

## CASE STUDY

# Application of integrated environmental management through the preparation of an environmental action programme: Case study from the Songkhla Lake Basin in southern Thailand

**Pakawan Chufamane<sup>1</sup> and Jens Lønholdt<sup>2\*</sup>**

<sup>1</sup>Chief of Water Resources, Mineral and Energy Section, Office of Environmental Policy and Planning, Ministry of Science, Technology and Environment, 60/1 Soi Pibunwattana 7, Rama 6 Road, Bangkok 10400, Thailand and <sup>2</sup>Project Director NIRAS A/S and External Associated Professor at the Technical University of Denmark, NIRAS A/S, 2 Sortemosevej, DK-3450, Allerød, Denmark

### Abstract

The concepts and principles for integrated environmental management (IEM), which is based on a strategic and participatory approach to environmental and regional planning, has been successfully applied to a large lake system in the southern region of Thailand. The application was achieved through the Danish Cooperation for Environment and Development funded project 'Environmental Management in the Songkhla Lake Basin' (EmSong Project) in the Office of Environmental Policy and Planning within the Ministry of Science, Technology and Environment. Through the application of the methods and tools for IEM, including the use of a participatory and strategic planning approach, and the establishment of a comprehensive database and an integrated surface water model for the lake system, an environmental action programme (EAP) has been developed. This action programme, which is based on a broad consensus at the local and regional level, includes vision and mission statements, resource objectives and strategies for management from an economically and ecologically important lake system in Thailand. The operational part of the EAP is a project catalogue, which contains immediately needed projects described to an international pre-feasibility level. The former is the tangible output of the EmSong Project. A more intangible output from the EmSong Project is committed and informed local and regional government and community-based organizations.

### Key words

**integrated environmental management, lake models, lake systems, participatory approaches.**

---

### INTRODUCTION

The Environmental Management in the Songkhla Lake Basin (EmSong) Project was a cooperation project between the Royal Danish Government and the Royal Thai Government from October 1996 to April 1999. The Project was executed in cooperation between the Danish Cooperation for Environment and Development (DANCED) and the Ministry of Science, Technology and Environment

(MOSTE). The EmSong Project was implemented by the Office of Environmental Policy and Planning (OEPP) within MOSTE supported by the Danish research and development company, VKI Institute for the Water Environment, which, as of 1 January 2000, became known as the DHI Institute for Water and Environment. The main aim of the Project was to develop a strategic environmental and development planning framework for the largest lake system in Thailand, which covers three southern provinces.

The Songkhla Lake Basin (SLB) is situated in the southern part of Thailand close to the border of Malaysia (Figs 1,2). The SLB has a total area of 8000 km<sup>2</sup> and a population of 1.5 million, 75% of which reside in rural

---

\*Corresponding author.

Email: jlt@niras.dk

Accepted for publication 23 January 2001.

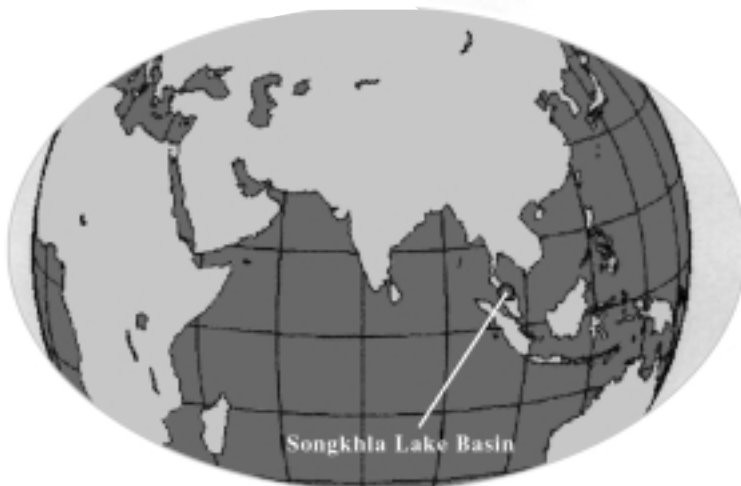


Fig. 1. Map of Thailand with the Songkhla Lake Basin.

areas. Eighty-eight percent of the SLB is land area, and the remaining comprises four interconnected lakes: Thale Noi, Thale Luang, Thale Sap and Thale Sap Songkhla. The last connects the lake system to the Gulf of Thailand. This con-

nection gives the lake system seasonal changes in salinity. The salinity ranges greatly. Thale Noi, the northern-most lake, is always fresh, while Thale Luang is usually fresh all year. Thale Sap can be fresh or brackish depending

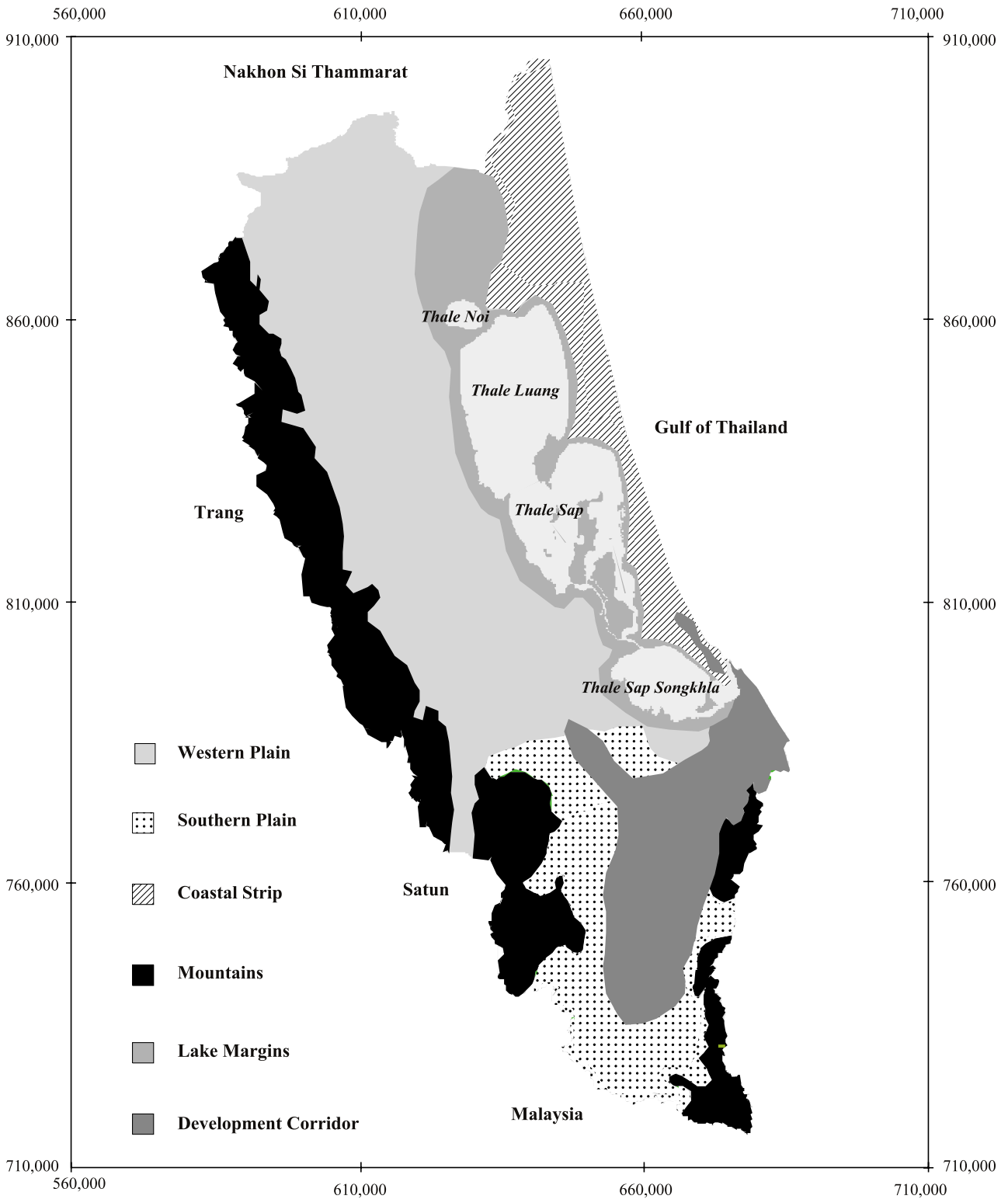


Fig. 2. Analysing and planning zones for the Songkhla Lake Basin.

on the season, and Thale Sap Songkhla can be either brackish or salty.

For a number of years, the lake system, which supports extensive fisheries and which contains a rich bird life and a rare fresh water dolphin population, has been under pressure. A number of plans have been prepared in order to manage this as it is a very important lake both for economic and for ecological reasons. The most comprehensive planning effort was carried out in the mid-1980s when an in-depth Master Plan was prepared. However, the Master Plan was never implemented as it was quickly rendered obsolete.

The major reasons for non-implementation were the limited flexibility of the Master Plan to accommodate changes in the assumptions, and the method of preparation of the Master Plan as a 'stand-alone consultancy plan' with very limited ownership in the Thai system. Consequently, when the Master Plan needed revision as a result of the rapid development in shrimp farming, neither the commitment nor the capacity to revise the Master Plan was available in the Thai system, and the Master Plan was therefore shelved.

In line with the planning history for the Songkhla Lake Basin, it has been increasingly recognized worldwide that master plans are more often shelved than implemented. Because of this, the Danish research and development institute, VKI Institute for the Water Environment, has developed an integrated environmental management (IEM) approach, which has been applied successfully to the SLB through the EmSong Project.

The main outcome of the EmSong Project, which was completed in April 1999, was the environmental action programme (EAP) for the SLB.

The EAP was approved by the SLB Development Committee (SLBDC) at its 9th Meeting on 8 October 1999. The SLBDC, which is a cross-provincial, cross-agency and cross-national, regional- and local-level basin-wide committee, approved the EAP as the strategic framework for environmental planning and management in the SLB. Furthermore, the SLBDC approved that the EAP should be forwarded to the Cabinet for final and formal approval through the National Environmental Board (NEB).

The EAP is given in three volumes. Volume One, titled *Strategies and Implementation*, contains a description of the comprehensive planning process leading up to the EAP, the scope, content and implementation of the EAP. Volume Two, titled *Project Catalogue*, contains a selection of projects that address the necessary strategic actions presented in Volume One. Projects have been selected that are immediately required in order to substantially move the development in the SLB towards sustainability, and more specifically, attain the objectives presented in Volume One. Volume Three, titled

*Background and Justification*, contains a more elaborated and detailed description of the background, rationale and justification for the EAP as presented in Volume One.

In accordance with the IEM approach that has been used as the main executing strategy for the EmSong Project, the EAP has been extensively discussed by the stakeholders in the SLB.

Important and main milestones in this interactive and participatory planning process were the: (i) Inception Workshop, 7–8 March 1997, in Hat Yai where the background and scope of the project was presented in order to stimulate active participation in project implementation; (ii) EAP Scoping Workshop, 15–16 October 1998, in Songkhla where the preliminary draft EAP was presented and discussed; (iii) comprehensive environmental assessment and identification of key environmental issues prepared by the EmSong Project Working Group (EPWG) and published in 'The Analysis of SLB natural resources and environmental status': the said report, which is prepared in Thai with an English summary, is rather unique in a Thai context as it presents the joint agreement about the state and the problems of the natural resources and the environment of the SLB, addressing relevant governmental line agencies, and national, regional, and non-governmental organizations (NGOs); (iv) results from an extensive public participation programme conducted from December 1998 to April 1999; (v) results from frequent, both scheduled and unscheduled, meetings and interactions between the Project Office, Environmental Office Region 12 and Office of Environmental Policy and Planning; (vi) results from frequent, both scheduled and unscheduled, meetings and interactions between the Project Office and the project environment including regional and local government offices, the Prince of Songkla University and different stakeholders and local NGOs; (vii) concluding EAP workshop, 1–2 April 1999, in Songkhla where the draft EAP was presented and discussed; (viii) national seminar, 28 April 1999, in Hat Yai where the draft final action programme was presented and discussed with a national audience; and (ix) completion workshops, 12–14 and 21–22 July 1999, where the 25 immediately needed projects were assessed and prioritized.

As background for the preparation of the EAP, 35 technical background reports were prepared covering different technical, institutional and public awareness issues.

The EmSong Project, including the EAP, the 35 technical background reports and the IEM tools developed through the Project, has also been provided in an interactive CD-ROM. A number of important decision-support tools were developed through the EmSong Project, used in connection with the preparation of the EAP, and are now available for the further integrated planning process for the basin. These

tools include an integrated surface water model for the SLB (ISWM) and the SLB integrated information system (SLBIIS). The ISWM is a comprehensive basin-wide model that addresses the run-off and load from the catchment area, and the quality of the lake system. It comprises a hydrology and hydraulic module and an eutrophication module. The SLBIIS is a computer-based information system that includes all data and information compiled, in addition to all decision-support tools developed through the Project. The SLBIIS interlinks the Office of Environmental Policy and Planning in Bangkok, the Department of Environmental Quality Promotion in Bangkok, Environmental Office Region 12 in Songkhla, and Prince of Songkla University in Hat Yai, which constitute a local resource centre for environmental management in the southern part of Thailand.

The CD-ROM, which is available on request from the Office of Environmental Policy and Planning within the Thai Ministry of Science, Technology and Environment, includes an English as well as a Thai 'click' for the Project.

## METHODS

It is an established fact that development is unpredictable, and that environment and development are so interrelated that traditional master planning based on rigid projections and sector considerations are quickly rendered obsolete. This calls for an integrated planning approach to environmental management that is more flexible towards the inevitable changes in the fundamental assumptions than is traditional master planning.

The IEM approach is an ongoing interactive strategic process that deals with environmental and development issues in an integrated manner, and is thus an important planning tool in ensuring sustainable development. The starting point for IEM is through three in-depth and comprehensive strategic analyses: (i) development analysis: the existing situation is described for relevant development issues, trends based on the monitoring results of key development indicators are assessed, and possible development scenarios are evaluated; (ii) environmental analysis: the current situation is described in relation to relevant environmental and ecological conditions, development trends, based on the monitoring results of key environmental indicators, are assessed, and the quality and the cause-effect relationships of the ecosystems are evaluated and the trends in ecosystem development assessed for different development scenarios; and (iii) affordability analysis: options for financing development and their inherent environmental protection activities are analysed.

These three analyses are the core of the process. Development policies and strategies are formulated by

weighing development benefits against economic and environmental costs. Based on this, environmental objectives and strategies can be formulated.

The initial part of the environmental management process is the formulation of strategies, which will achieve the environmental objectives. These strategies comprise two distinct groups: (i) strategies that can control and influence the establishment of activities with potential environmental effects through proper environmental planning; and (ii) strategies for introduction and implementation of interventions, which will ensure that the impact from potentially environmental adverse activities are in accordance with the established environmental objectives.

Interventions include legal and regulatory interventions, organizational interventions, economic incentive interventions, awareness interventions, and environmental technology interventions.

An important part of IEM is to monitor the environmental quality (environmental monitoring) as well as changes in the assumptions behind the strategy (development monitoring). Based on the results of this monitoring, the environmental strategies and interventions may be revised. Monitoring continues and provides feedback to the ongoing interactive strategic process of IEM. The main elements in and the flow of activities in IEM are shown in Fig. 3.

## RESULTS

The EmSong Project has been planned and implemented in accordance with the concepts and principles for IEM as outlined previously. In line with this, the EmSong Project has focused on two major areas of technology transfer and capacity development: (i) interactive and objective orientated strategic process, where the state of the exploitation of the natural resources and the impact on the ecological systems are assessed, and background objectives and implementation strategies are formulated; and (ii) decision support tools, which were introduced, developed and applied, and that constitute one of the most important support functions in the above strategic process.

Furthermore, the EmSong Approach was premised on the basic principles shown in Fig. 4. The Project should 'boost' the integrated strategic planning process for the area and, at the same time, ensure the sustainability of the planning process after project completion. It should include the further application of IEM as an ongoing interactive strategic planning process, and the use of the developed decision-support tools such as the ISWM and the SLBIIS.

Through the IEM process, entailing extensive cross-agency coordination and public participation, widespread consensus has been reached in the SLB concerning the goals for the desired state and management of the natural

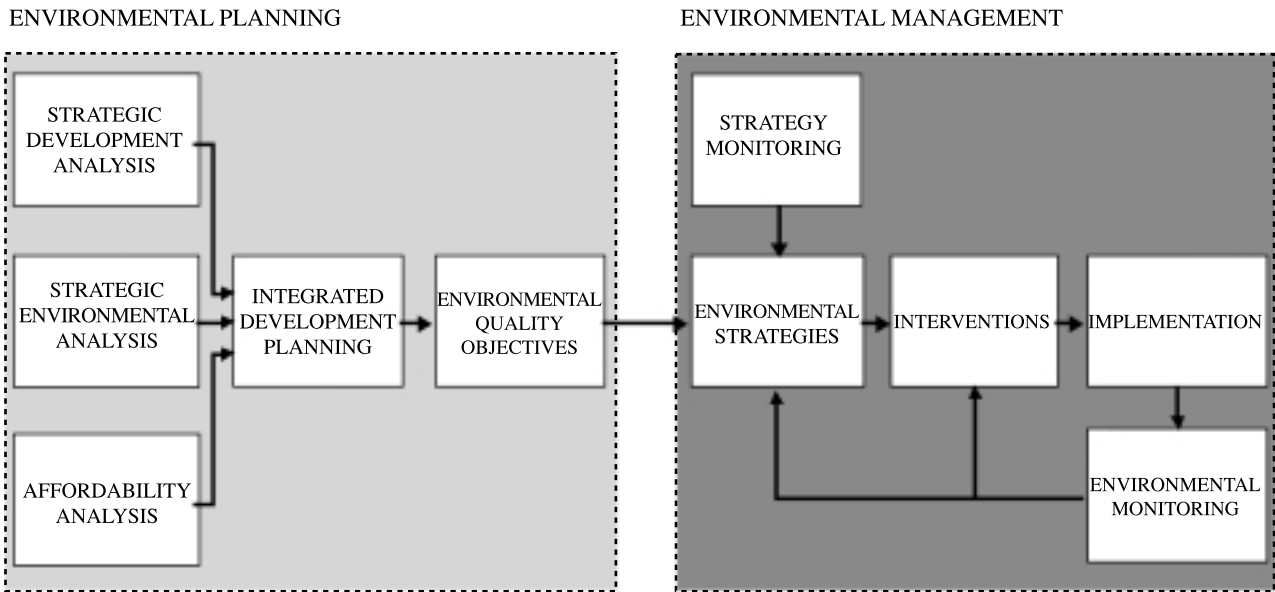


Fig. 3. Integrated environmental management: An ongoing interactive strategic process.

resources and ecosystems, key issues that need to be addressed in order to attain these goals, strategies that need to be applied in order to address the key issues, immediately needed projects that need to be implemented, and the institutional structure required to manage the above.

An overview of the IEM approach applied to the EmSong Project is given in Fig. 5, and comprises the following elements and activities.

1. The integrated and participatory strategic environmental and development planning process was conducted through the EmSong working environment. It involved the OEPP, Environmental Office Region 12 (EOR 12), the EPWG, the EmSong Project Team (comprising permanent Thai staff as well as expatriate and local consultants), and the public participation activities (workshops and forum meetings, and unscheduled activities). The public participation activities involved NGOs and community-based organizations as well as the general population.

2. The knowledge and findings of the EmSong working environment was structured in relevant sectors and issues, and reported in 35 technical background reports. These reports constituted the main technical background for the further planning process and, as shown in Fig. 5, they feed into every stage of the planning process.

3. Based on the processing in the EmSong working environment of the 35 technical background reports, an environmental diagnosis was prepared, goals were discussed and articulated, and potentials and constraints for the environmental development in the SLB were identified.

4. The end result of the above process was the agreement about and the formulation of the vision for the SLB.

5. This vision was then detailed into a time-bound mission statement for the implementation of EAP for the SLB, which constituted the main outcome of the EmSong Project.

6. The mission statement was then further detailed and quantified into objectives for the four main resource

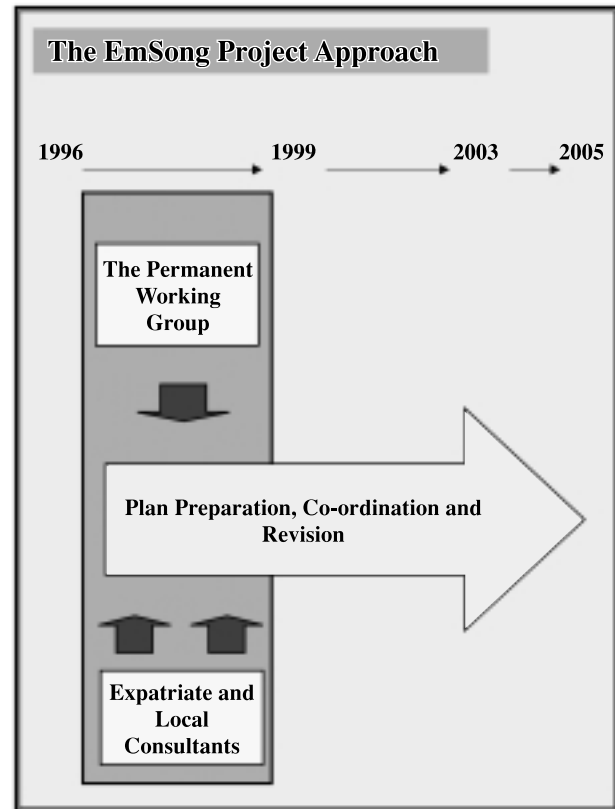


Fig. 4. EmSong Project approach.

systems, and for application of IEM, which is envisaged as the main carrier of the environmental planning and management process in the SLB.

7. By applying the 35 technical background reports through ‘eight guiding principles’, and based on the five resource objectives, 22 key issues were identified for environmental development for the SLB.

8. The 22 key issues were grouped into nine strategic thrusts that needed to be applied in order to address the vision, achieve the mission statement and meet the resource objectives.

9. The nine strategic thrusts were then detailed into 32 specific strategic actions that required implementation.

10. Based on this, and again by using the comprehensive EmSong working environment, 25 immediately needed projects were identified and prioritized that addressed the strategic actions that need to be implemented as soon as pos-

sible. These projects have been described to an international pre-feasibility level.

**Goals**

The main background for the proposed vision for the SLB involves the current emphasis on decentralization of government responsibilities, access to information and public participation as emphasized in the New Constitution of Thailand, the increasing environmental stresses occurring in the SLB and the uniqueness of the natural resources and the ecosystems of the SLB.

**Vision for the SLB**

Sustainable development is ensured for the Songkhla Lake Basin covering natural resources sustainability, and protection of important ecosystems, as well as socio-economic sustainability. Local capacity is developed to

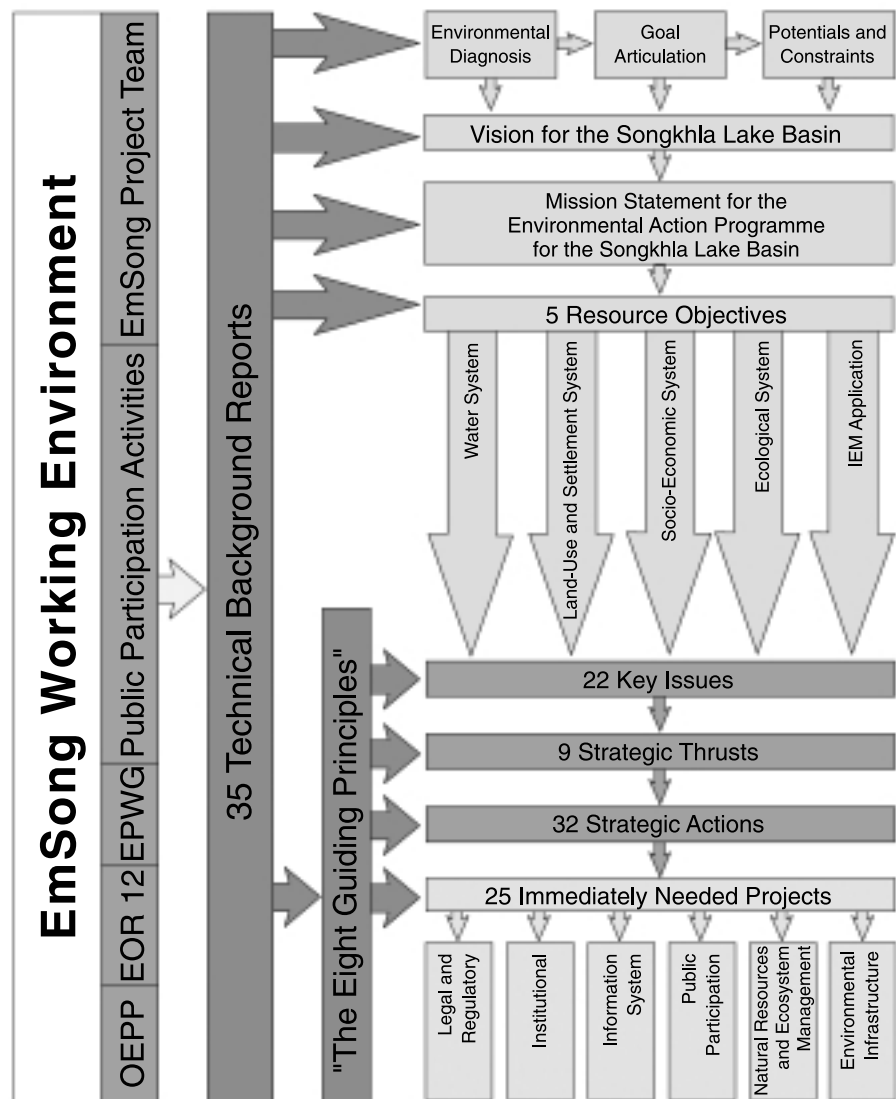


Fig. 5. Integrated environmental management approach applied to the EmSong Project.

be the main guardians of the sustainability based on the concepts and principles of integrated environmental management

Based on this, the following time-bound mission statement for the EAP for the SLB was formulated:

By year 2010, integrated environmental management is fully applied in all relevant central, regional and local government agencies, and in the private sector. Further, a significant part of the immediately needed projects has been implemented. Consequently, the overexploitation of the natural resources and the adverse impact on the ecosystems of the Songkhla Lake Basin have been significantly reduced

Based on the vision and the mission statement for the SLB, the following time-bound objectives were formulated for the four resource systems and for the application of IEM: (i) water system: *'Sustainable exploitation through i. a. exploitation of 25% of the available ground water resources, and 15% reduction in the irrigation amount'*; (ii) land-use and settlement system: *'Appropriate land-use management through i. a. no further encroachment into mangrove areas and reactivation of 25% of the idle arable land'*; (iii) socio-economic system: *'Increased resilience through i. a. 15% increase in crop diversification, and 15% increase in mixed farming'*; (iv) ecological system: *'Protection of important and threatened species through a stable and viable population of Irrawaddy dolphins, and stable ecosystems'*; and (v) IEM application: *'The concepts, principles, methods and tools for IEM have been introduced and fully applied in: Office of Environmental Policy and Planning, Pollution Control Department, Department of Environmental Quality Promotion, Royal Irrigation Department, Department of Fisheries, Land Development Department and Royal Forestry Department'*.

### Key issues

The key issues that need to be addressed comprise the following within the four resource systems and IEM capacity as the basic tool for ensuring sustainable development.

1. Water system issues: (i) significant load of nutrients and organic matter to upper lakes; (ii) several rivers and Phru Khuan Kreng Wetland are heavily polluted; (iii) contamination of several groundwater reservoirs; (iv) water shortages during the dry season; (v) serious hydrological changes as a result of surface water extraction; and (vi) the shallowing of Thale Noi and river mouths in the upper lakes.
2. Land use and settlement system: (i) the large number of abandoned and derelict shrimp farms; (ii) increasing incidence of idle arable land; (iii) incompatible and inap-

propriate land use; and (iv) difficulties in siting large environmental facilities.

3. Socioeconomic system: (i) declining productivity of crops and shrimp farms; (ii) fish catches reported to be decreasing; (iii) risk of economic instability; and (iv) shortage of farm labour.
4. Ecological system: (i) wetlands are under severe threat; (ii) Irrawaddy dolphins are facing the threat of extinction; and (iii) significant changes in the hydrological system.
5. IEM capacity: (i) inadequate data collection and management; (ii) lack of strategic planning and policy formulation; (iii) lack of coordinated programming and project identification; (iv) poor record of effective plan implementation; and (v) weak enforcement of regulations.

### Strategic thrusts and strategic actions

For addressing the above 22 key issues, nine strategic thrusts with 32 strategic actions have been identified within the three areas of IEM capacity, natural resource management and ecosystem management.

#### IEM capacity

1. Strategic thrust 1. Further increase the capacity for IEM.
2. Strategic thrust 2. Further develop the information system: (i) strategic action 2.1: establish monitoring systems; (ii) strategic action 2.2: establish data management system; and (iii) strategic action 2.3: establish ecological modelling centre at Prince of Songkhla University.
3. Strategic thrust 3. Further increase public participation: (i) strategic action 3.1: establish centre for participatory methods at Prince of Songkhla University.

#### Natural resources management

4. Strategic thrust 4. Improve waste management: (i) strategic action 4.1: improve urban waste water management; (ii) strategic action 4.2: improve industrial waste water management; (iii) strategic action 4.3: improve rural waste water management; (iv) strategic action 4.4: establish waste treatment and research centre; and (v) strategic action 4.5: develop emergency response system.
5. Strategic thrust 5. Improve water resources management: (i) strategic action 5.1: strengthen hydrological assessment capacity; (ii) strategic action 5.2: increase use of groundwater; (iii) strategic action 5.3: introduce water conserving irrigation technologies; and (iv) strategic action 5.4: phase in water pricing.
6. Strategic thrust 6. Improve industrial pollution management: (i) strategic action 6.1: restrict siting of new



- agri-processing industries; (ii) strategic action 6.2: promote rural rubber processing cooperatives; and (iii) strategic action 6.3: contain shrimp farming expansion.
- 7. Strategic thrust 7. Improve protection of critical natural resources: (i) strategic action 7.1: protect natural vegetation along Upper Khlongs; (ii) strategic action 7.2: preserve primary fish nursery sites; (iii) strategic action 7.3: research sludge disposal options; (iv) strategic action 7.4: reclaim land contaminated by shrimp farming; (v) strategic action 7.5: resolve contested land claims; (vi) strategic action 7.6: establish lakeshore development guidelines; and (vii) strategic action 7.7: facilitate agricultural land lease.
- 8. Strategic thrust 8. Ensure sustainable livelihoods: (i) strategic action 8.1: ensure sustainable fish catches; (ii) strategic action 8.2: promote crop diversification and erosion control; (iii) strategic action 8.3: promote mixed farming; (iv) strategic action 8.4: promote sustainable shrimp farming; and (v) strategic action 8.5: strengthen ecotourism development.

**Ecosystem management**

- 9. Strategic thrust 9. Ensure biodiversity of the ecosystems: (i) strategic action 9.1: introduce buffer zone management around protected area margins; (ii) strategic action 9.2: monitor Irrawaddy dolphin population; (iii) strategic action 9.3: protect prime tourism and recreational site; and (iv) strategic action 9.4: take final decision concerning the salt water barrier.

**Immediately needed projects**

The following 25 immediately needed projects have been identified based on a number of selection criteria covering environment issues as well as socioeconomic issues and other important issues as public and political support.

1. Legal and regulatory framework for the EAP and IEM.
2. System for waste water tariffs.
3. Ecological modelling centre.
4. Centre for participatory methods.
5. Waste and research centre.
6. IEM capacity development programme.
7. Lakeshore development guidelines.
8. SLB integrated information system.
9. Comprehensive monitoring programming.
10. Project promotion and public participation.
11. Crop diversification and erosion control on upper soils.
12. Integrated rice farming, horticulture and aquaculture.
13. Reclamation of land contaminated by shrimp farming.
14. Buffer zone management around protected area margins.
15. Ecotourism development: Khu Khut and Thale Sap Islands

16. Introducing sustainable fisheries management.
17. Exploitation of deep groundwater reservoirs.
18. Irrigation demand management.
19. Rural water supply.
20. Waste water management Phatthalung municipality.
21. Waste water management Sadao municipality.
22. Waste water management Ban Phru municipality.
23. Village sanitation Thale Noi.
24. Infectious waste management.
25. Industrial waste water management.

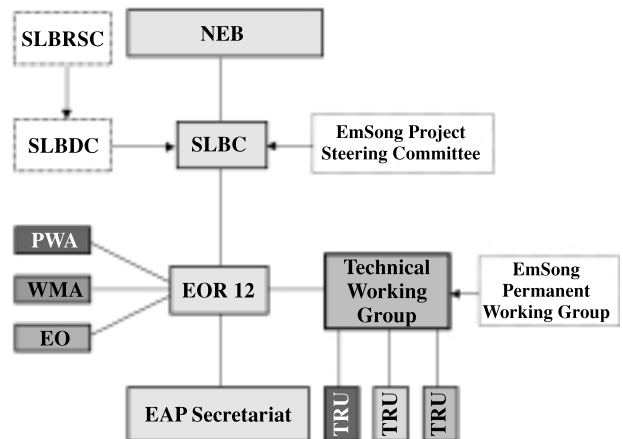
**Institutional structure for implementation**

It is proposed that policy formulation and overall coordination in relation to the implementation of the EAP should be the responsibility of a new Committee, the SLB Committee (SLBC). It is proposed as a merger of three existing committees: the SLB Development Committee, the SLB Rehabilitation Subcommittee and the Project Steering Committee for the EmSong Project. The SLBC should report to the Cabinet through the National Environmental Board (NEB). The institutional structure proposed is given in Fig. 6.

It is further proposed that the day-to-day coordination of the implementation of the EAP should be the responsibility of EOR 12 in Songkhla supported by an EAP Secretariat connected to EOR 12.

Cross-agency coordination is ensured through the establishment of a technical working group, as an outgrowth of the EPWG, supported by technical resource units in relation to water resources management, fisheries management and land-use management.

Institutional strengthening needs to be instigated, particularly for EOR 12 in order to enable it to shoulder these new responsibilities and tasks. Specific execution and implementation of responsibilities should be allocated to relevant line agencies.



**Fig. 6.** Institutional structure for implementation of the environmental action programme.

### Financing of the implementation

The affordability analysis has shown that the population affected by the 25 immediately needed projects is likely to be able to afford water and waste water fees. However, the financing and cost recovery assessment showed that with the existing designs, none of the specific environmental infrastructure projects will be able to fully recover investments within a 20-year period with a 10% internal rate of return. Increasing the proportion of grant money and lower interest rates will alter this assessment. However, for the rural water supply projects, even a 50% grant and a loan at a 7% interest rate are not enough to make the project affordable for the consumers.

In summary, all of the projects will require national resources and grants in combination with loans, preferably soft loans (i.e. loans with a low interest rate and often also a certain grace period). However, there should be significant

room for cost-cutting by carefully optimizing the design of the environmental infrastructure systems considered. This should be thoroughly examined through the preliminary design in feasibility studies, and the following detailed design. An overview of the costs, and the proposed financing of the 25 immediately needed projects are given in Table 1.

### Implementation of the EAP

It is proposed that the EAP be approved by the Cabinet as a Joint Changwat Action Plan in accordance with Section 40 of the Enhancement and Conservation of National Environmental Quality Act. The EAP should represent the overall environmental planning and management framework for the SLB, and thus govern all environmental related planning and management for SLB. An overview of the proposed distribution of the 25 immediately needed projects

**Table 1.** Overall financing plan for the immediately needed projects

Projects	Total cost US\$ Million	Cost recovery	National funding	International funding
Legal and regulatory	0.21	Not applicable	MOJ and MOSTE	DANCED
Waste water tariffs	0.50	Not applicable	MOJ and MOSTE	DANCED
Ecological modelling centre	0.54	Not applicable	MOU and MOSTE	DANCED
Centre for participatory methods	0.36	Not applicable	MOU and MOSTE	DANCED
Waste and research centre	3.50	Not applicable	MOSTE	DANCED
IEM capacity development	0.45	Not applicable	MOSTE	DANCED
Lakeshore development guidelines	0.18	Not applicable	MOAC	DANCED
SLB integrated information system	0.14	Not applicable	MOSTE	DANCED
Monitoring programming	1.00	Not applicable	MOSTE	DANCED
Promotion and participation	0.35	Not applicable	NEF	DANCED
Crop diversification and erosion control	0.22	Not applicable	MOAC	ADB
Integrated rice farming	0.55	Not applicable	MOAC	ADB
Reclamation of land	0.17	Not applicable	MOSTE and MOAC	DANCED/ADB
Buffer zone management	0.96	Not applicable	MOSTE and MOAC	DANCED/ADB
Ecotourism development	0.30	Not applicable	TAT	–
Sustainable fisheries management	0.54	Not applicable	MOAC	DANCED
Deep groundwater exploitation	18.00	Yes	MOI	OECF
Irrigation demand management	1.50	Not applicable	MOAC	OECF
Rural water supply	6.30	Yes	MOI	OECF
Waste water Phatthalung	15.00	Yes	NEF	OECF
Waste water Sadao	7.50	Yes	NEF	OECF
Waste water Ban Phru	7.20	Yes	NEF	OECF
Village sanitation Thale Noi	Thai Funding	Thai Funding	Thai Funding	Thai Funding
Infectious waste management	8.40	Yes	MOPH	DANCED
Industrial waste water management	0.65	Not applicable	Mol	DANCED

MOJ: Ministry of Justice; MOSTE: Ministry of Science, Technology and Environment; DANCED: Danish Co-operation for Environment and Development; MOU: Ministry of Universities; MOAC: Ministry of Agriculture and Co-operatives; NEF: National Environmental Fund; ADB: Asian Development Bank; TAT: Tourism Authority of Thailand; MOI: Ministry of Interior; OECF: Overseas Economic Co-operation Fund of Japan; MOPH: Ministry of Public Health; Mol: Ministry of Industries.

on coordinating, executing and implementing organizations is shown in Table 2.

It should cover national, regional and local government agencies, and the private sector. An overall implementation plan has been prepared covering the establishment of the implementation framework including the above approval, the scheduling of the implementation of the immediately needed projects, and the scheduling of the following review and revision of the EAP.

### Review and revision of the EAP

In accordance with the concepts and principles for IEM, the EAP is designed as a rolling programme.

At the end of each planning year, the EAP should be extended by a year, and the strategic actions, priorities and projects should be reassessed. If necessary, they should be revised or changed to take into account changing internal and external environmental and socioeconomic conditions.

It is envisaged that the first comprehensive revision of the EAP should be conducted in 2003 based on the envisaged history of two years of implementation in 2001 and 2002.

An array of indicators has been developed covering the monitoring of the environmental and socioeconomic effects of the EAP implementation, in addition to the possible changes in the development context. An assessment of these indicator values should be the technical background for the above annual revisions.

**Table 2.** Distribution of coordinating, executing and implementation responsibility for the immediately needed projects

Projects	Coordinating	Executing	Implementing
Legal and regulatory framework	EOR 12 with EAP Secretariat	MOJ	MOSTE, OEPP
Waste water tariffs	EOR 12 with EAP Secretariat	MOI	MOSTE, OEPP
Ecological modelling centre	EOR 12 with EAP Secretariat	MOU	PSU, EOR12
Centre for Participatory methods	EOR 12 with EAP Secretariat	MOU	PSU, EOR12
Waste and research centre	EOR 12 with EAP Secretariat	MOSTE/MOU	PSU, PCD
IEM capacity development	EOR 12 with EAP Secretariat	MOSTE	OEPP
Lakeshore development guidelines	EOR 12 with EAP Secretariat	MOAC	LDD
SLB integrated information system	EOR 12 with EAP Secretariat	MOSTE	DEQP
Monitoring programming	EOR 12 with EAP Secretariat	MOSTE	OEPP
Project promotion and participation	EOR 12 with EAP Secretariat	MOSTE	DEQP
Crop diversification and erosion control	EOR 12 with EAP Secretariat	MOAC	EO
Integrated rice farming	EOR 12 with EAP Secretariat	MOAC	EO
Reclamation of land contaminated	EOR 12 with EAP Secretariat	MOAC	LDD
Buffer zone management	EOR 12 with EAP Secretariat	MOAC	RFD
Ecotourism development	EOR 12 with EAP Secretariat	MOI	TAT
Sustainable fisheries management	EOR 12 with EAP Secretariat	MOAC	DOF
Deep groundwater exploitation	EOR 12 with EAP Secretariat	MOI/MOSTE	OEPP, DMR
Irrigation demand management	EOR 12 with EAP Secretariat	MOAC/MOSTE	OEPP, RID
Rural water supply	EOR 12 with EAP Secretariat	MOI/MOPH	TAO, DOPH
Waste water Phatthalung	EOR 12 with EAP Secretariat	MOI	Municipality, WMA
Waste water Sadao	EOR 12 with EAP Secretariat	MOI	Municipality, WMA
Waste water Ban Phru	EOR 12 with EAP Secretariat	MOI	Municipality, WMA
Village sanitation Thale Noi	EOR 12 with EAP Secretariat	MOSTE	TAO
Infectious waste management	EOR 12 with EAP Secretariat	MOI	Municipalities
Industrial waste water management	EOR 12 with EAP Secretariat	Mol	DIW

EOR 12, Environmental Office Region 12, MOSTE; MOJ, Ministry of Justice; MOPH, Ministry of Public Health; MOU, Ministry of Universities; MOSTE, Ministry of Science, Technology and Environment; MOAC, Ministry of Agriculture and Cooperatives; MOI, Ministry of Interior; Mol, Ministry of Industries; OEPP, Office of Environmental Policy and Planning, MOSTE; PSU, Prince of Songkla University; PCD, Pollution Control Department, MOSTE; LDD, Land Development Department, MOAC; DEQP, Department of Environmental Quality Promotion, MOSTE; EO, Extension Offices, MOAC; RFD, Royal Forestry Department, MOAC; TAT, Tourism Authority of Thailand; DOF, Department of Fisheries, MOAC; DMR, Department of Mineral Resources, Mol; RID, Royal Irrigation Department, MOAC; TAO, Tambon Administrative Organisation; DOPH, Department of Public Health, MOPH; WMA, Wastewater Management Authority; DIW, Department of Industrial Works, Mol.

## APPENDIX 1

The environmental action programme (EAP) is reported in three volumes and is available in both English and Thai.

Volume One: Strategies and Implementation

Volume Two: Project Catalogue

Volume Three: Background and Justification

The technical background for the EAP is reported in 35 background technical reports.

1. Evaluation of the recommendations of the 1985 NESDB Songkhla Lake Basin Planning Study 1997.
2. Preliminary status and assessment for the Songkhla Lake Basin. May 1997.
3. Implications for the future economic and environmental situation: Assessment of plans and parameters pertaining to the Songkhla Lake Basin. July 1997.
4. Data collection and field survey for the hydrological and water quality data in the Songkhla Lake. September 1997.
5. Integration of the environmental action programme in the existing planning system and public participation requirements. October 1997.
6. EmSong integrated information system. December 1997.
7. Guidelines and training in integrated environmental management. February 1999. (Also available in Thai.)
8. Updated cost–benefit analysis for the salt water barrier. January 1998.
9. Environmental diagnosis for the Songkhla Lake Basin. March 1998.
10. Environmental public awareness and participation for the Songkhla Lake Basin. May 1998. (Also available in Thai.)
11. Towards the institutional set-up for the implementation of the environmental action programme. February 1999.
12. Study tour I to Denmark: 19–25 October 1997. January 1998.
13. Integrated surface water model for the Songkhla Lake Basin. July 1998. (Includes a presentation on CD-ROM.)
14. Demonstration projects for sustainable development in the Songkhla Lake Basin. March 1998. (Also available in Thai.)
15. Preliminary draft environmental action programme. October 1998. (Also available in Thai.)
16. Songkhla Lake Basin integrated information system. April 1999.
17. Executive summary of the salt water barrier assessments. March 1999. (Also available in Thai.)
18. Water resources management for the Songkhla Lake Basin. February 1999. (Also available in Thai.)
19. Assessment of the environmental effects of salt water intrusion in Thale Luang and in Thale Noi. October 1998.
20. Study tour II to Denmark: 23 May to 4 June 1998. January 1999.
21. Environmental and socioeconomic profile and strategic indicators for the Songkhla Lake Basin. September 1998.
22. Project promotion for the Songkhla Lake Basin. September 1998.
23. Water resources management data. November 1998.
24. Data for the Pak Rawa assessment. September 1998.
25. Integrated surface water model for the Songkhla Lake Basin training programme September–November 1998. December 1998.
26. Environmental infrastructure in the Songkhla Lake Basin (Volumes 1, 2). January 1999. (Also available in Thai.)
27. Field trip programme for preparation of the environmental action programme. October 1998.
28. The analysis of Songkhla Lake Basin natural resources and environmental status. January 1999. (Only available in Thai with and English summary.)
29. Proceedings from the environmental action programme scoping workshop 15–16 October 1998 at Haad Kaew Resort. November 1998. (Also available in Thai.)
30. Preliminary draft project catalogue for the Songkhla Lake Basin. December 1998.
31. Towards sustainable fisheries management for the Songkhla Lake Basin. April 1999.
32. Financing framework for the environmental action programme for the Songkhla Lake Basin. April 1999.
33. Public participation in the Songkhla Lake Basin within the framework of the EmSong Project. April 1999. (Only available in Thai with English summary.)
34. Strategic indicators for the environmental action programme for the Songkhla Lake Basin. April 1999.
35. Project management training appraisal. April 1999.