2. ENVIRONMENTAL POLICY

2.1 The Chao Phraya River Basin

The Chao Phraya River basin is a part of a global water circulation system. The basin can be divided into three sub-basins by their differing topographic, hydrologic, and soil characteristics: the upper, middle, and lower basins.

2.1.1 Upper Basin

The area has steep mountains and is covered by forest. The area serves as a water retention area and is the headland for one of Asia's most important river systems.

2.1.2 Middle Basin

The area is made up of numerous small plains and mountainous areas. The area collects water from tributaries which feed the main rivers originate in the upper basin.

2.1.3 Lower Basin

This sub-basin comprises both the ancient deltaic area and the surrounding upland. The upper delta floods during rainy season which allows it to serve as a regulator for the rivers which flow to the lower delta where Bangkok is located.

The role of these sub-basins is a closely related ecosystem:

- Deforestation in the upper basin results in unstable water runoff which adversely affects human settlements, agriculture, and industry at the lower basin.

- Water pollution in upper basin can be quite detrimental to water quality in the heavily populated lower basin.

Therefore, for development of the Chao Phraya River basin and for safe use of water resources, the delicate relation between these sub-basins should be recognized. Environmental policies and their roles in development are summarized in Table 2.1.

Table 2.1 Environmental Policy in Chao Phraya River Basin

Environmental Policy	Role	Upper Basin	Middle Basin	Lower Basin: Upper	Lower
Conservation of forest Any kind of development is not permitted	Stability of amount of water flow				
Conservation of soil Efficient land use	Prevention of erosion				
Maintaining water quality for using various purpose	water pollution control				
Efficient use of rain water and prevention from flood in the BMR	flood control				

2.2 The UCR

The UCR is located at upper part of the lower basin of the Chao Phraya River. The UCR can be divided into two main sections by topography as follows.

2.2.1 Upland Area

Conservation of top-soil and appropriate land use are necessary to sustain agriculture on a long term basis.

2.2.2 Delta Area

Water quality control of the area along the river should be the first concern. The function of the area for water retention should also be maintained to control flooding in the lower delta.

Considering the roles played by each area, environmental policies suggested for development are summarized in Table 2.2, and an overall approach to environmental issues in line with development policies in the UCR is conceptually illustrated on Fig. 2.1.

Table 2.2 Environmental Policy in the UCR

Environmental Policy	Key Concept	Role
Natural Resource Management in Upland Area	Implimentation of appropriate preservation, restration and conservation in accordance with natural condition	Stability of flow Prevention of erosion Preservation of agricultural environment
Water Management in Chao Phraya Delta	Keeping the present water quality and quantity	Water supply for agricultural production in the UCR Water supply for urban, industrial and agricultural activities in the BMR *Flood retarding* function for the BMR

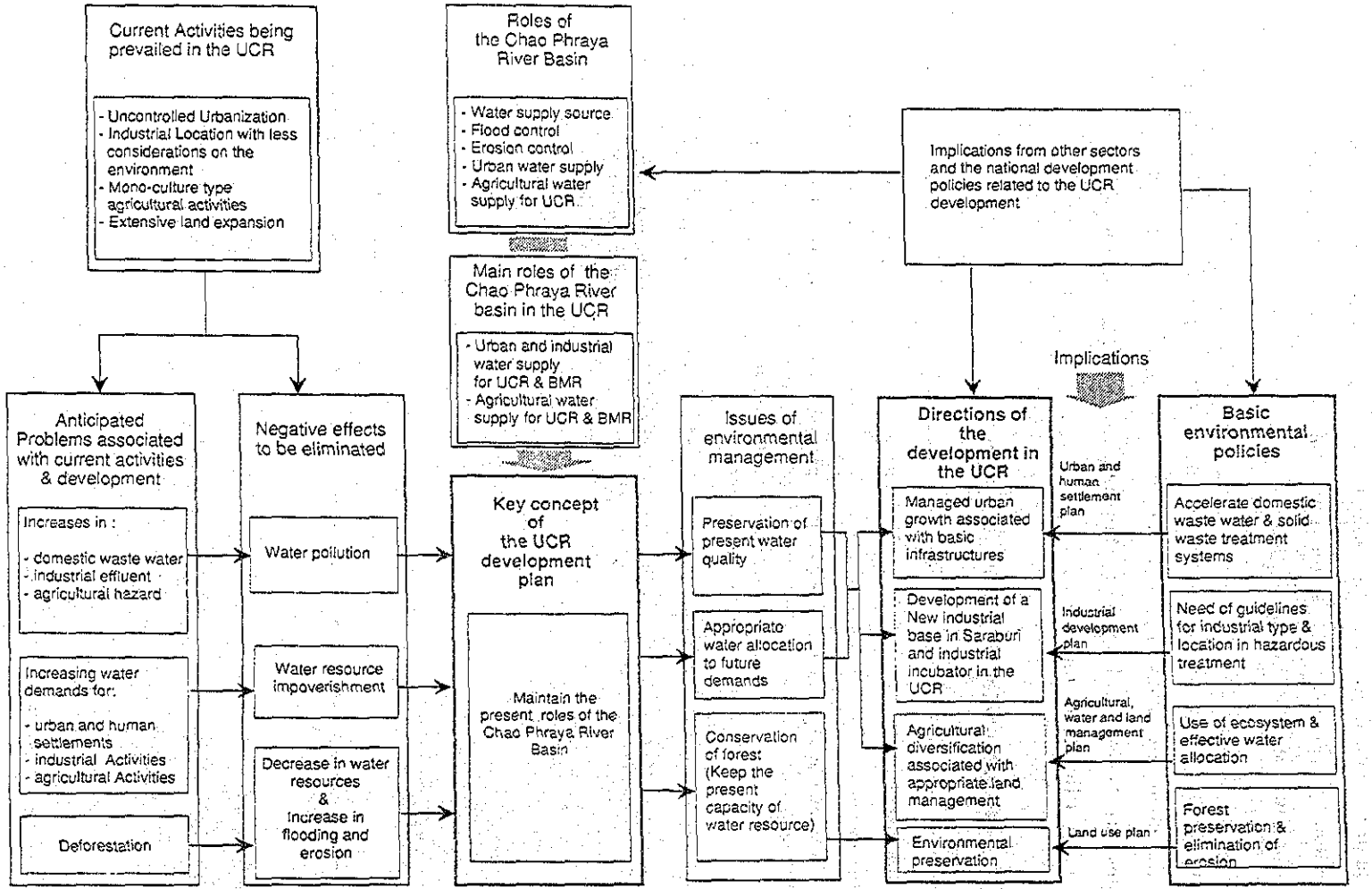


Fig. 2.1 Overall Approach to Environmental Issues for the UCR Development

3. Critical Issues to the Environment and to Development

3.1 Critical Issues

3.1.1 Chao Phraya River Delta

The critical problem is the water quality in the Chao Phraya River which is gradually and consistently deteriorating. The water quality of Chao Phraya River varies by location: from 2 ppm to 10 ppm COD (measured by the study team using a simplified method, shown in Fig. 3.1). In general, the level of contamination has already reached the maximum level allowed by the ONEB (refer to Fig. 3.2). Thus, no more pollution can be allowed.

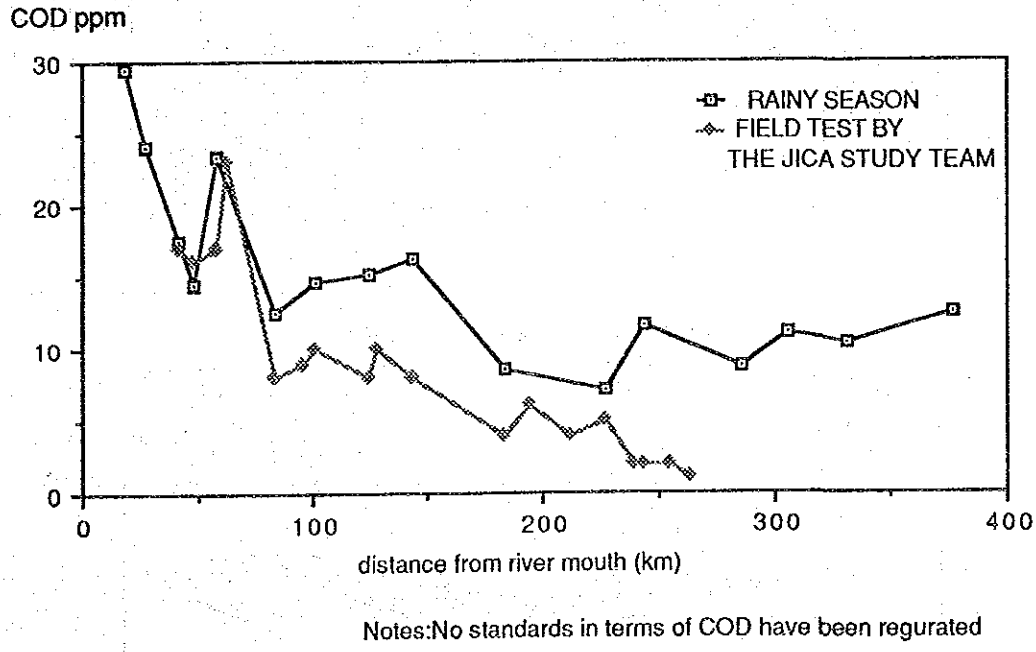
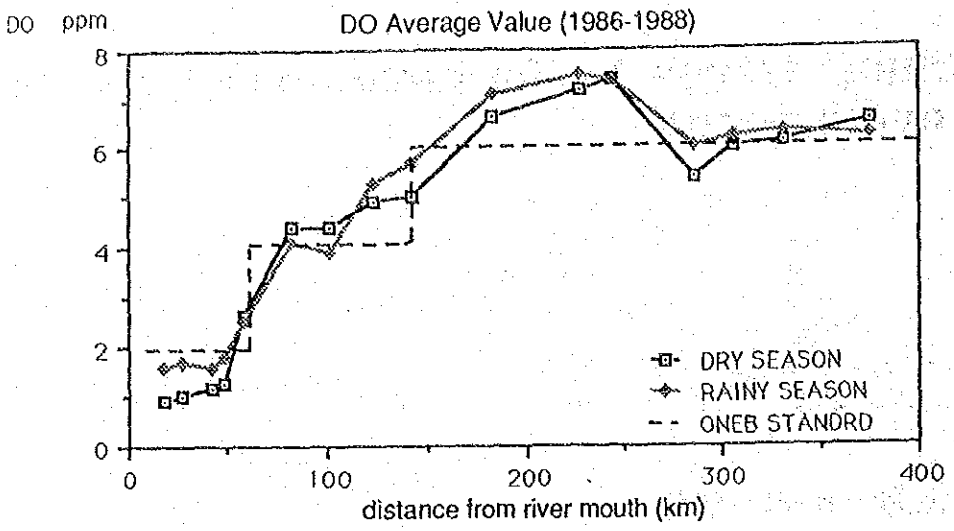
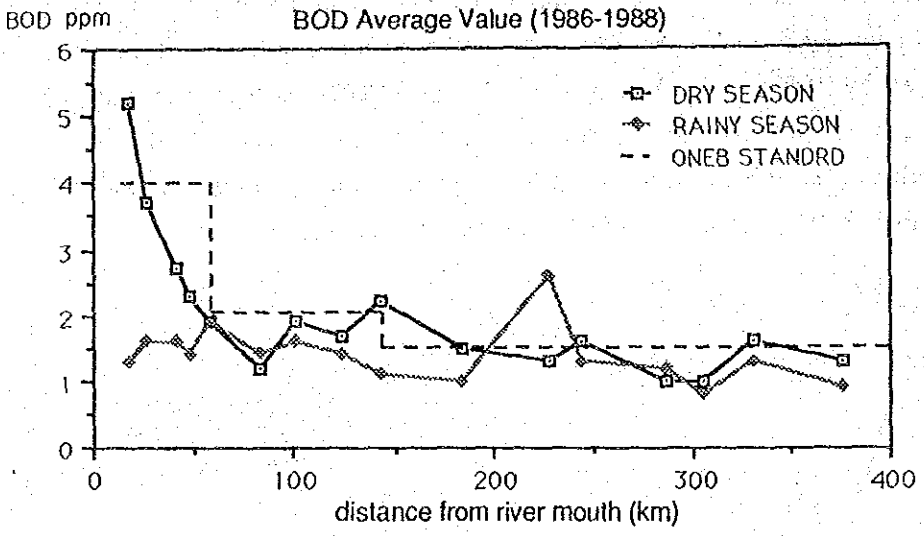


Fig. 3.1 COD Average Value (ONEB) & Test Value by the Study Team





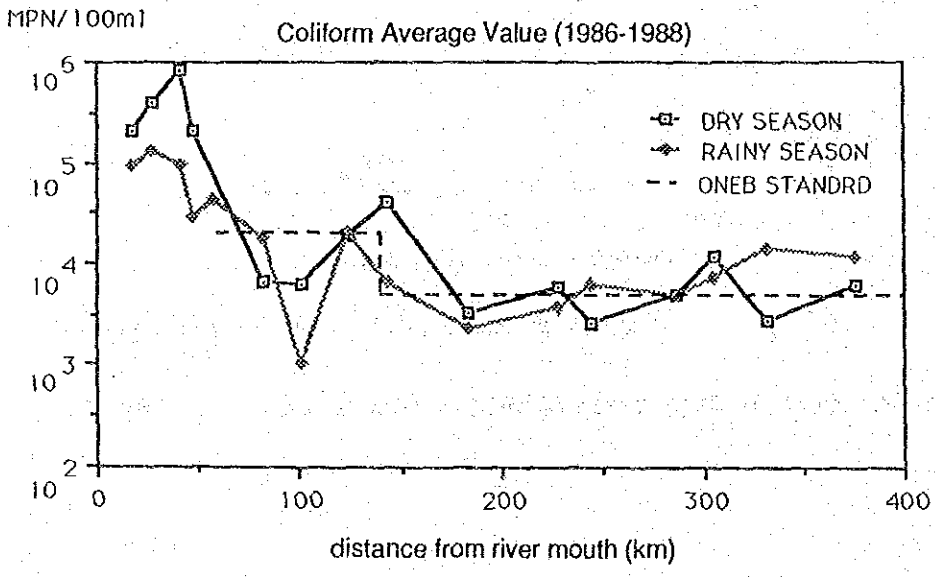


Fig. 3.2 Water Quality in Chao Phraya River

Source:ONEB

Untreated effluent from households and industries is directly discharged into the rivers, thus more severe water contamination will accompany uncontrolled regional economic development.

Although toxic substances of agricultural chemicals have affected river bottom sediments, the effect to the water itself is not yet significant so far. However, in addition to the danger of increased agricultural chemicals, other agricultural activities such as livestock breeding and fish ponds are beginning to be sources of water pollution.

However, if appropriate measures are taken right now, it is still possible to restore and preserve the quality of the river water. On the contrary, if any measures are not taken now, serious water quality pollution will occur and affect the water supply not only in the UCR but also in the BMR. Thus, appropriate measures to protect the Chao Phraya River basin, especially the delta area, are urgent. Delayed actions for environmental counter measures will be much more costly and court environmental disaster.

3.1.2 Upland Area

In the upland area, the critical issues are inappropriate land use and disorderly development. From the environmental point of view, sloped land should be protected from excessive use because of environmental sensitivity. If the sloped land is over or mis-used for field crops, soil erosion will undoubtedly occur.

The remaining forests, largely located on sloped land, are both environmentally important and sensitive. Deforestation has been clearly documented as the primary cause of many environmental problems.

Although appropriate land use is critical in these areas, there is at present no land use control. Therefore, these environmentally important and sensitive areas have been developed haphazard and used for crop fields. As a result of intensive land use, soil erosion is already occurring in these areas. In addition to this inappropriate land use, soil productivity is gradually deteriorating due to the inappropriate mono-culture.

To keep the Chao Phraya River basin environmentally sound, land use must have sufficient environmental control. Agricultural diversification should also be encouraged to keep soil fertility without increased use of chemical fertilizers.

3.2 Technical Measures

3.2.1 The Environment and Industrialization

The leading industries in the UCR are resource based such as food processing cement and ceramics industries. However, with industrialization pressure from the BMR, some linkage type industries such as light processing, precision machining, and electronic industries are already locating in the southern part of the UCR.

About 25% of the BOD in the Chao Phraya River Water is estimated to be the effect of industrial waste water. Further industrial development without creating sufficient control and management system of the waste water will incur rapidly increasing pollution of the river water.

Environmental measures must be established against negative impacts by UCR based factories.

1) Environmental Policies for Industrialization

Environmental policies for industrialization are needed to:

(1) Maintain water quality of Chao Phraya River basin through appropriate land use control and sufficient environmental standards for industries

(2) Pursue a proper balance between environmental conservation and industrialization which suits the features of the UCR

2) Problems

Although only a few linkage type industries are being developed in the UCR, serious environmental problems are already occurring due to:

- Industrial location
- Industrial type
- Hazardous industrial wastes
- Industrial water
- Air pollution

(1) Industrial location

The Chao Phraya River delta is particularly susceptible to environmental pollution caused by industrial discharge or mishaps. This is largely because the impacts are likely to rapidly spread over broader areas. In the UCR, the most sensitive areas are the riverside areas and flood prone areas like that near Ayutthaya.

Large scale industrial estates are already under construction in flood prone areas. These industrial estates are constructed within polders. In the rainy season, the water flooding the estates may be pumped outside. This type of operation disturbs the natural water cycle and expands the damage of flooding in the lower basin, since the land does not hold the water for a substantial length of time like surrounding rice fields.

(2) Industrial type

There is no control on industrial types by taking into account environmental suitability. Especially factories with toxic effluent should be prohibited in these areas. Contrary to this, industries producing hazardous wastes such as the high-tech industry are already being constructed in the sensitive flooding area near Ayutthaya.

(3) Measures to control hazardous industrial waste

At present there is insufficient control by industries producing hazardous industrial wastes. Factories creating hazardous wastes

should equip themselves with proper hazardous waste treatment facilities. The quality of industrial effluent and wastes should be checked independently by public officials.

At present, there are an insufficient number of both treatment facilities and control systems and there is no effective checking.

(4) Industrial water

There is at present no control on the use of underground water by factories in the UCR.

(5) Air pollution

Air pollution is caused by cement industry-related activities in Sara Buri.

3) Urgent measures

(1) Extend the 350 sq. km. restricted zone at the upstream of Sam Lae water intake.

To protect the water quality around the water intake for the public water supply of the BMR, a 350 sq. km. restricted zone was established. This restricted zone legally prohibits the construction of new factories as well as the expansion of existing factories which discharge hazardous wastes or high BOD waste water.

Since it is so important to protect the water quality of the upstream Chao Phraya River, as well as other rivers and canals, the restricted zone should be extended upstream, especially along the zones adjacent to rivers and in flooding zones.

(2) Undertake an environmental assessment of existing factories and study the impacts of industry on the environment in the affected areas.

(3) Create a law directing medium and large scale factories to install hazardous treatment facilities and small scale factories to relocate to industrial estates with common treatment facilities.

Industrial Hazardous Treatment Centers are scheduled to be established by Department of Industrial Works (DIW). It is expected that these centers will play a part of this role effectively.

(4) Restrict factory use of underground water.

Excessive use of underground water may cause the ground subsidence and increase susceptibility to flooding. The use of underground water should be restricted and factories should be charged for its use.

(5) Provide special guidelines for industrial location in the environmentally sensitive areas like Ayutthaya regarding:

- The types of industries to be promoted or prohibited.
- The engineering methods used in land preparation. The water retention capacity of the Ayutthaya area must not be reduced. For this reason the system of factories enclosed by polders is not recommended. A cut-and-fill method, creating factories enclosed by retarding ponds is preferred.
- Recommendations for hazardous treatment systems.
- Constraints on the users of underground water.

(6) Establish appropriate dust prevention methods for cement industries.

It is believed that the dust pollution sources are rock mining sites and cement factories themselves. A study should be conducted to estimate the load of pollution generated by these pollution sources.

It is also believed that the coarse dust is emitted from the rock mining sites and the fine dust is emitted from the cement factories. The fine dust pollution causes serious environmental problems because the fine dust diffuses widely and poses serious health risk to humans.

It is not difficult to prevent the dust pollution from cement factories since a dust-collecting equipment does not require complex technology, and high dust collecting efficiency can be attained easily. Electrostatic precipitators are normally used in cement factories.

The best and simplest way for the prevention of dust pollution is to require cement factories to equip themselves with appropriate dust-collecting systems and to check collection efficiency by themselves. Administrative guidance is thus the most important measure to control cement factories. It is also supposed that a subsidy for dust-collecting equipment would be an effective measure.

4) Long-term measures

The long-term measures should be taken not only in the UCR but throughout the kingdom.

(1) Provide an overall land use and zoning plan with legal enforcement not only in the Chao Phraya River basin but also in the other river basins, and designate industrial promotion zones.

(2) Promote agriculture based or recycling based industries which reuse industrial wastes and waste water.

(3) Promote well-arranged industrial estates with common industrial waste treatment facilities.

(4) Establish an environmental monitoring system to check the industrial waste water, airborne particulate matter, and toxic waste conditions.

An overall picture based on the above arguments is shown in Fig. 3.3.

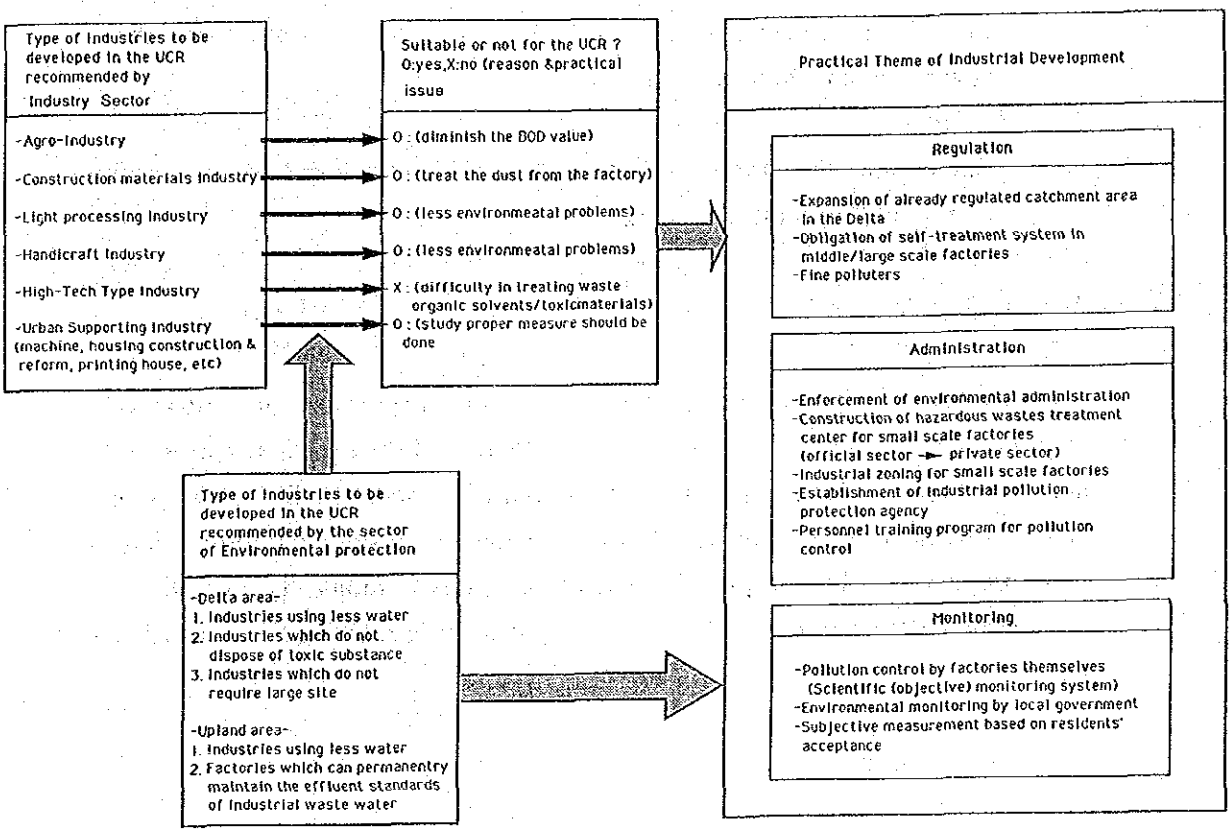


Fig. 3.3 Environmental Policy for Industrial Development

3.2.2 Environment and Agriculture

Agriculture is the most important activity in the UCR. It must be directed to become environmentally sound.

1) Environmental Policies for Agriculture

(1) Encourage diversified agricultural activities to strengthen the environmental base of the UCR.

(2) Encourage the farmers' environmental awareness, by promoting a proper agricultural system.

2) Problems

An increase of agricultural production by the expansion of cultivated area is now becoming impossible in the UCR. Still common, however, are inappropriate land use and mono-culture. Additionally, fish ponds and livestock farming are likely to be potential water pollution sources. Environmentally inappropriate agriculture causes many types of environmental problems. The most significant problems are described below.

(1) Mono-culture

The mono-culture or single crop culture which is being practiced decreases soil fertility and results in increased erosion problems in the upland areas.

(2) Environmental pollution sources

Livestock and fish ponds: Fish farming and livestock farming are likely to be potential water pollution sources. However, neither responsible public bodies nor systems exist to instruct farmers the methods for proper treatment of effluents.

Chemical fertilizers: Large scale field crop production with chemical fertilizers not only cause the eutrophication of surface water and ground water pollution but also deteriorate the soil.

Agricultural chemicals: Over use of agricultural chemicals cause water pollution and food contamination.

(3) Perception of farmers

Perception among farmers regarding deterioration of the agricultural environment is weak.

The frequent accidents caused by the abuse of agricultural chemicals is due to farmers' limited knowledge of proper use and handling procedures.

3) Urgent Measures

(1) Agricultural waste water treatment

It is necessary to provide guidelines especially for medium and large scale fish and livestock farming.

a) Livestock farming

As waste water from livestock farming, especially swine waste water, can load canals and rivers with high BOD, the waste water should be treated. The following treatment methods should be considered in the UCR.

- Oxidation pond method (using a septic tank with proper temperature and abundance of sunlight).

b) Fish pond

Waste water from large scale fish pond can be a source of water pollution. The National Inland Fisheries Institution has recommended an effective and economical biological treatment method of pond waste water, using fish such as Tilapia and phytoplankton such as Spirulina. Application of these methods should be considered.

(2) Proper uses of agricultural chemicals and fertilizer

It is necessary to promote public relations and educational activities to farmers for proper uses of agricultural chemicals and fertilizers by officials of Department of Agricultural Extension.

As for chemical fertilizers, increased fertilizer pollution is expected to some extent by the progress of agricultural intensification, but its seriousness varies by location, soil, precipitation, and type of crop. Generally, ensuring a proper use of fertilizer in terms of both quality and quantity, attentive monitoring activities are necessary in each catchment area.

On the other hand, as for agricultural chemicals, instructions on proper use of agricultural chemicals should be given to farmers. Promotion of mixed cropping and the creation of environmental forests are recommended as an effective pesticide method using a natural enemy system. These are more environmentally sound and often more economical in the long run than exclusive dependence on agricultural chemicals.

4) Long term measures

(1) New farming system

It is necessary to promote a new farming system (as proposed in the Agricultural Sector Report) with emphasis on environmental conservation. The upland area especially should receive attention to encourage environmentally sound agricultural practices.

To conserve the agricultural environment, an integrated farming system should be introduced. A model of this proposed integrated farming system is shown in Fig. 3.4.

The main purposes of the integrated farming system are:

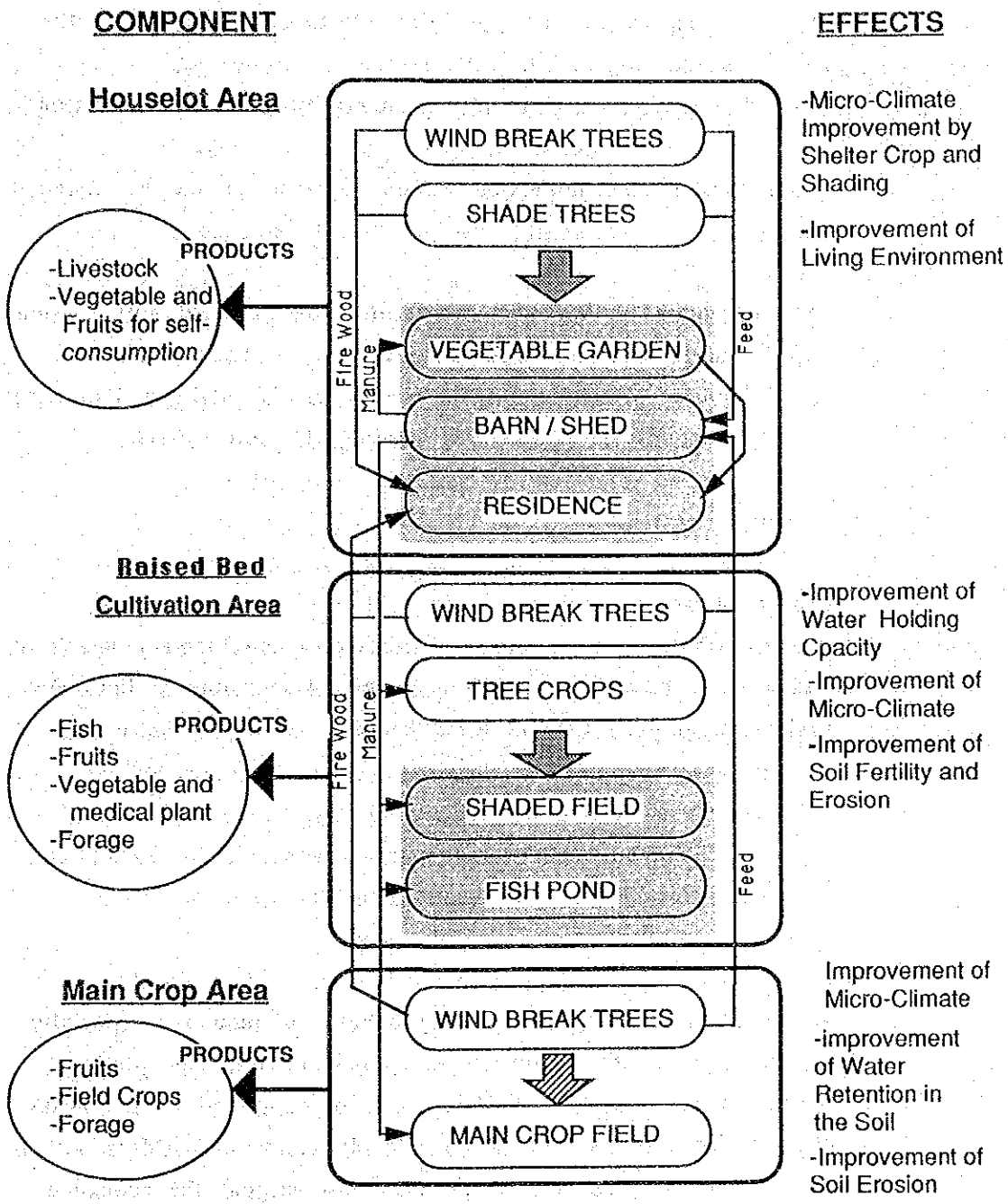


Fig. 3.4 Components of Integrated Farming System

- To increase the efficiency of using limited water resources.
- To improve the regional environment by increasing the number of trees or tree crops.
- To enhance agricultural productivity and diversification.

The effects of the integrated farming system on the environment and agriculture are as follows:

- Maintain or increase soil fertility and prevent soil erosion through covering the soil surface with tree crops.
- Increese water retention capacity in the soil by improving the micro climate and by shading the soil surface.

(2) Recycling system

It is necessary to initiate a waste and waste water recycling system. Purified waste water can be important water resource during dry season in the UCR. Promising recycling systems for application in the UCR are listed below.

- Reuse of treated domestic waste water
  If the quality of treated water is adequate for agriculture, the treated water is important water resource.
- Energy production by solid waste

Waste water and matter from agriculture or industry, especially pig raising which contains high organic matter, can produce bio-gas if the anaerobic digestion method is applied. Rice husks can be also used as fuel to generate electricity. Considerations for the use of these systems should take into account the economic aspects of their application.

a) Low price fertilizer

It is necessary to make use of farm manure and other agricultural residues. This has implications upon compost plants which may be constructed in the future by the BMR and UCR as a joint solid waste management plan.

b) Fish cultivation using waste water

Organic matter, nitrogen and phosphorus contained in waste water are pollutants and are also nutrients for fish and phytoplankton. As mentioned previously, raising Tilapia and Spirulina using waste water may be practiced, if it is technologically possible.

3.2.3 Environment and Urban and Human Settlement

Population in the UCR is expected to increase from 2.74 million in 1987 to 3.46 million in 2010. In 2010, the urban population will be about 1.29 million. With the increasing population, the pollution load will be heavier, and Chao Phraya River and its tributaries will be polluted. The amount of solid waste will also increase simultaneously.

1) Environmental Policies for urban and human settlement

Environmental policies for urban and human settlement are:

- To create an environmentally sound urban system, and
- To promote the quality of lives of local people and encourage urban and community activities.

2) Problems

Deterioration of water quality in rivers due to:

- Lack of domestic waste water treatment systems and facilities in major urban centers,

- Lack of efficient solid waste collecting systems in rural areas as well as in urban areas, where solid wastes are often disposed by dumping into the rivers,
- Lack of consciousness of individual responsibility among people for water quality, and
- Squatter settlement beside/over rivers with no urban management and no urban services.

3) Urgent measures

In the UCR, Ayutthaya and Saraburi cities will have a rapid population increase, and will be sub-regional centers with a wide variety of urban services, commercials and industries. In 2010, the two cities will have more than 150,000 population. Environmental measures are urgently needed especially for these cities.

(1) Domestic waste water treatment system

Domestic waste water treatment is the single most important measure to decrease the pollution load on the Chao Phraya River. The Public Works Department has developed plans for waste water disposal management in 65 cities with three levels of priority:

- Urgent 18 cities,
- High priority 25 cities,
- Priority 22 cities.

The Study Team, supporting the basic policies of PWD's program, recommends that the cities of Ayutthaya, Sara Buri, and Lop Buri should develop sewage treatment systems as soon as possible.

Basic requirements for domestic waste water treatment systems are:

- Simple operation and maintenance.
  Owing to shortage of trained personnels, the treatment process must require few control persons and be based on a simple technology for operation and maintenance.

- Low cost in construction, operation, and maintenance.
  Treatment facilities which can be constructed at a low cost and have a simple structure are recommended. Moreover, operation and maintenance costs (electric power, chemicals, repairing and personnel expenses, etc.) should be as low as possible.
- Sufficient capacity to handle peak loads
  Generally, the quantity and quality of sewage effluent have daily and seasonal fluctuations. For this reason, treatment processing capacity should be adequate to handle fluctuations of water quality and quantity.
- High treatment efficiency.
  Treatment processes with high efficiency are recommended, as it is important that the water quality of effluent from the plant does not fluctuate widely.
- Less waste sludge.
  It is both time consuming and expensive to treat waste sludge, so processes which generate less sludge are recommended.

Appropriate domestic waste water treatment processes and systems vary by urbanization and settlement patterns. Recommended processes of domestic waste water are:

- Conventional activated sludge process,
- Extended aeration process,
- Oxidation ditch process, and
- Aerated lagoon process.

These processes have various advantages and disadvantages as shown in Table 3.1. The processes which have evaluations "D" are not recommended in the UCR.

In addition to the conditions mentioned above, cost estimates must include pipe network construction. For this reason, population density is important to select an appropriate domestic waste water treatment system.

Accordingly, the recommendations for appropriate domestic waste water treatment system depend on the settlement patterns represented by the population density and size of population, as shown in Fig. 3.5 and as described below.

Table 3.1 Domestic Waste Water Treatment Processes

Treatment processes	Maintenance and operation	Construction cost	Consumption of energy	Stability of treatment	Efficiency of treatment	generation of sludge	Land preparation	References	
								Construction cost* (bahts/m3)	Preparing area (m2/m3)
Conventional activated sludge process	D	D	D	C	A	D	A	15,000 ~25,000	1.0
Extended aeration process	C	C	C	B	A	C	B	12,000 ~20,000	1.5
Oxidation ditch process	B	B	B	A	A	B	C	10,000 ~16,000	2.0
Aerated lagoon process	A	A	A	A	B	A	D	5,000 ~8,000	10.0

note: 1) advantage=A>B>C>D=disadvantage
2) construction cost* is estimated by 50,000m3/day base

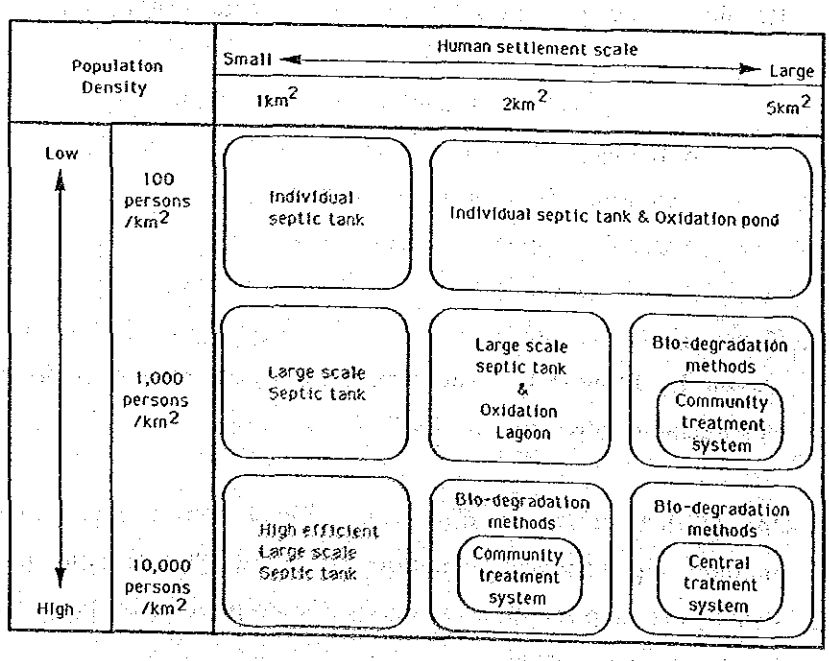


Fig. 3.5 Treatment Methods to Depend on Population Density & Human Settlement Scale

a) Densely and widely inhabited areas

Municipalities and the sanitary districts which have a high population density (approximately 50 persons/ha and over in terms of gross density) should be planned as treatment districts.

In these treatment districts, the waste water (night soil and gray water) should be collected by pipes and treated by appropriate facilities. Appropriate treatment processes depend largely on the size of land which must be prepared.

Given adequate and sufficient land, the recommended process is Aerated Lagoon Process. As mentioned in the preceding section, this process has many advantages except for the size of land to be prepared. Higher treatment efficiency can also be achieved if a facility using this process is equipped with a facultative pond and maturation pond to augment the main aerated lagoon.

On the other hand, for the area where adequate and sufficient land is hardly prepared, the recommended process is Oxidation Ditch Process.

b) Small Densely inhabited areas

Small areas in the municipalities and sanitary districts which have a high population density should also be designated as treatment districts. In these treatment areas, as in densely and widely inhabited districts, the waste water should be collected by pipes and treated by a community plant. Recommended treatment processes of community plants are the same as densely inhabited districts.

Houses in the areas surrounding municipalities and sanitary districts should equipped with individual septic tanks to treat night soil and gray water.

c) Suburban areas

These areas (less than 30 persons/ha in terms of gross density) should be equipped with the individual septic tanks which treat night soil and gray water because there is less merit for the cost of pipe systems to collect and treat the waste water. The waste sludge from these individual septic tanks should be treated periodically by the waste sludge treatment facilities.

d) Rural areas

Less dense areas (less than 10 persons/ha) should be equipped with a toilet system with leaching pits. The pollution load from these districts would not exceed natural purification capacity in drainage area. Nevertheless, a toilet system with leaching pits for preventing epidemic diseases should be established.

(2) Solid waste collection and treatment system

It is necessary to consider privately funded programs or concessions for solid waste treatment works at a local level. Measures which need to be taken are:

- Eliminate illegal dumping
- Increase efficiency in terms of productivity of equipment and personnel
- Integrate service areas to achieve economies of scale
- Promote recycling systems based on a private business, although supervisory function should be kept by a local government.

Existing problems of solid waste collection and treatment in the UCR are identified as:

- The service level and collection efficiency varies greatly by municipality.
- Existing disposal systems are limited to open dumping and open burning.

- Administrative bodies responsible for collection and treatment services have less coordinations and cooperations, thereby resulting in a less efficient management system in changwat as a whole.

To eliminate these problems, measures for improvement should focus on:

- Improving efficiency of collection system
- Applying conventional sanitary land fill treatment

The existing systems provide for poor sanitation. The development of an incineration plant is not recommended in this area, because the collected solid waste is too wet. A conventional sanitary land fill system with sufficient protection against pollution is more suitable than an incineration plant system the folloing considerations are necessary:

- Choice of waste for collection
  (except industrial waste and reuse of reusable waste)
- Choice of the area for land-fill
  (avoiding flooding area and suitable area for crop production)
- Reuse of the land damaged by rock mining

The recommended sanitary land-fill method and the structure of the site are shown in Fig. 3.6. A water sealing layer to prevent the leachate from penetrating into the ground and contaminating ground water is necessary. Rain water is collected by the rain drains and drain pipes, then drained into a water collecting pit and then to the leachate treatment plant.

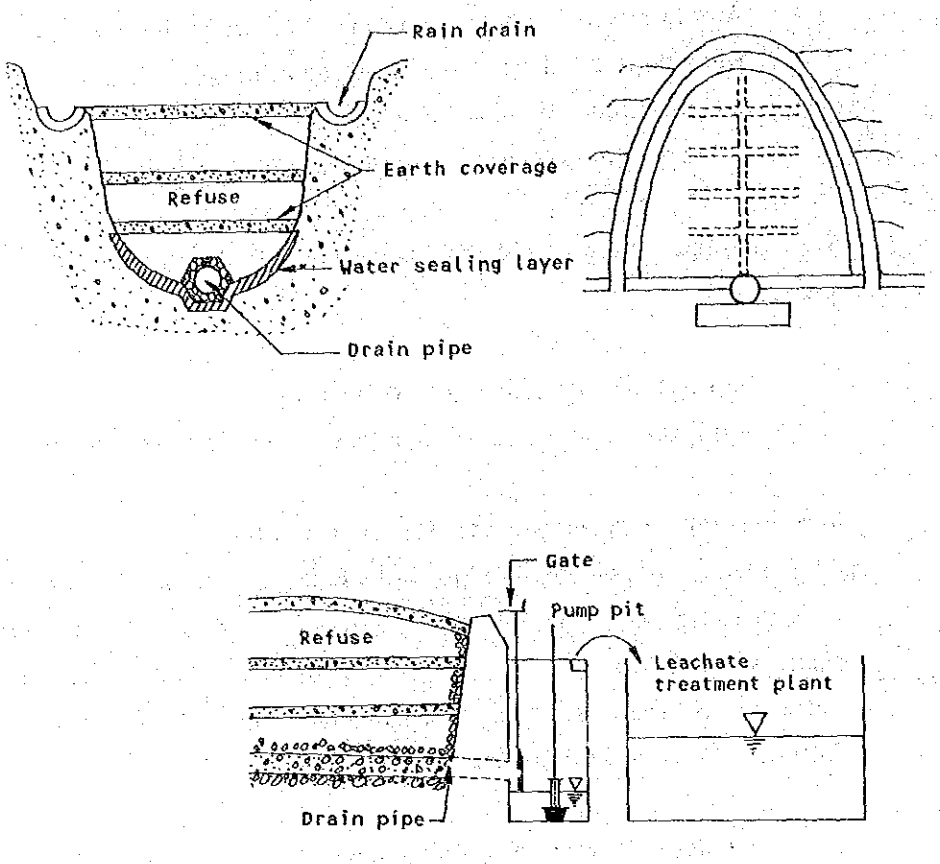


Fig. 3.6 Sanitary Land Fill Methods and Structure of Facilities

4) Long-Term measures

(1) Acceleration of Sewerage System Development in Major Cities

It is necessary to establish an authority exclusively responsible for facilitating development of sewerage system in major urban centers, which may be called as Provincial Sewerage Development Authority (PSDA). The PSDA shall provide numerous services for municipalities such as:

- Technical engineering services,
- Provision of funds (loans),
- Maintenance services, and
- Training of personnel.

The PSDA would need to issue bonds to collect funds, as well as be partially subsidized by the central government.

To develop a sewerage system, the issue of land acquisition and preparation for treatment facilities must be solved. To this end, the municipality itself must be responsible for the land preparation/acquisition, but a more flexible local administrative arrangement is necessary so that the municipality may render this obligation without critical hindrance. The PSDA shall have an advisory function to direct municipalities to prepare appropriate sites with sufficient size for treatment facilities. A more detailed discussion is made in Sector Paper Vol. 2 for this aspect.

(2) Establishment of Efficient Solid Waste Treatment System

A privatization policy is recommended to be explored for establishment of a more efficient solid waste treatement system at local level. For this end, several forms are conceivable: a concessionaire method, a BOT method or a public-private joint operation system.

The present administrative system (where three authorities of municipality, sanitary district and CAO are separately responsible for each territory, which is likely to reduce the efficiency of the work and bear difficulties in good coordination of the local authorities' responsibilities) should be structured by utilizing the private sector.

The overall picture showing the above arguments is illustrated in Fig. 3.7

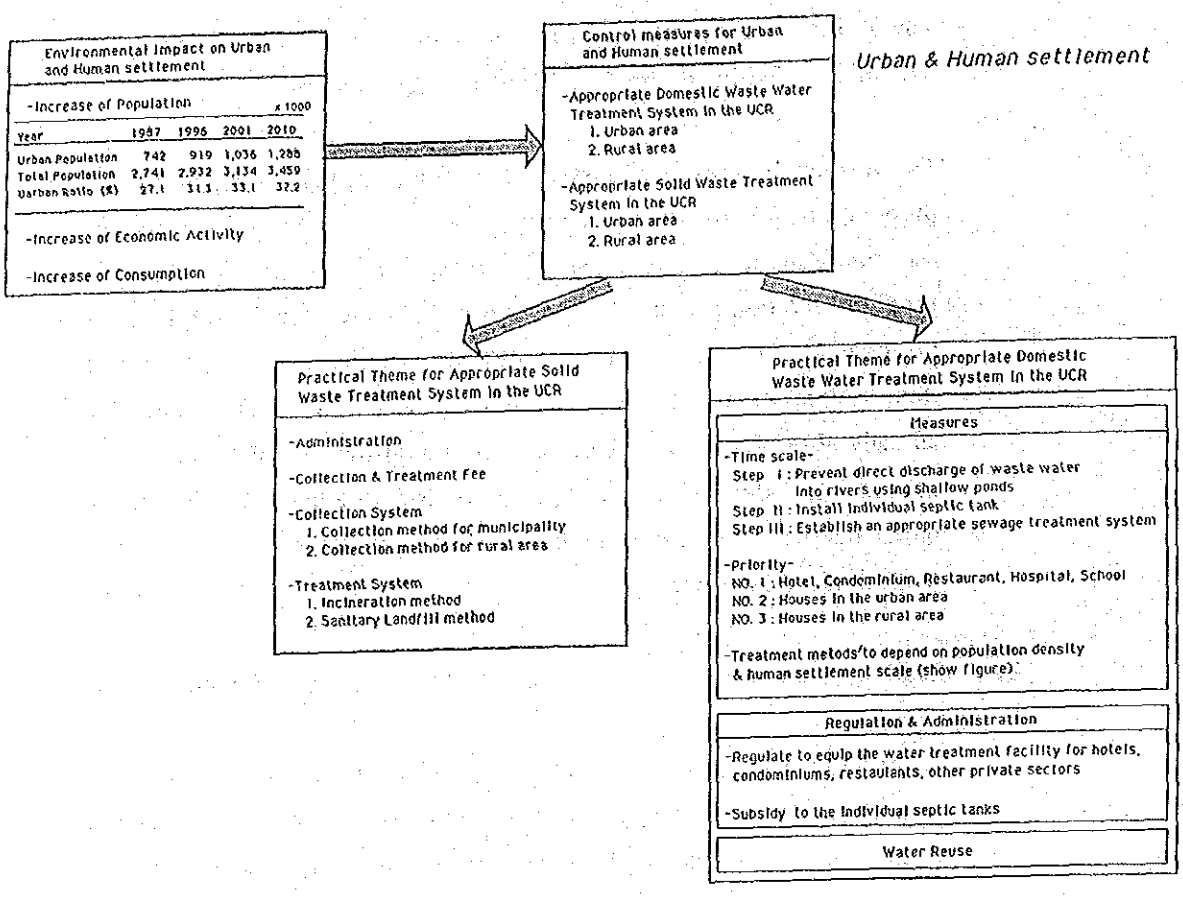


Fig. 3.7 Urban & Human Settlement

3.3 Environmental Management

3.3.1 Monitoring and Environmental Administration

1) Policies

Enforceable and nationally consistent policies should be designed to create workable monitoring and administrative systems over the country as well as for specific areas.

2) Problems

(1) Existing environmental regulations for water quality standards are not efficient due to:

- Lack of monitoring systems at local levels
- Weak coordinating power of ONEB
- Shortage in personnel, capabilities, and equipment for environmental administration at both relevant central and local agencies

(2) Inconsistent policies among government agencies with respect to environmental management

3) Urgent measures

(1) Re-organization of Chao Phraya River Environment Policy Committee

It is urgent to re-organize the Chao Phraya River Environment Policy Committee, whose authority should include the Pasak River basin, and to authorize basic national policies for environmental preservation in the Chao Phraya River basin area as a whole. The existing committee, focusing on the BMR, is recommended to be expanded in terms of the area to take care.

(2) Designation of specific attention areas and establishment of environmental local monitoring stations

"Specific environmental attention areas" should be the Ayutthaya Conservation Area, and Sara Buri Development Area. Local environmental monitoring stations with sufficient personnels and equipment in collaboration with Ministry of Industries, BOI, ONEB, the local governments, and academic institutes should be established, as a pilot project in order to monitor the environment in the specific environmental attentive areas.

4) Long-Term measures

(1) Environmental monitoring should be a function of local government

It is a long term and important measure to strengthen administrative functions of local governments (both Changwat and municipalities) in monitoring environmental effects and changes and directing appropriate corrective measures.

(2) Enhancement of NEB's function

Strengthening the NEB's function is necessary to:

- Coordinate national environmental policy making
- Foster and train personnel in charge of environmental administration
- Render technical assistance to local governments
- Conduct research and development

(3) Formation of a Comprehensive Environment Management System

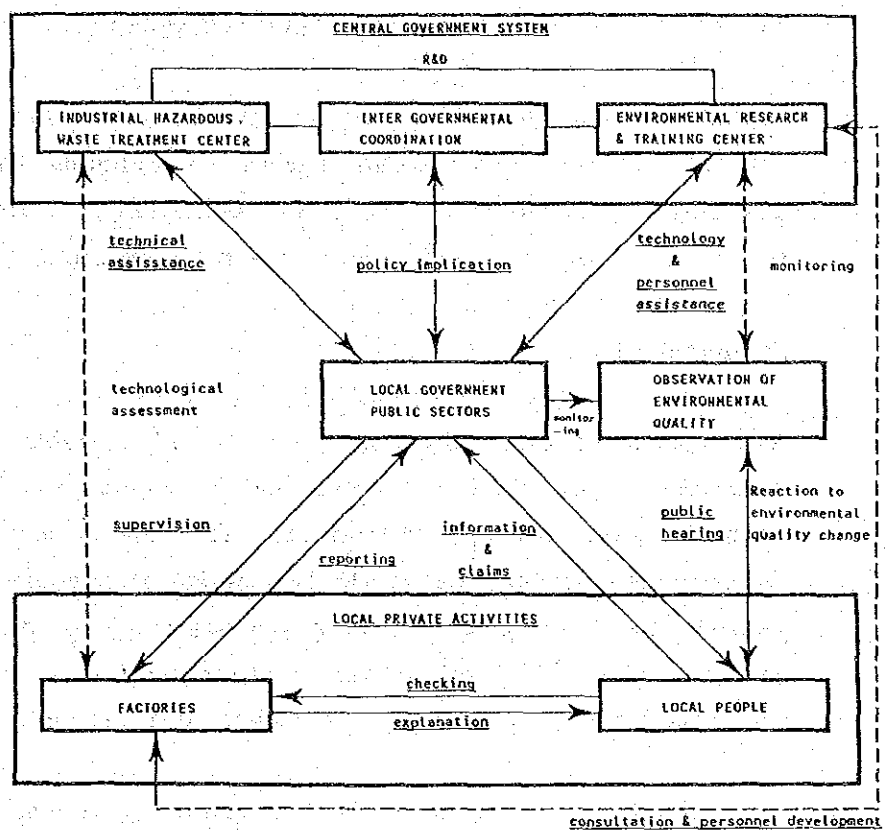
A series of administrations for issuing development permission, directing proper designs and supervising constructions should be undertaken based on definite policies agreed among all the agencies. A consistency in environmental policies is highly required. This task is performed by the Chao Phraya River Environment Policy Committee proposed as one of urgent measures.

On the practical ground, an effective environmental administration is required with inter-governmental coordination among relevant agencies, incolving local authorities. For this purpose, it is recommended to establish an environment management system in the long run, as conceptually shown in Fig. 3.8.

The Concepts underlying this system are threefold as follows:

a) Monitoring system at local level

An environmental monitoring system is to be built at local levels, involving residents and private sector as well as local authorities.



SOURCE : THE JICA STUDY TEAM

Fig. 3.8 Proposal of Environmental Management System

This system may employ two tools to check actual conditions in a balanced manner: scientific (objective) measurement of pollution levels and subjective measurement based on local residents' acceptance levels.

The former is undertaken and reported by trained staff/engineers of local authorities assisted by ONEB and should be periodically done at local stations. The later is collected through public hearing meetings by representatives of local authorities.

Observations of regional environmental quality are to be made by local people and NGO.

b) Enforcement of environmental regulation

Central and local authorities have to have powers to direct the polluters to take countermeasure against the pollution based on results of the monitoring. This needs a legislative reform regarding enforcement of environmental regulation.

c) Personnel training

The number of personnels who are technically capable of undertaking environmental administration should be increased in both central and local authorities. The Environmental Research and Training Center (ERTC), which is now under construction, is expected to have a significant role to play for this purpose. The ERTC will provide well-organized training programs for the people of a wide variety of fields such as:

- Implementing agencies of the central government related to agriculture, industry, energy and transportation, urban development, public health, education and so on.
- Planning agencies of the central government related to social and economic development.
- Local authorities such as municipalities, sanitary districts and CAOs.
- Private sector related to industrial activities.
- NGOs
- Academic institutes and
- Other organizations.

The training programs are expected to place emphasis not only on technical and scientific aspects but also on fostering leaders for organizations and groups. A wide variety of programs should also be prepared: short-, medium- and long-term programs.

3.3.2 Land Use Control

1) Policies

(1) Establish long term policies for land use and national resources with sufficient environmental control.

(2) Provide a legal rationale and basis to control disorderly development throughout the country.

2) Problems

Disorderly development is taking place in areas legally uncontrolable outside municipal zoning areas, thereby weakening administrative capacity for land use control. Because of this, administrative measures tend to be taken after problems occur, thereby lessening their effectiveness.

3) Measures

(1) *National Land Use and Zoning Plans*

It is most important to legislate national land use and zoning plans covering all of Thailand and to strengthen a legal authority.

The establishment of the Central Office for Land Use Management is necessary to coordinate the land development by various agencies and to prepare land use guidelines.

The guidelines shall include agricultural development, industrial location and type, urban development, and preservation requirements in conjunction with the national development plan and strategy, and shall take into consideration not only the natural environment but social and cultural issues as well.

Land use zoning should consist of three major categories:

- Preservation areas
- Conservation areas
- Development areas

a) Preservation areas

Preservation areas are designated to preserve the environment or to rehabilitate the environment. Major roles and functions of these areas are to foster water resources, to preserve valuable flora and fauna and to prevent natural disasters and soil erosion. In some culturally important areas, their role is to preserve the landscape and environment. All industries, human settlements, and crop cultivation should be prohibited in these areas.

In the UCR, 1.24 million rai is designated as preservation area which includes 250 thousand rai of existing primary forest, 750 thousand rai of secondary forest and 240 thousand rai of forest land encroached by farmers. These areas are not suitable for cultivation or for permanent settlement.

b) Conservation areas

Conservation areas have development potentials but are environmentally sensitive. Agriculture in these areas should be constrained from full utilization and intensive cultivation. The agglomeration of industrial activities and urbanization in these areas would easily cause environmental deterioration over a broad area. Therefore, certain measures should be taken to ensure the land use would not cause environmental deterioration and help to prevent flooding.

Major concerns in this area are soil conservation, prevention of water pollution, maintaining the flood retention capacity, and conservation of the surrounding environment including historical and archaeological assets.

Guidelines in the UCR are proposed as follows:

Agricultural areas

Conservation areas are designated in the upland crop area and delta area. Soil erosion has already taken place in a part of the upland crop area, especially at the sloped area of the UCR. These areas are designated as the conservation area. Forestry type agriculture (tree crops and perennial crops) shall be encouraged to rehabilitate soil fertility and to prevent soil erosion.

The upper part of Chao Phraya Delta in the UCR and a part of the old delta area function as a flood retention basin and water supply for the lower delta including the BMR. Potential flood areas in this area are identified and designated as conservation area.

The major crop is floating rice in these areas, while paddy and fish pond development have a minimum impact on flood retention. Fish ponds with measures preventing water pollution are necessary.

Urban and industrial areas

Location of large scale industries and urban development should be discouraged. Sloped land in the upland area is not suitable for industry or urbanization. Development of industrial estates should not be encouraged in the delta area to prevent water pollution. The industries to be located here in the future should be of pollution free. From an environmental and long term point of view, a handicraft industry is most suitable for the UCR. Industries already located in this area (delta area) must have proper waste water and solid waste treatment plants in accordance with the environmental standards.

Flood retention capacity should be kept at present level in the delta area of the UCR. Instead of the polder system, a cut and fill site preparation is recommended as mentioned before.

Ground water pumping for industry and urban water supply

should be restricted in the delta area. Excess use of ground water may cause more ground subsidence in the BMR.

Urban development is also limited. Priority should be given to the waste water treatment systems with high efficiency and to the development of solid waste disposal systems in the urban areas.

c) Historical and cultural conservation areas

Historical and cultural areas are important as not only national assets but also tourism resources. It is necessary to conserve historical and archaeological environment.

In the UCR, Ayutthaya and Lop Buri have historical and archaeological environment. Therefore, such a part of Ayutthaya and Lop Buri should be designated as the historical and cultural conservation zones and restricted from inappropriate industrialization and urbanization.

d) Development areas

Positive development can be induced in this area. Distinct zoning of urban development areas and agricultural development areas is necessary for efficient utilization of resources and to minimize the environmental deterioration.

In the UCR, two types of development area are designated. One is the development area in the Chao Phraya Delta which is mainly a paddy cultivation area and another is development area in the upland area.

Agricultural areas

Diversification and intensification of agriculture should be induced in the agricultural development zone. Environmentally sound agriculture based on resource recycling (proposed by agricultural sector) is recommended in the upland area, while

intensive rice cultivation is recommended in the delta area.

Provision of infrastructure and supporting services for full utilization of the natural resources should be emphasized in this zone.

Urban and industrial areas

Resource based independent type industries (recycling industries) are recommended to be located in this zone, but uncontrolled industrial land encroachment into the agricultural land should be avoided.

In the urban and industrial zone, the location of industries and supporting service industries are promoted with provision of necessary infrastructures and institutional supports. However, locating factories (with a fear of toxic effluent) should be avoided especially in the delta area

The construction of waste water treatment systems with high efficiency and the development of solid waste disposal systems in the urban area are necessary. Scale merit for construction of treatment plants and reuse of waste should be considered.

Ground water pumping for industry and urban water supply is not recommended in the delta area. Excess use of ground water may worsen ground subsidence in the BMR.

Fig. 3.9 shows a map of the proposed agricultural land use zoning in the UCR, and Fig. 3.10 indicates the areal distribution of each category. This map is prepared based upon the soil conditions, the flooding potential and the existing irrigation system. As a summary of recommendations, Table 3.2 shows an overall enviromental policy concomitent with land use zoning.

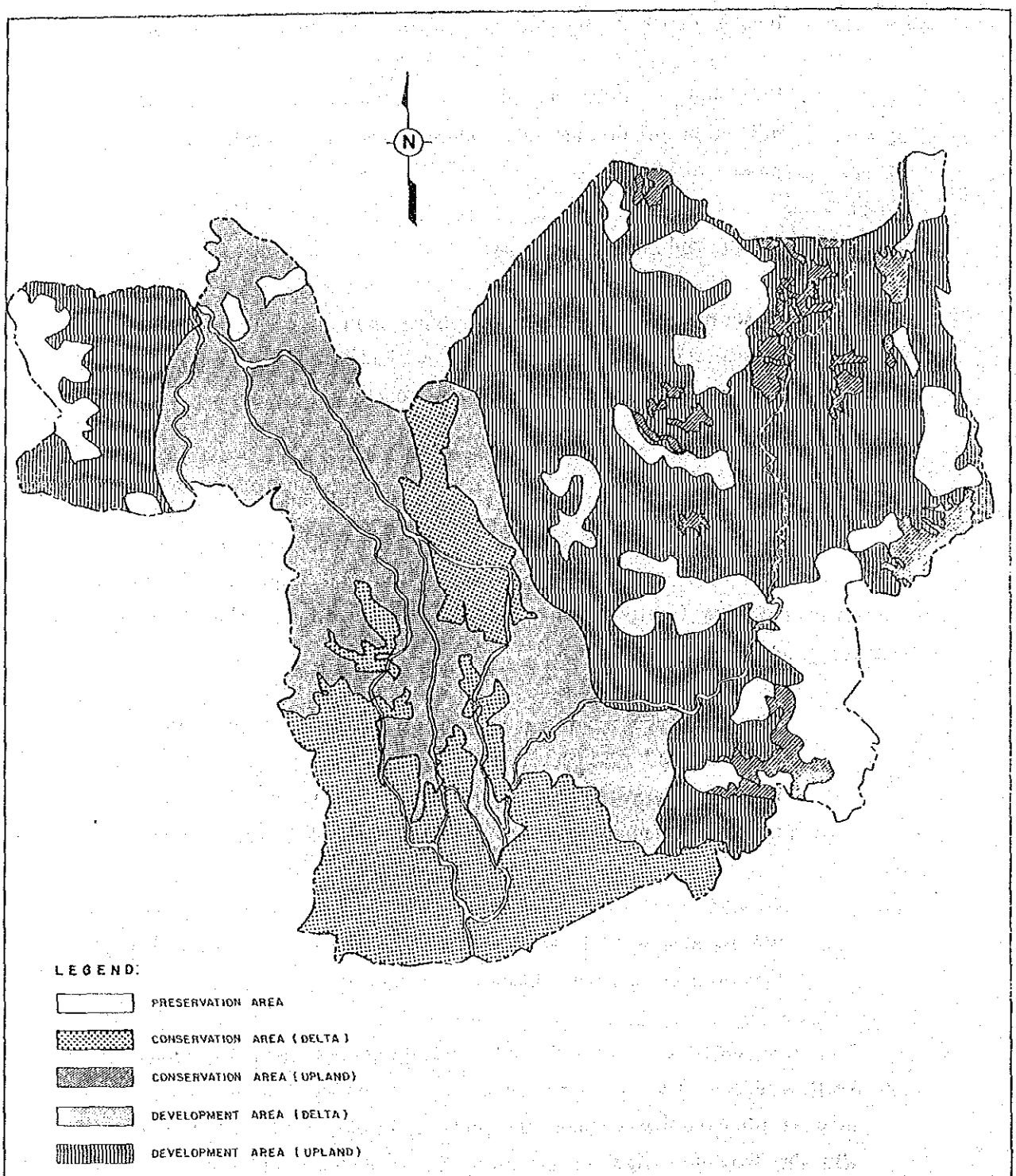


Fig. 3.9 Agricultural Land Use Zoning

SOURCE : THE UCR STUDY TEAM

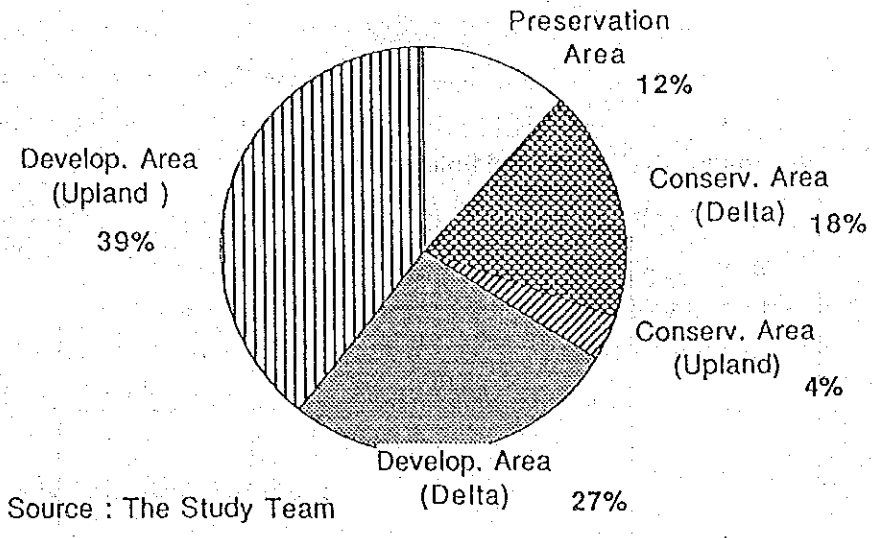


Fig. 3.10 Land Use Zoning in the UCR

3.3.3 Education for Environmental Awareness

Emphasis should be placed on social education and enlightening people to promote their perception level for importance of environment.

Three kinds of programs shall be prepared:

- For local people: Instruct appropriate methods of solid waste and sewage treatment, and promote a sense of hygiene.
- For school children: Educate history and tradition of Thai life style based on environmental benefits, and promote social norm.
- For private sector (hotels, restaurants, factories, and other commercials): Instruct appropriate ways and methods of solid waste and sewage treatment, and promote hygienic mind

Use of mass-media systems may be effective with non-formal education systems. Attention should also be paid to encouragement of cooperation with the NGO's activities as well as religious activities. To keep river environment sound, any parties and peoples should be joined under a spiritual slogan, which creatres consensus for keeping Chao Phraya River sound. For this purpose, it is recommended to promote "Love Chao Phraya" campaign to wake up a people's attention. This campaign is on-going by a NGO. More government supports will make it more effective.

Table 3.2 Environmental Management Policy in the UCR

Area	Development area				Conservation area				Preservation area	Historical and cultural area
	Delta area		Upland area		Delta area		Upland area		Forest area	
Zone	Agricultural zone	Urban zone	Agricultural zone	Urban zone	Agricultural zone	Urban zone	Agricultural zone	Urban zone	———	Ayutthaya Zone Lop Buri Zone
Main Urban Center	———	-Chai Nat -Sing Buri -Ang Thong	———	-Lop Buri -Sara Buri	———	-Ayutthaya	———	———	———	-Ayutthaya -Lop Buri
Role	———		———		———		———		———	-Historical and cultural important resources -Important tourist site
1.Water supply in the UCR	2		1		2		1		1	
2.Water supply in the Brit	2		1		2		1		1	
3.Flood retarding function	1		———		2		———		———	
4.Ground water recharge	2		———		2		———		1	
5.Stability of flow	1		1		2		2		3	
6.Preservation of agricultural environment	2		2		2		2		———	
7.Prevention of erosion	———		2		———		3		3	
Environmental impact	1		1		2		2		3	———
1.Water pollution	1		1		2		1		———	
2.Excess use of ground water	2		———		2		1		———	
3.Water resource depletion	———		2		———		2		3	
4.Soil erosion	———		1		———		3		3	
5.Destruction of forest	———		———		———		———		3	
Target	*Maintain the present water quality*		*Control appropriate land use*		*Prohibit any water pollution*		*Protect soil erosion*		*preserve forest*	*Conserve historical and archeological environment*
Land Use Management	-Control industrial estate (prohibit river side estate) -Restrict ground water use		-Manage appropriate land use for agriculture, industry, urban center		-Restrict industrial estates (restrict the estate on the flood retarding zone) -Restrict ground water use		-Prohibit excess use of sloped land		-Prohibit destruction of forest	-Conserve Ayutthaya and Lop Buri historical and archeological resources zone
Strategy — Agriculture	-Intensive rice cultivation	-Suburban agriculture	-Environmentally sound agriculture (recycling agriculture)		-Intensive rice cultivation	-Suburban agriculture	-Agro-forestry (only tree crop and terrenial crop)	-control	-prohibit	-control
Strategy — Industry	-Less or non pollution industry Handicraft industry Light-processing industry		-Agro-processing industry (recycling industry)		-Prohibit	-Non-pollution industry (handicraft industry)	-prohibit	-control	-prohibit	-restrict
Strategy — Urban and human settlement	-control (priority of sewage treatment facility)		-control (priority of sewage treatment facility)		-control (priority of sewage treatment facility)		-restrict		-prohibit	-restrict

NOTES: Indicate usual or possible magnitude of significant effects:
(3) = major, (2) = intermediate, (1) = significant.

Another important measure is mobilizing of local human resources to promote locally initiated activities. Teacher's colleges, provincial chambers of commerce, and similar local organizations should be fully involved in this purpose.

At the same time, this kind of policy is necessary to be linked closely with the social and rural development. Establishment of Local Environmental Center attached to the existing community library at each Amphoe center is recommended as a part of environmental administration.

3.4 Institutional Arrangement

It is a basic recognition that the key to success in keeping the Chao Phraya Rier Basin environmentally sound rests upon joint actions among the government, the private sectors, and the local communities.

The government will play the usual roles as policy and planning body. But emphais will be shifted from purely regulatory to more catalytic, supporting, and promoting roles. On the other hand, private sectors will play a partnership role with government agencies especially in terms of financial investment for construction, operation, and maintenance of facilities which will be implemented on a self-supportive basis, having various supports from the government in a form of tax incentives and privileges. Local governments and local communities will play more active roles through building trust among all parties.

In order to create a basis on which a well-coordinated system among the three parties works, some institutional arrangement is proposed to be explored. The approaches are various in this context, however, this study focuses especially on the following three:

1) Mobilizing resources, especially financial, from private sectors.

2) Strengthening capabilities of local governments and local communities in terms of man-power and know-how.

3) Establishing a body with the responsibility to coordinate policies and implementation plans of various sectors involved at an initial stage and at central and local levels.

For each aspect above, the following specific arguments are proposed:

(1) Polluter-Pay-Principle

The concept of polluter-pay-principle is basically recommended to be employed in line with a policy of mobilizing resources from private sectors. The major objective of this principle is to raise funds to compensate the costs for administrative services for environmental management, restoring the environmental damages and promoting research and development for maintaining environmental resources.

This principle is controversial, but the concept would be widely accepted that the costs for eliminating externalities accruing form economic activities must be compensated by those who are enjoying benefits through economic activities. In this sense, polluters are not different from beneficiaries, although its implications for the institutional structure would be greatly different. Advocating the beneficiaries-pay-principle, since the government itself is a great beneficiary from the economic growth, its financial contribution must be emphasized.

In line with a private participation policy, this concept, either one, has been applied in industrialized countries in various forms such as "Effluent Charge System", "Environment Tax System", "Tax-Surcharge System (on fuel oil, etc,)" and so on. In practice, for application of, for instance, "Effluent Charge System" to Thailand, the following difficulties are anticipated:

- difficulties in collecting the charges from small-scale industries, thereby being likely to result in a failure of the policy, and

- difficulties in building an appropriate (or justifiable from social welfare point of view) rate system acceptable by all sectors.

This principle should be recommended but needs further arguments and in-depth studies aiming at creation of social justice concerning environmental protection.

(2) Strengthening Local Government Capabilities

As mentioned in the preceding section, strengthening local government's capabilities is a key in forming a well-functioning environmental administration system. Adequate, practical and quick local solutions are indispensable. For this end, the following measures are recommended to be undertaken on long-term perspectives:

a) To establish provincial and municipal environment management offices, technically supported by the Regional Office of the NEB which has been planned.

b) To make clear the governor's and mayor's roles and powers in the environmental administration, noting their substantial importance in practice.

c) To train personnels of local authorities so as to be capable to administer the environmental policies, and increase the number of those personnels with creating/utilizing various opportunities such as:

- arrangement of in-service training, workshops, observation tours and so on,
- provision of fellowships for further education,
- dispatching to the Environmental Research and Training Center (ERTC) which is scheduled to be operated soon by ONEB.

d) To strengthen financial capabilities for environmental administration through privatization, specific government guaranteed loans, and modification of tax structure.

(3) A Public Body for Chao Phraya River Basin Management

The Chao Phraya River Basin has been the center of history, culture and economy in the kingdom, and a life-line of Thailand. Based on this recognition, the environmental management in the whole basin on long-term (more then one century) perspectives is necessary. For this end, a public body, which will be fully responsible for coordinations between planning and implementing agencies regarding the environment and development in this basin, may be organized in the long run, involving all agencies concerned such as: ONEB, NESDB, Ministry of Finance, Ministry of Interior, Ministry of Industry, Ministry of Agriculture and Cooperatives, Ministry of Health, relevant state enterprises such as PWWA and EGAT, and relevant local authorities.

The main roles of this body are:

- to perform inter-governmental policy coordination;
- to integrate information, data and expertise regarding environment and development in the whole basin;
- to implement environmental education and public relations; and
- to provide guidelines and consultation for development and private participation.

In the short run, the Chao Phraya River Environment Policy Committee proposed in the preceding section shall function as a significant part of the aforementioned body.

In the long run, the institutional arrangement would be necessary in such a way that the public body will be able to play the full roles. For this end, two alternative approaches are conceivable: an "authority" with a legislative power or a center

with an administrative function. Either one has both merits and demerits in terms of its effectiveness and usefulness. Further discussions are necessary to determine the approach appropriate for the Thai administrative system.

APPENDIX 1. LIST OF STUDY REPORTS AND PAPERS

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1. REPORTS

Design for the Study

Inception Report

Inception Report: Amendment

Progress Report

Interim Report
- Executive Summary
- Master Plan Report
- Technical Reports
  - Vol. 1 Spatial Framework for Development
  - Vol. 2 Environmental Management
  - Vol. 3 Land Use and Agricultural Development
  - Vol. 4 Industrial Development
  - Vol. 5 Distribution
  - Vol. 6 Water Resources Management
  - Vol. 7 Transportation
  - Vol. 8 Economic Environment
  - Vol. 9 Local Government Finance
  - Vol. 10 Energy
  - Vol. 11 Landsat Analysis

Draft Final Report
- Executive Summary
- Master Plan Report
- Sector Reports
  - Vol. 1 Spatial Framework and Network for Development
  - Vol. 2 Urban Management
  - Vol. 3 Environmental Management
  - Vol. 4 Water Resource Management, Agricultural Development and Land Use Management
  - Vol. 5 Industrial Development
  - Vol. 6 Distribution and Marketing
  - Vol. 7 Energy
  - Vol. 8 Social Development in Rural Economies
  - Vol. 9 International and National Economic Environment
  - Vol. 10 Human Resource Development
  - Vol. 11 Landsat Analysis

Final Report
- Executive Summary
- Master Plan Report
- Sector Reports
  - Vol. 1 Spatial Framework and Network for Development
  - Vol. 2 Urban Management
  - Vol. 3 Environmental Management

Vol. 4	Water Resource Management, Agricultural Development and Land Use Management
Vol. 5	Industrial Development
Vol. 6	Distribution and Marketing
Vol. 7	Energy
Vol. 8	Social Development in Rural Economies
Vol. 9	International and National Economic Environment
Vol. 10	Human Resource Development
Vol. 11	Landsat Analysis

2. PAPERS

Papers for Seminar, Sara Buri, November 2-3, 1989

1. Development Framework, Strategies, and Production
2. Urban, Land Use and Infrastructure Development
3. Critical Issues for Development Management

Papers for Seminar, Pattaya, July 28-29, 1990

1. Agriculture and Water Resources: Policies and Programs
2. Industry and Energy: Policies and Programs
3. Urbanization and Infrastructure Facilities: Policies and Programs
4. Development Administration and Environmental Management: Policies and Programs

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CUSRI: Chulalong Korn University Social Research Institute
ECFA: Engineering Consulting Firm Association
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