Sub-basin vision, goals and objectives

Given the issues and problems related to natural resources, environment, livelihoods and health that were identified in the Mae Kuang sub-basin, the next step under the project was to facilitate identification and articulation of what people hope to achieve by developing and implementing action plans for managing natural resources and environment in the sub-basin. The implementation consultants assisted the Mae Kuang Working Group in developing an initial overall vision statement, along with overall goals and objectives for the sub-basin.

During the review and modification process facilitated by local sub-basin networks, a considerable amount of debate emerged about the directions for sub-basin management of natural resources and environment. Much of this debate related to the different views that have developed in different areas of the Mae Kuang and Mae Tha watersheds, which have been combined into the Mae Kuang sub-basin. The simplest description would be that people in the upper portions of watersheds are concerned mainly about conservation, while people in middle parts of watersheds place emphasis on resource use and competition, and people in lower watershed areas focus largely on the negative impacts of upstream behavior.

Various groups, organizations and networks have been working in each of these areas, and most have already developed various visions and plans. Some of these groups are quite strong and have support from various government agencies and other powerful interests. Thus, it was a fairly difficult process to seek a synthesis that has a sufficient balance among the views of different stakeholder groups.

The compromise that finally emerged from this process used the vision, goals and objectives developed by the Mae Kuang Working Group, but with several key modifications and additions. The results are shown in Figure 3-39.

Figure 3-39. Mae Kuang: Sub-basin vision, goal & objectives

Vision: Restored local knowledge; Mae Kuang sub-basin has abundant water; Soil, water and forest deterioration disappears; Increased economic value; Support for all communities
Goal: To conserve and restore natural resources and improve environmental quality in the Ping watershed in order to provide good livelihoods and sanitation for the people
Objectives: 1. To provide the Mae Kuang sub-basin with rich & productive natural resources & environment, especially water resources that are the main basic resource in the local reservoir named by H.M. the King as Udom Thara 2. To care for and restore soil, water, and forest resources, which are natural resources that are important for livelihoods of the people in the Mae Kuang watershed, and to build capacity, knowledge, strength and participation of people in the watershed 3. People in the watershed are able to have balanced livelihoods, have strong community economies, and are able to have basic household incomes that are in balance with nature 4. People in the watershed have good quality of life, livelihoods, and physical health, and communities in the watershed have strength to better themselves by helping each other

Action Plan for the Mae Kuang Sub-basin

Initial project efforts to develop a sub-basin action plan for management of natural resources and the environment were facilitated by the implementation consultants. This process began with collecting many hundreds of proposed projects already identified by local organizations, along with some new projects that were identified through their "PRA"-type techniques or through members of the Mae Kuang Working Group.

The implementation consultants then classified and grouped individual projects according to how they fit with the general overall strategy structure they were proposing for all action plans. Measures for each strategy were then developed to reflect the types of projects considered by the Mae Kuang Working Group to be important under each strategy.

During the review and modification process facilitated by local sub-basin networks, there was again much debate among the various groups in the sub-basin. In addition to the different types of activities emphasized by different groups, several of the groups had also developed their own plans under activities supported by different government agencies. Since different agencies use different types of forms and planning models, it was again a quite difficult process to try to merge and synthesize plans from different areas of the sub-basin.

Finally, another compromise emerged based on fairly minor modification and rearrangement of the action plan structure developed by the Mae Kuang Working Group and implementation consultants. The resulting strategies and measures contained in the action plan are listed in Figure 3-40. Final project reporting documents from the sub-basin also include a revised list of names and locations for a total of 111 projects and groups of projects proposed for implementation under the 14 measures contained in the action plan.

Figure 3-40. Mae Kuang Sub-basin Action Plan: Strategies & component measures

Strategy 1. Management of natural resources and environment through participation of the people	
1.1	Control and enforcement of regulations and laws related to pollution prevention
1.2	Restore existing local organizations to have knowledge and capacity
1.3	Build people's participation in management of natural resources and the environment
1.4	Establish holistic natural resources management organizations in the watershed
Strategy 2. Conserve and restore natural resources to be fertile and productive	
2.1	Care for and look after natural resources and the environment to be fertile and productive
2.2	Strictly enforce use of laws and local codes and punish violators destroying forest resources
2.3	Develop potential and build networks to guard natural resources & the environment
2.4	Promote conservation-based tourism, and preservation of livelihoods, traditions, culture and local knowledge
Strategy 3. Build economic strength of communities to increase basic household & community incomes	
3.1	Promote employment and local occupations by supporting occupational knowledge and methods appropriate for local potential
3.2	Campaign for people to recognize savings so they can control and reduce unimportant household expenses
3.3	Build opportunities for people and community entrepreneurs to access occupational finance sources
Strategy 4. Good quality of life, health and livelihoods	
4.1	Training and providing knowledge related to community hygiene
4.2	Improve community environmental conditions to be pleasant
4.3	Promote, campaign and public relations on sanitation for better quality of life, health and livelihoods

Other strategy components for a long-term sub-basin management plan

As leaders in the Mae Kuang sub-basin move toward further improvement and development of a full-scale long-term river sub-basin plan, they should consider needs for further work on other strategies associated with a full-scale long-term sub-basin management plan, as follows:

- Monitoring and information strategy. Based on the descriptive names of projects listed under each measure of the action plan, there a considerable number of activities are being proposed that would expand local monitoring of natural resources and the environment, and that would both generate and use various types of information. Most of these appear to be directed toward specific issues or particular groups or organizations in the sub-basin.

Monitoring and information needs at the sub-basin level will need to be further identified and developed as part of the process to develop the sub-basin management organization discussed in the next section. Once the sub-basin management organization is established and its roles and duties become clear, it would be useful to begin identifying the full range of monitoring and information needs of the sub-basin. The next step would then be to develop an overall monitoring and information strategy to meet the full range of needs in the sub-basin in the most systematic and efficient manner possible.

- Partnership and capacity building strategy. The current situation regarding this strategy is similar to the monitoring and information strategy. There appears to be many projects that aim to build awareness and capacity among organizations, groups and people in the sub-basin. And many projects are being proposed by groups or organizations that already have or want to develop strong linkages with government agencies or other outside institutions, organizations, groups or networks. Furthermore, it appears that building of network linkages and partnerships among organizations and groups within the sub-basin will be a very important concern of the long-term sub-basin management organization. Thus, it would also be useful for the new sub-basin management organization to develop an overall partnership and capacity building strategy aimed at meeting the full range of needs in the sub-basin in the most systematic and efficient manner possible.

- Funding strategy. The current uncertainties surrounding funding support for activities of the sub-basin management organization and for projects and activities contained in the sub-basin action plan are still too great for sub-basin leaders to be able to identify a potential structure for an overall sub-basin funding strategy. Discussions have already begun, however, regarding alternative funding sources that may have potential for providing support for different types of projects and activities under the action plan. It is already clear that local governments (TAO, *tessaban*, PAO), province administrations, and various relevant central government agencies are seen as important partners and sources of support for particular types of activities.

  One of the most important current questions is whether or not the relevant central government agencies will be willing and able to provide basic core support for operation and development of the sub-basin organization itself. Once the source of this type of support can be identified, it will become more feasible to explore additional potential sources of support, and to make more progress toward developing an overall sub-basin funding strategy.

River Sub-basin Management Organization (RSBO) for the Mae Kuang sub-basin

The sub-basin Working Group's initial effort toward identification of an appropriate structure for a long-term sub-basin management organization began with a review of existing local organizations in the Mae Kuang sub-basin. Facilitated by implementation consultants, the initial review focused on the types of organizations shown in Figure 3-41. In the case of the Mae Kuang sub-basin, most types of organizations identified were established through efforts by government agencies, with each agency supporting its own local organization.

Working groups then conducted a SWOT analysis of these existing organizations, with assistance from implementation consultants, and the results are summarized in Figure 3-42.

After reviewing SWOT analyses from all pilot sub-basins, and developing their overall framework for a uniform type of RSBO structure, project implementation consultants proposed an initial structure for a long-term RSBO for the Mae Kuang sub-basin. Its characteristics are summarized in Figure 3-43. Leadership positions are all assigned to government officials

according to positions that they occupy, and members are to be selected according to organizational sector and zones within the sub-basin.

Figure 3-41. Initial review of existing local organizations: Mae Kuang

	Existing organization	*Established by*	*Remarks*
Restoration of natural resources & environment			
1	Joint sub-committee for restoration of natural resources and environment, Mae Kuang - Mae Tha	Dept. Nat. Parks	*established 2005*
2	Urban environmental network conservation organization		*no supporting budget*
3	Group against garbage	local people	
Plant forest, community regulations, forest care & maintenance			
4	Forest conservation and forest fire protection group	Dept. Nat. Parks	*no supporting budget*
Care for, conserve, rehabilitate, improve & maintain soil			
5	Soil doctor group	Land Development Dept	*no supporting budget*
Safe agriculture			
6	Composting group (biological fertilizer) and chemical safe home garden produce	Dept. Agricultural Extension	*no supporting budget*
Provide clean water			
7	Village water supply group (consumption & domestic use)		
Water management			
8	Mae Kuang Tara Dam irrigation water user organization	Irrigation Dept.	*strong*
9	Muang fai weir irrigation groups	local people	*strong*
10	Mae Kuang and Mae Tha sub-basin working group (Upper Ping basin management sub-committee)	Dept Water Resources	*no supporting budget until DWP got funds for 2006-07*

Figure 3-42. Initial organization SWOT analysis: Mae Kuang

Strengths	
1	customs, traditions and culture of people in the area related to conservation or natural resources are strong, and they support working together and dependence on each other
2	local governments - especially TAO - are ready to provide support for conducting management work
3	have clear organization management systems
4	people have real participation in conducting activities / conservation
Weaknesses	
1	insufficient water resources for consumption, domestic use, agriculture and industry
2	lack of implementation budgets
3	lack of coordination among development organizations in the area
4	no legal basis for organization implementation work
5	Local governments in some areas do not give importance to resource development
Opportunities for group development	
1	state policies, work plans, & projects that provide full support for natural resource conservation
2	state provides support for people's participation in managing natural resources and environment
Limitations	
1	related agency units do not provide real and continuous support so that results can meet goals
2	outside investors encroach on forests and use land inappropriately
3	duplication in implementation work of agency units
4	frequent changes in administrators and political policies of supporting organizations result in lack of implementation continuity
5	lack of benefits among members, among groups of individual outsiders, some stakeholders provide little collaboration

Results of this process generated much discussion and analysis during the subsequent review and modification process facilitated by local sub-basin networks.

One key issue raised by local network reviewers was the very limited range of types of existing local organizations considered during this process. Types of relevant organizations used in their local analysis include:

- Old existing community organizations related to ways of life, culture and religion
- Groups and organizations established by the government
- Groups emerging in response to problem situations related to forest, land, water, *etc*.
- Groups of local government organizations / administration groups
- Groups of businesses such as industrial estates or resorts
- Technical specialist groups and private development organizations (NGO).
- Groups of central or provincial government organizations or their local working units

Figure 3-43. Initial RSBO structure proposed by implementation consultants: Mae Kuang

Chairman	
Head, Coordination office for Upper Ping NRE restoration	1
Vice Chairmen	
Representative, Office of NRE, Chiang Mai Province	1
Representative, peoples sector	1
Secretary	
Head, sub-basin coordination working group, Coordination office for Upper Ping NRE restoration	1
Assistant Secretary	
Head, environment working group, Office of NRE, Lamphun Province	1
Members	
Local government (TAO, tessaban, PAO) – Mae Kuang (upper)	2
Local government (TAO, tessaban, PAO) – Mae Kuang (middle)	2
Local government (TAO, tessaban, PAO) – Mae Kuang (lower)	2
Local government (TAO, tessaban, PAO) – Mae Tha (upper)	2
Local government (TAO, tessaban, PAO) – Mae Tha (lower)	2
Government agency – irrigation	1
Government agency – water resources	1
Government agency – Royal Development Study Center,HHK	1
Conservation organization – soil	1
Conservation organization – water	1
Conservation organization – forest	1
Conservation organization - environment	1
Youth representative	2
Women's group representative	2
Religious leader	1
Education institution representative / resource person	1
Peoples sector – Chiang Mai Province	8
Peoples sector – Lamphun Province	7
Non-government organizations / Local specialists	2
Entrepreneur – services sector	1
Entrepreneur – industry sector	1
Total membership:	47

This wider range of types of existing local organizations is seen as the source of existing components that can provide the foundation for the RSBO. With this approach, the roles and duties of the RSBO, as shown in Figure 3-44, would focus on activities that would complement those of these other existing organizations, which would function in a partnership role.

Figure 3-44. Mae Kuang RSBO: Roles & duties

1.	Administer projects and budgets
2.	Coordination & joint implementation with the coordinating office for restoration of natural resources & the environment
3.	Monitor & evaluate implementation of activities and projects
4.	Consider roles & improve action plans for management of natural resources & the environment in the sub-basin that are not efficient and relevant to the real state of local areas
5.	Disseminate & publicize work plans & projects
6.	Consider certification of the status of local network organizations
7.	Negotiate and mediate conflicts related to management and uses of resources

There have also been major revisions to the membership structure of the RSBO, as shown in Figure 3-45. Leaders would all be elected locally, while membership would focus on representing an appropriate range of stakeholder networks and organizations.

A Selection Committee is required to establish the RSBO. It is to be composed of honorable individuals who have relationships with local management of natural resource and the environment. They will conduct processes to select individuals to participate in the organizational structure, also known as the Watershed Committee. In order to conduct this process, the selection committee must be appointed and roles must be specified.

Figure 3-45. Mae Kuang RSBO: Membership

Chairpersons & secretaries	
Elected locally	
Sub-committees	
Linkages with local sub-watershed committees	
Membership composition:	
Old existing community organizations	6
Community forestry networks	3
Stream conservation network	3
Farmers networks	3
Ethnic minority groups	3
Housewives groups, Women's development groups	3
Local government (TAO, *tessaban*, PAO)	6
Kamnan / village headmen	6
Government officials, agency local units	4
Local specialists	4
Non-governmental organizations (NGO)	2
Private investor / entrepreneur groups	2
Total membership:	45

Experience under this project appears to have helped local leaders appreciate the need for a real locally-led management organization at the sub-basin level, which is not dominated by one or a few particular factions in the sub-basin, or by links with one particular agency. The main missing roles that need to be conducted at the sub-basin level center on activities such as coordination, support, information, negotiation, monitoring and evaluation. These are exactly the types of functions that need to be present in order to avoid the types of difficulties that arose during implementation of this project.

3.3.3. Ping part 5 (Lower Ping) sub-basin

Sub-basin Context

Located at the southern end of the Ping River Basin in Kamphaengphet and Nakhon Sawan provinces, the Ping part 5 sub-basin is the final sub-basin through which the Ping River flows before joining other major tributaries in Nakhon Sawan to form the main channel of the Chao Phraya River. Thus, it is also known as the "lower Ping" sub-basin. Under this project, the Ping part 5 sub-basin represents the group of lower sub-basins located below the Bhumiphol

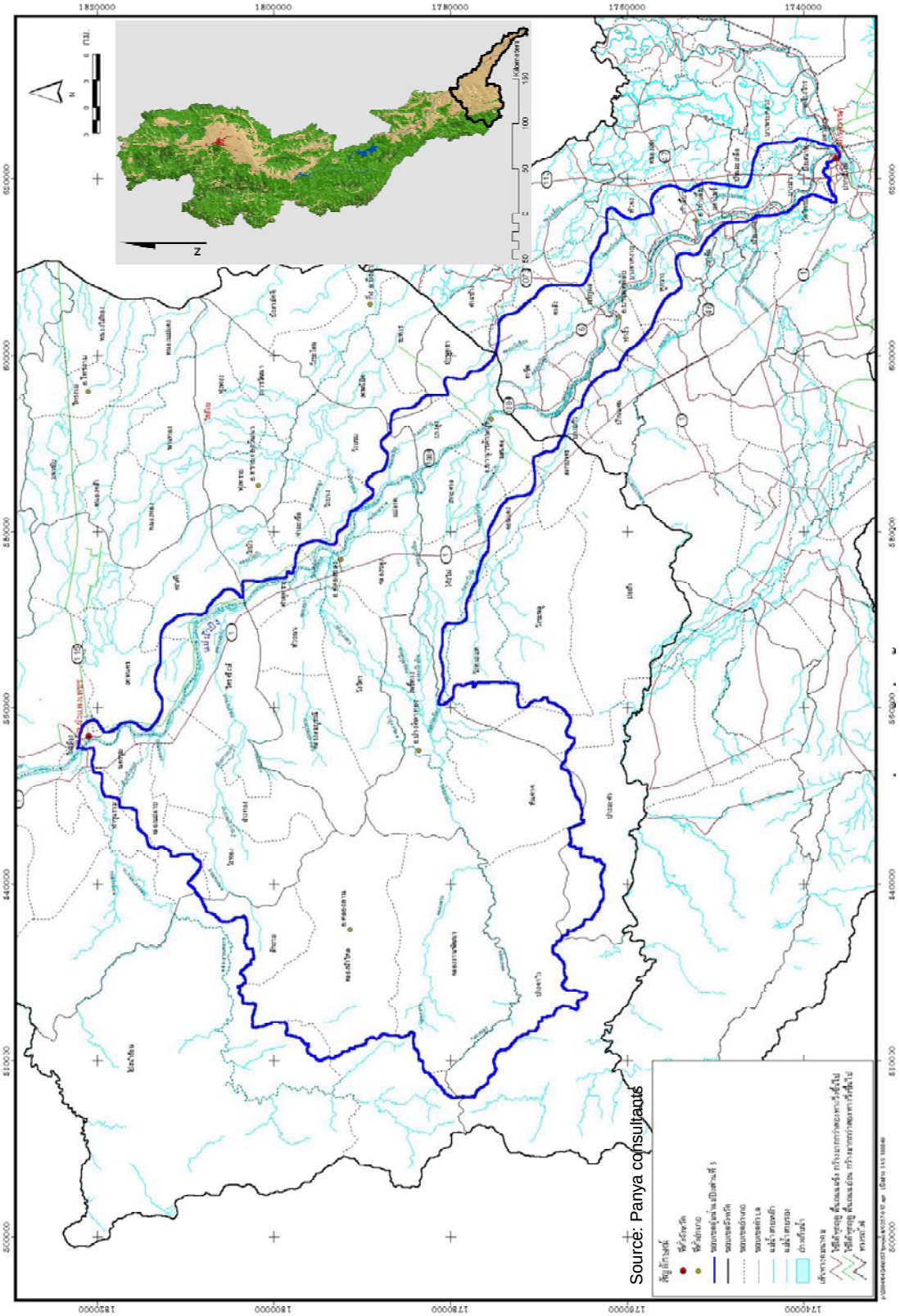
Figure 3-46. Sub-basin data table: Ping part 5

Sub-basin total area		*kilometer²*	**2,980**
Altitude zones			
	< 600 masl	*% land area*	95
	600 - 1,000 masl	*% land area*	5
	> 1,000 masl	*% land area*	1
Watershed classification			
1A	*protected forest*	*% land area*	8
1B	*protected forest*	*% land area*	0
2	*restricted uses*	*% land area*	3
3	*limited uses*	*% land area*	3
4	*conservation measures*	*% land area*	2
5	*unrestricted*	*% land area*	84
Climate			
- average temperature		*degree C*	**27.4**
	hottest month	*degree C*	*37*
	coolest month	*degree C*	*18*
- total average rainfall		*mm*	**1,054**
	rainy season	*mm*	*942*
	dry season	*mm*	*113*
- total average runoff		*million m³*	**645**
	rainy season	*million m³*	*519*
	dry season	*million m³*	*125*
Water storage		*million m³*	**5**
- large scale		*number*	-
	capacity	*million m³*	-
	service area	*% land area*	-
- medium scale		*number*	-
	capacity	*million m³*	-
	service area	*% land area*	-
- small scale		*number*	*8*
	capacity	*million m³*	***5***
	service area	*% land area*	0.6
Water requirements		*million m³*	**1,897**
- irrigation		*million m³*	***1,562***
	large-scale	*million m³*	*834*
		% land area	30
	medium / small / pumping	*million m³*	*378*
		% land area	15
	people's local irrigation	*million m³*	*350*
		% land area	14
- consumption & domestic		*million m³*	***18***
	municipalities	*million m³*	*8*
	rural	*million m³*	*10*
- industry & tourism		*million m³*	***1***
- ecological balance		*million m³*	***315***

Population			
- total population		*persons*	**378,141**
	municipalities	*percent*	*39*
	rural	*percent*	*61*
- overall population density		*pers/sq km*	***127***
Administrative units			
	municipalities	*number*	11
	tambons	*number*	58
	districts	*number*	8
	provinces	*number*	2
State forestlands			
- national park		*number*	*2*
	declared area	*% land area*	***11***
- wildlife sanctuary		*number*	-
	declared area	*% land area*	-
- reserved forest		*number*	*6*
	declared area	*% land area*	***38***
Total state forestlands		*% land area*	**49**
Land outside state forestlands		*% land area*	51
Land use			
- forest cover		*% land area*	**14**
- not under forest cover		*% land area*	86
- suitabile for agriculture		*% land area*	65
	suitable for rice	*% land area*	*45*
	suitable for field/tree crops	*% land area*	*20*
- agriculture		*% land area*	**79**
- settlements		*% land area*	**5**
- water & other		*% land area*	**2**
Municipality pollution			
	municipalities	*number*	*11*
	population	*persons*	*146,697*
- total wastewater		*million m³/yr*	**8.5**
- biochemical oxygen demand - BOD		*tons / year*	**851**
- garbage		*tons / year*	**53,483**
Agriculture pollution			
- pesticide use	*rice*	*tons / year*	0.3
	field crops	*tons / year*	4.8
	fruit trees / horticulture	*tons / year*	3.2
- nitrogen use	*rice*	*tons / year*	1,348
	field crops	*tons / year*	5,143
	fruit trees / horticulture	*tons / year*	433
- phosphorus use	*rice*	*tons / year*	314
	field crops	*tons / year*	909
	fruit trees / horticulture	*tons / year*	65
- estimated BOD	*rice*	*tons / year*	1,254
	field crops	*tons / year*	14,353
	fruit trees / horticulture	*tons / year*	78

Reservoir. Basic data on physical, demographic, administrative, and land and water resource characteristics of the sub-basin are shown in Figure 3-46, and the spatial configuration of the sub-basin is shown in Figure 3-47. It includes large areas of irrigated lowland paddy, and extensive gently sloping areas that were declared reserved forest land, but only a few mountainous areas declared protected forest. Economic development has brought intensive commercial production to paddy areas and urban centers near the Ping River. It has also attracted settlement of reserved forest lands by communities that include migrants from Isan and some ethnic minorities, producing sugarcane, cassava, oranges, other crops and livestock.

Figure 3-47. Sub-basin map: Ping part 5 (lower Ping)



This sub-basin has much stronger economic and social linkages with the adjacent Central Plains region, and is well integrated into a broad range of government agencies and systems at multiple levels. Thus, most all local organizations related to management of natural resources and the environment are linked closely with government agencies and their working styles, and especially with those related to irrigation and water resources. This has been reflected in the manner in which they have participated in project activities.

Project implementation leadership in the Ping part 5 Sub-basin

The structure and composition of the initial project working group that provided leadership for project implementation in the Ping part 5 sub-basin is shown in Figure 3-48. The project implementation consultant team facilitated work by the Ping part 5 working group. This included providing information both from their rapid initial surveys in the sub-basin and from secondary sources, as well as organizing and analyzing data for the working group. They also helped prepare meeting agendas and documents, and provided various specialists to assist with particular topics as appropriate. Members of ONEP staff also attended major Working Group meetings.

Figure 3-48. Working Group: Ping part 5

Chairman	
Heads, Province NRE offices (KPP, NSW)	2
Secretary	
Province ONEP officer	1
Members	
Province governments	2
Province irrigation offices	2
Province NRE office - water working group	2
Project Consultant	1
Local officials	1
Lower Ping Committee	1
Local organization supported by DWR	1
Local specialists	2
Peoples representatives	4
Peoples organizations	2
NGO	1
Business representative	2
TOTAL	24

The subsequent process to review and modify sub-basin plans and proposed organizational arrangements was led by well-known people working in the sub-basin who are actively involved with networks and organizations related to management of natural resources and the environment. Deliberations of major meetings and forums conducted under this process are documented. There was much more continuity between these two stages of project implementation in the Ping part 5 sub-basin than in the two pilot sub-basins located in the Upper Ping basin.

Remaining parts of this section discuss the results of these processes in terms of the progress made toward completing the requirements of phases 1 and 2 of the process for developing sub-basin management organizations summarized in section 3.2., and developing the basic components of a draft long-term sub-basin management plan.

Identification of sub-basin problems

The first basic component of a long-term sub-basin management plan is clear statement of the problems to be addressed by a sub-basin organization and its planning process.

Problem assessments facilitated by project implementation consultants used secondary information, previous planning information, and “PRA”-type techniques, resulting in identification of a range of important problems. Much of the initial assessment was able to build on earlier planning processes supported by the Department of Water Resources, so that it could focus largely on topics such as livelihoods, public health and some types of pollution, which were not part of the previous planning processes. The subsequent local review and revision process facilitated by local networks in the Ping part 5 sub-basin continued to maintain the basic structure

of this problem identification approach, and only made a few modifications in how problems are described. The resulting list of issue topics and problems identified in the Ping part 5 sub-basin is shown in Figure 3-49.

Figure 3-49. Issues & problem situations: Ping part 5

Important issues	*Problem*
1. Forest resources	
	1. High levels of forest resource usage without allowing for restoration
	2. Encroachment and forest destruction in watershed forest areas
	3. Policies and laws related to natural resource use and conservation are not in line with current conditions
	4. Some officials responsible for forest resources lack sincerity in implementing their duties
2. Water resources	
	1. Water shortages; lack of supplemental water sources for dry season; flooding during rainy season
	2. Problems of river bank collapse and accumulation of sediment cause waterways to become more shallow
	3. Encroachment into waterways and riverside areas
	4. Inefficient water resource management by all parties
3. Land resources	
	1. Lack of tenure in farm lands and lands left uncultivated due to rapid purchase & hoarding of land for speculation by investors
	2. Erosion of topsoil from agriculture and flooding; soil acidity from excessive pumping of groundwater
	3. Soil deterioration from accumulation of agricultural chemicals, use of chemicals in orange orchards
	4. Encroachment into lands along water distribution canals
4. Environment	
	1. Problem of deteriorating water quality in surveyed areas of 11 municipalities, resulting from contamination by organic chemicals and household and community sewage, from pig farms in some areas, and from various of the 208 industrial factories
	2. Garbage in municipal areas surveyed is currently at the level of 126 tons/day & steadily increasing; garbage is disposed of in vacant areas not in accordance with sanitary principles, and may be a source of disease impacting the health of the people
	3. Air pollution from vehicles and construction is not severe, but from forest fires and burning of vacant areas causes dust, soot, and smoke that affects air quality
	4. Pollution from agriculture; toxic chemical use is highest in fruit orchards
5. Livelihoods & public health	
	1. Health and sanitation: there is good access to public health services; intestinal and respiratory illness rates are higher than other diseases; illness rates related to water are high, especially diarrhea; chemicals are used in agriculture, but no reports of impacts on illness rates; traffic accidents are quite high
6. Natural resource management	
	1. State polices are not in line with current conditions
	2. Management is not an integrated system, each unit goes its own way
	3. No clear implementation plans
	4. People have no participation in resource management
	5. People in watershed communities lack consciousness in using and caring for natural resources
	6. Communities have no host organization and lack knowledge about management and solving environmental problems

Sub-basin vision, goals and objectives

Based on the issues and problems related to natural resources, environment, livelihoods and health that were identified in the Ping part 5 sub-basin, the project next sought to facilitate identification and articulation of what people hope to achieve by developing and implementing action plans for managing natural resources and environment in the sub-basin. The implementation consultants assisted the Ping part 5 Working Group in developing an initial overall vision statement, along with overall goals and objectives for the sub-basin.

This process again showed strong continuity by building on and expanding analyses conducted under previous planning processes that were more narrowly focused on water resource and watershed management. The review and modification process facilitated by local networks in the

sub-basin again continued to further refine wording in the context of the same overall structure. The results are shown in Figure 3-50.

Figure 3-50. Ping part 5: Sub-basin vision, goals & objectives

Vision:	Forest on the mountains, water in the fields, beautiful environment, sustainable nature
Goals:	
1.	Develop, promote, conserve, and restore natural resources and the environment
2.	Use of natural resources that has value and is appropriate with ways of life
3.	Reduce use of agricultural chemicals
4.	Reduce pollution problems from the environment
Objectives:	
1.	To conserve and restore natural resources and the environment to be rich and sustainable for the people to have good quality of life
2.	Promote people and communities jointly caring for, conserving and restoring natural resources and the environment, in order to build community capacity in managing natural resources and the environment
3.	To provide people and stakeholders from all parts of the community with awareness and consciousness for participating in managing natural resources and the environment
4.	To address community pollution through prevention, solution of problems, and efficient control
5.	Community environments are beautiful and build the quality of life of people in the communities

Action Plan for the Ping part 5 Sub-basin

Initial project efforts to develop a sub-basin action plan for management of natural resources and the environment were facilitated by the implementation consultants. This process began with collecting many hundreds of proposed projects already identified by local organizations, many or most of which were already listed in plans from various sources in the sub-basin, along with some new projects that were identified through their "PRA"-type techniques or through members of the Ping part 5 Working Group. The implementation consultants then classified and grouped individual projects according to how they fit with the general strategy structure they were proposing for all action plans. Measures for each strategy were then developed to reflect the types of projects considered by the Ping part 5 Working Group to be important under each strategy.

During review and modification processes facilitated by local sub-basin networks, discussion focused largely on strengthening the reasoning that links strategies, measures and projects. Three factors appear to have helped make this process much more smooth and continuous than in the other pilot sub-basins:

- Previous organization and planning efforts at the river basin and sub-basin levels had been facilitated by a single government agency (Department of Water Resources), so that the leadership was similar and each new plan clearly built on and refined earlier ones.
- Most all local organizations and networks related to management of natural resources and the environment have been induced by government programs and have close links with specific government agencies.
- The general style of local organization and leadership appears to be very compatible with processes that follow standardized approaches and procedures of government agencies.

Thus, planning processes focused mainly on coordinating local organization and project approaches promoted by various government agencies. Resulting strategies and measures contained in the action plan are listed in Figure 3-51. Final project sub-basin reports include a

revised list of names and locations for a total of 1,498 projects and project groups proposed for implementation under the 4 strategies and 18 measures contained in the action plan.

Figure 3-51. Ping part 5 Sub-basin Action Plan: Strategies & component measures

Strategy 1. Conservation & restoration of natural resources & the environment
1.1 Developing & promoting knowledge on ways to restore natural resources & environment
1.2 Solving problems of water shortage, floods, & encroachment of waterways & riparian areas
1.3 Reforestation
1.4 Reducing agricultural chemical use & using natural materials in soil maintenance
Strategy 2. Management of natural resources and the environment
2.1 Provide knowledge & public relations for managing natural resources & environment, soil, water, air, forest, & wildlife
2.2 Establish networks to watch for threats of river bank collapse in riverside areas
2.3 Build networks to guard against illicit logging, forest destruction and forest fires
2.4 Establishing organizations for unified management of all sub-basin resources
2.5 Participation of the people in making management plans for natural resources & environment in Ping part 5 sub-basin
2.6 Promote & support in occupations appropriate for the potential of communities, natural resources & environment, and occupations that use local knowledge and principles of the sufficient economy philosophy
Strategy 3. Management of environmental pollution for better quality of life, public health & livelihoods of the people
3.1 Training to provide knowledge & understanding related to household hygiene practices, & campaigns & public relations on sanitation, for better quality of live, public health and health
3.2 Improving community environments to be more pleasant by considering community culture and local knowledge in managing natural resources & environment to increase safety and absence of disease
3.3 Manage garbage and wastewater and reduce air pollution
Strategy 4. Build consciousness of environmental stewardship
4.1 Build consciousness of community members to have awareness & participation in conserving & restoring natural resources & environment in their communities
4.2 Training to provide knowledge for youth as extremely important in national development & caring for natural resources & environment in the future
4.3 Environmental conservation campaign using public relations media that is modern, easy to understand & worth following
4.4 Training to provide knowledge & understanding related to use of chemicals in agriculture

Other strategy components for a long-term sub-basin management plan

As leaders in the Ping part 5 sub-basin move toward further improvement and development of a full-scale long-term river sub-basin plan, they may wish to consider further work on:

- Monitoring and information strategy. Based on the descriptive names of projects listed under each measure of the action plan, there are a number of proposed activities that would expand local capacity to monitor natural resources and the environment. Most appear to be directed toward specific issues, groups or organizations in the sub-basin.

  Monitoring and information needs at the sub-basin level will need to be further identified and developed as part of the process of developing a long-term sub-basin management organization. Once the organization is established and its roles and duties become clear, it may be useful to begin identifying the full range of monitoring and information needs. An overall monitoring and information strategy could then be developed to meet the range of needs in the sub-basin in the most systematic and efficient manner possible.

- Partnership and capacity building strategy. There also appears to be many projects aimed at building awareness and capacity of organizations, groups and people in the sub-basin. Many

of the groups or organizations have or will develop linkages with government agencies or other outside institutions. Since it appears that building network links and partnerships among organizations and groups in the sub-basin will be an important concern of the long-term RSBO, it may be useful for it to develop an overall strategy for meeting partnership and capacity building needs in a systematic and efficient manner.

- Funding strategy. Current uncertainties surrounding funding support for activities of the RSBO and for projects and activities contained in the sub-basin action plan are still too great for sub-basin leaders to be able to identify a suitable structure for an overall sub-basin funding strategy. Discussions have begun, however, about various funding sources with potential for providing support for different types of projects and activities under the plan. Local governments (TAO, *tessaban*, PAO), province administrations, and relevant central government agencies are seen as key partners and sources of support for most types of activities.

  One important question is whether relevant central government agencies will be willing and able to provide basic core support for RSBO operations and development. If a source for this type of support can be identified, it will be more feasible to explore additional potential sources of support and an overall sub-basin funding strategy.

River Sub-basin Management Organization (RSBO) for the Ping part 5 sub-basin

Initial efforts by the sub-basin Working Group toward identification of an appropriate structure for a long-term sub-basin management organization began with a review of existing local organizations in the Ping part 5 sub-basin. Facilitated by implementation consultants, this initial review focused on the types of organizations shown in Figure 3-52. In the case of the Ping part 5 sub-basin, most all types of organizations identified were established through efforts by government agencies, with each agency supporting its own local organization.

Figure 3-52. Review of existing local organizations: Ping part 5

Existing organization	*Established by*	*Remarks*
Conserve and restore natural resources and environment		
1 Network of natural resource and environment protection volunteers	Dept. Water Resources	*established 2005, groups just formed, difficult communications and coordination*
Manage natural resources & environment		
2 Networks of village and city natural resource and environment volunteers, Kamphaengphet and Nakhon Sawan Provinces	Dept. Environmental Quality Promotion	*established 2005, no incentives for work, lacks participation by villagers*
Reduce waste		
3 Materials handicraft group (natural materials scraps)		
Conserve forest		
4 Western forest committee network, Kamphaengphet Province	Dept. National Parks	*lacks important materials and equipment*
Manage soil		
5 Soil doctor volunteers	Land Development Dept.	
Agriculture		
6 Biological fertilizer producers group	Dept. Agricultural Extension	
Provide clean water		
7 Village water supply users groups		
Water management		
8 Irrigation water users group network	Irrigation Dept.	*lacks participation by local people*
9 Lower Ping basin water management working groups at province level (Kamphaengphet & Nakhon Sawan) and district level (11 districts)	Dept. Water Resources	*no supporting budget until DWP received funds for 2006-07*

Working groups then conducted a SWOT analysis of these existing organizations, with assistance from implementation consultants, and the results are summarized in Figure 3-53.

Figure 3-53. Organization SWOT analysis: Ping part 5

Strengths
1 have sacrifices in terms of effort and resources
2 people in the area use water frugally
3 have good participation in management
4 have a participatory planning model that is strong and has good participation
5 have a management committee model that is systematic and strong
6 have environmental groups & organizations to provide good support, such as NRE village volunteer networks
Weaknesses
1 some networks lack good coordination and public relations
2 lack budgetary support from various parties
3 members of some water user cooperative groups lack participation in paying water fees
4 lack knowledge in dissemination of correct information to the people
5 formal and informal groups and organizations in the area lack coordination in conducting their work, causing duplication and conflict
Opportunities for group development
1 state policies, work plans, and projects that provide full support for natural resource conservation
2 state provides support for people's participation in managing natural resources and environment
Limitations
1 related agency units do not provide real and continuous support so that results can meet goals
2 duplication in implementation work of agency units
3 frequent changes in administrators and political policies of supporting organizations result in lack of implementation continuity

Based on review of local organizations and local experience with sub-basin planning processes, the initial set of general RSBO roles and duties proposed by the implementation consultants was further modified for the context of the Ping part 5 sub-basin. Results are shown in Figure 3-54.

Figure 3-54. Ping part 5 RSBO: Roles & duties

1. Evaluate sub-basin physical & biological conditions, resource use & quality of life, to provide a framework for government agencies, networks & organizations managing natural resources & environment in the sub-basin, to conduct action planning
2. Monitor & evaluate implementation of activities and projects to manage natural resources & the environment
3. Consider, review & improve action plans for managing natural resources & environment by government agency units, networks, & organizations in the sub-basin, to be efficient & relevant to current conditions & realities in the sub-basin
4. Determine a frame for dissemination & public relations regarding management of natural resources & environment for government agency units, networks & people's organizations to know & understand various implementation methods under action plans to manage natural resources & the environment.
5. Coordinate & implement jointly with the coordinating office for restoration of NRE in the Lower Ping Basin
6. Consider certification of the status of local network organizations for managing natural resources & environment in the sub-basin
7. Promote & develop knowledge regarding mediation of disputes for organizations & networks to gain knowledge & capacity in reconciliation disputes in initial areas, & have duties in coordination & negotiating reconciliation of disputes related to NRE management & use that emerge within the sub-basin

In a similar manner, the initial draft structure for a Ping part 5 RSBO as proposed by project implementation consultants was reaffirmed with only minor modifications during subsequent review and modification processes facilitated by local sub-basin networks.

Basic characteristics of the Ping part 5 RSBO are summarized in Figure 3-55. Leadership positions are assigned to government officials according to positions that they occupy, and

members are to be selected in a manner that can help provide appropriate balance in each of the six major NRE "sector"-oriented network sub-committees of the RSBO.

This structure reflects a great deal of detailed consideration and substantial negotiation among the various stakeholder networks and associated government units and agencies closely linked with them in the Ping part 5 sub-basin operating environment.

Due in large part to the particular historical, demographic, social and economic characteristics of the Ping part 5 sub-basin, the primary local organizational building blocks for an RSBO are networks that have been induced and supported by government units and agencies. Thus, concern about balancing of roles within the context of the overall matrix of multi-level government organizations becomes a much more prominent feature for the Ping part 5 river sub-basin management organization.

Figure 3-55. Ping part 5 RSBO: Membership

Chairman	
Head, Coordination office for Lower Ping NRE restoration	1
Vice Chairmen	
Representative, Office of NRE, Kamphaengphet Province	1
Representative, Office of NRE, Nakhon Sawan Province	1
Secretaries	
Representative, Office of NRE, Kamphaengphet Province	1
Representative, Office of NRE, Nakhon Sawan Province	1
Members	
Water allocation	
Farmer representative – crop production	3
Farmer representative – livestock production	1
Farmer representative – fisheries	1
Water user organizations	2
Local specialists (water allocation)	3
Local government (TAO, tessaban, PAO)	2
Government agency – irrigation offices 3 & 4	2
Water for consumption & domestic use	
Provincial water supply organizations	1
Regional water resources office	1
Province industry offices	2
Water users – consumption & domestic use	2
Water users – industry	2
Government agency – public health	2
Flooding	
Center to prevent & abate public hazards, Kamphaengphet	1
Local government (PAO) – Kamphaengphet Province	1
Local government (PAO) – Nakhon Sawan Province	1
Local government (TAO/tessaban) – Kamphaengphet	1
Local government (TAO/tessaban) – Nakhon Sawan	1
Wastewater	
Local government (tessaban) – Muang Kamphaengphet	1
Local government (tessaban) – Nakhon Sawan	1
Local government (TAO, tessaban, PAO)	1
Farmer representative – paddy rice	1
Farmer representative – orange orchards	1
Soil Resources & agriculture	
Province agriculture office (Kamphaengphet)	1
Province agriculture office (Nakhon Sawan)	1
Province land development station (Kamphaengphet)	1
Province land development station (Nakhon Sawan)	1
Sub-basin specialist (soil)	1
Farmer representative – model organic farmer	1
Forests	
Conservation region 12 management office	1
Sub-basin specialist (forestry)	1
Non-governmental organization (NGO)	1
Total membership:	48

3.4. Creating implementation handbooks

In addition to project processes focused on action plans for management of natural resources and environment, and consideration of models for sub-basin organizations, the project also formulated documents aimed at supporting implementation processes related to participatory sub-basin management in the form of implementation handbooks. These implementation handbooks included 9 volumes under the title of "Handbooks for Building Community Capacity in River Basin Management", divided into three sets:

- ***Technical handbooks*** include handbooks covering (1) natural resources and environment, (2) forest resources, (3) water resources, (4) soil resources, (5) pollution and (6) the sufficient economy approach;
- ***Organization handbooks*** include coverage of (7) policy and planning, (8) organization duties and responsibilities;
- A separate handbook covers (9) ways to ***build consciousness and participation***.

The process used to formulate and develop all three sets of project handbooks began with analysis of conditions and emerging general problem issues in the Ping River Basin, and specific problems that have emerged in the pilot sub-basins. This was combined with analysis of needs to address these problems, and use of local knowledge to solve previous problems, in order to conduct an overall analysis and formulate the handbooks. This was done by persons experienced with developing curricula and designing publications. Use of these handbooks was pre-tested with sub-basin facilitators and community facilitators in the three pilot sub-basins (see the next chapter). Recommendations resulted in improvements to make the handbooks easy to understand and apply in further basin management work.

4. *Component 2:* Enhancing the capacity of communities in pilot watersheds

Implementation activities under this project component sought to help build capacity of sub-basin stakeholders related to participatory management of natural resources and environment at sub-basin and more local levels. This chapter summarizes results according to four main capacity building components of the project implementation process.

4.1. Selecting sub-basin target groups for capacity building activities

The project implementation strategy included four primary target groups for capacity building activities:

4.1.1. Sub-basin facilitators

Role and duties: (1) lead training for community facilitators; (2) lead training for community members; (3) collaborate with community facilitators in conducting activities according to negotiated agreements reached with local polluters; (4) collaborate with community facilitators and community members in planning and conducting community activities in the sub-basin; (5) serve as coordinators among agency units and organizations related to conducting activities.

Qualifications: In each pilot sub-basin 5 persons with the following qualifications were selected to be sub-basin facilitators: (1) must be local people that are accepted by local communities, agency units, and local organizations; (2) must be dedicated and willing to sacrifice time for the work; (3) must have preliminary knowledge about natural resources and environment and be able to communicate well with people in the area; (4) must have leadership skills and be enthusiastic about assisting people in the area; (5) must have experience in working together with local communities.

Additional selection considerations: (1) sub-basin facilitators in each sub-basin must have bases that are distributed among important areas within the sub-basin; (2) sub-basin facilitators in each sub-basin must have an overall distribution of knowledge among natural resources (soil, water, forest), agriculture (land use, agriculture systems, agricultural chemicals), industry environment (garbage, hazardous wastes, water quality), community environment (garbage, wastewater control, water quality), public sanitation; (3) in the Ping part 1 sub-basin, at least one of the 5 sub-basin facilitators must be from an ethnic minority group.

Selection process: Through a 3-step process consisting of: (1) Receive candidates from (a) qualified applicants for the position; (b) people nominated by the project steering committee (representatives from the 3 pilot sub-basins), or from agency units conducting activities in the area (Department of Water Resources or Department of National Parks, Wildlife and Plant Conservation); (2) Making a short-list of the most qualified candidates; and (3) Final selection through joint consultation among the project steering committee, selected experts, agency representatives, and provincial offices for coordination of natural resource and environmental restoration.

4.1.2. Community facilitators

Role and duties: To work together with sub-basin facilitators in building capacity of communities through conducting training activities for community members in pilot sub-basins. Training is to build their capacity to work together in improving environmental quality in order for the people to have better livelihoods and hygiene.

Qualifications: Each sub-basin was to have 15 community facilitators with qualifications similar to sub-basin facilitators. But they may have more limited specialized expertise in some topics or less diverse knowledge than sub-basin facilitators. The 15 selected community facilitators were to be distributed around the sub-basin area according to social, economic and knowledge needs.

Selection process: Since community facilitators must work closely with sub-basin facilitators and work together with them as a team in the long-term, each sub-basin facilitator nominated 3-5 persons to be community facilitators. Nominated persons were considered jointly by all 5 sub-basin facilitators in the sub-basin, and 3 persons were selected from those nominated by each of the five sub-basin facilitators in each sub-basin.

4.1.3. Community members

Role and duties: Community members who received training are to provide support for activities conducted by sub-basin facilitators and community facilitators, transfer knowledge and experience to people in the sub-basin area. This includes all local natural resource and environment management activities.

Qualifications: Community members were to be people with interests related to natural resources and the environment, and who are members of watershed conservation networks, community environment networks, or water user networks.

Selection process: In each sub-basin about 150 community members were to receive training on participatory basin management. The 150 community members were to be distributed among areas in the sub-basin according to their livelihoods, age, education, and ethnicity. They were selected by sub-basin facilitators and community facilitators.

4.1.4. Local government leaders:

It is clear that local governments [tambon administration organizations (TAO) and municipalities (*tessaban*)] are stakeholders that will play a very important role in sub-basin management of natural resources and the environment. Thus, the project also viewed leaders of local government units as a target group for training aimed at providing them with an overview level of knowledge and understanding about management of natural resources and the environment at the sub-basin level. It is hoped that they will be encouraged to become active stakeholders participating in sub-basin organizations and related planning and management processes, and that they will apply this knowledge and understanding in developing local plans within their jurisdictions. Participants in this component were selected according to their leadership positions in local government organizations.

4.2. Analyzing community training needs and developing training curricula

In order to develop training curricula appropriate for these major target groups, the project conducted

4.2.1. Overview of sub-basin training needs.

In addition to the rapid assessments of sub-basin conditions conducted in each of the three selected pilot sub-basins, an additional line of activity centered on identifying training needs perceived by major stakeholder groups in each sub-basin. This was accomplished by organizing focus group sessions in each sub-basin during 1-2 June 2006 in Chiang Mai (Ping part 1 sub-basin), Lamphun (Mae Kuang sub-basin), and Kamphaengphet (Ping part 5 sub-basin) provinces. Results of training needs identified for each sub-basin are shown according to topics in Figure 4-1.

Figure 4-1a. Training needs identified through focus groups

Natural Resources & Environment	Ping 1	M.Kuang	Ping 5
problems & impacts from nature			X
natural resource conservation			X
caring for the environment			X
status of problems in local areas			X
natural resource situations in local areas			X
importance of resources			X
relationships among forest, water, people & livelihood occupations			X
problem situations, impacts, future directions			X
- Forests			
forest ecology	X		
forest conservation	X		
forest management	X	X	
caring for forest, planting forest with people's participation		X	
forest resource use, benefits from forest, efficient methods for use		X	
encroachment / destruction by investors	X		
- Land & soil			
geology of the upper Ping watershed	X		
land use	X		
causes & impacts of soil degradation	X	X	
chemical accumulation in soil		X	
soil conservation	X		
soil erosion & its impacts; landslide prevention	X		
planting vetiver grass	X		
- Water			
resources from water that nourish life			X
water ecology	X		
natural water sources			X
resources in watersheds from the past until the present			X
water resource captial in upper parts of the country			X
upper origins of river basins			X
watershed area, clear boundary specification			X
water problems in local areas		X	
water, stream, swamp, canal, lake & river conservation	X		X
local knowledge in water resource management			X
thrifty use of water			X
water allocation and management			X
water sources & water use allocation (rainy / dry season) (upper/middle/lower watersheds)			X
water management in irrigation canals			X
water management, relations, local regulations on water use		X	
role of water users in maintenance		X	
case studies on water management	X		
causes of water turbidity, flooding, sediment deposits	X		
dredging waterways, check dam damage, flood prevention	X		
preventing encroachment on Ping River banks	X		
major flood disasters			X
pollution in watersheds			X
toxic contamination in water	X		
factors that cause water polluition			X
managing water quality	X		X
- Environmental pollution			
pollution in watersheds			X
sanitation in households, livelihoods, industry			X
solving problems in agricultural factories			X
garbage / waste			X
municipal waste			X
managing garbage & waste	X		X
agricultural chemicals	X		X
chemical use, pesticide use			X
reducing use of chemicals	X		
chemical-free & alternative agriculture	X		

Figure 4-1b. Training needs identified through focus groups *(continued)*

	Ping 1	M.Kuang	Ping 5
- Ecology			
resources and ecology			X
relationships among forest, soil, mountains			X
importance / relationships of resources, environment, living things			X
interrelationships among traditions, people, animals, things & nature	X		
Building Consciousness			
restraining globalization to reduce its impacts	X		
building consciousness			X
building awareness/consciousness in cherishing/conserving/caring for natural resources	X	X	X
system-based thinking / qualitative & quantitative information	X		
community culture	X		
methods to build understanding	X		
building ownership	X		
people's participation		X	
participation techniques			X
conducting activities conscientiously	X		
conflict management			X
adjusting leadership processes	X		
have a series of continous projects	X		
training / venues	X		
Policy, Planning & Organizations			
systems-based thinking	X		
decentralization to have local natural resource management	X		
environmental planning clearly assigned to an organization	X		
organization goals			X
having communities participate in community / local planning emphasizing environment	X		
govts			X
groups / organizations have activities with clear roles of local organizations	X		
relationships among organizations, agency units, communities, networks, groups			X
role of watershed sub-committees			X
role of groups & organizations			X
roles & duties of local government & community planning	X	X	
role of local leaders			X
role of representatives of people in the watershed			X
role of youth and community participation			X
community forestry networks	X		
project formulation			X
continuous coordination	X		
laws, regulations, penalties related to municipal law	X		
seeking budgets, budget allocation		X	
Sufficient Economy			
examples & case studies of application of sufficient economy theory	X		X

Findings of the focus group assessments in each sub-basin were then summarized into an overall set of training needs, as follows:

1. ***Technical information***
   - Natural resources and environment
   - Land and soil resources
   - Water resources
   - Forest resources
   - Environmental pollution
   - Sufficient economy
2. ***Building consciousness***
   - Building consciousness
   - Participation in watershed management
3. ***Planning and organizations***
   - Planning management
   - Organization management

Based on these findings, curricula were developed for the four target groups. Training materials were also drafted, and several of them contributed to development of the handbooks described in the final section of the previous chapter. The basic structure of training curricula for the target groups are as follows:

4.2.2. Training curricula for main target groups

Training curriculum for sub-basin facilitators

1. Management of natural resources and environment in sub-basins
    - Management principles
    - People's participation in sub-basin management
    - Management tools – plans, regulations, organizations
2. Public relations
    - Mass relations techniques
    - Public relations principles
    - Techniques for transferring knowledge
3. Management of environmental pollution
    - Environmental management and water pollution
    - Agricultural pollution management
    - Industrial and community pollution management
4. Community public health
    - Causes of disease
    - Methods for disease prevention
    - Health maintenance
5. Local knowledge
6. Ethnic groups

Training curriculum for community facilitators

1. Management of natural resources and environment
2. People's participation in sub-basins
3. Management tools: plans, regulations and organizations
    - Practice for stakeholders
    - Propose results of stakeholder analysis
4. Managing agricultural pollution
5. Managing community pollution
6. Managing industrial pollution
7. Economic dimensions of managing natural resources and environment

Training curriculum for community members

1. natural resources and environment
2. forest resources
3. soil resources
4. water resources
5. environmental pollution
6. building consciousness and people's participation
7. sufficient economy
8. policy and planning
9. organizations

Training curriculum for local government leaders

1. Policy, planning and organizations for managing the Ping River Basin
2. Natural resource and environmental crisis and trends in the Ping River Basin
3. Roles, duties and participation by local governments in Ping River Basin management
4. Setting priorities for problems and management plans for the Ping River Basin

4.3. Conducting training and transferring knowledge

After identifying key target groups and developing appropriate curricula, training was conducted for each target group. The following sections document the venue and participants in these training sessions, and data on participant evaluation of the overall value of training

.

4.3.1. Training for sub-basin facilitators

Training for sub-basin facilitators was conducted during 9-13 November 2005 at a training center of the Department of National Parks, Wildlife and Plant Conservation located in Tak province. A total of 21 participants from the three pilot sub-basins included:

Ping part 1 sub-basin (upper Ping)	7 participants
Mae Kuang sub-basin	8 participants
Ping part 5 sub-basin (lower Ping)	6 participants

Participants evaluated the results of each component of the training according to the training modules of the curriculum. In addition to operational and instructional aspects of the training, responses to the following four questions are indicative of participant perceptions of the overall quality and usefulness of the training.

1. How much did the instructor's communications abilities help problem understanding?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	71	24	5
Mass relations techniques	86	9	5
Public relations principles & knowledge transfer techniques	71	24	5
Environmental management and water pollution	67	33	-
Agricultural pollution management	47	37	16
Industrial and community pollution management	42	58	-
Public health: communicable disease related to water	67	33	-
Local knowledge	84	16	-
Ethnic groups	67	24	9

2. How much was your interest stimulated to learn more about the topic?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	71	29	-
Mass relations techniques	71	29	-
Public relations principles & knowledge transfer techniques	57	43	-
Environmental management and water pollution	72	28	-
Agricultural pollution management	37	53	10
Industrial and community pollution management	37	47	16
Public health: communicable disease related to water	56	39	5
Local knowledge	79	21	-
Ethnic groups	33	62	5

3. How much opportunity & encouragement was provided to express opinions?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	67	33	-
Mass relations techniques	71	24	5
Public relations principles & knowledge transfer techniques	57	43	-
Environmental management and water pollution	72	28	-
Agricultural pollution management	42	47	11
Industrial and community pollution management	37	58	5
Public health: communicable disease related to water	72	28	-
Local knowledge	69	26	5
Ethnic groups	52	43	5

4. How much increased knowledge did you gain from this training?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	67	28	5
Mass relations techniques	86	14	-
Public relations principles & knowledge transfer techniques	67	33	-
Environmental management and water pollution	83	17	-
Agricultural pollution management	58	37	5
Industrial and community pollution management	78	22	-
Public health: communicable disease related to water	83	17	-
Local knowledge	74	26	-
Ethnic groups	52	33	14

4.3.2. Training for community facilitators

Training for community coordinators was conducted during 27-30 November 2005 at the Phucome hotel in Chiang Mai province. A total of 61 participants from the three pilot sub-basins included:

Ping part 1 sub-basin (upper Ping)	19 participants
Mae Kuang sub-basin	24 participants
Ping part 5 sub-basin (lower Ping)	18 participants

Participants evaluated the results of each component of the training according to the training modules of the curriculum. In addition to operational and instructional aspects of the training, responses to the following four questions are indicative of participant perceptions of the overall quality and usefulness of the training.

1. How much did the instructor's communications abilities help problem understanding?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	50	31	19
People's participation in sub-basin management	29	52	19
Management tools: regulations & organizations	30	57	13
Stakeholder analysis and practice	54	31	15
Agricultural pollution management	74	22	4
Community pollution management	35	52	13
Industrial pollution management	30	57	13
Economic dimensions of managing natural resources and environment	73	27	-

2. How much was your interest stimulated to learn more about the topic?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	56	31	13
People's participation in sub-basin management	47	53	-
Management tools: regulations & organizations	52	35	13
Stakeholder analysis and practice	54	38	8
Agricultural pollution management	70	26	4
Community pollution management	35	61	4
Industrial pollution management	39	57	4
Economic dimensions of managing natural resources and environment	77	23	-

3. How much opportunity & encouragement was provided to express opinions?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	31	56	13
People's participation in sub-basin management	37	44	19
Management tools: regulations & organizations	52	39	9
Stakeholder analysis and practice	46	39	15
Agricultural pollution management	70	26	4
Community pollution management	39	61	-
Industrial pollution management	48	48	4
Economic dimensions of managing natural resources and environment	68	27	5

4. How much increased knowledge did you gain from this training?

Curriculum component	Evaluation Opinion (%)		
	Much	Average	Little
Management of natural resources and environment in sub-basins	50	37	13
People's participation in sub-basin management	35	65	-
Management tools: regulations & organizations	43	44	13
Stakeholder analysis and practice	62	38	-
Agricultural pollution management	74	26	-
Community pollution management	52	39	9
Industrial pollution management	52	39	9
Economic dimensions of managing natural resources and environment	77	18	5

4.3.3. Training and study tours for community members

Training and study tours for community members was conducted during August 2005 for the Ping part 1 sub-basin and the Ping part 5 sub-basin, and during December for the Mae Kuang sub-basin. A total of 424 participants from the three pilot sub-basins included:

Ping part 1 sub-basin (upper Ping)	124 participants
Mae Kuang sub-basin	131 participants
Ping part 5 sub-basin (lower Ping)	169 participants

In addition to the training curriculum modules, participants were able to visit several locations where promising activities relevant to management of natural resources and environment are taking place. This allowed discussions to include people at these sites who are actively conducting activities that can serve as examples for potential lines of future work in the pilot sub-basins.

4.3.4. Training for local government leaders

Training for community members was conducted during 20-22 August 2005 at the Bhumiphol Dam in Tak province. A total of 67 participants included heads, deputies and officials from TAO and *tessaban* governments from all three pilot sub-basins.

After conducting the modules in the training curriculum, participants brainstormed about their perceptions of priority issues in their local jurisdictions. In order to help get a clearer picture of their overall sense of priorities, a synthesis of their views was made by constructing a prioritized list of issues according to the number of participants voting for each issue. The results were as follows, with the number of participant votes indicated in parentheses:

1. Forest destruction and shifting cultivation (22)
2. Drought, insufficient water for domestic consumption, irregular rainfall, insufficient dry season water storage (20)
3. Garbage – no disposal sites, garbage put into waterways (17)

4a. Floods and related disasters (13)
4b. Air pollution from vehicles, agro-industrial dust, unpaved roads, and burning (13)

5. Degraded soil, chemical accumulation in soil – limits plant growth (10)
6. Wastewater from industry, pig farms, and agriculture (9)
7. Wastewater from garbage sites, community wastewater sources such as markets (8)
8. Chemical residues from agriculture (5)
9. Soil erosion, topsoil loss, soil filling waterways (3)

10a. No land tenure, insufficient crop land (2)
10b. Water scouring riverbanks, riverbank collapse (2)
10c. Reduced amounts of wildlife due to hunting and use as food (2)
10d. Public streams becoming shallow, encroachment into waterways (2)

Participants evaluated the results of each component of the training according to the training modules of the curriculum. In addition to expressing their satisfaction with operational and instructional aspects of the training, responses to the following questions are indicative of participant perceptions of the overall quality and usefulness of the training.

Aspect of evaluation	**Evaluation Opinion** (%)		
	Much	Average	Little
Satisfaction with training style & methods	31	65	4
Suitability of training handbooks & documents	76	22	2
Satisfaction with instructor presentations	53	47	-
Opportunities for participants to express opinions	82	18	-
Value of this training	57	41	2
Usefulness of the training	65	33	2

5. *Component 3:* Strengthening regulatory and incentive measures for improved behavior of users in pilot watersheds

Implementation of this project component included four major lines of activity under the sub-components introduced in chapter 2. Results are summarized below for each sub-component.

5.1. Classifying and selecting pollution sources

One fundamental requirement of the project was that study sites must be located in the three pilot sub-basins. Thus, 20 to 25 representative pollution sources were selected from each of these sub-basin areas. The pilot sub-basins had initially been broadly characterized in terms of types of pollution source as: (1) primarily pollution from agriculture in the Ping part 1 sub-basin; (2) primarily pollution from industry in the Mae Kuang sub-basin; and (3) primarily pollution from municipalities and communities in the Ping part 5 sub-basin. These categories of types of pollution sources were also a basic requirement of the project.

When results of pollution source surveys were analyzed and used to develop a representative set of pollution sources, however, they showed that a slightly different combination of categories would be better.

- Expansion of agriculture has been rapid in the highlands of the Ping part 1 sub-basin, which is considered an important area for watershed protection. Since the sub-basin is not industrialized and has a relatively low population density, sites in the sub-basin have been selected to represent agricultural pollution sources. Some agricultural pollution source sites were also selected in the Ping part 5 sub-basin, because it is the sub-basin with the highest rates of pesticide usage per unit area for rice, other field crops, and horticulture. Comparisons are made between pollution source sites from these two areas.
- Representative sources of industrial pollution were selected only from the Mae Kuang sub-basin. A large number of small-scale and cottage industries flourish in this area and cause considerable water pollution. These industries generally lack efficient treatment systems for wastewaters from their production processes. Because they do not require industrial licenses from the Ministry of Industry, they are not affected by legislation for factories or declarations promulgated by that Ministry. One such declaration states that factories must not discharge effluent unless it has passed through treatment processes other than dilution, and that discharged wastewater should meet quality standards for industrial effluent.
- Sites in the Ping part 5 sub-basin were selected to represent pollution sources from municipalities and communities. The area includes communities of diverse sizes, which is useful: Nakhon Sawan municipality is large, while Kamphaengphet represents a medium-sized community; small-sized communities are represented by sub-district municipalities and sub-district administrative organizations. Some medium-size municipalities were also selected in the Mae Kuang sub-basin so that they could be compared with those from the Ping part 5 sub-basin.

In addition to this sample of agricultural, industrial and municipal/community pollution sources, sample sites relating to pollution from community solid waste were selected in the Ping part 5 sub-basin, and to pollution from livestock in the Mae Kuang sub-basin.

Pollution issues and selected study sites in each sub-basin are summarized as follows:

5.1.1. Ping part 1 (Upper Ping) sub-basin

Sources of agricultural pollution

Agricultural sources of pollution were the focus of selection of pollution source sites in the Ping part 1 sub-basin. Project criteria for selecting representative sources of agricultural pollution included consideration of:

1. The crops grown must be economically significant in the provinces or pilot sub-basins
2. The farms (pollution sources) concerned must be at risk of being sued over effects of use of chemical fertilizers or pesticides on health of the local population or the environment.
3. The farms selected must use one of five groups of chemical pesticides: (a) Organochlorine (compounds of carbon, hydrogen and chlorine), with brand names that include Thiodan, Endosulphane, Sanfan, Teofos, Benefit 35, Dithong, Dynamite, *etc*. (b) Organophosphate (organic insecticides based on phosphorus compounds), with brand names that include Wave Super 505, Yaguza 500, Crothyon, Gurazan, Condomate, Pholidol Malate, *etc*. (c) Carbamate (compounds based on nitrogen with structure similar to organophosphates), with brand names that include Furadan, Carbofuradan, Darin 85, Eswin 85, *etc*. (d) Pyrethrum and pyrethroids, with brand names that include Karate 2.5 EC, Pro exist 15, CS Sprint Tec, Super Clean, New Metric 30, *etc*. (e) Other chemicals/chemical groups considered which included Gramoxone, Glyphoset, Paraquat, Round-up, *etc*.
4. Selected farms must include use chemical fertilizers containing nitrogen and phosphorus.
5. There was good cooperation from farm owners in providing relevant information on the amount and frequency of use of chemical fertilizers and pesticides, and in visiting the selected pollution sources.

Based on these selection criteria, review of secondary data, and field surveys, 25 sites were selected to represent sources of agricultural pollution in the Ping part 1 sub-basin. The type of use made of agricultural land in the Ping part 1 sub-basin depends on local topography. For example, rice is grown mainly on the flood plains. If there is insufficient water in the dry season, farmers grow crops that are less water-dependent, such as soybeans, peanuts, sweet corn, potatoes, etc. Fields in upland areas are planted to field crops such as maize or peanuts, or to fruit trees such as longan or tangerines. Five types of crops were selected from the 25 representative sources as the basis on which to analyze agricultural pollution in the Ping part 1 sub-basin. Of the selected sources, rice was grown on five, maize on one, sweet corn on two, longan on eight and tangerines on nine farms. The specific locations are listed in Figure 5-1.

Figure 5-1. Crop types & locations of agricultural pollution sites in the Ping part 1 sub-basin

Crop type	Topography	No. of Sources	**Location**			No. of Farmers
			Sub-District	*District*	*Province*	
Rice	Undulating	1	Muang-Na	Chiang Dao	Chiang Mai	2
	Flat	2	Thung Khao Phuang	Chiang Dao	Chiang Mai	4
		1	Chiang Dao	Chiang Dao	Chiang Mai	3
		1	Muang Kaen Phattana	Mae Taeng	Chiang Mai	4
Maize	Undulating	1	Muang- Na	Chiang Dao	Chiang Mai	4
Sweet corn	Flat	1	Thung Khao Phuang	Chiang Dao	Chiang Mai	3
		1	Muang Kaen Phattana	Mae Tang	Chiang Mai	1
Longan	Flat	2	Chiang Dao	Chiang Dao	Chiang Mai	2
		6	Muang Kaen Phattana	Mae Tang	Chiang Mai	7
Tangerines	Undulating	3	Muang Na	Chiang Dao	Chiang Mai	4
		2	Thung Khao Phuang	Chiang Dao	Chiang Mai	3
		4	Ping Khong	Chiang Dao	Chiang Mai	5
Total		25				42

Cropping practices and chemical use in these crops can be summarized as follows:

- ***Rice*:** The size of paddy fields in the study area ranged from about 3 to 12 rai. High yield varieties (HYVs) commonly grown are Ko-Kho 2, Ko-Kho 6, Ko-Kho 10, Niaw San Pa Tong 1 and Kao Dok Mali 105. In low-lying wetlands, wet seeding of rice is practiced, and HYVs grown are Ko-Kho 7, Ko-Kho10, Ko-Kho 15, Niaw San Pa Tong 1 and Suphanburi 60. Generally, the cultivation season is from May to August, and farmers use a seeding rate of 25-30 kg/rai. Main chemical pesticides used for rice are organo-phosphates, carbamates, and organochlorine compounds. Chemical fertilizers used include (N-P-K) 21-0-0, 46-0-0 and 16-20-0, *etc*. Rice can be harvested from October but highest productivity – typically between 500 and 700 kg/rai – is obtained by harvest in December.
- ***Maize*:** A single crop of rain-fed maize is grown each year. Maize is grown mainly in the highlands on farms that typically range in size from about 3 to 8 rai; cultivation is most extensive in Chiang Dao District. Weed management is done by burning vegetation in the fields before cultivation. The cultivation season for maize used as livestock feed begins in May or June, and crop harvest is in September or October; yields average 800 kg/rai. Popular high yield varieties are C.P. 888 and Cargil 919, with a seeding rate of about 2.5 kg/rai. Main chemical pesticides used are organophosphates and carbamates; chemical fertilizers commonly used include 15-15-15 and 46-0-0 (N-P-K).
- ***Sweet corn*:** The most common variety of sweet corn grown in the study area is ATS-2; other high yield varieties are also grown. Farm size ranges from about 2 to 10 rai, and the cultivation season starts in May or June. The main chemical pesticides used are organophosphates, carbamates and pyrethroid compounds. The main chemical fertilizer formulations used (N-P-K) include 21-0-0, 46-0-0, 18-46-0, 15-15-15, 13-13-21 and 14-14-21, *etc*. Depending on the variety grown, harvest may be anywhere between about 70 to 90 days after sowing. Average productivity is between 1,700 and 2,000 kg/rai
- ***Longan*:** The most common longan cultivar grown in the study area is the Edo variety. Typical farm size is between about 5 to 20 rai. Longan is an important export crop and may be sent to other countries as ripe or canned fruit, or dehydrated. The main chemical pesticides used in longan orchards are organophosphates and carbamates. Chemical fertilizer formulations (N-P-K) most commonly used include 15-15-15, 13-13-21, *etc*. Potassium chlorate can be used to produce off-season longans, but it is rarely used here because of high chemical cost and marketing limitations. Normally, the flowering season for longans is from late December to early February and they are harvested for sale from late June to September. The highest productivity is in August from longan trees that are 6 years old, when they may yield an average of 500 to 800 kg/rai.
- ***Tangerines*:** Tangerine farms in the study area range in size from about 10 to 300 rai. Most tangerines are grown in Chiang Dao District. Although they are available throughout the year, the main crop is harvested in the early rainy season. The most common varieties grown are Bang Mod, and Chogun or Sai Nam Phung. Tree density in orchards is about 44 per rai, and each tree yields an average of 40 to 60 kg (1,760 to 2,640 kg/rai). The main chemical pesticides used in tangerine orchards are organophosphates, carbamates and pyrethroid compounds. Chemical fertilizer formulations (N-P-K) used include 46-0-0, 15-15-15, 13-13-21, 14-14-21, 16-20-0+2Cao+15S, 15-15-15+Mgo+Cao+S, *etc*.

Summary of chemical fertilizer and pesticide use in agriculture that can cause pollution

The following summary of issues related to pollution is based on field survey results, as well as information from farmers, from agriculture officers in Chiang Dao and Mae Taeng districts, and from chemical fertilizer and pesticide dealers in local areas:

(1) Chemical fertilizers: Nine chemical formulations (N-P-K) are in common use: 21-0-0, 46-0-0, 15-15-15, 13-13-21, 14-14-21, 18-46-0, 16-20-0, 16-20-0+2Cao+15S and 15-15-15+Mgo+Cao+S.

(2) Chemical pesticides: three categories of pesticides are most commonly used:

- *Insecticides:* Farmers in the study area use ten types of insecticide to eliminate worms, aphids, moths and red mites: Eraset 25 EC, Wave Super, Itin, Yaguza 500, Anglo-Slug, Tamaron 600 SL, Lannate, White Date L, Metasistox R and Poss.
- *Fungicides:* Farmers in the study area use nine types of fungicide to eliminate sheath rot disease, bakanae disease, *Puccinia allii*, leaf spot, bacterial blight, downy mildew, powdery mildew, etc: Tax Super, Biocide, Pesry-85, Bentac Dithane LF, Dithane M 45, Apron 35 SD, Sulphur powder, and Rofral.
- *Herbicides:* Farmers in the study area use eight types of herbicide to eliminate narrow and broad leaf weed flora such as paragrass, large crab grass, beach wire grass, amaranth, purslane, torpedo grass, *etc*: Glyphoset 48, Paraquat, Gramoxone, Round-up, Pursuit, Touch Down, Galant 240 ME and Goal 2 E.

(3) Amount and frequency of chemical fertilizer and pesticide use depend on many factors such as the severity and spread of disease and insects, crop fertility, produce price trends, and the farmer's budget and available fund sources, as well as extent of the farmer's knowledge of proper agricultural chemical usage.

5.1.2. Mae Kuang sub-basin

Sample sources representing industrial pollution were selected only from the Mae Kuang Sub-Basin. A large number of small-scale and cottage industries flourish in this area and cause considerable water pollution. These industries generally lack efficient treatment systems for wastewaters from their production processes. Because they do not require industrial licenses from the Ministry of Industry, they are not affected by the 1969 legislation for factories or the 1982 declaration by the Ministry of Industry that factories must not discharge effluent unless it has passed through treatment processes other than dilution, and that wastewater discharge should meet quality standards for industrial effluent.

While selection criteria for Mae Kuang sub-basin focused on sources of industrial pollution, it was noted that other types of pollution sources also exist in the area, including both livestock farms and communities. Thus, the 24 pollution sources selected in the Mae Kuang sub-basin (Figure 5-2) include fourteen from industry, six livestock farms and four communities:

Sources of industrial pollution

Project selection criteria for sources of industrial pollution included consideration of five factors: (1) Factories generating wastewater; (2) Cottage industries generating wastewater, excluding factories operating or controlled under The Factory Act of 1992; (3) Industries generating either mixed/general wastewaters or wastewaters containing specific forms of pollutants, *e.g.,* heavy metals; (4) Potential for results from selected factories in pilot sub-basins to be applied to other river basins; and (5) Factories located in the northern industrial estate at Lamphun are excluded from the selection process because their sewerage systems are under the control of the industrial estate.

Figure 5-2. Selected pollution sources in the Mae Kuang sub-basin

Source	Type	Location		
		Sub-district	*District*	*Province*
Pollution from industrial sources				
1	Mulberry paper factories	Ton Pao	San Kam Phaeng	Chiang Mai
2	Mulberry paper factories	Ton Pao	San Kam Phaeng	Chiang Mai
3	Mulberry paper factories	Ton Pao	San Kam Phaeng	Chiang Mai
4	Mulberry paper factories	Ton Pao	San Kam Phaeng	Chiang Mai
5	Traditional alcohol factory	Ton Pao	San Kam Phaeng	Chiang Mai
6	Thai vermicelli factory	Chom Phu	Saraphi	Chiang Mai
7	Pickled garlic factories	Umong	Muang	Lamphun
8	Pickled garlic factories	Umong	Muang	Lamphun
9	Pickled garlic factories	Umong	Muang	Lamphun
10	Pickled garlic factories	Pa Sang	Pa Sang	Lamphun
11	Pickled garlic factories	Mae Raeng	Pa Sang	Lamphun
12	Pickled garlic factories	Mae Raeng	Pa Sang	Lamphun
13	Pickled garlic factories	Mae Raeng	Pa Sang	Lamphun
14	Pickled garlic factories	Muang Noi	Pa Sang	Lamphun
Pollution from livestock sources				
15	Dairy farms	Chae Chang	San Kam Phaeng	Chiang Mai
16	Dairy farms	Chae Chang	San Kam Phaeng	Chiang Mai
17	Dairy farms	Chae Chang	San Kam Phaeng	Chiang Mai
18	Pig farm	Tha Sob Sao	Mae Tha	Lamphun
19	Pig farm	Tha Sob Sao	Mae Tha	Lamphun
20	Pig farm	Tha Sob Sao	Mae Tha	Lamphun
Pollution from community sources				
21	San Sai Luang Municipality	San Sai Luang	San Sai	Chiang Mai
22	San Kam Phaeng Municipality	San Kam Phaeng	San Kam Phaeng	Chiang Mai
23	Umong Municipality	Umong	Muang	Lamphun
24	Pa Sang Municipality	Pa Sang	Pa Sang	Lamphun

On the basis of project industrial pollution source selection criteria and a survey of the area, the most significant industrial pollution sources were found to be groups of cottage industries with similar size, productivity and processes. Factories selected include manufacturers of mulberry paper, traditional alcohol, Thai vermicelli, pickled garlic and batik cloth:

- ***Mulberry paper factories*** can be found throughout Mae Kuang sub-basin, but are mainly located in Ton Pao sub-district in the Sankamphaeng District of Chiang Mai Province. Interviews with officers of Ton Pao Municipality and results of a field survey show there are about 20 factories in the area. Four of them were selected for inclusion in the study.

  Mulberry paper production begins with soaking mulberry pulp in water for one day. Then, 1kg of caustic soda, 16 kg of mulberry pulp and 200 liters of water are mixed and boiled for 3 to 4 hours. The mixture is then pounded and spun, before being dyed and left in water overnight. Finally, the mixture is stirred thoroughly in cement buckets, spread on a sieve and dried in the sun to form mulberry paper.

  Interviews with owners showed that each mulberry paper factory produces approximately 5 to 10 m^3/day of wastewater from manufacturing processes. This includes wastewater from boiling mulberry pulp, consisting of caustic soda with other alkaline salts, as well as foul-smelling wastewater contaminated with chemicals derived from the dying process. At present, many of the factories discharge wastewater into digestion tanks. The solids settle and clear water is discharged to fields and drainage ditches in the municipality, which affects the wider community. Because of this, some factories have been sued.

- ***Traditional alcohol factories*.** Traditional alcohol is a by-product of other agricultural products, and is produced throughout Sankamphaeng District of Chiang Mai Province. Since

manufacturing processes generates wastewater and wastes that could affect the environment in the future, one traditional alcohol factory was selected.

There are 4 major steps in production of traditional alcohol: Preparation of fermentation waters, distillation, quality improvement and packaging in bottles. First, rice fermentation waters are prepared by mixing sugar with yeast and allowing them to ferment for between 3 to 15 days. After this, the alcohol is extracted by distillation and the alcohol content is adjusted to improve the quality of the product. Finally, it is packed and labeled.

Factory owners explained that each traditional alcohol factory generates wastewater at a rate of between about 0.6 and 1 m^3 wastewater per day from fermentation tanks, cleaning the boiler and molasses vats, and cleaning filter tanks, containers and other equipment. Manufacturing wastewater from traditional alcohol factories is discharged into collecting ponds from which only a small proportion overflows.

- ***Thai vermicelli factories***. The one Thai vermicelli factory selected as a sample pollution source is located in Sarapee District in Chiang Mai. The manufacturing processes used generate wastewaters and waste that could affect the environment in the future. The wastewater from manufacturing processes contains about 2,000 mg./liter of BOD.
- ***Pickled garlic factories*.** A considerable number of pickled garlic factories are distributed throughout Kuang River Basin, but most are located in U-mong sub-district of Muang district in Lamphun Province. Information from U-mong municipality officers and results of a field survey show that there are ten factories in this area. Three of them were selected.

  Wastewater from manufacturing is generated from both cleaning and pickling of garlic. The wastewater content is mostly organic, with about 2,000 mg/liter of BOD. If this water is discharged without proper treatment, it could cause environmental problems. According to some owners, wastewater from garlic pickling is generally discharged into a collecting pond, but they may then overflow into local rivers without treatment. Some complaints have been raised over this problem.
- ***Batik factories*** can be found throughout the Mae Kuang sub-basin, mostly in Mae Rang sub-district of Pa Sang District in Lamphun Province. According to municipal officers of Mae Raeng sub-district, there are thirteen batik factories in their area. From these, five were selected for use in the study: three from Mae Raeng sub-district, one from Pa Sang sub-district and one from Muang Noi sub-district.

  An interview with factory owners and a field survey showed that the batik dying processes produce large quantities of wastewater, and efforts are currently being made to solve this problem. The wastewater has a high organic content with a BOD range of between about 100 and 1000 mg/liter; the pH is high and there is a significant load of heavy metals. Wastewater from batik production goes to a collecting pond and is then pumped out to the municipal drainage. Many complaints are received because of this.

Sources of livestock pollution

A field survey confirmed that dairy and pig farms are or can be significant sources of pollution. Such farms can be found widely throughout the Mae Kuang sub-basin:

- ***Dairy farms*.** There are a numerous dairy farms in the Mae Kuang sub-basin, mostly in Chae Chang sub-district of Sankamphaeng District in Chiang Mai Province. Data from interviews with officers of the Department of Livestock Development and a field survey show there are about 114 dairy farms in the sub-basin. Three were selected for this study.

From interviews with the farmers and the field survey, it was found that dairy cows can rest, sleep, eat and be milked all in the same barn. Feeding troughs for the cows are long, which makes the feeding process more convenient. (Dairy cows can be fed by any one of several different feeding processes) Some cows are also housed in cattle pens. Many of the processes involved in the raising of dairy cows could generate wastewater, especially the washing of cows and their stalls, and cleaning up after milking.

This study showed each dairy cow generates between 0.1 and 0.6 m^3/day of wastewater via the various washing and cleaning processes. A 2005 report states this wastewater contains between 206 and 1,269 mg/liter of BOD. Most wastewater treatment systems in use on dairy farms in the sub-basin are comprised of a series of sedimentation and septic ponds. Water flows through such systems under gravity from the top down to the final pond. Around Chae Chang sub-district, many dairy cows are raised near the banks of the Mae Orn River. In this case, wastewaters from septic ponds flow directly into the Mae Orn River, which is polluted as a result. Sankamphaeng Municipality is trying to restore the river and overcome this problem.

- ***Pig farms*.** There are a numerous pig farms across the Mae Kuang sub-basin, and most are in Mae Tha District of Lamphun Province. Data from a field survey combined with information from officers of the Department of Livestock Development in Lamphun Province showed there are 90 pig farms in this area, from which three were selected.

  Interviews with pig farm owners and the field survey showed most of the farms operate on a large scale, with more than 200 pigs each. Farmers' incomes are derived from increase in pig weight. Wastewater from pig farms, *e.g.* from washing out pig pens and pig waste (urine and faeces), usually contains high levels of BOD – typically about 3,000 mg/liter. Each pig can generate around 40 liters of wastewater/day.

  Wastewater from small-scale pig farms is commonly discharged into collecting ponds from which the settled liquor overflows into paddy fields. Sometimes wastewater may be discharged directly into fields without pre-treatment. Larger-scale pig farms normally have proper waste treatment systems, some of which are designed to generate energy in the form of biogas from the waste biomass.

Pollution sources in communities

Although the main focus pollution source selection in Mae Kuang was on industrial pollution, pollution by communities is also important, especially in densly settled portions of the sub-basin. Thus, four medium-sized municipalities in Mae Kuang sub-basin were selected as case study sites as community sources of pollution. Findings from these study sites were compared with findings from the larger sample of communities in the Ping part 5 sub-basin.

Since the main pollution issues associated with communities are generation and management of wastewater and solid wastes, basic features of selected communities in Mae Kuang are summarized in terms of wastewater (Figure 5-3) and solid waste (Figure 5-4) management.

Figure 5-3. Selected municipalities in Mae Kuang: Basic water & wastewater patterns

Municipality	Water System	Slaughterhouse		Wastewater	
	source	*anim/day*	*Water treatmt*	*collect*	*treat*
Chiang Mai Province					
San Sai Luang sub-dist	groundwater pumps, treat, distribute	120-150	ponds, EM treated	None	None
San Kam Phaeng sub-dist	District waterworks, some shallow wells	30-40	some hygienic	None	None

Municipality	Water System	Slaughterhouse		Wastewater	
	source	*anim/day*	*Water treatmt*	*collect*	*treat*
Lamphun Province					
U-mong sub-dist	Province waterworks, some wells	(30 ton)	grease trap, septic tank	None	None
Pa Sang sub-dist	80% groundwater, some prov waterworks	35		None	(plan)

Figure 5-4. Selected municipalities in Mae Kuang: Basic solid waste patterns

Municipality	Population	Area	Solid waste			
	persons	*sq km*	*tons/day*	*segregate*	*collect*	*dispose*
Chiang Mai Province						
San Sai Luang sub-dist	22,000	36	7.7	Plans	Munic	Private
San Kam Phaeng sub-dist	18,000	23	7.8	Project promoting	Munic	Private
Lamphun Province						
U-mong sub-dist	14,000	21	8.4	None	Munic contract	Private
Pa Sang sub-dist	9,700	12	6.5	None	Munic	Private (munic plan)

5.1.3. Ping part 5 (Lower Ping) sub-basin

The Ping part 5 sub-basin was the focus for considering selection of representative pollution sources from municipalities and communities. The Ping part 5 sub-basin includes communities of diverse sizes, which is useful. Nakhon Sawan municipality is large, while medium-sized communities are represented by the Kampaeng Petch and small-sized communities by the municipalities of sub-districts including sub-district administrative organization. Some representative localities were selected in the Mae Kuang Sub-Basin so that they could be compared with those from the lower part of the Mae Nam Ping Sub-Basin.

Project criteria for selecting sources of pollution from communities included consideration of four issues: (1) Communities in municipalities or sub-district administrative organization areas; (2) Existence/presence of large or very crowded communities housing many people; (3) Existence of municipalities or sub-district administrative organizations covering all or part of one of the pilot sub-basins; (4) Potential for results from selected communities to be applied to other river basins.

Although criteria for selecting the 20 to 25 pollution sources required in the Ping part 5 sub-basin are focused on community sources, the desk study and field survey showed that other sources of pollution, especially agriculture, also exist in the study area. Thus, results of the selection process for the Ping part 5 sub-basin, as shown in Figure 5-5, include 23 pollution sources – thirteen representing community-related pollution and to representing sources of agricultural pollution:

Sources of community-related pollution

Pollution sources associated with local communities have been the main focus in the Ping part 5 sub-basin. Thus, thirteen municipalities and sub-district administrative organizations of various sizes were selected as case study sites regarding community sources of pollution in the Ping part 5 sub-basin. Findings from study of these sites were compared with findings from the sample of for medium-sized communities in the Mae Kuang sub-basin.

Since primary pollution issues associated with communities are generation and management of wastewater and solid wastes, basic features of selected communities are summarized in terms of wastewater (Figure 5-6) and solid waste (Figure 5-7) management.

Figure 5-5. Sources of pollution selected in the Ping part 5 sub-basin

No.	Type	Location		
		Tambon	*Amphoe*	*Province*
Community-related pollution				
1	Kamphaeng Phet Municipality	Nai Muang	Muang	Kamphaeng Phet
2	Nakhon Chum Tambon Municipality	Nakhon Chum	Muang	Kamphaeng Phet
3	Pak Dong Tambon Municipality	Trai Trueng	Muang	Kamphaeng Phet
4	Tha Putsa Tambon Municipality	Tha Phutsa	Khlong Khlung	Kamphaeng Phet
5	Tha Ma Khua Tambon Municipality	Tha Ma Khua	Khlong Khlung	Kamphaeng Phet
6	Khlong Khlung Tambon Municipality	Khlong Khlung	Khlong Khlung	Kamphaeng Phet
7	Khanu Woralaksaburi Tambon Municipality	Pa Phuttha	Khanu Woralaksaburi	Kamphaeng Phet
8	Salok Bat Tambon Municipality	Salok Bat	Khanu Woralaksaburi	Kamphaeng Phet
9	Banphot Phisai Tambon Municipality	Tha Ngio	Banphot Phisai	Nakhon Sawan
10	Kao Liao Tambon Municipality	Kao Liao	Kao Lieo	Nakhon Sawan
11	Nakhon Sawan Municipality	Pak Nam Pho	Muang	Nakhon Sawan
12	Tambon Khlong Lan Administrative Organization	Khlong Lan	Khlong Lan	Kamphaeng Phet
13	Tambon Mae Lat Administrative Organization	Mae Lat	Khlong Khlung	Kamphaeng Phet
Agriculture-related pollution				
14	Rice	Khana Thi	Muang	Kamphaeng Phet
15	Rice	Khlong Khlung	Khlong Khlung	Kamphaeng Phet
16	Rice	Pho Thong	Pang Sila Thong	Kamphaeng Phet
17	Tangerine farm	Sak Ngam	Khlong Lan	Kamphaeng Phet
18	Tangerine farm	Sak Ngam	Khlong Lan	Kamphaeng Phet
19	Tangerine farm	Sak Ngam	Khlong Lan	Kamphaeng Phet
20	Tangerine farm	Pa Phuttha	Khanu Woralaksaburi	Kamphaeng Phet
21	Tangerine farm	Pa Phuttha	Khanu Woralaksaburi	Kamphaeng Phet
22	Jasmine	Maha Pho	Kao Lieo	Nakhon Sawan
23	Jasmine	Bang Muang	Muang	Nakhon Sawan

Figure 5-6. Selected municipalities in Ping part 5: Basic water & wastewater patterns

Municipality	Water System	Slaughterhouse		Wastewater	
	source	*head/day*	*Water treatmt*	*collect*	*treat*
Nakhon Sawan Province					
Nakhon Sawan City	City tap water system from Ping River	40	Stabilize pond	System into river	Under construct
Kao Lio sub-district	Province waterworks – old rusty pipes	Yes (?)	Stabilize pond	System into river	None
Banphot Phisai sub-dist	Village tap water from groundwater	Yes (?)	?	None	None
Kamphaengphet Province					
Kamphaengphet Munic	Province waterworks	Yes (?)	?	System into river	None
Salokbat sub-dist	?	47	Unusable pond	System into fields	Yes
Nakhon Chum sub-dist	Province waterworks from Ping River	10	?	System into river	None
Pak Dong sub-dist	Province waterworks from Ping River	None	-	Drain to fields	None
Tha Phutsa sub-dist	Province waterworks from Ping River	None	-	Drain into canals	None
Tha Makhua sub-dist	Province waterworks	Not used	-	System into river	None
Khlong Khlung sub-dist	Province waterworks	None	-	Gutters into river	None

Municipality	Water System	Slaughterhouse		Wastewater	
	source	*head/day*	*Water treatmt*	*collect*	*treat*
Khanu Woralaksaburi s-d	Province waterworks	None	-	Gutters into river	Yes
Khlong Lan TAO	?	None	-	Drain to fields-streams	None
Mae Lat TAO	?	None	-	Drain to fields-river	None

Figure 5-7. Selected municipalities in Ping part 5: Basic solid waste patterns

Municipality	Population	Area	Solid waste			
	persons	*sq km*	*tons/day*	*segregate*	*collect*	*dispose*
Nakhon Sawan Province						
Nakhon Sawan City			82.0	By people	City	City
Kao Lio sub-district			4.0	Employees/ project	Munic	Munic
Banphot Phisai sub-dist			3.0	None	Munic	NS City
Kamphaengphet Province						
Kamphaengphet Munic			20.0	Project promoting	Munic	Munic
Salokbat sub-dist	8,600	11.7	?	None	Munic	Munic /private
Nakhon Chum sub-dist	8,020	3.5	?	Few participate	Munic	KP munic
Pak Dong sub-dist	3,700	2.4	2.0	None	Munic	KP munic
Tha Phutsa sub-dist	1,600	4	1.0	None	Munic	Munic
Tha Makhua sub-dist	4,000	55	15.0	School campaign	Munic	Munic
Khlong Khlung sub-dist		27	2.0	None	munic	munic
Khanu Woralaksaburi s-d	8,400	11.6	6.0	Promote	Munic	Munic
Khlong Lan TAO			1.0	School campaign	None	None
Mae Lat TAO			< 2.0	School campaign	None	None

Sources of agricultural pollution

Although the Ping part 1 sub-basin was the main site for selection of sites representing agricultural sources of pollution, secondary data and field surveys indicate the highest rates of agricultural chemical use in the Ping River Basin are found in the Ping part 5 sub-basin. Thus, a second set of sites representing agricultural sources of pollution were selected in the Ping part 5 sub-basin, as described in Figure 5-8.

Figure 5-8. Crop types & locations of agricultural pollution sites in the Ping part 5 sub-basin

Type of Crop	**Terrain**	No. of Sources	**Location**			No. of Farmers
			Sub-District	*District*	*Province*	
Rice	Flat	1	Khon Thi	Muang	Kamphaengphet	7
		1	Khlong Khlung	Khlong Khlung	Kamphaengphet	3
		1	Pho Thong	Pang Sila Thong	Kamphaengphet	4
Tangerines	Flat	3	Sak Ngam	Khlong Lan	Kamphaengphet	9
	Flat	2	Pa Phuttha	Khanu Woraluksaburi	Kamphaengphet	11
Jasmine	Flat	1	Maha Pho	Kao Lieo	Nakhon Sawan	7
		1	Bang Muang	Muang	Nakhon Sawan	9
Total		10				50

These sites were selected to represent three of the crops known to have the highest levels of agricultural chemical use in the Ping part 5 sub-basin:

- ***Rice*:** The average size of farms growing rice in the sub-basin is about 15 to 70 rai. On the right bank of Ping River, rice can be grown only in the rainy season, except where there are pumping stations. Since most of the area on the left bank of the Ping River is irrigated, rice can be grown as wet seeded paddy in both single-crop fields and low-lying wetlands. The rice cultivation season is from May to August and the most commonly grown high yield varieties are Chai Nat 1, Suphanburi and Kao Dok Mali 105, with seeding rates of 25 to 30 kg/rai. The main chemical pesticides used are organophosphates, carbamates, and organochlorine compounds. Chemical fertilizer use includes (N-P-K) 21-0-0, 46-0-0, 16-20-0, *etc*. Harvest starts in October but highest productivity – around 700 to 1,000 kg/rai – is obtained in December.
- ***Tangerines*:** The average size of farms growing tangerines in this area is about 20 to 150 rai. Tangerines are grown mainly in Khlong Lan and Khanuworaluksaburi Districts of Kamphaengphet Province. Harvest occurs throughout the year, but is mostly in the early rainy season. Most tangerines are cultivated on ridges. The main varieties are Bang Mod and Chogun. Tree density is 44 per rai, and trees yield between about 40 and 60 kg each – or about 1,760 to 2,640 kg/rai. The main chemical pesticides used are organophosphates, carbamates, and pyrethroid compounds. Chemical fertilizer formulas (N-P-K) include 46-0-0, 15-15-15, 13-13-21, 14-14-21, *etc*.
- ***Jasmine*:** Jasmine is grown in small areas of about 0.5 to 6 rai, mostly in private backyards, and most are located in Kao Lieo and Muang districts of Nakhon Sawan Province. The main variety is Ratburana. Plant density is about 1,500 to 1,600 per rai, which yields 3 to 5 kg /rai. The main chemical pesticides used are organophosphates, carbamates, and pyrethroid compounds. Chemical fertilizer formulas (N-P-K) include 46-0-0, 15-15-15, 13-13-21, *etc*.

Summary of chemical fertilizer and pesticide use in agriculture that can cause pollution

The following summary of information on fertilizer and pesticide use is based on field survey results, as well as information from farmers, from staff of district agriculture offices, and from chemical fertilizer and pesticide dealers in local areas:

(1) Types of chemical fertilizers: There are six main formulas in common use: 21-0-0, 46-0-0, 16-20-0, 15-15-15, 13-13-21 and 14-14-21.

(2) Types of chemical pesticides: Chemical pesticides can be grouped into 3 main categories:

- *Insecticides:* Farmers in study areas use twelve types of insecticide to eliminate worms, aphids, moths and red mites: Sevin 85 WP, Padan 4 G, Malathion 83, Sumithion 50 EC, Cascade, Danitol, D. C. tron Plus, Omite, Nisorun, Lannate, Dencall and Poss.
- *Fungicides:* Farmers in study areas use seven types of fungicide to control sheath rot disease, bakanae disease, *Puccinia allii*, leaf spot, bacterial blight, downy mildew, powdery mildew, *etc*: Dithane M 45, Furadan, White Date L, Dithane LF, Apron 35 SD, sulphur powder and Rofral.
- *Herbicides:* Farmers in study areas use nine types of herbicide control of both narrow and broad leaved weeds, *eg.*, paragrass, large crab grass, beach wire grass, amaranth, purslane, torpedo grass, *etc*: Red Horse, Glyphoset 48, Paraquat, Gramoxone, Round-up, Pursuit, Touch Down, Galant 240 ME and Goal 2 E.

(3) Amount and frequency of chemical fertilizer and pesticide use depends on many factors including the severity and spread of disease and insects, crop fertility, trends in the price of the

produce, and the farmer's budget and available funding sources, as well as the extent of the farmer's knowledge about the proper use of agricultural chemicals.

5.2. Reviewing economic incentive measures

Pollution is considered a very serious problem and leads to imbalances in economic, social and environmental systems. In the Ping River Basin, the potential for pollution problems can be identified particularly in things like the substantial increase in wastewater generation. Population growth and rapid development of the economy have affected water quality in the Ping River, which is a major tributary of the Chao Phraya River, the main water channel supporting populations in the central region of Thailand.

Two approaches are thought to be significant in the management of these pollution problems

- *The command and control (CAC) or regulatory approach* is implemented through legislation that seeks to change behavior of polluters by issuing environmental measures that polluters should practice, and/or by requiring polluters to treat their wastewater. The CAC system is based on sets of various regulations and fines.
- *Economic incentives (EIs)* provide continuous inducements to encourage responsible parties to change their behavior. EIs are based on a concept called the "Polluters Pays Principle" (PPP). Incentive measures are divided into different categories so that each category can be applied to different types of problems. The success of using EIs to solve pollution problems depends on the suitability of the measures available and the level of incentives (or disincentives) provided to motivate behavioral change and participation of those involved, especially the polluters.

In Thailand, the command and control (CAC) approach has been used to manage the environment by legislative means.

- Wastewater generated by communities is subject to special regulations in areas that are designated as special pollution control areas by the National Environment Commission. Discharge control standards have been specified for some types and sizes of buildings. Provisions under public health legislation seek to regulate cleanliness in marketplaces and public areas, and bathing and cleaning in public waterways.
- Community garbage and solid waste disposal is regulated by public health legislation and disposal facility regulations issued under the Factory Act, while types of plastic garbage bags and containers for public places are specified by the Pollution Control Department.
- Regulations for industrial activities related to distillation of alcohol specify wastewater treatment systems, and sewerage and environmental management systems that meet minimum specified standards must be clearly shown before permits are issued by the Excise Department. Wastewater from dying factories must meet standards set by the Ministry of Industry, the Pollution Control Department and the Harbor Department.
- In the case of water pollution from industrial estate areas, the Department of Industrial Works is responsible for issuing regulations and environmental measures, as well as for inspections and enforcement. These tools require those responsible for sources of pollution to control or reduce pollution to meet the prescribed effluent standards before discharging to public areas. Outside these areas, however, ambient standards for the control of discharges into public waters are set by the Pollution Control Department.
- Regulations related to pollution from agriculture include controls on chemical fertilizer factories and product labels, restrictions on manufacture and sales of hazardous chemicals,

and licenses for production of organic fertilizers. Pollution and wastewater discharged from pig farms is regulated by ministerial declarations under national environmental legislation, while public health legislation regulates allowing animals to defecate along roads or other areas where it is forbidden.

Away from major industrial areas, environmental inspection and enforcement become relatively expensive because sources are more widely dispersed and smaller. In addition, the regulations are inflexible, with homogeneous sets of standards that take no consideration of the size, type or location of pollution sources, which has decreased the reliability of these tools for managing the environment. Such features are especially important in developing countries where the resources available to deal with pollution are severely limited.

In many circumstances, economic incentives (EIs) have a number of advantages over traditional CAC methods for controlling environmental problems. In principle, EIs provide polluters with the necessary motivation to reduce pollution below permitted levels when it is economically feasible to do so. Technological improvement to reduce polluting activities will be stimulated, resulting in a cleaner environment. This type of approach can have a strong influence on polluting behavior of firms, farms and consumers, and can persuade them to move to more environment-friendly activities. In recent years, economic instruments have been used extensively worldwide, and some instruments have been applied in Thailand.

5.2.1. Types of economic incentive measures

Economic incentive measures that can be used to manage pollution problems can be classified into six different types:

1. **Taxes and charges/fees** are measures that are intended to increase awareness of polluters of their responsibility for the environmental damage they cause. Such measures require that polluters pay a tax (or a charge or fee) for each unit of pollution. As costs are explicitly imposed on polluting activities, these tools serve as an incentive for polluters to change their behavior through management or treatment of wastes prior to release, including making changes in production technology to benefit the environment. They also relate to production volumes and resource utilization in an appropriate way. Pollution-related taxes, charges and fees can be used in the following ways:

   - Product charges/ taxes refer to collection of charges or taxes from products that cause pollution problems, such as farm chemicals. They produce a change in the relative price of the chemical products concerned compared with substitutes such as organic materials. This should serve as an economic incentive to farmers and others to reduce their use of products that damage or destroy the environment.
   - Tax/ fee exemption is used to support pollution prevention and control activities and help manage environmental pollution. Thus, for example, favorable tax treatment or tax exemption might be given for products or equipment believed to pose relatively low environmental risks.
   - User charges involve collection of fees from polluters through provisions of central or local government treatment services. Levels of charges can be determined according to the volume or type of pollutants/polluted materials to be managed/treated, such as whether they are infected, or consist of dangerous refuse or household wastes, etc.
   - Effluent charges refer to collection of fees due to release of wastes such as polluted waters, *etc*, and are based on the volume and concentration of the waters released to public waterways, *etc*.

- Administrative charges involve collection of fees arising from the management of environmental problems. These are collected from polluters, often together with a license fee for each activity for each year.

2. **Financial support measures** refer to provision of positive incentives to enable polluters to manage pollution problems with financial support from the government. This support might take various forms, such as partial investment subsidies, interest at lower than market rates (soft loans) via loan sources established by financial institutions (such as the Bank for Agriculture and Cooperatives), environmental funds, *etc*. Financial support can also take the form of grants or cash subsidies for pollution control facilities. Financial assistance is used for activities involving waste treatment or reductions in pollution, in the form of end-of-pipe treatment, or changes in production methods or technology to more environment-friendly ways.
3. **Eco-labeling** is a type of positive incentive measure through publication of standards and performance certification, *eg*, to show that production was achieved using environment-friendly technology, proper/suitable waste treatment, *etc*. Another variant is product identification and certification, such as labeling of agricultural products as being chemical-free and safe for consumers. Eco-labeling should lead to positive effects for businesses or people involved in building up markets for labeled products, and thus serve as an incentive for producers to implement eco-labeling.
4. **Deposit-refund systems** require a monetary deposit at the time of sale of a product. The deposit is returned when the item is returned at the end of its use. One of the objectives is to discourage illegal or improper disposal of waste products. Under conditions of the deposit-refund system, consumers incur additional costs in handling used products which are normally harmful to the environment, such as various types of packages, batteries and rubber tires. When these products (which can still be recycled) are returned, the refund of the deposit increases the economic value of the product while, and reduces environmental problems, particularly in terms of the level of funds needed to manage the wastes. If some consumers are not able to return the residual product, deposits retained become revenues that can be used for management of pollution problems in the future.
5. **Marketable permits** are measures intended to regulate volumes of wastes so that they remain at an acceptable level. Marketable permit systems work on the basis of a limit on the total amount of permitted releases of a pollutant. Trading in permits is allowed among polluters in order to minimize the cost of achieving the emissions limit specified. Those who are able to reduce their waste at relatively lower cost are able to sell their permits to those who cannot treat or reduce their waste based on their existing permits or have higher costs. Trading of permits or waste release has to go through a marketing channel, and the price of permits is based on supply and demand. In this system, those who can treat or reduce release of their wastes can also receive payment or rewards in the form of income from the sale of permits. At the same time, those who cannot treat their wastes have to pay a cost for their discharge. Thus, such systems offer positive incentives through the income arising from sale of permits, and negative incentives through payments needed to buy permits to discharge wastes. These incentives can lead to changes in behavior of polluters and help reduce pollution problems.
6. **Information/ public disclosure** on environmental performance has provided a strong incentive for polluters to reduce their polluting emissions. When such information is made easily accessible to the public, workers and local communities should become more aware of the environmental risks that they face. If information disclosed to the public is negative, *eg*, the level of pollutants being released in excess of standards, this should lead to pressure for polluters to reduce their polluting activities in order to maintain their status and the image of

their business operations. On the other hand, if the information being disclosed to the public is positive, such as a list of industries that are able to reduce or treat their wastes, this can help to form a good image of the industries in the public mind, and good public relations with their employees and local communities. Disclosure of information on a positive long-term environmental performance record could affect business operations by making their products more desirable for consumers.

5.2.2. Experience with economic incentive measures

The various economic measures mentioned above can be used to solve pollution problems in many ways. In this study, focus is on water pollution problems in the Ping River Basin. Thus, both worldwide experience with such measures and some applications found in Thailand have been reviewed in relation to managing wastewater quality problems arising from three main pollution sources: communities, industry and agriculture (Figure 5-9).

Figure 5-9. Experience with economic measures reviewed by the study

Economic measure	Wastewater source					
	communities		industry		agriculture	
	international	*Thailand*	*international*	*Thailand*	*international*	*Thailand*
Taxes & charges/fees						
• product charge/tax		X	X		X	
• tax/fee exemption			X	X	X	
• user charges	X				X	
• effluent charge	X	X	X	X		X
• admin charges			X		X	
Financial support						
• environment fund		X	X	X		X
• subsidies	X	X	X		X	X
Certification / labeling		X	X	X		X
Refundable deposit						
Tradeable permits			X			
Public disclosure		X	X	X		
others				efficiency	toxic VAT	Q_GAP

5.3. Participatory development of incentive measures

Based on identification of pollution sources in pilot sub-basins and review of experience with economic incentive measures in Thailand and internationally, economic measures with potential for application in addressing problems found in pilot sub-basins were identified. These measures are summarized in Figure 5-10 according to the type of pollution problem that they could help address.

In order to further explore the potential for application of these measures using a participatory approach, pollution source sites selected as case studies in each of the pilot sub-basins were matched with potential economic measures according to the main type of pollution source at the site, as shown in Figure 5-11.

Figure 5-10. Summary of measures with potential for use in managing pollution problems

Economic measures		Supportive measures	Social measures
Policy measures	Measures to be used with polluters		
Community – Wastewater			
	1. Subsidies for building central treatment facilities 2. Charges for wastewater treatment. 3. Financial measures to promote "the use of septic tanks". 4. Projects to manage areas used by food booths, by zoning and supporting the installation of an area for washing and the collection of wastes.		"community monitoring system" project
Community – Solid Waste			
1. Tax on the production of plastic bags / foam 2. Promotion of a deposit-refund system 3. Tax (or charge) reduction for materials or packages that can be re-used or refilled	1. Project that sells garbage bags that are classified into three colors and sizes, with no fee for garbage collection 2. Marketing measures to promote the business of waste collectors (Sa-Leng) 3. Project to promote the production of compost fertilizer from wastes in the community through financial and marketing measures	Promote cooperation to reduce plastic bag use in commercial & wholesale centers & convenience stores, by public relations or certify environment-friendly businesses.	community monitoring system" project
Industry			
	1. Clean technology project 2. Effluent tax (charge) 3. Charges for wastewater treatment 4. Financial support for installation, etc, of central treatment systems 5. Financial support for on site treatment		community monitoring system" project
Agriculture – Crops			
Product charge	1. Incentive measures for use of organic materials to substitute for synthetic chemicals • Providing credit in the form of organic materials (credit in kind) • Project to produce organic materials by farmers (as individuals or groups) through financial and technical support 2. GAP (Good Agricultural Practice) and Q standardization 3. Promotion of integrated pest management (IPM system) and certification 4. Safe agriculture project (contract farming in form of agreements to insure price and quality)	1. Demonstration production plots using organic materials 2. Mobile agricultural clinics 3. Safe agriculture business network	community monitoring system" project
Agriculture – Livestock			
	1. Subsidy for the production of biogas by pig and cattle farms • Low interest credit • Partial financial support 2. Financial support for setting up on-site waste treatment for livestock farms (meeting farm standards) through dairy cooperatives 3. Measures to support the processing animal manure to produce fertilizer pellets		"community monitoring system" project

Figure 5-11. Pollution sources selected as case studies in pilot Ping River sub-basins

Sub-Basin	**Community Size**			**Industry**	**Agriculture**	
	Small	*Medium*	*Large*	*product*	*Crop*	*Livestock*
Ping part 1 Sub-Basin					Tangerine, Longan, Maize, Rice	
Mae Kuang Sub-Basin		Sankhampaeng, Pasang, Umong, Sansai Luang		Mulberry (*Sa*) paper, Dyeing, Fermented garlic, Community liquor		Swine, Dairy cattle
Ping part 5 Sub-Basin	Banpotphisai, Kao-liew, Nakhonchum, Pakdong, Klongklung, Khanuworaluck-buri, Salokbat, Thamakheua, Thaphutsa, Mae Lad TAO, Klong Lad TAO	Muang Khamphaengphet (also solid waste)	Nakhon Sawan		Tangerine, Rice, Mali rice	

5.3.1. Opinions of polluters regarding proposed economic incentive measures

Incentive-based mechanisms are widely used and accepted in environmental management. They are used as instruments to give those responsible for pollution an incentive to change their behavior and adopt less polluting activities. But if economic measures are to be successful in application, measures that have potential to solve environmental problems must be fully accepted by the stakeholders involved.

Thus, this section summarizes views on the importance of, and opinions about, measures with potential for use in managing water quality in the Ping River Basin. These views are the results of dialogue with representatives of each category of polluters identified as case studies in the three pilot sub-basins. Overall attitudes and feedback expressed about the potential of the measures presented are discussed according to the three major pollution source categories - community, industry and agriculture.

Community sector opinions on economic measures

The main source of community-related pollution affecting the quality of the Ping River is wastewater from households, businesses and the various service-oriented areas. Another problem is leachates from community solid wastes, particularly when they have been buried close to public waterways. Thus, the measures discussed are intended to provide incentives to solve community-related pollution problems arising from both wastewater and solid waste. Opinions were received from representatives of all case study municipalities and TAOs.

Opinions about measures to assist with community wastewater pollution

The economic measures with potential for use in managing community-related problems arising from wastewater were discussed with representatives from municipalities and TAOs, as indicated in Figure 5-12.

Figure 5-12 Ranking of economic measures for managing community wastewater

Sub-Basin	Size of municipality[1/]	Number of respondent	Economic measure[2/]			
			Subsidy to build central treatment facilities	Charges for wastewater treatment	Financial support to promote use of septic tanks	Zone food stalls & install areas for washing & collecting wastes
Ping river Basin	Small	9	2 (8.63)	4 (5.06)	1 (8.81)	3 (5.44)
	Medium	6	2 (7.88)	4 (6.75)	1 (9.07)	3 (7.75)
	Big	1	3 (5.00)	2 (7.00)	1 (10.00)	3 (5.00)
Mae Kuang Sub-Basin	Medium	5	2 (7.75)	4 (4.50)	1 (8.13)	3 (7.50)
Ping part 5 Sub-Basin	Small	9	2 (8.63)	4 (5.06)	1 (8.81)	3 (5.44)
	Medium	1	3 (8.00)	2 (9.00)	1 (10.00)	3 (8.00)
	Large	1	3 (5.00)	2 (7.00)	1 (10.00)	3 (5.00)

1/ *Small-sized municipalities have residents of not more than 10,000*
Medium-sized municipalities have residents between 10,000 and 49,999
Large-sized have residents of 50,000 or more

2/ *Figure in parenthesis indicates average score from 10*

Views of these important stakeholder representatives in the relative potential importance of the four types of economic measures presented for consideration can be summarized as:

1. *Financial support to promote use of septic tanks* was assigned the highest importance. Large, medium and small-sized communities all agreed on the appropriateness of this measure. The relative importance of this measure is due to the fact that septic tank installation solves the problem at an early stage by treating wastewater before it is released to public waterways. It is also a relatively low-cost option and is easy to implement.

   - Small-sized municipalities see use of septic tanks as important because it would enable each person in the community to become aware of the need to treat wastewater that they produce, and to participate in preventing environmental problems in their own community. This measure enables treatment of wastewater at the outset, and can be easily implemented even in a small community. On the other hand, acceptance in a small-sized municipality or TAO may be limited because it increases the expense burden in communities that often have low incomes, very small budgets for environmental management, and populations that do not attach much importance to the environment or pollution problems. Thus, weaknesses of the measure lie in the budget, especially when wastes are collected and managed together, and in campaigns not comprehensive enough to reach everyone.

   - In medium-sized municipalities the impact of the measure may be limited by lack of acceptance by communities and business enterprises. This may occur because a municipality has characteristics of an urban community and it is difficult to gain access to the people. Thus, provision of public relations information could be a useful channel for promoting this measure.

2. *Providing a subsidy to construct a central wastewater treatment facility* was seen as the second most important economic measure to help solve water quality problems, especially by small and medium-sized municipalities. This may be because most do not currently have a central treatment facility, whereas large communities either are already using them or are in the process of constructing them. Thus, large municipalities consider establishing charges for

wastewater treatment more important than subsidies for installation of a central treatment facility. Small- and medium-sized municipalities believe this measure would also bring systematic management, easier monitoring and technical efficiency. Its weakness lies in high investment costs and difficulties involved in its administration and implementation, as well as subsequent problems of collecting wastewater treatment fees.

3. *Designation of food stall zones and joint washing and waste collection areas* was the third-ranked economic measure. Medium- and small-sized municipalities gave it importance because it is easy and convenient to implement and control. There is concern, however, that if designated zones are found unacceptable, spread of food stalls at various points outside the zone could lead to further difficulties for assembly or zoning.
4. *Collection of fees/charges for wastewater treatment* had the lowest score of the 4 measures presented, and was accorded the least importance from participants' perspectives. They indicate a major weakness is lack of acceptance by people of the need to pay the fees or charges. This would cause conflicts between the municipal authorities and the population, which would, in turn, become a political issue. On the other hand, the measure has the strength of generating income that can be used for the management and administration of the wastewater treatment facility, and to improve the locality.

   Even though the collection of fees/charges for wastewater treatment is less acceptable than other economic measures, it is thought to be necessary for management of the environment. Although it establishes a negative incentive, it will certainly make polluters aware of the problems they have created and the attempt to reduce or solve them on the basis of the polluter pays principle. If people do not cooperate when the measure is introduced, however, efforts to collect fees/charges may fail. Social measures in the form of public relations or a campaign to build public consciousness and make people aware of the burden and problem would seem to be a prerequisite for this measure to be implemented successfully.

Opinions about measures to assist with community solid waste pollution

Economic measures with potential for use in managing community-related problems arising from solid waste pollution were discussed with representatives from small and medium-sized municipalities and TAOs located within the portion of the Ping part 5 sub-basin that is within Kamphaengphet province, as indicated in Figure 5-13.

Although scores given to alternative measures are quite similar, views of these important stakeholder representatives regarding the relative potential importance of the three types of economic measures presented for consideration can be summarized as:

1. The measure to *sell color- and size-coded waste bags* was accorded highest overall importance. The medium-sized municipality gave it the top ranking, but small-sized municipalities considered it the second most important measure. The strength of the measure was seen to be its potential to reduce the quantity of wastes and to make household waste segregation simpler. Its weakness is that municipalities receive no income from garbage collection fees or charges.
2. The measure to *promote production of compost from community wastes through financial/ marketing support* was ranked second in importance. Small-sized municipalities gave it the highest ranking because it enables both waste reduction and reuse of materials, which may be farm, food or vegetable waste, *etc*. Its weakness is that it does not solve problems of non-degradable wastes.

Figure 5-13 Ranking of economic measures for managing community solid wastes

Sub-Basin	Size of municipality[1/]	Number of respondent	Economic measure[2/]		
			Pre-paid garbage bags / no garbage collection fee	Finance/marketing support to produce compost from community wastes	Marketing to promote business of waste collectors (*Sa-Leng*)
Ping river Basin	Small	7	2 (8.00)	1 (8.17)	2 (8.00)
	Medium	1	1 (9.00)	2 (8.00)	3 (7.00)
Ping part 5 Sub-basin	Small	7	2 (8.00)	1 (8.17)	2 (8.00)
	Medium	1	1 (9.00)	2 (8.00)	3 (7.00)

: [1/] *Small-sized municipalities have residents of not more than 10,000*
Medium-sized municipalities have residents between 10,000 and 49,999
Large-sized have residents of 50,000 or more
[2/] *Figure in parenthesis indicates average score from 10*

3. The proposed marketing measure to *promote the business of waste collectors* or sa-leng was the least acceptable measure presented. The measure's strength is its ability to reduce amounts of non-degradable waste through recycling, while also increasing incomes and improving livelihoods of the sa-leng group. Its weakness is that it may be hard to implement because: a) the group of cart-driving buyers has little knowledge about separating wastes considered dangerous; b) some groups of cart-driving buyers tend to steal or destroy assets in public areas, and it is difficult for municipalities and TAOs to manage or control this type of activity. And in practice, municipalities and/or TAOs would still need to administer, collect and manage residual wastes not taken by cart-driving buyers, which are likely to include toxic or poisonous materials.

Industrial sector opinions about economic measures

Four types of community industries were included as case studies, including those producing community liquor, pickled garlic, mulberry (s*a*) paper, and dyed cloth. Their views on five potential economic measures are summarized in Figure 5-14.

Figure 5-14. Ranking of economic measures for managing industrial wastewater

Sub-Basin	Type of industry	Number of respondent	Economic measure[1/]				
			Clean technology program	Subsidy for on-site treatment	Subsidy for joint wastewater treatment	Charges for wastewater treatment	Effluent charges
Mae Kuang Sub-Basin	Community liquor	1	1 (10.00)	1 (10.00)	1 (10.00)	2 (3.00)	2 (3.00)
	Fermented garlic	3	2 (9.33)	1 (9.67)	1 (9.67)	3 (7.67)	4 (6.00)
	Dyeing	5	4 (6.80)	1 (9.60)	2 (9.00)	3 (7.80)	5 (6.20)
	Mulberry (*Sa*) paper	2	4 (5.50)	2 (6.50)	1 (7.50)	3 (5.00)	3 (5.00)

[1/] *Figure in parenthesis indicates average score from 10*

These industries fall into two groups on the basis of the characteristics of pollutants in their wastewaters, including problems caused by the pollutants. Group 1 includes the community

liquor and pickled garlic producers; while group 2 consists of mulberry paper production and the dyeing industry. Wastewaters of the latter group characteristically contain insoluble solids, making wastewater treatment and management more difficult and complicated, often leading to conflicts with communities surrounding the factories.

Opinions from Group 1: community liquor and pickled garlic industries

1. Regarding economic measures for use in solving wastewater problems from Group 1 community industries, both the community liquor and pickled garlic industries accorded greatest importance to *financial support measures for setting up either a joint wastewater treatment system for the industry or on-site treatment systems* – both measures were given similar average scores. The scale, discharge patterns and treatment technical considerations for these two types of community industries suggest that such subsidy measures may also help community industries upgrade the type of treatment provided to more efficient systems. Views of representatives from the two industries indicate the strength of the financial support measure would be the resulting reduction in their own cost burden in setting up wastewater treatment. Especially for joint treatment systems, the weakness of the measure is in wastewater collection, and in negotiations among and between the businessmen.
2. The next most important measure in the view of the representatives of these two industries, is the *clean technology project*. For community liquor factories this might take the form of a tool to measure the amount of sugar or alcohol in the fermentation vat. This would improve liquor quality and reduce the risk of fermenting fluid being destroyed or fed to animals (*e.g.* pigs). The strength of this measure is that it solves the environmental problem directly, while providing indirect benefit by improving the reputation of the factory, which will be seen as being environment-friendly. Its weakness lies in its inability to deal with environmental problems as they occur, and to treat wastewaters to a high standard.
3. The *collection of effluent taxes and charges for wastewater treatment* are ranked at the very bottom of the list in importance, especially by the representative from a community liquor factory. This may be due to the resulting increase in the cost burden for the industries. Even though they are not very attractive to polluters, these measures would make businessmen aware of the environmental or external costs resulting from their operations, as well as the need to make more economic use of water.

Opinions from Group 2: textile dyeing and mulberry paper industries

1. Like those in the first group, the textile dyeing and mulberry paper industry representatives placed a high level of importance on *financial support for installing joint wastewater treatment facilities or on-site treatment systems* – average scores of these two economic measures are not very different. Treatment of wastewater with high suspended solids content and insoluble color particles usually depends on use of expensive and technically complicated measures and techniques that may not be suitable for community industries. Methods using chemicals to alter dyes to be more amenable to biological degradation do not work for all types of dyes, and can produce derivatives that adversely affect human health. Since systems that facilitate aerobic degradation of solids are better but have high investment costs, financial support may be needed to meet acceptable standards of wastewater treatment.
2. *Collection of charges and fees for wastewater treatment* was regarded by dyeing industry representatives as being of secondary importance. It would, however, tend to make water use more efficient in the industry because excessive use would increase their costs.
3. The *clean technology project* is ranked third. Since new technologies might enable use of smaller amounts of chemicals that are harmful to the environment, or allow a move from more to less concentrated colors, this measure may allow the industry to solve wastewater problems

directly and more efficiently. It may also help reduce costs through clean technology program inspections and suggested improvement in production processes. The main weakness of this measure is a lack of experts capable of transferring appropriate technologies to those involved, so that business owners may not feel confident problems can be solved efficiently.

4. *Collection of effluent taxes* was considered to have the lowest value of measures presented, because it increases production costs directly, which will inevitably affect the competitive ability of these small community industries.

Agricultural sector opinions on economic measures

Economic measures related to activities in the agricultural sector are assessed according to those directed toward crop production, and those focused on livestock production.

Opinions on economic measures relating to crop production

Agricultural activities conducted in upper and lower Ping River sub-basins produce a diverse range of cultivated crops, including rice, other field crops (*e.g*. maize), horticultural crops (*e.g*. tangerines, longan) and ornamental plants (*e.g*. jasmine). This leads to use of considerable amounts of agricultural chemicals, such as fertilizers, herbicides, pesticides, growth hormones, *etc*, which can have negative environmental impacts on soil, water and atmospheric quality. Thus, incentive measures presented to farmers in this study are intended to reduce rates of chemical use or to change production systems to be more environmentally friendly. Five economic measures were offered for discussion in order to obtain opinions from farmer representatives, as shown in Figure 5-15.

Overall views of farmers growing all 5 crop types in both sub-basins can be summarized as:

1. The project for *chemical-free agriculture with a contract farming mechanism for price and quality assurance* was the highest ranked measure for reducing agricultural problems in both sub-basins. Most farmers held this opinion, especially if they felt they would be able to increase income stability by reducing marketing risks in selling their farm produce. It would also enable farmers to gain knowledge and other inputs from contractors. The weakness of the measure may lie in the pricing mechanism because prices of produce sold in local markets during some periods may be higher than the contracted price. Some farmers also lack confidence in implementation of agreed production quality standards, and in some cases companies or merchants/traders may take advantage of farmers by making slow or delayed payments.
2. The *GAP (Good Agricultural Practice) project and certification of Q standard* was the second-ranked economic measure. This measure already exists and farmers felt its strength comes from its systematic management on the basis of safety standards covering all aspects of the production process. It includes safety of the farmers within the process of certifying the standard of the produce. The measure also creates confidence in the minds of consumers, so that products meeting the Q standard can be sold at higher prices – which helps farmers to obtain higher incomes. On the other hand, qualification criteria to join the project are strict, and includes proper documentation to show farmers owns their land. This means that farmers owning no land cannot join the project. The project also emphasizes transfer of knowledge from experts who make recommendations and continuously monitor work. Farmers think for the project to be successful, they should have continuous access during implementation to an officer or organization that can provide relevant knowledge. Lack of this type of assistance caused maize farmers to rate this measure last.

Figure 5-15 Ranking of economic measures for managing wastewater from crop production

Sub-Basin	Type of crop	Number of respondent	Economic measure[1/]				
			Safe agriculture project (contract farming)	Q-GAP (Good Agricultural Practice & Q certification)	Incentives to substitute chemicals with organic materials		IPM (integrated pest management program & certification)
					Credit in kind: organic inputs	Finance-tech support to produce organic materials	
Ping river Basin		**61**	**1 (8.88)**	**2 (8.20)**	**3 (7.99)**	**4 (7.48)**	**5 (6.80)**
Ping part 1 Sub-basin	Tangerine	20	1 (8.75)	1 (8.75)	3 (8.35)	2 (8.45)	4 (7.75)
	Longan	2	1 (10.00)	1 (10.00)	1 (10.00)	3 (8.00)	2 (8.50)
	Maize	8	4 (5.25)	5 (5.13)	3 (7.25)	2 (7.63)	1 (8.13)
	Rice	6	1 (9.00)	2 (8.67)	3 (8.33)	4 (7.83)	5 (6.83)
Ping part 5 Sub-Basin	Tangerine	7	1 (9.00)	4 (6.71)	3 (7.29)	2 (7.43)	5 (5.14)
	Rice	11	1 (9.64)	3 (7.18)	5 (6.55)	4 (6.73)	2 (7.55)
	Jasmine	7	3 (6.86)	1 (7.86)	2 (7.43)	4 (6.43)	5 (5.00)

[1/] *Figure in parenthesis indicates average score from 10*

3. Creation of incentives to use organic matter instead of chemical substances to build soil fertility, including *in-kind (organic) credits* and *provision of financial and technical support* for farmers producing organic materials, were ranked third and fourth, respectively. Farmers agreed that both measures are strong. Both can lead to reductions of investment needed in terms of production inputs, and make the whole process safe in terms of the health of farmers and consumers. Soil structure is rehabilitated and improved, as are other soil properties, due to increased organic matter content, which also reduces soil erosion. The quality of water resources is improved because of less accumulation of agricultural chemicals, so that farmers can use water for animals or plants from any source on their farms. Air quality is improved because of reduced spraying of chemicals, which poses danger both to farmers themselves and to others living in the area.

   Farmers agreed the weakness of these measures lies in use of organic matter instead of chemicals. Some organic materials are less long-lasting than chemicals and/or do not provide the complete set of minerals necessary for crops, and their effectiveness can be quite slow. Thus, many farmers are hesitant to use large amounts of organic matter, and incentives derived from these measures are not as great as might be expected. Farmers also think technicians and experts should be available to come and provide knowledge about benefits and properties of organic matter to farmers, in order to encourage their use in place of chemicals.

4. *Promotion of pest management using IPM and certification of standards* was the lowest rated measure overall. Farmers agreed that IPM improves environmental conditions and encourages increases in crop diversity, which can increase farmers' incomes. This was the reason maize farmers rated this measure first. But most farmers felt they lacked sufficient knowledge and understanding of the implementation of IPM. Thus, application of IPM to a diversified plot sometimes leads to a decrease in yields of main products, and hence income. Another limitation is the relatively small size of farms, which cannot normally accept or afford risks of agricultural damage arising from not using chemicals.

Opinions on economic measures relating to livestock production

Two types of livestock farming – pigs and dairy cattle – were selected as case studies in the Mae Kuang sub-watershed. These two activities create water pollution problems because farmers normally discharge wastewater in the form of manure and other liquors that flow untreated into public waterways. This causes pollution and the quality of the receiving water is no longer good enough for it to be used by people living in the surrounding area. The three measures presented in dialogue with livestock farmers should enable livestock farms to achieve quality standards specified by the Department of Livestock Production. Results of the dialogue are shown in Figure 5-16:

Figures 5-16 Ranking of economic measures for managing wastewater from livestock

Basin/Sub-Basin	Type of livestock	Number of respondent	Economic measure[1/]			
			Support processing animal manure to fertilizer pellets	Subsidy to produce biogas		Subsidy of on-site treatment for dairy farm through coops
				Partial financial support	Low interest credit	
Ping river Basin		**28**	**1 (8.29)**	**2 (8.00)**	**3 (7.69)**	**4 (7.64)**
Mae Kuang Sub-Basin	Swine	9	2 (8.78)	2 (8.78)	1 (9.33)	3 (8.11)
	Dairy cattle	19	1 (7.79)	2 (7.21)	4 (6.05)	3 (7.16)

[1/] *Figure in parenthesis indicates average score from 10*

Views of pig and dairy farmer representatives can be summarized as:

1. *Support for processing animal manure into fertilizer pellets* received the top rating. The strengths of this measure are seen to lie in the ability to recycle waste into fertilizer, and in reduction of production costs, while increasing farm incomes through sale of excess fertilizer. In dairy farming, it also helps to solve the problem of wastes in public areas and the smell of the manure. Its weaknesses are that processing of animal manure requires both knowledge and investment, and that if production of fertilizer is greater than demand, distribution of excess fertilizer could create other problems.
2. *Support of biogas production in the form of credit at low interest and/or partial financial support* was ranked second. The strengths of this measure are that it can solve problems of acrid smells in the local area, and that production of biogas could help reduce farm energy costs. Weaknesses are the need for a substantial area for construction, and high investment costs of biogas treatment. It is also important to include safety systems for biogas production, to prevent gas leakage and explosions. This includes need for regular safety inspections. Low interest credit for biogas production was rated first by pig farmers.
3. *Support for construction of simple wastewater treatment systems through dairy cooperatives* was the lowest ranked measure. According to farmers, the strength of this system is in solving wastewater treatment problems and improvement in the quality of effluent discharged to public waterways. This would enable farms to receive certification from the Department of Livestock Promotion. Its weaknesses are needs for a considerable area on which to set up the treatment facility, and high investment costs. Beyond this, the farmers have to bear operating and maintenance expenses of the system.

5.3.2. Opinions on social measures

The only social measure offered in discussion meetings was the *community monitoring system* program. All participants appeared to agree with the importance of this social tool because it allows local people to commit to and participate in monitoring of activities that may cause environmental damage in their locality.

Setting up an effective environmental network of local people will strengthen its activities and efficiency, and lead to long-term social and ecological sustainability. Weaknesses may arise, however, if some people are unwilling to collaborate because they perceive that the program would not benefit them directly, and because people must bear the opportunity costs of their participation. Security could be another problem under some circumstances, making those joining the network reluctant to talk about or report on damage, activities, *etc*.

In practice, networking is a time consuming process that needs to build knowledge, linkages, trust, and good perceptions for environmental management. Because of this, municipalities and local government organizations need to work closely with local people to improve knowledge and to develop a strong community environmental work force. The program should be evaluated continuously if its management is to be successful and sustainable.

5.3.3. Opinions concerning supplementary measures

Community sector. One supplementary measure was presented to representatives of the community sector. It was intended to help solve problems of solid waste, through collaboration with the commercial sector. It involves collaboration with large wholesale centers, department stores and convenience stores, in *reducing use of plastic bags through certification of environmentally-friendly businesses.*

Representatives from small- and medium-sized municipalities and TAOs agreed with this measure because it gives the business sector an opportunity to participate and become responsible for solution of environmental problems, especially those arising from excessive use of plastic bags. Waste generated from widespread use of plastic bags poses disposal problems as the bags themselves are not biodegradable and disposal involves some difficult waste management techniques. Municipalities spend a large amount of money each year on waste disposal. Implementation of this measure will need effort to inform and educate the public about the objectives and benefits of the program. Otherwise, it might have a negative effect on the sales of participating firms.

Agricultural sector. Three supplementary measures were presented to farming representatives to help in reducing water pollution from the agricultural sector. included the following:

1. Development of a *safe agriculture business network* was ranked as the supplementary measure of most importance. Such a network would help reduce use of chemicals in farming and, hence, agricultural water pollution. From the participants' perspective, networking of safe agriculture businesses will generate exchange of knowledge, and field or technical expertise with respect to food safety and related matters. These will serve as inputs relevant to further development of better production processes or systems in terms of quantity, quality and safety. In addition, linkages may provide a wider market channel and advertisement for the produce of group members. This should increase the desirability and sales of their produce. The weakness in the scheme, however, may be associated with the lack of available experts. A strong and capable leader and working team will be needed to drive the program successfully.

2. *Demonstration production plots using organic materials as fertilizers* were rated second in importance. The strength of this measure is that it actually demonstrates production and management processes, as well as output from farm sites in local circumstances and surroundings. Thus, greater credibility and reliability should be gained for the organic campaign if the demonstration farm operates successfully. This measure also enables local farmers to participate and learn, gaining experience that can then be applied to their own farms. Limitations in budget and plot sites advocated for demonstration would, however, prevent wide application of this measure in practice. Farmers living significant distances from the demonstration plots would not benefit from visits because of the traveling and time costs involved.
3. *Agricultural mobile clinics* appeared to be of least important of the three supplementary measures presented. The strength of the measure would be that problems could be solved directly by technical advice from experts, and farmers could learn more about the appropriate use of chemicals and other relevant management techniques, to supplement local wisdom. But weaknesses pointed out include the non-continuous operation of the clinics and the expenses to be borne by farmers. Beyond this, the program will need to receive wide collaboration and input from academics and experts if it is to effectively meet the demand from farmers.

5.4. Implementing incentive measures

Information from the above activities was used to help refine assessments of economic incentive measures, and formulate recommendations on next steps toward implementing priority activities in each sub-basin. This included recommendations about roles of government agencies, development of indicators to monitor and evaluate their use, and guidelines for application of incentive measures in pilot sub-basins. Requirements for implementing recommended measures were too complex, however, to allow their establish-ment and testing during implementation of this project.

Thus, implementation efforts under the project focused on assistance with initial steps toward establishing selected high priority measures in pilot sub-basins. These efforts emphasized initial training related to high priority incentive measures for major target groups in all three sub-basins. Training was organized and coordinated by staff of the Office of Natural Resources and Environmental Policy and Planning, in collaboration with staff from other key agencies and universities. Key components of the training included:

Training to promote Good Agricultural Practices (GAP)

The objectives of this training were to improve farmer knowledge, understanding and awareness related to the good agricultural practices program, in order to increase the capacity of target farmers to conduct these activities in their own local areas. This includes developing their agricultural production to higher standards through use of more environmentally friendly production processes. Training was held on 19 June 2006 at Chiang Dao District of Chiang Mai province. Participants included 42 farmers from target groups in the Ping part 1 and Ping part 5 pilot sub-basins, as well as 8 local government staff from the Ping part 1 sub-basin. Farmers participating in the training volunteered to join the GAP program.

Participants identified problems associated with implementation of this incentive measure to include: (1) lack of farmer knowledge about chemical use, (2) shortage of farm labor with knowledge about good agricultural practices, (3) shortage of knowledgeable people to provide continuous advice and assistance, (4) high initial investment costs, (5) lack of product price standards, and (6) climatic conditions not conducive for cultivating some types of crops.

Needs for government support identified by participants were to: (1) provide tangerine entrepreneurs with knowledge about GAP, (2) organize regular training related to GAP, (3) provide knowledge about how to apply modern technology, (4) establish networks, receive membership applications and disseminate data at local community level, (5) provide price guarantees and find markets for agricultural produce, (6) provide materials, equipment and production inputs used in organic fertilizer production, (7) conduct monitoring of water and soils in agricultural production areas, (8) provide data on appropriate use of various types of chemicals, and enforce penalties for excessive use.

Training for campaigns for farmers to use organic fertilizers instead of chemical fertilizers

Objectives for this training were (1) to provide farmers with knowledge and understanding about full cycle production of compost, including production, funding sources and sales, and to enable them to apply these in their own agricultural areas; and (2) to increase awareness of the importance of applying compost to reduce the amount of chemicals used in agricultural areas. Training was held on 20 June 2006 at Mae Jo University in Chiang Mai province. Participants included 55 farmers from target groups in the Ping part 1 and Ping part 5 pilot sub-basins, 3 local government staff from the Ping part 1 sub-basin, and a member of the staff of the Agriculture Research and Development Office Region 1. Most farmers participating in the training were able to apply the knowledge they gained to their own local areas.

In terms of problems associated with implementation of this incentive measure, participants identified: (1) lack of farmer knowledge regarding chemical use, (2) lack of knowledgeable people to provide advice, (3) farmers have insufficient investment capital, and (4) production takes a long time.

Thus, their perceived needs for government support include: (1) provide knowledge regarding organic fertilizers, (2) conduct regular training, (3) assign a person to be based in the area to provide knowledge for farmers when they encounter problems, (4) provide more knowledge regarding modern technology that can be applied, (5) establish networks receive membership applications and data for dissemination in local communities, (6) provide price guarantees and locate markets for agricultural produce, (7) provide materials, equipment and production inputs used in organic fertilizer production, (8) conduct monitoring of water and soils in agricultural production areas, (9) provide data on appropriate use of various types of chemicals, and enforce penalties for excessive use.

Training to promote use of "clean technology" in cottage industries

Objectives of this training were (1) to provide cottage industry entrepreneurs with knowledge, understanding and awareness about application of clean technology in production processes and wastewater management; and (2) to provide adjustments for production processes that can be used to reduce wastes generated by cottage industry. Training was held on 8 July 2006 at the Agro-Industrial Product Improvement Institute of Kasetsart University. Participants included 41 people from mulberry paper producing cottage industries and 4 municipality officials, all from the Mae Kuang sub-basin. Entrepreneurs and officers received increased knowledge about clean technologies that they could disseminate to their local communities and use in adjusting their industrial activities.

Participants perceived needs for government support to include: (1) providing knowledge about clean technologies, (2) organize regular training, (3) assign a person to be based in the area to provide knowledge for entrepreneurs when they have problems, (4) provide knowledge about

application of modern technologies, (5) accept members interested in clean technologies, (6) provide information for dissemination at the local community level.

Training on management of community wastewater treatment systems

The objectives of this training were (1) to provide knowledge and understanding, and to increase awareness of local government officers related to all levels of management of community wastewater treatment systems, and (2) to help local government officials be prepared and able to manage construction of wastewater treatment systems. Training was held on 27 June 2006 at the Kamphaengphet Municipality office. Participants included 47 officers from municipalities and TAOs in the Ping part 5 sub-basin. They gained increased knowledge they can use in public relations and dissemination to communities and factories located in community areas, and they also began drafting projects to construct community wastewater treatment systems.

Problems identified by participants related to wastewater management include: (1) most TAO and municipalities have not yet constructed wastewater treatment systems, (2) they lack budgets and people with specialized knowledge, (3) insufficient land area available to local governments for construction of wastewater treatment systems.

Needs for assistance from the state to local governments include: (1) budgetary assistance, (2) people with specialized knowledge to introduce local governments to wastewater systems appropriate for particular areas, (3) conduct regular training related to technologies for wastewater treatment management, and (4) provide information related to modern technologies for local dissemination.

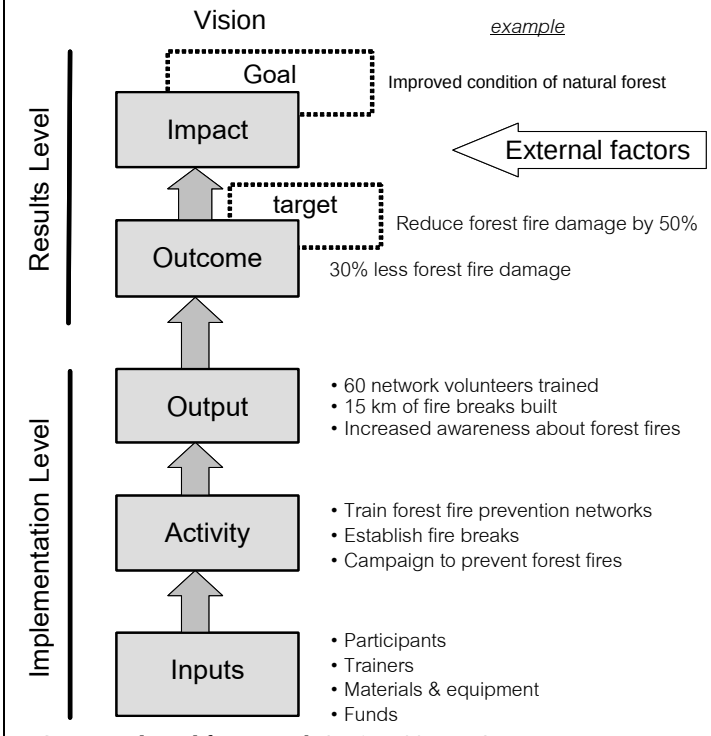
6. Component 4: Project coordination, results measurement & dissemination

In this era of globalization, there are growing pressures on governments and organizations around the world to respond to demands of both internal and external stakeholders for good governance, accountability and transparency, more development effectiveness and delivery of tangible results. Stakeholders wanting better performance include governments, parliaments, citizens, the private sector, nongovernmental organizations, civil society, international organizations, and funding organizations. Results-based monitoring and evaluation of policies, programs and projects is seen as an important tool for helping to achieve these goals.[5]

Results-based management[6] requires movement from traditional implementation-based approaches focused on project monitoring and evaluation, into the newer area of results-based approaches. The central question in a results-based approach is 'so what?'. In other words, governments or organizations may successfully implement projects, plans or policies, but have they actually produced the intended results? How do people know how much progress is being made toward longer-term goals desired by stakeholders?

A basic example of elements of results-based approaches is shown in Figure 6-1. Example information is for a project aimed at improving the condition of natural forests by reducing damage caused by forest fires, through a set of training, action and public education activities.

Figure 6-1. Logical chain of results-based management



Source: adapted from Kusek & Rist 2004, p.18

The lower part of the figure shows implementation components of the management process, including the planned activities, the inputs they use and the outputs they produce.

Results components are in the upper part of the figure. The outcome is the actual changes in conditions that are linked with activities and their outputs, in this case a 30 percent reduction in damage from forest fires. The outcome is assessed through comparison with targets that projects have set for themselves, which in this case was a 50 percent reduction in forest fire damage. The impact is the extent to which the outcome helps achieve the higher level goal toward which the activities are aimed. In this example, the goal improved condition of the natural forest. Higher level goals usually need to be achieved through several lines of activity. In our example, they might include reduced hunting, logging, land clearing, *etc*. Thus, impact assessment is usually in terms of contribution toward achieving the goal. For both outcomes and impacts, there are likely to be various other

[5] For more detailed discussion and references, see project report on results-based measurement [Thomas 2006]
[6] Also known as 'managing-for-results', 'performance-based' management, or other similar terms

factors that also influence the degree to which targets and goals are achieved. In our example this might include unusual rainfall, change in forest policy or economic conditions, etc.

The most prominent tool used for summarizing and presenting this type of logical structure is the Logical Framework matrix. Its basic components are shown in Figure 6-2. The vertical logic of the table reflects the components shown in the left side of Figure 6-1, while the horizontal logic shows how progress can be assessed, as well as assumptions and risks.

Figure 6-2. Typical Logical Framework format

	Narrative summary	Objectively verifiable indicators	Means of verification	Assumptions and risks
Results	**Goal** – the overall aim to which the project is expected to contribute	Measures (direct or indirect) to show the project's contribution to the goal	Sources of information and methods used to show fulfillment of the goal	Important events, conditions or decisions beyond the project's control necessary for maintaining the progress towards the goal
	Outcomes (or objectives) – the new situation which the project is aiming to bring about	Measures (direct or indirect) to show what progress is being made towards reaching the objectives	Sources of information and methods used to show progress against objectives	Important events, conditions or decisions beyond the project's control, which are necessary if achieving the objectives is going to contribute towards the overall goal
Implementation	**Outputs** – the results which should be within the control of the project management	Measures (direct or indirect) to show if project outputs are being delivered	Sources of information and methods used to show delivery of outputs	Important events, conditions or decisions beyond the project's control, which are necessary if producing the outputs is going to help achieve the objectives
	Activities – the things which have to be done by the project to produce the outputs	Measures (direct or indirect) to show if project activities are being completed	Sources of information and methods used to show that the activities have been completed	Important events, conditions or decisions beyond the project's control, which are necessary if completing activities will produce the required outputs
	Inputs	Resources – type and level of resources needed for the project Finance – overall budget Time – Planned start and end date		

Source: after Blakewell 2005, p. 3

Use of the Logical Framework matrix (or "Logframe") to summarize the basic structure of a project or workplan is a very widespread practice around the world. While its use has been strongly promoted by international donor institutions, it is also widely used in national institutions and large organizations, including the government of Thailand.

But the logical framework matrix is intended to be used as only one tool in what is known as the Logical Framework Approach (LFA). Seven important components of this approach are listed in Figure 6-3. The LFA is concerned with wider planning procedures of problem analysis, development of objectives and indicators, and identification of risks and assumptions, as well as how they are used to help build the overall program plan. At least in principle, this type of program planning should be based in participatory development of a consensus among a wide range of stakeholders on a program of work, which can then be summarized in a logical framework matrix.

While these planning and management approaches are very common, there are also two major types of criticisms about them [Blakewell 2005]. The first type of criticisms center on ways the logframe matrix is used, rather than on the concepts and processes that it promotes. For example, the logframe has been used to make a 'contract' between a project implementing organization

Figure 6-3. Major components of the results-based Logical Framework Approach (LFA)

1. Identifying clear and measurable objectives (results), assisted by logical frameworks.
2. Selecting indicators that will be used to measure progress towards each objective.
3. Setting clear targets for each indicator, for use in judging performance.
4. Developing performance monitoring systems to regularly collect data on actual results.
5. Reviewing, analyzing and reporting actual results in comparison with the targets.
6. Integrating evaluations to provide complementary performance information not readily available from performance monitoring systems.
7. Using performance information for internal management accountability, for learning, and for decision-making processes, and also for external performance reporting to stakeholders and partners.

Source: Blakewell 2005, p. 4-5.

and its funding agency, which results in the logframe being seen as a 'blueprint' for implementation. This reduces flexibility to respond to unforeseen issues, problems or opportunities that emerge during the project. The second type of criticism is directed toward the very simple logic used in the Logframe and the LFA. Many argue that the real world is much more complex than what is explained by categories of information in the Logframe. Truly meaningful development requires a very responsive, adaptive, and experimental approach that integrates learning and change during implementation of a project or program. This can result in pathways of change that are much more complex and indirect than what is usually reflected by information in a logframe or a results-based (LFA) approach.

Despite these criticisms, use of the logframe and the results-based (LFA) approach is very common and continues to expand. Since no feasible alternative methodology has been proposed by critics, many people, especially in government and larger organizations, see the logframe and results-based approaches to be the best available tools to help them organize their work, improve the performance of their management systems, and document their progress and problems for concerned stakeholders. Thus, many efforts are being made to help the process become as participatory, responsive and flexible as possible.

A results-based approach places strong emphasis on developing objectives and indicators for the results level, as shown in Figures 6-1 and 6-2. It is important to note, however, that monitoring of indicators at the implementation level is still required to provide information that is very important for assessing performance in results-based management systems. Furthermore, performance measurement must be linked with evaluation, reporting, and use of findings if the overall system is to function properly.

In order to help bring together these various lines of thinking and experience into a useful format, the World Bank has recently published a handbook on what needs to be done to build an effective results-based monitoring and evaluation system [Kusek & Rist 2004]. The handbook describes a 10 step process that is summarized in Figure 6-4, together with a simple key question to be answered through activities conducted under each step. This handbook is primarily directed toward development of systems by national governments. But since the steps and basic recommendations are very relevant for many types and levels of organizations, it would be very useful to have a version of this handbook with examples directly relevant for organizations at more local levels, such as RSBOs.

Figure 6-4. Ten Steps to building a results-based monitoring & evaluation system

	Step or Component of the overall process	***Key Question to Answer***
1	Conducting a Readiness Assessment	Do we have what we need to start?
2	Agreeing on outcomes to monitor and evaluate	What do we want to achieve?
3	Selecting key indicators to monitor outcomes	How do we know success?
4	Baseline data on indicators	Where are we today?
5	Planning for improvement – selecting results targets	How much change should we make during our projects or plan?
6	Monitoring for results	How do we measure change?
7	The role of evaluations	How do we know how much change resulted from our projects?
8	Reporting findings	Who needs to know about our information and findings?
9	Using findings	How will our information and findings help improve our work?
10	Sustaining the M&E system within the organization	How can we keep our system healthy and productive over the long term?

Source: adapted from Kusek & Rist 2004

If outcome measurement, monitoring and evaluation are to be fully integrated into the management system of an organization, it is very important to have high levels of stakeholder participation in all major types of activity. Since participation by local communities, groups and networks is an important reason for developing sub-basin organizations, strong efforts should be made to develop and apply tools to make their participation as effective as possible in activities that include: (1) defining outcomes and identifying indicators, perhaps using tools like participatory analysis and strategic planning; (2) conducting measurements and monitoring that use participatory methods and tools based on appropriate combinations of both scientific and local knowledge; and (3) using information in conducting analysis, program improvement, and further planning. Indeed, participation in all three types of activity should greatly increase understanding and the quality of results in each of the individual types. It should then become clearer where and why partnerships and further capacity building are needed to improve the overall process.

Building an effective results-based monitoring and evaluation system requires long-term effort and commitment. Thus, the World Bank handbook includes a 'readiness' assessment to help determine whether key commitments and basic capacities are in place and available.

Project studies have shown very substantial variation among sub-basins in the Ping River Basin, including the three pilot sub-basins under this project. Variation includes dimensions related to physical and ecological characteristics, to social, economic and cultural characteristics, and to the experience. capacity and general approach of local organizations and local governments. This appears to result in substantial variation in management approaches taken by watershed management organizations (RSBOs) in pilot sub-basins, and further differences are likely among organizations established in other sub-basins.

Thus, the project has proposed five alternative models of organization for RSBOs. Working groups in each sub-basin have been considering these different approaches as they draft sub-basin action plans and seek consensus on the initial design of a long-term management organization

appropriate for conditions in each of their sub-basins. The results of their considerations will influence the types of information their monitoring and evaluation system will need to provide, and how the information will be used. This, in turn, will influence which stakeholders and partners will need to be directly involved in operating and using the monitoring and evaluation system.

We are still only beginning to see emergence of issues related to interactions among sub-basins. The first concern seen is flooding in the Chiang Mai valley, which is resulting in concern about upstream land use. This raises the need for good monitoring and evaluation of how work plan outcomes affect flood-related environmental conditions. Results will be useful in interactions with other sub-basins located downstream.

This issue also points out the potential importance of monitoring and evaluation systems in providing information that is useful in negotiations among stakeholders. These types of negotiations can occur within a single sub-basin, or between local stakeholders and those representing the legitimate interests of downstream or larger society. Within a sub-basin, there may be important upstream-downstream issues such as water pollution or land use practices on sloping land that valley people believe are increasing risk of flash floods or landslides. External stakeholders may want evidence that activities in a sub-basin are not increasing risk of downstream main river channel floods, or are not destroying biodiversity or other resources important for the whole nation. Thus, another function of sub-basin monitoring and evaluation systems is its role in serving as a *negotiation support system*. And again, types of information the system needs to provide, and the appropriate roles for different stakeholders, will probably vary among sub-basins with different characteristics and conditions.

Another type of variation that sub-basin monitoring and evaluation systems will probably face relates to changes over time in national level policies. For example, activities to develop new laws related to water and community forestry have been going on for many years. It is possible, but still very uncertain, that such laws could be enacted in the near future. But terms and conditions in the draft laws are still not widely known by most people, and they may still be changed before they are finally enacted. Similarly, a new national 5-year plan is being developed, and various national policies are being modified. Current political turmoil at the national level may bring significant changes in national political leadership and many more changes in national policy. Even the basic support for developing sub-basin management organizations could be seen as associated with a political faction, which could lead to efforts by other factions to end all support.

Such change in national laws and policies can affect sub-basin management plans, activities, and expected outcomes and impacts. Thus, they can also affect the types of monitoring information that is needed, and especially ways in which outcomes are evaluated. In the results-based logical framework approach, these types of issues are seen as assumptions and risks. Many organizations that implement projects feel that risk management and coping with unexpected changes are critical for the success (or failure) of most development projects. Thus the assumptions column may be the most important part of the logical framework matrix [Blakewell 2005]. But much more emphasis is usually given to developing positive outcomes and indicators, so that consideration of assumptions and risks is often one of the weakest parts of the planning process. There is even some concern that too much attention to assumptions and risks could make the logic of a logframe become less clear, and thus reduce its chances for receiving funding.

Monitoring and measurement can tell managers and stakeholders what was done under an activity, project or workplan. Evaluation is needed to help them understand more deeply the quality of the work and why outputs have (or have not) resulted in the observed outcomes.

6.1. Results measurement framework

This section summarizes the proposed results measurement framework for sub-basin management organizations, and progress toward implementation in project pilot sub-basins.

6.1.1. Overall framework

Frameworks for monitoring and evaluation depend on objectives and important principles. Project-level monitoring and evaluation can generally be divided into two forms according to its characteristics and objectives:

- *Monitoring and evaluation of project implementation* (input monitoring & evaluation) emphasizes examining use of resources and implementation processes in order to evaluate efficiency of implementation, which requires information on project inputs and outputs.
- *Monitoring and evaluation of outcomes according to project objectives* (project results monitoring and evaluation) emphasizes evaluation of project results and impacts, and requires information on outputs, outcomes, and impacts.

Both of these types of monitoring and evaluation have characteristics that are similar in their level of importance, but they differ in their sources of information and in the timing of when they are conducted. For the first type, most data will come from agencies, implementers or project administrators, such as data on finance, personnel, or outputs from project implementation. For the second type, most information will be obtained from project beneficiaries or stakeholders, or from technical examination and measurement of results.

Results-based monitoring and evaluation is an important focus of this project component. But both forms of monitoring and evaluation are necessary, and their structures and implementation need to be linked together. Thus, the proposed monitoring and evaluation framework is based on a combination of both of these forms of monitoring and evaluation.

Levels of sub-basin management and operations

A monitoring and evaluation framework for pilot sub-basins also needs to consider the organizational and operational levels at which monitoring and evaluation will be conducted. Since the focus of this project is on development of new sub-basin management organizations and plans, it is also very important to consider the roles and responsibilities of existing organizations at other levels, and how they will be linked with the sub-basin level.

Experience under the project in working with all three pilot sub-basins has shown some similar directions in thinking about how sub-basin management organizations (RSBOs) should relate to other existing institutions and development plans. Implementation of at least most types of projects that use government funds is seen to be under the responsibility of local governments, provincial administrations, or agencies of the central government. These organizations already have their own planning systems, implementation procedures and budgets. They are also already required to collect and report various types of monitoring information related to projects they implement. There has been overall agreement that an RSBO should not try to compete with or duplicate these types of duties or functions. Thus, responsibilities and methods for most implementation-level monitoring and evaluation of projects will probably remain with these institutions.

All of these institutions are also seen as important partners participating in management processes under sub-basin management organizations (RSBOs). The role, responsibilities and leadership of each type of institution will depend on the type of organizational structure that is used in each sub-basin. There appears to be general agreement, however, that RSBOs will have important responsibilities in relation to the development, monitoring and evaluation of overall workplans for sub-basin management and development. Individual projects will be under the various strategies of overall sub-basin workplans. Thus, monitoring and evaluation at the results level will probably become a very important part of work managed and conducted by RSBOs.

Results under the first component of this project include specification of strategies, workplans and measures, together with various types of development projects for the three pilot sub-basins. Thus, the framework for monitoring and evaluation must set frames for two levels: the level of overall sub-basin development, which deals mainly with strategies and workplans; and the level of individual projects that are under each sub-basin development strategy and workplan. Accordingly, consideration of the framework for monitoring and evaluation is divided into two parts that specify a framework for project-level monitoring and evaluation, and a framework for workplan-level monitoring and evaluation.

Project-level monitoring and evaluation framework

Based on their experience with monitoring and evaluation systems under the results-based management approach of agencies in Thailand, project implementation consultants proposed a five step process for conducting monitoring and evaluation at the project level.

Frames and methods for monitoring and evaluation of individual projects, and especially parts related to outcomes and impacts, may vary according to types and categories of projects. This may be due in part to the project implementing agency or the agency evaluating the project, as well as to human resources and budget used in conducting monitoring and evaluation. Thus, the frame proposed here is not one that should be regarded as a definitive methodological framework. Rather, it is meant as an approach to make design, planning and implementation of monitoring and evaluation to be systematic according to the project cycle.

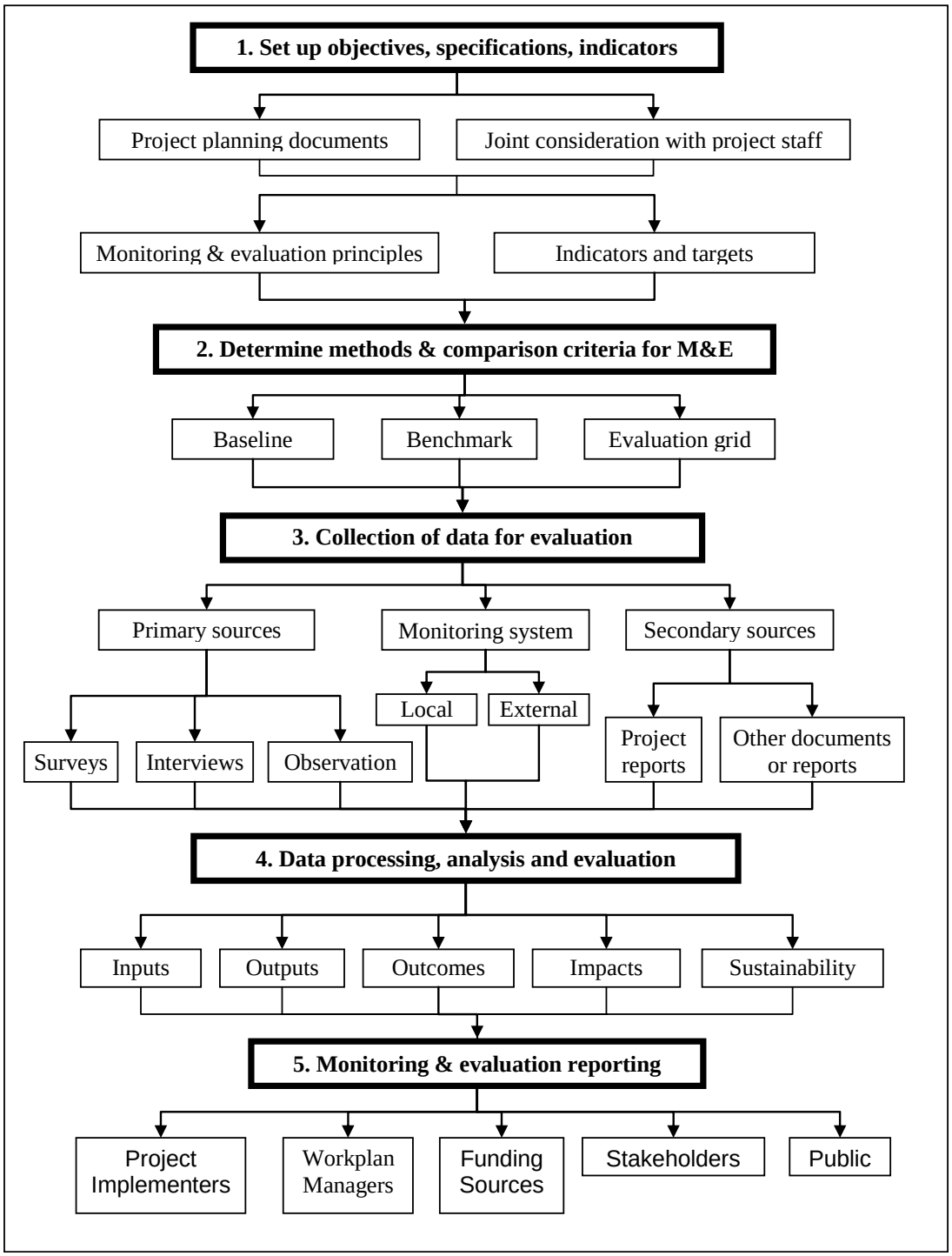
The frame for conducting project monitoring and evaluation has steps and important methods that must follow the sequence displayed in Figure 6-5. The main components of each step can be summarized as follows:

Step 1. Set up objectives, specifications and indicators

The objective of conducting this step is to specify the scope of the frame for monitoring and evaluation, which will depend on what is the objective of monitoring and evaluation. This will be linked to evaluation principles, and to indicators that will be used in evaluation.

This step begins with study, understanding and analysis of project management using the Logical Framework Approach as a tool in reviewing project organization. Under the government's results-based management (RBM) system, agencies managing projects must have specified objectives, outputs and outcomes for a project, along with clear measurable indicators and targets. These are shown in a project Logical Framework Matrix (Figure 6-6). A project analysis table can be used to clarify the basis for monitoring and evaluation and the specific objectives of evaluations to be conducted.

Figure 6-5. Steps & methods in implementing project monitoring & evaluation



Source: Panya Consultants

Criteria for selecting indicators used in the logframe matrix are:

- Indicators must be ***clear*** and correct, with no ambiguity about what is to be measured
- Indicators must be ***relevant*** to project objectives and needs of stakeholders
- Indicators must be ***economical*** in terms of cost, and have a clear data source
- Indicators must be ***adequate*** for use in measurements under evaluation principles of both efficiency and effectiveness
- Indicators must be ***useful*** for monitoring, and flexible if conditions change.

Figure 6-6. Model structure of a Logical Framework Matrix

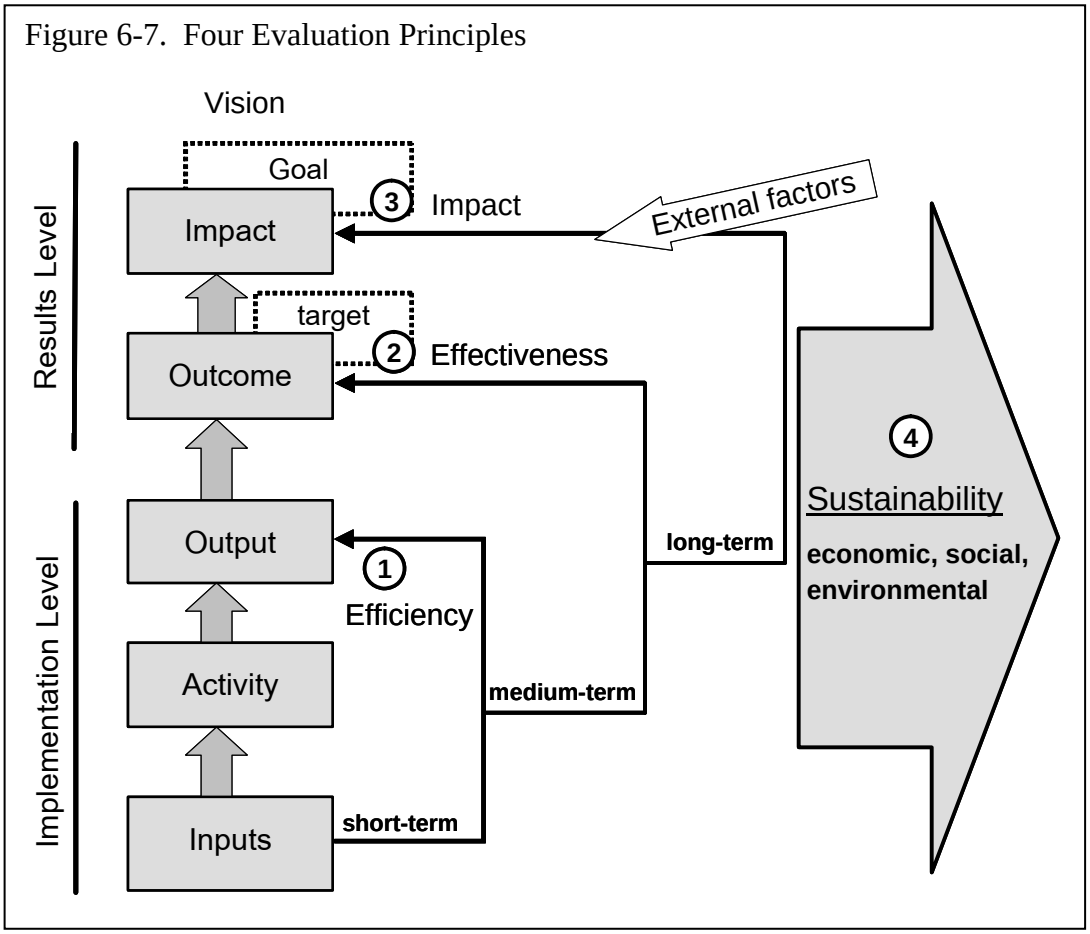
	Summary of items / results	indicators	Data source & methods	Assumptions & risks
Goal / objective				
Outcome				
Output				
Activities		inputs	budget	
				Initial conditions

In terms of establishing principles for monitoring and evaluation, this can be done for all stages in the project cycle, or for only one stage. Thus, it is important to clearly specify monitoring and evaluation objectives. Common specifications will be in line with the project's scope of work, by considering the order of relations in project plans. In specifying the scope of work, four main monitoring and evaluation principles are used as criteria for consideration of each project. All or only one of these principles can be used, depending on the evaluation objectives mentioned above.

- Efficiency considers use of project resources or inputs and outputs that are derived from it
- Effectiveness is investigated according to the objective of the project
- Impact considers project objectives, goals, and external factors
- Project sustainability considers economic, social and environmental aspects

Figure 6-7 shows how these evaluation principles relate to the project cycle .

Figure 6-7. Four Evaluation Principles



Step 2. Determine monitoring & evaluation methods & comparison criteria

The objective of this step is to specify the methodological approach for monitoring and evaluation, and the criteria for comparing change in indicator values.

It is important to establish a starting point or baseline data for the indicator, and a final point or benchmark, as criteria for comparative evaluation of change. Baseline data for indicators is actual data on the status of indicators before implementation of the project. Benchmarks may be considered to be the highest target levels needed, and they may be determined from accepted standard values. An Evaluation Grid can be used as a tool for determining the scope of activities to be conducted according to evaluation principles.

Step 3. Collecting data for evaluation

Data collection can be divided into three main parts: one part for gathering data from primary sources, a second part for collecting data from secondary sources, and a third part for gathering data from monitoring systems at various levels. They may be summarized by data category, source, and data collection method, according to the evaluation principles.

Various types of monitoring systems can be important sources of information for project monitoring and evaluation. Since projects will be implemented in the context of sub-basins or smaller sub-watersheds, use of monitoring systems can be considered at two levels:

- *Local level monitoring systems* may include components that already exist within sub-basins or more local areas, or they may be developed as part of the sub-basin management process.
- *External monitoring systems* exist at national, regional, river basin, province and other levels, and may be able to provide important information useful for evaluating outcome, and especially impact levels.

Step 4. Data processing, analysis and evaluation

Data processing and data analysis will depend on requirements of evaluation principles to evaluate which aspects, what will be used as criteria in each aspect, and what different importance weights will be assigned to factors to be used in evaluation.

Step 5. Monitoring & evaluation reporting

Since monitoring and evaluation under this framework includes monitoring and evaluation in terms of both project implementation and project achievements, basic monitoring and evaluation reporting should be divided into two parts: a report on monitoring and evaluation of implementation process results, and a report on monitoring and evaluation of project outcomes.

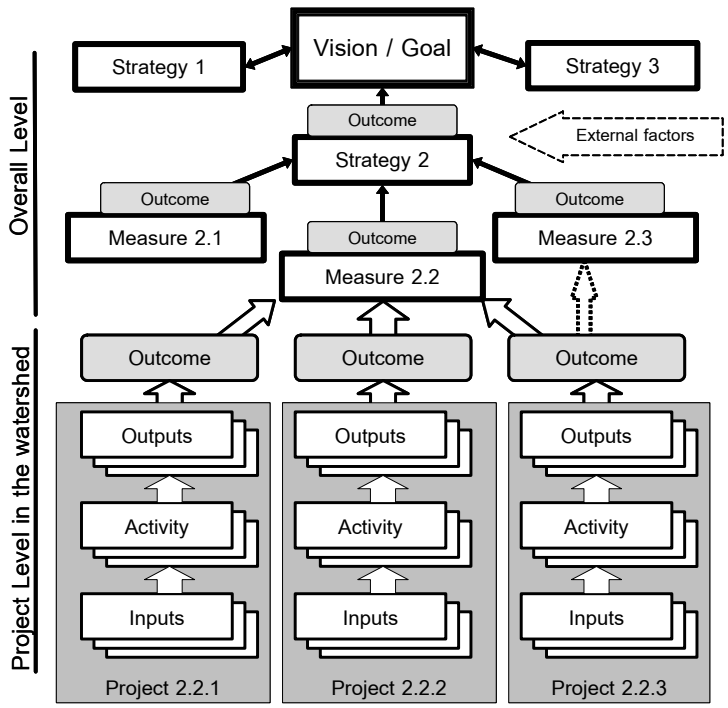
At least five categories of potential users of reporting services need to be considered:

- ***Project implementers*** are the main target group for reports in implementation process results, and may be able to use some data directly from regular monitoring systems.
- Overall sub-basin ***workplan managers*** are a major target user of project outcome reports.
- ***Sources of funding and support*** will be prominent users of both implementation process reports and project outcome reports related to projects they support.
- ***Stakeholders*** need to see that sub-basin management is achieving important results and impacts on issues that are important to them. Information may need to be packaged in formats appropriate for different stakeholder groups.
- The ***general public*** can be an important user of findings from results-based measurement. Information can help maintain credibility of the sub-basin management process, and gain popular support that can help it remain viable over the long term.

Sub-basin management-level monitoring and evaluation framework

The main focus of this project is on developing sub-basin level management organizations and sub-basin-level management planning. Working groups in each of the three pilot sub-basins have developed planning frameworks for their sub-basins. These frameworks generally have an overall vision statement and various levels of goals and objectives that determine the direction of their management program or 'workplan'. Sub-basin workplans are then sub-divided into three more levels of organization. Figure 6-8 shows a generalized example of how these workplans are organized.

Figure 6-8. Generalized structure of a sub-basin plan



The overall workplan seeks to achieve the sub-basin vision, which is quite broad. Thus, several strategies have been developed to achieve the sub-basin vision. There are then several measures through which each strategy will be implemented, and each measure is divided into various specific projects. This general structure has been adjusted to be more appropriate for conditions in each sub-basin, as discussed in section 3.3.

The framework for monitoring and evaluation at the project level has been discussed in the previous section. Project-level monitoring and evaluation includes forms of evaluation at both the project implementation process level, and at the project outcome and impact level.

The issue here is how to monitor and evaluate the overall workplan at the sub-basin and strategy levels. The main focus of monitoring and evaluation at these levels is on outcomes of projects, measures and strategies, and their impacts on overall economic social and environmental conditions in the sub-basin. Use of the logical framework matrix (Logframe) and the logical framework approach can also be useful in helping to provide systematic organization of the complex sets of concepts and information that are needed at this level.

In order to conduct monitoring and evaluation at this level, it is important to specify expected outcomes for each level where monitoring and evaluation will be conducted. Appropriate indicators must also be determined for each outcome, as well as baseline data and relevant benchmarks, in order to provide the basis for comparisons that can determine how much progress has been made. This will help identify strengths and weaknesses in strategies and in the overall workplan, which may need more attention or adjustments to improve the overall sub-basin management program.

Monitoring and evaluation at the program or "workplan" level builds on results from monitoring and evaluation of individual projects under the workplan. Methodologies for evaluation of the overall workplan follow the same framework as for individual projects under the workplan. Results of individual projects are integrated in order to evaluate overall results at the workplan strategy level using techniques to help match levels of inputs, outputs, outcomes and impacts. Evaluation combines results from all projects, and compares results with workplan targets, baselines or benchmarks.

Since the workplan level will be an overall evaluation of development at the whole sub-basin level, it will emphasize evaluation of outcomes or achievements and impacts of development plans under the various collaboratively determined strategies for the sub-basin. Although various parts may have the same indicators as some individual projects, the scale and coverage of the goals will be much larger than for individual projects.

It is important for those responsible for monitoring and evaluation reporting to develop mechanisms for communicating information in their reports to stakeholders other than project-level and sub-basin-level managers, for use in their work related to sub-basin analysis, planning and management. Thus information needs of stakeholders must be reviewed, and appropriate forms for communicating this information must be developed. Information must be in forms that are appropriate for the situation and information users in each sub-basin.

There needs to be an assessment of needs for continuous monitoring of some types of sub-basin conditions, and how such information could provide feedback to stakeholders at multiple levels. Some parts may be through partnerships with technical agencies or others collecting relevant time series data, while other parts may use local collaboration with participatory methods.

Sub-basin action plan logic and performance indicators

The framework for monitoring and evaluation discussed above uses a project design tool in the form of the logical framework matrix (or Logframe), which also helps determine the basis for monitoring and evaluation. Thus, specification of indicators for various levels of the project is usually determined during the project planning stage by those organizing the project.

Project organization may not always follow the form of the Logframe, however, or indicators may not always be clearly specified. Especially for indicators of outcomes and impacts of projects that involve linkages among natural resources and the environment, public health and livelihoods of people in the sub-basin, it may be important to review and re-determine indicators. It is particularly important for indicators to meet the criteria discussed above under step 1 of the project-level monitoring and evaluation framework. And once indicators are selected, baseline data must be established and benchmarks need to be determined, in order to provide a basis for comparative evaluation.

Since indicators are established according to the project logical framework described above, their determination will depend on how objectives and aims of workplans and important projects are specified. Thus, indicators specified in implementation plans (action plans) for managing natural resources and environment are examined for each of the 3 pilot sub-basins.

As already explained in chapter 3, efforts were made for the first initial draft of action plans for each of the three pilot sub-basins sought to have a similar overall structure. During the final round of revisions, however, working groups in each sub-basin responded to requests from stakeholders within their sub-basin to adjust the plans to fit more closely with local views of

conditions and problem situations in their sub-basin. This has demonstrated the importance of processes oriented more toward planning that is appropriate for local problems and conditions, than toward fitting a single template format. Resulting overall plan structures for each sub-basin are summarized in Figure 6-9, along with an indication of the level at which initial efforts have been made to establish indicators for monitoring and evaluation.

Figure 6-9. Summary of levels and terminology in current sub-basin plans

	Sub-basin		
Planning level	**Ping part 1**	**Mae Kuang**	**Ping part 5**
Vision / mission level	Vision statement	Vision statement	Vision statement
Policy / approach level	Goal (1)	Goal (1) Objectives (4)	Goals (3) Objectives (5)
Sub-basin level	Workplan	Workplan	Workplan
Broad components	Strategies (6)	Strategies (4)	Strategies (4)
Specific components	*** Measures (22)	*** Measures (14)	Measures (17)
Implementation level	Activities (35)	Projects/groups (111)	*** Projects (67)

*** *level of specified "indicators'*

The following sub-sections summarize information on the status of development of performance indicators in each of the three pilot sub-basins. As shown in Figure 6-9, sub-basin plans have sought to specify indicators at the level of either measures or projects. At this point, however, most of these "indicators" are really closer to statements of expected outcomes. Thus, the following summaries have classified these outcome statements and aggregated them at both strategy and overall workplan levels. This allows us to see more clearly what types of specific results are expected from sub-basin plans. These expected results can then be compared with the reasoning of each plan, as described earlier under section 3.3. It also allows us to see what types of more specific indicators and measurements will need to be further developed in order to implement a results-based measurement system.

6.1.2. Ping part 1 (Upper Ping) sub-basin

Outcomes at the strategy level. In order to help clarify the types of outcomes expected under different levels of the Ping part 1 sub-basin workplan, expected outcomes ("indicators") that have been specified at the measures level are listed in Figure 6-10 under the strategy with which they are associated. Outcomes are categorized on the left side according to the general type of outcome that is expected. This provides a general picture of the types of results expected from different strategies, which can then be compared with the title of the strategy for consistency.

This approach allows us to see quite clearly the expected results under each strategy:

- Strategy 1 is named "Building capacity of community organizations (human resource development)", and about half of the outcomes it seeks to achieve focus mainly on building knowledge and organizational capacities of existing local organizations at various levels within the sub-basin. Remaining outcomes focus on local participation and more direct (but still quite general) health and livelihood outcomes.

Figure 6-10. Ping part 1 Strategies – Types of Expected Outcomes

Strategy 1. Building capacity of community organizations (human resource development)

KNOWLEDGE		1	Communities are aware of and understand problem conditions in the area,
		2	Use of concepts & local knowledge consistent with community ecosystems
ORGANIZATION	network	1	Existing local organizations join together in community networks to manage natural resources in the Ping part 1 sub-basin and local sub-watersheds with substance & participation
	knowledge	2	Local organizations at all levels in watersheds begin developing knowledge potential that can be used in participatory management of resources in the watershed
PARTICIPATION		1	and communities participate in managing natural resources & the environment
HEALTH		1	Have support for basic public health & household and community sanitation
LIVELIHOODS		1	Communities in the Ping part 1 sub-basin & local sub-watersheds receive promotion of occupations appropriate for community potential & the local area

Strategy 2. Studying and gathering of community datasets and knowledge

ORGANIZATION	data	1	Communities begin to use the knowledge base in NRE management planning, in order to bring relevance to problem conditions & needs of communities in the area
		2	Have studies & knowledge collections related to resource management, such as forest utilization, bamboo, fuelwood use, weir management
PARTICIPATION		1	Communities have capacity to initiate & collaborate in villager research
		2	Communities begin exchange on problem situations at local levels

Strategy 3. Building mechanisms for collaboration with local parties

ORGANIZATION	network	1	Existing villager organizations join together in community networks in order to manage natural resources in the Ping part 1 sub-basin & local sub-watersheds in a solid & participatory manner, together with building mechanisms to move community resource management plans into the organization
PARTICIPATION		1	Local governements in the area participate, support & promote activities of villagers
		2	Communities draft participatory NRE management plans that can join with local governments

Strategy 4. Promoting & supporting natural resource management activities (natural resource conservation)

ORGANIZATION	network	1	Networks of community organizations that manage resources have activities for resource conservation & restoration using community local knowledge
PARTICIPATION		1	Communities & the state collaborate in conducting activities
	nre	2	Communities participate in sustainable management & use of resources
FOREST-WATER-SOIL		1	Natural resources are fertile & abundant

Strategy 5. Managing resources and watershed management organization structure

ORGANIZATION		1	(short term) get a community organization structure for watershed management & capable of adapting to various situations
		2	(long term) Begin study of villager organizational models for watershed management together with various partners
PARTICIPATION		1	Communities participate in thinking, analysis, determinations, & follow-up

Strategy 6. Policy monitoring & advocacy

ORGANIZATION		1	Initiate mechanisms for following & advocating laws affecting communities
PARTICIPATION	policy	1	communities become aware and join in advocating laws, such as the community forest law

- Strategy 2 is named “Studying and gathering of community datasets and knowledge”, and what it seeks to achieve focuses on building a local data and information system in local organizations that incorporates strong participation in increasing local capacities and in utilization of the system to assess and address local problem situations.
- Strategy 3 is named “Building mechanisms for collaboration with local parties”, and what it seeks to achieve focuses on building networks among local organizations, strengthening participation by local governments, and community-initiated planning that is able to join with local government processes.
- Strategy 4 is named “Promote and support natural resource management activities (natural resource conservation)”. Most of what it seeks to achieve appears to focus on building network organizational capacities and on participation by both communities and state agencies. A single outcome appears as a general outcome for all specific natural resource outcomes – this is a very clear example of a measures level outcome that needs to be broken down according to the expected outcomes of specific activities under the outcome aimed at directly affecting natural resources in the sub-basin.

- Strategy 5 is named "Managing resources and watershed management organization structure", and what it seeks to achieve focuses on short- and long-term measures that would develop sub-basin organization structures, along with one outcome focusing on community participation in these processes.
- Strategy 6 is named "Policy monitoring and advocacy", and what it seeks to achieve focuses on developing organizational alliance mechanisms to follow and advocate laws and policies affecting sub-basin communities, together with an outcome regarding local community participation in these processes.

Outcomes at the overall sub-basin workplan level. The same approach was used to aggregate outcomes at the overall sub-basin workplan level, as summarized in Figure 6-11. This overall view of expected outcomes stated in the Ping part 1 sub-basin plans shows that nearly 80 percent of expected outcomes at the measures level relate to improved organization and local participation in basic processes underlying sub-basin problem analysis, planning, management, monitoring and evaluation. Remaining outcomes focus (1) on awareness, understanding and use of knowledge, and (2) on direct impacts on natural resources, livelihoods and public health, which will need to be disaggregated by activities under the measures in order to be measurable. This summary of overall expected outcomes can now be compared with the sub-basin vision and goal, as shown in Figure 3-26.

Figure 6-11. Ping part 1 Overall Sub-basin Workplan – Types of Expected Outcomes

KNOWLEDGE	1	Communities are aware of and understand problem conditions in the area,
	2	Use of concepts & local knowledge consistent with community ecosystems
ORGANIZATION	1	(short term) get a community organization structure for watershed management & capable of adapting to various situations
	2	(long term) Begin study of villager organizational models for watershed management together with various partners
	3	Initiate mechanisms for following & advocating laws affecting communities
network	4	Existing local organizations join together in community networks to manage natural resources in the Ping part 1 sub-basin and local sub-watersheds with substance & participation
	5	Existing villager organizations join together in community networks in order to manage natural resources in the Ping part 1 sub-basin & local sub-watersheds in a solid & participatory manner, together with building mechanisms to move community resource management plans into the organization
	6	Networks of community organizations that manage resources have activities for resource conservation & restoration using community local knowledge
knowledge	7	Local organizations at all levels in watersheds begin developing knowledge potential that can be used in participatory management of resources in the watershed
data	8	Communities begin to use the knowledge base in NRE management planning, in order to bring relevance to problem conditions & needs of communities in the area
	9	Have studies & knowledge collections related to resource management, such as forest utilization, bamboo, fuelwood use, weir management
PARTICIPATION	1	and communities participate in managing natural resources & the environment
	2	Communities have capacity to initiate & collaborate in villager research
	3	Communities begin exchange on problem situations at local levels
	4	Local governements in the area participate, support & promote activities of villagers
	5	Communities draft participatory NRE management plans that can join with local governments
	6	Communities & the state collaborate in conducting activities
	7	Communities participate in thinking, analysis, determinations, & follow-up
NRE	8	Communities participate in sustainable management & use of resources
policy	9	communities become aware and join in advocating laws, such as the community forest law
NATURAL RESOURCES	1	Natural resources are fertile & abundant
HEALTH	1	Have support for basic public health & household and community sanitation
LIVELIHOODS	1	Communities in the Ping part 1 sub-basin & local sub-watersheds receive promotion of occupations appropriate for community potential & the local area

Some of the single statement outcomes at the measures level are still quite complex and ambiguous about specific outcomes expected from each measure. They are, however, considerably more clear than the types of measures-level outcome statements in the Mae Kuang plan discussed in the next sub-section. One can reasonably expect that more specific measures for each of these outcomes could be developed as the specific activities to be conducted under each measure are designed in more detail and articulated using tools such as the LogFrame. Moreover, there are strategies during this initial phase that are specifically directed toward developing local information and data systems that could help identify specific measurable indicators, means of measurement, and appropriate baseline data.

6.1.3. Mae Kuang sub-basin

Outcomes at the strategy level. In order to help clarify the types of outcomes expected under different levels of the Mae Kuang sub-basin workplan, expected outcomes ("indicators") that have been specified at the measure levels are listed in Figure 6-12 under the strategy with which they are associated. Outcomes are again categorized on the left side according to the general type of outcome that is expected. This provides a general picture of the types of results expected from different strategies, which can then be compared with the title of the strategy for consistency.

This approach again allows us to see quite clearly the expected results under each strategy:

- Strategy 1 is named "Management of natural resources and environment through participation of the people", and what it seeks to achieve appears to focus mainly on improving organizations and increasing participation, including enforcement of laws and regulations to prevent pollution.
- Strategy 2 is named "Conserve and restore natural resources to be fertile and productive". One portion of what it seeks to achieve appears to focus mainly on expanding network organizations to protect natural resources, and on increasing participation to care for and enforce laws and regulations related to natural resources. A second portion of what it seeks to achieve focuses on promoting eco-based tourism, and preservation of livelihoods, culture, traditions and local knowledge.
- Strategy 3 is named "Build economic strength of communities to increase basic household and community incomes", and what it seeks to achieve appears to focus mainly on promoting "appropriate" local occupations, on encouraging households to increase savings and reduce unnecessary expenses, and on helping local people and entrepreneurs gain more access to sources of occupational finance.
- Strategy 4 is named "Good quality of life, health and livelihoods", and what it seeks to achieve appears to focus mainly on increasing local knowledge about hygiene and sanitation, and on improving community environmental conditions to be more "pleasant".

Outcomes at the overall sub-basin workplan level. The same approach was again used to aggregate outcomes at the overall sub-basin workplan level, as summarized in Figure 6-13. This overall view of expected outcomes currently stated in the Mae Kuang sub-basin plans shows that one-half of the outcomes would result in stronger organizations and increased participation, with considerable emphasis on conservation and enforcement of laws and regulations. Just over one-third of their outcomes relate to improving livelihoods through several still quite ambiguous lines of activity, and remaining outcomes focus on increased local knowledge about community hygiene and sanitation.

Figure 6-12. Mae Kuang Strategies – Types of Expected Outcomes

Strategy 1. Management of natural resources & environment through participation of the people

ORGANIZATION	1	increased establishment of holistic natural resource management organizations in the watershed
knowledge	*2*	existing local organizations are restored by increased knowledge & capacity
PARTICIPATION	1	increased enforcement of regulations & laws related to pollution prevention
nre	*2*	increased management of natural resources & environment through people's participation

Strategy 2. Conserve and trestore natural resources to be fertile & productive

ORGANIZATION *netwk*	1	increased development of potential of networks to guard natural resources & the environment
PARTICIPATION *nre*	1	increased care for natural resources & environment to make them fertile & productive
forest	*2*	increased enforcement of laws & local codes & strict punishment of violators destroying forest resources
LIVELIHOODS	1	increased conservation-based tourism & preservation of livelihoods, traditions, culture & local knowledge

Stragtegy 3. Build economic strength of communities to increase basic household & community incomes

LIVELIHOODS	1	local occupations receive increased promotion and support in knowledge & methods appropriate for local potential
	2	People have increased recognition of savings and are able to control and reduce unimportant household expenses
fund	*3*	People & community entrepreneurs have more ability to access occupational finance sources

Strategy 4. Good quality of life, health & livelihoods

KNOWLEDGE *health*	1	increased training and provision of knowledge related to community hygiene
	2	increased campaigns & public relations on sanitation
LIVELIHOODS	1	more community envirionmental condtiions are improved to be pleasant

Figure 6-13. Mae Kuang Overall Sub-basin Workplan – Types of Expected Outcomes

KNOWLEDGE *health*	1	increased training and provision of knowledge related to community hygiene
	2	increased campaigns & public relations on sanitation
ORGANIZATION	1	increased establishment of holistic natural resource management organizations in the watershed
networks	2	increased development of potential of networks to guard natural resources & the environment
knowledge	3	existing local organizations are restored by increased knowledge & capacity
PARTICIPATION	1	increased enforcement of regulations & laws related to pollution prevention
nre	2	increased management of natural resources & environment through people's participation
	3	increased care for natural resources & environment to make them fertile & productive
forest	4	increased enforcement of laws & local codes & strict punishment of violators destroying forest resources
LIVELIHOODS	1	increased conservation-based tourism & preservation of livelihoods, traditions, culture & local knowledge
	2	local occupations receive increased promotion and support in knowledge & methods appropriate for local potential
	3	People have increased recognition of savings and are able to control and reduce unimportant household expenses
	4	more community envirionmental condtiions are improved to be pleasant
fund	5	People & community entrepreneurs have more ability to access occupational finance sources

This summary of overall expected outcomes can now be compared with the vision, goals and objectives of the sub-basin plan, as shown in Figure 3-39.

Based on a review of the various plans and lists of projects that were assembled for consideration during the planning process, there is good reason to believe that there may be various lines of activity and types of projects that are not reflected in the higher level outcomes that are currently stated in the Mae Kuang sub-basin plan. For example, objective 1 places emphasis on water resources, but outcomes of strategy 1 do not indicate any direct effects on water. Indeed, there are not yet any outcomes related to direct effects on natural resources or health. One suspects that this is due to a combination of too little time available for work by sub-basin networks and leaders during the review process, and the difficulties they were having in reaching a rapid

consensus that could overcome some still quite basic differences of opinions. In any event, considerable work will be necessary to articulate clear outcomes and measurable indicators required for an effective results measurement system in the Mae Kuang sub-basin.

6.1.4. Ping part 5 (Lower Ping) sub-basin

Initial efforts in the Ping part 5 sub-basin to determine indicators for monitoring and evaluation focused at project level. Although at this point these are really expected outcome statements rather than indicators, most have become quite clear during the most recent round of revisions within the sub-basin.

Outcomes at the strategy level. In order to help clarify the types of outcomes expected under different levels of the Ping part 5 sub-basin workplan, expected outcomes ("indicators") that have been specified at the project levels are listed in Figure 6-14 under the strategy with which they are associated. Outcomes are again categorized on the left side according to the general type of outcome that is expected.

Given the level of detail that this provides, it is now quite easy to get a general picture of the types of results expected from different strategies, which can then be compared with the title of the strategy for consistency.

- Strategy 1 is named "conservation and restoration of natural resources and the environment", and what it seeks to achieve focuses mainly on building various type of knowledge in local communities, and on achieving tangible improvements in natural resources related mainly to water, but also to forest and soil conservation.
- Strategy 2 is named "management of natural resources and the environment", and much of what it seeks to achieve is focused on building and strengthening organizations at local group, network and sub-basin levels. It also seeks to build some types of knowledge and increase local participation in natural resource management. Behavioral change is expected to affect local livelihoods by improving household financial management and supplementary occupations. Direct effects on natural resources aim to reduce damage from forest fires and soil erosion. There is one water-related health outcome.
- Strategy 3 is named "management of environmental pollution for quality of life, public health and better livelihoods of the people". The focus of half of its outcomes is on directly improving health conditions, primarily through improved management of garbage. It also seeks to build knowledge and participation related to health-related issues, and to have some direct effects on health-related aspects of water and crop management.
- Strategy 4 is named "build consciousness of environmental stewardship", and more than two-thirds of its achievements are expected to focus on building knowledge and providing information through media distributed through sub-basin organizations. It also seeks to expand participation by youth, and to have direct effects on health and livelihoods through improved handling of agricultural chemicals.

Figure 6-14a. Ping part 5 Strategies – Types of Expected Outcomes

Strategy 1. Conservation & restoration of natural resources & the environment

KNOWLEDGE *NRE*	1	increased knowledge of nature conservation
	2	people's knowledge about natural resources
agriculture	3	increased number of people with knowledge of agricultural chemical hazards
	4	increased number of people with knowledge about making compost
PARTICIPATION *for*	1	increased participation of people in caring for forest
- FOREST	1	amount of forest not reduced, increased economic forest
- WATER	2	increased water source capital
	3	increased moisture, more water source capital
	4	increased water storage, no flood problems (2)
	5	decreased river bank collapse problems
health	6	sufficient water for consumption & domestic use
- PLANTS / SOIL	7	increased area of plants to provide soil cover

Strategy 2. Management of natural resources and the environment

KNOWLEDGE *NRE*	1	increased consciousness of the people in conservation of NRE
	2	people have increased knowledge in managing NRE
ORGANIZATION	1	increased budget for individual development
	2	structure of NRE organization has increased efficiency
	3	individuals involved in making NRE plans have increased efficiency
	4	Organization members have increased capacity for managing water resources
networks	5	increased number of networks to report river bank collapse threats
groups	6	increased number of Lower Ping protection groups
	7	increased number of strong community occupational groups
	8	Increased number of efficient water user groups
PARTICIPATION *NRE*	1	increased number of people participating in managing NRE
forest	2	individual violators receive punishment
- FOREST	1	reduced damage from forest fires (2)
- PLANTS / SOIL	2	increased planting of vetiver grass
HEALTH *garbage/water*	1	reduced disposal of garbage into river
LIVELIHOODS	1	increased number of households able to reduce expenses (2)
	2	increased occupational funding source
	3	communities have good supplementary occupations
	4	increased efficiency in household finance

Strategy 3. Management of environmental pollution for quality of life, public health and better livelihoods of the people

KNOWLEDGE *water*	1	increased number of households & entrepreneurs with knowledge about wastewater treatment
health	2	increased number of people knowledgeable about medicinals
ORGANIZATION *network*	1	increased number of easily understandable disaster warning systems
PARTICIPATION *health*	1	increased number of people participating in sanitation activities
	2	increased number of people participating in sanitation campaigns
- WATER *health*	1	reduced amount of household waste water
	2	reduced amount of wastewater from industrial factories
- PLANTS / SOIL *health*	3	increased number of people planting home gardens
HEALTH	1	increased number of people participating in exercise activities
	2	reduced number of people getting dengue fever
air	3	reduced amounts of pollution from particulate matter & smoke
garbage	4	increased number of garbage disposal sites
	5	increased number of people burning leaves & garbage correctly
	6	increased number of sanitary garbage disposal sites
	7	increased number of households managing their garbage
	8	increased number of households who separate garbage correctly

Figure 6-14b. Ping part 5 Strategies – Types of Expected Outcomes *(continued)*

Strategy 4. Build consciousness of environmental stewardship

KNOWLEDGE *NRE*	1	increased number of people in communities who highly value natural resource & the environment (2)
agriculture	2	increased number of households knowledgeable about agricultural chemical hazards
ORGANIZATION	1	<environment camp project>
media-communic	2	increased number of communications media on NRE that are easy to understand, modern, & worth following (6)
	3	increased amount of communication media on safe use of agricultural chemicals
	4	public relations that reaches communities well
PARTICIPATION *NRE*	1	increased number of youth joining environment project (3)
HEALTH *agriculture*	1	reduced amount of people affected by agricultural chemical hazards
LIVELIHOODS *health*	1	increased number of people using agricultural chemicals safely

Outcomes at the overall sub-basin workplan level. The same approach was again used to aggregate outcomes at the overall sub-basin workplan level, as summarized in Figure 6-15. This overall view of the Ping part 5 sub-basin plans shows that more than half of the outcomes it seeks to achieve are focused on expanding and strengthening various forms of social organization, on increasing knowledge about natural resources, agriculture and health, and to a somewhat lesser degree increasing levels of participation in activities related to natural resources and health. The remaining expected outcomes are split between direct effects on natural resources (mainly water, but also forest, soils and home gardens), and direct effects expected to improve health and livelihoods, with particular emphasis on management of garbage, household financial management, supplementary occupations, and safety in using agricultural chemicals.

This summary of overall expected outcomes can now be compared with the vision, goals and objectives of the sub-basin plan, as shown in Figure 3-50.

6.1.5. Further development of indicators, roles & responsibilities

This section summarizes needs for further efforts to develop indicators at outcome levels of sub-basin plans, and the roles and responsibilities of various sub-basin stakeholders in monitoring and evaluation processes.

Further development of outcome indicators

Working groups in the three pilot sub-basins have been trying to develop indicators to measure outcomes at measure or project level. In most cases they are making good progress. Indicators in the first draft plan in each sub-basin were really just a rearrangement of the words used to describe the measure or project associated with them. In the case of the consolidated Mae Kuang workplan, they are still at this stage, although at least one of the component workplans that were merged into the consolidated plan included efforts to make some real outcome statements.

In all cases, what they have achieved at this point is really a set of expected outcome statements. Some of these are quite clear and can be used for at least the first round of results-based measurements. Other outcome statements, however, are still too broad and general to be measured, so that additional work will be needed before the results-based measurement framework can begin to be implemented.

Figure 6-15. Ping part 5 Overall Sub-basin Workplan – Types of Expected Outcomes

KNOWLEDGE *NRE*	1	increased consciousness of the people in conservation of NRE
	2	people have increased knowledge in managing NRE
	3	increased number of people in communities who highly value natural resource & the environment (2)
natural resources	4	increased knowledge of nature conservation
	5	people's knowledge about natural resources
water	6	increased number of households & entrepreneurs with knowledge about wastewater treatment
agriculture	7	increased number of people with knowledge of agricultural chemical hazards
	8	increased number of households knowledgeable about agricultural chemical hazards
	9	increased number of people with knowledge about making compost
health	10	increased number of people knowledgeable about medicinals
ORGANIZATION	1	structure of NRE organization has increased efficiency
	2	increased budget for individual development
	3	individuals involved in making NRE plans have increased efficiency
	4	Organization members have increased capacity for managing water resources
	5	<environment camp project>
networks	6	increased number of networks to report river bank collapse threats
	7	increased number of easily understandable disaster warning systems
groups	8	increased number of Lower Ping protection groups
	9	increased number of strong community occupational groups
	10	Increased number of efficient water user groups
media-communic	11	increased number of communications media on NRE that are easy to understand, modern, & worth following (6)
	12	increased amount of communication media on safe use of agricultural chemicals
	13	public relations that reaches communities well
PARTICIPATION	1	increased number of people participating in managing NRE
	2	increased number of youth joining environment project (3)
forest	3	increased participation of people in caring for forest
	4	individual violators receive punishment
health	5	increased number of people participating in sanitation activities
	6	increased number of people participating in sanitation campaigns
NATURAL RESOURCES		
- FOREST	1	amount of forest not reduced, increased economic forest
	2	reduced damage from forest fires (2)
- WATER	3	increased water source capital
	4	increased moisture, more water source capital
	5	increased water storage, no flood problems (2)
	6	decreased river bank collapse problems
health	7	sufficient water for consumption & domestic use
	8	reduced amount of household waste water
	9	reduced amount of wastewater from industrial factories
- PLANTS / SOIL	10	increased area of plants to provide soil cover
	11	increased planting of vetiver grass
health	12	increased number of people planting home gardens
HEALTH	1	increased number of people participating in exercise activities
	2	reduced number of people getting dengue fever
air	3	reduced amounts of pollution from particulate matter & smoke
garbage/water	4	reduced disposal of garbage into river
garbage	5	increased number of garbage disposal sites
	6	increased number of people burning leaves & garbage correctly
	7	increased number of sanitary garbage disposal sites
	8	increased number of households managing their garbage
	9	increased number of households who separate garbage correctly
agriculture	10	reduced amount of people affected by agricultural chemical hazards
LIVELIHOODS	1	increased number of households able to reduce expenses (2)
	2	increased occupational funding source
	3	communities have good supplementary occupations
	4	increased efficiency in household finance
health	5	increased number of people using agricultural chemicals safely

To continue developing outcome measurements, suggested lines of further activity include:

- ***Review expected outcomes (current plan "indicators")*** to see that they are clear, relevant, economical, adequate and useful. Since many outcome statements are still too broad and general to be measured, they need to be clarified so that specific measurable indicators can then be identified. Many of the most broad and complex indicators are provided at the level of measures, rather than the project level. Based on the example of the Ping part 5 sub-basin, the others may want to consider making clear outcome statements for each project or activity under the measure, which can then be aggregated to bring more clarity at the measure level.
- ***Determine ways to make real measurements that can indicate progress toward expected outcomes.*** Even in the case of Ping part 5, however, it is still not clear how various expected outcomes will actually be measured. In other words, they have not yet identified real measurable indicators. In many cases, a major part of the problem is that there are not yet enough details available about the design of individual projects or activities under each measure. Thus, once more detail on project design is available, outcome statements can be reviewed and modified, and appropriate measurable indicators can be identified. It may also be useful to provide sub-basin planners with more information on tools such as simple qualitative methods for measuring some types of outputs with which they are having difficulty.
- ***Determine sources of needed baseline and benchmark data***. Once real indicators are identified, then they will need to seek appropriate baseline data and any relevant benchmark data. Many of the current outcome statements assume a baseline of zero, since the focus is on measuring what is actually done by the project. In some cases this will be appropriate, but in others this may be focusing too much on the project implementation process rather than on the results level. Where baseline data needs are identified, secondary sources or methods for collection of primary data will also be needed. Again, there are likely to be additional needs for assistance with access to information and/or methods and tools for collecting baseline data. Some measures include projects or activities that seek to build information systems in sub-basins that may also help provide baseline data for other measures.
- ***Set clear outcome targets for projects and/or measures***. Once really measurable indicators have been identified and baselines have been established, targets need to be established for the amount of change that is expected to be achieved during implementation of the project, activity or measure. In many cases, initial efforts to set targets are likely to be difficult, and the targets are likely to be quite different from what can really be achieved during implementation. This is normal and should be expected. It will take time and experience to gradually improve abilities to make more accurate estimates of expected outcome targets.
- ***Establish any local outcome-level monitoring systems that are needed***. For some types of information needed to assess progress toward expected outcomes, it may be necessary to develop local monitoring systems, as discussed at several points in this report. In establishing any local monitoring systems, careful consideration needs to be given to selection of indicators and measurement methods, as well as how often the measurements will be made, who will be responsible for measurements and keeping the data, and how will costs of operating the system be supported.
- ***Identify who needs to receive information about results, and how it will be used***. This is a very important issue for at least two reasons. First, results measurements are a waste of time and resources if the findings are not used. And second, design of monitoring and

evaluation processes need to be matched with the needs of users. Several potential types of users whose needs may be considered are discussed under step 5 in the project monitoring and evaluation framework.

- ***Identify external partnerships or sources of assistance where needed***. Good assessments of progress at the outcome level often require information that may be beyond the current capacity of individual projects or sub-basin management organizations to collect. In some cases, someone else may already be collecting relevant data. In other cases, there may be useful simple tools or participatory approaches that are not yet known in the sub-basin. These are only a few of many reasons why external partnerships and sources of assistance for developing and operating sub-basin results management systems should be explored.

One particularly important challenge is understanding and monitoring natural resource and environment processes and conditions that are now beginning to be linked with public health, livelihood and poverty issues. Initial directions are indicated in the expected outcomes of each pilot sub-basin. Considerable attention and probably assistance and exchange through external partnerships will be needed to further improve these approaches.

Determining roles and responsibilities

As explained earlier in this section, effective monitoring and evaluation, and especially results-based measurement processes, will require participation of various sub-basin stakeholders. At the same time, it is important to clarify the roles and responsibilities of different actors in this process, in order to avoid confusion and misunderstanding, and to help build appropriate capacities in a systematic manner. Particular attention needs to be given to roles for seven different groups of sub-basin stakeholders, as summarized in Figure 6-16.

Community groups, community organizations, networks and business groups

Since community organizations have areas of responsibility that are limited to only one part of a sub-basin, their roles and responsibilities in monitoring and evaluation should be mainly limited to the level of projects implemented within their community areas. In these cases, community organizations need to designate individuals responsible for project monitoring and evaluation duties. They will follow the framework, approach and steps for project monitoring and evaluation discussed above. Under the step for reporting results of monitoring and evaluation, persons responsible for monitoring and evaluation by community organizations will report their findings to the next higher level of management organization, so that they can be integrated into monitoring and evaluation at the sub-basin workplan level.

For some types of projects, specialized local groups, networks or even private sector organizations may play this type of role, either as the leader or in collaboration with a community organization. This is especially likely in cases where they are participating in implementation of the project and/or when they have special perspectives, knowledge or skills appropriate for monitoring and evaluation of particular types of projects or activities. Networks and private sector organizations may also help coordinate monitoring and evaluation activities when project implementation includes several local community areas.

All of these types of groups also have potential roles to play in monitoring and evaluation at the overall sub-basin level. Their roles at this level will place particular emphasis on information they can provide to overall sub-basin monitoring and evaluation processes. Some groups or networks may have important social, economic or environmental monitoring data they can provide. Many may be able to provide useful information in their status as stakeholders, and

Figure 6-16. Stakeholder group roles & responsibilities in monitoring & evaluation

	Project Level	*Overall Level*
1) Local community groups, organizations, networks, business groups		
Leadership	Projects under their responsibility	report project information to sub-basin
Information source	as participant or if have impacts	monitoring data, stakeholder, have impacts
User of results measurements	improve management & design	as sub-basin / RSBO stakeholder
2) Sub-basin management organizations (RSBO's)		
Leadership		Main Leadership
Information source	data to assist outcome/impact levels	sub-basin plans / database / monitoring
User of results measurements	help improve projects under workplan	improve management / sub-basin plans, help negotiations among stakeholders
3) Local governments (tessaban, TAO, PAO)		
Leadership	Projects under their responsibility	report project information to sub-basin
Information source	Project database / plans	information system / as key institution
User of results measurements	improve management & design	RSBO collaborator / stakeholder
4) Local units of central government agencies		
Leadership	Projects under their responsibility	report project information to sub-basin
Information source	Project database / plans as participant, or if have impacts	monitoring data, agency plan data, as stakeholder, if have impacts
User of results measurements	improve management & design, to help projects elsewhere	source of funds/assistance, status of programs, help programs elsewhere
5) Provincial governments		
Leadership		
Information source	data on outcome / impact indicators	monitoring data, province plans, stakeholder, other
User of results measurements	as source of funds / support, to help projects elsewhere	status of programs/conditions in province, as funding source, to help programs elsewhere
6) NGOs, independent institutes, higher-level networks		
Leadership	may assist with evaluations	may assist with evaluations
Information source	monitoring data, indicators, standards, methods, tools, & training	monitoring data, indicators, standards, methods, tools & training
User of results measurements	for dissemination, analysis	for dissemination, analysis
7) Academic institutions		
Leadership	may assist / lead evaluations	may assist / lead evaluations
Information source	monitoring data, indicators, standards, methods, tools, & training	monitoring data, indicators, standards, methods, tools & training
User of results measurements	for analysis, dissemination, teaching	for analysis, dissemination, teaching

particularly if they have experienced particular positive or negative impacts resulting from implementation of sub-basin plans.

Another type of role that community organizations and local networks can play at both levels is as a user of monitoring and evaluation findings, and a channel for communication and dissemination of findings to those who will find them useful.

Sub-basin management organizations

Since sub-basin management organizations have areas of responsibility that include their entire sub-basin, their roles and responsibilities in monitoring and evaluation should mainly cover the overall sub-basin workplan level. As with community organizations, sub-basin management organizations need to designate individuals to whom overall workplan-level monitoring and evaluation duties will be delegated. They will follow the framework, approach and steps for project monitoring and evaluation discussed earlier in this chapter.

Sub-basin management organizations also have an important role to play in terms of information for monitoring and evaluation. They will be the main point for collection of overall information on project monitoring and evaluation from different sources within the sub-basin. They will also have important responsibilities for collecting data and information needed for outcome and impact level evaluations at the overall sub-basin level, and some of this data may be useful for outcome-level evaluation at the project level. Thus, they will need to establish linkages with both local and external monitoring systems, and they may also support further development of local monitoring systems to improve data needed for management, monitoring and evaluation at different levels within the sub-basin.

Both the monitoring information and the results of evaluations at the overall sub-basin level will be important inputs into future sub-basin problem analysis and workplan development. This type of information can also be very important in supporting negotiations among different stakeholders during analysis and planning processes. Successful negotiations can increase participation by and benefits for various stakeholders, while reducing conflict and negative impacts.

Local government organizations

Local government organizations include Tambon Administrative Organizations, Province Administrative Organizations, and municipalities, which have been considered in parts of this study related to organizations. Individuals from some of these organizations – especially Tambon Administrative Organizations and municipalities – will have roles following from their status as designated members of the sub-basin management organization. Their roles and responsibilities in monitoring and evaluation may be limited to self-evaluation at the project level, with particular emphasis on project management processes. Additional roles and responsibilities of project implementers include building a project-related database at input, output and outcome levels in accordance with project plans. This will help support data for monitoring and evaluation by community organizations and the sub-basin management organization.

The main roles of Province Administrative Organizations will probably be as a source of funding and support, as well as helping with coordination between sub-basin workplans and province plans and development processes. Thus, their role in monitoring and evaluation should emphasize information on province plans and higher-level stakeholders. They should be a user of monitoring and evaluation findings to help them assess projects for which they have provided support, and they may use this information to help improve projects that they support elsewhere in the province.

Provincial and central government agencies & organizations

Two other types of government organizations are also important for monitoring and evaluation. Various central government agencies have field implementation units responsible for areas and various types of work in sub-basins. Individuals from some of these agencies will have roles that follow from their status as designated members of the sub-basin management organization. As with local governments, their leadership roles and responsibilities in monitoring and evaluation may be limited mainly to self-evaluation at the project level, with particular emphasis on project management processes. These agencies will have their own processes and procedures for monitoring and evaluation of projects directly under their responsibility. They will need to designate persons responsible for providing information on the results of their findings to the sub-basin management organization, in order to help build the sub-basin-level database. These units can also provide important linkages with monitoring systems operated by their agency, which can be of great assistance in providing information for evaluation at outcome and impact levels for

both individual projects and the overall sub-basin workplan. These agencies are also stakeholders representing interests of broader society in sub-basin management, and resources or conditions under their responsibility may have positive or negative impacts from sub-basin projects and/or workplans. They may also be a source of funding or other types of support for individual projects. Thus, they should be an important user of the results of monitoring and evaluation at both project and overall sub-basin levels.

The provincial government is another type of government organization important for monitoring and evaluation processes. Under the overall authority and responsibility of the Provincial Governor, the provincial government includes many different types of units at the province level, as well as district administrations, sub-district *kamnan*, and village headmen. While the results from this study project suggest that these officials are not likely to be directly in charge of implementing individual projects, they have responsibilities to monitor and supervise most types of activities taking place within their jurisdictions. They also have a leading role in the provincial planning process, and may be an important source of funding and other types of support for individual projects or activities. Thus, their main roles in monitoring and evaluation are likely to be as a source of various types of information, and as an important user of the results from monitoring and evaluation.

Academic and other organizations

Other organizations may include private sector organizations, public sector organizations, educational institutions, or other types of institutions related to natural resources and the environment, public health or livelihoods. Even though they may not be directly related with monitoring and evaluation of projects and workplans in the sub-basin, these organizations – especially educational institutions or natural resource and environment institutions – may have a role as an external evaluator, particularly in evaluation of the impacts of projects and workplans. Moreover, monitoring and evaluation of indicators for outcomes and impacts may require use of technical specialists to collect data. One example might be indicators of various types of pollution. Thus, it may be important to have an organization with technical specialists to be responsible for this type of evaluation. There are also a growing number of regional and national level networks that may help provide access to technical specialists from various types of institutions to help support or lead various monitoring and evaluation activities.

Various of these types of institutions may be able to provide access to different types of indicator monitoring data and information on standards, benchmarks, or new monitoring and evaluation tools that may be especially useful for evaluation at the outcome and impact levels. They may also be a potential user of the results of monitoring and evaluation at project and overall sub-basin levels as input into wider analysis and as a channel for dissemination of information and experience. Educational institutes may also be able to use such information in helping to strengthen their education and training programs.

6.2. Capacity building requirements to implement results measurement

Experience from governments and public and private organizations around the world has demonstrated that building an efficient and effective results-based measurement system requires a long-term process. The Thai government has been trying to build results-based measurement into its management systems for more than 10 years, and it is clear that many government officials either do not yet fully understand the system, or do not yet understand why it is important and useful.

In many ways, progress under this pilot project indicates that there is considerable potential for integrating results-based measurement into sub-basin management processes. Even at very local levels, people are becoming familiar with the idea of developing vision statements, objectives and strategies as part of their planning process. Working groups in pilot sub-basins also seem to understand the need to identify the expected outcomes of individual projects or groups of projects, and indicators that could help them know whether or how well results are being achieved.

Everyone acknowledges, however, that there are still many gaps and needs for improvement to build efficient and effective results-based measurement systems at sub-basin level.

Issues, gaps and needs for implementing results-based measurement

Gaps in understanding and capacity building need may be summarized into five issue areas:

- Understanding the results-based measurement approach
- Building and strengthening the approach through plans and the planning process
- Developing systematic methods for collecting necessary data and information
- Building skills and tools to analyze results
- Using the results to improve sub-basin management programs

In terms of understanding the results-based measurement approach, it is clear that the approach and some of the concepts it uses are still quite new for many people in pilot sub-basins, as well as for many officials and community workers who are sources of assistance for them. Thus, there is a need for practical basic introductory information on results-based management in a format that can be easily understood by people working with sub-basin management organizations and major stakeholders. Introductory information should focus on answering three basic questions: (1) Why is results measurement important? (2) How can it be used by managers and stakeholders to improve projects, management workplans and programs? (3) How can local information systems be built to support it?

Strengthening the logic of sub-basin management plans

The processes of analysis of local problems and development of sub-basin plans to help solve those problems are the obvious place to begin strengthening results-based management. And since the Logical Framework Approach and the Logical Framework Matrix (LogFrame) provide the basic organizing tools for results-based measurement, practical information, 'hands-on' training, and possibly a handbook could be developed in order to provide:

- A clear explanation of the Logical Framework Matrix (Logframe), what the rows and columns mean, how they relate to each other, and the types of information that it requires. This would provide the "basic training" in Logframe concepts and project analysis both for individuals in the sub-basin management organization, and for the various project implementing organizations in the sub-basin. It may be useful to have separate training sessions for managers of individual projects and managers who will work mainly at the

overall sub-basin plan level. The specific curricula or training content will depend on the current level of knowledge of the participants. In any case, it should include numerous relevant practical examples.

- What are its strengths and weaknesses? While the basic Logframe table may seem to appear quite simple, it is often very difficult to use with some types of activities. As introduced in the introduction to this chapter, the LogFrame has sometimes been used in ways that creates new types of problems. And in some cases its simple cause and effect relationships may not fit well with the processes a project or activity is trying to use. Some practical examples of both good applications and poor applications of the Logframe would probably be very useful.
- How can local participation be integrated into the Logframe approach? The Logframe approach is the process that develops the reasoning that is then used to fill in the Logframe Matrix. This process can be conducted by a few elite leaders sitting in a room, or it can involve a very long and complex process that includes detailed participation by a wide range of stakeholders. And many levels in between these two extremes are also possible. It is also possible to use other types of participatory processes to develop the reasoning for a project, measure or strategy, so that the information needed for the Logframe is just one part of what results from the processes. There are a growing number of English language publications that discuss many issues and approaches, and it may be useful to review, summarize and translate some of the main points into Thai.
- How to work with information that is difficult to measure. There is often a tendency for outcomes and indicators in a Logframe to place strong emphasis on things that a person can easily see and count. But some very important expected outcomes cannot be easily seen and counted, such as awareness and knowledge. Other expected outcomes, such as healthy forest ecosystems can be seen but are very difficult to measure. It may be useful to review the lists of expected outcomes in current sub-basin plans to identify major types of outcomes that will be difficult to measure, and suggest some approaches that can help sub-basin organizations to work with these issues. Some simple qualitative methods may be useful for this purpose.
- How to improve expected outcomes, indicators and measurement methods. Since development of an efficient and effective results-based measurement system is a long-term process, it may be useful to place initial emphasis on what is needed to get started with the types of information currently available. At the same time, however, people and local organizations need to be encouraged to look to the future in thinking about how they can improve their identification of expected outcomes and the ways that they measure results. They can then develop a capacity building strategy to develop their skills, tools, and sources of information through a process of gradual improvement.

The main roles and responsibilities for the sub-basin management organization in monitoring and evaluation are focused at the sub-basin level. But these processes will depend on good monitoring and evaluation information coming from those who are actually implementing individual projects under overall sub-basin workplans. It will also depend on external sources of monitoring data and other types of necessary information. Thus, it is clear that effective sub-basin results-based measurement processes will depend on good working relationships and close coordination with several types of organizations and levels of government.

In order to help build a strong foundation for this work, capacity building activities need to include practical information on how sub-basin results measurement can link with:

- TAO and *tessaban* planning and management systems
- Provincial planning systems

- Planning and management systems of government agencies related to natural resources and environment, public health, livelihoods, and any other key topics in sub-basin plans
- Higher level monitoring, evaluation and management at Ping River Basin levels
- Regional and national environmental monitoring systems
- Provincial and national systems that monitor health, livelihoods, income, poverty, etc.

Expanding the tools for results-based management

As this project encouraged sub-basin working groups to develop outcome statements and indicators for their plans, one very frequent type of complaint was the lack of information on and access to information on indicators from monitoring systems that already exist in Thailand, and the standards and benchmark values that they use. Thus, a 'resource collection' that compiled this type of information in a form that could be easily accessed and used by sub-basin organizations, and perhaps some training on how the information can be accessed and used, would be very useful contributions toward capacity development.

There are also a quite large and growing number of methods and tools being used by efforts to improve results-based management approaches in public and private organizations around the world. Much of this information is now available through the internet, but very little of it is available in Thai language. Thus, another useful capacity building approach would be to review this literature and select some of the most useful parts for translation into Thai language 'resource collections' of information on topics such as:

- participatory monitoring (environmental, economic, social aspects)
- use of both local and scientific knowledge in monitoring
- participatory evaluation
- participatory development of local visions and desired outcomes
- use of monitoring and evaluation information to support negotiations among stakeholders and management of conflict

Using information from results-based measurement

A results-based measurement system cannot help improve sub-basin management unless the information it produces is actually used. Five different potential user groups were identified under step 5 of the monitoring and evaluation approach described earlier in this chapter, and potential uses by various stakeholders were mentioned in section 6.1.5. The categories used in either or both of these sections could be used to develop a set of practical booklets that suggest and describe ways in which information from the results-based measurement system can be used for each of these types of groups. This could then provide the basis for local orientation and training sessions focused on each particular type of user.

As part of this process, it would be important to explain potential uses of the various types of potential reporting products from a results-based monitoring and evaluation system. This should include the time intervals at which different types of monitoring or evaluation information can be reported, and how this might match with processes such as project management, sub-basin-level reviews and planning, and even stakeholder negotiations and conflict management.

Training on monitoring and evaluation, and use of the results-based measurement framework

After initial development of the results-based measurement framework, the project organized training on monitoring and evaluation and use of the results-based measurement framework. Training participants included 150 officers from local government organizations in the three pilot

sub-basins. Objectives of the training were to build capacity of local government officers by providing knowledge and understanding about basic elements of project monitoring and evaluation, as well as use of the results measurement framework. This included establishing proper indicators and ability to apply knowledge from the training to future local project implementation.

6.3. Dissemination of project results

Three major workshops were organized by the project to disseminate project findings to wider audiences in Thailand.

- ***RSBO Seminar***. The project organized a national-level seminar meeting on 'Developing models for natural resource and environment management organizations at sub-basin level in the Ping River Basin'. The seminar was held on 6 July 2006 at the Miracle Grand Hotel in Bangkok. Sixty participants were invited to the seminar, including representatives of related government agencies, technical specialists and resource persons, representatives of non-governmental organizations, and representatives of villagers in the 25 major river basins of the country. Seminar objectives were to disseminate project implementation results related to natural resource and environmental management organization models, including exchange of ideas and soliciting suggestions about sub-basin management.

- ***Regional and National Meetings.*** After completion of project implementation, the project organized two major meetings to disseminate project implementation results of the Participatory Watershed Management for the Ping River Basin Project. Objectives of the meeting were to present results of implementation under the project, and to receive ideas and suggestions about results that can be used in adjusting results for application to participatory management of natural resources and the environment in other river basins of the country.

  Meeting participants included representatives from related government agencies, technical specialists and resource persons from educational institutes and independent specialists, representatives of local governments, representatives of community organization networks and non-governmental organizations, and representatives of business and the private sector. A total of about 350 participants were invited to each meeting.

  Regional Meeting. The northern regional-level project meeting was held on 25 August 2006 at the Lotus Pang Suan Kaew Hotel in Chiang Mai.

  National Meeting. The national-level project meeting was held on 29 August 2006 at the Century Park Hotel in Bangkok.