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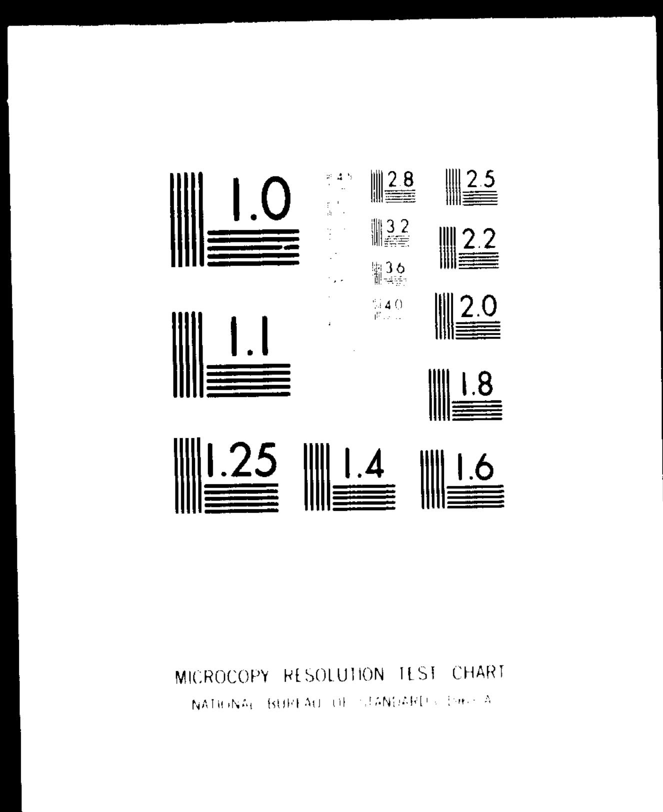

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ENVIRONMENTAL ASPECTS OF INDUSTRIAL DEVELOPMENT IN DEVELOPING COUNTRIES.

Case study on the textile industry of Thailand

Prepared under the joint UNIDO/UNEP
Environmental Programme

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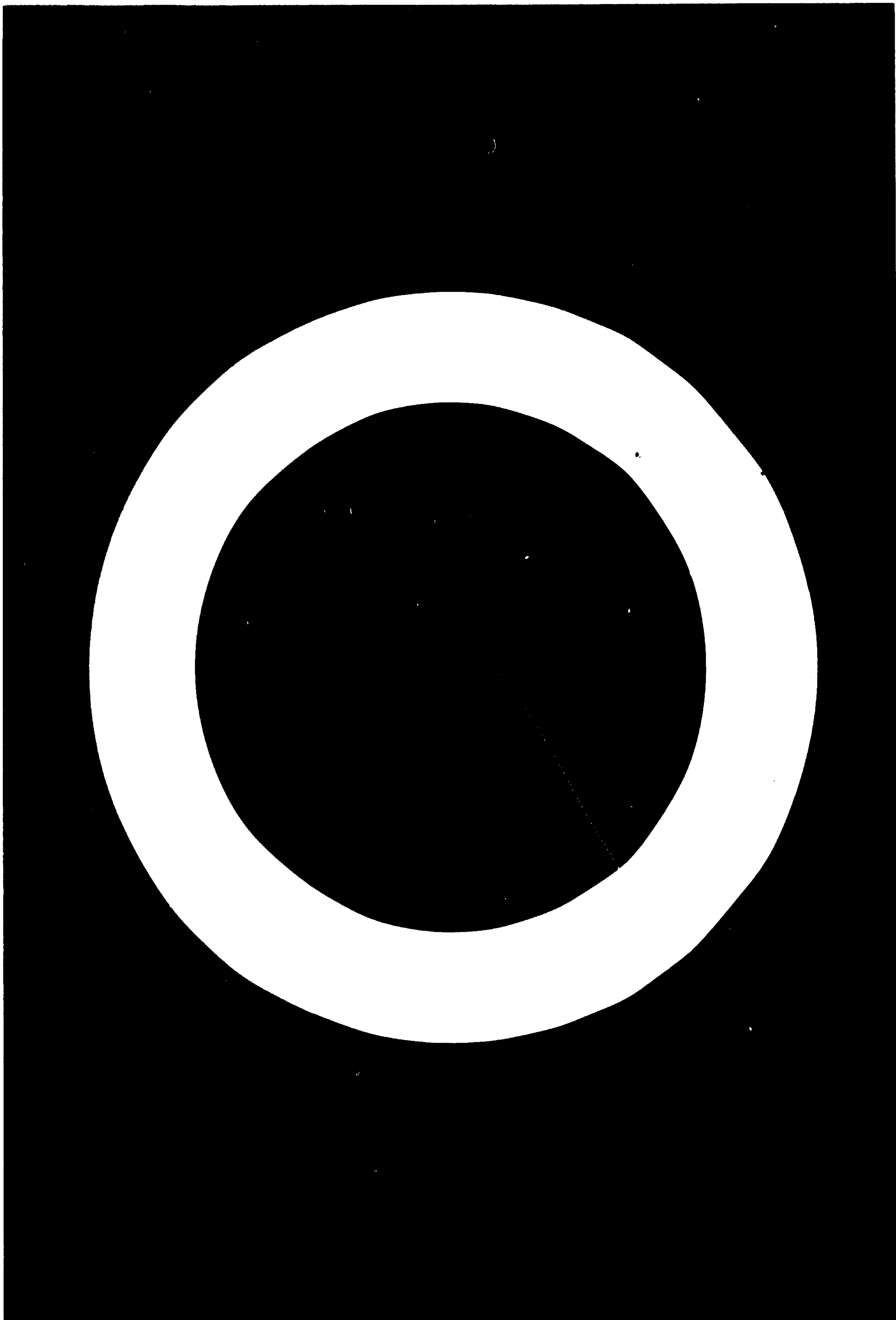

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INTRODUCTION

Subsequent to the United Nations Stockholm Conference on the Human Environment, UNIDO and UNEP adopted the objective of developing an integrated programme covering the environmental effects of industry in developing countries.

Case studies have been prepared of the environmental impacts of four industries. These include the chemical industry in India and Turkey, the textile industry in Thailand, the cement industry in Iran, and an integrated iron and steel mill in Brazil.

This report is a study of the textile industry in Thailand. It was prepared by Ms. P. Marstrand and Messrs. A. Barnett, D. Hislop and M. Howes from the Science Policy Research Unit of the University of Sussex, England.

BACKGROUND

Reasons for impact studies

Industrial enterprises have always been undertaken for the benefits they bring and it can be assumed that, over-all, they are more beneficial than not. However, in view of the past history of unforeseen and unwanted side effects, most noticeable in the older industrial regions and in those developing most rapidly, it is reasonable to seek ways of identifying such effects in advance and designing to mitigate them as far as possible. As less damaging technology is now available for many processes, and much is known about the treatment of polluted discharges, it is now possible to plan new enterprises without repeating all the mistakes of the past. To design for control of damage from the beginning of a project will in some cases be cheaper than introducing physical controls at a later stage, and integration of different industries can improve their individual performance. It should also be possible to select the degree of control which can be afforded at each stage, weighing up the expected costs and benefits, as long as there is adequate provision to monitor the harmful effects so that action can be taken before they get beyond control, or require vast expenditure of money and resources.

An impact study should be one made to establish the total social, economic and ecological effects of an industry or plant on its environment occurring over some specified time and bounded by specified limits, and whether these effects are caused directly by the industry, or by some other influence. The impact must also be seen relative to the situation which would have occurred if the resources involved in building the plant had been used in some other feasible way. Assessment involves comparison of "with" and "without" situations rather than "before" and "after". Just as prediction of the future involves possibly arbitrary assumptions about the present, so does prediction of what might have been. Such a study would require much more information about conditions preceding the building of the industry than is usually available, and several months of field work.

The physical impacts of an industrial plant can in principle be seen as a series of positive or negative contributions to a set of objectives. Every political or social group, from governments and private foreign investors to workers and farmers, will have its own set of objectives. From these objectives a value system is derived within which benefits can be described as contributions to the stated objective while costs can be defined as the maximum feasible benefit sacrificed that is opportunity costs or ex post benefit[1/] which would have occurred.

The extent to which an impact is to be regarded as a cost or benefit is a function of the set of objectives chosen and is therefore specific to the group which determines these goals. For instance in the context of pollution control the chemical effluent of a plant may have no value relative to the plant manager's objectives while the same physical phenomenon imposes a very real cost relative to the objectives of the farmer whose crop is reduced when the effluent reaches his fields. Although the problem can be simply described, practical implementation is another matter. Objectives are rarely stated, even by governments, in a fully articulated or consistent form; this means that if the analysis of impacts is to involve more than a list of physical events, assumptions as to value weights have to be made.

In the event the value of many costs and benefits can be specified according to market prices when dealing with managers' objectives, and in terms of aggregate consumption when dealing with governments' objectives. More complicated objectives can then be introduced in the form of constraints and specified in an appropriate unit (e.g. employment, environmental protection, minimum health standards).

1/ These concepts, together with a more complete statement of economic and financial analysis of projects, can be found in a number of recent publications. Among the best is Guidelines for Project Evaluation (United Nations publication, Sales No. 72.II.B.11).

Statements as to the value of one set of impacts (the plant actually constructed) in relation to another set (e.g. not having the plant) involves specifying a trade-off between the various components of the objectives chosen. While some options will be superior on all objectives it will usually be the case that some of the objectives will have to be given up in order to benefit more from others; in the context of damage control it will be important to examine to what extent a trade-off situation exists between, say, less damage and profits or less damage and employment.

The present study is an impact study in the sense that it tries to identify actual effects which have occurred and to quantify them, and to test the availability and reliability of existing information. In this way individual plants can be assessed for the extent of impact they make, and gaps in knowledge can be identified.

Plant, animal and human communities may be represented in terms of structures of interdependency which govern the relations between their component organisms. Where the external environment of any particular community remains unchanged then its structure will remain in a state of broad equilibrium. Changes in the external environment will lead to a change in the structure, and a movement to a new state of equilibrium; the extent of which will be a function of the nature of the external change in relation to the degree of interdependency previously exhibited by the organisms effected. The survival of plant communities may rest upon a certain pH of the water or a certain level of calcium in the soil, either of which could be significantly altered by the discharge of industrial effluent in the vicinity. Human communities may rest upon a certain demographic balance of sex and age groups, which might be upset by the migration of labour elsewhere; and so forth. In addition, each of the three types of community will constitute an element in the environment of the others. As such, a change in the external environment of one, may have broader implications, with, for example, reorganization of plant or animal communities having harmful or beneficial effects upon the nature of human activity.

An investment project will have consequences for various elements of the environment within which it operates. The elements can be divided into four categories - ecological, sociological, economic and technological. In order to identify as many as possible of the effects on the existing situation the following is important:

(a) Existence of information on social, economic, technological and ecological conditions before the industrial development took place; involving access to local population, old records by naturalists, diaries etc., or comparable areas still in existence affording a basis for comparison;

(b) Availability of local technical expertise and services for analysis when there is no data, and for checking records;

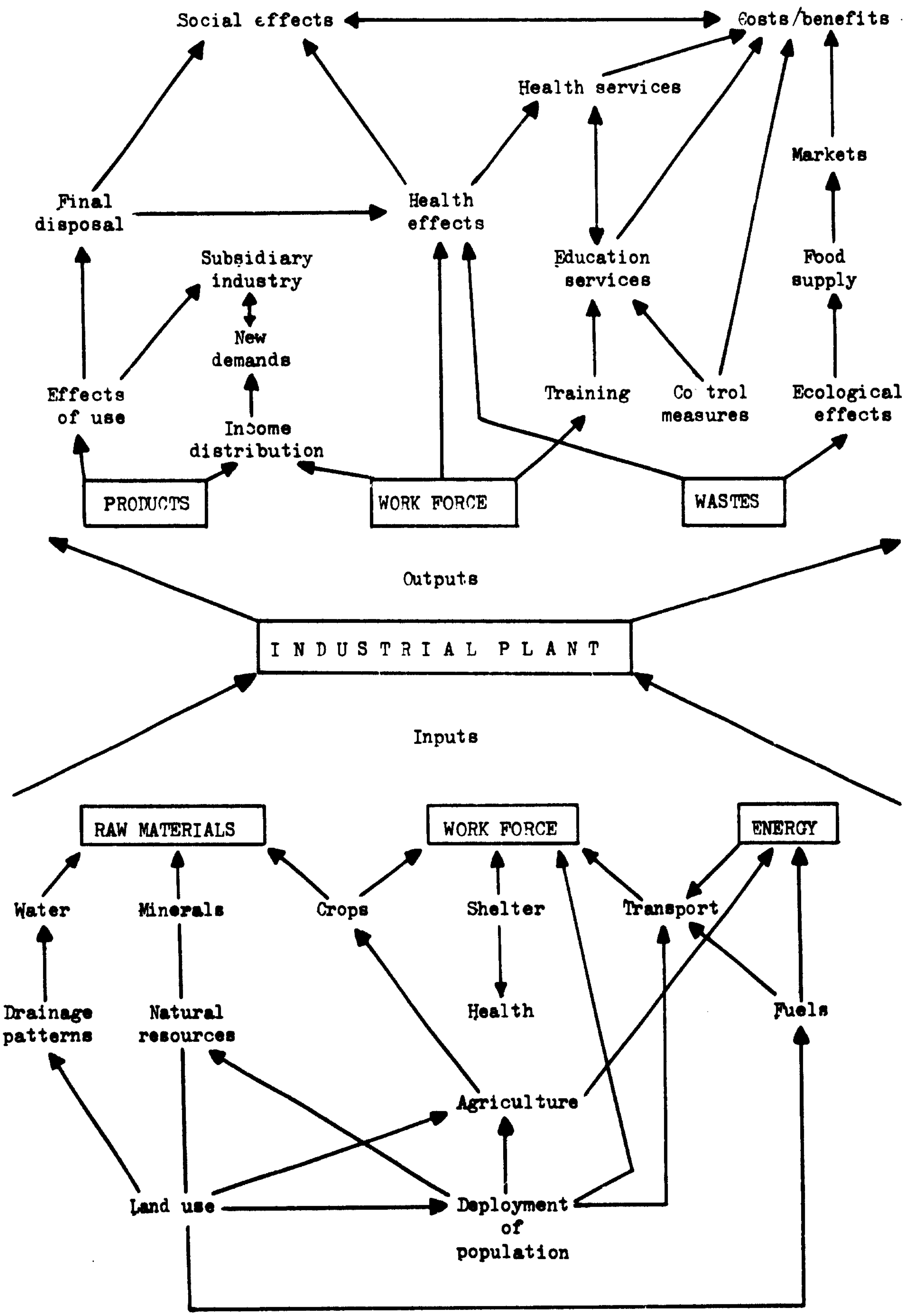
(c) Co-operation from responsible authorities;

(d) Access to economic data on construction and running of plant and any treatment processes in use or which could be used.

Methodology

Figure I represents an industrial plant and its main environmental, social and economic consequences. Those designated as inputs arise mainly from the fact that the factory draws upon the resources of the region and thus alters them. The outputs arise by the action of the products, the changed work force and the waste products upon the environment and the community. Because of the enormous breadth of this field of impacts, the present study has, except in the case of some sociological effects, concentrated upon the outputs. The physical impacts have been identified: dust or noise hazards, wastewater, displacement of farmers. The secondary consequences, industrial disease, changes in water quality and redeployment of labour have been followed up, and wherever possible, values have been attached to the consequences of these, costs of prevention or of loss of efficiency, costs of water treatment, or value of crops and fish lost, and degree of change in income distribution.

Figure I. Representation of principal interactions between an industrial plant and its socioecological environment



A number of problems in practice are associated with marginality. Many effects may be disregarded from the analysis on the grounds that their effect is too small to matter in the decision about the projects' viability; however, these effects will have a very large impact if they are associated with a large number of projects. A case in point is the migration and urbanization effect; the cost to society of another few entrants to the metropolitan area would be difficult to measure and might be presumed to be insignificant with respect to an individual plant's impact, and yet rural migration to urban areas is forcing many cities to the point of collapse. When looking at the plant it is only too easy to assume that costs approximate to the average, rather than to a more extreme marginal cost.

The detailed methods employed for each category of effect, ecological, social, economic and technological, are described in appropriate sections or in the case studies. Inevitably there have been some overlaps, some oversights and many gaps caused by incompatibility of some sets of data, by non-existence of relevant information and by the newness of the concept of including environmental factors in planning, which means that the situation as it might have been without the plant or industry is often difficult to determine. However, sufficient information was learned of these gaps for the production of a possible methodology, which is detailed in annex V.

I. ADMINISTRATION OF ENVIRONMENTAL CONTROL[2/]

Background and legislation

Legislation enacted by the Thai government up until the beginning of the 1960s indicates an ad hoc approach to the problems related to the environment, and a fragmentation of the authorities responsible for control (see annex I). From our present point of view, the only significant piece of legislation passed during this period was the Public Health Act (1941). This gave the Ministry of Public Health broadly based powers covering all matters which might be construed a public nuisance or a danger to health, including the disposal of industrial waste.

The current upsurge of interest in the environment may be traced back to 1962, when on the advice of the National Economic and Social Development Board (NESDB), the Government established the Bangkok Sewerage and Drainage Committee. After a long and detailed study of the problem the committee's findings were finally embodied in a master plan and published in 1968. The work carried out has been represented as a substantial advance, but owing to the costs involved, little has been done by way of implementation. Various other committees have since been convened, but their work is more conveniently discussed later, as a part of a general consideration of the current administrative structure.

The Factory Act (1969) and the additions made to it in 1970 provide the current legislative basis for control of industrial damage. The relevant sections of the Act empower the Under Secretary of the Ministry of Industry and his representatives to:

(a) Issue licences for the establishment and building of industrial plants, and the discharging of wastes;

2/ See Harvey P. Ludwig, "Water pollution control in the Bangkok metropolitan region" (NRC/USOM, January 1973).

(b) Require factories which "cause grave danger to the public ... to cease temporarily total or partial operation and to complete modification of the factory within the specified period of time". ("Grave danger", being defined as effluent discharge in excess of the levels laid down by the Ministry of Industry in its "Working standards for effluent discharging to inland streams". See annex II);

(c) Enter factories for purposes of inspection (although not without prior warning, or at night).

In theory, therefore, an adequate framework for control exists, but in practice a number of serious problems remain. These may now be discussed as a part of a general account of the way in which the administrative structure functions.

Administrative structure

The Ministry of Public Health

Contains three groups whose work is relevant to our present enquiries.

The Sanitary Engineering Section

The section was established in 1971 as an extension of existing work on the quality of water supplies. At present it has four professional engineers, fifty ordinary engineers, and twelve laboratory technicians. Its work consists of taking river samples (about 1,000 per year, analysed for 30 parameters), developing recommendations for a comprehensive programme of water pollution control, designing waste collection and disposal systems requested by public agencies, investigating complaints about water pollution, the fostering of public awareness through lectures, seminars and publications, and the design of industrial waste disposal systems.

The over-all effectiveness of the section is limited by a number of factors. Samples, at present, are taken only from the rivers, and not from the smaller klongs[3/] where most of the industrial wastes are

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3/ Klong: canal used for transportation and drainage.

discharged. Instances of pollution are supposed to be reported to the investigating team by local authorities, but in practice the officials concerned are as yet insufficiently conscious of the dangers involved, and activity is therefore confined to the following up of cases reported in the press. Even where illegal discharges are identified, nobody in the Ministry of Public Health has the power to act directly. The official procedure is either to report findings back to the local authority (who are virtually powerless), or to the Director General of the Department, who in turn may then contact his counterpart in the Ministry of Industry, who would have the authority to act. In practice this latter possibility is ruled out by the considerations of status which govern inter-ministry relations. The Director General of the Department of Health hesitates to report information to his counterpart, since such an action would carry with it the implication that the latter was in some sense failing to carry out his job, which would in turn imply that nothing in any case would be done as a result. What technical expertise the section currently possesses is therefore effectively immobilized as far as the making of any immediate contribution to the solution of the problem of industrial wastes is concerned.

The Occupational Diseases Section

The Occupational Diseases Section was established in 1962, following an outbreak of manganese poisoning in a battery factory. There are now 35 officers carrying out research into a variety of problems. The section co-operates with a group of some 10 doctors at Mahidol University, and has under its auspices an occupational health centre, located in an industrial area on the border of the metropolis, which supplies protective clothing and equipment, and provides medical treatment for the workers from the factories.

As presently constituted, the section has no legal powers to inspect factories or to enforce standards, and is therefore dependent upon the co-operation of factory managements, on the one hand, and of the Ministry of Industry, on the other. Enforcement is constrained by a general lack of awareness of the problems involved, the absence of any register of industrial diseases, and the consequent difficulty of conclusively establishing the sources of potential health damage in the minds of those with authority to act. The drafting of legislation to overcome some of these difficulties is now, however, underway.

The Department of Dermatology

The work of this department is mainly concerned with the curing of advanced cases of skin disease. There is an awareness of the problems associated with specific industries, including textiles, but time and resources appear to exclude the possibility of conclusive research being carried out in this area, and hence of any impact being made upon the problem of prevention.

The Ministry of Industry

Department of Industrial Works

The powers granted to the Ministry of Industry by the Factory Act are exercised by the Department of Industrial Works. The task of inspection, and the making of appropriate recommendations falls to the technical section of the Factory Control Division, who are in turn supported in their work by the Section of Physics and Engineering in the Department of Science. The former consists of 6 engineers, most of whom have no graduate training in waste processing, plus 40-50 field inspectors, whose duties include the examination of waste treatment installations. The latter includes 10 scientists, who take samples and provide analysis prior to the granting of licences, assist in the general evaluation of situations and draw up preliminary designs for treatment systems.

The ability of these bodies to locate discharges in excess of the standards laid down is severely limited. At present there is no regular sampling of rivers, although this is planned for the future, and samples from individual factories cannot be taken over a suitable period of time, or without the prior knowledge of management. In practice, investigations tend therefore, to be mainly limited to situations where complaints have been received from the public. Where these arise, an ad hoc committee comprising members of the two sections is convened for consideration of the specific complaint, and action may then subsequently result.

The limited effectiveness of this procedure both reflects, and is compounded by a number of other difficulties. In the first instance, the standards set have been unanimously condemned by expert observers as representing a "counsel of perfection" rather than a realistic target towards which factory managements might direct their efforts. Secondly, the number of field inspectors is grossly inadequate, given the existence of some 40,000 factories in the country as a whole.

The Industrial Estates Authority

This is a new body, which has been established as a joint Ministry of Industry/UNIDO venture. To the apparent surprise of those concerned it was, in April of this year, given the responsibility for devising standards for the estates under its jurisdiction. These standards are now in the process of being worked out.

The Ministry of the Interior

Within the Ministry a Planning and Policy Bureau was established in 1972 to advise the Government on needed policy changes. It was at first anticipated that this would exercise a considerable influence upon issues relating to the environment, since members of the bureau were at that time active in the organization of a pressure group for environmental conservation. Little mention is now made of its work, however, and it is assumed that the Ministry now exercises its influence through the more recently constituted committees, whose work is described later.

In addition to these bodies mentioned there exist a number of other departments and organizations within the framework of the Government which are in various ways concerned with pollution and the quality of the environment. By and large, these fall beyond the scope of the present enquiry, and therefore need not be investigated further.

Research and educational institutions

The Asian Institute of Technology (AIT)

As an integral part of its graduate research and training programme, AIT has, for a period of some twelve years, been working on the monitoring of water quality, and the designing of industrial treatment plants. In the process, it has developed the capability to carry out all necessary quality testing, and is now the nation's most advanced source of relevant expertise. In the early years of operation it was frustrated by the low level of public awareness of the issues involved, whilst more recently, as this consciousness has grown, the administrative structure has become the most serious obstacle preventing implementation. Some headway has, however, been made through direct contacts with industry, and managements are now turning to AIT in increasing numbers, for the design of suitable treatment plants.

Applied Scientific Research Corporation of Thailand (ASRCT)

In 1972 an Environmental Engineering Unit was established at ASRCT as a part of the Environmental and Ecological Research Institute. Its work has included evaluation of the pollution of klongs and rivers, and the design of waste treatment plants for smaller industries. Like AIT it is considered competent to carry out all necessary tests, but its effectiveness is similarly limited, through a lack of close working relationships with the relevant parts of the administration.

Chulalongkhorn University

The Faculty of Sanitary Engineering is concerned primarily with undergraduate training, but, with the assistance of a UNDP expert, is now in the process of developing a research and monitoring capability. In addition, an Environmental Research Centre has recently been established with the intention of carrying out multi disciplinary investigations. It is anticipated that these will include a study of the impact of the textile industry in the Phrapadoeng district.

Mahidol University

The university includes a Faculty of Public Health which is the primary training centre for Thailand in its field. Little work has as yet been carried out on the problems of water pollution, but a recently formed environmental studies group is in the process of training graduates from various disciplines to become practical environmental administrators.

Ad hoc committees and recent developments

From what has already been said, it is apparent that the major problem confronting Thailand as far as the protection of the environment is concerned, is not only a lack of resources and expertise, but also an inability to utilize that capability which already exists. To a large extent this may be attributed to the fact that solutions have continued to be sought within a pre-existing and fundamentally unsuitable administrative framework. Within this context it seems that the primary response has been for individual government bodies to attempt to utilize the issue to extend their own powers, rather than to co-operate in the search for effective solutions. In recognition of this situation, a number of committees have been established in the last three years, with a view to creating some over-all form of control. These may briefly be outlined as follows:

The Committee on Environmental Quality Control (CEQC)

This was established in 1971 under the chairmanship of the head of the National Research Council. It included members from several ministries, and was designed to co-ordinate research into the problems of environmental pollution, and to advise the government on planning and policy making for pollution abatement. Among other things it was responsible for drawing up Thailand's contribution to the United Nations Conference on the Human Environment, (Stockholm 5-16 June 1972). The committee has now been superceded by others, but at least represented the first step towards the more substantial developments described below.

The National Committee on the Human Environment

This was convened at the end of 1972 and established subcommittees for water, air and noise, and soils and land. Its membership was more broadly based than CEQC, and its major functions were to propose a master plan to the cabinet for approval, to co-ordinate the efforts of concerned organizations, and to follow up action taken and report to CEQC. The Committee was disbanded with the change of Government in October 1973.

The National Council of the Environment

This was set up by the cabinet at the end of 1973, but then disbanded with the resignation of the Government earlier this year. It is anticipated that this will shortly be reconvened to serve as a fore-runner of the new controlling agency which is to be set up.

Legislation to establish a new agency is under consideration by a subcommittee of the Advisory Council of Administrative Re-organization, and it is anticipated that a bill will shortly be presented for discussion in the legislative assembly. The new body will be set up within the Prime Minister's office, and will be required to develop national policy, evolve environmental standards, and evaluate new large-scale public sector projects from the environmental point of view. The latter point has led to a certain amount of controversy since it will represent an encroachment upon the existing responsibilities of the National Economic and Social Development Board. In spite of this, NESDB is pushing ahead with its plans to add an environmental division to its existing organization, and hopes that this will be able to act in concert with whatever body finally emerges.

When legislation is complete a number of problems are likely to remain. The new authority will only be responsible for evaluating the work of individual ministries, and will not concern itself with actual implementation; it will have little direct influence over the private sector of industry, and is likely to be composed of representatives of related ministries who will, in addition, continue to perform their previous duties, and presumably retain their previous loyalties. It is, however, possible that it will include members of the public who have involved themselves in the organization of pressure groups, and judgement must, for the present therefore, be suspended.

II. SOCIAL EFFECTS AND CONSEQUENCES

Theoretical model

A general model for determining the total consequences of an industrial plant has already been outlined. Working from the concepts of input and output effects, and "with" and "without" situations, a more detailed framework for the consideration of social effects and consequences is presented in figure II. The figure illustrates the way in which the creation and operation of a plant can have modifying consequences for the communities which provide labour, and to which the labour is drawn, and that in addition, it becomes a community or social group in its own right. The connexions linking these communities are represented in terms of simple input and output relationships, or of second order input relationships where the creation of a plant may be expected to set in motion a process of "feedback".

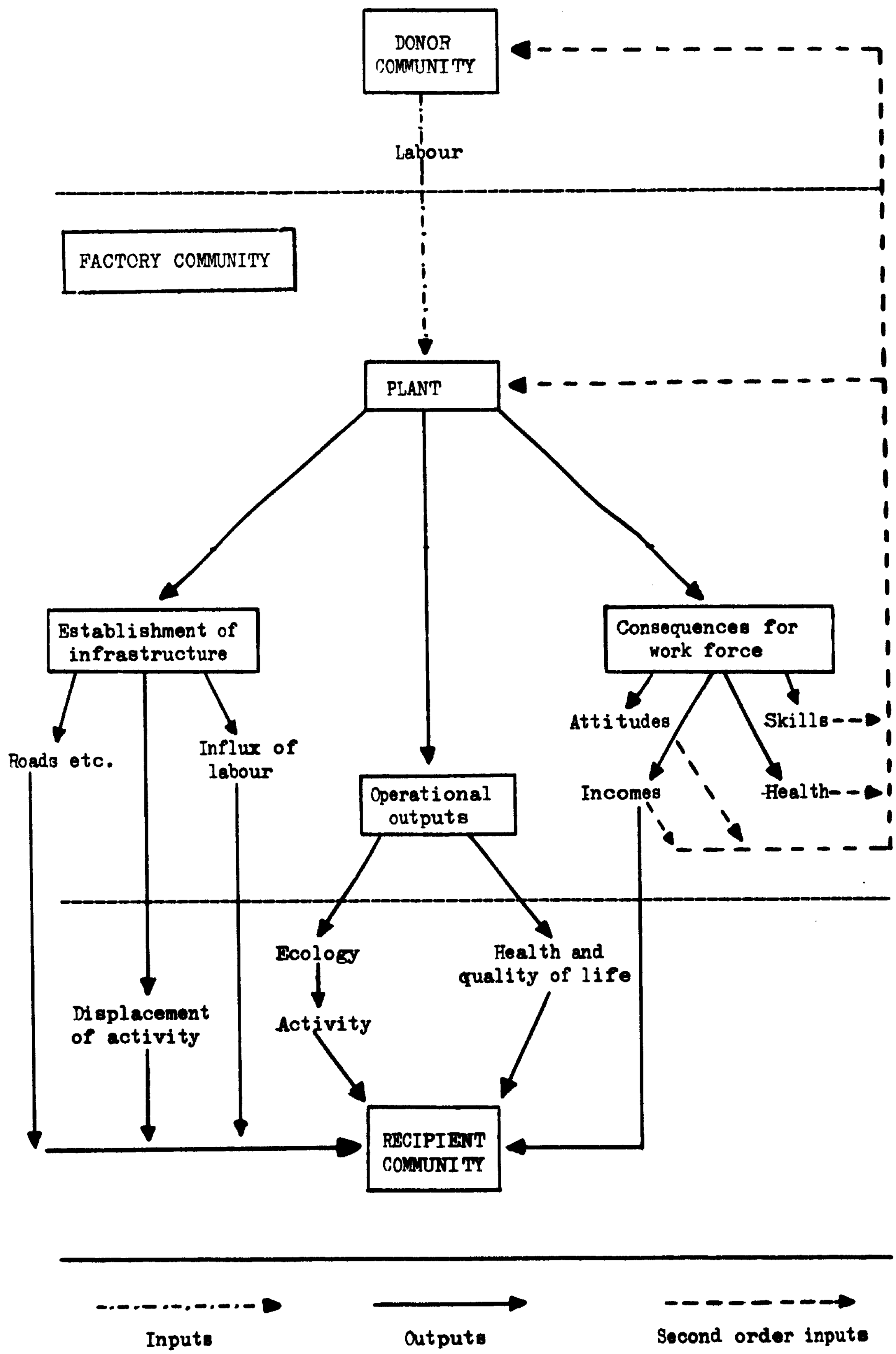
The issues raised in the theoretical model may be arranged in three broad categories, which can then be applied to each of the three community types outlined to provide an ideal matrix for empirical investigation in the following way:

	Direct health effects	Indirect health effects	Social consequences
Donor community		x	x
Factory community	x	x	x
Recipient community	x	x	x

x = aspects considered

Direct health effects will include the impact of the working environment upon the worker's health, and the health damage in surrounding areas attributable to pollution emanating from the plant.

Figure II. Social effects and consequences of an industrial plant



Indirect health effects include those potential connexions, of second and succeding orders, to health arising from such things as changes in income.

Social consequences refers primarily to second order input relationships, but includes in general all phenomena unrelated to physical health, but pertaining more to the general viability of the communities and new social groupings coming about as a result of the plant.

In practice direct and indirect health effects will often be difficult to differentiate, but are retained in order to preserve the distinction between effects to which numerical weightings may in principle be attached, and social consequences which cannot be quantified.

Presentation

Taking the three community groups outlined, a framework for empirical investigation of three plants was devised. This is outlined below.

	Factory A	Factory B	Factory C	General information
Donor community	x	x	o	o
Factory community	o	x	o	o
Recipient community	x	o	o	o

o = aspects considered; x = aspects not considered

Plant C was selected for a complete investigation, since it includes both the processes potentially most damaging to the workers' health (spinning, weaving) and the dyeing of yarn and cloth, which carry the greatest danger of pollution of the surrounding environment. At plant A, where no dyeing is carried out, enquiries were confined to effects upon the plant community itself; and at plant B, which has no spinning and weaving, to the external pollution problem. Owing to the limited time and resources at our disposal, it was impossible to conduct an exhaustive enquiry. In certain instances we lacked the facilities to carry out necessary tests, in others the phenomena to be considered were simply too complex to be properly researched in the period available. It has therefore proved necessary to supplement our direct observations with information of a more general nature obtained from other sources of research. These do not refer directly to the factories with which we were concerned, but none-the-less cast a certain amount of light on the broader areas of interest, and demonstrate the possibilities for a more substantial investigation.

Empirical investigation

Effects and consequences for the donor community

Under some circumstances labour will mainly be supplied by the communities in the area surrounding the location in which the factory is built, in which case the donor/recipient distinction and the phenomena associated with it will not apply. This appears broadly to have been the situation in the Thai textile industry, until the early 1960s when major expansion of local industry got underway. For various reasons, almost all major textile plants are located in and around Bangkok, but until recently the local supply of labour was sufficient, and few workers were employed from the provinces. Plant A, which was built 25 years ago and was the oldest we considered, draws only 25 per cent of its present labour from beyond the immediate area in which it is located, but when current expansion is complete, will depend entirely upon provincial sources for further inputs. Plants B and C which have been established in the last 10 years, have both largely depended from the outset upon an inflow of provincial labour. For present and future purposes, considerable importance must therefore be accorded to the impact of plants upon the communities from which labour comes.

Presentation here will proce from simple input effects, through outputs to second order inputs, including also indirect effects upon health and broader social consequences. Where appropriate, methods for valuing impacts will be discussed, actual weightings being attached in instances where sufficient information is available. It was originally our intention to enquire about relevant phenomena in factories A and C, but direct access to workers at the former proved impossible owing to labour unrest, so findings here are limited to what we were able to discover through interviews with management, and consideration of records. At factory C, both management and workers were interviewed, and this case therefore provided the major basis for the conclusions which are drawn.

Input relationships

The nature of the impact upon a donor community will depend, in the first instance, upon (a) the structure of activity which would have continued had migration not oocurred and (b) the change in that structure resulting from the migrant's absence. Some preliminary impression might be formed (a) by identifying the areas from which labour is drawn, and (b) by outlining the demographic balance of the work force in terms of age, sex and marital status. This information was collected from individual workers. Time and circumstances did not allow the taking of an accurate random sample. In all, 50 workers were interviewed, representing 2.8 per cent of the total labour force. Of these 10 were men (1.8 per cent of all male workers) and 40 women (3.3 per cent of all female workers). Results are presented in tables 1 and 2 below.

Table 1. Regional sources of labour in factory C

Region	Number of workers	%age
Central Plain	35	70
North-East	8	16
North	1	2
South	6	12
Total	50	100

Table 2. Composition of labour force in factory C (Percentage)

Marital status	Male	Female	Total labour force
Married	-	7.5	6
Single	100	92.5	94
Total	100	100.0	100
Age			
19	-	5	4
20	20	12.5	14
21	10	15	14
22	20	17.5	18
23	-	12.5	10
24	30	10	14
25	-	7.5	8
26	10	5	4
27	-	5	4
28	-	2.5	2
29	10	5	6
30	-	2.5	2
Total	100	100.0	100

Two points of general interest emerge. Firstly, it is apparent that the majority of workers are drawn from the central plain region, in which the factory is located. A breakdown of origin by province would demonstrate further that within this region workers come mainly from those areas most closely adjoining Bangkok. These findings are contrary to general belief regarding migration, which holds that workers tend mainly to come from poorer regions of the country, but are confirmed by research carried out elsewhere[4/] which has identified a general pattern of local migrations. Secondly, workers tend mainly to be unmarried, and to fall within the age range of 20-30 years, and therefore constitute a group which, in an agricultural situation would be expected to make a substantial contribution to production.

The impact of the factory upon the general viability of donor communities will rest to a large extent upon whether migration is a temporary or permanent phenomenom. Where families are large, the absence of one child is unlikely to cause any substantial change in the general way of life. Of the workers questioned 59 per cent reported that none of their unmarried brothers or sisters had left their parents home, and in only 12 per cent of all cases were more than two unmarried siblings living away from home. Further investigations would be required to confirm this point, but it would appear unlikely that the plant, has in many cases exercised a significant impact on the general social relations of donor communities. In the minority of cases where a large number of siblings had migrated, it was found that the home area was normally close to Bangkok where migration of young people may almost be described as the norm. In these instances, further inquiries would aim to discover the importance of the marginal effect upon family life of the extra migrant, bearing in mind that the rapid expansion

4/ Unpublished research carried out under the supervision of Dr. Jacques Amyot, Chulalongkhorn Social Science Research Unit, Chulalongkhorn University, Bangkok.

of textiles in comparison to other industries, makes it relatively more likely to have altered situations in donor communities to an extent where critical thresholds of change are crossed. In addition, it was discovered that 78 per cent of all informants had found out about their current jobs through contact with family members or friends in the communities from which they came, whilst only a minority actually reported others from their community presently working in the factory. In many instances a job was discovered as a result of a friend or relation who no longer worked in the factory, which suggests a continuing sense of allegia among workers to their place of origin, which one would not expect where communal viability had in some way been impaired by migration.

Given the composition of the labour force, and the contribution which it might be expected to make in an agricultural community, the economic impact of migrant labour appears potentially more significant than the broad impact upon social relations of which ultimately it may be seen as a part. In general workers coming from places close to Bangkok, would most probably show a low, if not negligible marginal productivity as far as agricultural output was concerned. Land in this area is a scarce commodity, with individual families working small plots, and several workers from these parts gave as their reason for coming to the factory, the fact that there was little for them to do at home. In the cases of workers from further afield the problem becomes more complex. If the official view is to be believed, the migration of labour here would most probably not be considered a problem in so far as the rural community was concerned, since it is held that the major difficulty is one of underemployment. This, however, does not allow for changes in the seasonal demand for labour, or for the fact that absence of workers at critical times of the year might lead to reduction in output. The situation is further complicated by the variable potential productivity of the land which donor communities farm, or would reasonably have been expected to farm. A worker from a poor farming area will clearly find it relatively more in his own interest to seek employment elsewhere, than a worker from an area where soils are better, but in some national or aggregate sense it might be more advantageous if both were to remain in their home communities.

Ultimately the issue could only be resolved by hypothesizing what the workers would have done if they had not come to the factory, and what their average marginal productivity would have been. Some indication of the former may be obtained from activities prior to coming to the factory presented below.

	Percentage
Farming	24
Other occupation	32
No previous occupation	44
Total	100

Of those reporting no previous occupation the majority completed their education only shortly before coming to the factory. Having studied to the age of 16 or 17 it may be assumed that they did not contemplate the possibility of working as farmers. If we adopt a simple distinction between potential food and non-food producers, the figures split 24/76 per cent respectively. If we then assume that all non-farming activities are differentiated in their aggregate benefits in terms only of the wages which they command, the net aggregate cost or benefit may be represented in terms of the potential marginal productivity of the proportion of the 24 per cent who would not otherwise have left agriculture. By taking a random sample of this population it would, in principle at least, then be possible to determine marginal productivity. Where this was zero, the departure of the migrant would be beneficial in that it would represent an increase in the average productivity of those who remained. Where it was other than zero, the cost of lost production would also have to be taken into account.

Output relationships

The primary output effect upon the donor community during the period in which the worker remains away comes from the savings remitted home. It is comparatively rare to find a worker who saves on his or her own account, and the normal practice is for any surplus to be sent back to the family. On an average this amounted to 154 baht per month[5/] or 13 per cent of total income. This may be represented as a net benefit to the donor community.

Information gathered was insufficient to account for variations from the average, or to determine to what use the money was put. Research carried out elsewhere has, however, indicated a tendency for workers from poorer communities to return larger amounts, and it seems probable that this should also be the case at the factory under consideration. The distributional as opposed to the absolute benefits will therefore be a function of the place from which the worker comes, with the benefits accruing to poorer communities - where necessities will constitute a higher proportion of total consumption - being relatively greater. Far more detailed enquiries would, however, be necessary if the existence or extent of this effect were to be conclusively demonstrated.

The number of workers helping to support their families, and the relatively substantial sums of money involved are both suggestive of a strong and continuing commitment to the parent community. Other research however shows firstly that workers tend to stay away from home longer than they might originally have intended, and secondly that financial contributions tend to decline over a period of time, as the worker's values are modified by his new environment. The information which we were able to collect was again insufficient to demonstrate or disprove the existence of this phenomenon, but a more substantial study should be able to suggest whether and how the distributional aspects of income benefits change over time.

5/ In mid-1974 the rate of exchange of the Thai currency unit baht (B) was $US 0.05 to B 1.00.

Second order input

Second order input effects will only arise where migration is a temporary phenomenon. Since the factory is relatively new, and since it was impossible in the time available to contemplate following up workers who had already left, only the broadest guidelines were available for establishing the relative importance of temporary and permanent migration. Less than half of the workers questioned had any clear intention as to when they would leave the factory, and only 43 per cent were fairly sure that they would return to their home communities when the time came.

Without being able to form any clear impression of numbers involved, it still appears likely that the case of the returned migrant as a change agent in his own community will be one of the most interesting and ultimately significant social effects which a factory can exercise. Although the direct skills acquired are unlikely to be of any value, the period of general exposure to the new environment, and the new values and ideas he or she has acquired carry with them the possibility of innovations effecting, for better or worse, the nature and quality of communal life. This phenomenom should be accorded a central place, where more extensive enquiries are possible.

Effects and consequences for the plant community

Output relationships

Occupational health effects will be discussed in four sections. The first deals with the general nature of the problems likely to arise in the textile industry, and discusses research findings from elsewhere. The second deals with the medical facilities provided in case study factories A, C and D, analyses medical statistics from cases A and C, and outlines the need for further research. Section 3 discusses the workers' own attitudes towards their health, and draws attention to the additional information whioh would be required to complete an in-plant health impact study.

Section 1. General problems

There are three health hazards in the textile industry:

(a) Respiratory disease caused by inhalation of dust;

(b) Deafness caused by exposure to loud noise;

(c) Dermatitis caused by handling the fibres or the chemicals used to condition, dye and finish the yarn or fabric produced.

In Thailand there is no consistent record of people with symptoms of respiratory disease or obligation on factory managers to report cases. Workers themselves often do not associate coughing with their work and hospital records do not usually include a person's occupation. That dust is recognized as a hazard, however, is evinced by the fact that the Department of Occupational Health has recommended to the Ministry of Industry, Factory Control Division, that licensing requirements should include the provision of masks, and that these were provided in at least two of the factories we visited; that several firms require their workers to have annual chest x-rays and that dust-removal systems have been provided in the newer factories.

Distinction must be made between the simply irritating effects of inhaling any dust, and the power of the particles to penetrate lung tissue and there to damage the lysosomes and cause degeneration of cells; and the specific effects of particular kinds of dust, including allergic effects. In the former category, fine particles of synthetic fibres are likely to be more penetrating than those of cotton, but the dust derived from the leaves of the cotton plant, almost always present in bales of raw cotton, contains a chemical substance which causes the bronchioles of the lungs to constrict. In an environment laden with cotton dust, a person adjusts to this by breathing more deeply. During periods away from the dust, breathing returns to normal, but when working is resumed, the person feels the constriction, and coughs in a vain attempt to relieve it. This cough after a rest period is characteristic of the early stages of byssinosis, known as "cotton carders disease", which, although found in some workers in the cotton industry, is much commoner among those in the opening, cleaning, blending and carding rooms than elsewhere. There are no figures available for Thailand, but in the Lancashire cotton industry more than 50 per cent of the workers in the carding rooms were found to be affected. Similar proportions would be expected among the openers and carders of the older plants in Thailand, but to evaluate the social costs of this an extended study of the health of those presently and previously employed in these processes would be required. The costs of taking preventive measures by providing masks and protective clothing are small when compared with the costs of treating or mitigating subsequent diseases, while incorporation of dust removal devices with new machinery is now regarded as so normal that separate additional costs, if they exist, cannot be identified.

In the textile industry the danger is from continuous loud noise rather than from the sudden shock effect of very loud impact noise. Continuous noise, especially at levels of 85 decibels and over at frequencies of 300 or more produces gradual loss of hearing which follows a distinctive pattern as measured by an audiometer. This pattern of hearing loss has been described in a study made by Stone for the British Textile Workers Union in 1969-1970, in the preparation of evidence for the establishment of industrially caused deafness as an occupational disease for compensation.

In Thailand the Section of Occupational Health within the Ministry of Public Health conducted noise level tests in 33 factories in 1971. Table 3 shows the number of workers involved in the noisiest processes and the number of locations in excess of standard acceptable levels.

Table 3. Noise levels in different processes

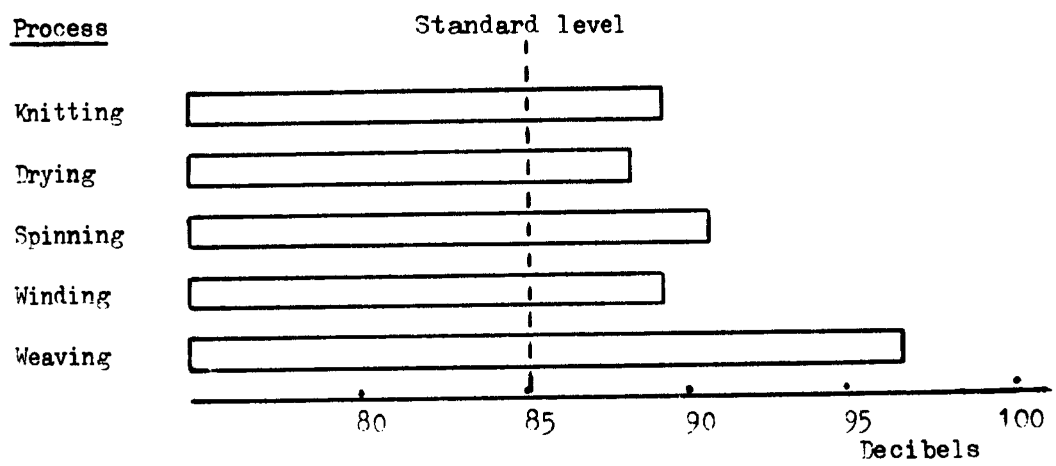
Process	Number of workers	Number of places measured	Number of measurings	Recordings exceeding standard
Weaving	6409 (43.47%)	85	935	733 (78.4%)
Winding	2043 (24.7%)	17	187	121 (64.7%)
Spinning	3552 (42.21%)	16	176	135 (76.7%)
Knitting	120 (35.93%)	1	11	8 (72.7%)
Drying	12 (2.61%)	1	11	8 (72.7%)

From this it can be deduced that possible ratios of workers exposed to the risk of hearing loss are:

Weaving	6,409 x 7.841 = 503
Winding	2,043 x 6.471 = 132
Spinning	3,552 x 7.670 = 272
Knitting	120 x 7.273 = 9
Drying	12 x 7.278 = 0.9

Measurements were taken on three separate occasions in each separate section of the 33 factories, and the noise was analysed according to frequencies. Figure III depicts the averaged results of the three readings.

Figure III. Average noise levels from 33 factories surveyed



Tables were made of the frequency analysis for each of the processes in the range 300-4,800, most crucial for human hearing, which show that for each of the processes the number of factories with noise levels below 85 decibels was as follows:

Process	Number of factories		
	Below 85 dB, frequency range 300-600	Below 85 dB, 1+ frequencies	Below 85 dB, frequency range 300-5000
Weaving	6		2
Winding	10	9	8
Spinning	4	7	0

Unfortunately, when the same factory gave readings of high noise levels on some occasions but not on all, there is no record of whether or not it was in full production on all occasions. However, the fact that some factories gave acceptable readings on all occasions for some processes, even weaving, suggests that some quieter machinery is already available in Thailand, or that better design of shop lay-out can achieve acceptable levels. There are no records of industrial deafness among Thai textile workers, and no ear-protectors are provided or worn. Investigations in the United Kingdom suggest that about 15 per cent of workers continually exposed to levels above the acceptable limits suffer from impaired hearing. In the 33 factories studied by the Department of Occupational Health the total number of workers was 32,395, of which 12,136 were working in the processes with noise levels above acceptable limits. So, out of 12,136 workers in the noisy processes, 1,800 are likely to be affected by deafness. This represents a considerable social cost.

Annex III shows a critical level of intensity for each frequency range, based on measurements of hearing loss occurring as a result of various ranges of frequency at different levels of intensity of noise. Levels of noise in some of the 33 factories have been plotted out for the relevant processes. It can be seen that the noise/frequency levels lie above the critical line for most readings, even when these are below 85 decibels.

Many of the chemicals traditionally used in the textile industry, such as sodium hydroxide, sodium hypochlorite and sulphuric acid, are damaging to human skin and produce lesions if frequent contact with even solutions of the above is made. In addition many dyes, or their solvents, have grease solvent properties and the ability to cross living membranes and thus penetrate intact skin. In older industrial countries these dangers are recognized and rubber or other protective gloves and galoshes are provided. Two of the factories had safety posters urging the wearing of protective foot-wear. None were seen concerning gloves and not many workers were seen using these.

We were told at the Department of Dermatology, Bangkok, that there is circumstantial evidence that workers in the textile industry do suffer from dermatitis, but to date the types of records kept do not enable analysis to be made of the incidence among these workers, still less of the substances involved. Neither is it possible to determine whether any skin allergies from the fibres themselves are occurring. In Thailand at present 10 per cent of all cases receiving medical treatment are dermatites, and of these 20 per cent are contact dermatites, mostly industrial. Work is just beginning to identify the principal industries and processes involved, in the course of which the methods of recording particulars of patients will be changed so that in future epidemiological studies will be possible. It would help if the nurses in factories and the medical officers retained as consultants by some factories were required to keep records of cases with symptoms, processes and materials specified and to make periodic inspections for hearing loss and dermatitis as well as chest X-rays.

Section 2. Health care in three factories

Three factories were chosen as representative of the conditions seen in Thailand. Factory A carried out all processes from opening and cleaning to weaving, of cotton and some synthetics; factory C carried out all processes from preparation of filament through spinning to weaving and dyeing of synthetics only; and factory D carried out dyeing and finishing of cotton and mixed cotton/synthetic cloth. Among them they all were exposed to the three main hazards, dust, noise and contact with irritating particles or chemicals.

Factories A and C allowed inspection of their medical records. In factory A about 900 workers asked for medical advice in the first six months of 1974; 386 of them reporting respiratory complaints or coughing; 2, hearing or ear troubles; and 15, skin irritation. Medical records did not indicate in which sections they worked, so it was not possible to correlate these complaints with presence of dust, noise or chemioals.

Table 4. Medical records of factory C for April 1974

Section	Number of patients	Symptoms					
		Respiratory		Auditory		Dermal	
		Number	Percentage	Number	Percentage	Number	Percentage
Spinning	390	33	9.6	7	1.9	15	11.9
1st weaving	300	26	8.6	3	1.0	10	3.3
2nd weaving	502	26	5.1	10	2.0	17	3.4
Dyeing	134	11	9.0	2	1.2	7	6.3
Finishing	76	13	14.0			1	1.25
Maintenance	88	5	5.9			1	1.5
Inspection	76	1	1.25			2	3.0
Office	35	7	20.0			5	14.0
Packing		5		2		3	
	Total	137		24		61	

The respiratory category was difficult to analyse further since the symptoms described have many causes; the table shows, however, that all of them are relatively more frequent in the spinning and weaving sections, where there is some dust composed of minute fibres of synthetic materials, and in finishing, where urea and aldehyde resins are used, producing irritating vapour. Some of the dermatites were specified as contact, allergic etc., and these were further analysed. Unfortunately, it seemed that not all the medical staff specified probable cause, and it is possible that more of the unspecified cases could have been classified. The results, by section, were as shown:

Section	Type of dermatitis			Total
	Allergic	Contact	Unspecified	
Spinning	4		6	10
1st weaving	2	1	3	6
2nd weaving	8	1	5	14
Dyeing	3	1	3	7
Finishing	2			2
Inspection			1	1
Maintenance	1			1
Packing	1			1

The second weaving room involves pre-treatment with chemicals to assist setting of dyes, and this may account for the increased incidence of allergic response among these workers. Fibres of synthetic materials are able to perforate skin, thus dust could also cause dermatitis. In order to prove causal relationships it would be necessary to conduct patch tests with chemicals and to make a study of epidermiological records kept with this end in view. To follow up the records of this factory, interviews with some of the cases and the medical staff could further clarify the degree of relationship between their occupations and the symptoms exhibited.

In order to perform a full cost effectiveness study on these factories it would be necessary to identify the sections from which the workers came in factory A and to interview the medical staff in order to identify cases likely to be attributable to industrial causes and then, by interviewing the workers, to establish the degree of their health impairment and the extent to which it interferes with their normal work and leisure activities. This impairment could then be assessed in terms of loss of effioiency, with financial connotations and in terms of social deprivation, mainly qualitative. The noise problem is at present under investigation in Thailand. The gradual introduction of shuttleless looms and open-ended spinning will reduce the noise problem, but the question of compensation for those currently undergoing damage to hearing will require attention over the next 20-30 years.

Research reported in section 1, indicated that some 50 per cent of the workers exposed to the conditions described, would be likely to suffer some form of respiratory damage. Taking the total number of workers on related processes in factories A and C the total number likely to be affected had there been no control, are 255 and 230 respectively. If we assume a 50 per cent loss of efficiency and an average wage of 30 baht per day the total financial costs to factories would be 7,650 baht per day for factory A and 6,900 baht per day for factory C. Additional social costs, involving the change in activities of affected workers outside the factory would also have to be taken into account. The cost of prevention is or could be confined to approximately 3 baht per worker per year. For factory A total annual costs would be 1,533 baht and for factory C, 1,380 baht.

Proceeding upon a similar basis the number of workers likely to suffer hearing damage would be 129 in factory A and 114 in factory C. Loss of working efficiency is probably not great, but the social costs incurred by an impaired ability to comprehend others, and hence to communicate may be reckoned as substantial.

A further study to evaluate the costs and benefits of health care would involve:

(a) Complete translation of the records to reveal the treatment given and the results, and thus further identify those cases of respiratory trouble probably or definitely attributable to dust;

(b) Determination of the incidence of similar respiratory disease in a sample of a comparable population outside the factory;

(c) Follow-up studies on those who attended the clinic more than once for the same complaint;

(d) Audiometric studies on a sample of workers from each of the noisy sections;

(e) Measurements of noise levels in these sections;

(f) Investigation of causes of absenteeism among the workers;

(g) Interviews with any who have left due to disease;

(h) Studies on efficiency/competence of affected and unaffected workers.

Section 3. Workers' opinions and general conclusions on health

The majority of workers notice no great difference in their health since coming to the factory, but as we have seen, some of the harmful effects, particularly to hearing and respiration, may not be noticed by the person who suffers the consequences, or may not be attributed to the working environment. The things which workers do notice, and to some extent complain about, are relatively trivial by comparison. The most common include colds, and loss of sleep. The former is a problem for workers in the weaving and spinning sections, where temperature and humidity are controlled to prevent thread breakages, and contrast with conditions outside. The latter results from the unpopular rotating shift system, which involves working different hours each week, and having to sleep during the daylight hours every two weeks out of three.

For a total assessment of impact upon health, three further factors would need to be taken account of.

The first is change in diet. No precise measurements were taken here, but general questioning revealed a tendency for workers from the poorest communities to value the food eaten at the factory more highly than that which they would otherwise have eaten, and for the remainder to make relatively negative evaluations although acknowledging that the standard was satisfactory. Since an improvement in the diet of a person who has previously been poorly fed is likely to exercise a greater influence upon general standards of health, than is a decline in the diet of one who has been fed well, the over-all effect is most probably beneficial here.

The second is access to medical care and attention. With nurses available at all times, doctors visiting the factory each day, and free treatment and medicine, it is likely that any perceptible health problems will be more quickly and effectively treated than would otherwise be the case, the net benefit here being most pronounced for workers coming from rural areas.

The third is the health impact relative to what it would have been if the worker had not come to the factory. Without far more detailed enquiries here it is impossible to arrive at any approximation to the nature of the contrast.

Second order input relationships

Output relationships covered those aspects in which the plant may be seen to exercise simple effects upon the work force. Second order input relationships are more complex in that they deal with inter-relations between the work force (their age, sex, marital status, background and conceptions of work to be done) and their environment (which includes the attitudes of management, the nature of the work carried out, and the general conditions of employment). Ultimately this interaction may be represented in terms of the extent to which the working environment becomes a social environment in itself with exclusive patterns of roles and hierarchies, and assumes further implications for the organization of labour and the improvement of working conditions.

The kind of research required to throw light upon this inter-relationship could clearly not be contemplated in the time available. Work carried out at factory C does, however, provide a few indications of the general situation, some of which might be taken as a basis for a more extensive enquiry. These may briefly be summarized as follows:

(a) General conditions. Nearly all of the work force were housed in pleasant dormitories on the factory site. Ordinary workers sleep eight to a large room, more senior workers four to a room.

Facilities were provided for washing and ironing clothes, but not for cooking. All meals were eaten in a large restaurant where workers chose and paid for their own food. The restaurant had 2 televisions and a recreational area with various facilities, and a sports field had also been provided;

(b) Workers' evaluation of their conditions. The workers appeared to be satisfied with their living conditions and valued the extra freedom and opportunities for making friends which the work situation offered, when compared with life in the communities from which they came. Where complaints were made they tended to concern pay, but it was generally acknowledged that factory C was better than most other factories from this point of view. Further confirmation of this point is supplied by the considerable lengths of time for which workers have stayed, and generally say they will continue to stay at the factory;

(c) Social groups. It is to be expected that a number of informal social groups operate for various purposes within the factory, but no attempt was made to investigate these. The over-all situation, until recently, appears to have been one where a paternalistic management controlled a passive work force, through recourse to the cultural norm of strong respect for authority, and through the provision of a generally convivial living and working environment. Workers, in any case, tended to be young and knew, in most cases, that they would probably be leaving the factory when they got married. As such the idea of worker co-operation seems not to have taken root. Spurred partly by inflation, and partly through the general atmosphere in Thailand following last year's revolution, textile workers are now beginning, for the first time, to organize themselves as an interest group. It is to be anticipated that this movement will continue to grow, and that management will have increasingly to come to terms with workers' demands for improved conditions. Substantial changes in the attitudes of all workers are therefore likely, and the impact of the plant upon the attitudes of future generations of migrants may become far more radical than is, at present, the case.

III. ECOLOGICAL EVALUATION

Ecological effects are not really separable from sociological effects, since they affect the lives of human communities in the long run, if not immediately. The two groups of effects are alike in being dynamic, changing over time and producing a reaction from the systems affected. The adaptability of the receiving environment to change may be taken as a measure of its ability to cope with pollution. Broadly speaking, the greater the variety of biological species present the better able a habitat is to re-adjust to any change, including pollution; so species-diversity can be used as a guide to quality of the environment. However, in developing countries it is rare that much is known of the species composition of the selected environment, so this method of assessing changes can only be used if ecological studies are made before development takes place and continued through a number of years afterwards. It is possible however, by interviewing local people, to learn of changes in the agricultural environment and about fisheries if there are any.

Acute effects are those which are obvious and immediate. They are usually well known and if allowed to occur, produce a relatively rapid response from the public. This, and the fact that the costs of damage are usually also obvious, often ensures that such effects are prevented. As well as these, however, there are accumulative effects, which are not obvious, may not be associated by local people with the factory, and which build up over time until irreversible damage is done.

Figure IV. <u>Relationship between environmental capacity and accumulative effects of pollution</u>

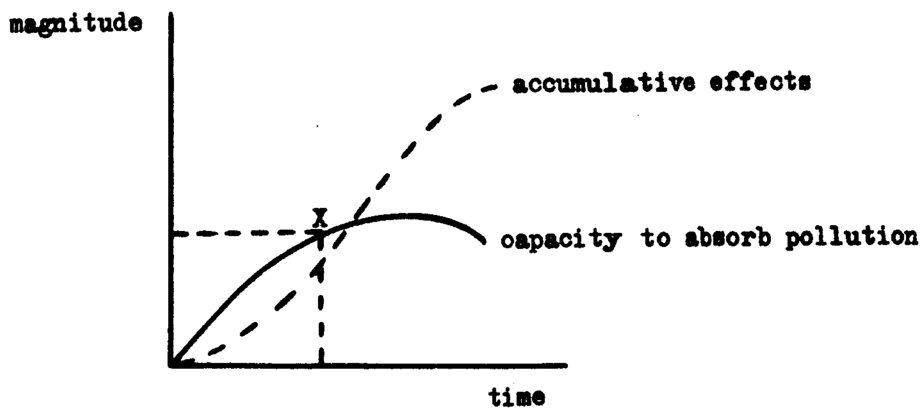


Figure IV shows a possible relationship between a given environment's capacity to absorb pollution and these accumulative effects. A successful management policy would operate controls at some point "x" such that the accumulated effects had not begun the process of reducing ability to absorb, and revolves around selection of the optimum time at which to spend money for the reduction of accumulative effects. In practice these decisions depend on the political goals of the society and the ways in which these interact with the goals of other associated nations and of the various funding agencies, so that in the foreseeable future environmental optima are not likely to be more than approximated.

At first sight there appears to be a conflict between financial interests seeking development, and not necessarily even aware of possible damage, and the interests of those using the environment for more traditional purposes such as agriculture and fishing. When the damage begins to be apparent, conservation interests tend to arise and to resist all changes. Consideration of environmental factors at an early stage in development could, on the basis of existing knowledge, reduce the damage and enable development to proceed without irreversible loss of natural resources.

Because the interaction between industry and its environment is a dynamic process, and because it has only recently been a subject of investigation, the mathematics of the relationships is still to be developed; meanwhile studies of the effects of particular industrial plants can be used to guide policy and at the same time contribute to the development of the mathematics.

This section concentrates on the environmental effects and refers to the resulting social effects. Environmental effects, as well as falling into the categories "acute" and "accumulative", also divide into locational effects, such as displacement of drainage patterns, loss of plant cover, reallocation of land and so on, and pollution effects caused by the gaseous, liquid and solid wastes or by-products of the factory.

A full environmental impact study would include both categories, since a factory cannot exist without causing both kinds of effects. The case studies presented here deal mainly with the second, owing to constraints of time. There is little outside air pollution from the textile industry, and what there is derives from the power houses and is thus not specific to this industry. The main problems are liquid wastes discharged to water and sludges from treatment plants dumped on land.

Main problems in the textile industry

See table 5 and the main processes as shown in figure V.

Table 5. Pollution effect of cotton processing wastes (Composite of all waste connected with each process.)

Process	Wastes (ppm)			Per 1000 lb of goods		
	pH	BOD	Total solids	Waste (gallons)	BOD (lb)	Total solids (lb)
Slashing, sizing yarn a/	7.0- 9.5	620-2500	8500-22600	60- 940	0.5 - 5.0	47- 67
Desizing	-	1700-5200	16000-32000	300- 1100	14.8 - 16.1	66- 70
Kiering	10 -13	680-2900	7600-17400	310- 1700	1.5 - 17.5	19- 47
Scouring	-	50- 110	-	2300- 5100	1.36- 3.02	-
Bleaching (range)	8.5- 9.6	90-1700	2300-14400	300-14900	5.0 - 14.8	38- 290
Mercerizing	5.5- 9.5	45- 65	600- 1900	27900-36950	10.5 - 13.5	185- 450
Dyeing						
Aniline Black	-	40- 55	600- 1200	15000-23000	5 - 10	100- 200
Basic	6.0- 7.5	100- 200	500- 800	18000-36000	15 - 50	150- 250
Developed colours	5 -10	75- 200	2900- 8200	8900-25000	15 - 20	325- 650
Direct	6.5- 7.6	220- 600	2200-14000	1700- 6400	1.3 - 11.7	25- 250
Naphthol	5 -10	15- 675	4500-10700	2300-16800	2 - 5	200- 650
Sulphur	8 -10	11-1800	4200-14100	2900-25600	2 -250	300-1200
Vats	5 -10	125-1500	1700- 7400	1000-20000	12 - 30	150- 250

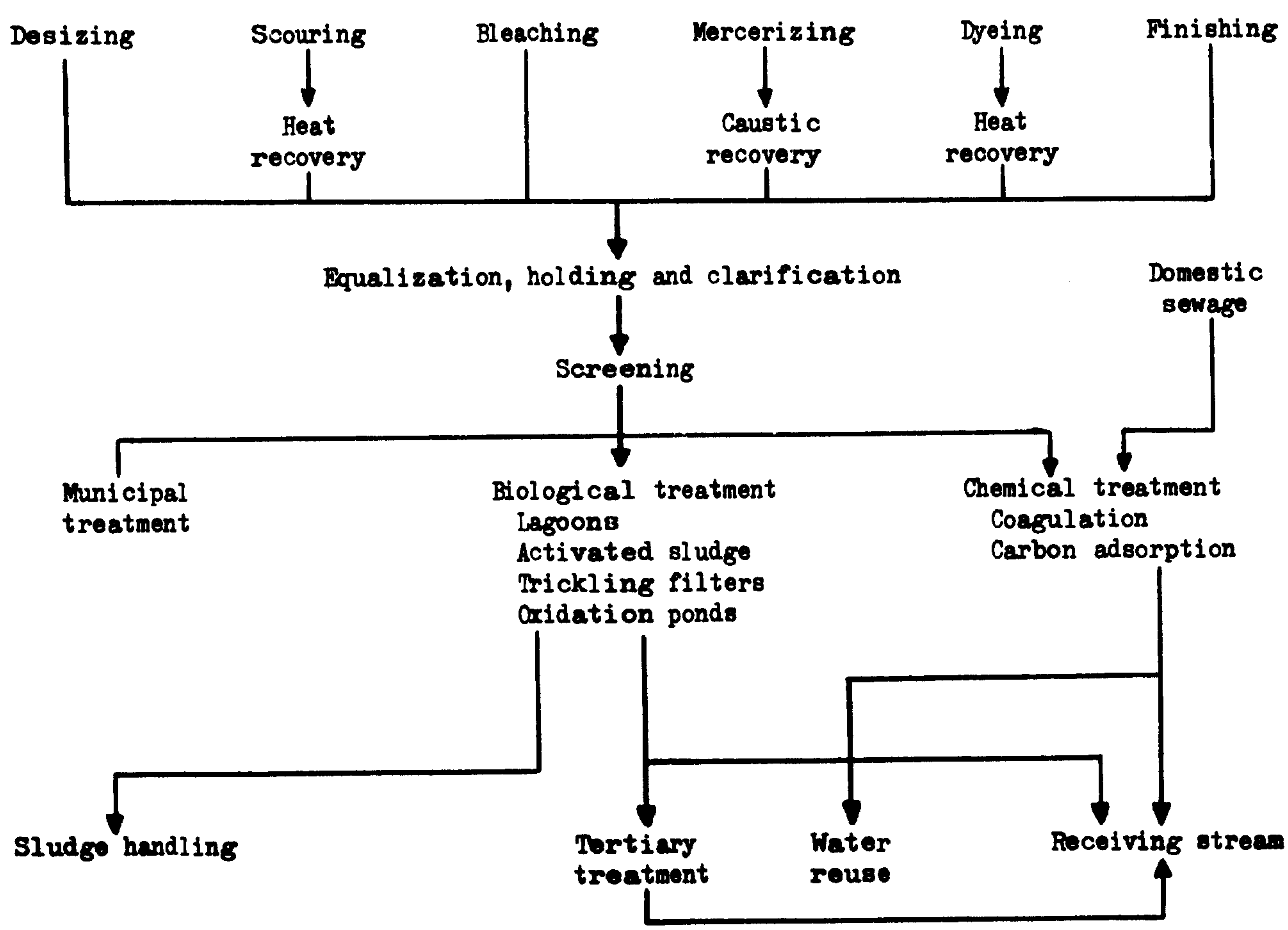
Source: H.R. Jones, Pollution Control in the Textile Industry (Park Ridge, New Jersey, Noyes Data Corp., 1973). From EPA Report 12090 ECS-02/71.

a/ Cloth weaving mill waste

The polluting effluents arise from the following:

(a) Sizing and slashing. The waste is the washings from the equipment. It is of low volume but high BOD (i.e. degradable organic content). Traditional materials such as starches are degradable and can thus be removed by the biota of receiving water or in a biological treatment plant. Some newly developed ones, starch phosphate complexes, can be reused. Other new substances, such as polyvinyl alcohols and carboxy methyl celluloses are not degradable and therefore pose serious pollution problems;

Figure V. Flow chart for cotton waste processing



Source: H.R. Jones, Pollution Control in the Textile Industry (Park Ridge, New Jersey, Noyes Data Corp., 1973). From EPA Report 12090 ECS-02/71.

(b) Desizing. In this process the size is hydrolysed or otherwise denatured. Diluted sulphuric acid is used, or sometimes enzymes if the size is starch. The liquor is of variable and unknown composition and cannot be reused. It has high BOD and low pH, i.e. acid;

(c) Scouring. There are two main methods, the commonest uses sodium hydroxide or soda ash and detergents, the Kier process uses sodium hydroxide and sodium silicate. Both produce a large volume of waste liquor with about 31 per cent by weight BOD and 0.3 per cent alkalinity. Because of the presence of detergents, the solutions cannot be used in other processes, but could possibly be reused for scouring if make-up amounts were calculated;

(d) Bleaching. The commonest methods use sodium hypochlorate with sulphuric or hydrochloric acid, sodium chlorite with acetic acid, and hydrogen peroxide. The first produces a liquor of pH 9-11, very alkaline, the second of pH 3.5-5.5, very acid, while the last breaks down into water and thus produces no pollution, but is not suitable for all fabrics;

(e) Mercerizing. This is done to soften the cloth and make it receptive to dyes and finishes. The cloth is steeped in 30 per cent sodium hydroxide solution, after which the effluent contains about 5 per cent hydroxide which can be evaporated for reuse or used in the desizing process;

(f) Dyeing. The waste waters from dyeing are changing all the time as new and more permanent dyes are produced. Many of the traditional dyes were biodegradable and thus amenable to biological treatment. Many of the new ones are not. In addition, many of the chemical configurations which bestow colour are toxic, although little work has been done on the toxicity of dyes to people or other organisms likely to be affected. Colour is the most serious problem for dye works, as it leads to numerous complaints. Toxicity may in fact be the major danger;

(g) Finishing. Nowadays many fabrics are treated to make them crease, or grease and moisture resistant. A number of proprietary resins are used, many of which are not biodegradable. Little is known of their toxicity.

Usually these wastes are discharged into connecting channels and the resulting mixed waste is characterized by high BOD, high suspended solids, high pH (alkaline), high salt concentrations (mainly sodium salts) and deep colour. If any treatment is given, there will be sludges with a high residual BOD and containing alum or polyelectrolyte coagulants and dyes. Whether either of these wastes can be disposed of to the environment depends on the climate, the nature of the soil and the surrounding uses of water and soil.

The ecological background in Thailand

Apart from silk, the textile industry in Thailand is concentrated on the Central Plain around Bangkok. This has been laid down by centuries of deposition from the Mekong and Chao Phya rivers, and is a deeply weathered soil of silt and clay. In some areas, e.g. Rangsit, it is very acid with deposits of aluminium sulphate and cannot be planted until there has been sufficient rain to leach out the acid salts. This is tested by spitting red betel juice into the ditches, if it turns black, the soil is still insufficiently leached. In this area the quantity of early rains is thus very important. If they are sparse, planting will be delayed and the crop will be small. Other areas have less tendency to acidity, and after centuries of cultivation are among the most fertile rice growing soils in the world. Like all soils derived from tidal estuaries, the soils have a high sodium content and the sodium absorption ratio is high, so that there is a tendency to salinity and any addition of water containing sodium salts will hasten the process. Because they have been produced by siltation, the distribution pattern of types is complicated and the direction of drainage evolved by trial and error very important to the maintenance of fertility. There is visual evidence, unverified in the time available that the construction of new highways and the various factories, is interfering with this pattern.

The climate is monsoonal, but in the central plain humidity is high all the year round; not all the klongs dry up in the dry season and water from those that do not is used for all domestic purposes and for cultivation of fish and irrigation of raised vegetable gardens and banana and coconut groves. The monsoon begins with sporadic but sometimes heavy showers in mid-May and builds up to a rainy season in late September-October, with maximum discharge in the Chao Phya in November. Because of the seasonal nature of the rain, and its volume when it comes, and because of the mountainous region of its source, the Chao Phya is always silt laden, with high suspended solids and in the central plain, because of the agricultural activity and the building of houses over waterways, it always has a high BOD. However, at the temperatures pertaining, $30^{o}C$ and over, and with the enormous volume of discharge for most of the year, the capacity for absorption is great, and the existing klongs, assisted by aeration from weirs or other means, could probably be managed as giant oxidation ponds, were it not for the industrial pollution producing substances toxic to the degrading biota.

The people in the central plain grow rice, bananas, coconuts and vegetables, mainly for their own use. The fish in the klongs are an important component of the diet, and many families construct a fish pond in which to grow fish both to eat and sell.

Water quality standards in Thailand

The Factory Control Division of the Ministry of Industry has issued a set of standards with which factories are required to comply in order to get a licence to operate. It is not known how these standards were arrived at, but in view of the high organic content of a large tropical river in its flood plain, and its heavy silt load, they do not seem realistic for discharges to water associated with the Chao Phya. They set no standard for sodium salts and a very low, probably unattainable level for total dissolved solids. In 1971, a WHO consultant made recommendations which are set out in annex IV. They are in general less stringent than those of the Ministry; they also include tight limits on toxic ions such as heavy metals, arsenic, zinc, copper and iron. The consultant considered that these standards were attainable. The emphasis was on health, and there is still no mention of sodium salts and the problem of salinity.

N.B. Pescod of AIT, in a report written in 1973,[6/] stresses the need to determine the controlling or dominant use to which the receiving waters are put and to set standards accordingly. He tabulates suggested standards as shown in table 6 reproduced from his paper. The sodium absorption ratio (SAR) can be calculated if the concentrations of Na^{+}, Ca^{++} and Mg^{++} are known:

$$SAR = \frac{(Na^{+})}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

6/ See M.B. Pescod, Investigations of Rational Effluent and Stream Standards for Tropical Countries, Interim Research Report (Bangkok, Asian Institute of Technology, 1973).

Table 6. Suggested stream standards according to controlling water uses

Controlling water use	Stream standard	
	Quality parameter	Suggested level
Potable water supply	Most probable number of coliforms (MPN)	Effluent quality similar to the natural state of surface water
	pH	6.5-8.5
	Dissolved oxygen	Greater than 2 mg/l
	Arsenic	Less than 0.05 mg/l
	Lead	Less than 0.05 mg/l
	Chromium (hexavalent)	Less than 0.05 mg/l
	Cyanide	Less than 0.2 mg/l
	Phenolic substances	Less than 0.002 mg/l
	Chlorides	Less than 1,000 mg/l
	Total dissolved solids	Less than 4,000 mg/l
Irrigation	Total dissolved solids (TDS)	Not more than 400 mg/l where there is poor drainage, saline soil and inadequate water supply. (Electrical conductivity (EC) less than 0.75 millimhos per cm at 25°C.) Not more than 1,000 mg/l where there is good drainage and proper irrigation management. (EC less than 1.75 millimhos per cm at 25°C.) Not more than 2,000 mg/l where there are salt-resistant crops, good drainage, proper water management and low SAR of water. (EC less than 2.25 millimhos per cm at 25°C.)
	Sodium absorption ratio (SAR)	Not more than 10 where there is poor drainage. Not more than 18 where there is good drainage.
	Boron	Not more than 1.25 mg/l where there are sensitive crops. Not more than 4 mg/l where there are tolerant crops.
	Dissolved oxygen	Greater than 2 mg/l. A level of 2 mg/l should not occur for more than 8 hours out of any 24-hour period.

Controlling water use	Stream standard	
	Quality parameter	Suggested level
	Pesticides	
	DDT	0.002 mg/l
	Endrin	0.004 mg/l
	BHC	0.21 mg/l
	Methyl parathion	0.10 mg/l
	Malathion	0.16 mg/l
Fishing	CO_2	12 mg/l
	pH	6.5-8.5
	NH_3	Less than 1 mg/l
	Heavy metals	Less than 1 mg/l
	Copper	Less than 0.02 mg/l
	Arsenic	Less than 1 mg/l
	Lead	Less than 0.1 mg/l
	Selenium	Less than 0.1 mg/l
	Cyanides	Less than 0.012 mg/l
	Phenols	Less than 0.02 mg/l
	Dissolved solids	Less than 1,000 mg/l
	Detergents	Less than 0.2 mg/l
Waste disposal	Dissolved oxygen	Greater than or equal to 4 mg/l

Source: M.B. Pescod, Investigation of Rational Effluent and Stream Standards for Tropical Countries, Interim Research Report (Asian Institute of Technology, 1973).

Calcium and magnesium ions maintain soil structure and thus a good "tilth" because they adsorb onto negative ions in the clay and cause flocculation, so that the soil becomes granular, with better drainage properties. Sodium ions replace those of calcium and magnesium when all are present, but do not adsorb, so the structure breaks down into separate particles which pack together and reduce drainage. The saline water then accumulates at the surface, and takes longer to penetrate. Exposure to high temperature then causes evaporation and deposition of salt in the soil. Irrigation schemes in many tropical and sub-tropical regions have in the past run up against this problem and if wastes with high dissolved salt concentrations are discharged to water used for irrigation the resulting solution should be tested with the specific crops grown in the actual soils likely to be affected. Where drainage is good, and SAR low, there is high salt tolerance of more than 1,000 mg/l or even 10,000 mg/l with salt tolerant strains in parts of the Union of Soviet Socialist Republics, but in sensitive soils such as those in the Bangkok region levels of less than 400 mg/l are desirable. Salinity is most conveniently measured as electrical conductivity in millimhos. Tests carried out in the United States of America suggest the following tolerances for various crops at 25°C. They would probably be lower at the prevailing temperatures in Thailand.

Crop	EC tolerance limit (millimhos)
Rice	8 - 9.3
Sugar cane	2 - 4
Maize	6.3- 8.0
Cotton	16 -17.3

It will be noted that cotton is relatively tolerant of salt, and if the food supply of Thailand could be guaranteed elsewhere, and if she were to grow more of her own raw cotton, it could well be that cotton growing in the neighbourhood of textile factories would allow a lower quality discharge at the same time as reducing the over-all costs of raw materials.

In developed countries where there is already considerable infrastructure connected with supplies of water, the setting of standards in ambient water destined by policy decisions for particular uses is at least feasible. In developing countries, where almost always there are no plans to provide alternative sources, the standards must be set with regard to the existing use, and this must therefore be determined before the standards are set. In the factories we examined the water was previously used for domestic purposes, including drinking and personal washing, for irrigation and to support fisheries.

Procedure and selection of factories for case studies

In all, the team visited eight factories. The information on chemical processes and waste treatment was obtained by interviews and by touring the factories to observe the processes, the waste water channels and the treatment plant, if any. Having identified the discharges and located the exit points the factories were asked what was known about the composition of the effluents and whether there had been complaints from local people. The treatment plants were visually assessed for effectiveness and enquiries made about capital and running costs and how the particular treatment process was chosen. (See annex V for criteria for environmental impact assessment.) Having obtained all this information, the three factories selected for case studies were chosen on the basis of the amount of information available, the competence of the technical staff to supply additional information, their willingness to supply samples for analysis and the extent to which they were representative of the problems and control we had observed.

The three factories chosen were as follows:

Factory B. Large factory on new industrial estate of some 70 rai[7/] surrounded by rice fields. Spinning, bleaching and dyeing of yarns only. Biological treatment developed from chemical dosing tanks.

Factory C. Large factory built in 1965 on 40 rai of land surrounded by rice fields on soil prone to acidity. Treatment by chemical dosing tanks inadequate. Evaluation by AIT in progress. Spinning, weaving and dyeing of synthetic fibres only.

Factory D. Large factory built about 1965 on site of older plant in suburban Thonburi. Area built up all round, with numerous small industrial premises, including other old dye works. Carries out

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7/ 1 rai = 16 a (1600 m^2)

desizing, bleaching, mercerizing and dyeing for its own spinning and weaving factory elsewhere. Has no waste water treatment, but discharges mixed liquor straight to klong, as do all the other factories and dwellings in the area.

For factories B and C interviews were made with local people. Salient points about the three factories are summarized in table 7.

Samples were taken as follows:

Factory B. In first sedimentation tank and from outfall to klong.

Factory C. From mixed waste channel before treatment and from outfall to klong.

Factory D. From outfall from bleaching process and from outfall to klong.

These were analysed by the Environmental Health Department of the Ministry of Health.

The factories B and C dispose of sludge by tipping, but the location of the tips was not known, so the effects of this could not be followed up.

The effects of water pollution, as indicated by interviews are summarized for factories B and C.

Factory B (Out plant effects)

Location

The plant is located at the end of a lane about one kilometre from the Lardprao road. A number of small roads run off the main one to a series of modern Thai middle-class homes. The last road, which leads to the factory, has homes for senior factory employees of the company combine (which includes a number of factories on one site all concerned with some aspect of haberdashery). Beyond the factory

Table 7. Comparison of problems and treatments for three textile factories in Thailand

Factory	Water consumed (tons/day)	Waste water discharged (tons/day)	Problems	Type of treatment	Costs	Effectiveness and comments
1	1200 (all purposes)	400 to 500	High pH, BOD, SS[a] and colour. Low nutrient value. Detergent foaming salty after neutralization.	Adapted from plant built for alum coagulation. Now neutralization by 30% sulphuric acid, sedimentation, activated sludge with addition of urea phosphate nutrient, surface spray to reduce foaming, second sedimentation.	Original plant 800000 baht and alum. Now running costs include acid and urea phosphate and 3 man-hours/day. Still cheaper than alum.	Reduces BOD and SS below 20 and 30 respectively and removes most colour. Must still contain salt and local inhabitants complain of taste. Factory supplies fresh water free of charge from water treatment plant.
2	5000 (processing only)	4500	Usually high pH, high BOD, SS and colour. Sodium carbonate and detergent. Irritating, toxic to plants and fish.	Alum dosing, followed by turbulator and then settlement in open pond.	120000 baht over 8 years, and 6000 baht per day for alum.	Largely ineffective because too small owing to miscalculation in laboratory tests. Activated sludge thought unlikely to remove the colour from the dyes in use. Experimentation with polyelectrolytes in progress and evaluation for recommendations by AIT.

Factory	Water consumed (tons/day)	Waste water discharged (tons/day)	Problems	Type of treatment	Costs	Effectiveness and comments
3	3840	2400	High pH, BOD, SS, colour and detergent. Probably toxic and irritating.	Nil	Nil	Discharge area filled with predominantly dark blue slime, black water, much foam near exit of bleaching waste. Little smell, probably because of toxicity

a/ SS = suspended solids

local farmers continue to cultivate rice fields - the appearance of which confirms the factory's claim that little or no environmental damage has resulted from their effluent discharge.

Note on condition of klong: Plants on banks and right down into water looked healthy. Water was muddy but not blue or black and not covered with scum or bacterial slime except in stagnant backwaters. There were fish in it. There was no unpleasant smell when boats passed. The exit pipes of the two factories were each about 18 in. in diameter, small in relation to the volume of receiving water at that point.

Complaints

Shortly after the factory started production a few complaints were made by villagers at Baan Wangtonglang whose homes immediately adjoined the canal into which the effluent was discharged. These concerned the colour of the water, but this was only a problem during the dry season. At other times the flow of water was sufficient to disperse any discharge quickly. Since the change in treatment methods at the factory no further complaints have been received.

Interview with village headman

Even if the factory were responsible for serious pollution of local water the effects would be difficult to isolate. Food factories (which have been established for about 10 years) discharge their effluent at the same point, and the canal is fed by a larger river which has also suffered a certain amount of industrial pollution. The headman had, however, lived in the village all of his life, about 40 years, and was therefore able to speak in general terms about the consequences of industrialization on the quality of water.

The systems of irrigation had been changed by the establishment of factories in the area, but this had not involved any net costs to the community since flow could be controlled by lock gates. When more water was required for irrigating the fields all that the farmers had to do was to get in touch with the irrigation department by telephone.

The only significant crop grown was rice, some of which was sold and some retained for domestic consumption. As is the case everywhere in Thailand, yields varied radically from year to year according to the amount and distribution of rainfall. In so far as the headman could tell, there had however, been no over-all trend of declining yields, and no noticeable change in the quality of the crop.

All of the families in the village catch fish in the canal. Fishing was represented as a spare time activity, designed mainly to supplement diet. Small surpluses might be sold, from time to time but nobody engaged in fishing as an important commercial activity. This situation had not changed as a result of industrialization. Before there were any factories in the area a large variety of fish lived in the canal. There were so many different kinds that the headman said that he could not possibly remember them all. With the establishment of factories, and subsequent water pollution, certain species had disappeared, but those which the villagers liked to catch and eat (blaachom - "serpent head" and blaaduk - freshwater catfish) remained with no noticeable change in numbers, quality or habits.

Before industrialization the water in the canal could be used for everything, although rain water was also collected and used primarily for drinking and cooking. Even now the canal water can be used for washing plates and cutlery when the flow is rapid, but not when the lock gates are closed and the flow reduced. The company accepted that they were polluting the water, and about five years ago extended piped water supplies to the villagers free of charge. This is now used for cooking and drinking, but since pollution is not serious the villagers still find it more convenient to use the canal for showering and washing their houses and clothes.

Social consequences

The factory employs 475 workers; 145 work in the dyeing section, the remainder on spinning. In the factory dormitory, 360 workers are housed and the others are drawn from the local area. Of the workers living in the dormitory some 20 per cent come from Bangkok, but stay in the dormitory because of the shift working system; the remainder are drawn from the North and North-East. Since dormitories are provided no apparent additional burden is placed upon the local infrastructure.

The land on which the factory was built was previously owned by 7 families from the village, and used for cultivating rice. It was purchased by the Thai fore-runner of the company about 30 years ago for 40 baht per rai. The company apparently already had a small plant in another location, but purchased the new land for future expansion. (This explanation as given to us seems rather improbable. It is more likely that the land was simply acquired by a landlord with a view to its more immediate financial possibilities.) The land was subsequently rented back to farmers, rates having reached 50-60 baht per rai per year or 5 tang (a measure of rice) per rai per year five years ago when the plant was built. The present value of the land was put at 100,000 baht per rai. (This again seems unlikely, the figure being quoted probably indicating that the price was now simply far too high for local people to contemplate purchasing it.) Members of the families previously renting the land were said to have gone to work in the factory when they were displaced.

The village headman said that about 20 members of his village had gone to work in the factory. Workers were all single and usually female. The money which was earned was shared among the families concerned, and not retained by individuals. No significant changes had been noticed in the behaviour or habits of people going to work in the factory. He gave the impression that villagers would prefer to continue to work as farmers, but were unable to secure sufficient land and were therefore obliged to take on other forms of employment.

Factory C (Out plant effects)

Location

The plant is close to the super highway to the North, about 40 km from Bangkok. There is a row of fairly poor homes over the klong parallel with the road on the same side. Inside the compound are seven villas for senior management, flats for middle management and dormitories for workers. The surrounding area appears to have been rice fields on acid soil. Most of this was semi-derelict when seen in July 1974, with no water in the intersecting channels. The factory discharges in a small klong to the east of the factory. The small klong joins a larger one which then flows westward across an area formerly used for the cultivation of rice. At this point the klong is joined by another which appears to carry the effluent from the airfield, located approximately two kilometres south of the factory. The klong then passes under the main road, and a railway track, before arriving at a village. About two hundred yards further on it joins klong Premprachakoon, which in turn is connected to the Chao Phya River some distance to the north. At this point it is black and turbid with transparency of only a few centimetres. Bubbles of gas burst frequently, producing a permanent smell of hydrogen sulphide. There are no fish, and the bordering plants are stunted or dead, except for the ubiquitous weed, water hyacynth, (Eichornia sp.) which survives even here, though less luxuriantly than usual.

Complaints

In March 1974, a group of villagers wrote to the Siam Rat newspaper claiming that discharge from factory C had polluted klong Premprachakoon and smaller surrounding klongs to an extent that various vital communal activities had been impaired. In verifying these complaints, we were unable to demonstrate conclusively that the damage of which the villagers had complained could be attributed entirely, or even primarily to the factory. There is, however, no apparent reason why they should have singled it out for criticism if the airfield were also to blame, and from their own reports of the time from which they have been suffering, a strong connexion appears to exist between the establishment of the factory and the first signs of the problem. In the absence of further evidence it would therefore be reasonable to assume that the existence of factory C has been detrimental to the village and the surrounding land.

Interviews with local people

On two occasions we attempted to contact the person who had written to the newspaper, and finally opted for interviewing his father, and another villager who appeared conversant with the nature and extent of the problem. Both had lived in their present homes for several years and were able to compare the situation before and after the establishment of the plant. In considering what information they were able to supply, two qualifying factors should be borne in mind. Firstly, Thai farmers do not keep accounts, and therefore have only rough impressions of income and profits over a period of time; since, in many cases, we were asking for information about activities seven or eight years ago, further inaccuracies must be anticipated. Secondly, if our informants were correct, the numbers of people affected were large, and the range of activities practised therefore considerable. In certain instances our informants had never carried out the activities in question themselves, and were therefore only able to give a rough impression of their general economics. Under the circumstances findings may only be considered reliable in so far as they give some impression of the order of magnitude of the problems arising. A great deal of painstaking research would be required to arrive at a more precise understanding. Bearing all this in mind, the apparent impact may be outlined as follows:

(a) Domestic use of water. About seven years ago, before the factory had started on full production, the water from the large and smaller klongs could be used for all domestic purposes, including drinking and cooking, although as far as the latter are concerned, it is probable that the major source was the rain water which all the villagers collect. Nobody is now able to use klong water for cooking or drinking, whilst other uses now depend upon the location of individual homes. Those with access to klong Premprachakoon itself, where the water moves, are able to use it for showering, washing clothes, and washing their houses. Those having access only to the smaller klongs, where the water is stagnant and smelly for the greater part of the year, can only use it for washing concrete floors. The situation changes somewhat from September until the end of the year. At this time rainfall is heavy, and the normal direction of flow in klong Premprachakoon is reversed. Water flows from the river through to the community, and for a time the effects of pollution are not felt, but this provides only temporary respite. A small number of villagers, who live near to the road are able to draw tapped water from a source adjoining the airfield about half a mile away. This is provided free, but supplies are limited, and transportation back to the village inconvenient. The remainder of the 1,000 families said to be affected apparently rely upon the rain water they collect and, in certain instances, upon the wells they have constructed. No direct financial costs are therefore incurred here, but varying degrees of hardship and inconvenience are experienced in obtaining water, and in obtaining it in sufficient quantities;

(b) Fish farming. Before the factory was built about 100 families were said to have been engaged in fish farming, often as a major economic activity. Villagers dug their own ponds and filled them with water from the klong. A number of different varieties were reared including serpenthead (plaahua), globe fish (plaabaaw), pilot fish (plaasalit), dace (plaathapian) and cap (plaaduk). When the water became polluted about seven years ago, the fish began to die, and hardly any of the farmers are now able to continue the activity. Farmers reported that the fish would not eat, and thought this was possibly due to an absence of vitamins in the water. In the case of the farmer to whom we spoke, gross income from seven ponds was about 35,000 baht per year, and expenses less than 25,000 baht, giving a net profit of more than 10,000 baht. The only significant expense was the bran (rice husks) on which the fish were fed. In this particular case expenditure was reduced by the substitution of dung from the chickens and pigs which he also reared, but most farmers would not have been in the position to do this, and net income of about 10,000 baht was considered to have been likely to have been the average for an operation of this scale. In fact, most farmers were said to have had only 2-3 ponds of equivalent size, so the average annual net income per family would have been in the region of 3,571 baht per year. Assuming that all farmers have now ceased production this would give an over-all cost of 357,100 baht per year at 1967 prices.

Some farmers had been able to continue with chicken and pig farming since the water became too bad for fish farming. These activities yield a more regular income, and the inconvenience here is therefore only slight. Chickens, in particular, however, require fairly large amounts of clean water so this alternative is effectively ruled out for the majority. Most of the people who previously farmed fish are now employed in factories and elsewhere, earning about 17-20 baht a day, or 5,000-6,000 baht a year at current prices. This would appear to compensate for the money lost, but other activities have also been affected by the water pollution, and it was felt that, over-all, most people were financially worse off. Thai people, in any case, show a marked preference for self-employment as opposed to working for others, but for most of these people this alternative no longer exists. Finally the people are now unable to rear the fish themselves and therefore have to purchase them elsewhere. There tends to be a negative impact upon both income and diet in this respect;

(c) Vegetable gardens. A few years ago about 70 per cent of the 1,000 families cultivated vegetable gardens, usually as a main occupation. Of this 70 per cent about half did not own the land which they farmed but we did not find out what rents had been in these cases. Crops and plants grown included domestic vegetables, chillies, macua (a green fruit of the tomato family), sugar cane and sweet corn. The average family cultivated about 4 rai, although some families had as much as 10-20 rai. The majority of production was for sale. Average annual income was about 2,000 baht per rai per year, with costs, other than rent, negligible. The income was relatively high since all of the plants in question had a growing cycle of only 90 days. With water pollution almost all of this activity came to a halt, causing a total annual loss of about 5.6 million baht (2,000 baht x 4 rai x 700 families) at 1967 prices.

About 50 per cent of the families affected ceased cultivation altogether, and now seek employment elsewhere. The remainder have switched to growing bananas and farang (guava). We were unable to contact any of the farmers concerned directly, but it was estimated that incomes were about 75 per cent of what they would otherwise have been. The actual income from agricultural activities substituting previous activity would therefore be about 2 million bahts at 1967 prices. Again it must be remembered that some of the former production would have been consumed by the families themselves, and that the displacement of the activity will have led both to increased expenditure on food and probable deterioration in diet;

(d) Fishing in the klong. An unspecified number of families previously fished from the klongs, earning about 30-40 baht per day, and supplementing their diets in the process. No fish now remain in any of the local waterways, and this is said to place a particular burden upon the poorer families, who now spend about 30 baht a week buying fish. If we make an arbitrary assumption that the number of affected families totalled 100 (the number is in fact probably higher) then the loss of income will be about 750,000 baht per year (30 baht x 5 days x 50 weeks x 100 families) plus additional food expenses of 150,000 baht giving a total of 900,000 baht;

(e) Rice. Some 400 rai of rice fields have been abandoned since the factory was built. Gross income at current prices was estimated at about 2,000 baht per 3 rai, so the gross loss would be about 266,666 baht per year. Expenses by comparison were slight, with the exception of rent (if and where this was paid). It was thought that about thirty to forty families had previously worked the land, and that they had now gone to seek employment elsewhere.

Management of water in the textile industry

In any country with increasing pressure on water resources, it will pay the textile industry to reduce water use by recycling as much as possible, particularly as water quality requirements for this industry are higher than for drinking water so pre-treatment has in any case to be given. Evaluation of water pollution control in any one plant is complicated by the variability of flow in both volume and composition. The maximum volume in any hour frequently exceeds the mean hourly flow by more than twice, and releases from batch processes such as dyeing, impose shock loads on receiving waters or treatment plant. For this reason retention tanks in which sedimentation and equilibration can occur are the basic minimum treatment requirement. The characteristic mixed effluent of a cotton plant is an alkaline solution pH 10 or higher, with a high BOD and SS. The BOD is in principle removable by aerobic biological treatment, but the pH has to be adjusted to around 7 in order to encourage the necessary biota. Suspended solids include fibres and particles of pigment, neither of which settle well, but sedimentation can be encouraged by addition of coagulants, traditionally alum, though ferrous sulphate has also been used. Some of the new polyelectrolytes are more effective, but expensive for a country which does not produce its own. Sheffield Corporation sewage works finds that excess Fe^{+++} ion in steel waste facilitates coagulation when pH is adjusted, and it is possible that this might be one advantage of juxtaposition of steel and textile factories, although studies carried out by AIT suggest that Fe^{+++} is less effective in colour removal than alum.

Table 8. Comparison of alum and iron coagulation efficiency

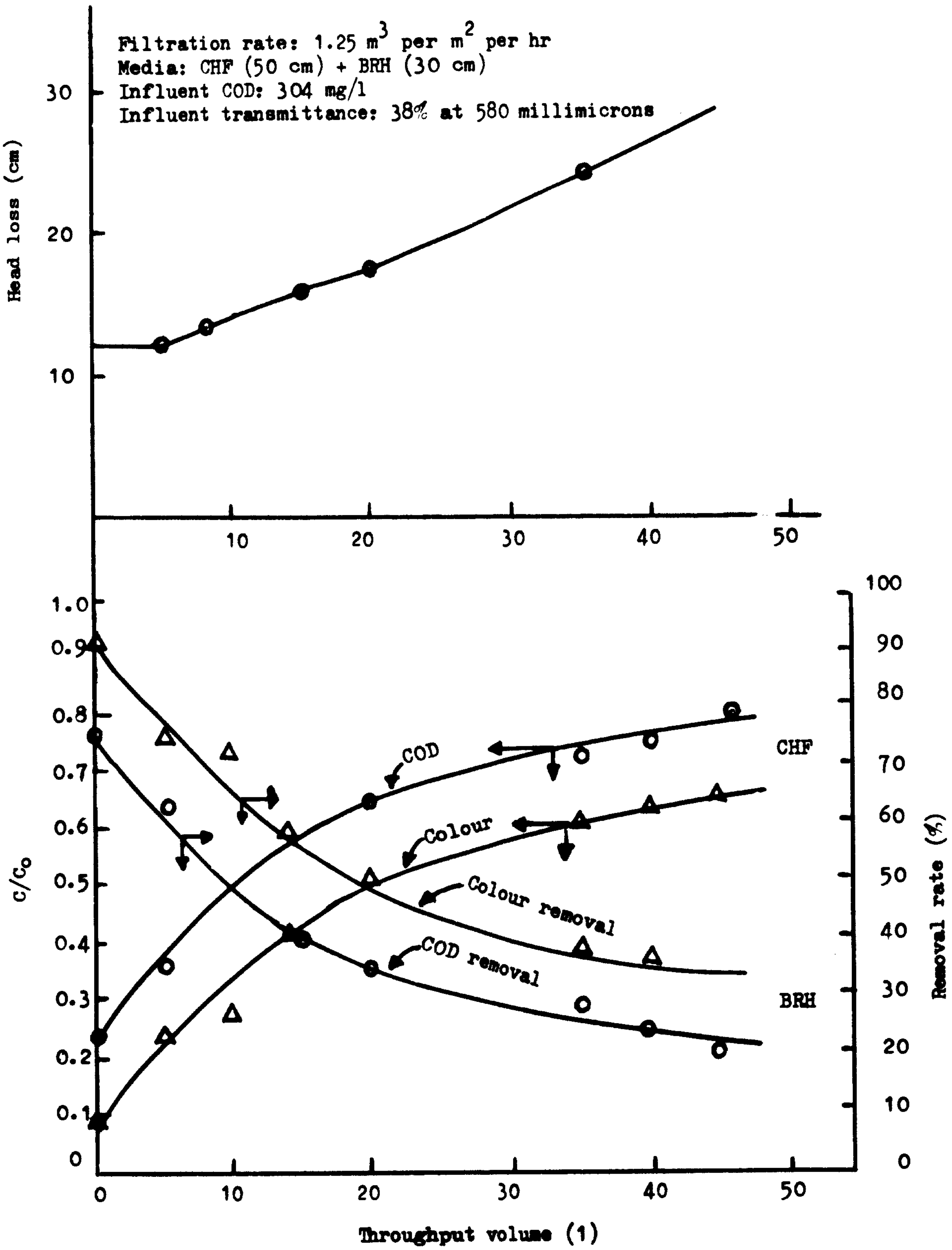
Chemical	Dosage (mg/l)	Acid dosage (mg/l)	Optimal pH	Supernatant COD (mg/l)	Supernatant Trans-mittance (%)	COD removal (%)	Colour removal (%)	Cost (baht/ton)
Alum	250	77.2	6.0	62.4	74	50.7	83	0.95
Ferric sulphate	250	247.0	5.0	67.8	36	52.4	72	6.62
Ferric chloride	250	257.5	5.0	73.4	72.5	48.4	43	6.64

Table 8 summarizes analysis results of the waste waters in factory C. It shows that alum is much cheaper than ferric salts and also more effective, but if acid wastes from a steel plant, high in Fe^{+++} were available free of charge they could be added in controlled amounts simultaneously to adjust pH and produce coagulation. This would eliminate the need to purchase sulphuric acid for neutralization that is a major component of running costs of treatment processes in factory B.

The performance of two filter column media for colour removal was also compared. The results are presented in figure VI from which it can be seen that burnt rice husk carbon could provide a relatively cheap and locally available filter material with reasonable performance. Further tests on a larger scale would be required fully to evaluate the feasibility of both these methods. Because of the variability it would be necessary either to conduct a detailed analysis of each process over a period, or to design equipment to measure the flows of the various waste streams. This was not possible in six weeks and no suitable records were available for any of the factories.

A complete cost benefit study of these factories should include an evaluation of the benefits of "good housekeeping" with respect to water and chemicals, and the extent of savings to be made by adopting reuse and counter-flow techniques.

Figure VI. Performance of a filter column for colour removal using as filter a commercial preparation and burnt rice husk carbon



CHF = commercial preparation
BRH = burnt rice husk carbon
COD = chemical oxygen demand

C_o = initial concentration
C = actual concentration

Technological alternatives for waste treatment

Basically the available alternatives for dealing with potential damage from textile wastes are four:

No treatment

Conventional primary, secondary and tertiary waste treatment

Maximum reutilization of water and chemicals

Choice of different process chemicals

The first imposes no cost on the enterprise, but extensive social and environmental costs on the community, which could be measured in terms of agricultural production and other uses foregone.

The second contains a range of options both of degree and method, which could be adopted over a planned period of time to achieve an agreed standard. Costs are available for other countries than Thailand and these could form a basis for comparison, but would need adjustment by someone familiar with the Thai market and the degree of availability of equipment and skills.

The third and fourth have not been considered at all in Thailand, and are indeed only beginning to be considered in developed countries as water resources are nearing maximum exploitation and pumping costs are rising.

Existing factories could probably not convert economically to more conservative use, but projected ones could be designed to maximize possibilities for reuse and recycling. In the central plain of Thailand, as in the United Kingdom, water appears so abundant and cheap that it is carelessly used. The principal reason for reducing quantities consumed and amounts of pollution discharged would be to protect a valuable agricultural resource. The reduced volume of effluent to be treated will produce additional benefit in reduced treatment costs. Developing countries have the opportunity to plan the siting of industrial plant to optimize the benefits of both industrialization and agriculture, and with the pressure on food-producing areas increasing, no country with a potentially fertile region can afford to consider only the short-term maximization of gains by rapid unplanned industrialization. This is discussed further in chapter V.

Incorporation of environmental factors into policy decisions

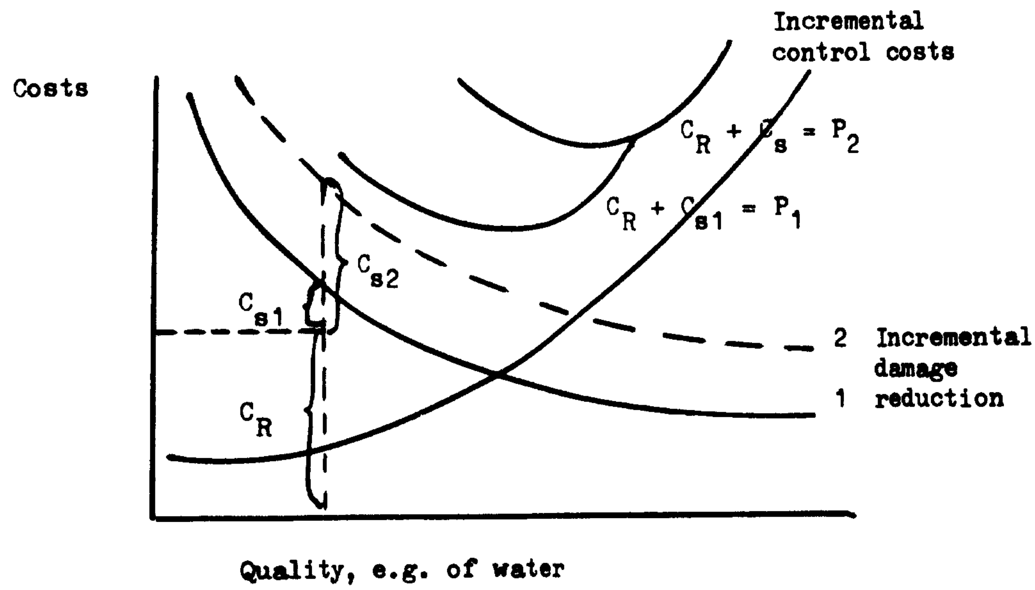
In figure VII the costs of damage control, P, can be established, though not always without difficulty. The costs of damage are here assumed to be made up of two components, the actual financial losses incurred, such as damage to fisheries, crops and so on, which can be measured, or at least realistically approximated - the real costs C_R, and the subjective costs, or nuisances, such as time consumed in fetching water, discomfort in using it for washing, disagreeable appearance, odour etc., C_s. In any society, with a given set of goals, the value accorded to these subjective costs will reflect the attitude of the policy makers to the non-financial damage, and the degree of tolerance of the affected population. In the diagram two levels of perception of damage are indicated by C_{s1} and C_{s2}, giving two damage cost curves and two economic optima. The subjective valuation of the effective policy makers, be they government, industrialists or funding bodies, determines the level of expenditure on damage control. In any given situation, if costs of actual preventive measures taken, and costs of damage incurred can be determined, it is possible to estimate the valuation put on the nuisances by the policy makers, and thus to compare industry with industry or plant with plant[8/]; if it is assumed that what is actually happening reflects what is perceived to be the optimum for that industry or plant, then:

$$\text{Total control costs } P = C_R + C_s$$
$$\text{thus } C_s = P - C_R$$

This can be used to identify industries or plant which could usefully spend more on prevention, and also those which are spending more than is necessary for optimality.

8/ See C. Sinclair, The Cost Effectiveness Approach to Industrial Safety (London, HM Stationery Office, 1973).

Figure VII. Economic optima given two different subjective valuations of damage costs



<u>Summary of costs and benefits associated with pollution control in the textile industry</u>

Costs	Benefits
Capital equipment	Water available for reuse
Land for treatment plant	Some reclamation of materials
Chemicals	Increased value of water discharged
Labour	Reduction in damage to health, crops and fisheries
Maintenance	Increase in 'amenity' with consequent increased opportunity for recreational use
Research into methods	

Obviously all the costs fall on the industry, which may well decide, if free to do so, that the benefits to itself do not justify the expenditure. If a political decision is made that the social benefits are sufficient to justify the expenditure, then either society as a whole must assist with the costs of prevention, through taxation and subsidies, or prevention must be enforced by law, in which case society will ultimately have to accept higher prices for the products. Again it is apparent that the actual level of control adopted will depend on the balance between industrial interests and political decisions, influenced to a greater or lesser extent by the community.

IV. TECHNOLOGY TRANSFER

Technology transfer has been considered one of the main benefits associated with overseas investment. In evaluating the impact of new or expanded plants in the textile industry, the ability of the enterprises to transfer technology, induce linkages, and develop a skilled labour force, are necessary elements to be considered. For this, discussion of technology transfer in the Thai textile industry will be in three sections:

A. Theoretical background and framework for analysis.

B. General discussion of determinants and patterns of technology transfer for the Thai textile industry as a whole.

C. Evaluation of impacts, conclusions, and discussion of alternatives.

A. Theoretical background and framework for analysis

Technology transfer (TT) includes the transfer of a whole range of knowledge, skills, hardware and software from a variety of sources - individual, industrial, institutional, to individuals, firms and institutions. Many of these transfers take place across national boundaries, and it is these in which we are particularly interested. Some TTs also stimulate further technology transfers, usually in industries other than that in which the original TT took place. Such TTs are part of the linkages effect of the original TT.

The form and content of TTs are determined by various characteristics of the environment within which they take place - political, social, economic and technical. In turn, the TTs themselves have impacts on the local political, social, economic and technical systems. As shown in figure VIII the determinants, impacts, and consequences can be considered in three main parts.

The basic TT

(a) The determinants of TT - historical, political, social, economic, technical, ownership patterns etc.;

(b) The pattern of TT - the decision-making process, the methods used to set the TT in motion, the history of the TT;

(c) The technological impact of TT.

The various elements of technological impact

These can be divided into five.

(a) The technologies chosen for inputs, processes, products and waste treatment. In a large majority of industrial processes, there is a range of feasible technologies for inputs, processes and products. Process technology can vary both in type and in labour/capital utilization, while input and product technologies can vary according to design and specification, sources, market constraints etc.;

(b) Contractual elements. Many TTs involve constraints or obligations on the users or recipients, particularly when the technology transferred is new, or more sophisticated than those previously in operation locally. Such constraints and obligations include patent, licence and royalty payments, overpricing of intermediate and spare parts, restraints on markets, raw material supplies, use of foreign technicians etc.;

(c) The technological capability of the firm. In any given techno-economic venture, the firm, and/or specific individuals within it, will have a certain degree of technological capability, i.e. it will be able to manipulate technology to a certain degree. In order of rising capability, the firm or individual will be able to operate production, modify or innovate in production, and initiate production;

(d) The technological capability of the capital goods sector. The growth of an indigenous capital or quasi-capital goods industry has important consequences for the development of economic growth. The extent to which TT increases demand for the products of this sector and/or stimulates new technology within the sector is an important consideration for evaluation of TT impact;

(e) Other technological capabilities. There are a variety of other ways and fields in which TT can have impacts: through the supply of raw materials, contact with research and extension agencies, the provision of quality control, and through training of individuals, both inside and outside the firm.

The consequences of TT

When attempting to determine the impact of TT by evaluating the impact, the problem immediately arises of deciding which impacts can conveniently be evaluated in economic terms, and which cannot. The normal method used for economic evaluation of projects, and the method utilized in the economic section of this project, is social cost benefit analysis (CBA). Many of the impacts noted above will give rise to changes in flows of goods or services which are evaluated as part of CBA. For example, choice of technique will be reflected in the relevant flows of capital relative to those of labour, increasing skills within the firm which result from training may well be reflected in changing input/output relationships within the firm.

However, many impacts of TT will not be reflected in normal CBA for any of several reasons. The impacts may not occur within the period of time normally covered by CBA, e.g. the contribution to the economy of a man trained in one firm may not make itself felt until that man changes firms. The impact may be of a type not included in CBA, e.g. training by or contact with a local research or extension institution is of benefit to the institution, but this is not normally reflected in CBA evaluation of the impact. Evaluated changes in economic flows may reflect the stimulation of local production of raw materials, but not the extent to which new technologies, with their potential for future production, are stimulated within raw material producing industries. Therefore, evaluation of TT impacts is divided into two parts. The first evaluates those impacts, or the aspects of impacts, which can be identified by changes in economic flows, and are valued in terms of cost and benefit in CBA. The second, which we shall deal with in the following paragraphs, concerns the impacts, or aspects of impacts, which are not amenable to such evaluation and so are analysed outside the usual framework of CBA.

The method we shall use to deal with these impacts is to evaluate them as far as possible in terms of their contribution to a "local technology manipulation capability" (LTMC). This can be defined as a store or system of technological knowledge and skills, of experience in the choice, manipulation, operation and development of technologies. This store or system is defined as existing within given social boundaries, usually national, independent of external sources of aid. The system may, if developed sufficiently, generate decisions concerning technology transfer in accordance with a given set of entrepreneurial, institutional or national goals.

The skills, knowledge and experience within LTMC accrue in individuals, firms, research, extension and education institutions, government agencies etc. In so far as skills, knowledge and experience existing within national boundaries are possessed and/or controlled by non-nationals, their contribution to LTMC is diminished. Increases in LTMC can be assumed to be beneficial to national society in two different respects. The first is that nationally controlled and owned technology is more likely to accord with national goals than is non-nationally controlled or owned technology. Technological decisions taken in accordance with national goals are more likely to result in appropriate technologies, with resulting lower imports of technology-linked goods and services, and in more appropriate capital/labour usage etc. than are decisions taken in accordance with foreign goals.

The second is that nationally controlled manipulation is more likely to satisfy the important "merit want" of local or national, technological and economic independence.

However, it must be noted that there may be situations in which increases in LTMC and achievement of other local or national goals are not compatible. In such cases a trade-off between the two different sets of goals according to society's or government's value systems is necessary. An example is given in (d) below.

We now list the main ways in which TT may contribute to LTMC.

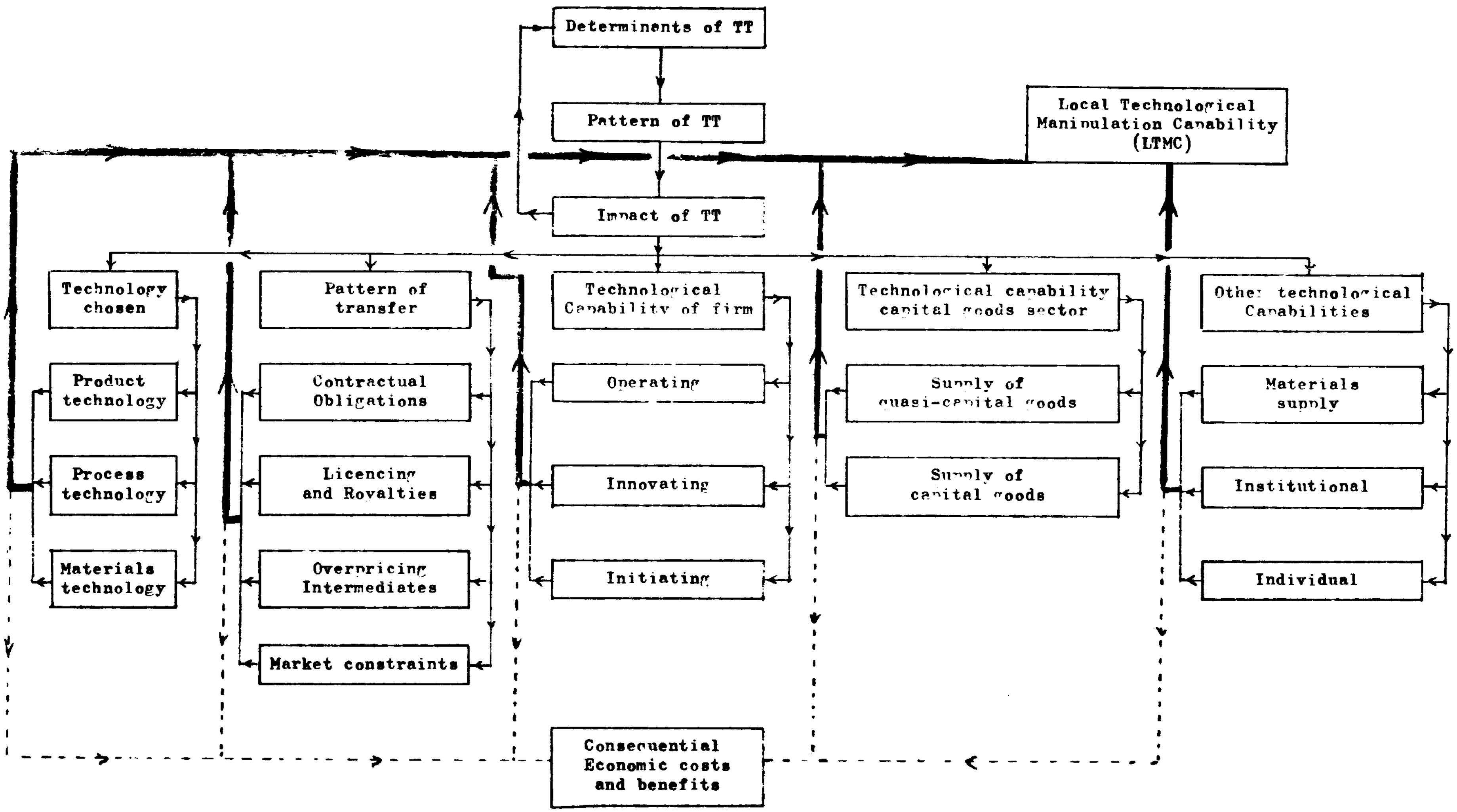
(a) Through decision making. The greater the extent to which local nationals are involved in decision making before and during the TT - at all levels ranging from the decision to invest, to choice of technique and factory layout - the greater is the probability that local nationals will be able to take these decisions independently in further rounds of TT or expansion, through the process of learning by doing;

(b) Through training. The higher the level of ability to which local nationals are trained to manipulate technology independently, the greater will be the LTMC, the greater also will be the ability to take decisions concerning technology as above;

(c) Through contact with institutions. In many local environments there exist research and extension institutions and government agencies contributing to LTMC, with capabilities and interests in fields related to TTs. The effectiveness of these organizations is largely dependent on continual contact with industrial firms - if TTs take place in isolation from these organizations, they will not be able to build on their expertise and experience, and will become moribund;

(d) Through choice of technology. The choice of an appropriate (particularly in a capital/labour use sense) technology in TT is likely to lead to greater contributions to LTMC than inappropriate choices, at least in the short run. This is because the level of expertise necessary for manipulation of "appropriate" is usually lower than that necessary for inappropriate technologies, and thus is more likely to be near the existing level of LTMC. However, in the long run, the choice of inappropriate technology may contribute more to LTMC, as training and experience with the technology develops. In evaluation, such considerations of time scale must be taken into account;

Figure VIII. Technology transfer



(e) Organization of the firm. The existence within the firm of potential change components with wide ranging responsibilities for quality control maintenance, repair, spare part manufacture, can be a valuable stimulus to LTMC, particularly in respect to process and product innovation.

B. General discussion of determinants and patterns of technology transfer for the Thai textile industry

Discussion will be in three sections. Firstly, we examine some of the determinants on the technology demand or Thai side; and secondly, we examine those on technology supply or foreign investor side. Thirdly, we examine some aspects of the predominant patterns of TT to the industry.

The demand determinants

Pre-promotion technology

Data on the size and technological level and capability of the textile industry before the main promotion and expansion period which started in the early 1960s is very limited. Available economic data are given in the introduction to chapter V of this report. On technology, all available evidence suggests that the level and capability was very low - the machinery utilized was old, often second hand, often on a very small scale. Thus it would be fair to say that there was in Thailand no technological capability for dealing with the much more modern techniques introduced in the 1960s, and that there was very little mill management experience and ability.

Promotion policies

Since 1959, the Board of Investment (BOI) has played a prominent role in the development of manufacturing industry. Several elements of its policy have contributed to determining some of the technological characteristics of promoted industries. Although the extent to which these elements apply to the textile industry in particular is not known, further analysis might well be profitable.

There are three elements of the Board's policies which are of particular interest. The first is its tendency to encourage and promote larger more modern technologies. J.C. Ingram writes "In addition to type of product, the Board of Investment often stipulated a minimum size of plant, and the technology to be utilized. Typically, Board approval was required for machinery and equipment, and its emphasis was upon use of modern technology and equipment".9/ Secondly, BOI privileges included the right to bring in technical and managerial personnel thus reducing incentive to find Thai technical capability or to help create it. Again, available evidence suggests that there was no limit to the extent of this privilege, although recently public opinion has criticized the lack of promotion of Thai technical and managerial staff.

Thirdly, BOI privileges included exemption from import duties and business taxes on imports of capital equipment to be used in a new plant thus reducing any incentive to minimize on capital expenditure.

Moreover, the general aim of the BOI's promotion policy has been import substitution, despite inconsistencies in its choice criteria.10/ Few promotion certificates, and probably none in the textile industry, have specified the need for exports. It seems to have been the Board's hope that regulations concerning minimum size and use of modern technology and equipment, would enable promoted firms to compete on the international market within a reasonably short time, thus avoiding the problem of creating a purely import substituting industry, with

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9/ J.C. Ingram, Economic Change in Thailand: 1850-1970 (Palo Alto, Ca, Stanford University Press, 1971), p.289.

10/ Ibid, p.290

small scale high cost output and no economies of scale. But, again quoting Ingram, "The danger is that these requirements will not be enough to produce large scale plants, but that they will be enough to prevent creative innovations and adaptations of small- to medium-scale operations to fit Thai factor costs and managerial capabilities, thus precluding an evolution of industry after the Japanese pattern".10/

The conclusion that we can draw from these considerations is that on the Thai or technology demand side there were no incentives for, or constraints on, foreign investors to choose or adapt their technologies to suit Thai factor prices, or management capabilities. To put it another way, there was no incentive from this side for investors to utilize appropriate technologies. Indeed, the three elements of policy noted above are inducements for inappropriate technologies in many instances, although it must be admitted that there may well be other very good reasons for requiring inappropriate technologies in many instances.

The supply determinants

We may now turn to a brief analysis of the determinants of transfer from the point of view of the overseas investing firms. In the Thai textile industry Japan is by far the most important overseas investor, holding over 80 per cent of the total foreign capital of the industry. For this reason, and as information on other investing countries (Burma, India, Portugal, United Kingdom, United States of America) is not available for this report, we confine our comments to the Japanese investment on the assumption either that other overseas investors have the same characteristics or that the impacts of different characteristics are not of major importance.

The main source of information is a paper of the Economic Co-operation Centre for Asia and the Pacific11/ which attempts to provide some knowledge of the general characteristics of overseas Japanese enterprises

11/ T.W. Allen, Direct Investment of Japanese Enterprises in South East Asia (Bangkok, Economic Co-operation Centre for Asia and the Pacific, 1974).

in order to assist host countries in assessing fully the impact of Japanese investment, and to judge the appropriate policies that it should pursue should it wish to encourage such investment or influence the form that investment might take. The paper covers several industry categories, including textiles, over most South East Asian countries. Although information is not specific to Thailand, and usually not specific to the textile industry, some of the data are useful in providing general background information in the absence of more detailed work.

A major section of this paper is devoted to the analysis of the motives for Japanese overseas investment. One particular motive of significance to the Thai textile industry is that of trade. In a sample of 110 Japanese manufacturing equity investments over 1960-1970, 75 per cent gave the securing, maintaining and developing of overseas markets as the dominant motive. "Many of the projects in this category were also implemented with the continued trading possibilities in mind, either through the supply of components and raw materials and/or the provision of the needed machinery and equipment to establish the enterprise."12/ The significance of this last motive for the Thai textile industry is clear, the vast majority of machinery and equipment imported since the early 1960s has been Japanese. Equally, overseas sources of artificial fibres are mainly Japanese, as is the major ownership of local artificial fibres facilities. (It should be noted that the trading consideration appears to be decreasing in importance, having been particularly important during the early 1960s.) Allen also adds a significant foot-note: "It is also apparent that overpricing supplies of plant and equipment, components and materials from Japan to the host country is common, as well as the underpricing of the host country exports to Japan. Such intrafirm pricing policies are common even within developed countries".13/

12/ *Ibid.*, p.12.

13/ *Ibid.*, p.15.

Further evidence of the importance of the trading and supply of equipment comes from analysis of source of profits. An Export-Import Bank survey of overseas Japanese enterprises stated that 36 per cent of 606 firms interviewed gave export of raw material and half-finished goods to the foreign company from Japan as their main source of profit, and another 9 per cent gave the major source as export of equipment and machinery from Japan to the project.

Given the difference in technological capabilities between Thailand and Japan, it is also of interest that about 16 per cent of primary and manufacturing projects overseas of Japanese investors have been undertaken with the receipt of royalties and technical and management fees as one of the aims of the project, although it is certain that the majority of investments involve payments of this type.[14]

The above considerations do not provide us with any conclusive causal link between the motives of Japanese overseas investment and the type of technologies that they are likely to be utilized in the Thai textile industry. However, it is clear that, given the motives outlined above, there is little reason for Japanese joint-venture partners to choose or adapt technologies to suit the given Thai conditions, particularly as far as factor prices and management capabilities are concerned. As in the "demand" section, the converse is probably true, that there may well be economic incentives for utilizing what to the Thai situation may be inappropriate technologies. Amongst these we may list: (a) the higher profits to be gained from exporting "higher" technology equipment rather than "lower" technology equipment; (b) the greater scope for technical fees etc. from the use of high technology; (c) the greater likelihood of exporting spare parts for such equipment; (d) the greater availability of high technology equipment from manufacturers in Japan; and (e) the longer period during which the local company will not be able to manipulate the technology independently.

14/ Ibid.

Concluding these sections of demand and supply determinants of technology, we may suggest that on the demand side, there is no incentive in government policy for overseas investors to choose technologies specifically suited to Thai conditions, and that on the supply side there may well be reasons why investors should choose not to do so. One obvious argument is that investors will take advantage of Thai conditions, particularly of cheap labour, from their own profit motive, but it is clear that in many cases, the benefits from utilizing their own technologies outweigh any benefits to be gained from adaptation. This is particularly probable in the Thai textile industry, where a very high degree of protection allows for high profits without necessarily taking full advantage of low labour costs.

The predominant pattern of TT

If we turn now to the pattern of technology transfer which occurs in the Thai textile industry, we find that the overwhelming majority of transfers take place in the form of joint ventures. Indeed, with the exception of UNIDO's involvement in the Textiles Industry Division of the Ministry of Industry, it is likely that no other transfer method is utilized. Again looking at Japanese investment in particular, Allen notes a series of reasons why joint ventures are preferred by the Japanese:[15/]

(a) The local partner is often familiar with local conditions;

(b) The risk of the venture is spread;

(c) The local partner is often a major customer or selling agency for the product;

(d) Joint ventures tend to generate local acceptance more readily than direct ownership;

(e) Some motives for the over-all investment, such as trade or raw material procuring, do not require ownership or even majority control;

15/ Ibid.

(f) Local markets or supply sources are often controlled by local partners;

(g) Local partners may have necessary skills, knowledge etc.;

(h) For several reasons, the types of process in which Japanese joint ventures take place are at the simpler end of the product and process characteristic scale. It is felt that for these processes, joint ventures are the most suitable form of investment, as they do not require the direct close and expert control which may be necessary for some of the more sophisticated and complex processes and products. In Allen's classification, textiles falls into the above category, being classed as "simple, multiple process" (spinning and weaving) and "simple, dominant single process" (dyeing). This contrasts with car assembly (complex, multiple assembly) and steel (complex, multiple processes).

A more precise analysis of the form of TT of Japanese overseas investors is given in a survey of industry categories.[16] For the textiles industry, 43 projects were covered, and the survey showed that the dominant form of TT in the textile industries is know-how, and that the level of product and process technology transferred is fairly low. An important form of transfer is organizational, which occurred in all cases of the sample. Significant is the low occurrence of research and development as a form of transfer outside know-how; this is perhaps to be expected in the textile industry, where product standards and process techniques have long been determined within the industries of the developed countries.

16/ Ibid., p.33.

C. Evaluation of impacts, conclusions and discussions of alternatives

In this section, we briefly summarize the information about technology transfer in our textile factories, and in some cases suggest alternatives existing in each impact of technology transfer, together with some factors requiring further analysis. Impressions of other companies seen briefly during the project are also given.

Determinants and patterns

The determinants and patterns of TT in three of the four companies fell within the range which would be expected within the Thai industry; initiative coming either from the overseas investor, or from a Thai recognizing the market opportunities for investment in textiles, but not having enough experience to initiate investment without a great deal of Japanese help. Company A was an interesting contrast where the necessary expertise did exist, and this is reflected in other impacts also.

Impacts

Technology chosen

Product. The most significant factor here is the extra use of labour required to produce the quality standards required for the export market. At similar levels of capital intensity that prevail in large sector of the industry, policies favouring the export market would tend to lead to greater utilization of low cost labour than would policies favouring the domestic market. Without much deeper analysis, the extent of this cannot be estimated.

Process. The range of technologies seen was wide-ranging (from 25 year-old looms in company A to automatic looms in company C). Allen suggests that in general the technology utilized in Japanese joint ventures is not as developed as the most sophisticated available.

From the companies seen this would appear to be true. However, it later turned out that eight companies within the Thai industry possess auto-coners, at least one company uses open-ended spinning, and at least two use shuttleless looms. The extent of the use of these technologies is not known, but as the labour-saving possibilities of combinations of them reach as high as 50 per cent or more, they clearly have considerable significance if their use is extensive. Similarly, transfer lines and carrier systems were not seen at the companies visited; however, company A plans to utilize chute feed for carding in its expansion. More automated systems probably exist in other plants.

Materials. The main factor noted here was the great dependence of Thailand on the use of imported cotton at high prices and high freight costs. Company A is so affected by the high costs that it has considered promoting its own cotton production in Thailand. The impact of domestic production of artificial fibres should also be noted.

Contractual elements. Little was found about contractual elements but they clearly exist and are an important element in the flow of funds back to the overseas investor. They are closely related to the technology chosen and to ownership/TT patterns.

Technological capability of the firm

In general, it is clear that the operating capability of firms is highly developed, and that it is also developed in the Thai management. The initiating capability, however, is much lower and the innovating capacity is very low.

Technological capability

Capital goods sector. There has been no impact or stimulus for a textile machinery industry in Thailand, and this is not likely to happen in the near future. Moreover, it would be unrealistic to suggest that the utilization of more labour intensive technologies would have led to the start up of such an industry in Thailand.

Quasi capital goods sector. The extent to which domestically produced spare parts are utilized by companies varies from firm to firm, and between categories of part. The generally held opinion about spare parts made in Thailand is that they are either not available, of low quality, or of high price. However, there are enough exceptions to this in companies visited to suggest that the situation could be improved. Indeed, the BOI has recently given promotion to a spare parts manufacturer. But, as noted earlier, one of the main constraints on impact in this sector is the lack of information on spare parts manufacturers.

Other technological capabilities

Individual. It is clear that company policies vary considerably over the extent to which local individuals can be trained and promoted to positions of responsibility and decision making in management. It would appear that there is scope for policies which either restrict the use of foreign technicians, or promote further training and experience of Thais. A real cost of not having Thais in middle management positions appears to be that in such cases the likel hood of labour troubles is increased. It is apparent that one company with high dependence on foreign technicians was one of the first to suffer in the present series of disputes. A factor which needs further analysis is the extent to which movement of trained employees out of one firm into another contributes to increased production and LTMC.

Institutional. Contact with institutions is minimal, although some foremen have been trained at the Textiles Industry Division. It may well be that other companies have more contact than those interviewed. One institution not utilized is the Rubber Division of the Department of Science. Two companies mentioned the problem of quality in rubber belts; the Rubber Division is at present active in providing solutions to this problem, but is hampered by a lack of contact with industrial consumers.

Quality control and research and development. A high level of quality control is prevalent throughout the industry, but research and development is not a feature, as virtually all textile research and development is in the developed countries.

Workshop facilities. These are common in the industry, although the range of activities varies widely, from little more than maintenance on the one hand to projected gear manufacturing on the other.

Pollution. A final comment is necessary concerning pollution and technology transfer. In all the factories visited, the problem of pollution was recognized. However, the characteristics of some of the methods utilized to cope with the problem were similar to some of those of technology transfer, in that there was very little attention paid to local conditions when considering solutions, and in some cases, solutions were not sought with any energy until outside pressure, usually in the form of complaints, was applied. More significantly, in several companies the solutions were sought from a Japanese water treatment consultancy with an office in Bangkok. The consultancy itself appeared to have paid no attention to local conditions in deciding what techniques to use. Often the techniques were incorrect, and on one occasion had been improved and adapted by the textile company itself. The consultancy appeared to have considered few of the many alternatives that exist for textile effluent treatment such as those described by H.R. Jones in Pollution Control in the Textile Industry.[17/]

17/ (New Jersey, Noyes Data Corporation, 1973).

V. ECONOMIC IMPACT

Introduction

The major reason for undertaking investment in the textile industry may be assumed to be the financial effects which accrue to investors and managers and which ought to be reflected in the factories accounts. These effects will usually be valued in market prices. In addition to these internal effects there are financial effects which are external to the factory and its accounts; these effects rarely are taken into account in the decisions to invest, although they may be made internal by the enforcement of rules, regulations, taxes and subsidies. The view society (or some other grouping, such as government) takes of these effects is unlikely to be reflected by the values of market prices and therefore it is necessary to revalue the effects in terms of socio-economic costs and benefits.

Financial and economic analyses were carried out on two of the factories selected for their damage control characteristics. The techniques of analysis used are standard economic and financial procedure though the application in each case depends on a series of assumptions supported by varying degrees of evidence. The financial accounts of both companies were examined and the analyses are derived from notes taken of these accounts. As the economic concepts and categories were not often reflected in the accounts, the economic analysis was produced with some difficulty.

The choice of national parameters

The choice of discount rate, real cost of unskilled labour and the premium (if any) to be placed on foreign exchange are discussed in relation to the case studies, but some preliminary discussions are in order. The actual values determined for each of these parameters should normally be set by the government project planning centre in relation to national planning objectives and based on a thorough understanding of the economy. The parameters are crucial to all economic appraisal but they have a particular relevance to damage control practices. Firstly, each parameter reflects society's (or government's) valuation of costs and benefits such that the cost of controlling damage, the cost of damage and therefore the optima, will change for varying parameter values (see figure VIII).

Although it is a matter of debate how stable the parameters will be over time, governments usually plan precisely in order to change the values (e.g. by reducing unemployment or by increasing the productivity of capital by the provision of infra-structure).

Secondly, as damage to people and places occurs over time the importance of the discount rate (which values effects at one time in respect to effects at another) is particularly relevent. It has been argued that it is the use of discount factors which predispose investors, both public and private, to save current expenditure if the costs of so doing will only be apparent in the future. If this procedure is thought to lead to more environmental damage than "society" wants, there would seem to be three options:

(a) To use a lower discount rate for projects involving the environment. This suggestion is sometimes made in respect of investments in trees where viability is achieved only at very low rates of discount as the benefits only accrue after a large number of years. However, as the use of a discount rate is used as a means of allocating resources between different uses there is considerable importance in maintaining a consistent discount rate for all projects;

(b) To specify the avoidance of ecological damage in the form of a merit want, a goal whose national importance is not determined by individuals in their capacity as consumers. The problem with this kind of solution is that the prevention of such damage is not usually desired at all costs, there is a trade-off between damage prevention and cost. The exception to this is where some regulation can be enforced such as safety standards;

(c) To ascribe a higher cost to this sort of damage. It may be argued that ecological damage is both undervalued by the market and by economic appraisal. This implies that the physical effects are incorrectly predicted, that the market does not adequately reflect people's wishes (for the usual reasons of unsatisfactory income distribution, incomplete information, etc.) or that some form of externality is associated with such damage.

The third option would seem to be the preferred option but if there was reason to believe that the physical damage was consistently being underestimated corrections could be made.

Thirdly, if there is a choice of techniques for damage control the appropriate technique will change as the cost of labour, the cost of domestic resources relative to imports and the cost of capital change. It is not possible to determine the appropriate technical solution without making assumptions, at least implicitly, about these parameters.

Cost-benefit techniques and total impact studies

A number of practical difficulties have been suggested already which serve to limit the use of cost-benefit techniques in total impact studies and more will be apparent in the case studies. There is a further objection which derives from the historical development of the technique. Cost-benefit analysis was developed as an aid to choosing between alternative investment opportunities and as such concerned itself with the relative rather than the absolute impact of projects. This procedure greatly simplified the analysis (without such a procedure most project analysis would be impossible) and is justified when comparison is made of two or more similar projects usually in the same sector e.g. two types of irrigation system or a variety of transport modes. This allows effects which are assumed to affect both projects equally to be neglected; these effects might be those said to result from industrialization, modernization, extension of the monetary sector, increases in self-sufficiency for instance.

This short-cut is valid in a total impact study only to the extent that certain effects may be said to exist both in the situation with the project and without it and should therefore not be described as a plant impact; but there is clearly a danger of using this as a rationalization of our inabilities to quantify certain effects which we know to be important and furthermore places considerable strain on our ability to predict the "without" situation.

Valuation of inputs and outputs

The economic analysis is conducted from the view point of government and inputs and outputs are in principle valued in terms of their contribution to foreign exchange. The valuations is in terms of a "numeraire" of uncommitted social income measured at border prices or savings in the hands of government. This method is certainly easier to apply where most inputs and outputs are at least in principle traded, and where the distribution of domestic income and other "imperfections" might be considered to throw doubt on the market valuation of consumers willingness to pay.

The greatest barrier to incorporating all costs and benefits into the analysis is undoubtedly the problem of estimating the physical effect rather than one of valuation. But clearly it is precisely these effects that are usually neglected as there is an unfounded tendency to give more value to the quantified than to the qualitative evidence. Many of these qualitative effects can be merely listed, but this makes trade-offs between these effects and other objectives particularly difficult. In the planning process many implicit goals and merit wants can, in fact, be taken into account in the macro-allocation of resource between sectors and there is no need in practice to attempt to construct a single index of a plant's impact as is often implied with the calculation of a plant's net present value.

The valuation of land, both as a project input and as an asset whose value is reduced by pollution poses particular problems. In principle its economic value is its opportunity foregone in its alternative use - usually agriculture (or as another industrial site). This value is often implied by the free market value, but it is argued that such a valuation is so low relative to its productivity used for an industrial plant as to result in some of the best agricultural land being used for industrialization. There is clearly good reason to use the worst agricultural land first for an industrial zone, but problems arise when there are costs in doing so. What benefits could match these costs? The price of land may not reflect the real cost of potential agricultural output either because the social value of more extra food is higher than its market price (e.g. because of the rice premium on exports) or because the future value of food is underestimated. This last reason would seem to be a real probability. We may merely state that the direction of industry to non-agricultural land is a merit want to be achieved at almost any cost.

Data

Ex post economic and financial evaluation of investments in the private sector must rely heavily on company accounts. It is rarely possible to determine the physical inputs and outputs of the operation from such accounts.

This presents problems for the economic analysis and usually prevents any check being made on the possible bias towards a loss in the financial accounts.

Economic environment of the Thai textile industry

The establishment of modern large-scale cotton and synthetic textile mills in Thailand dates from the early 1960s, when the government gave up its dominant role in initiating, owning and running industry as a whole in the country and instead began to promote foreign and private investment. Previously, a mainly privately-owned textile industry had existed at a very low level of economic and technical activity, together with the remnants of a cottage textile industry which had suffered severely from the inroads of cheap cotton textile imports since the end of the 19th century. Exact data on the industry, either before or after the early 1960s is not available. J. C. Ingram, in his definitive study, states that "the statistics necessary for a detailed analysis of the development of manufacturing in Thailand do not exist. One cannot obtain data by industry, on employment, investment, output, wages, number and sizes of firms, profit margins and the like".[18] However, a general impression may be gained from certain evidence.

Ever since 1850, textiles had been one of Thailand's major imports and the cottage textile industry, which previously had been found in all areas of the country, was, by 1950 almost non-existent in the central plain area. However, despite the inroads of imports, weaving was still a major rural activity in large areas of the country, particularly the North and the North East, although the yarn was often imported. By 1950, Ingram writes that some commercial weaving establishments had been set up, but they rarely employed more than 20 - 30 workers, and never used modern machinery.[19] In the Bangkok area there were about 330 such workshops employing 3,000 people, the number outside Bangkok was probably smaller. There was still a large household weaving industry: "It seems safe to say that the great bulk of the cloth produced in Thailand is woven in households for family use".[19] In the spinning industry there was one mill of 23,000

[18] Ingram, op. cit., p. 287
[19] Ibid, p. 122

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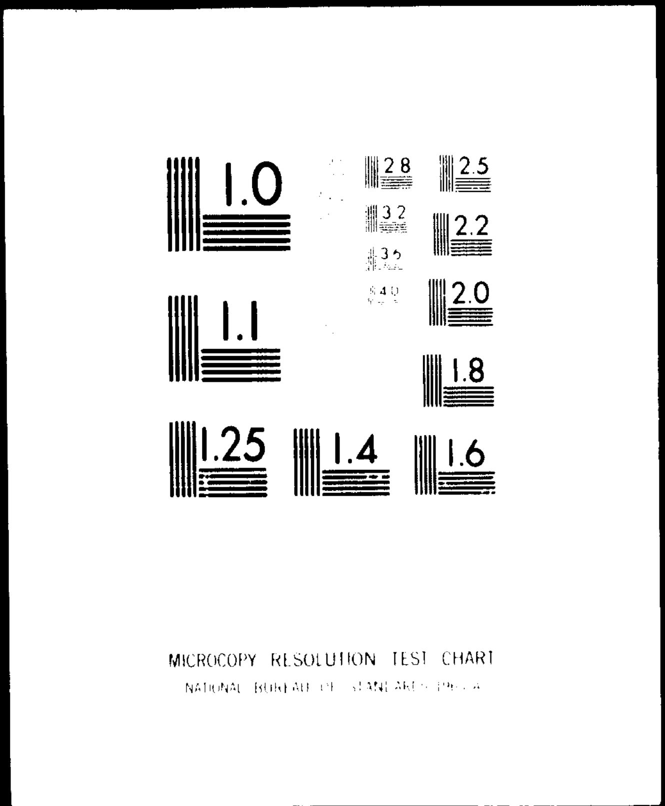

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spindles owned by a Shanghai and Hong Kong company, some government owned mills totalling 10,000 spindles and a number of small private mills totalling 10,000 spindles.

The 1960s marked the start of investment promotion with the creation of the Board of Investment (BOI) (1959) and the resurrection of the rarely used "Act on the Promotion of Industries" (1954). This act, together with ammendments (1960, 1962, 1965 and 1968 and National Executive Council Announcement No. 227) gave guarantees both to foreign and domestic investors against uncompensated nationalization and government competition, the right to own land, the right to repatriate profits and capital, the right to bring in technical and managerial personnel, exemption of import duties and business taxes on new plants, exemption of income tax for a specified period, exemption of import duties on imports etc.

At the same time the tariff structure was changed so as to increase effective protection on domestically produced goods. Ingram suggests these tariffs were changed in response to pressure from the manufacture.[20] As no input-output data for Thailand exist precise rates of effective protection are not available; crude estimates, however, put the rate on cotton textiles for firms with promotional privileges at 63.87 per cent in 1960 rising to 115.33 per cent in 1971. Nominal tariffs are of the "cascade" ad valorem variety and had a weighted average value for cotton textiles of 37 per cent in 1960, 40 per cent in 1966 and 60 per cent in 1971.[21]

The result of these two incentives has led to an industry effectively controlled by foreign companies (though only 38 per cent of registered capital promoted firms was held by foreigners in 1971, of a 32 firm sample of the 58) comprising a number of quite modern plants satisfying a predominantly domestic market (39 per cent of total production of cotton fabric exported in 1971 and less than one per cent in 1966) behind high tariffs giving a potential for high profits or inefficient production or both. The coincidence of interests between private foreign investors, local in-

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[20] Ibid., p. 297.

[21] See Dhavil Wisuthachinda, Customs Tariffs of Thailand: 1971 (Bangkok Department of Customs, 1971).

vestors, and government were often remarked upon (including by Ingram) and is reflected in a variety of policies ranging from industrial protection, to the rice export premium and clearly has implications for future industrialization and damage control policies.

Data on the industry as a whole are lacking but the BOI has recently begun to collect data on promoted firms which would allow a researcher with access considerable scope for analysis. The data are confidential and collected from firms voluntarily (43 firms out of 58, 74 per cent in the textile sub-group); they are not checked for reliability (e.g. against tax returns).

Case studies

The two factories (factory B and factory C) which were subject to detailed economic and financial analysis were selected for their damage control characteristics rather than on economic factors. Company C has been operating since 1966 and currently produces about 6.8 million yards of dyed synthetic cloth per year. The factory is fully integrated from spinning through to dyeing and finishing and produces both piece-dyed and yarn-dyed cloth (73 per cent and 27 per cent respectively in May 1974). Total investment up to the end of 1972 was 254 million baht ($US12.7 million) and employment is now approximately 2,000 workers. The main inputs are polyester fibre and yarn and these are supplied by the Japanese parent company in Thailand. The registered capital amounts to 36 million baht and is 49 per cent Japanese and 51 per cent Thai owned. The Japanese share is owned by two Japanese conglomerates while the Thai share seems to be split between individuals and large local concerns not directly connected with textiles (e.g. an insurance and warehouse company and a transport operation).

Company B has only been in operation since February 1973 and produces about 1.4 million pounds of yarn (synthetic cotton and mixed) per year. The company itself is concerned solely with the spinning and dyeing of yarn but is part of a parent company network situated at the same site which is involved with all other aspects of the textile trade including the manufacture of zips. The factory does, however, maintain a separate management. Total investment by November 1973 was 110 million baht

($US 5.5 million) and employment had reached 6,500 workers. The registered capital of 35 million baht is 60 per cent Thai and 40 per cent Japanese owned (though other companies within the union have different ownership relations - for instance the zip factory is 99 per cent Thai owned). No information was available as to who the owners were.

Data

Both factories made available their capital and running cost accounts and provided aggregate figures for revenue. Neither company would allow photocopies to be made of their accounts although both permitted extensive notes to be taken. In the case of factory C, which provided cost data disaggregated by month, factory section and item, it was only possible to summarize three typical years in the time available although aggregate total costs were obtained for each year. Both companies seemed to have a tight grip on their financial situation and both conducted detailed costings of each item produced (though it was not clear how much costs determined selling price).

It was not possible to determine how the costs had been arrived at, nor was it possible to determine how the price of sales between jointly owned companies were managed. There would seem to be considerable scope within each company for over and under invoicing of all inputs and most outputs. It did not appear that any adjustment was made between the accounts made available at the factory and information supplied by the factory to the government (the BOI).

Supplementary data, particularly on treatment costs were provided on request by plant personnel.

Financial analysis

The financial position of both factories is summarized in tables 7 and 8. Company C which has an extremely high gearing of loan to equity shows phenomenal pre-tax returns to equity (153 per cent in 1970/71). The BOI records show that the company paid a dividend of 21.6 million baht in 1971/72 or 60 per cent. For company B with a lower loan/equity gearing the return is more modest at 29 per cent. The percentage profit on sales was of the same order of magnitude for both companies (17.6 per cent for company C in 1971/72 and 16.2 per cent for company B in 1973) though the margins have been squeezed in since a 1970/71 high of 26 per cent.

In order to show the internal rate of return (IROR) interest and depreciation were excluded from total costs and assumptions were made about the terminal value of capital; as the depreciation rates shown in the accounts seemed to approximate to the physical deterioration of plant and equipment (for company C, 5 per cent buildings, 10 per cent machinery, 20 per cent vehicles) these rates were used for the estimation of capital used up. Data on capital expenditures were available only as yearly totals and as depreciation shown in the accounts was calculated from the precise month in the year when the investment was made, the total depreciation is somewhat less than the figure which results if the depreciation percentages are applied to the yearly total investment (on the assumption that total capital investment took place on the first day of each year). For this reason, for company C two terminal values are assumed: (a) based on total investment minus depreciation shown in the accounts and (b) based on the same total investment figure but subtracting a larger (and more appropriate) depreciation rate in order to match the fact that capital data are given as an aggregate figure for the whole of each year. The importance of these assumptions is considerably lessened by the discounting procedure and the difference in internal rate of return caused by this assumption alone is only three per cent.

For factory B with only one year of operation the IROR was calculated on the assumption that the average weighted sum of depreciation was 12 years (i.e. depreciation as in the accounts was 8.6 per cent of total investment) and that the total profit excluding depreciation and interest would remain constant at the 1973 rate.

The resulting internal rate of return of 22.5 per cent to 25.5 per cent for factory C and 23.5 per cent for factory B are not strictly comparable. The rates for factory C are in current prices (except that no correction is made for increased prices in the rate of depreciation and therefore somewhat under estimates the real market terminal value). The rate for factory B is in constant 1973 prices and might be considered an underestimate in that the plant operated at less than full capacity in 1973 owing to lack of demand (if the 1973 profit is increased by 16.7 per cent, which is the difference between actual expected capacity, the IROR increase to 30 per cent).

The rate of inflation over the period as shown in the official wholesale price indices shows 1.5 per cent per annum for 1952-1969, 3.3 per cent for 1969, almost constant prices for 1970 and 1971 and rises of 7.9 per cent and 2.2 per cent in 1972 and 1973; this represents an average rate for 1966-1973 of 4 per cent per annum. As inflation has increased more in recent years (and less when capital expenditures were made in factory C) it might be expected that the constant 1966 price rate of return of factory C would be at or about 20 per cent.

Table 7. Factory B: Financial analysis, 1973

	Million baht
Total costs (including depreciation and interest)	52.6
Total sales	62.8
Pretax profit	10.1
	Percentage
Profit as percent of sales	16.2
Profit as percent of equity (35 million baht)	29
	Million baht
Total cost (excluding depreciation and interest)	40
Total profit (excluding depreciation and interest)	22.7
Depreciation[a]	9.5
Interest	3.1
Capital investment	109.8
	Percentage
Internal rate of return[b]	23.5

[a] At 8.6 per cent of capital

[b] Assuming 12 year capital life and constant profit with no allowance for inflation.

Table 9. Factory C: Financial analysis - 1966-1972

Item	1966/67	1967/68	1968/69	1979/70	1970/71	1971/72
			million baht			
Total costs (incl. depreciation and interest)	75.4	79.1	107.8	124.5	156.3	182
Total sales	71.4	89.7	128.1	157.2	211.4	220.8
Pretax profit	4	10.5	20.4	32.7	55	38.7
			percentage			
Profit as per cent of sales	5.6	11.7	15.9	20.8	26.0	17.6
Profit as per cent of equity (36 million baht)	11.2	29.2	56.6	90.9	152.9	107.6
			million baht			
Total cost (excluding depreciation and interest)	71.4	72.9	97.4	104.3	139.	158.8
Total profit (excluding depreciation and interest)	41.2	16.7	30.8	53	71.6	62
Depreciation	4.1	4.1	7.6	12.2	14.8	16
Total						58.7
Capital investment	81.2	66	54.6	71.2	31.6	15
Total						253.8
Terminal value[a] (a)						195.1
Terminal value (b)						164.3
Costs/benefits (a)	81.1	16.7	23.9	18.2	40	242
(b)						211.3

Terminal value

	Assumption (a)	Assumption (b)
	million baht	
Net present value at 15 %	+46.5	+31.2
20 %	+22.1	+ 9.8
25 %	+ 3.2	+ 6.8
30 %	-11.6	-19.9
	percentage	
Estimated internal rate of return[b]	25.5	22.5

[a] Terminal values are based on (a) estimated real depreciation rates and (b) depreciation rates assuming capital purchases take place on first day of the year. This is to correspond to the fact that the figure of capital investment can only be estimated on this basis. Assumption (b) is likely to be the best estimate.

[b] Terminal values are not adjusted for possible price increases during the period, IROR estimates are, therefore, under-estimates.

The financial cost of pollution

An attempt has been made to determine the financial cost of water pollution created by factor C not reflected in its accounts. The procedure and limitations of this attempt are described in chapter III, but taking the data at face value the total net financial cost may be crudely summarized in 1967 prices as follows:

	Thousand baht
Loss from fish pond	- 357
Gain from new employment	+ 384
Loss from vegetable production	-5,600
Gain from wages	+1,923
Gain from fruit	+1,960
Loss from klong fish	- 750
Loss due to increased food purchases	- 115
Total	2,555
	or ($US 128 per family per year)

Discounting these costs at a constant price IROR of 15 per cent (equivalent to a current price rate of say 20 per cent for 25 years) the total 1966/67 present value cost amounts to about 19 million baht. Very approximately this would effectively reduce the project's IROR from somewhere near 25 per cent to about 20 per cent.

The financial costs of pollution control

The cost of treating the liquid effluent of factory C by neutralization, sedimentation, activated sludge (with nutrient addition), some coagulation and settlement in order to reduce BOD, suspending solids and colour to a satisfactory level has been crudely estimated, based on the costs of the existing inefficient treatment plant at factory C and on an estimate of necessary chemicals. These estimates are necessarily very approximate. Further cost might arise if the resulting effluent were found to require further treatment by ion selective resin to remove the salinity or if flocculation with expensive alum were required. These costs were estimated in the following way:

	Thousand baht	
	1973 prices	1966 prices
Capital costs	3,000	2,174 (38% inflation)
Running costs	434	317
Chemicals	420	304 (38% inflation)
Labour	14	11 (30% inflation)

This represents a present value of costs at 15 per cent over 25 years of 4.5 million baht in 1966 prices which can be compared with the cost of damage estimated in the previous section as 19 million baht. Although both costs are extremely crude, they do show the order of magnitude of pollution costs and cost savings; indeed if the effects external to the company were internalized by enforced legislation or the activities of pressure groups, over five times as much could have been spent on chemicals per year for the cost of treatment to have been less than the cost of damage at 15 per cent real rate return.

The "adequacy" of profits

The decision as to how the financial costs of projects are distributed is to some extent influenced by the distribution of benefits. If a factory makes large profits it is likely to be more possible to internalize pollution effects by enforced legislation and the activities of pressure groups (such as farmers) than if the company can only manage to break even. Whether government should bear some of the cost might be determined to some extent by the economic profitability.

It was not possible to investigate what levels of profit are thought to be adequate or minimum by investors or government in Thailand. However, profits relative to sales of both factories B and C exceeded the average profits of all textile companies reporting to the BOI in 1972 and 1971 by a considerable margin: in 1972 the average profit as percentage of sales was 5.92 per cent for 33 reporting companies and in 1971 it was 3.69 per cent for 43 companies (figures supplied by Board of Investment). This might provide at least prima facie evidence that a number of the external financial effects of the factories could be internalized without prejudicing the level and composition of investment at least in these two factories.

Economic analysis

The costs and benefits of the textile factories to the economy were evaluated in terms of the Little and Mirrlees method by dividing all financial costs and benefits into four categories: tradables, non-tradables, tax, and unskilled labour. This procedure gives prime importance to the aggregate consumption objective (though the numeraire is in fact in terms of savings) an further adjustments can be made to incorporate objectives such as income redistribution, employment etc. It mus be recognized that although this is a conventionally used value system, other systems are possible and could produce quite different valuations of the net effects of the factories.

As the data provided by the financial accounts did not give any guide to prices or the physical quantities involved (except on the output side and then only as an average of all types of good produced) the division into the four categories was very approximate. However, the analysis even on these crude assumptions does provide a guide to the order of magnitude of the impacts of the textile factories on the economy and provides a context for judging the importance of the costs of damage.

The results of the various assumptions are shown for factories B and C in tables 9 and 10. The crucial nature of the assumption concerning the valuation of output is quite clear. Where it is assumed that the factories' output is effectively substituting for imports (which is highly likely) neither factory shows an acceptable economic return even when the most favourable (and extreme) assumptions are made about the cost of domestic resources and unskilled labour. This sort of conclusion is indirectly supported by recent BOI promotions in textiles which insist that future output should compete in world markets. This apparently adverse conclusion is, of course, highly tentative it depends on possibly dubious assumptions about the world price of output (namely, that it is equal to Thai domestic prices minus tariffs) and neglects the fact that productivity both per worker and per machine may improve in the future. This is the basis of the infant industry argument; however, factory C has already had seven years in which to learn the trade.

Protection provides help to industry at the expense of agriculture not necessarily at the expense of imports.[22]

Any help that the textile industry might have had in the form of backward linkages to cotton production have not materialized as the amount of cotton produced domestically has fallen in recent years illustrating that linkages are not a necessary consequence of new industries.[23] Forward linkages into garment production might also have been hampered if the textile industry sells its products at prices exceeding import prices.

Under certain of the assumptions both factories produce social returns which are greater than the financial returns. The shadow wage rate, understandably for such a small proportion of total costs, has little influence on returns but the variation in foreign exchange rate changes the IROR of factory B by as much as two and a half times.

The most likely value for NPV for both factories would be that which arises from no foreign exchange premium, zero wage rate and import substitution in both input and output; for factory B this is a present social loss of 50 million baht at 10 per cent and for factory C a loss of 84 million baht, at 15 per cent.

Indirect effects

A number of indirect effects are implicitly taken into the economic analysis already; the advantages of employing labour and of redistributing income are reflected in the shadow wage rate. Congestion costs arising from the Bangkok location are implicitly valued in transport costs etc. though again there are dangers in taking the financial cost as an indicator of this problem as the marginal costs imposed by the factory on others may be large. None of the managers interviewed considered locating their factories far from Bangkok though the new modern factories were often located some distance from existing populations.

22/ I.M.D. Little and J.A. Mirrlees, Manual on Industrial Project Analysis in Developing Countries: Volume II, Social Cost Benefit Analysis (Paris, OECD, 1968).

23/ See R.J. Grimble, The Economics of Cotton Production in Thailand (London, ODA/FCO, 1971).

Table 10. Factory B: Economic analysis

Foreign exchange premium, conversion factory	Shadow wage rate	Import substitution of inputs	Import substitution of output		
			Yes/No	NPV[a] at 10% (million baht)	IROR[b] (percentage)
1	Market wage rate	Yes	no	+107.6	37
			yes	- 68.9	-
		No	no	+ 81.1	30
			yes	- 95.4	-
	Zero	Yes	no	+126.5	44
			yes	- 50.0	-
		No	no	+100.0	36
			yes	- 76.5	-
0.75	Market wage rate	Yes	no	+ 31.9	18
			yes	- 26.9	0.5
		No	no	+ 5.3	11.5
			yes	- 53.5	-
	Zero	Yes	no	+ 46.0	22.5
			yes	- 12.8	6.5
		No	no	+ 19.5	16
			yes	- 39.3	-

a/ Net present value.

b/ Internal rate of return over 12 years.

Table 11. Factory C: Economic analysis

Foreign exchange premium, conversion factor	Shadow wage rate	Import substitution of inputs, yes/no	Imports substitution of output yes/no	Imports substitution of output NPV[a/] at 15% (million baht)
1	Market wage rate	yes	yes	-120.9
			no	+ 96.6
		no	yes	-158.1
			no	+ 59.5
	Zero	yes	yes	- 84.0
			no	+133.6
		no	yes	-124.0
			no	+ 93.6
0.75	Market wage rate	yes	yes	- 77.0
			no	- 4.5
		no	yes	-120.7
			no	- 48.2
	Zero	yes	yes	- 5.5
			no	- 95.2
		no	yes	- 95.2
			no	- 22.6

a/ Net present value.

The benefits or costs of forward and backward linkages are taken into account in the valuation of inputs and outputs but neither plant could be said to have had much effect which would not have followed as readily from imports; the possible exception to this would be the man-made fibre inputs, but it was not possible to check the relative domestic or world prices for these commodities.

The external costs of damage by effluent would be of the same order as those calculated in the financial analysis unless extra weight was attached to food or the avoidance of social dislocation etc. The costs of poor hearing and respiratory diseases may well be valued more highly by society than is implied by man hours lost and would no doubt considerably exceed the cost of prevention.

Amenity value might be considered a low priority by a relatively poor society but it is difficult to decide how the construction of a factory affects amenity when the plant increases the value of surrounding land and houses and the distribution of income attaches more value to urban dwelling views of amenity than rural dwellers.

Concluding remarks

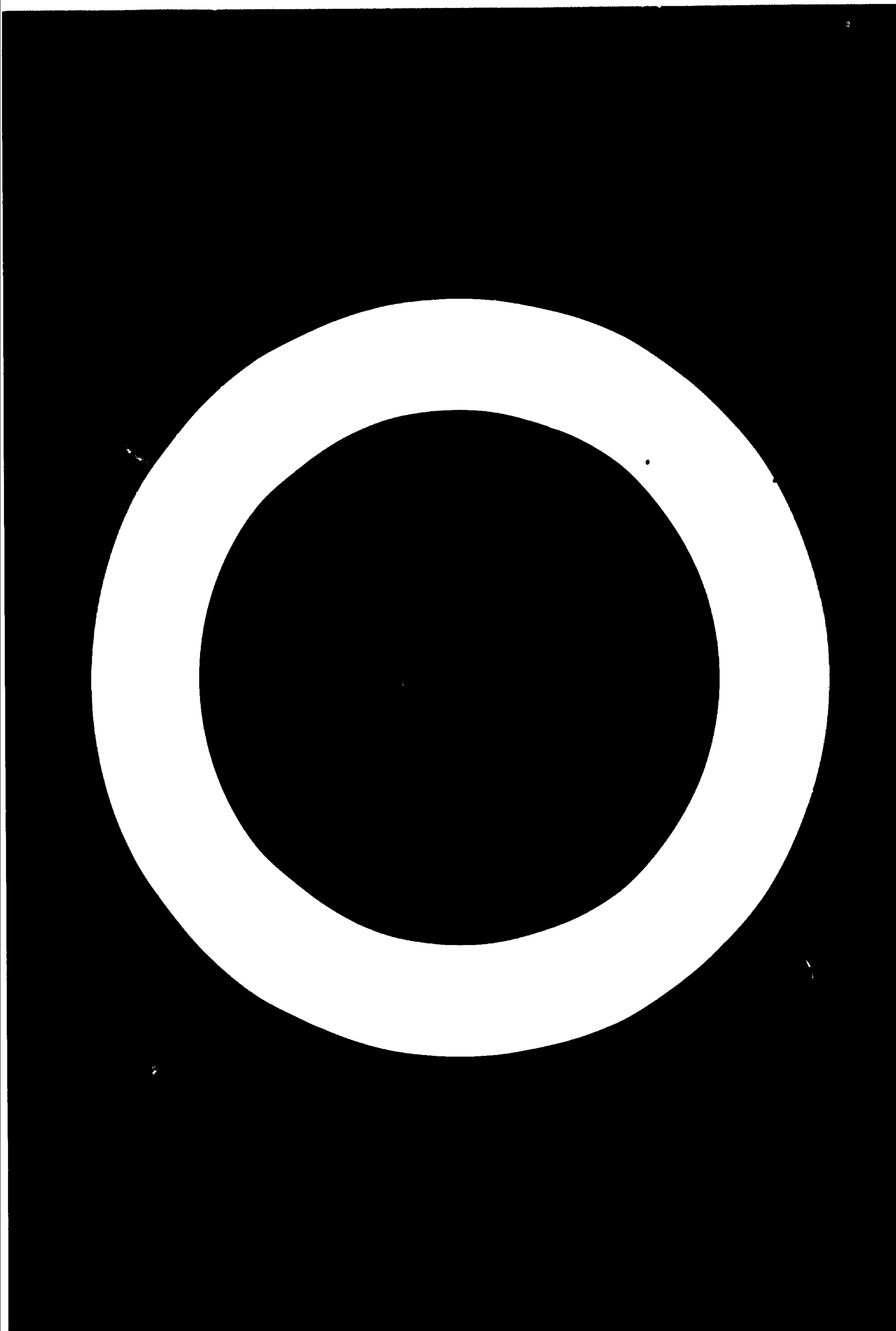
The economic and financial analysis shows at least prima facie evidence that the net impact on society of the textile plants is not necessarily as beneficial as the impact reflected in the company accounts. Furthermore, the net effects of obvious pollution, though quite large, are of a lesser order of magnitude, though the longer term ramifications of pollution are still uncharted. The costs of damage control on the other hand are small in relation to both the costs of damage and the profits of the companies. Indeed it has been suggested that the smallness of these control costs results in low priority being attached to them by management, as the cost savings are equally small. This has further resulted in the subsequent installation of unnecessarily expensive treatment.

The companies were apparently completely open with their data but for the economic analysis exact data would have required a more thorough examination of the companies' affairs and possibly even an examination of invoices.

During the course of the present study only limited opportunity arose for examining the attitudes of managers particularly in relation to the adequacy of profits and the factors considered important in the decisions to invest, to buy certain machinery and location.

Government data and planning parameters were difficult to obtain; however, the Board of Investment and the National Economic and Social Development Board both have project appraisal capability which might be utilized if a longer term study were contemplated.

The problems of incorporating indirect and external effects of plants into the analysis of projects would still seem to remain firmly fixed with the problems of predicting the magnitude of physical effects. It is only when this is done that economic valuation can be contemplated.



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Annex I

THAI LAWS CONCERNING THE ENVIRONMENT

Ministry of the Interior

Care of canals (Royal command (?) 121)

Care of canals used for water supply, 1913 (2456)

Control of sewage for fertilizer use, 1947 (2490)

Ministry of Agriculture and Co-operatives

Toxicity, 1967 (2510)

Retention of plants, 1964 (2507)

Royal irrigation law, 1942 (2485) (Plus Revolutionary decree 146)

Royal fisheries law, 1947 (2490)

Forestry, 1941 (2484)

National forestry conservation act, 1964 (2507)

Protection of wild animals, 1960 (2503)

Ministry of Communications

Water transport, 1913 (2456)

Revolutionary decree no. 16 concerning the port authority

Ministry of Industry

Toxicity, 1957 (2510)

Factory act, 1969 (2512)

Ores, 1967 (2510)

Ministry of Public Air

Air act, 1941 (2484)

Toxicity, 1967 (2510)

Control of cemetries and burial places, 1938 (2481)

Bangkok Municipality

Control of construction of large buildings, 1936 (2479)

Control of public burial places, 1938 (2481)

Public health, 1941 (2484)

Cleanliness and order of city dwellings, 1960 (2403)

Police Department

Revolutionary notice no. 16 and notice of the traffic authority

Department of Public Prosecutions

Code of Civil Offences nos. 1339, 13340, 1342, 1343, 1355

Code of Criminal Offences nos. 228, 234, 237, 238, 239, 375, 380, 396, 370, 372, 376

Annex II

WORKING STANDARDS FOR EFFLUENT DISCHARGING TO INLAND STREAMS: MINISTRY OF INDUSTRY, THAILAND

Industrial ·· tewater effluents

Item	Maximum permitted values
B O D (5 days 20°C)	20 pm
Suspended solids	30
Dissolved solids	2000
pH value	5-9
Permanganate value	60 ppm
Sulphide (as H_2S)	1
Cyanide (as HCN)	0.2
Oils and grease	nil
Tar	nil
Formaldehyde	1
Phenols and cresols	1
Free chlorine	1
Zinc, Chromium, Arsenic, Silver, Selenium, Lead, Nickel } individually or in total	1
Insecticides	nil
Radioactive materials	nil
Temperature	40°C
Disagreeable taste and odour	nil

Sewage effluents

Volumes of dilution	Max. permitted suspended solids (ppm)
8 - 150	30
150 - 300	60
300 - 500	150

Annex IV

RECOMMENDED STANDARDS FOR EFFLUENTS OF INDUSTRIAL WASTE WATER AND SEWAGE; MINISTRY OF PUBLIC HEALTH, THAILAND

The requirements set by Ministry of Industry are tabulated for comparison

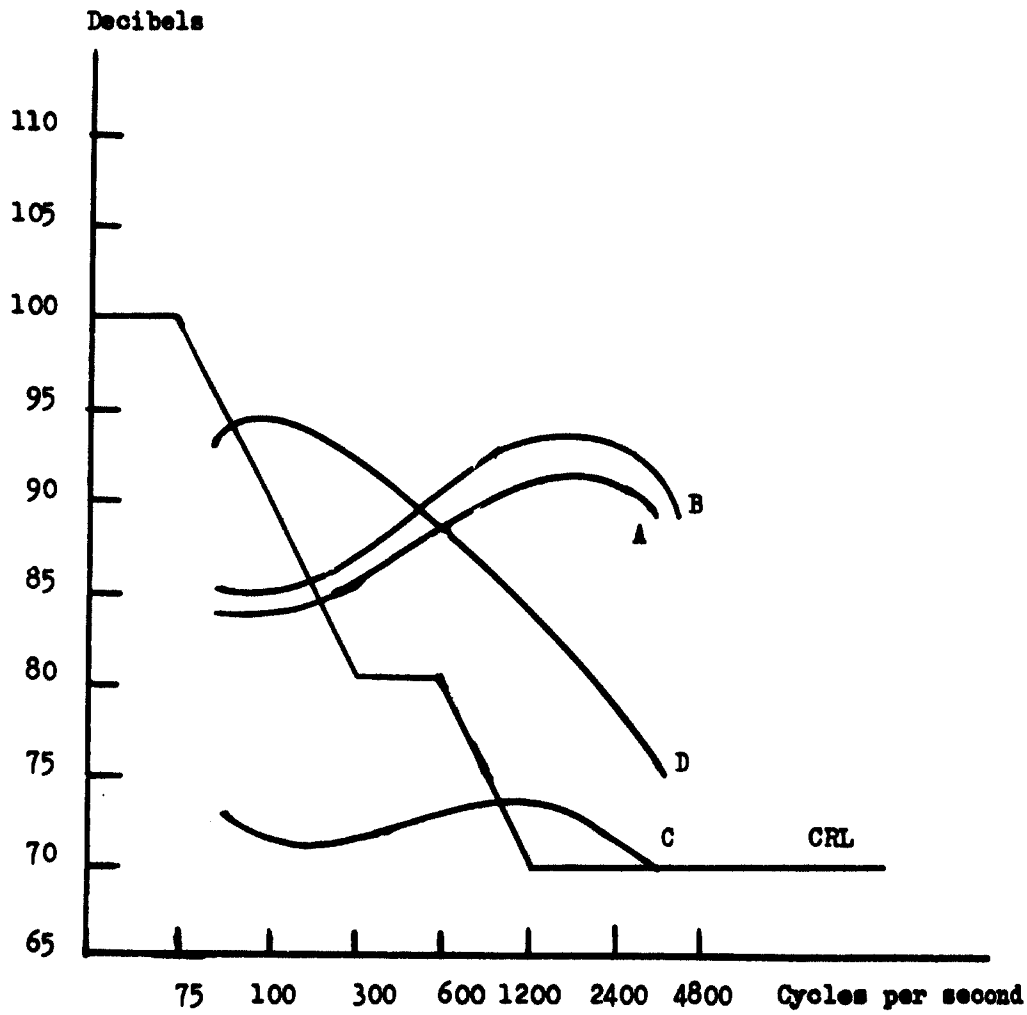
Item	Recommended values	Ministry of Industry requirements for industrial wastes
BOD	40 ppm	20 - 60 ppm
COD	100	not established
Suspended solids	60	30 - 150
Heavy metals (total)	5.0	1.0
Arsenio	0.1	...
Zinc	2.0	...
Copper	2.0	...
Iron	5.0	...
Cyanide	1.0	0.2
Ammonia nitro	5.0	...
Sulphide	3.0	1.0
Oil and grease	15.0	nil
Tar	none visible	nil
Phenols	0.05	1.0
Pesticides	0.01	nil
Detergents	1.5	...
Total disolved solids	2,000	200
pH	5-9	5-9
Chlorine	5.0	1.0
Temperature	40°C	40°C

Source: C.D. Parker, Recommended Standards for Lakes, Irrigation Canals, Klongs and Waste Water Effluent, WHO report prepared for Water Pollution Control Section, Sanitary Engineering Department, Department of Health, Thailand (1971).

Annex III

DAMAGE RISK LEVELS: WEAVING, WINDING, SPINNING

Comparison of noise levels in weaving departments of four factories



Source: Burns and Little (1960).

CRL - critical risk level

Annex V

CRITERIA FOR ENVIRONMENTAL IMPACT ASSESSMENTS

The criteria can be grouped into five main sets of questions:

1. How far does the development contribute to distribution of benefits? (a) nationally and (b) as between nations?
2. To what extent are the costs bourne by those receiving the benefits?
3. To what extent are damage effects to health, envorinment and agriculture reversible if policy or budgets change in the future?
4. How many possible future uses for the area are/will be precluded by the development for the future?
5. What is the significance of the location for food supplies, (a) locally, (b) nationally and (c) world-wide; now and in the future?

Methods

1. Thorough preparation and discussion. Establishment of contacts, sources of relevant literature, transport arrangements, co-operation with local experts. Interpreters/counterparts to be included in this planning stage of at least two weeks.
2. Arrange back-up facilities - laboratories capable of doing series of water and soil analyses (and air monitoring for some industries).
3. (a) Interview management (for existing factories) and planners (for proposed factories):

   Identify processes with potential for health or environment problems

   Determine levels of nuisance in terms of noise, dust, volumes, concentration, periodicity

   For existing factories investigate actual damage levels, e.g. number of workers affected

   Investigate control measures, health care, waste treatment, process control, recycling/reclamation

   Determine costs of these procedures relative to total costs

   (b) Assess the existing/proposed arrangements, effects of prevention at various possible levels, compared with other methods, possibility of recycling, etc., and determine why the existing/proposed methods were chosen.
4. (a) Interview a sample of workers:

   Determine age, sex, marital status

   Where they come from

   Previous occupations

   Number in family and family occupation

Continued economio contribution to region of origin
State of health before and after joining factory
Diet before and after
Future intentions

(b) Assess likely economic and social impacts on do[illegible]nity, on receiving community and on workers themselves.

5. (a) Interview relevant Government Departments:
Establish pre-existing land-use
Establish pre-existing productivity
Establish numbers of families dependent on this
Establish pre-existing drainage patterns
Identify types and distribution of soils, tolerance to salt and other components of proposed discharges (by laboratory tests if necessary)
Determine usual ammounts, type and time of rain

(b) Assess likely effects of existing/proposed development:
Calculate losses/gains to the affected community
Calculate losses/gains to the nation
Calculate losses/gains to world food potential

6. Interview members of surrounding community (representative sample):
Establish significant uses of land and water
Determine the inoome derived from these
Establish, if food is produced, what contribution it makes to their diet
Identify alternative occupations/souroes of inoome
Find out about changes since factory was built or monitor ohanges over a period
Estimate opportunities for other uses in future as sooiety ohanges: recreation, amentity, housing, etc.
Assess potential reveribility of the ohanges wrought and probable period before threshold of irreversibility is reached
Assess net losses and gains due to changes in financial status and changes in health status resulting from this.

7. Take samples of waste products over a complete cycle of operations and of final effluent after appropriate period. Analyse to determine effectiveness and adequacy of treatment plant. Take samples of receiving waters in affected community. Assess probability that damage is due to the factory.

8. (a) List costs and benefits from all of 1 - 7 above. Quantify and attach values wherever possible, explaining how these were derived. Analyse the cost and benefits with respect to the:

   Factory
   Community
   Nation
   World Community

   (b) Summarize non-quantifiable effects and comment on their permanence, probable secondary and higher order effects.

Team requirements

In the light of experience in Thailand the following are considered to be essential:

A translator
An ecologist
An Economist with expertise in social/environmental cost and benefits analysis
An engineer/chemical engineer with experience of the industry in the country concerned
Permanently available transport
Laboratory back-up facilities

In most countries it is probably desirable that the team should not consist entirely of nationals, but there are usually non-nationals with relevant knowledge who could be included.

The interviews with local people are particularly important for assessment of environmental impacts and it is essential that time should be spent in discussing the information required with counterparts so that they may successfully undertake some of the interviewing.

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