, message-handling and answering services, news, etc. In this setting, the "information center" will also behave like an electronic publisher--accepting data/information from author (source) for repackaging and marketing. Since the "information center" is still attached to TDRI, an appropriate slogan could be "Development through Information". By having an efficient information services, capable of supplying sufficient information, even a fool can make the right decision (for development).

6. Specific Issues and Possible Difficult Areas

Besides the normal issues/difficulties expected in setting up an information center such as the issues of computer and office equipment, administrative procedures, recruitment of technical staff, etc., some

other specific issues with potential difficulties include the following:

- Data/Information acquisition problems: The present situation reveals that most or almost all the data/information required by TDRI will not be collected by TDRI itself, but by some other appropriate government agencies. Information is a vital resource and it becomes more so when someone else requests for it. Thus, there would be the real need for utmost diplomacy, tough negotiation and all kinds of pulling to ensure that the flow of data/information is continuous.

- Breaking in and integrating into the existing community of libraries and information centers: TDRI's information center (and library) will be a young, small, and aggressive new member of the information service community. With the inherent nature of information services which calls for a high-degree of cooperation and sharing of the data/information-gathering work, together with the ambitious goal of TDRI's information center, the task of breaking into the community becomes more difficult.

- Market for bibliographic information system: TDRI will move towards the implementation of a bibliographic information system on Thailand development. The system may be implemented at some other institutes or, at TDRI itself. But the success of a bibliographic system is normally reflected in the number of citations, with associated increase in "inter-library-loan" traffic. The user-base for the bibliographic system can be difficult to develop unless there is an efficient transport/network for "inter-library-loan" traffic.

- Move towards an efficient network of electronic link-up: There is a natural inclination for TDRI to move towards setting up a star-like network with TDRI at the center serving as a link (electronics) to other institutes/information centers. This set-up would provide TDRI with the market infrastructure, the link-up for data/information capture for

processing and repackaging and the link-up for offering TDRI's information services to others. The technical issue is straightforwatd but the funding issue could be insurmoutable. The chicken and egg situation reveals that, until the network is fairly large enough as to allow TDRI to offer many information products then, the incentive for other information center to link-up with TDRI's information center will remain small.

- Data-specification and standard: Almost every organization will have some means of providing itself with the much-needed information. Many information systems are still of the manual type and an increasing number of these information systems are now being computerized. Each type of information system will have its own standard and data-specification for the particular organization's own use. And almost with certainty, other organizations compiling similar data will have it differently. Getting an agreement on data-definition across organization line and having it enforced will not be easy. Another related issue is that, a lot of data are available but they exist (published) as just data. For these data to be non-misleading and hence to be more useful, concrete effort will be needed in the practice of publishing other support information along with these data, such as its sources of origin, raw data-collection methodology, degree of reliability, and the formula/specification of derived information.

- Thai encoding standard: At present there is no agreed standard on how the Thai text/character should be encoded and stored in the computer. The proliferation of many encoding schemes (of Thai text) is a major obstacle to information interchange. There have been sufficient basic research work on how best to encode the Thai character in digital form but there is the danger of adopting a "standard". In the short-term, an interim solution might be to agree on a number of encoding schemes and to provide data-conversion software (hardware).

- Thai bibliographical system: The development of a computerized bibliographic information system requires appropriate software for handling bibliographical record type data base. There are at present known to us to exist and in operation in Thailand, four software packages detailed in Appendix 3.

  Of the in-use software packages, only STAIRS is claimed to be able to handle the Thai language. And a Thai language bibliographic information system based on STAIRS in actual operation is still to be proven. A software system capable of handling both Thai and English bibliographical record data base is of critical importance. IDRC could play the role of a catalyst toward the development of such a software.

- Telecommunications: This issue is one that TDRI cannot do much about. The issue is that communication technology has advanced substantially in the past several years. With new technologies such as satellite communication, fibre-optic, packet-switched network, digital phone, cellular radio, etc., and with a hotly-contested market, it seems inevitable that the communication facilities in Thailand will improve somewhat, somehow. However, the expected improvement may take a long time to come. Indeed,the very foundation for which electronic information service depends on is so frustrating and costly.

- Data problems: Patience and other qualities will be needed to cope with the many problems associated with data: lack of data; jump(s) value in time-series data due to change of definition, change of collection method (most of the time undocumented); poor quality and unreliability problem, missing gap(s) in data collection; inaccessibility such as in documents requiring massive conversion and data entry.

7. Conclusion

Information is a vital resource. And as civilization moves forward to

"Information Society," planners, decision makers, researchers, and others have become more aware of the importance of information. Due to foresightedness or possibly just simple-minded reasoning, the establishment of TDRI has incorporated in its plan of operation a component calling for the setting up of a research library and a development information center. This development information center program is only but rational. In the present day and the years ahead, with the advancement in computer and information technology, a leading research institute should have a supporting information service and computing facility.

The establishment and the continued operation of an information/document center requires a long-term substantial investment. After considering the many constraints of the just start-up institute including the lack of space, the lack of equipment, the lack of long-term "permanent" funding, and the high priority of other programs for putting TDRI as a significant institute on the development research scene, it is then proposed that the establishment of the development information center be assigned secondary priority for the initial one to two years.

The recommended implementation plan is scheduled into two phases. For the first phase lasting from one to two years, it is recommended that effort be concentrated on setting up some basic facilities including the building up of a library, some in-house computing capability and linkage to international data base and linkage to needed computer capacity. In this first phase, it is also recommended that a feasibility study and a systems analysis study be commissioned to determine information requirements and to draw up a detailed plan for setting up the development information center. The second phase is then just the implementation and operation of the development information system which will be recommended by the feasibility and systems analysis studies.

Considering the inherent difficulties in the information system such as information requirement for development planning, the strength and weakness of TDRI i.e., its administrative flexibility as a non-governmental organization, its dependence on data/information from government agencies,

etc., it is recommended that the development and operation of the information center should follow the conceptual approach of "services orientation" as against being a "collection and storage center," "application-specific approach" as against the more grandiose "total integrated approach," and "complement and coordination" as against the more self-centered "competition and centralization."

The development and operation of TDRI's information center will have its fair share of challenging obstacles including technical obstacles, data problems, cooperation needed, conflict of interest, etc.

In conclusion, it is appropriate to emphasize that,the development of information service means a long-term cost-intensive investment, which will yield the result--"information"--only after a comparatively long starting period, and that, the task would be onerous, complex and challenging.

8. Appendices

APPENDIX 1 A selected listing of existing information

Title	Agency
AGRIS - The International Information System for the Agricultural Sciences and Technology.	The Food and Agriculture Organization of the United Nations (FAO) Note: Kasetsart University Library is the present National AGRIS Center.

systems

Description and Purpose

AGRIS is a decentralized system in which each participating country is responsible for identifying, cataloguing, indexing, and inputing records for the documents published within its borders. There are currently almost 100 countries and international organizations participating in AGRIS, and an average of 11,000 records being processed every month. Note that the subject scope of AGRIS are Plant Production, Animal Production, Plant Protection, Forest, Economics, Fishery, Natural Resources, Machinery and Buildings, Food Sciences, Home Economics, Human Nutrition, Pollution, Agriculture in general, Geography and History, Education, Administration and ancillary disciplines.

Title	Agency
INIS - The International Nuclear Information System	IAEA - The International Atomic Energy Agency
DOCPAL - Sistema de Documentacion sobre Población en America Latina	CELADE (Centro Latino-Americano de Demografia) in Santiago
INPADOC - The International Patent Documentation Center	World Intellectual Property Organization (WIPO)

Description and Purpose

This system provides worldwide coverage of literature dealing with all aspects of the peaceful uses of nuclear energy. It is the international, fully decentralized, computer-based information system and it serves as a model for the systems developed by the Food and Agriculture Organization (FAO) and the United Nations Educational Scientific and Cultural Organization (UNESCO).

This regional information system is used for identifying and collecting population-related documentation dealing with the Latin American region.

INPADOC would compile a central data base of patent documents from all over the world.

Title	Agency
INFOTERRA - An International Referral System for Sources of Environmental Information	United Nations Environment Program (UNEP)
POPIN - An International Information Network for the Population Field	United Nations Population Division
INRES - The Information Referral System for Technical Cooperation among Developing Countries	United Nations Development Program (UNDP)

Description and Purpose

This is a decentralized network of environmental information systems.

This system will offer information for doing development planning, needing to establish information infrastructure , particularly at the national and regional levels. (To help developing countries build their own information infrastructure).

The purpose of the system is to collect and disseminate information on the capacities of a developing country that are available for technical cooperation programs, projects, and activities with other developing countries, through bilateral or multilateral arrangements. The major elements of technical cooperation projects of this system are: 1) Training and education; 2) Research and technological

Title	Agency
TIPS - Technological Information System	UNFSSTD
TIES - Technological Information Exchange System	UNIDO
PROSPIN - The Project Profile Screening and Pre-Appraisal Information System	UNIDO

development facilities; 3) Consultancy and expert services; and, 4) Scientific and technical information services.

The objective of the system is to establish initially on a limited scale, and to demonstrate the viability of a current information flow among developing countries in the field of science and technology.

This system provides particular economic and technological information contained in approved and registered contracts thrcugh exchange on confidential, reciprocally-equal, and mutually-beneficial basis.

The system is a microcomputer-based project development tool. It has been developed so as to help the sponsors and promoters improve the quality of industrial projects offered to

Title	Agency
DEVSIS - The International Information System for the Development Sciences	The system has been developed and is being applied experimentally in several countries
ISIS - The Integrated Set of Information System	ILO - International Labour Office

investors. Another reason is to speed up the preparation of project profiles in quantities sufficient to support developing countries investment targets and speed the flow of industrial investment to developing countries.

DEVSIS has been promoted by the idea of IDRC, the Organization of Economic Cooperation and Development (OECD), and several UN agencies. The system, essentially bibliographical and decentralized, will be specifically-oriented to the needs of development planners. It will be global and comprehensive; duplication with sectoral systems will be avoided.

ISIS provides bibliographic awareness information on all monographs obtained by the ILO library. It produces registrations and bulletins and offers on-line services, searches on request, reprography and advisory services on systems.

Title	Agency
PLADIC - The Agricultural Information Program for the Central American Isthmus	IICA - Inter-American Institute of Agricultural Sciences
EBIS - ESCAP Bibliographic Information System	ESCAP
MSIN - The Multi-Sectoral Information Network	UNDP

Description and Purpose

PIADIC has been established as a result of an agreement between the IICA and the United States Agency for International Development Regional Office for Central America (ROCA). The system's design is aimed at improving national information system and helping integrate them into a network. The system gathers, processes, analyzes and distributes the numerical information supplied by its members; socioeconomic information for planners is given priority.

The main objective of the system is to collect data and information in any field. It also allows other centers to join the system. Interaction with the system can be either on-line or off-line mode.

The major purposes of the MSIN Project are 1) to develop and promote the technical and organizational structures and the capabilities for the collection, transfer, storage, processing

Title	Agency
ISDS - SEA - The International Serials Data System-Regional Center for Southeast Asia	NATIONAL Library of Thailand
PIN - The Patent Information Network	The World Intellectual Property Organization

and disseminating information at the national, sub-regional, regional and international levels; 2) to provide the information necessary for planning and implementing development activities at the national and international levels.

ISDS - SEA has been established with the purpose of creating and maintaining a regional data bank for information essential for the identification of serials published in the countries of the region-Indonesia, Malaysia, the Philippines, Singapore and Thailand.

PIN provides access to technical information contained in patent documents and builds a worldwide data base of bibliographic data relating to patent documents. Services include indexes, magnetic tape, questions/answers, reprography.

Title	Agency
IMARD - The International Monitoring of Adverse Reactions to Drug	The World Health Organization (WHO)
AGE - The Asian Information Center for Geotechnical Engineering	AIT - The Asian Institute of Technology
IFIC - The International Ferrocement Information Center	AIT

Description and Purpose

The system provides information on drug hazards to ensure maximum safety and to assist in the efficacious use of drugs. Services include regular publication (Drug Information Bulletin), searches on request, reprography, translation.

AGE has been established on the recommendation of the Southeast Asian Society of Soil Engineering (SEASSE). Its main objective is to provide Asian developing countries with the geotechnical information they need at a price they can afford. AGE's information system covers soil mechanics, rock mechanics, foundation engineering, earthquake engineering, engineering geology and related fields.

IFIC covers all aspects of ferrocement and related materials technology. It is responsible for collecting and disseminating information on ferrocement and related materials to promote

Title	Agency
RERIC - The Renewable Energy Resources Information Center	AIT
ENSIC - The Environmental Sanitation Information Center	AIT

their utilization, and to transfer ferrocement technology to the rural areas. Other services which can be provided on request are the reference and referral services and the reprographic service.

The main topics cover by RERIC are solar energy, wind, biomass, and small-scale hydropower. The objective of the center is to provide users in developing countries with the information they need on renewable energies and appropriate technologies at a price they can afford.

ENSIC's main interests are low-cost options for disposal deposition devices, re-use of wastes, on-site collection and treatment, collection and off-site treatment (cartage systems, water-borne systems, ponds, composting, aquatic weeds), re-use options (irrigation, aquaculture, algae, fertilization,

Title	Agency
The World Numerical System	ECOSOC - The Economic and Social Council of the United Nations
Trade Data and Information System of Thailand	Trade Data Processing and Disseminating Center, Department of Business Economics, Ministry of Commerce

biogas), disposal systems, waste water reclamation, and water conservation.

The member countries of the United Nations Statistical Office supply the statistical data for the system through national organizations specializing in the field. ECOSOC records the countries' needs in this field and decides on the work and information policies for the office. The office publishes manuals on principles and procedures for collecting and processing statistics and provides the countries with technical assistance on how to use computers in this process.

The purposes of the system are 1) to develop a better system of trade data collection, compilation and analysis so as to ensure a more complete trade data and information to serve the needs of farmers, private enterprises, consumer, and government organizations in an

Title	Agency

efficient manner; 2) to have an up-to-date information dissemination of price movement and market condition of the agricultural products together with their forecasts to the farmers and traders in the regional areas, including creating a better understanding among the users of the information for decision making; 3) to improve trade data that are in good quality, analyzed and projected for the high-ranking officials for verification and formulation.

APPENDIX 2 Organizations and Institutions in Thailand with Information/ Document Services

The National Statistical Office

- official authority on Thailand statistics
- software package for bibliographical data base is in use (ISIS)

Thammasat University

- implementation of a rural development information system

Department of Technical and Economic Cooperation

- a (manual) information system on Thai experts
- local INRES center for Thailand (UNDP's TCDC program)

The National Research Council

- Directory of Thai researchers (= 5,192 entries) and research centers/units (= 431 entries)
- inventory of research projects/studies (= 31,180 entries)

Ministry of Agriculture and Cooperatives

- data on price, production and planting areas of agricultural products (Agriculture Statistics Center)
- data on agricultural planning and agricultural planning models (Office of Agricultural Economics)

Ministry of Commerce

- Trade Data and Information System of Thailand (Department of Business Economics): this is a comprehensive information system on trade-related data/information which captures data from many diverse sources/agencies.

ESCAP

- ESCAP Bibliographic Information System: the system contains

bibliographic data on ESCAP library holding

- the first system in Thailand implemented on the IRS software package on NEC computer as a joint project with NESDB
- Thai Khadi Research Institute as the collector and compiler of data related to studies about/related to Thailand.

Office of the National Primary Education Commission

- starting up a nationwide system for collection of data supporting the primary education program. Major relevance is the impressive high-quality infrastructure for data collection. The mechanism is through the possibility of having school teachers as data collectors/interviewers having access to just about every household in the country. This unique data collection infrastructure can be very useful for collecting other socioeconomic data not directly relevant to the primary education program.

The National Energy Administration

- maintains a library on energy
- collection and compilation of data related to energy production and utilization
- operates on energy information system based on MINISIS software.

Department of Fisheries

- fisheries information system based on MINISIS.

Kasetsart University

- local AGRIS center for Thailand.

Asian Institute of Technology

- AGE -- the Asian Information Center for Geotechnical Engineering

- IFIC -- the International Ferrocement Information Center
- RERIC -- the Renewable Energy Resources Information Center
- ENSIC -- the Environmental Sanitation Information Center

Bangkok Bank

- Office Banking Services provides on-line access to financial data

APPENDIX 3 Software Package on Bibliographic System Presently Available in Thailand

(1) STAIRS

- commercial IBM software product
- run on big IBM mainframe computer
- can request for demonstration from IBM Thailand

(2) ISIS

- a 'public domain' software package developed in 1965 for application in the library of the International Labour Office in Geneva

(3) IRS

- a commercial information retrieval system for NEC mainframe computer
- currently used by ESCAP on its NEC 350 system (and probably by other institutes with NEC system such as King Mongkut Institute of Technology and Thammasat University)

(4) MINISIS

- developed by IDRC in 1975 to replace the high cost ISIS
- run on HP 3000 series minicomputer
- in use at the Department of Fisheries and the the National Energy Administration.

III ISSUES OF DISCUSSION

1. Lack of standard for data collection and storage leading to a waste of resources.

Comment: At present, there is a large number of information centers and data banks in various government agencies. However, there is neither a common standard,nor a coordinating body to coordinate for the work on data collection or storage among these agencies. Therefore, acute problems arise. There is a lot of duplication and even with this duplication, data or information on the same subject cannot be compared, shared or exchanged because of the lack of standard and common definition. This is a clear case of a waste of resources.

It was suggested that TDRI information center should serve as an integrating body of various information sources. The center at TDRI should set standard format, standard coding systems, etc. for various government agencies but allowing these agencies to do their work independently. For instance, data/information on education should be handled by the Ministry of Education and that on agriculture,by the Ministry of Agriculture, but using the set standard format. By doing this, information or data from various agencies can be coordinated, related and readily used.

Data-updating should be planned simultaneously with the programming of collection and storage, emphasizing on an easy-to-operate method.

Data-collection must be done with a reliable methodology.

2. Reliability of data

Comment: How can TDRI make sure of the reliability of data collected?

Editor's note: This paper was presented last at the seminar to be followed by an open discussion on general issues. More time was taken on general issues.