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Developing Watershed Management Organizations in Pilot Sub-Basins of the Ping River Basin
Final Report to ONEP under the Participatory Watershed Management Consultancy

submitted by

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TRANSFORMING LIVES AND LANDSCAPES

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Abbreviations

ADB	Asian Development Bank
aka	Also known as
ALRO	Agricultural Land Reform Office
ASB	Alternatives to Slash-and-burn Consortium of the CGIAR
ASEAN	Association of Southeast Asian Nations
AWGWRM	ASEAN Working Group on Water Resources Management
BAAC	Bank for Agriculture and Agricultural Cooperatives
CCPE	Coordinating Committee for Protection of Ping River Basin & Environment
CDD	Community Development Department
CGIAR	Consultative Group for International Agricultural Research
CMU	Chiang Mai University
DLD	Department of Land Development
DMC	Developing member countries (ADB term)
DNP	Department of National Parks, Wildlife & Plant Conservation
DoLA	Department of Local Administration
DWR	Department of Water Resources
EPA	United States Environmental Protection Agency
EU	European Union
GIS	Geographic information system
GDP	Gross domestic product
GPP	Gross provincial product
GRP	Gross regional product
GWF	Green World Foundation
GWP	Global Water Partnership
GWP-SEATAC	Global Water Partnership Southeast Asia Technical Advisory Council
GWP-TAC	Global Water Partnership Technical Advisory Council
ICRAF	World Agroforestry Centre
IFPRI	International Food Policy Research Institute
IMPECT	Inter-Mountain Peoples Education and Culture in Thailand Association
IRBM	Integrated river basin management
IWMI	International Water Management Institute
IWRM	Integrated water resources management
JWA	Japan Water Agency
KUFF	Kasetsart University Faculty of Forestry
masl	Meters above sea level
MCC	Multiple Cropping Center, Chiang Mai University
MoAC	Ministry of Agriculture & Cooperatives
MoI	Ministry of Interior
MoNRE	Ministry of Natural Resources & Environment
MoPH	Ministry of Public Health
NARBO	Network of Asian River Basin Organizations
NASA	U.S. National Aeronautics and Space Administration
NESDB	Office of the National Economic and Social Development Board
NGO	Non-governmental organization
NIMBY	The 'not in my back yard' phenomenon
NSO	National Statistics Office of Thailand
OAE	Office of Agricultural Economics
OECD	Organization for Economic Cooperation and Development

ONEP	Office of Natural Resource & Environmental Policy & Planning
OTOP	One Tambon One Product program of the Thai government
PDF	Portable Document Format (readable with Adobe Acrobat)
PLP	Participatory land use planning approach
PRA	Participatory rapid appraisal
PYB	Village headman (<i>phuyaibaan</i>)
RBC	River basin committee
RBO	River basin organization
RFD	Royal Forest Department
RID	Royal Irrigation Department
RSBO	River sub-basin organization
SPK	Land use certificate issued by Agricultural Land Reform Office
STK	Land use certificate issued by Royal Forest Department
TA	Technical assistance
TAO	Tambon Administration Organization
TEI	Thailand Environment Institute
TOR	Terms of reference
TRF	Thailand Research Fund
TVA	Tennessee Valley Authority
UN	United Nations
USAID	United States Agency for International Development
USGS	United States Geological Survey
WB	The World Bank
WME	Watershed management expert
WWC	World Water Council
WRI	World Resources Institute

I. The Ping River Basin

In order to help clarify the overall context of activities under this project, the first part of this report begins with an overview of the Ping River basin in the context of national and provincial patterns of economic growth and environmental change. The overview includes a brief introduction to some of the key natural resource management problems that are perceived as resulting from these changes, and major policy responses that have sought to address these problems. This is followed by a brief review of efforts that have sought to move toward development of basin and sub-basin level plans and organization in the Ping River Basin, including introduction of concepts related to natural and administrative hierarchies, and discussion of some key gaps and operational issues.

This sets the stage for subsequent parts of the report. The second part seeks to pursue in greater detail concepts, processes and data associated with surveying the diversity of Ping River sub-basins. These are then used to develop technical criteria and indicators for use in helping to select pilot sub-basins for the project. This approach is then compared with the actual pilot sub-basin selection process that occurred during implementation of the project. In its third part, the report seeks to build on theory and both international and local experience in developing an array of organizational alternatives, and a process for developing sub-basin level management organizations in the Ping Basin. The fourth part of the report seeks to review progress in project implementation up to the time this report was written, and to identify some key lessons from experience under the project. The fifth and final part of the report seeks to draw on learning under this project to contribute to development of the agenda for further RSBO development in the Ping, and possibly other river basins of Thailand.

A. Contextual overview

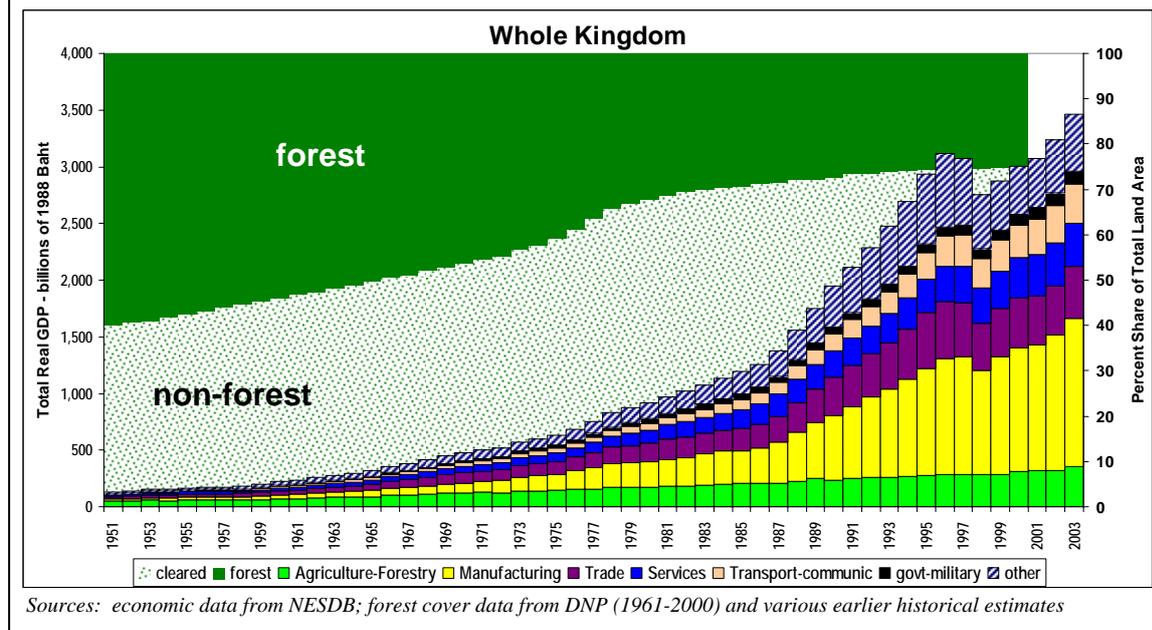
This section provides a brief overview of patterns of economic and environmental change at several higher levels of the hierarchies within which Ping River sub-basins are nested. Particular initial focus is on spatial gradients of change, and on patterns of change over time during recent decades. The final two sub-sections turn the focus to national perceptions of watershed problems that have arisen in association with these patterns of change, and some of the major national government policy responses that have followed, as well as to important changes in approaches to resource governance associated with broader change in Thai society.

1. National concern and response to environmental change

Thailand has demonstrated impressive economic growth for more than 40 years, and its resilience is being demonstrated through its recovery from the Asian economic crisis. The development strategy that has brought this growth and structural change to the Thai economy has long relied on intensification of agriculture, rapid industrialization, and expansion of mining, fisheries, and tourism. These processes have also involved the drawing down of natural assets such as forest, water, mineral ores, fisheries, and land resources. In order to help clarify these patterns in a visual mode, national economic growth in major sectors is depicted graphically in Figure 1-1, along with declining forest cover.

Public awareness of the growing negative impacts of economic development on environmental conditions and quality of life has increased rapidly during recent years. Greater integration into global information systems has helped strengthen environmental awareness and efforts to seek creative means to improve environmental sustainability, including emergence of advocacy oriented civil society institutions. At the same time, efforts to reform governance structures and processes in Thailand also seek to integrate environmental and natural resource management concerns. As a result, deforestation, water scarcity and pollution, declining fish stocks, haphazard urbanization and air pollution have emerged as important issues of concern in the national public policy arena.

Figure 1-1. Thailand's economic growth and forest cover change, 1951 – 2003



Moreover, there is also growing awareness that much of the impact of problems associated with environmental change falls on the poor, whose livelihoods are disrupted and health is threatened. And as livelihood options of the poor become foreclosed, many are forced to turn to alternatives that are seen as causing further natural resource and environmental degradation.

Recent establishment of the Ministry of Natural Resources and Environment (MoNRE) was in recognition that rapid economic growth cannot be sustained if natural assets are not well maintained. Its mission to conserve, protect and rehabilitate natural resources and the environment are consistent with government objectives that include sustainable development and equitable growth. And, since the 1997 national constitution specifically entrusts the environment and natural resources of the nation to its people, and mandates their participation and involvement in environmental management and conservation, the government is now seeking to delegate more responsibility to local communities, and encourage their participation in improving environmental quality.

Among the range of environmental issues of growing concern, seasonal water availability and water quality are currently particularly high priorities for both the government and the general public. Serious floods and landslides have generated many headlines during recent years, while growing demand for dry season water and concern about water pollution from upstream agriculture and industry are a common feature of increasing public anxiety and conflict in many local areas. Given the perceived importance of interrelationships among forest, water and land management to these issues, the government is seeking to develop a river basin management framework for encouraging, facilitating and supporting participatory multi-sectoral collaboration that can help to improve management of natural resources and the environment, and to reduce rural poverty. Of the 25 officially delineated river basins of the country, the Ping Basin was selected as one of 3 initial basins for intensive development of this approach. It was selected both because of its strategic importance in relation to resources, livelihoods and rural poverty, and because of strong concern about impacts of deforestation, soil erosion, sedimentation, water use and pollution.

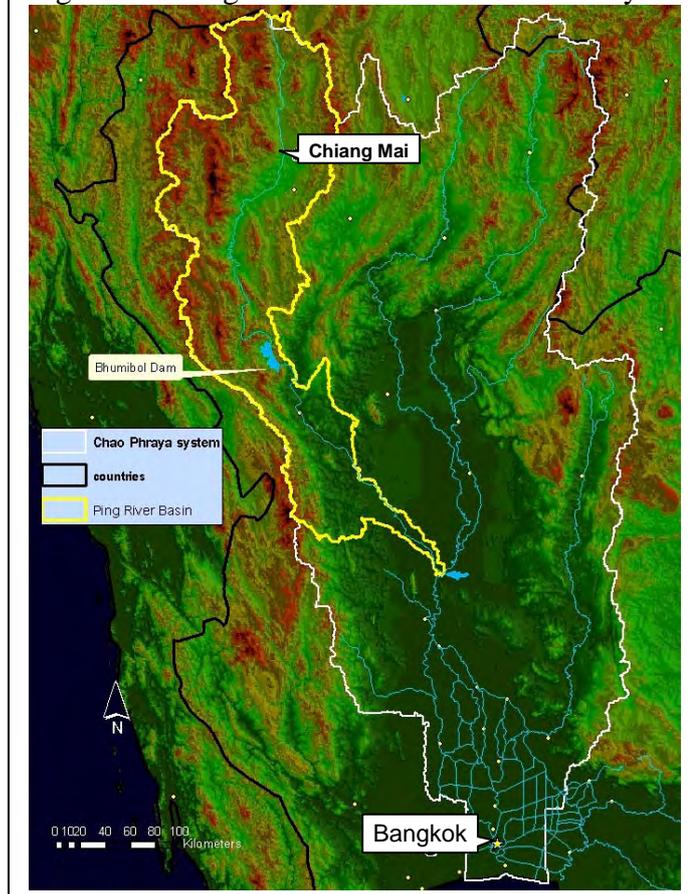
2. The Ping River Basin in the Chao Phraya River System

The Ping River Basin is the largest of the eight river basins that together form the Chao Phraya river 'system'. The Chao Phraya system covers about 30 percent of Thailand's land area, and is home to about 40 percent of its total population. It also is said to employ more than three-fourths of its work force, and generate about two-thirds of Thailand's GDP. Lower (southern) portions of the Chao Phraya system include the fertile Central Plains, often known as the major 'rice bowl' of

Thailand's agricultural production, most of the historically important centers of power and dynasties in the Siamese Kingdoms, as well as the huge primate urban-industrial mega-city of Bangkok – the current capital of political and governmental power, and the central hub of the nation's growing and diversifying commercial, industrial and service sectors.

With a catchment area of about 35,000 km², the Ping River Basin covers about 22 percent of the larger Chao Phraya river system within which it is nested (Figure 1-2), and contributes about 24 percent of the system's average annual runoff. During early days of opening to trade with western countries after the mid-nineteenth century, teak wood from northern Thailand's forests became one of Siam's primary export products, and logs were floated down the Ping River to be taxed and traded in downstream centers. Along with the Wang, Yom and Nan river basins, the Ping is one of the four 'upper' tributary river basins that merge together and become known as the Chao Phraya River at Nakhon Sawan. Together, these four tributary basins contribute more than 70 percent of the total average annual runoff that feeds the entire Chao Phraya river system and its highly complex system of downstream barrages and irrigation canals that have been an integral part of Siamese civilization and the Thai nation state. Thus, from the centers of political and economic power in the lower Chao Phraya, the four 'upper' river basins are viewed as areas to be protected from any activities that would threaten water-consuming downstream processes.

Figure 1-2. Ping River Basin in the Chao Phraya



In 1964, the largest dam in the Chao Phraya system was completed, after which the Ping River Basin was conceptually and functionally split into lower and upper portions. The Bhumibol Dam has a live storage capacity of about 9.7 billion m³, compared to an average annual inflow of 6.6 billion m³ from a drainage basin of 26,400 km², and it is equipped with a hydroelectric generation capacity of 713 MW managed by the Electrical Generation Authority of Thailand (EGAT). Protection and maintenance of the capacity of this strategically important irrigation, water control and electrical generation facility has become another major feature of efforts to manage water and watersheds, especially in 'upper' portions of the Ping River Basin.

3. Gradients of diversity in the Ping River Basin

Overall, the Ping River Basin is part of a gradient of change that begins in Bangkok and passes through the lowlands of the Central Plains, before entering the Ping River Basin at Nakhon Sawan. It then proceeds through the lower North into major valleys of the upper North, before ending in mountainous upper sub-basins with very small areas where lowland traditions can be established. This gradient is physical in terms of terrain and its upstream direction, it is demographic in terms of population density, it is economic in terms of integration, and it is cultural and linguistic in terms of traditions, language, livelihoods and lifestyles. The 'center-periphery' character of this gradient is underscored by the concentration of rural poverty in uppermost sub-basins.

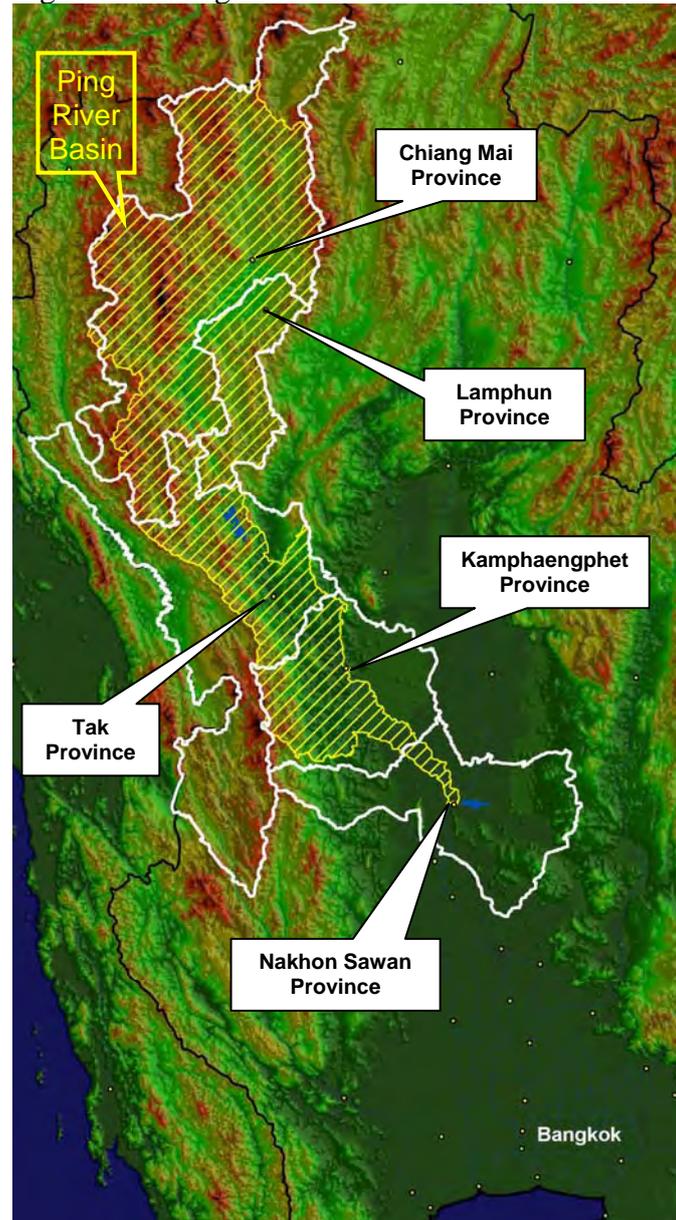
The ‘lower’ portions of the Ping River Basin below the Bhumibol Dam are located near the western margin of the ‘lower north’ region in Nakhon Sawan, Kamphaengphet and Tak provinces (Figure 1-3). While the Ping Basin covers substantial portions of Tak and Kamphaengphet, it includes only a quite small portion of Nakhon Sawan province. Areas within the Ping Basin are quite strategically important, however, and it is worth noting that provincial capital cities are all located within or near the boundary of Ping Basin lands (and waters). Especially in the lowland areas of Nakhon Sawan and Kamphaengphet provinces that are contiguous with the lowlands of the Central Plains, irrigated commercial agriculture and industrial activities have been growing in major valleys along the Ping River. Penetration of these processes into smaller tributary valleys to the west, however, has often been fairly limited.

While some of these processes have also extended into lowland areas of Tak Province, this province also includes more substantial ‘upland’ areas of hills and mountains, as well as more remote valleys beyond the western boundaries of the Ping River Basin. With the Bhumibol Reservoir located within its boundaries, this province is located at the transition between the ‘lower’ and ‘upper’ parts of the Ping River Basin.

Within the ‘upper’ portion of the Ping River Basin further to the north, lowlands of the intermontane Chiang Mai – Lamphun Valley are home for a major center of people and economic activity that has evolved from the Lanna empire, for which it was the center of power before its ‘merger’ with Siam as part of Thailand’s nation-building process that began during the late 19th Century. As with the Siamese further downstream, dominant Tai cultures in the Chiang Mai – Lamphun Valley have strong roots and traditions based in lowland irrigated paddy agriculture, water management, and river bank life. Major lowland valley areas have been integrated into Thailand’s economic and social development infrastructure and programs, as symbolized by the emergence of Chiang Mai City as the second largest city in Thailand (albeit still more than an order of magnitude smaller than Bangkok). Boundaries of Chiang Mai and Lamphun provinces provide a close, but not quite perfect fit with natural boundaries of ‘upper’ portions of the Ping River Basin.

Still within the ‘upper’ Ping, but beyond its large river valleys lie a set of ‘uppermost’ tributary valleys, where lowland paddy-centered civilizations have been limited to relatively small valley floors, nestled within large areas of steeply sloping lands that rise into mountain ridges that include the highest peaks in Thailand. As elsewhere across the montane mainland Southeast Asia (MMSEA) ecoregion [Thomas 2003], which includes mountainous areas of northern Myanmar, Thailand,

Figure 1-3. Ping River Basin Provinces



Laos, Vietnam, and southwest China, midland and highland zones in these ‘uppermost’ tributary areas are inhabited by a quite diverse range of ethnic groups employing various livelihood strategies and types of agroecosystem management practices. Some groups in midland zones of the Ping River Basin, such as the Lawa and at least some of the Karen, are believed to pre-date ethnic Thai groups in the area. Various others (especially highland groups) are seen as moving into Ping Basin areas during the last century, largely from China via Myanmar. Current day middle zone groups have traditions that employ combinations of paddy, rotational forest fallow agriculture, and preserved forest patches in their local landscapes. Various highland groups began with ‘pioneer’-type shifting cultivation that included production of opium as a cash crop to provide food security in areas too high for then-existing rice technologies.

Until recent years, mountain ethnic minority communities in Thailand were not considered part of mainstream society, they had no citizenship, and government administration treated them as a ‘welfare’ issue or as a target for opium crop substitution, shifting agriculture eradication, or in some cases resettlement programs. Any land use claims they may have are precluded by declaration of forest reserves that blanketed those areas, and are now being replaced by more stringent protected watershed and expanded national park and wildlife sanctuary status. These areas are home for most of the rural poor in the Ping River Basin, and their land use practices are now seen as threats to the sustainability of water resources and biodiversity.

While this ‘center-periphery’ gradient has existed in the Ping River Basin for a substantial period of time, there is nothing static about conditions along this gradient. Major processes of change have already swept through the Ping River Basin into even its furthest reaches, and these processes are continuing to evolve rapidly. Perhaps the two strongest forces driving change at this point in time are grounded in economic and governance processes, and their growing links with change at international and global levels.

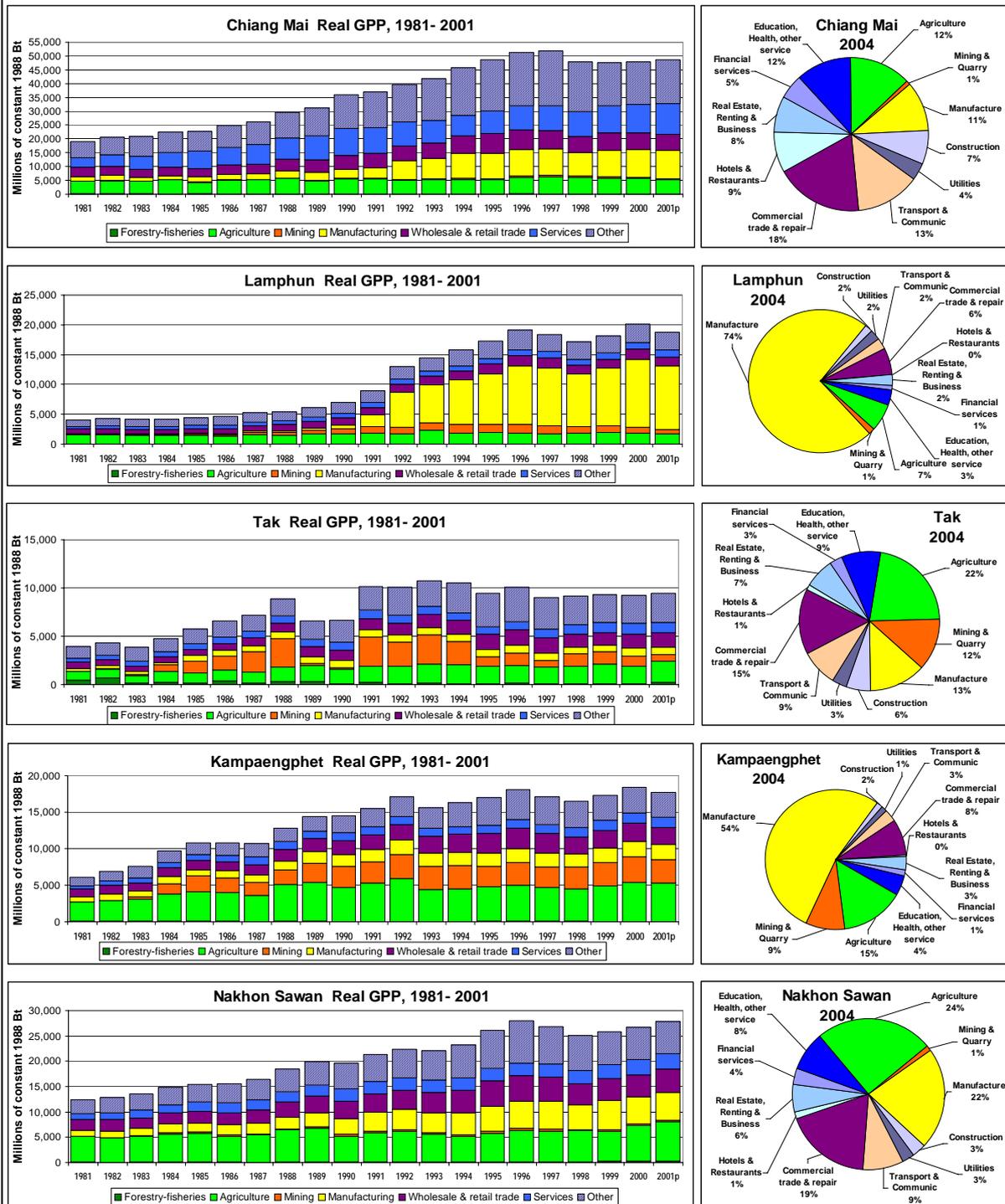
4. Economic change in Ping River Basin provinces

Economic change has various faces as it passes through the gradient of conditions found along the Ping River Basin. It has already brought commercialization, capitalization and industrialization of agriculture in valley lowlands, which in tandem with opium crop substitution and road programs has begun reaching even formerly remote mountain areas. Timber stocks in the natural forests that remain primarily in upland areas, have already been largely logged out and sold. At the same time, a major tourism industry has emerged in some areas, and rapid growth associated with commerce, industry and service sectors is driving urbanization at strategic river valley locations. Government programs are emphasizing development of local entrepreneurship (such as OTOP) and local micro-finance mechanisms. This entire system, however, is now faced with questions about how economic activities can best adapt and restructure themselves in response to international free trade agreements, growing capacity of neighboring countries with lower costs of production, and perceptions of a deteriorating natural resource base.

In order to help clarify the patterns of economic change along the Ping River Basin gradient, Figure 1-4 contains graphical displays of economic change in the five Ping Basin provinces since 1981. Bar graphs on the left display economic change during a 20-year period by major sectors used in national accounts during this period. Values are expressed in constant 1988 baht in order to remove inflation effects. The relative scales of provincial economies are emphasized by using 5 billion baht grid lines on the value axis in all graphs. Pie charts on the right indicate estimated composition of provincial economies during 2004, using the new system of national accounts that helps provide more insight into components of provincial economies.

These charts indicate quite clearly that economic patterns of change are by no means uniform. It is also important to note the degree to which overall economic growth rates are much lower than those seen at the national level, as displayed in Figure 1-1. At the same time, while effects of the Asian economic crisis are observable in provincial economic data, the relative degree of impact seen at this level is considerably less dramatic than at the national level.

Figure 1-4. Real Gross Provincial Product (GPP) in Ping River Basin Provinces



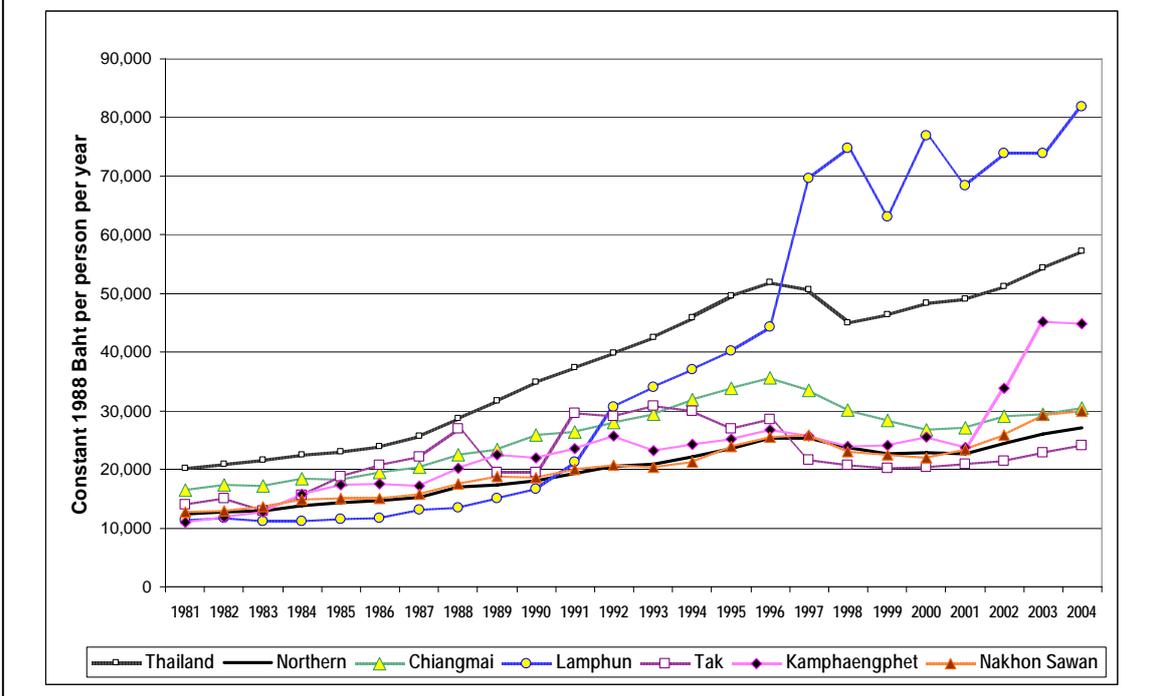
Data source: NESDB – based on old national income structure (bar charts) & new structure (pie charts)

We can also see variation in the overall economic development strategies of provinces along this gradient. In Nakhon Sawan, economic growth since 1981 has come largely from gradual expansion of industry and trade, whereas growth in Kamphaengphet has placed more emphasis on mining and quarries than on industry, at least until the recent surge in industrial investment that appears to have occurred since 2001 (as reflected in the pie chart on the right). Emphasis on mining has also been a major component in the economy of Tak province, although it has clearly passed through periods of boom and bust, and is now at a relatively low level; this is also the only province where forestry formed a visually evident portion of the economy, but its contribution has dropped since logging concessions were revoked in national forest lands. In the major inter-

montane valley of the Upper Ping, the province of Lamphun has placed very strong emphasis on industrial development since 1990, which has now grown to about three-quarters of the provincial economy. In the large and diverse Chiang Mai province, there has also been substantial growth in industry and trade, but growth in the service sector of the provincial economy (much of it associated with various aspects of tourism) has clearly been much greater than in other provinces of the Ping Basin. While agriculture plays a significant role in the economy of all five provinces, its relative share of the economy is greatest in lower Ping provinces, and its rate of growth in real value terms has been more modest and less consistent than other sectors of the economy.

Given the very substantial differences in the size of economies and populations among these provinces, Figure 1-5 describes the overall impact of these different strategies in terms of real gross product per capita, including comparison with averages at national and northern regional levels. One of the first patterns to notice in this graph is the widening gap between national and northern regional levels over time. The economy of Nakhon Sawan has quite closely mirrored the northern regional level, although it appears to be making modestly more rapid growth during the last few

Figure 1-5. Annual Real Gross Product per Capita, 1981 – 2004



years. Per capita levels of the Kamphaengphet economy have been modestly higher than the northern regional average during much of the last 25 years, and as made an impressive surge beginning in 2002 due to the very recent boom in industrial expansion. Indeed, perhaps the most impressive story in terms of per capita GPP is Lamphun province, which before 1990 had per capita levels significantly lower than the northern regional average. Since then, however, their clear strategy on industrial expansion has led to a dramatic surge in per capita GPP levels that allowed them to match national overall economic growth rates during the boom period of the 1990's, and pushed them well beyond national averages since the Asian economic crisis in 1997. Chiang Mai, with the largest provincial economy, has experienced consistently higher GPP per capita levels than the northern region as a whole, but even its impressive growth during the 1990's boom period was not fast enough to prevent a gradually growing gap with national averages. Moreover, since the Asian economic crisis, per capita GPP in Chiang Mai has dropped back to levels much closer to the northern regional average, and appears to still be losing ground in relative terms.

While patterns of change in per capita levels of the overall economy help clarify the overall economic environment in Ping Basin provinces, it is still difficult to see the distribution of impacts of economic growth and structural change among major components of provincial populations. Thus Figure 1-6 displays a range of additional data on economic and labor characteristics of Ping Basin provinces, most of which is based on preliminary data for 2004.

The relative overall labor intensity of agricultural production is evident. While the amount of wealth that agriculture contributes to provincial economies ranges from 10 to 25 percent, its share of the labor force is from 34 to 63 percent, resulting in much lower levels of economic output per worker than in non-agricultural sectors. Within the agricultural sector, distribution is generally somewhat more equitable than in non-agricultural sectors (except in the case of Tak province), as reflected in their Gini coefficients. That being said, the combination of low population growth rates, growing employment in non-agriculture sectors, and the constant to very modestly growing overall value of agricultural production, suggests that at least some components of the agricultural labor force are also increasing their per capita economic output. And, the fact that Gini coefficients within the agriculture sector are not as radically different from non-agriculture as one might suspect indicates differentiation within agriculture. Even at the provincial level, it is noteworthy that the

Figure 1-6. Current economic and labor characteristics of Ping Basin provinces

< data 2004 except as noted >			Nakhon Sawan	Kamphaeng- phet	Tak	Lamphun	Chiang Mai
OVERALL							
Land Area	total	sq km	9,598	8,607	16,407	4,506	20,107
Population	total	thou per	1,008	790	486	381	1,586
	density	per/sq km	105	92	30	84	79
Gross Prov Product (GPP)	total	mill Bt	56,800	56,414	22,824	49,305	97,994
	per person	thou Bt	56	71	47	130	62
Labor	total	thou per	673	394	244	289	939
	GPP/worker	thou Bt	84	143	94	171	104
Unemployed		% total labor	1.3%	1.9%	2.3%	1.3%	5.2%
Poor (2002)		% pop	7.7%	0.7%	30.1%	6.5%	7.8%
Poverty Line (2002)		thou Bt	9,936	9,600	9,948	10,176	10,236
		USD/day	0.68	0.66	0.68	0.70	0.70
Inequality (2002)		Gini coeffic	0.51	0.41	0.54	0.44	0.45
AGRICULTURE							
Area (2001)		sq km	6,386	3,990	1,667	832	2,215
	share	% total	67%	46%	10%	18%	11%
GPP	share	% total	24%	17%	24%	10%	14%
Labor	share	% total	54%	63%	42%	35%	34%
	GPP/worker	thou Bt	37	38	54	50	45
	area/worker	rai	11.0	10.1	10.1	5.2	4.4
Unemployed		% agric labor	0.1%	1.3%	1.1%	0.8%	1.9%
Inequality (2002)		Gini coeffic	0.40	0.32	0.56	0.34	0.33
NON-AGRICULTURE							
GPP	share	% total	76%	83%	76%	90%	86%
Labor	share	% total	46%	37%	58%	65%	66%
	GPP/per	thou Bt	141	320	123	235	135
Unemployed		% non-agr labor	2.8%	2.8%	3.2%	1.6%	6.9%
Inequality (2002)		Gini coeffic	0.50	0.43	0.48	0.43	0.43
Mining quarrying							
GPP	share	% total	1.0%	16%	5%	0.8%	0.7%
Labor	share	% total	0.26%	0.07%	0.57%	0.21%	0.02%
Industry & handicrafts							
GPP	share	% total	21%	38%	14%	66%	10%
Labor	share	% total	10%	8%	17%	30%	20%
Construction							
GPP	share	% total	3%	2%	6%	2%	7%
Labor	share	% total	6%	5%	6%	6%	7%
Public utilities							
GPP	share	% total	1.5%	1.1%	2.7%	1.8%	2.0%
Labor	share	% total	0.17%	0.09%	0.06%	0.14%	0.38%
Commerce & banking							
GPP	share	% total	21%	11%	16%	8%	20%
Labor	share	% total	14%	11%	12%	17%	15%
Transportation							
GPP	share	% total	5%	1.8%	4.3%	1.4%	8%
Labor	share	% total	1.7%	1.5%	3.6%	0.9%	1.5%
Services, other							
GPP	share	% total	22%	12%	26%	10%	38%
Labor	share	% total	14%	12%	18%	12%	23%

sources: (1) economic & poverty data from NESDB datasets; (2) labor data from NSO datasets; (3) agricultural holding area from OAE datasets

average value of agricultural production per worker is relatively high in Upper Ping Basin provinces, while the average area of farmland per worker is about one-half that of their counterparts in Lower Ping Basin provinces. Tak province again represents the transition, with high value and high land area per worker, together with relatively high distributional inequality.

While non-agricultural sectors are clearly of growing importance in terms of both the economy and the labor force, the relative balance between contributions to the economy and to employment vary:

- Mining, public utilities and transportation appear to have a low labor intensity per unit of economic output. Thus, while they have generated significant levels of wealth in some provinces, their benefits are confined to a relatively small component of the population.
- The labor intensity of industrial output appears to be quite low in lower Ping provinces and Lamphun, but relatively high in Tak and Chiang Mai provinces. This is probably associated with the relative importance of crafts and cottage industries in the latter two cases, where the relative share of industry in the provincial economy is also lowest. Overall, in those provinces where we have seen dramatic growth in industrial contributions to the provincial economy, its impact on the economy is considerably greater than its impact on the overall provincial labor force.
- Construction, commerce and service sectors appear to have a relatively more balanced overall impact on both economic output and employment.

Overall, if we can assume that the relatively high GPP per worker in non-agriculture sectors (and especially in larger-scale industry) translates into similarly relatively high wage rates, there appears to be a strong incentive for further movement into the industrial sector. The same is true for the service and transportation sectors in some provinces. Incentives for trade and commerce, and especially construction appear to be more modest, while the scale of employment opportunities are likely to be limiting in remaining sectors. More detail on the distribution of employment among sectors in more localized areas will be provided in the second part of this report under discussions of the stakeholder and institutional context of Ping sub-basins.

Within the agriculture sector, we can also anticipate continuing strong incentives for movement into crops offering higher value per worker. A number of constraints, however, are likely to limit the rate and extent to which this occurs. In terms of current agricultural production, the following distributional aspects are particularly noteworthy:

- Paddy Rice. Lower Ping Basin provinces have extensive irrigated areas that produce multiple crops of paddy rice. Irrigated areas also occur in the more limited lowlands of Tak, and expand again in the large inter-montane valley in Upper Ping Basin provinces, where traditional irrigation facilities have been reworked with 'modern' structures. In mountainous areas of Tak and Upper Ping provinces, much smaller pockets of paddy land are found in small valleys and areas where terrain allows, and especially main season paddy crops are often assisted by weir and canal structures long managed by traditional water management organizations (*muang fai*).
- Short-season Field Crops. The most extensively planted short field crop in the Ping River Basin is maize, most of which is sold for use in producing animal feed. There are also substantial areas planted to various legumes, especially soybean, mungbean and groundnut. Various upland areas planted to legumes have been displaced by maize during recent years.
- Long-season Field Crops. Lower Ping Basin Provinces have extensive areas planted to long-season industrial crops, especially sugarcane and cassava. While sugarcane extends a bit into Tak Province, these crops become very rare in inter-montane valley and mountain areas of the Upper Ping Basin. While a bit of cotton appears in Tak, the main long-season field crop in mountain areas is upland rice, which occurs in areas where terrain does not allow establishment of paddy fields. Especially in inter-montane valley areas, tobacco has also been an important crop,

- **Vegetables.** Lower Ping Basin provinces have relatively little commercial production of vegetables, although there is some production of long bean, greens, chillis and eggplant in Kamphaengphet. Garlic production begins to appear in Tak, and expands in scale along with shallots and onions as one travels north into inter-montane valley areas, where production of greens, chillis, cucurbits, tomatoes, eggplant, sweet corn, tubers, and a variety of other minor crops add up to a substantial level of production. In hill and mountain areas, a range of more cool season vegetable crops also appears. Upper Ping Basin vegetables are produced for both domestic and export markets, although various important crops are now facing increasingly stiff competition from imports from China.
- **Ornamentals.** Although there are a few orchid farms and minor plantings of a few crops like jasmine in Kamphaengphet and Tak provinces, in Upper Ping provinces, production of roses, orchids, gladiolas, and various other flowers and ornamental plants becomes an important activity for some areas and households.
- **Fruits.** Although a variety of fruits are grown in home gardens throughout the Ping Basin, commercial production at significant scales are first seen in terms of citrus production in Kamphaengphet. But it is not until Upper Ping Basin provinces that fruit tree production becomes a major enterprise. The largest is the major longan industry in the inter-montane Chiang Mai-Lamphun Valley, but there are also extensive plantings of mango, litchi, and a range of other crops often planted in mixed orchards. A substantial citrus industry has also begun in the far northwest corner of the Ping Basin, and it has been expanding during recent years. Strawberry production has also become important at higher elevations, and a range of sub-tropical and temperate fruits have expanded in some mountain areas with assistance from opium crop substitution and highland development programs.
- **Other Trees.** While few other industrial tree crops appear to be important in Nakhon Sawan, eucalyptus plantings appear in Kamphaengphet and extend northward into Tak, along with some minor areas of coconut. In Upper Basin provinces, mountain areas of Chiang Mai also include some plantings of coffee and tea, including both Chinese types of tea and 'miang' tea gardens that are traditionally planted into natural forests.
- **Others.** Of course there is also a substantial range of herbals, medicinals, mushrooms, dyes, and various other types of products that are obtained either from natural forest sources or are being produced at various stages and levels of domestication. These can be seen more as 'niche' products, and mainstream government information systems are not willing or able to try to keep track of their production levels. There does, however, appear to be increasing levels of production as one moves north into the complex environments found in mountain areas of mid to upper Ping Basin provinces.

Livestock and wildlife are also important in the Ping Basin, as in other areas of Thailand. Some data that helps indicate distribution of livestock production for sale in Ping sub-basins will be presented in the second part of this report.

5. Changing patterns of natural resource use

The growth of these types of agricultural activities has left their 'footprint' on the land use patterns of Ping Basin provinces. In order to see how these patterns have changed during the last 20 years, Figure 1-7 shows the relative proportion of land in each province allocated to various major types of land use during 1986-2001.

Two types of patterns are immediately evident in these data. The first relates to substantial differences that correspond to the gradient of change that occurs from the lower to upper portions of the Ping Basin, while the second relates to change over time.

Gradient Changes. In terms of difference along the lower-to-upper gradient in the Ping Basin, the most obvious is a dramatic increase in the proportion of land under forest cover. In Nakhon Sawan, about 90 percent of the total land area has been cleared. But to the north in Kamphaengphet prov-

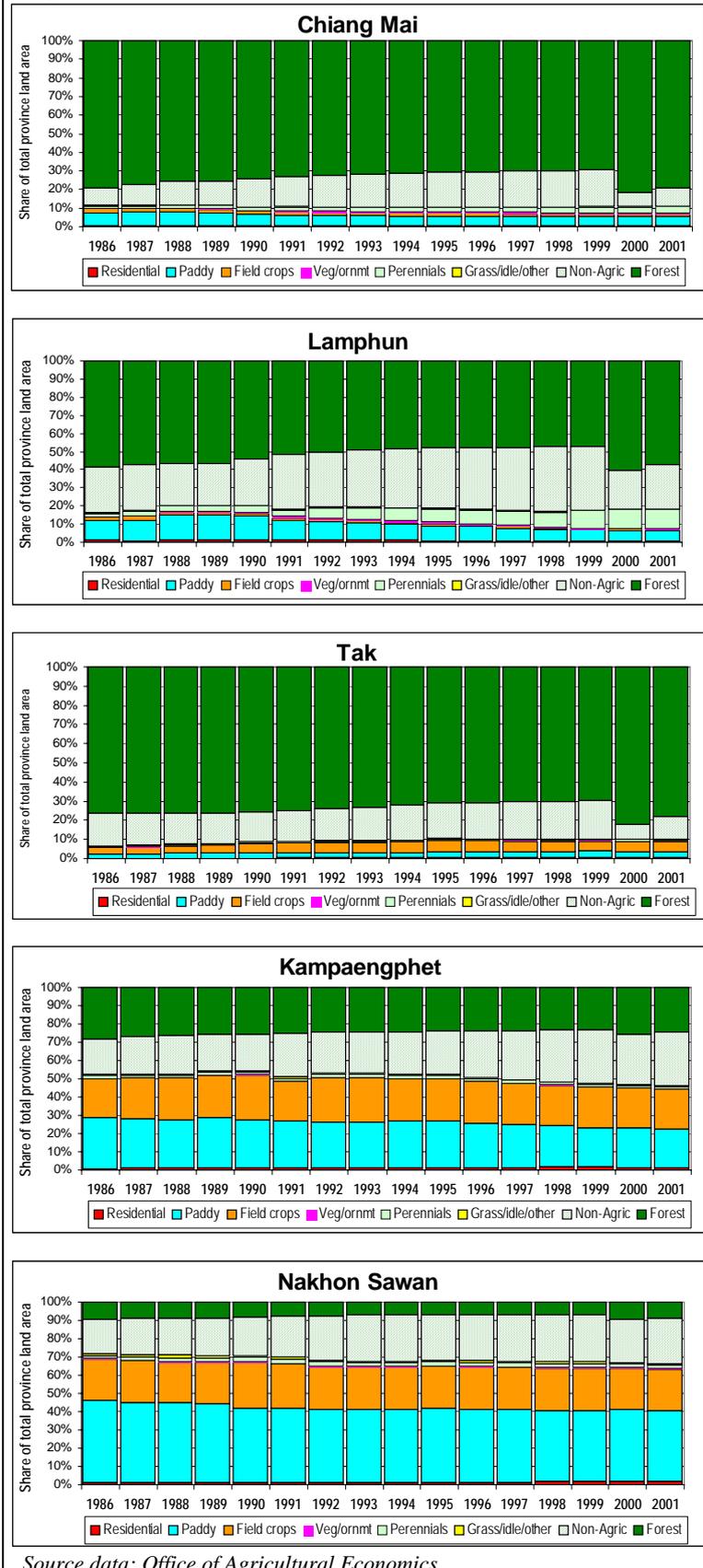
ince forest cover increases to about 30 percent of the land area. In the transition province of Tak, forest cover rises to between 70 to 80 percent, and it is fairly similar in Chiang Mai province. Smaller Lamphun province retains only about 50 to 60 percent forest cover, but that relates to the relatively large proportion of its land that lies within the inter-montane Chiang Mai-Lamphun Valley.

The curious difference between forest cover data in 1999 and in 2000 is linked with a change in the type of remote sensing platform used to detect forest cover to a newer and higher resolution type of equipment. Of course, this also raises questions about the accuracy of pre-2000 forest cover data and the actual extent of land identified as cleared of forest but not within recognized farm land holdings. Analysts in the Ministry of Natural Resources and Environment are currently working to clarify this issue.

Another corresponding aspect of change along this gradient is the relative proportion of land in agricultural holdings of various types. Between 60 to 70 percent of land in Nakhon Sawan is accounted for as recognized types of private farm land holdings, and two-thirds of this area are in paddy fields, much of which is irrigated from water originating in upstream areas of the Ping and other river basins in the northern region that have all merged together by the time they reach Nakhon Sawan, where they collectively form the Chao Phraya River. As we move north to Kamphaengphet, the proportion of area in farm

land holdings drops to about 40 to 50 percent of the total area, and only about half of the farm land is in paddy fields. This corresponds to the increasing relative importance of major upland crops, and especially sugarcane, cassava and maize. In the largely mountainous transition province of Tak, recognized farm holdings drop to less than 10 percent of total land area, with most of it in up-

Figure 1-7. Land use in Ping Provinces, 1986 – 2001



Source data: Office of Agricultural Economics

land fields. In the Upper Ping Basin provinces of Chiang Mai and Lamphun, recognized farm holdings increase to between 10 to 20 percent of total land area, much of which is in paddy, and most of which is located in the major inter-montane valley.

Temporal Changes. Other than the curious ‘hiccup’ in forest cover data (already discussed above), the most obvious aspect of change during the last 20 years has been that the proportion of area in farm holdings has not increased in any of the 5 Ping Basin provinces. Indeed, it appears to have actually decreased in all provinces except Tak, where it was already at a very low level. And, this decrease in farm land holdings includes the proportion of area in paddy fields in all four provinces. Possible explanations for this pattern include (a) the previous expansion of paddy and upland fields into increasingly marginal areas that subsequently proved incapable of sustaining satisfactory levels of productivity; (b) stabilization of population growth and migration of members of the labor force from agriculture into other sectors of the economy; (c) expansion of urban and industrial areas into farm lands surrounding the locations where urban industrial areas developed, which were almost universally in lowland areas with productive farm lands; and (d) shifts into more intensive multiple cropping systems in productive farm lands surrounding growing urban industrial centers.

The second obvious pattern of change over time has involved shifts among components of farm land holdings, which are particularly evident in Upper Ping Basin provinces. The most obvious component of this change has been a shift from paddy land into perennial crops, which has occurred mainly in the major inter-montane valley of the Upper Ping Basin. This shift is primarily associated with expansion of fruit tree plantations, which includes longan, mango and mixed orchard and perennial systems. Primary explanations for this process center on (a) the higher returns to land and labor offered by expanding access to domestic and international markets for these products; (b) the relatively lower labor intensity of orchard production, which became important as labor migrated from agriculture into other sectors of the economy; and (c) simply the ‘bandwagon’ effect created by the previous factors in combination with promotion programs by public and private sectors, as well as by the lack of sufficiently attractive alternatives.

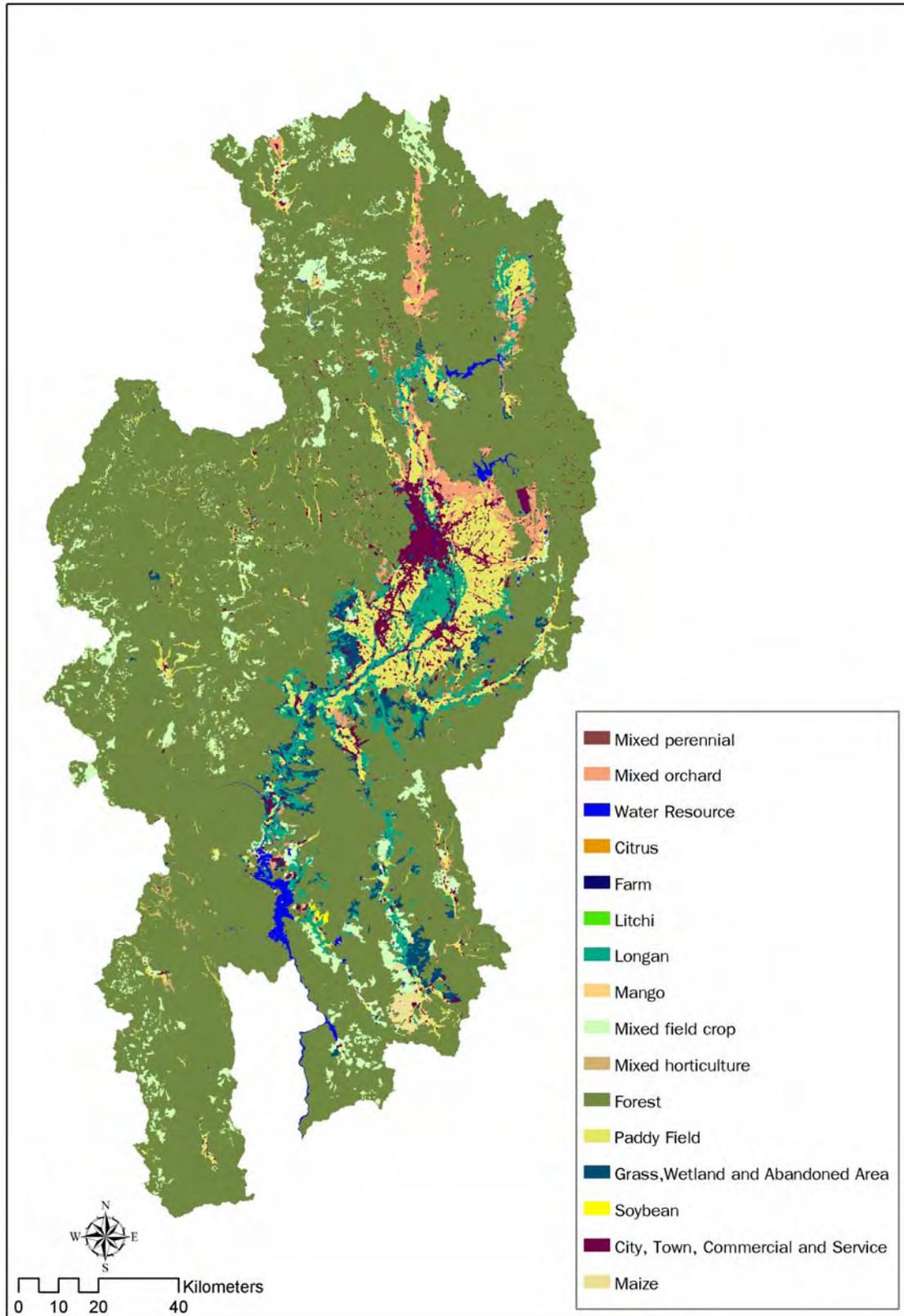
While there has not been dramatic expansion of the total area in recognized farm land holdings during the last 20 years, these shifts among components of land use within farm land holdings has also been associated with changing demands for water resources. In earlier times, main season rice crops were the primary focus of lowland water demand, and a second crop of rice or other post-rice crops was a ‘luxury’ possible in areas that were particularly well located in terms of water resources. As production has shifted more into year-round intensive multiple cropping systems and perennial orchards, however, a dependable year-round supply of irrigation water moves from being a luxury into becoming a necessity. And especially as perennial fruit tree orchards have expanded into upland rainfed areas around the periphery of irrigated lowland areas, growers have learned that availability of irrigation water at critical times in the fruit production cycle are an extremely important element of the abundance, marketability and profitability of the crops produced. Thus, overall demands in the lowlands and surrounding upland areas for a reliable year-round supply of irrigation water have been growing.

At the same time, year-round water demands are increasing for growing major urban and industrial centers located in the lowlands, as well as demands for water to irrigate golf courses, supply resorts and tourist facilities, and various other types of uses that emerge along with structural shifts in the economy. Moreover, often extremely high land values in expanding riverside urban centers has also brought strong incentives for encroachment into flood plains, drainage channels, canals and river banks, as well as pressure to build roads, bridges and various other structures that can impede water flows. These factors contribute to increased incidence and impacts of flooding during peak flow seasons.

In order to help clarify the spatial patterns of many of these elements of change, which are becoming particularly complex in the Upper Ping Basin, Figure 1-8 presents a detailed map of agricultural and urban land use in the Chiang Mai and Lamphun portions of the Upper Ping River Basin. It has been prepared by Dr. Methi Ekasingh and his colleagues at the Chiang Mai University Multiple Cropping Centre, using the pilot provincial information systems they have recently developed for

these provinces (along with Chiang Rai) under support from the Thailand Research Fund (TRF). Patterns in this figure indicate quite clearly why the World Agroforestry Centre (ICRAF) refers to mosaic agroforestry landscape patterns of land use in the region.

Figure 1-8. Detailed current agricultural land use in the Upper Ping



Source: Methi Ekasingh, CMU Multiple Cropping Centre, using their Decision Support System for Agricultural Resource Planning (Ekasingh et.al. 2005)

6. Perceived watershed problems and government policy responses

Watershed issues in Northern Thailand in general, and the Ping River Basin in particular, have been a focus of concern at national policy levels for many years. Indeed, the first major World Bank report on Thailand [World Bank 1959], which was associated with establishment of the nation's first national development plan, placed considerable emphasis on recommending protection of forest cover in mountainous areas, in order to maintain reliable supplies of water for production areas in the Central Plains. In following years, a legal basis was provided for declaration of national forest reserves, national parks and wildlife sanctuaries. Then, during the 1960's and 1970's, forest reserve status was declared over areas that blanketed most all Ping Basin areas except flat lowlands in major valleys. Subsequently, various reserved forest areas began to be declared protected national parks and wildlife sanctuaries. Figure 1-9 displays a fairly current depiction of the extent of these protected forest areas, along with remaining reserved forest lands. There are, however, additional protected areas that are in the process of being established that are not yet depicted in this map.

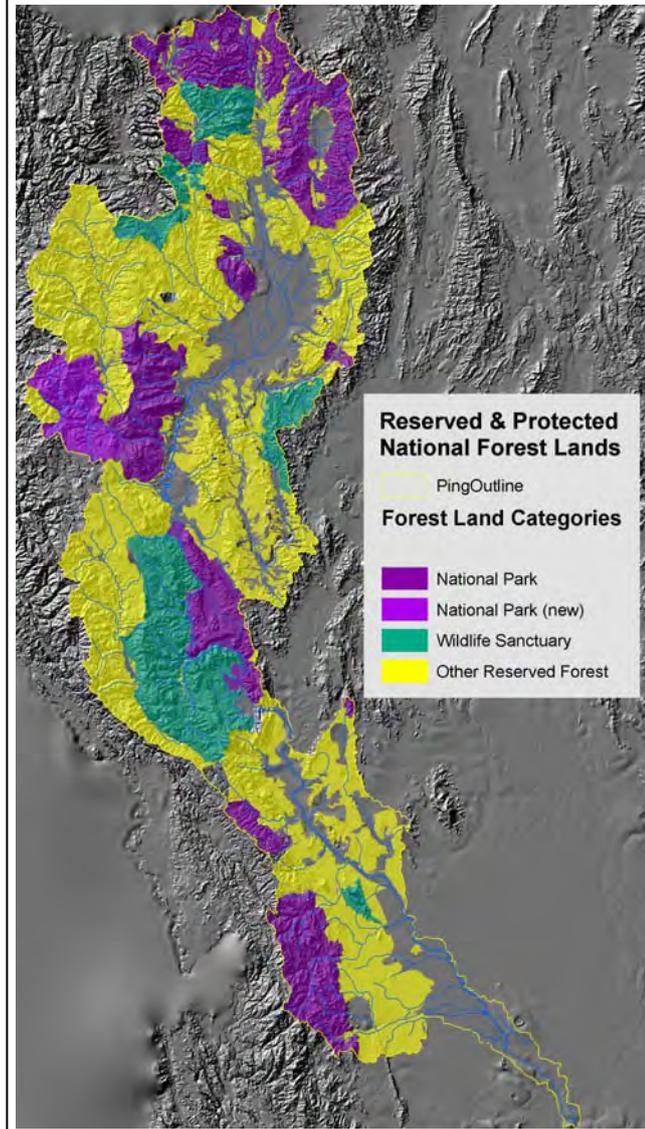
Obviously, many of these reserved forest areas included lands where people were living, as evidenced by references in the historical lore of local principalities, and in the self-described exploits of several Siamese Kingdoms that had relationships in the region during various times.

One of the major implications of this official land status was that these communities and their lands were not eligible to apply for official land tenure documents that were being issued under national land titling programs. Initially, life in these communities was little changed, since forest laws were rarely enforced, and official land tenure appeared to add little value to traditional ways of managing local land resources.

As conditions began to change, however, implications became more clear. On one hand, migrants from elsewhere in the region or from outside the country have moved into local areas and laid claim to local lands. In cases when local communities could not muster sufficient force to maintain their claims, they were unable to get support from official authorities because their lands were not legally recognized. These problems were often exacerbated as infrastructure established under opium crop substitution and national security programs opened access to remote communities.

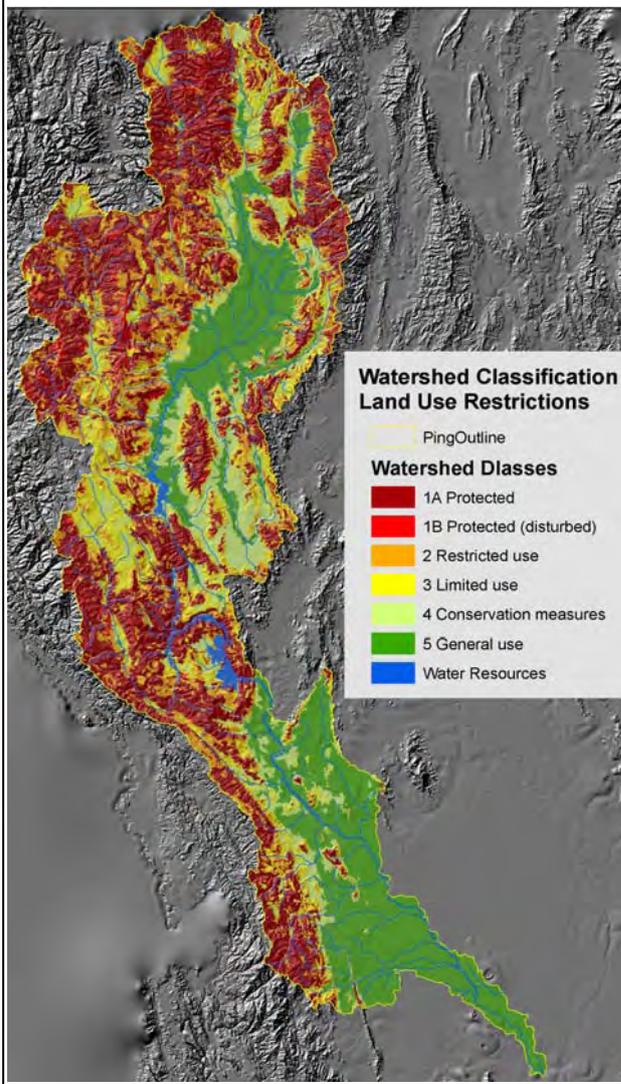
On the other hand, the Thai government began to see long-established communities as 'encroachers' in national forest reserves and protected areas. Since they could demonstrate no legal right to reside there, and most were never granted Thai citizenship, they were lumped together with more recent migrants into the area under the general banner of *chao khao* (which has been poorly, but popularly translated into the term 'hilltribes', but more appropriately translated as 'highland-

Figure 1-9. State forest lands in the Ping Basin



ers’). As such, they have become targets for a range of programs launched by outsiders, from well-intentioned efforts to improve medical care, education and livelihood opportunities, to often misguided attempts to bring ‘civilization’ to their world. Various conditions have improved during recent years, and most mountain communities in the Ping River Basin (except for the most recent wave of migrants fleeing strife and hardship in Myanmar) now have citizenship and are being integrated into local administration and governance systems. The lack of any legal recognition of land holdings and local boundaries, however, remains a major obstacle for local land use management.

Figure 1-10. Ping Basin watershed classes



Moreover, effects of internal population growth and economic change have brought increasing resource scarcity, incentives for commercial activity, and a range of new stakeholder interest groups that profoundly changed the operating environment of mountain communities. While lowland society has long misunderstood and condemned all forms of shifting cultivation in mountain agroecosystems (no matter how well managed), it is the expansion of commercial agriculture that is the most commonly cited source of the serious degradation of forest and soil that is perceived to be occurring in mountain watersheds today. Indeed, economic incentives for expansion of upland field crops began driving expansion of lowland agriculture into reserved forest areas in Lower Ping provinces during the 1970’s, as well as the subsequent penetration of agro-industrial crops (especially maize) into mountainous areas. This was further facilitated by anti-shifting cultivation programs that forced conversion of rotational forest fallow systems in many areas into fixed field agriculture that required use of purchased chemicals to replace agronomic and ecological functions of forest fallow. Meanwhile, the success of opium crop substitution programs and expansion of road access in highland areas brought market forces into mountain areas that are driving expansion of a range of commercial

crops, some of which employ technologies that include sprinkler irrigation and intensive use of agricultural chemicals. Expansion of tourism has also brought incentives to develop resorts, golf courses, vacation homes, and various associated facilities. And, since there are no legal boundaries to land holdings in any reserved or protected forest lands, there are few tools available to manage rising levels of competition for land resources and the resulting changes in land use patterns. Moreover, some of the newer stakeholders are backed by wealthy and powerful investors, who are sometimes able to use their connections and wealth to ‘purchase’ land documents not available to local long-term residents.

National authorities responsible for management and maintenance of reserved and protected forest lands observed these changes with growing concern. Their first major response came during the mid-1980’s when a new national program was launched to classify all lands in the country according to their watershed characteristics. The resulting classification of watershed zones is meant to serve as a basis for efforts to restrict land use practices in critically important areas. Figure 1-10 depicts the outcome of this process for the Ping Basin.

Backed by a resolution of the Ministerial Cabinet rather than specific legislation, watershed zones were an integral part of thinking that underlied the first national forest policy, approved and established in 1985. As a result, programs of the Watershed Conservation Division (then located within the Royal Forest Department) and their distributed watershed management units began receiving stronger support. While their programs began rapid growth a decade earlier, much of their effort was related to a combination of planting pine plantations (often in forest fallow fields where they were subsequently destroyed), or implementing projects related to national security and/or opium crop substitution. As part of the new approach, there was an expansion of watershed-oriented highland development projects that included the UN-supported Sam Mun Highland Development Project in the Mae Taeng upper tributary valley of the Upper Ping, as well as the Queen Sirikit Forest Development Project that succeeded an earlier USAID supported project in the Mae Chaem upper tributary. Under Thai leadership provided by staff from the Watershed Conservation Division and its local watershed management units, both of these projects became pioneers in working with communities in upper watershed areas, employing a range of approaches developed in association with academics and other non-agency groups working on emerging community forestry and social forestry programs.

Despite impressive progress made under these and other projects, which included collaboration in the development and testing of now internationally recognized and emulated participatory land use planning (PLP)¹ techniques, national authorities remained unwilling and/or unable to establish any means for official recognition of land use zoning boundaries delineated in collaboration with local communities in these project areas. Rather, with backing from environmental interests and lobby groups, protected areas have continued to expand, and now all Class 1 watersheds located outside national parks and wildlife sanctuaries have been placed in the status of “being prepared” for protected area status. This precludes access by local communities to land use recognition (less than full title) that might be provided under any of the Ministry’s community forestry programs.

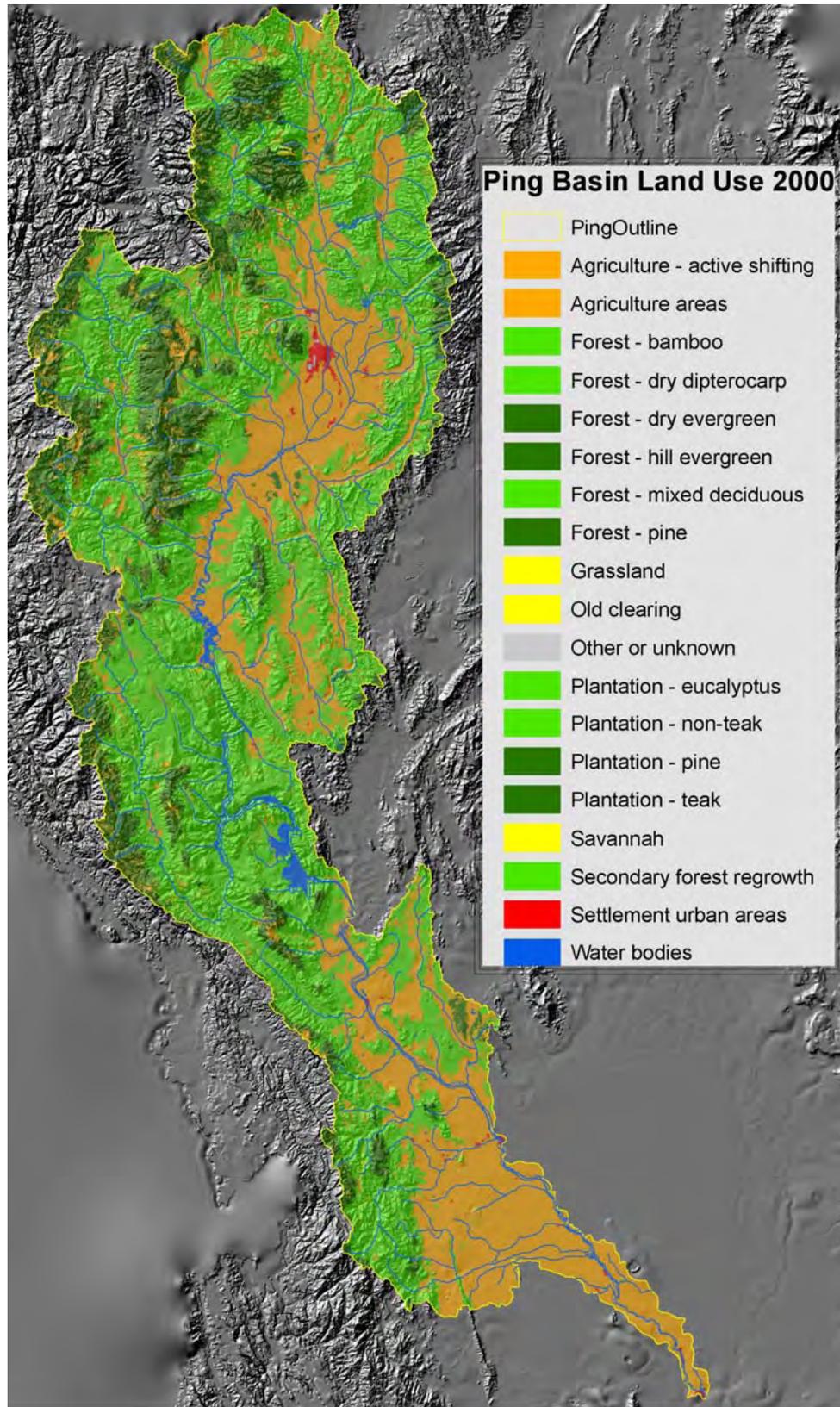
It is not so much the current magnitude of cultivated areas in the mountains that concerns environmental interests, as it is the strategic locations of various cultivated areas, along with fears of further expansion driven by economic forces believed to be beyond the capacity of local communities to manage. Somewhat ironically, it is the absence of enforceable land use boundaries that facilitates expansion of the types of land use that environmentalists so abhor. In order to help clarify the nature of these concerns, Figure 1-11 displays overall land use patterns in the Ping River Basin during 2000, as interpreted from satellite imagery by forest department technical analysts. While similar types of forest have been merged into the same color codes to simplify the presentation, differences between evergreen and mixed or fully deciduous forest have been retained. Similarly, all types of agriculture are merged into one color, which eliminates issues associated with forestry analysts assigning fixed or shifting cultivation status to particular areas.

Hill evergreen forests are perceived by forest hydrologists and environmentalists as being particularly important for hydrological processes at the watershed level. There is still substantial debate about whether evergreen forests cause increased rainfall [Tangtham 1998], or whether they exist because of higher rainfall associated with altitudinal gradients. While most existing hard evidence points to the latter [Bruijnzeel 2004], foresters and environmentalists in Thailand remain unconvinced. In any event, their location is associated with headwater areas of streams important for downstream agriculture and other forms of water use, and forest cover is viewed as very important for maintaining the most even seasonal distribution of rainfall possible [Tangtham 1998]. Although factors affecting infiltration of water may be more important for buffering seasonal stream flow than forest cover per se [van Noordwijk 2003], foresters and environmentalists do not believe that any alternative forms of land use can maintain infiltration rates similar to those found in productive natural forest. As close examination of Figure 1-11 indicates, many hill evergreen forest areas in the Ping Basin include orange areas that indicate the presence of strategically important highland agriculture. Moreover, a considerable number of these areas are where intensive horticultural

¹ Dr. Uraivan Tan-kim-yong coined this term to characterize techniques developed and tested by a collaborative team for which she was the major source of conceptual and intellectual innovation and guidance.

tural crops are now being grown in contiguous fixed fields, often employing sprinkler irrigation and substantial use of agricultural chemicals. For foresters and environmentalists, then, these are the most important “hot spots” of forest degradation in Ping Basin watersheds, and the most important targets for efforts to limit land use.

Figure 1-11. Ping Basin land use, 2000



Source: Forest department data provided by ONEP

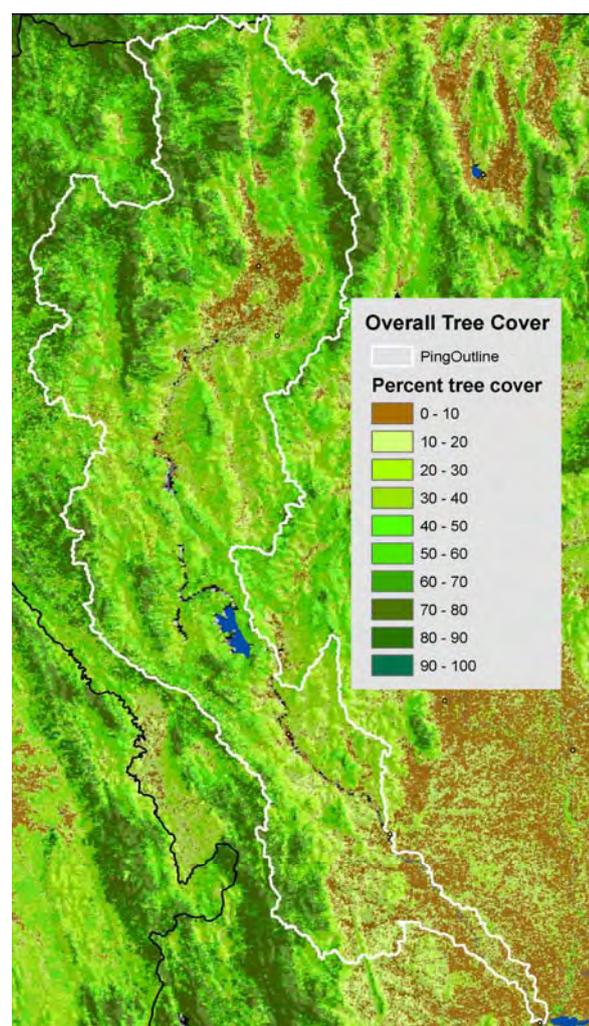
A second source of concern relates to the total proportion of land under forest cover, regardless of the type of forest involved. For more than 50 years, the Thai forestry establishment (with the backing of certain international forestry and environmental interests) has maintained that a minimum of 40 to 50 percent overall forest cover is necessary for the nation to remain environmentally sustainable. And, since most of the lowland areas of the country have long been converted to non-forest forms of land cover (as in the two Lower Ping Basin provinces), large areas of forest cover must be maintained in mountain areas in order to achieve this overall percentage. While there may well be a need for a more rational approach to determining which areas that society wants to maintain under forest cover, the overall percentage approach has been enshrined in national policy, ingrained in the mindsets of environmentalists, and accepted by many segments of Thai society.

In addition to forest clearing conducted by lowland communities expanding their upland crop production (as has been particularly dramatic in the Lower Ping Basin), the culprit responsible for much, if not most deforestation is widely believed to be mountain communities practicing any form of shifting cultivation, regardless of the type of forest within which they are located. Indeed, the use of fire in these systems provides an easily recognizable indicator of their existence, with so much smoke filling the air during burning season that even air traffic can be disrupted. Moreover, areas burned each year are classified and calculated as deforestation, while fields returned to forest regeneration in rotational forest fallow systems are ignored. These factors have helped inflate public perceptions of deforestation beyond the reality that can be observed by remote sensing.

In addition to conversion of forest to other types of land use, foresters and environmentalists are now emphasizing degradation that is occurring within areas classified as forests. While this type of forest degradation is somewhat more subtle and difficult to detect from remote sensing, some relevant tools are under development. For example, Figure 1-12 shows moderately coarse resolution data (500m cell size) from NASA's Modis satellite platform, also from the year 2000. This data focuses exclusively on the density of tree cover, without regard for classifications of forest or agricultural types of tree cover. While we can see that evergreen forest areas are indicated as dense cover, a substantial number of additional areas also have similar densities. Moreover, at least a modest to medium level of tree cover is present in many agricultural areas, as can be clearly seen in comparison with the fruit orchard areas around Chiang Mai City identified in Figure 1-8). At the same time, various forest areas (especially in dry deciduous forest zones) have relatively modest levels of forest cover. Clearly this type of density, which is a function of tree leaf area, is only one indicator of forest quality. It indicates, however, directions of technological development that hold considerable promise for more robust measures of forest quality in the future.

Environmental concerns about watershed management, however, are not limited to forest cover and quality issues, and they are not the exclusive domain of environmental activists and foresters. Indeed, public environmental awareness and concern about

Figure 1-12. Ping Basin overall tree cover



source: NASA Modis data from USGS website

land use in upper watershed areas has been fed by a range of trends, events and perceived risks that can strongly affect people in their everyday lives. In terms of water flow regimes, major issues include:

- Flash floods and landslides. News media have reported a series of incidents involving relatively localized flash floods and landslides that have resulted in serious agricultural and property damage, and sometimes substantial loss of lives. Sites within the Ping River Basin have been included, and they are usually located in upper tributary valleys at the foot of steeply sloping small mountain stream valleys.
- Main channel floods. Damage caused by major floods along the main channel of the Ping River and its major tributaries have also been featured in mass media, and there is a general impression that they are increasing in frequency and magnitude. The most recent example is the series of floods that hit Chiang Mai City during 2005, which have been described as the most serious floods in 40 years. And given the level of riverside and floodplain development during that period, the level of their damage is unprecedented.
- Dry season agricultural water shortages. Rising demand for reliable year-round water supplies for irrigated agriculture at downstream locations has increased sensitivity to, and competition for water during the dry season. Thus, many have been taking an increasingly critical look at uses of both land and water at upstream locations.
- Inadequate village and urban water supplies. Similarly, efforts to improve supplies of water for drinking and domestic use in villages and urban areas alike have added an additional element of competition for water resources, which reaches a peak during dry seasons and during El Nino years.
- Diminishing ground water supplies. A growing number of communities have invested in shallow and deep wells to help provide access to water for agricultural, domestic and even industrial uses. In some areas, such as parts of the Chiang Mai Valley, many are now reporting receding groundwater tables that are causing increasing alarm.

Another dimension of public concern relates to water quality, and begins making the link between natural resources and public health more directly. Areas of particular concern include:

- Waste water pollution. A growing volume of wastewater is being generated at village, urban and industrial levels. This includes sewage and domestic wastewater, which has disease implications for downstream populations, as well as threats of toxic chemicals and other substances present in wastes from business operations of various types. While waste treatment programs have expanded during recent years, there are major concerns that the pace of these programs has been inadequate to meet the challenges faced.
- Poisoning by agricultural chemicals. Increasing levels of use of agricultural chemicals is perceived as posing two types of public health threats. The first is through applicator poisoning, while the second is through pollution of waterways with toxic substances. Both appear to be perceived as serious and growing issues among many sectors of the general population.
- Effects of industrial pollution. Waste by-products of industrial processes of various types and scales are a related concern. Much of the concern focuses on disposal of potentially toxic or disease-laden substances into waterways, but air and noise pollution can also be important in some cases.

This latter point introduces two additional important issues that are also growing concerns of communities and general populations within the Ping River Basin:

- Solid waste disposal. Trash and garbage are currently the main issues here. Rising levels of solid waste are associated with processes of economic integration and lifestyle change, and many communities find it difficult to cope with the problem. The 'NIMBY' (not in my back yard) phenomenon is evident when landfill sites are sought, and burning is subject to increasingly strict restrictions. Waste reduction programs are still in their infancy.

- Air pollution. Emissions from vehicles and industry are primarily an urban-related problem. While emissions from power generation plants are relatively localized, emissions from burning are more generalized. Burning associated with land clearing and agriculture can be seasonally very widespread (in both lowland and mountain areas) and quite heavy. Government restrictions are beginning to emerge, but enforcement will not be easy.

While these problems are widely associated with a variety of natural resource management and public health issues, agency personnel and their programs often underestimate the importance of the livelihood issues with which they are associated. Many, if not most of the practices associated with these problems are a reflection of the lack of viable alternative livelihood opportunities available to the people employing them. Moreover, the poorest components of the population are the ones who most frequently encounter constraints on their access to such alternatives. And at the same time, they are also often among those most vulnerable to the negative impacts that they cause.

It has also become quite clear that approaches of the past have been inadequate to effectively deal with most of these issues. Indeed, it is increasingly widely recognized that there are also serious gaps in resource governance structures and processes located at levels that are intermediate between national and local community levels. More functional arrangements at these levels are necessary in order to analyze and understand problems that emerge at broader landscape levels, to identify and negotiate viable, practical and equitable means for addressing those problems, and to mobilize the range of human and financial resources required to implement such solutions.

7. Changing approaches to resource governance

Changes in local governance processes accelerated rapidly after passage of the 1997 national constitution and related reforms. Most all communities in the Ping River Basin now have citizenship and elected local governments at the sub-district (*tambon*) level, even in more remote mountain areas. Tassabans and Tambon Administrative Organizations (TAO) are building their capacity in many areas, including levying and managing local taxes. Mandates are in place for communities and *tambons* to increase their role and participation in natural resource governance, but many *tambon* and *tassaban* governments lack relevant information and skills, and most of their constituents (especially in poorer areas) feel the need to place higher priority for use of scarce funds on providing basic infrastructure and services that are necessary to improve aspects of their livelihoods that are perceived to be of more immediate day-to-day concern. At the same time, however, many government ministries and their agencies and programs are being reorganized to provide more emphasis at local levels, and especially for support of initiatives by local communities. And, there has been a surge in efforts by local communities to organize themselves in various forms and formats, including local networks that are now beginning to develop alliances at broader levels.

All of these changes are overlaid by growing education, information flow, and public awareness that are increasingly linked with trends at international and global levels. One important dimension of these linkages that is of particular relevance to this project relates to environmental awareness and action. Many environmental problems are now perceived and identified in the Ping River Basin, and local initiatives are being developed and launched to help address them.

- Major problems perceived in lowland areas near main river channels include lack of proper planning, administration and management of fluvial systems, environmentally insensitive river engineering projects, inappropriate development of flood plain areas, pollution of rivers from sewage and agricultural and industrial drainage, encroachment into river corridors and water bodies that narrows rivers and canals and reduces public access, and loss of river landscape quality, aesthetic beauty and cultural legacies [CMU 2004]. Excessive groundwater extraction is a problem in and around urban areas, as well as in some areas of intensive agriculture.
- In mountain areas, perceived environmental problems focus on deforestation of watershed headlands, which is believed to result in loss of biodiversity, accelerated soil erosion, and a range of impacts on hydrological systems, with claims extending beyond dry season stream flow to include flooding, landslides, and even assertions about impacts on total annual water yield, rainfall patterns and climate change [Walker 2002]. Highland agriculture [Tangtham

1998] and roads [Ziegler 2004] are seen as the worst offenders, along with stream pollution by agricultural chemicals, and dry season water use by sprinkler irrigation. Forest fallow agriculture and its use of fire are seen as the source of major negative problems in the midlands, and together with expansion of field crop production into sloping lands above lowland paddies, they are seen to be generating serious negative impacts on watershed services and biodiversity.

Although environmental concerns began to be integrated into agendas of civil society organizations as they emerged in the national political arena 20 years ago, a significant division in their directions and positions has taken place during the last decade or so. Activities initially focused largely on opposition to dam construction, logging concessions and large forest plantations, and there still appears to be substantial agreement about issues and actions that need to be taken regarding environmental problems in lowland, urban and industrial areas, and along main river channels. All tend to place much of the blame for these problems on unbridled commercialization, growth of consumerism, and very weak planning and regulatory mechanisms that are easily overridden by the wealthy and powerful. Their division is most apparent, however, in rural, and especially mountain areas:

- On the one hand, ‘deep green’ environmental groups are pushing hard for severe restrictions on midland and highland land use and segregation of local communities from forest lands, including strong support for efforts by conservation agencies to expand national parks and wildlife sanctuaries to cover all class 1 watersheds and remaining natural forest areas in the Kingdom.
- On the other side, ‘populist’ environmental groups are pushing for community management and control of forest lands, based on local traditions, knowledge and practices. They have lobbied hard for passage of community forestry legislation ‘stuck’ in Parliament, and support resistance by communities threatened with displacement by protected area expansion.

Both sides have been very active in the Ping River Basin, and have built alliances that include different factions in academia, government and other sectors of society. Tension between them has sometimes erupted into open conflict, such as in the Chom Thong district of Chiang Mai province a few years ago. Both sides also appear to be learning from this experience, however, and few want to see a repeat of such unproductive and divisive events.

And perhaps most importantly, as local communities are exposed to the arguments and advocacy from both sides, many are listening to both points of view and seeking to identify a ‘middle way’ to improve their overall quality of life and safeguard the legacy of future generations. Many have begun to invest considerable effort to develop ‘peoples organizations’ based largely on informal networks among local communities, and some are developing broader alliances among networks. More astute government agencies and urban-based NGOs have seen the important potential of these networks, and have begun to seek ways to support and facilitate their further development.

Moreover, Thailand’s Royal Family have shown exceptional leadership in these issues, and are constantly urging Thai society to develop a common vision of the future that combines improved livelihoods with sustainable natural resource management. This is a very important source of inspiration for efforts seeking unity across government, business, civil society, and local community sectors of society.

It is in this context that river basin management programs and this project have emerged. Anecdotal evidence already clearly indicates that communities and groups in various parts of the Ping River Basin are building organizational capacity and experience with multi-community networks, often across ethnic and other social boundaries, to manage local sub-watersheds (called *lumnamyoi* in this report). And in some areas, these local networks are building alliances and federations among themselves to extend their organizational and management capacities to sub-basin levels. These are efforts that can provide the localized building blocks upon which sub-basin and river basin level management organizations such as those envisioned by this project can and should be built to effectively address the wide range of intertwined livelihood and environmental issues that organizations promoted under this project must address.

B. Movement toward sub-basin management in the Ping River Basin

This project did not begin with a blank slate. Thus, this section seeks to provide a brief review of some of the key milestones in processes that have led to this project. It also discusses some of the basic concepts related to natural and administrative hierarchies, and seeks to identify some of the key gaps and operational issues that are emerging.

1. Governmental Ping River Basin organization initiatives

According to Dr. Apichart Anukularmphai [2004a], river basin management in Thailand was first initiated in 1994 when the government allocated budgets to study and prepare a strategic plan for water management in the Chao Phraya river system. The study formulated a comprehensive water management strategy for river basins [Sethaputra 2001], and a committee was appointed in 1998 to establish a river basin committee (RBC) for the Chao Phraya. Two workshops were organized with participants from line agencies, provincial officials, and other stakeholders to explain the ideas and seek feedback. Agreement was reached to establish pilot river basin committees in the Upper Ping, Lower Ping and Pasak 'sub-basins', and they were officially established in April, 1999.

Upper and Lower Ping 'sub-basin' committees

As part of an agricultural restructuring program loan from the Asian Development Bank to Thailand's Ministry of Agriculture and Cooperatives, consultants were engaged to conduct studies related to the water sector in the Upper Ping and Lower Ping 'sub-basins'. Through consultative meetings under these studies, it was agreed to establish three working groups responsible for preparing basin plans, collecting and maintaining basin data and information, and conducting public relations and awareness raising campaigns. It was also agreed that the Upper Ping needed to be further sub-divided into 15 smaller sub-basin watershed working groups, whereas the Lower Ping should be sub-divided into 18 district working groups.

The three working groups held 3 subsequent workshops-consultative meetings in 2000 in order to prepare basin plans for the three pilot areas for submission to line agencies to be included in their budget requests. Line agencies were reluctant to include projects of the working groups, however, as each agency already had its own plan. Thus, in order to have a basin plan with truly effective participation by stakeholders, RBCs appear to need authority to prepare and approve basin plans. This is seen as one reason leading to development of the Water Sector budgetary request process.

The consultative workshops also made it apparent that stakeholders must play a higher role than government officials. Thus, RBC's were changed in 2001 to add more stakeholders, NGOs and academicians. But since projects are implemented by agencies, representatives of agencies remain necessary. Resulting RBC structures are displayed in figure 1-13, while the overall evolution of participation in Ping RBC's is charted in figure 1-14.

Figure 1-13. Ping Basin Committee Structures 2001

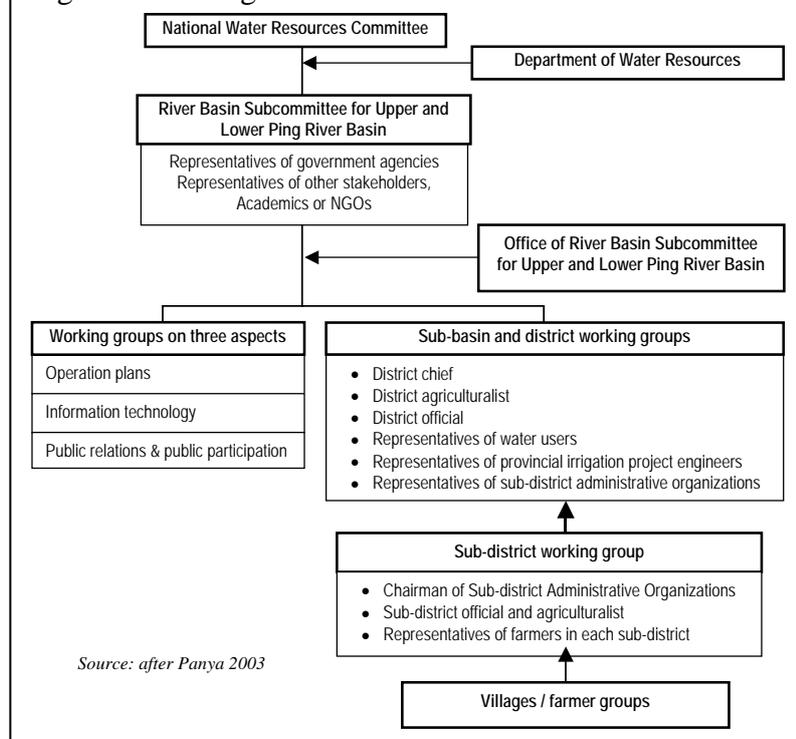
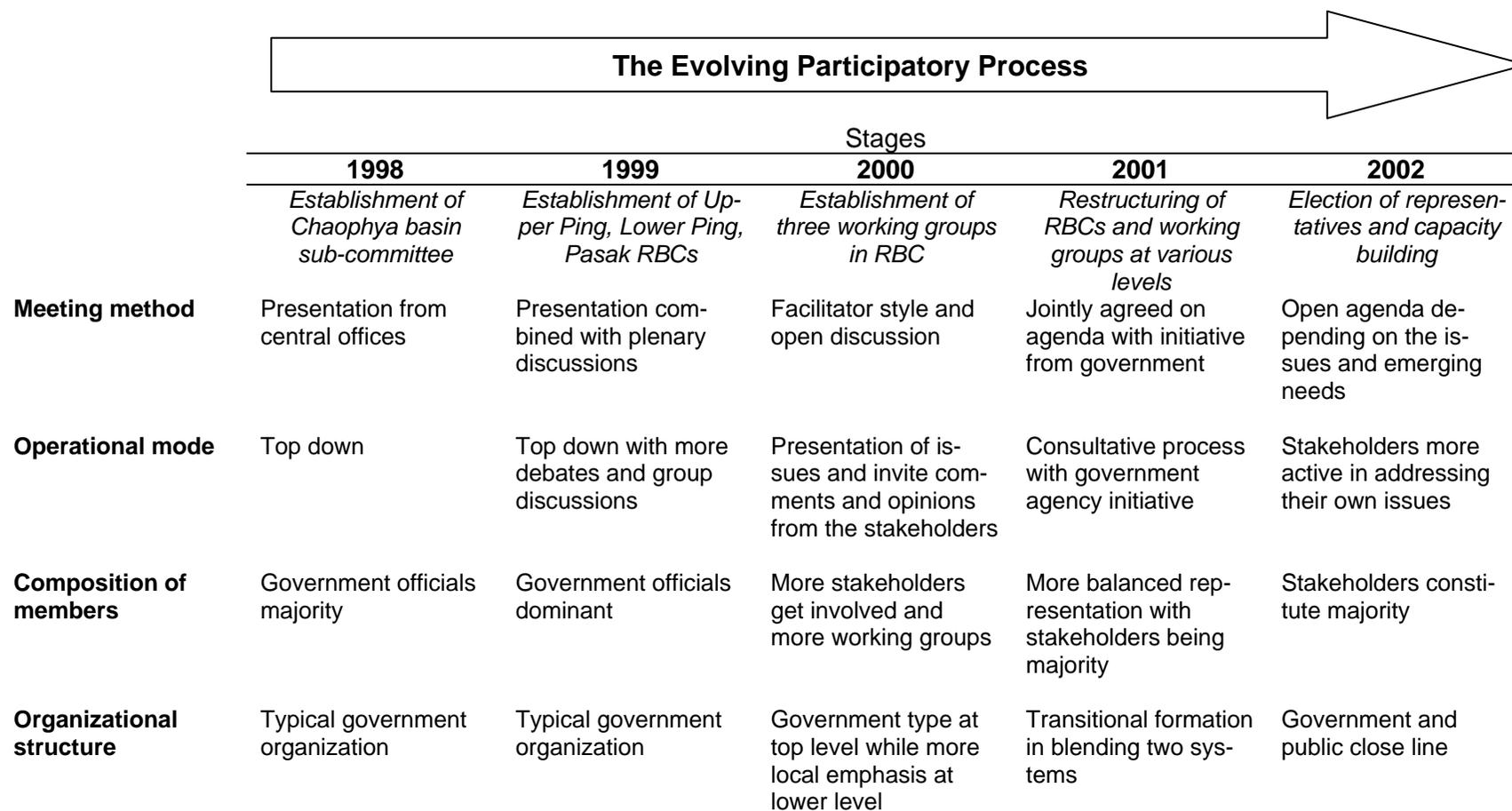


Figure 1-14. Evolving participation in River Basin Committee development in Thailand



Source: after Anukularmphai 2004a

As Dr. Apichart notes, stakeholder participation increased after establishment of working groups for basin planning, information systems, and public relations and awareness. Stakeholders started realizing their roles, and their desire to have their share in planning and decision-making processes. Stakeholder motivation became clear as key players started to emerge and play leading roles in consultative meetings. They began questioning roles of government agencies and their contribution to RBCs, and soon began demanding changes in the organizational set-up and composition of members (see also Tan-kim-yong 2001). Changes were discussed and agreed upon during a series of workshops, and new appointment orders were issued in 2001 (see figure 1-15 for Upper Ping). The selection procedure for stakeholder representation was also challenged, resulting in broadening the stakeholder base by representation down to village level, with selection processes either by election or popular consent. This issue has received serious attention, and some RBC groups are still conducting this process in order to ensure transparency and achieve effective and active representation. [Anukularmphai 2004a]. In many local areas, however, agency interaction is still limited to forms of ‘consultative participation’ [Heyd 2004].

Figure 1-15. Upper Ping working group membership

Directive for appointment & composition of working groups at various levels:

1. To appoint working groups at sub-district, district and sub-basin with the following composition
 - 1.1 Sub-district working group
 - (1) one farmer representative from each village
 - (2) sub-district chief
 - (3) chairman of tambon administrative organization (TAO)
 - (4) sub-district community development worker
 - (5) sub-district agricultural extension worker
 - (6) District officer responsible for the sub-district
 - (7) Respected local person i.e. teacher or monk
 - 1.2 District working group
 - (1) One farmer representative from each sub-district working group
 - (2) District community development worker
 - (3) District agricultural extension worker
 - (4) Representative of local administration
 - (5) District officer responsible for planning
 - (6) Respected person i.e. teacher, retired official, or monk
 - (7) Representatives from commercial and industrial sectors
 - 1.3 Sub-basin working group
 - (1) District officers responsible for planning
 - (2) Three farmer representatives from each district
2. The district selects three representatives from the district working group to work with the three RBC working groups i.e. one for each working group (planning, information, public relation and awareness raising)
3. Farmer representatives in the three RBC working groups select from among themselves 15 members to work in the river basin committee (RBC).

Source: Anukularmphai 2004a

DWR Planning Process

With establishment of the Ministry of Natural Resources and Environment (MoNRE) in 2003, river basin programs found a new home in the Department of Water Resources (DWR). During the transitional stage, a team of consultants was commissioned to prepare a basin water resource management framework. The consultants were directed to not prepare the basin plan themselves, but rather to assist basin working groups and stakeholders to identify their own needs and their own ideas of how to solve their problems. The consultants were asked to hold grassroots level workshops as well as to build local capacity in planning processes. The large detailed sets of water resource-focused assessments, plans and projects resulting from these efforts are reported in a six volume final report submitted to the Department of Water Resources [Panya 2003].

DNP-DWR Planning Process

With strong endorsement by the Prime Minister, the new MoNRE ministerial leadership embraced efforts to make the Ping River Basin a model for effective river basin organization, and began launching a new round of initiatives. In an effort to broaden the mandate for river basin management, accelerate implementation, and draw in more of the field resources of the new ministry, a new Cabinet Resolution was obtained in 2003 to establish the Ping River Basin Restoration Project [Samabuddhi 2003]. Among the key ministry changes made in association with this new wave of effort was assignment of the Department of National Parks, Wildlife and Plant Conservation (DNP)

(which includes the watershed management division) to take the lead from the ministry side for activities in the Upper Ping Basin – activities in the Lower Ping Basin remained under leadership of the Department of Water Resources. There was also a decision to have sub-basins be the main units for more localized operations, with 14 sub-basins specified for the Upper Ping and 6 sub-basins for the Lower Ping, resulting in some boundary shifts from those employed by DWR. In addition, the Department of Environmental Quality Promotion and the Office of Natural Resources and Environmental Policy and Planning (ONEP) began commissioning studies and conducting activities to provide additional support for these efforts [e.g. Nitivattananon 2004], although coordination among them appears to have been problematic.

The DWR quickly launched a series of planning activities in Lower Ping sub-basins that built on results of their previous studies and plans. This enabled them to also move quickly to begin implementing specific projects, which initially focused largely on ‘check dams’, many of which appear to provide small water resources for pump irrigation of nearby agricultural fields. Plans also included more substantial water resource structures, but these required more time to complete associated design approval and construction procedures.

Meanwhile, the DNP launched a new round of ‘participatory action planning’ processes in upper Ping sub-basins through committees and working groups under their leadership, resulting in another set of plans and projects that is still being refined. It appears that the DNP has made very considerable efforts to facilitate articulation of plans that are based on local ideas and perceived needs. The scope of plans and projects was also expanded to include forest and watershed conservation, as well as environmental issues such as trash and use of agricultural chemicals. As DNP officials have stated informally, however, they believed the scope should not be extended further for fear of their moving beyond their agency mandate and their perceptions of the mandated role for river basin organizations.

The DNP has also made very impressive progress in building a spatial information system based in their Huay Kaew Office in Chiang Mai, with particular emphasis on natural resources and land use in forest lands in Upper Ping sub-basins. It even includes attempts to map locally perceived village boundaries and land use zones in reserved forest and protected watershed lands where no boundaries are officially recognized, in a manner somewhat similar to work conducted earlier by ICRAF, DNP staff, and other partners collaborating with villagers in the Mae Chaem sub-basin [Thomas 2004a].

ONEP-World Bank Planning Process

The current project of which this report is a part, is seeking to establish and test ‘pilot’ sub-basin management organizations that will conduct action planning processes to develop short, medium and long term plans to address natural resource, environment, health and poverty issues in the pilot sub-basins. Considering the above context, it should not be too difficult to understand why many government agencies, local governments, local communities, civil society organizations and other stakeholders are viewing this project as yet another wave of planning for river basin activities.

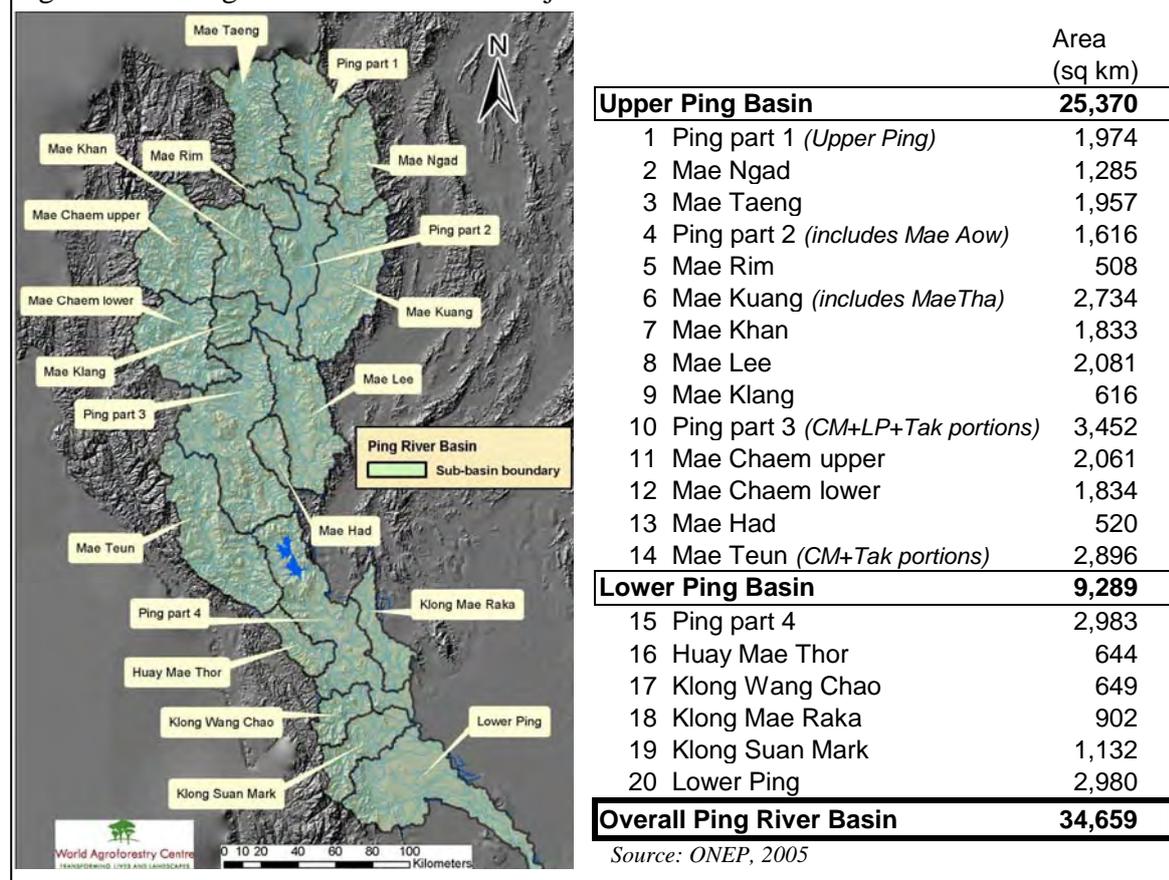
2. Sub-basin delineation

Associated with the difficulties commonly encountered in coordination among government agencies – even when located within the same Ministry – is the multiplicity of sub-basin delineations within the Ping River Basin that are presented as “official”. Current classifications shown to this author range from 20 to 25 in number, with considerable variation in boundaries. Although sub-basin classification boundaries are associated with natural physical boundaries of watersheds, smaller watersheds are combined with others, presumably in order to be able to achieve more impacts and economies of scale for administration and management. At the same time, larger natural watersheds are sometimes split, either according to provincial administrative boundaries or other less apparent reasons.

The project recognized this issue from the outset, and this author collaborated in efforts to propose a reasonable compromise that would fit with ONEP's stated need to have a total of 20 sub-basins in the Ping River Basin, pursuant to a Cabinet resolution. Recommendations submitted to ONEP were mostly approved, with the major exception being the splitting of the Mae Chaem physical watershed into two sub-basins. Results are basically now the same as the delineation used recently by Chiang Mai University [CMU 2004]. Experience later found the lack of local participation in this process led to problems that could have been avoided (see Part IV of this report).

In any event, there now is now a defined set of 20 sub-basins recognized by ONEP as the operational units for this project. The sub-basins are mapped and listed in Figure 1-16, along with data from ONEP on the area of each sub-basin. Boundaries and official area data have been provided by

Figure 1-16. Ping Sub-Basins for this Project



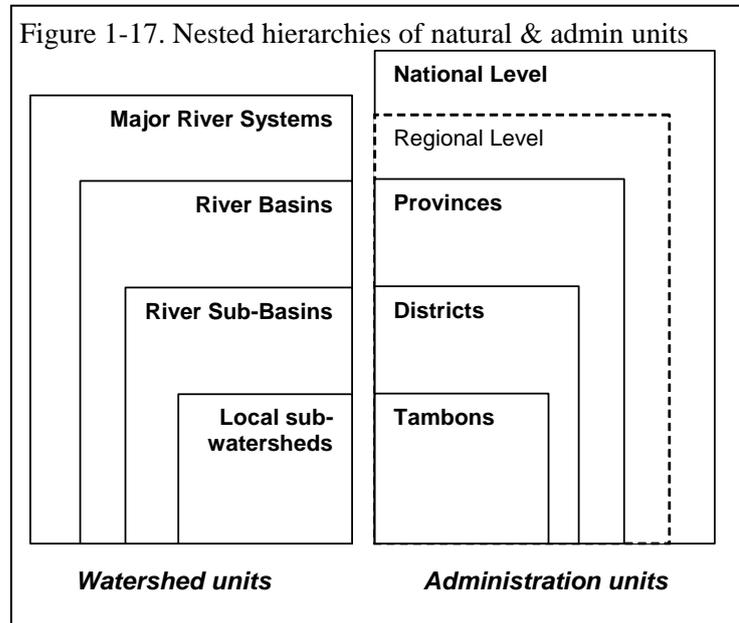
ONEP in a GIS shape file format.

While sub-basin delineation is an important initial clarification for operations under this project, there is still a need for ONEP to collaborate with other agencies of the Ministry of Natural Resources and Environment, as well as other relevant government agencies, to reach agreement on a common sub-basin delineation scheme for the Ping River Basin (and in the future other river basins). This is necessary in order to: (a) achieve common understandings that are essential for building participatory management organizations within the sub-basins, and (b) for coordinating communication with and support from the range of government agencies (as well as other public and private organizations and institutions) that will be associated with integrated basin management in both the immediate and longer-term future.

3. The sub-basin level in natural and administrative hierarchies

Any effort to foster social organization that aims to help manage natural resources at the sub-basin level must consider the context of the sub-basin level in both the biophysical and governance hierarchies within which it is located.

The nested nature of the watershed and public administration hierarchies of Thailand is illustrated in Figure 1-17. Given the somewhat parallel nature of these hierarchies in a depiction such as this, some advocates of integrated watershed and river basin management are often quick to suggest that both hierarchies should be merged by adjusting administrative unit boundaries to fit with naturally determined watershed boundaries. While this type of administrative boundary reform would greatly simplify social organization for integrated watershed governance, it is unlikely that it would be reasonable or even desirable to advocate such an approach at this time.



While nested units in the watershed hierarchy are determined by physical terrain characteristics associated with water drainage patterns, nested units in the administration hierarchy of Thailand are determined by social factors that have been quite dynamic over time. Whereas national boundaries have remained relatively fixed since the colonial era, provincial, district and *tambon* units have fissioned and been adjusted many times as a function of growing populations and a range of other political considerations. The administrative hierarchy is of critical importance to water and natural resource governance, however, since it provides the channels through which social and political decisions are made concerning issues such as property rights, development and resource allocation. Indeed, constitutional and legal responsibilities for natural resource management from central to local levels are assigned to units within this hierarchy.

Central arguments of global water and natural resource management trends, however, are based in notions that these natural resources can be most effectively managed through efforts that are both integrated and focused on natural units in the watershed hierarchy. Yet, given the very different nature of the forces driving determination of unit boundaries in these two hierarchies, it is not reasonable to expect that they would be able to merge any time within the foreseeable future. Moreover, despite Thailand's apparent commitment to integrated water and river basin management, its leadership has clearly indicated that it does not want to burden society, its decision-making processes and its taxpayers with a parallel system of watershed-defined bureaucratic institutions that would end up duplicating functions and most likely competing with units of the administrative hierarchy for power and resources.

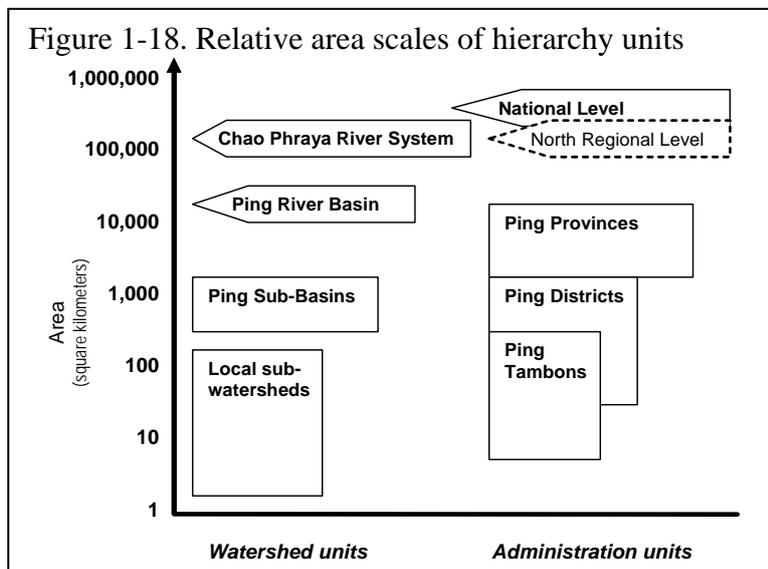
Thus, the current challenge is how best to develop social organization that can improve management of natural resources and environmental services in nested watershed units, in a manner that can effectively interact with, and better inform and monitor, existing governance processes that function through the administration hierarchy.

The primary aim of this project is to initiate development of organizations that would seek to accomplish this task at the sub-basin level in pilot areas of the Ping River Basin. Thus, we need to

consider in more depth characteristics of units in both of these hierarchies in this more specific context.

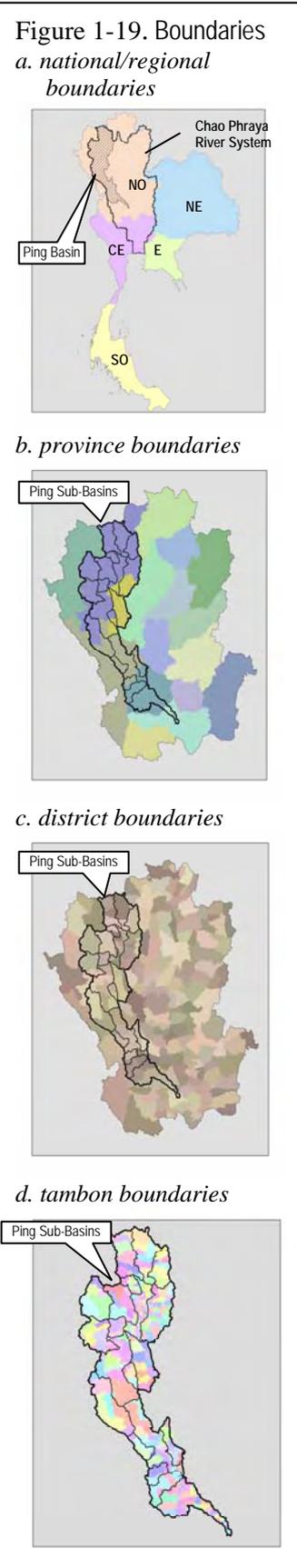
Figure 1-18 begins this process by providing a graphical depiction of the relative spatial scale of units in both hierarchies. The large range in the spatial scale of these units, as measured in square kilometers, requires use of a logarithmic scale on the vertical axis. Units with a single fixed size are indicated by tapering of the box into a point on the left side, whereas rectangular boxes indicate the approximate range of spatial scale among different units at the same hierarchical level.

The actual spatial distribution of all of these units except local sub-watersheds can be seen in the four small maps displayed in Figure 1-19. Together, these diagrams allow us to see more clearly some of the important interaction and coordination requirements for social organization at each level of the two hierarchies.



From a watershed hierarchy point of view, Ping River sub-basins are most closely associated with the district level. While boundary differences are clear, there are relatively few districts within each sub-basin. As several entire sub-basins are contained within single provinces, overall coordination among provinces would appear to be most appropriate at the river basin level. At the entire Chao Phraya river system level, coordination among provinces and regions would appear to be necessary, but since the administrative system provides very few functions at the regional level, one might also expect more national level effort.

Indeed, the relatively large number of *tambons* within a given sub-basin would appear to present an important challenge, and a possible constraint for some functions at the sub-basin level. This could be an especially important challenge because of the important and growing role seen for Tambon Administration Organizations (TAO) in governance, public administration, and management of natural resources and environmental services. This issue leads directly to reasons why the local sub-watershed level has been included in this analysis.



The local sub-watershed level is an intentionally ambiguous term meant to reflect a somewhat flexible scale of natural physical boundaries. The rough range of scale that is implied, however, is indicated in figure 1-18. For the most part, these are relatively small sub-watersheds that range in size from a few to as large as a 2 or 3 hundred square kilometers, and many if not most include land that is claimed by people in one to a few tens of villages. This, then, is the level where the greatest amount of day-to-day human interaction occurs, and where many complementary and interacting forms of social capital are the strongest. It is also the level that is closest to the many individual decisions are made that most directly affect land use patterns, water use, pollution and many of the other issues that this project seeks to address. Moreover, it is also the level where many different types of stakeholders come into most direct and frequent contact, and are thus most likely to understand the reasons and specific interests and livelihood needs of each other. Similar types of arguments have been forwarded by successful efforts to place major emphasis on building the capacity and authority of local governance at the *tambon* (TAO) and *tessaban* level in the administration hierarchy.

Thus, it should not be surprising that this is the level where the greatest amount of ‘grassroots-oriented’ effort has been targeted – by government agencies, NGOs and ‘people’s organizations’ alike – during recent years. As a result, many of these areas (especially in upper Ping sub-basins) have made far more progress in raising public awareness and initiating local initiatives and network organization related to natural resource and environment issues than most people residing in urban or more distant locations realize. Recognition is also slow within various government agencies with local field units, because information flow from local field staff to central leadership levels is often subject to many levels of filters and re-interpretations. Accordingly, there is good reason to believe that interactions between TAO and local sub-watershed networks can realistically form a basic building block for organization at the broader sub-basin level in many areas.

4. Potential role of the sub-basin level in the overall Ping RBO context

Efforts to facilitate development of sub-basin level organization need to assess the potential role of such organization in terms of its comparative strengths and weaknesses within the context of the watershed and administration hierarchies discussed in the previous section. Indeed, it is a much more than trivial issue to clarify perceptions of its fundamental position relative to ongoing efforts that are both top-down and bottom-up in their nature. While more detailed discussion of these ongoing efforts are provided in following sections, this section seeks to set the context of those discussions through initial consideration of this fundamental overarching issue.

Specifically, as in broader regions of Asia [Barker 2004], two important trends and associated lines of activity are apparent:

- Initiatives to develop official river basin organizations have begun through top-down processes launched at the national level. Bolstered by conservationists, environmental organizations and activists at the national level, national government has made numerous efforts to strengthen national forest land and water policies, and to link the rationales for both [Kaosa-ard 2000]. One result has been formation of the Ministry of Natural Resources and Environment, including provision of a home base for the National Water Resources Committee, creation of a Department of Water Resources, and a new base for efforts to further develop river basin organizations. With strong endorsement from the Prime Minister, multiple efforts have been launched by MoNRE agencies to form pilot river basin and sub-basin committees and plans. As one indicator, Figure 1-20 contains a recent address by a key MoNRE deputy permanent secretary.
- Local ‘grassroots’ initiatives have involved a combination of: (a) efforts by government agencies to induce local efforts to comply with national policies; (b) efforts by environmental NGOs and activists to build popular perceptions of an environmental ‘crisis’ resulting from behavior at local and upstream community levels; (c) efforts by more populist NGOs and activists to strengthen and adapt more ‘environmentally friendly’ components of local behavior based in their cultural heritage and local knowledge; and (d) widespread public acceptance in most sectors of society that environmental issues must become a more prominent consideration if development is to become more ‘sustainable’. All of these types of efforts frequently feature emphasis on multi-

community networks at scales ranging from local sub-watersheds to larger tributary river valleys. In upper watersheds, they also commonly feature local zoning and land use regulations, even in areas where land use is technically illegal under national policies.

Figure 1-20. Keynote Address by Dr. Siripong Hungspreug,

Deputy Permanent Secretary, Ministry of Natural Resources & Environment
on World Water Day 2005 and Launch of the UN International Decade for Action Water for Life 2005-2015

It is my great honor to have the chance to give keynote address to the audiences today on the World Water Day 2005 and the Launch of the United Nations International Decade for Action Water for Life 2005-2015.

Every human being recognizes the significance of water, particularly freshwater that is limited in its amount. At the same time we are facing a growing demand for freshwater and an ever increasing in water-related disasters year by year. Extreme weather events encountering the world today are becoming more and more severe. The storms, floods and droughts bring mounting human suffering and escalating economic loss.

Combining all these factors, it leads us to an urgent necessity for all human being, ranging from policy makers to civil societies to collaboratively identify and implement all measures that leads to disaster alleviation, access to safe and clean water, sufficient supply of water, fair allocation, and water conservation.

Considering such huge challenges, wise water management is a real need. Water governance which places an importance to managing water with transparency, accountability and participatory approach is necessary factors contributed to a success. It encompasses water provision and allocation, water resources conservation, water-related disasters alleviation, and water quality protection. All of these should be considered by taking into account other related resources and promotion of participation from multi-stakeholders.

Considerable efforts at global level have been made in facilitating individual country to implement the essence of the agenda and principles reached at the two important Conferences in 1992, the Conference on Environment and Development held in Rio de Janeiro and Dublin Conference on Water and Environment. After Agenda 21 was established, the Commission on Sustainable Development was formed and its multi-year programme of work for the period 2004 – 2017 is now emphasized on freshwater.

The United Nations has proclaimed the Millennium Development Goal and several follow-up activities have been undertaken related to water for domestic consumption. MDG are targets every nation will or are trying to reach for. Therefore, there is a need to consider how to implement for the aimed success.

In eradicating the problem of population lacking access to safe drinking water, a great necessity is to develop a systematic water resources management *i.e.* the above-mentioned aspects should be harmoniously and integratedly managed. Thus, there is the need for Integrated Water Resources Management or IWRM. However, IWRM process cannot be accomplished overnight. The process needs both time and willingness from every related sector.

Geographical differences of each country resulted in different measures applied for solving the same problem. For instance, in monsoon nations they possess much precipitation but rainfall tends to concentrate in a certain period of time and is intense in some areas. This is the major cause of flood and drought where a specific solution may be required for different areas.

In Asia-Pacific region, many countries are developing countries. Water resources management plays a crucial role in poverty alleviation. A holistic approach in water resources management implementation will result in equitable water allocation and maintenance of water quantity and quality. These are necessary prerequisites for maintaining livelihood and reducing poverty.

IWRM as a holistic approach, is a process that should be considered very similar at any country in terms of concept. However, its implementation is varied according to political and social contexts. The United Nations is the core advocate who pushes and plants an enabling environment for IWRM implementation.

Thailand has a policy on increasing well-being for the general public and in this case public oriented approach is applied. Although Thailand can fulfill the goal of population accessing to safe drinking water supply, there are still steps to take such as improvement of water quality and water resources conservation.

Following IWRM process, Thailand places high importance to river basin management. Implementation areas link the scope from upstream where watersheds are originated to middle stream and downstream where rivers run into seas. These include conservation and maintenance of watershed areas, equitable water allocation, improvement of water quality, among others. The ultimate objective is the management of Water for Life.

In Thailand, IWRM concept and river basin management has been tested in many occasions and lastly two pilot river basins have been conducted an integrated approach in management in one major river basin each in the North and Northeast. The process concerns integrated implementation of various related agencies. Participation and local wisdom is also effectively incorporated.

At the same time, encouraging urban communities to use water economically is no less important. Awareness raising campaigns and dissemination of knowledge on how to use water economically have been successfully undertaken by concerned agencies in spite of increasing demand from urban growth.

IWRM is a process that needs much efforts from every unit of the societies to mobilize and guide toward sustainable development. Its implication and definite goal are reflected in many examples cited in various meetings. A launching of the International Decade for Action is another attempt that will provide us with excellent opportunity to reach out to different stakeholders including the public-at-large, civil society, the media, national governments and policy-makers.

At this opportunity of World Water Day 2005 and the launch of the United Nations International Decade for Action Water for Life 2005-2015, I would like to call for full attentions and efforts from every sector in Thailand and in the world community to closely collaborate and strongly cooperate for the betterness of water resources management and the happiness of the global population.

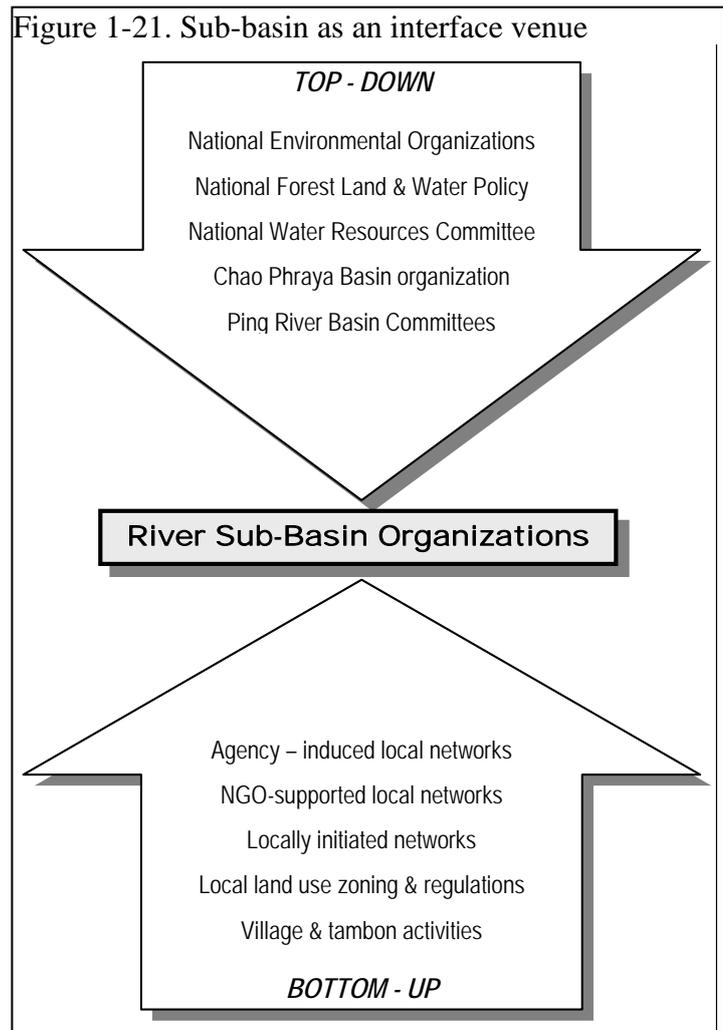
Thank you.

Indeed, many environmental and especially water-related issues and principles have become nearly sacrosanct in the public policy arena, and in many sectors and levels of society. Any opposition to various specific elements of many of these environmental policies has largely been neutralized by fear of being labeled as ‘anti-environment’ in the political arena. How these various principles and policies are interpreted and applied, however, varies considerably among these different actors.

Given this context, as depicted in figure 1-21, the first fundamental question is whether sub-basin organizations will be viewed as

- downward extensions of top-down processes
- upward extensions of bottom-up processes
- fora where bottom-up processes can interface with top-down processes

All three perspectives are possible, and different stakeholders will no doubt advocate each of these points of view.



In terms of comparative strengths and weaknesses, however, it appears that the sub-basin level may be most suited to provide the interfacing functions suggested in the third option. This follows both from characteristics that provide potential strengths at the sub-basin level, and from weaknesses of other levels to provide this function. Aspects of these characteristics and potentials are explored in subsequent parts of this report.

5. Other current planning processes within sub-basins

Efforts under this project to launch ‘pilot’ sub-basin management organizations must also recognize various other very closely related activities that already underway. This is especially important because of the degree to which various stakeholders in these activities – from national to local levels – have already developed perceptions about Ping River Basin organization, and have already conducted a range of problem analysis and action planning activities.

Non-Governmental Planning Initiatives

Perceptions of redundant planning systems are based on even more than multiple iterations of government initiatives. In one different non-government line of activity, the Coordinating Committee for the Protection of the Ping River Basin and Environment (CCPE) was established in 1993, with a volunteer membership that included academics, teachers, students, monks and other interested people [Jompakdee 2004]. It now seeks to cooperate closely with the Upper Ping ‘sub-basin’ committee in conducting major lines of activity that include: (1) awareness raising; (2) development of knowledge and skills and a river monitoring program; (3) cooperation and networking. A set of 8 work plans have been developed, focusing on administration, land use regulation, environmental

rehabilitation, revitalization of culture and indigenous knowledge, promotion of public participation, research and study, and monitoring and evaluation.

Building on the experience of CCPE, a large study team was assembled by Chiang Mai University under a project to develop a master plan and implementation plan for conservation and development of environmental and water quality in the Ping River and its tributaries. An elaborate study process, which included considerable stakeholder consultation around the Ping River basin, resulted in a 590 page report submitted to the Office of Natural Resources and Environmental Policy [CMU 2004]. One of the distinguishing features of this line of activity was its emphasis on history and cultural aspects of life and changing conditions along rivers and major streams in the Ping River Basin, as well as articulation of impacts of riparian activities and construction on water flow, water quality, and broader considerations of quality of life. As a prominent leader in these activities, Dr. Wasan Jompakdee of the CMU Faculty of Engineering is seen as a strong advocate of seeking negotiated balance in river basin planning [ADB 2004]. Dr. Wasan is now leading a new ONEP-funded CMU study to develop monitoring standards and processes for the Ping River Basin.

The emergence of numerous types of local network groups and broader alliances among them have already been mentioned, and will be discussed further in other parts of this report. Such initiatives are particularly widespread and active in Upper Ping sub-basins, where they have been assessing problems and developing plans, activities and projects to address many local issues. These networks are increasingly seen by DNP and others as an important local mechanism in identifying problems, plans and projects under government and non-government river basin initiatives. And in Lower Ping sub-basins, agency-induced networks centered on natural resource and environment volunteers are also seen as a prominent feature in DWP-led activities there.

In addition to these lines of activity aimed directly at establishing organization and plans for managing the Ping River Basin, there has been a substantial range of additional activities that focus on various pieces and elements directly relevant to river basin organization and management in the Ping Basin. A substantial range of NGO-supported networks are also active in efforts to address a range of related issues, ranging from citizenship and land rights for upland communities, to the water monitoring and environmental education networks among schools supported by the Green World Foundation. Even cultural and ethnic networks are beginning to make increasing contributions to addressing key river basin issues, including networks among Karen communities in the midlands, and among Hmong communities in highland areas.

Development Planning Processes

In this context, we also need to mention the regular development planning processes that are ongoing activities in all Ping River sub-basins. In addition to overarching national economic and social development plans and the plans and projects of the various government ministries, individual provinces, TAO and *tessaban* all have their own development plans that reflect their own assessment processes, priorities and resource allocation decisions.

Indeed, under the governance reforms of recent years various efforts have been made to encourage TAO and *tessaban* to incorporate more environment and natural resource issues into their regular plans and to push for their inclusion in provincial plans. But limited budgets, especially in poorer jurisdictions, together with the pressures for infrastructure development from their constituents, have led locally elected governments to place their resource allocation priorities in other areas. This is especially true where many of the beneficiaries of natural resource or environment activities would be located beyond their jurisdiction. Moreover, there has often been uncertainty about how to formulate meaningful natural resource and environment plans, and how to convince constituents that such activities would provide high priority benefits that would improve their lives and livelihoods, and thus gain or maintain their political support. And finally, even in areas where local initiatives are helping to understand the importance and nature of natural resource and environmental issues, some of the most important forces driving processes of change appear to be beyond the control of local governments to address. Examples of this would include lack of land use security, use of chemicals in agriculture, influential and powerful outside investors, *etc.*

These types of issues and problems are among the central considerations that have helped drive the movement toward establishment of river basin and sub-basin organizations. But the challenge remains as how to coordinate, or even better to integrate basin and sub-basin plans with regular development planning processes.

6. Key gaps and operational issues

Having briefly reviewed the recent history and current status of basin and sub-basin initiatives, this section seeks to review major issues and gaps in these efforts. These have been identified through discussions with participants from various agency and stakeholder groups who are directly involved in various of these activities, including pilot sub-basins, as well as with assessments vis-à-vis major views from international literature discussed in Part III of this report. While some of these issues are general, others vary according to conditions in different sub-basins.

(a) *Confusion and uncertainty*

One of the most general weaknesses is an overall state of confusion and uncertainty felt by most stakeholders – including government agencies – about the directions of the Ping River basin program and the status of the various committees, working groups, networks and initiatives that have been formed and are under development. This is resulting in a general feeling of tension that is usually somewhere on a continuum that runs from apprehension to frustration, that appears at all levels from the Ping River Basin to local communities. This author has been asked by a quite wide range of stakeholders at different levels, “Why is there a need for this project?” This is usually followed by, “Why doesn’t the government just provide some of the funds they have promised for several years, and let us get started with activities we have already planned?”

Especially in the Upper Ping, there is now considerable confusion about the apparent continuing expansion of the mandate of river basin and sub-basin organizations and planning. The first round of committees and planning seemed to be focused quite directly on water resources. Then the second round of planning seemed to shift much of the focus to forest conservation, land use, agricultural chemicals and trash. Now this new project wants to add public health and poverty *cum* livelihood issues. Most local communities appear to have few problems about seeing how these issues are important, linked, and affect their lives, but they feel a need to get some clarity and definition so that they can do what is required and get on with their activities and their lives without spending so much time planning and re-planning. For government agencies, concern is even stronger because of the lingering questions about who is or will be the “owner” or “patron” (*jao khong ruang*) of this program (and its budgets), and how are they supposed to act vis-à-vis other agencies.

And at a more specific level, there is also quite considerable confusion about the roles and status of the various existing levels of committees and working groups, as well as the plans they have already developed. A number of people have stepped forward to assume leadership roles, and some are beginning to wonder if they have been wasting their time, or if people at higher levels are for some reason not pleased with their performance. Perhaps even worse, some are wondering if the continuing lack of action in receiving support for the plans and projects they have worked to help articulate and develop will damage their credibility and social standing within their communities.

High-level ministerial meeting rooms in Bangkok, meeting halls in Chiang Mai or Nakhon Sawan, and meetings of TAO, local communities or networks are three very different types of venues, and clarity in one type of venue by no means implies there will automatically be clarity at other levels. Unless there can be more effective, consistent and persistent efforts to bring clarity to these issues, the credibility of the Ping River Basin program is likely to suffer seriously, and prospects for effective participatory organizations and programs are likely to diminish.

(b) Common identity and direction

There are at least three basic types of issues affecting RSBO identity and direction:

Lack of common vision. One factor that exacerbates problems associated with confusion and uncertainty, and makes efforts to seek clarity more difficult, is an overall lack of a common vision at two levels. At the first level is a vision of what is the desired direction and future of society, livelihoods and landscapes at a sub-basin, river basin or broader level.² Some groups appear to have an internal vision that clearly includes forested mountains free of agriculture and settlement, but often less clarity in terms of the roles of urbanization, commerce and industry. Others want to see a hyper-modern commerce, service and high-tech industry based economy centered in glitzy ‘world class’ urban centers, but are not too clear about rural areas beyond their provision of visual ambience for posh resorts and golf courses. Still others seem to advocate simply ‘turning back the clock’ to mimic conditions in some earlier time perceived as a ‘golden era’ when all was well. Some simply feel the future should be what the *phuyai* want to make it. Probably the majority, however, have either not thought much about such things, or feel quite uncertain about directions in which development and change could or should be headed, and about how much they will benefit or suffer from change. Differences among these types of visions have often been reflected during efforts to identify natural resource, environmental, health and livelihood problems at early meetings in pilot sub-basins of this project.

Such differences are normal in a diverse and open society, and it would be alarming if everyone had a single uniform vision for the future. Problems arise, however, when decisions need to be made that affect allocation of resources toward investments that affect the ability of various groups to try to achieve their desired vision, and especially when one group seeks monopoly power that it can use to impose its vision on others without their consent. What is needed in an open society, then, is functioning institutions that can facilitate articulation, advocacy and debate about major resource allocation and regulation decisions, so that such decisions can be reached in the most transparent, equitable and accountable manner possible.

At the second, and more specific, level is a vision of what should be the overall role of river basin and sub-basin organizations to help achieve desired future visions. Movement toward development of river basin organizations has to a large extent been driven by the perceived need for various important resource allocation decisions to be assessed in the context of their potential impacts on, and contributions to, environmental quality, public health, socio-economic equity, and overall sustainability at broader scales than those commonly perceived at local government or various interest group levels. Thus, it would appear that one rather important function of sub-basin organizations would be to provide a venue for discussion and even debate among stakeholders with different visions of the future, with the aim of creating at least mutual understanding of commonalities and differences, and an atmosphere where reasoned compromise solutions can be formulated. Substantial progress in this direction is being made at local to sub-basin levels in various Ping sub-basins, but progress varies among sub-basins according to the range of interests and stakeholders, as well as local leadership and proclivities to engage in such activity.

Factions and sense of community (us versus them). One important difficulty in establishing the type of dialogue needed for sub-basin level dialogue and negotiation relates to the role of faction groups (*pak puak*). These types of groupings still appear to be quite strongly linked to identity, and often result in binary ‘us’ and ‘them’ perceptions of different interests and perspectives. In addition to common rural-urban, upstream-downstream, and other much more local differences based in social and cultural rivalries, there are often overtones of ethnicity (especially toward mountain minorities or *chao khao*), xenophobia (especially toward refugees and foreign investors), or class distinctions (especially fear or jealousy toward capitalist investors and patronizing attitudes toward the poor). Again, social factions are quite normal in an open society, but mechanisms are needed for increased communication among groups that can at least help manage or reduce potential for conflict and facilitate some degree of mutual understanding.

² This is associated with different opinions about the best type of knowledge to guide decisions [Lebel 2004].

Often closely associated with the binary us-them views of *pak puak* factions, is a tendency for groups to view most issues as a zero-sum game, wherein any gains by one group can only be made at the expense of the opposing group. Thus, all points of competition are seen as a contest where the only thing that matters is 'winning', especially where money, property, power or prestige are involved. Accordingly, one major challenge for sub-basin organizations will be the need to develop enough of a common 'us' identity (*puak rao*) at the sub-basin level that the various stakeholder groups can engage in give-and-take negotiations and seek to make resource allocation decisions that are in the best overall interest of all groups. Again, substantial progress is being made in some sub-basins, but much remains to be done. Project meetings at the Upper Ping and Lower Ping levels, however, exhibited a nearly complete absence of this type of *puak rao* approach.³

Government bureaucracy sub-culture. Efforts to establish river basin and sub-basin organizations began as a central government initiative, and government agencies are, and will continue to be important stakeholders in sub-basin organizations. As government and other stakeholders assess the various potential roles for government agencies and officials, however, they also need to consider some of the sub-cultural characteristics of government organizations, and how they affect the ability of sub-basin organizations to achieve their overall goals.

How will government agencies be able to engage in dialogue, coordination and negotiation concerning a broad set of development issues in Ping sub-basins? Government 'line' agencies follow their own separate lines of authority, and each time a new ministry is created, huge barriers are created almost immediately. For example, creation of MoNRE reflected a hope for increased efficiency and effectiveness by separating production into the agriculture ministry (with rumors of a potential merger with commerce), while MoNRE would focus on conservation of natural resources (primarily forests and water) and environmental degradation (mainly pollution). As is clearly being demonstrated by problems identified under this project, however, many important issues relate to interactions among production, natural resources and environmental quality, as well as relationships with issues that primarily fall under the jurisdictional domains of agencies in other ministries, local administration units, the private sector, or civil society. Lack of clear policies and lack of coordination among organizations are cited as two major obstacles to effective water management in Thailand [Sethaputra 2001].

We have seen in some of the sub-basins, and especially the Lower Ping, that identity as determined by agency affiliations is an important issue: To whom does the organization belong? Who will issue the organizational order? Will all agencies have equal representation? Will senior leaders in other agencies allow their junior staff to participate? Will junior staff fear doing things beyond their job descriptions or what their seniors want?

Moreover, in the sub-culture of government agencies, career goals and incentives generally flow from above (higher levels in the hierarchy), and thus upward accountability tends to dominate. To the extent that downward accountability occurs, it is usually due primarily to other social considerations by the particular individual officials involved. There are numerous examples in Ping sub-basins where agency staff exhibit very sincere relationships with local leaders and local communities, and have clearly sought to be as transparent and responsive to their needs and views as is possible. But these relationships tend to be much more personal than structural, and experience shows that agency staff rotation policies threaten the sustainability of this approach [Kaosa-ard 2000].

How much, then, should emphasis be placed on having one or more government agencies be the 'patron' of sub-basin organizations? If sub-basin organizations are to have a relatively broad problem-solving mandate, how can coordination or integration actually be accomplished? Is it really possible through the type of top-down sector-oriented processes inherent in government organization? On the other hand, will the bottom-up TAO or *tessaban*-type model be able to work effectively now or in the foreseeable future? Should agencies see themselves as patrons or leaders of these efforts, or should they see their role (together with academic and non-governmental groups) as service providers and stakeholder representatives of the legitimate interests of larger society

³ See Part II.C.2. regarding these meetings.

within their agency mandate? These are questions of considerable significance for development of sub-basin organizations.

(c) Analysis and negotiation skills

Systematic problem identification & analysis. Problem identification by government officials naturally tends to be viewed through the lens of the mandate of their agency, whereas much local problem identification has been broader but unsystematic and often occurs too late to consider preventative measures. Empirical data-based analysis has generally been extremely rare, and unquestioned popularized general theories backed by emotional arguments are still featured prominently at most public discussions. Indeed, some people seem to be cultivating their identities as oratorical champions of various issues, and rarely do they miss an opportunity to make a performance. Seldom, however, do they seem to offer innovative practical solutions to address issues they identify. Moreover, issues often tend to be viewed as simply good or bad, rather than as involving situations where there are trade-offs that must be made between the benefits and costs accruing to different groups. Assessments of such trade-offs, however, would also often require information, data, and analytical tools that are frequently not available to or accessible by local leaders and communities.

That being said, more quiet progress toward more dispassionate and reasoned analysis is being made in various sub-basins. Local leadership, sometimes assisted by staff from government agencies or academic or civil society institutions, often features prominently in these cases. We have seen examples at early project meetings, especially at Chiang Dao and Mae Kuang. These processes are resulting in some quite insightful problem identification results. When it comes to identification of clear actionable (and fundable) projects to address these problems, a somewhat more modest degree of progress is evident. This appears to be largely because some of the (quite appropriately) identified problems – such as forest policies and lack of secure land tenure, lack of water use rights, powerful outside investors, *etc.* – cannot at this point be effectively addressed by locally formulated and implemented projects. It is also sometimes constrained by the focus of ideas and assistance that can be provided by agency staff or other contacts they currently have, as well as by their current perceptions of what are acceptable projects for funding under this program.

Negotiation mindset. The type of progress we have seen in some sub-basins also demonstrates local progress toward development of a “negotiation mindset” that will be required to effectively develop and implement solutions to many, if not most problems. There are usually costs and benefits associated with all potential solutions to a problem, and their distribution is frequently not even or balanced across the range of stakeholders involved. Thus, in order to achieve sufficient participation, this distribution of costs and benefits needs to be negotiated among concerned stakeholders. A negotiation mindset shifts emphasis from a focus on ‘winning’ or ‘losing’ to seeking an outcome wherein concerned stakeholders (at all levels) incur various costs and benefits that are mutually perceived as equitably distributed, as they jointly seek a ‘best possible’ outcome.

(d) Coalitions and Subsidiarity

As we have seen in early project sub-basin meetings, stakeholders feel some problems can be addressed by simply constructing small check dams, developing local community forestry regulations, or a range of other activities that can be organized into projects that are relatively easily fundable, and which local groups can implement under their own initiative, or with assistance from nearby agency officials. Other problems, however, are much more complex and require involvement by a wider range of actors, skills, tools, and/or resources from different sectors and levels of society.

In these cases, problems faced by sub-basin organizations will be somewhat similar to those faced by many TAO and *tessabans*. Where actions need participation from local groups or individuals that are in different groups or sectors of society, coalitions need to be built within sub-basins in order to mobilize the necessary actors and resources. There are also likely to be occasions when coalitions need to be built among multiple sub-basins when and where it will help stakeholders achieve common goals. The network of TAO in the Ping part 1 sub-basin, and the association of TAO in Chiang Mai province are early examples of peer-to-peer coalitions. Some of the emerging networks

of smaller local networks (various types: *muang fai*, sub-watershed, forest conservation, village doctors, *etc.*) also represent beginnings of cross-sector coalitions in various sub-basins where they are occurring.

The principle of subsidiarity seeks to locate decision-making at the most local level where it is possible and effective.⁴ Following this principle, in sub-basins where more local networks – and especially local sub-watershed management networks – are already active and functioning, it would make sense for them to become the basic building block units for decisions about activities they are capable of managing. Thus, issues that would come to the sub-basin level would be able to focus on those actions that require sub-basin level assessment, decisions and action. Similarly, sub-basins will need to pass some issues that they are unable to resolve at the sub-basin level up to higher levels, such as the Ping RBO or province level, for consideration. In some cases, such as land use security in upland areas classified as reserved forest land, for example, sub-basins may need to build coalition consensus among multiple sub-basins in order to effectively pass issues up to high enough levels that the issue might finally be resolved.

(e) Transparency, accountability and learning

Although there is great variation from area to area, complaints about transparency and accountability in local government matters are common. They are also common in relation to decisions by government agencies regarding regulations and activities in local areas. At the same time, there is often an aversion to monitoring and especially ‘evaluation’ activities (in both central agencies and local government), usually do to fear either of disclosure of sub-standard or dubious practices, or to suspicion that evaluators will raise unfair accusations, either because of their lack of understanding of conditions, or in order to advance their own particular interests. Thus, it has proven to be quite difficult to develop systematic monitoring systems that provide sufficient information for these types of organizations to systematically and effectively learn from their experience in order to make incremental improvements to their processes and programs. Especially given the nature of many of the issues they will be seeking to address, as well as the changing economic, social and political environment in which they will be operating, it will be an important challenge for sub-basin organizations to seek to overcome these barriers.

Systematic monitoring and learning. There are three rather distinct, but complementary types of monitoring that will need to be conducted by sub-basin organizations. The first type is monitoring of project inputs and outputs. It seems to be widely perceived that resource allocation decisions made by sub-basin level organizations will, at least for the most part, need to be implemented through local government or central agency channels. It has repeatedly been expressed in working groups at project workshops, however, that once decisions are made to allocate resources to a specific activity, funds passing through local government or central agencies need to be clearly earmarked by the budgetary process for use only in support of the designated activities. In addition, there needs to be transparent monitoring to assure that this actually happens. This concern obviously reflects previous experience, and indicates the level of skepticism that is present among at least some of the stakeholders.

The second type of monitoring needs to be directed toward indicators of progress toward achieving the types of goals that sub-basin organizations and their plans, programs and projects seek to accomplish. This is where the real learning process becomes central, as people see whether the various projects and activities are actually accomplishing what their proponents claim. Currently, general impressions and feelings of change, mixed with fears about perceived negative impacts, are used far more extensively than data from empirical studies using transparent methodologies. This needs to change.

The third type of monitoring is needed to set the context and understand the nature and significance of program impacts. Sub-basin organizations will need to develop and evolve systems for monitoring the status of a range of conditions that corresponds to their overall mandate. Given a mandate that corresponds to the domain indicated by this current ONEP-World Bank project, their mandate

⁴ Further discussions of subsidiarity can be found in sections III.A. and III.B.4. of this report.

would include natural resources, environment, public health, poverty and livelihoods. This range of issues could be expanded if considerations such as the cultural and quality of life issues advanced by Chiang Mai University studies [CMU 2004] are also included. Ideally, local people and institutions within the sub-basins should be operating monitoring systems and processes to the greatest extent possible, with outside “expert” components helping provide standards and cross-checks among sub-basins on data compatibility and quality, and perhaps assembling data from multiple sub-basins for periodic broader analyses.

At the core of this sub-basin monitoring and learning system should be a modest team of capable and relatively independent but trustworthy people. They would lead efforts to assess changing conditions and the impacts being made by projects, programs and other types of activities and events; to raise issues and suggestions about how programs and projects could be improved in order to improve their contributions; and to help identify potential new issues and/or problems that should be raised for consideration by the sub-basin organization. Their findings would feed back into problem analysis and planning processes, as part of the continuous overall learning cycle of sub-basin management.

Systematic information. One of the critical components of a monitoring, feedback and learning approach to sub-basin management will be an effective information management system that can provide reasonably robust and accurate information and data for the range of areas covered by the monitoring and learning system. While the range and quality of information available to local government and civil society groups is gradually improving, sources are fragmented and access still tends to be very narrow, compartmentalized and incomplete.

There are at least three lines of ongoing activity, especially in the Upper Ping, that could make major contributions to establishment of effective sub-basin information systems.

- The Upper Ping spatial information system being developed by Mr. Wittaya and colleagues at the DNP’s Huay Kaew office in Chiang Mai, under support from ONEP, which is especially strong on natural resource and forest land use data;
- The pilot provincial spatial information systems for Chiang Mai, Lamphun and Chiang Rai provinces being developed by Dr. Methi and colleagues at the CMU Multiple Cropping Centre, under support by the Thailand Research Fund, which is especially strong on land, production, and some economic and social data.
- ONEP-supported work on environmental standards and monitoring conducted by Dr. Wasan and colleagues at CMU [2005], as well as results of their earlier study [CMU 2004].

If these three lines of activity could be effectively interfaced into a system that could be operated, maintained, and updated on a long-term basis, this could provide the core of an information system for at least the Upper Ping, and project discussions indicate DWR wants to extend this approach to the Lower Ping. Dr. Methi’s system includes a Thai language interface and various decision support modules. It is intended for use at provincial level, but is designed for use at district, *tambon*, basin, sub-basin, or local sub-watershed levels when sufficient interest and capacity are present.

Ideally, two additional lines of activity could then further enhance this system:

- Establishment of linkages with other types of relevant databases. While Dr. Methi’s system already includes links with rural development databases such as Kho Cho Cho 2 Kho and agricultural statistics, further links could be made with databases on public health or other relevant subjects, and the system is designed to facilitate such expansion.
- Development of local monitoring activities within sub-basins and linkages of their findings with the information system. Examples could include community-based land use zoning and watershed service monitoring such as that piloted by ICRAF, Care, and DNP in Mae Chaem [Thomas 2004], which also incorporates use of the water quality bio-indicators championed by the Green World Foundation and already used by a network of schools in the Ping Basin. It should also include additional factors viewed as important by sub-basin stakeholders (at multiple levels), which could be added to the system.

This type of information system could also be further enhanced by linkage of the spatial database with specialized analytical techniques, including simulation or programming models, to help strengthen understanding about basic processes, trade-offs, or implications of different future development scenarios that are high priority concerns among sub-basin stakeholders. Some examples are introduced in an ICRAF report to the Rockefeller Foundation [Thomas 2004a], and more detail is presented in their ASB report to the World Bank [van Noordwijk 2003].

Summary of Suggestions and Recommendations in Part I:

1. This part of the report proposes a framework for understanding the context of efforts to build sub-basin management organizations for the Ping River Basin that includes:
 - Diversity of physical, economic & social characteristics of the Ping River Basin should be viewed in the context of a gradient of conditions that begins with large areas of paddy & rolling uplands in lower parts of the basin adjacent to the Central Plains, then runs through the hills of lower & transition provinces into the inter-montane Chiang Mai Valley, and finally extends into largely mountainous upper tributary watersheds.
 - Overall economic growth & development strategies, general patterns of land use change & their impacts on natural resources, and broader impacts of national land use & resource conservation policies should be assessed along this gradient using spatial & provincial time series data, along with other forms of available information.
 - National natural resource governance issues & debates should be assessed for how they apply to each major portion of the river basin along this gradient.
 - Current progress & status of watershed & sub-basin management, including the nature and status of any related emerging organizations, should be reviewed & assessed at major levels of watershed units & administration units, from local sub-watersheds & *tambons* to river system & national levels.
 - Hierarchies of administrative units & natural watershed units should be compared as part of an initial assessment of levels where interaction needs to occur between administration & watershed units, and potential strengths & weaknesses at each level.
 - In the current Ping Basin context, initial assessment of comparative strengths & weaknesses indicates the sub-basin level should place emphasis on its potential for providing a venue for interaction between top-down & bottom-up processes of organization for watershed & natural resource management.
 - Both non-governmental planning initiatives & regular local development planning processes need to be reviewed in terms of how they can & should interact with basin & sub-basin management at various levels.
2. Efforts to build sub-basin management organizations should strive to address current key gaps & operational issues that include:
 - Effective & consistent efforts need to be made to reduce confusion & uncertainty about river basin & sub-basin programs, which is largely due to repeated rounds of planning under changing mandates & shifting responsibilities of agencies & organizations, without a clear commitment to actual implementation.
 - Venues & processes should foster stakeholder discussion & debate aimed at building mutual understanding of commonalities and differences in interests & visions of the future, development of a common identity among stakeholders at the sub-basin level, and an atmosphere where reasoned compromise solutions can be formulated.

- Government agencies need to examine their own strengths & weaknesses, and join with other stakeholders in identifying means for overcoming problems associated with poor coordination & cooperation among agencies, & lack of downward accountability.
 - Problem identification & analysis needs to become more empirical & data based, and recognize the need for negotiating trade-offs among the benefits & costs accruing to different stakeholder groups. There needs to be less focus on winning/losing, and more focus on equitably achieved 'best possible' outcomes.
 - Principles of subsidiarity & specialization need to be used in identifying & building appropriate coalitions that can help achieve broader & more difficult goals.
 - In order to provide a solid basis for transparency, accountability & learning, sub-basin management organizations should place substantial emphasis on building their capacity to conduct three types of monitoring: (1) project inputs & outputs; (2) progress toward achieving program & plan objectives; (3) status of the range of conditions corresponding to their overall mandate. Partnerships & coalitions will be needed to effectively achieve all these types of monitoring.
3. A systematic & effective information management system needs to be developed at the Ping River Basin level. It needs to build on previous & on-going work, and provide linkages with emerging sub-basin organizations that can support their functions & further development.

II. Selecting Pilot Sub-basins

This part of the report seeks to pursue in greater detail concepts, processes and data associated with surveying the diversity of Ping River sub-basins, and proposing a technical approach for selecting pilot sub-basins for the project. This approach is then compared with the actual pilot sub-basin selection process that occurred during implementation of the project.

A. Purpose of selecting priority sub-basins

This project aims to select three Ping River sub-basins where intensive pilot projects will develop, establish and test “model” participatory sub-basin management systems. Results from these pilot sub-basins are then to be applied to other sub-basins in the Ping River Basin.

In order to maximize the potential relevance of results in the pilot basins for application elsewhere in the larger basin, the three pilot sub-basins need to represent a reasonable range of conditions present in the Ping River Basin. Thus, from a technical point of view, sub-basin selection needs to focus to a large degree on sampling issues, and particularly on sampling those conditions that are likely to affect the nature of sub-basin management organization structure, composition and participatory processes, as well as the range of potential and actual natural resource management problems that need to be addressed.

At the same time, there may be substantial variation among sub-basins in the complexity and difficulty of building effective participatory management organization. While the sample needs to avoid selecting only the easiest cases, which would limit their relevance for other sub-basins, it also needs to avoid a focus on only the most difficult cases, which would make it unlikely that significant results could be achieved within the limited time frame of the pilot projects.

Moreover, it needs to be clear to local leaders in all sub-basins of the Ping River Basin that selection of the three pilot sub-watersheds does NOT mean that those not selected will receive no support for efforts to build participatory management organizations within their sub-basins. They need to clearly understand the government’s continuing commitment to efforts throughout the basin, and that anything they can do to help achieve significant positive results in the pilot sub-basins will help accelerate the rate at which broader, more inclusive efforts can be planned and implemented.

B. Proposed Sub-Basin Selection Criteria: Pragmatic technical approach

Although it is an intellectually interesting exercise to imagine innovative conceptual approaches for criteria that could help inform selection of pilot sub-basins (*aka* “micro-watersheds) under this project, reality calls for a far more pragmatic approach. Indeed, the approach must be able to build on existing data from readily available secondary sources, it must be relatively easy to implement within a very short time horizon, and it must be simple enough to be readily communicated to a wide range of stakeholders in the Ping Basin. At the same time, however, it should be reasonably rigorous, quantitative, logically sound, and able to address major issues that underlie motivation for initiating, conducting and providing funding support for this project. This section seeks to articulate an approach that aims to meet as many of these divergent needs as possible.

Relationships with Sub-Basin Rankings in Recent Studies of the Ping River Basin

The author has been provided reports on two previous efforts to rank sub-basins of the Ping River Basin: (1) Chiang Mai University Ping Basin Master Plan Study for ONEP [CMU 2004]; and (2) Panya Consultants Proposal to ONEP [Panya 2004] and an earlier report to DWP [Panya 2003]. These were based on recent and fairly extensive efforts to collect, compile and assess various types

of information and data in a systematic manner. For the purposes of pilot sub-basin selection under this project, key aspects of their approaches and the one used in this report include:

- **Ranking Approaches.** The CMU sub-basin study appears to be directed toward identifying priorities for investment according to the relative “importance” of sub-basins for conservation and development of the Ping Basin. Criteria were divided into three categories: physical and ecological, historical and cultural, and economic and social. The Panya study took an approach that sought to rank sub-basins according to the intensity of problems that need to be addressed in each sub-basin regarding natural resource management, with particular emphasis on water; needs for additional criteria are acknowledged in their proposal to ONEP. Given their somewhat different approaches to ranking, values for some indicators need to be inverted to make them conceptually compatible with the other source. This report draws on various of their data, and in some cases directly on indicators developed under both studies.
- **Scoring Approaches.** The CMU sub-basin scoring system appears to be based on a mix of thresholds for quantitative data and (for indicators using multiple or less quantitative types of data or information) expert opinion said to be based on review of a quite wide range of data and information sources. The precise nature of many of these expert interpretations, however, remains somewhat obscure. The Panya scoring system relied more heavily on interpretation of quantitative data according to thresholds based on expert opinion. Since many of the new indicators proposed in this report seek to combine multiple data components in various ways, most rely primarily on a combination of quantitative data and relative weights. Relative weights are transparent and can be adjusted according to expert opinion or stakeholder consensus.
- **Scaling Systems.** Both reports produced sub-basin rankings based on indicators that employed a three-level scoring system, which appears to be a quite reasonable and useful approach. The CMU study used a scale of 1, 2, 3, while Panya used a scale of 0, 0.5, 1. Thus, results from one can be easily converted to be compatible with the other. Indicators in this report also use a 3 point maximum value scheme, which facilitates inclusion of some useful indicator values already estimated as part of those efforts.
- **Indicator Weights.** The Panya approach used a simple average of scores across its indicators, implying equal weights for each, but giving de facto weights resulting from the relative number of indicators representing each subject area. Preliminary indicators in their proposal to ONEP reflect an emphasis on water resources, but they note that additional types of indicators need to be added. The CMU approach used weighting factors to equalize relative influence of its three major subject groupings on overall scores for sub-basin ranking. Various indicators proposed in this report use weights in calculating values for an individual indicator to affect relative influence of data components on overall indicator scores. Provision is also made for a transparent method of assigning relative weights among indicators.

1. Grouping Sub-Basins into Lower, Middle & Upper Zones of the Ping Basin

This section develops a simple criterion and practical quantitative indicator for a more meaningful and systematic approach to classifying sub-basins according to lower, middle and upper sub-basin groups within the overall context of the Ping River Basin. A range of available data is then used to assess the characteristics of these groupings, and their relative scale and role in the context of the overall Ping River Basin. This provides a basis for a brief survey discussion of major types of stakeholders associated with forces driving change in land and water use in the Ping Basin, and how distribution of their relative role may vary across sub-basins and groupings. All of this provides input into articulation of a minimal simple set of key criteria that may be applied for pilot sub-basin selection under the limitations and constraints faced by the project. Following sections articulate specific indicators for each of the three remaining major sets of these criteria.

(a) *Relative Sub-Basin Position in the Ping River Basin*

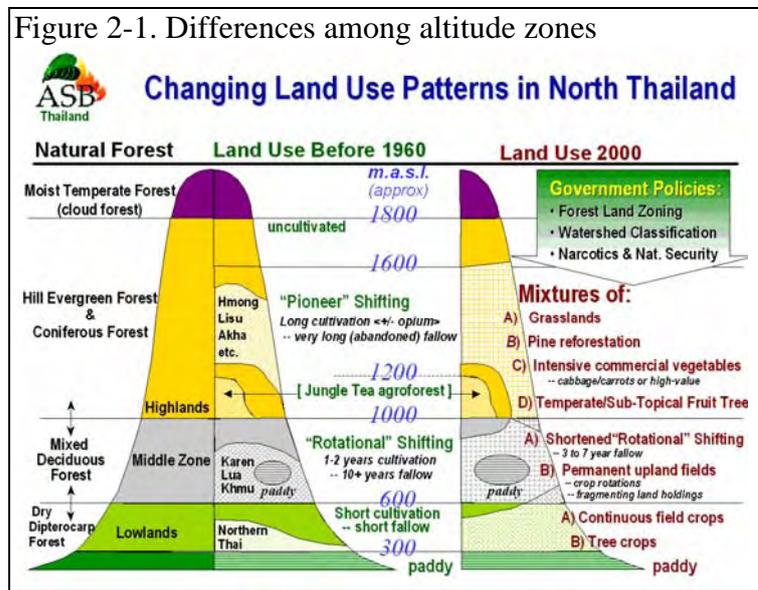
Project documentation suggests that the three sub-basins should be selected so that “lower, middle and upper” sections of the Ping River Basin are represented by one sub-basin each. This was initially interpreted by Panya Consultants (and others) to mean southern, middle, and northern por-

tions of the Ping River Basin. After considerable discussion among consultants and colleagues in ONEP, it has been agreed that other interpretations would be considered.

An alternative approach for interpreting the “lower, middle and upper” sub-basin issue is to consider the physical characteristics of the sub-basins. Our experience has been that many conditions and issues differ between what we have often called “upper tributary watersheds” and their more “lowland-dominated mainstream” counterparts. One of the major characteristics that helps distinguish between these types of watersheds is the relative proportions of the area that is located within different altitude zones.

Important differences among conditions and traditional agroecosystems found in mountain areas throughout mainland Southeast Asia correlate closely with altitudinal gradients. Accordingly, three major altitudinal zones have commonly been recognized around the region, corresponding to what can be characterized in the English language as: lowland, midland and highland zones. Indeed, this distinction is so basic that distinct terms in the Lao language [*Lao loum*, *Lao theung*, *Lao soung*] have been used for many generations to refer to the people whose history and culture is most closely associated with each zone.

A very generalized illustration of how these three altitudinal zones manifest themselves in northern Thailand is provided in Figure 2-1 [Thomas 2002]. The main features of this diagram are that natural forest and ecological conditions vary along an altitudinal gradient, as do the traditional (indicated here as before 1960) land use systems and associated ethnic groups. As suggested in the right side of the diagram, current land use and settlement patterns often deviate from traditional ones due to a variety of government policy, economic and social forces that have brought change to this region during recent decades.



This author proposed that distinctions between “middle” and “upper” portions of the Ping River Basin are more appropriate when made on the basis of the relative distribution of land among these three altitudinal zones.

There appears to be general agreement among consultants and ONEP staff that the “lower” portion of the Ping River Basin should refer to sub-basins located below the Bhumibol Reservoir, since the existence of this structure fundamentally affects the nature of conditions, issues and potential management approaches associated with at least the main channel of the Ping River. Indeed, this distinction between upper and lower portions of the Ping River Basin was made by the Office of the National Water Resources Committee after construction of this reservoir in 1964. Even for the sub-basins located in the “lower” portion of the Ping River Basin, however, it may still be instructive to assess the relative distribution of land and people among these altitude zones.

In order to incorporate altitude zone considerations into overall Ping River Basin assessments and the project’s pilot sub-basin selection process, operational definition of zone boundaries needs to be agreed upon by project stakeholders. As a first step in this process, the following are proposed:

- **Lowland-Midland Boundary.** The altitude of 600 masl is proposed for this boundary because it appears to have been advocated and used by numerous natural resource management related agencies as the boundary above which land use (and land tenure) should be restricted by government policies. In addition, the survey of ethnic minority villages conducted in as-

sociation with the National Security Council [DPW 1998] uses this as the lower boundary of their survey, in line with various “highland” policies of the government.

- **Midland-Highland Boundary.** The altitude of 1,000 masl is proposed for this boundary because it is considered as the rough lower boundary of what was the opium production zone in earlier years, and because areas near or above that altitude appear to generally be associated with hill evergreen or cloud forest types that are the highest priority concern of interests concerned with protection of watershed headlands and biodiversity.

This classification is easily converted into a spatial data format derived from sub-basin boundaries and a digital elevation (terrain) model. An example of this type of spatial classification of the Ping River basin and its sub-basins is provided in Figure 2-2. This map was constructed using sub-basin boundary data from ONEP, and a medium resolution digital elevation model constructed by World Agroforestry Center (ICRAF) staff using data from ICRAF and the Thailand Environment Institute (TEI) derived from 1:250,000 topographic maps with a 100 meter contour interval. This level of resolution should be sufficient for sub-basin classification purposes at this stage of the project.

This map also includes further sub-divisions of both the lowland and highland zones. The lowland zone is divided into areas above and below 300 masl, with the low portion approximating areas in major valley floors where paddy production is usually extensive. The highland zone is divided into areas above and below 1,600 masl, with the upper portion approximating mountain peak zones where cloud forest is often a prominent feature, and agricultural cultivation is relatively rare.

Criterion 1. Groupings of middle and upper sub-basins within the Ping River Basin should be made according to bias in their relative distribution of land area and human populations among lowland, midland and highland zones.

Indicator 1.1: Altitude Zone Area Bias Score. In order to derive a quantitative indicator that reflects variation among sub-basins in the distribution of land areas within these zones, Figure 2-3 illustrates how a “Lowland Zone Bias Score” can be calculated from land areas in each zone derived from the map. Under this method, a score of 3.0 would indicate all land is in the lowland zone, while 1.0 would indicate all land is in the highland zone. Reversing the values of the relative weights would produce a “Highland Zone Bias Score” that would reverse the order of the scores indicated in the table.

Based on these calculations, Ping sub-basins are listed in the order of their Lowland Area Bias Scores. Within the Upper Ping Basin, we can see that four sub-basins (Ping part 2, Mae Kuang, Mae Lee, Mae Had) have a strong area bias toward the lowlands, with scores of 2.5 or greater and more than 50 percent of their land area in the lowland zone. Thus, these form the core of the proposed “middle sub-basin” category. Six other sub-basins (lower & upper Mae Chaem, Mae Taeng, Mae Tuen, Mae Klang, Mae Khan) have lowland bias scores less than 2.0, and all have more than 20 percent of their area in highland zones combined with less than 30 percent in lowland zones. They form the core of the proposed “upper sub-basin” category.

The remaining four sub-basins (Ping parts 1 & 3, Mae Rim, Mae Ngad) fall in between these two groups, and all have a similarly more balanced distribution among the three altitude zones. Of the three, Mae Rim differs in its much higher population density, and a more proportionate share of urban settlements and industry (see the following section for data). The Ping part 3 sub-basin differs in that it includes a long section of the main channel of the Ping River. Thus, it is proposed that a lowland bias score of 2.30 be used as the cut-off point between the “middle sub-basin” and the “upper sub-basin” categories.

Figure 2-2. Altitude Zone Map of the Ping River Basin

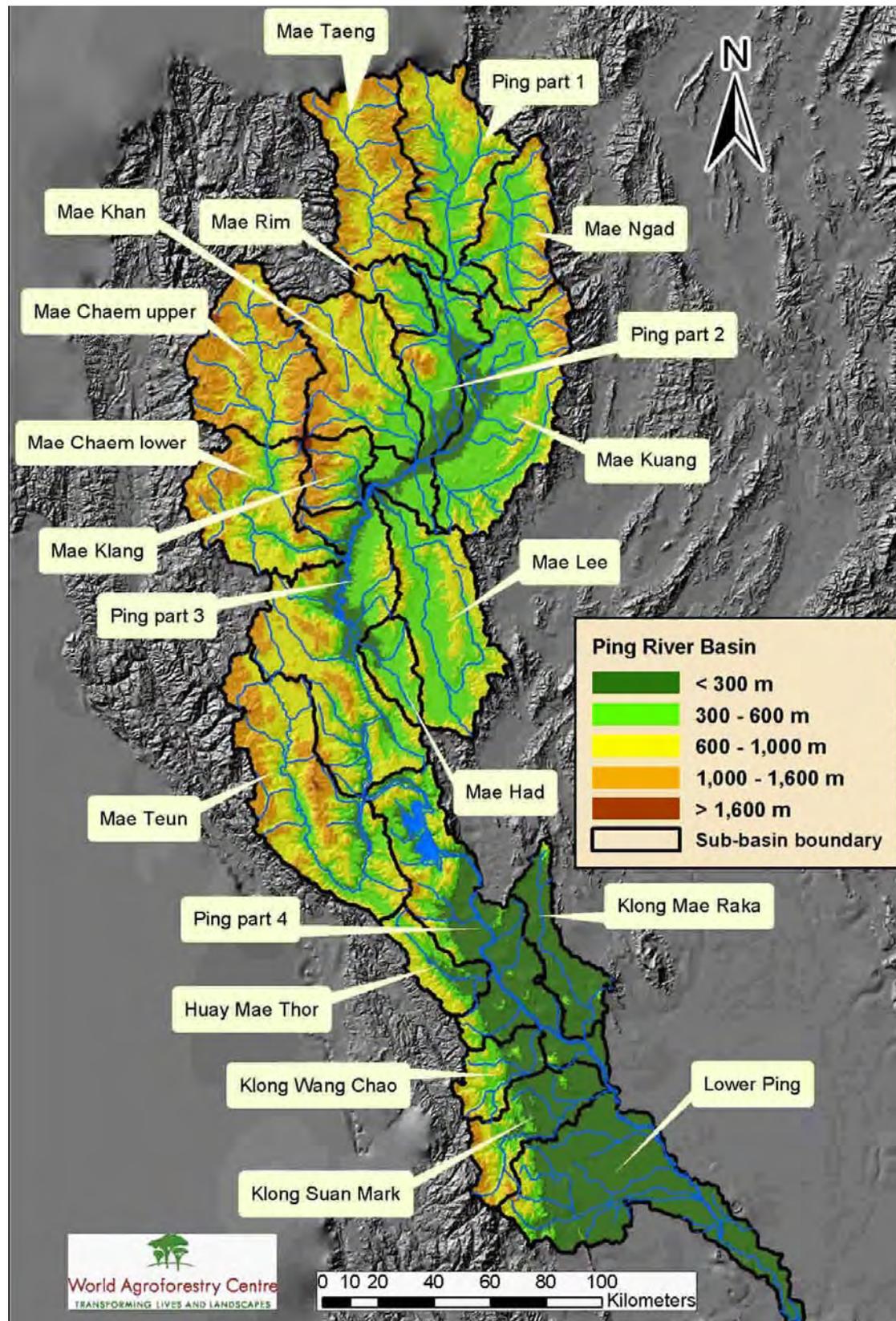


Figure 2-3. Calculation of the Lowland Zone Area Bias Score for Ping Sub-Basins

Sub-Basin	Share of Ping Basin	Total	Area Distribution <small>unit: square kilometers</small>					Percentage Distribution <small>unit: Percent</small>			Area Bias Score <small>unit: Score 1.1.</small>			
			<300 m	300 - 600m		600 - 1,000m		<600m	600 - 1,000m	Highland >1,000m	Lowland	Midland	Highland	Lowland Zone Bias Score
				600 - 1,000m	1,000 - 1,600m	>1,600 m	Relative Weight multiplied by % of area							
							>50%							
11 Mae Chaem upper	5.9	2,061	-	34	827	1,150	51	2	40	58	0.05	0.80	0.58	1.434
3 Mae Taeng	5.6	1,958	-	129	902	893	34	7	46	47	0.20	0.92	0.47	1.592
9 Mae Klang	1.8	616	33	145	177	227	34	29	29	42	0.87	0.57	0.42	1.866
12 Mae Chaem lower	5.3	1,834	21	320	938	531	23	19	51	30	0.56	1.02	0.30	1.884
14 Mae Teun (CM+Tak)	8.4	2,896	74	608	1,343	852	19	24	46	30	0.71	0.93	0.30	1.934
7 Mae Khan	5.3	1,833	10	417	894	496	16	23	49	28	0.70	0.98	0.28	1.954
1 Ping part 1	5.7	1,974	-	795	857	308	13	40	43	16	1.21	0.87	0.16	2.240
2 Mae Ngad	3.7	1,285	-	560	516	208	1	44	40	16	1.31	0.80	0.16	2.273
"upper sub-basins"	42	14,458	138	3,009	6,453	4,666	192	22	45	34	0.65	0.89	0.34	1.882
5 Mae Rim	1.5	508	7	225	206	71	0	45	41	14	1.36	0.81	0.14	2.315
10 Ping part 3 (CM+Tak)	10.0	3,452	511	1,033	1,511	395	1	45	44	11	1.34	0.88	0.11	2.332
8 Mae Lee	6.0	2,081	34	1,221	789	37	-	60	38	2	1.81	0.76	0.02	2.585
6 Mae Kuang (w/M.Th)	7.9	2,734	307	1,583	670	167	8	69	24	6	2.07	0.49	0.06	2.627
13 Mae Had	1.5	520	55	331	126	8	-	74	24	2	2.22	0.48	0.02	2.725
4 Ping part 2 (w/M.Aow)	4.7	1,616	454	918	165	79	1	85	10	5	2.55	0.20	0.05	2.799
"middle sub-basins"	31	10,911	1,367	5,310	3,467	757	10	61	32	7	1.84	0.64	0.07	2.542
Upper Ping Basin	73	25,370	1,506	8,319	9,920	5,423	202	38.7	39.1	22.2	1.16	0.78	0.22	2.166
17 Klong Wang Chao	1.9	649	217	178	204	47	2	61	31	8	1.83	0.63	0.08	2.532
16 Huay Mae Thor	1.9	644	173	191	264	17	-	56	41	3	1.69	0.82	0.03	2.539
19 Klong Suan Mark	3.3	1,132	582	180	227	132	11	67	20	13	2.02	0.40	0.13	2.546
15 Ping part 4	8.6	2,983	1,856	614	447	67	0	83	15	2	2.48	0.30	0.02	2.805
20 Lower Ping	8.6	2,980	2,664	156	141	18	-	95	5	1	2.84	0.09	0.01	2.940
18 Klong Mae Raka	2.6	902	852	42	8	-	-	99	1	-	2.97	0.02	-	2.992
Lower Ping Basin	27	9,289	6,343	1,361	1,290	282	14	82.9	13.9	3.2	2.49	0.28	0.03	2.798
Ping Basin	100	34,659	7,849	9,680	11,210	5,704	216	51	32	17	1.52	0.65	0.17	2.335

These considerations result in this grouping of sub-basins:

- **Lower Sub-Basins:** Ping part 4, Lower Ping, Klong Wang Chao, Huay Mae Thor, Klong Suan Mark, Klong Mae Raka
- **Middle Sub-Basins:** Ping parts 2 & 3, Mae Kuang, Mae Lee, Mae Had, Mae Rim
- **Upper Sub-Basins:** Mae Taeng, Mae Chaem (both), Mae Tuen, Mae Klang, Mae Khan, Ping part 1, Mae Ngad

These groupings of sub-basins, as illustrated in Figure 2-4, appear to correspond rather well with our general perceptions of major differences in the relative distributions of natural resource characteristics of “upper tributary” versus “major lowland valley-oriented” sub-basins. This appears to support our perception that the Altitude Zone Area Bias Score is a useful tool for distinguishing between “upper” and “middle” sub-basins in the Upper Ping River Basin, as well as for identifying where middle and upper zone natural resources are more or less important in sub-basins of the Lower Ping Basin.

(b) Relative Scale & Role of Sub-Basin Groups

Having established a rationale, criterion and quantitative indicator for grouping sub-basins into lower, middle and upper categories, we can now turn to their relative importance in the biophysical and human settlement regimes of the overall Ping River Basin. In order to assess distribution of some of the Ping River Basin’s major overall characteristics among the various sub-basins and groupings, Figure 2-5 has been constructed from a combination of data available from ONEP, Panya, and the study by CMU [2004]. Some data for Mae Chaem was not in formats that could differentiate between “upper” and “lower” areas where ONEP seeks to divide the physical sub-basin. Otherwise, the table is reasonably complete.

To help assesses the degree to which the proposed criterion and quantitative indicator for establishing sub-basin groupings appear to be effective in differentiating among groups with significantly different characteristics, we can see the following patterns in the data in Figure 2-5:

- **Lower Sub-Basins** include a quite balanced 27 percent of the area, 28 percent of the people, and 26 percent of the total income of the Ping River Basin. They have a disproportionately large share, however, of the urban people (39%), industry (53%), and agriculture – both total (50%) and irrigated (48%) – due largely to their high concentrations in two larger sub-basins (Ping part 4, Lower Ping) through which the Ping River’s main channel flows. Perhaps not surprisingly, they also account for disproportionately low shares of the Ping River Basin’s total forest cover (19%) and protected conservation (19%) and watershed (14%) forest zones, about half of which is located in three smaller tributary sub-basins. Their shares of runoff and soil erosion are roughly proportionate to their share of overall basin area.

Figure 2-4a. Lower Sub-Basins

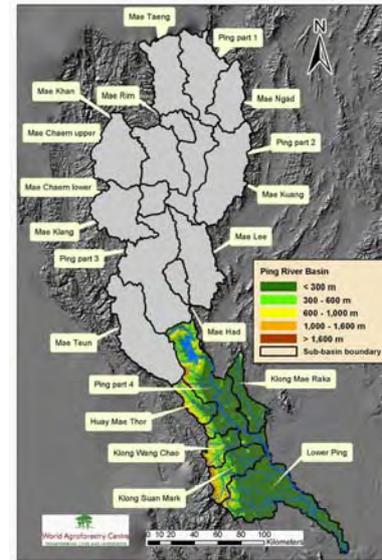


Figure 2-4b. Middle Sub-Basins

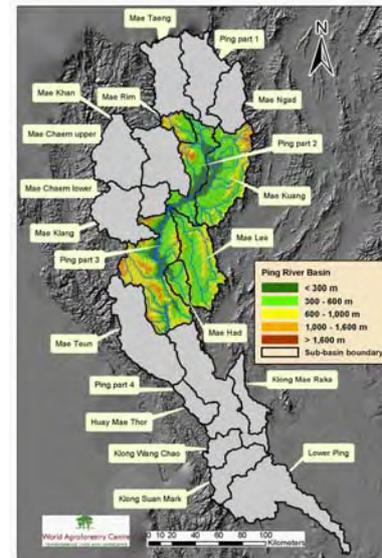


Figure 2-4c. Upper Sub-Basins

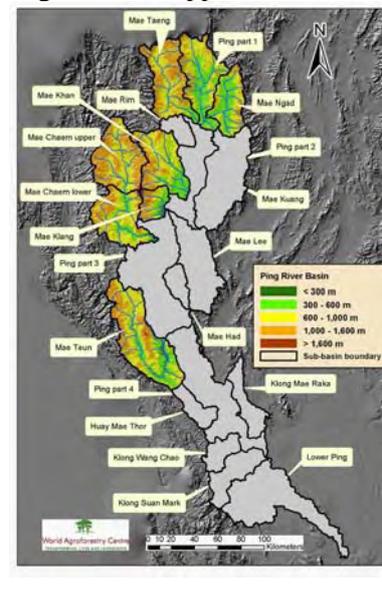


Figure 2-5. Sub-Basin Shares of Major Ping River Basin Characteristics

Sub-Basin	Terrain	Land		People, Settlement, Income					Cropped Area		Forest Cover Area			State Forest Zone Area			Soil Loss		Water		River
	Lowland Bias	TOTAL AREA	URBAN AREA	POP Density	TOTAL PEOPLE	UPLAND MINORITY	URBAN PEOPLE	NO. OF INDUST	OVERALL INCOME	TOTAL AGRIC	IRRIG AGRIC	SCRUB FOREST	DEGRAD FOREST	TOTAL FOREST	FOREST LANDS	PROTECT FOREST	WS 1AB ZONE	TOTAL EROSION	ANNUAL RUNOFF	DRY SEAS RUNOFF	STREAM LEVEL
unit:	score	% total		per km2	Percent of total Ping Basin					% total		% total			% total		% total		score		
602 Ping part 1	2.24	6	3	40	3	7	1	0	2	4	1	1	21	5	6	11	7	7	6	6	3
603 Mae Ngad	2.27	4	3	52	3	2	1	0	3	2	4	1	2	4	4	9	5	4	4	4	2
604 Mae Taeng	1.59	6	3	37	3	6	1	1	2	4	7	0	2	7	7	11	11	6	7	8	2
608 Mae Khan	1.95	5	5	59	4	8	4	2	4	3	5	9	2	6	6	2	6	7	5	6	2
610 Mae Klang	1.87	2	1	72	2	5	2	2	2	1	1	3	1	2	2	4	2	3	3	3	2
612 Mae Chaem upper	1.43	6	1	**	**	**	0	0	**	1	**	0	1	8	7	0	11	**	**	**	2
613 Mae Chaem lower	1.88	5	1	25	4	21	0	0	4	2	2	1	2	7	6	11	8	13	13	16	2
615 Mae Teun	1.93	8	1	18	2	12	0	0	2	3	2	0	7	12	10	10	14	15	11	9	2
Upper Sub-Basins	1.88	42	15	36	21	62	9	6	18	20	22	16	39	52	49	58	64	55	49	52	
605 Ping part 2	2.80	5	26	404	25	4	40	29	32	8	7	8	8	2	2	2	2	2	4	4	3
606 Mae Rim	2.32	1	2	153	3	2	2	2	3	1	1	0	2	2	2	1	2	4	3	4	2
607 Mae Kuang	2.63	8	20	108	12	2	7	9	12	10	13	13	9	6	6	3	5	5	9	6	2
609 Mae Lee	2.59	6	6	71	6	12	1	1	6	5	6	17	6	6	5	1	3	4	3	2	2
611 Ping part 3	2.33	10	5	23	3	10	1	0	1	4	0	20	3	12	11	14	8	4	5	5	3
614 Mae Had	2.73	2	1	84	2	1	1	0	2	1	3	1	1	2	2	1	1	3	4	5	2
Middle Sub-Basins	2.54	31	60	117	51	31	52	41	56	29	30	58	29	29	28	23	22	22	26	25	
616 Ping part 4	2.81	9	8	57	7	1	6	8	6	8	6	20	19	7	7	6	5	6	6	6	3
617 Huay Mae Thor	2.54	2	0	25	1	1	1	1	1	0	0	0	3	2	2	2	2	2	1	1	2
618 Klong Wang Chao	2.53	2	0	31	1	2	0	1	1	2	0	0	3	2	2	3	2	2	2	2	2
619 Klong Mae Raka	2.99	3	1	31	1	0	2	1	1	4	2	4	5	2	2	0	0	1	2	2	2
620 Klong Suan Mark	2.55	3	1	60	3	0	0	2	2	4	2	0	1	3	4	5	3	4	4	4	2
621 Lower Ping	2.94	9	14	121	15	4	30	40	15	32	38	2	0	2	5	3	2	7	10	8	3
Lower Sub-Basins	2.80	27	25	72	28	8	39	53	26	50	48	26	32	19	23	19	14	23	25	23	
Ping Basin	2.33	100	100	70	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

data source: ICRAF ONEP CMU calc Panya MOI Panya Panya Panya Panya Panya Panya CMU CMU CMU KUFF KUFF ONEP Panya Panya Panya CMU

** These data for Mae Chaem cannot be split into upper and lower sub-basins – overall data listed under lower Mae Chaem

Disproportionately large share

Disproportionately small share

- **Middle Sub-Basins** account for 31 percent of the area, but 51 percent of the people and 56 percent of the total income of the Ping River Basin. They also have more than half (51%) of the people living in urban areas, and 41 percent of the listed industries in the Ping Basin. These high shares are largely due to concentrations of these features in the Ping part 2 and Mae Kuang sub-basins. The grouping has a roughly area proportionate overall share of agriculture (29% of total, 30% of irrigated), upland ethnic minorities (31%), total forest cover (29%) and total forest lands (28%), but a somewhat lower share of protected conservation (23%) and watershed (22%) forest zones, runoff (26% annual, 25% dry season), and estimated soil erosion (22%).
- **Upper Sub-Basins** cover 42% of the area, but include only 21% of the people and 18 percent of the total income of the Ping River Basin. They account for only 9% of urban people and 6% of industry, but they have a share of agriculture (20% of total, 22% of irrigated) proportionate to their share of total population. Their disproportionately large shares are in upland ethnic minority populations (62%), total forest cover (52%), protected conservation (58%) and watershed (64%) forest zones, total state forest lands (49%), runoff (49% of annual, 52% of dry season), and estimated soil erosion (55%). Their spatially proportionate share of degraded forest (39%) is due to a concentration in the Ping part 1 sub-basin, whereas estimated soil erosion is disproportionately high in Mae Tuen and Mae Khan sub-basins.

These characterizations further confirm significant differences among lower, middle and upper sub-basins of the Ping River Basin, even though groups are based only on consideration of land area distributions among altitude zones. In selecting sub-basins to “represent” these conditions, however, it is also very important to note the significant variation among sub-basins that remains within each of these categories. While smaller sub-basins (in terms of area or people) may appear attractive for a short-term pilot project such as this one, it is the smaller sub-basins that appear to vary the most from overall characteristics of each of the groupings. And for many factors, this type of variation appears to be greatest in the lower and middle sub-basin groupings.

2. Current stakeholder and institutional context for sub-basin organizations

The project seeks to focus on pilot efforts to develop participatory approaches, methods and tools for building sub-basin management organizations. Results from these pilot efforts are intended to provide the basis for informing efforts in the remaining sub-basins of the Ping River Basin. Since requirements for engaging major stakeholders in participatory processes are likely to vary across different types of interests, groups and organizations, there should be a substantial priority placed on inclusion of as many of the major stakeholder groups in the Ping River Basin as possible (and practical) in the pilot projects.

Given the substantial differences in characteristics of sub-basins in the lower, middle and upper groupings, however, we do not necessarily need to believe that all stakeholders with a presence in the basin need to have an equal emphasis in each of the pilot sub-basins. On the other hand, it would not be prudent to focus on only one or two major elements in a particular sub-basin if important minority interests are also present. Thus, the emphasis needs to be on including an appropriate “mix” of stakeholders in pilot participatory management processes.

Patterns that emerge from the data in Figure 2-5 can provide a good starting point for identifying some important characteristics of the “footprint” left by major stakeholder groups associated with forces driving land use change in each sub-basin. There are also very important elements associated with human organization that underlie these patterns, which are particularly important for characterizing the full range of key stakeholders that should or could play key roles in pilot sub-basin management organizations.

Thus, this section provides a quite simplified discussion seeking to summarize the rationale through which various stakeholders are linked with trends of change associated with natural resource management in the Ping Basin and major driving forces underlying these trends [Thomas 2004b]. This information sets the stage for identification of further criteria and indicators in the following sections. Most of the tables in this section are derived from the author’s analysis of 2003 data extracted from a national village-level database (กชช.๒๓), which were provided by ONEP staff. These are reported by village leaders every two years on an administrative village basis. Especially in mountain areas, multiple local communities and settlements are grouped into single administrative villages, so that data represent an overall pattern that can mask diversity among individual settlements, which can vary by ethnicity and other factors. Nevertheless, this is perhaps the most extensive database available at the village level, and its overall coverage includes the entire country.

(a) Central government agencies

One of the major lines of argument used to justify river basin management organizations is the need to bring more coherence to government programs that are implemented by sector-oriented ministries and their line implementation units. However, despite at least thirty years of conscious efforts to adjust policies, organizational structures, regulations, programs and budgets to facilitate cross-ministerial coordination, relatively little progress is apparent at the central government level. Indeed, even cross-departmental coordination within individual ministries is a very daunting task, and a frequent source of problems for the ‘beneficiaries’ of complex or ‘integrated’ government programs. Twenty-five years ago, for example, this author worked in a unit of the Permanent Secretary’s office of the Ministry of Agriculture and Cooperatives responsible for coordinating complex and integrated projects in the northeast region of Thailand. Although sound in theory, this effort ultimately failed because of rivalries and lack of cooperation among departments in the ministry, and the lack of authority in the permanent secretary’s office to enforce compliance. There appears to have been very little change in these types of relationships since that time.

Higher level government leaders and technocrats have long recognized the importance and difficulty of achieving cross-agency coordination, as well as needs for decision-making that could more effectively address the diverse range of needs of communities in different parts of the country. Decentralization has been seen for quite some time as an important potential approach for accomplishing these objectives. Thus, major efforts were made by a series of government leaders and their administrations get ministries to place their ‘field’ implementation units under the authority of pro-

vincial governors, who would seek to oversee development of integrated provincial plans and coordinated implementation programs within their provinces. While various ministries did comply with these efforts, at least to some degree, there has also been substantial resistance. Indeed, various departments successfully argued the need for ‘regional’ offices (each with their own peculiar spatial definitions for regions) to provide technical support for operations under provincial authorities, or to manage natural resource units that include areas in multiple provinces (such as national forests, parks or water resources). Many of these units then found it necessary to establish numerous smaller units or stations to accomplish their tasks (such as watershed management).

Thus, of the ministries and departments with mandates relevant to issues that this project seeks to address, there are three basic types of overall structures:

- central agencies with no field units beyond the regional or provincial level (such as ONEP);
- central agencies with field units that have been decentralized by placing them under the direct authority of provincial governors (such as district agricultural extension or forestry offices);
- central agencies with field offices that remain under the direct control of central offices

Examples of units under direct central control that are very relevant to natural resource management in the Ping River Basin include forestry units in charge of national parks, wildlife sanctuaries and headwater conservation units, as well as units responsible for forest protection, forest fire control and community forestry. Irrigation and land development units, as well as military and border patrol police, also operate in this mode and have their own jurisdictional boundaries. Other types of government organizations, such as schools and academic institutions, for example, can also play roles that can be important at particular points in space and time, but these tend to occur on more of an ad hoc than a programmatic basis.

The resulting mosaic of government units in many areas of the Ping River Basin is often quite complex, and responsibility for ‘coordination’ among these units falls largely on the local administration hierarchy.

(b) Local administration

The local administration hierarchy centers on career official staff who have long managed government administration at provincial and district levels under the authority of the Ministry of Interior’s Department of Local Administration. Their authority and functions were extended further down to the *tambon* and village levels through establishment of the official positions of *kamnan* and village headmen.⁵ While the local administration apparatus is ubiquitous throughout all sub-basins, the presence or absence of units representing ‘line’ ministries can vary somewhat, as can their relative capacities and resources. Decentralization programs brought staff from various other central agencies into administrations at provincial and district levels. Agriculture, forestry, public health, education, community development, police and others have a history of representation at district levels, but reorganization during recent years is reducing their presence. Some, including forestry, have been abolished. A wider range of agencies is represented at the provincial level.

While staff at provincial and district levels are career staff who rotate at regular intervals among positions around the country, *kamnan* and village headmen are local residents who are nominated for appointment through local election processes. Although this local administration hierarchy of provincial governors, district officers, *kamnan* and village headmen is usually responsible for ‘coordinating’ government agency activities in their respective domains, such coordination usually has few means for assuring compliance or accountability.

(c) Forestry agencies and policies

An important example of units under direct central control that are very relevant to natural resource management in the Ping River Basin include forestry units in charge of national parks, wildlife sanctuaries and headwater conservation units, as well as units responsible for forest protection and forest fire control. These units, which are all under the jurisdiction of the Department of National

⁵ See Figure 1-19 for spatial depiction of provincial, district and *tambon* jurisdictional units

Parks, Wildlife and Plant Conservation (DNP) all play especially prominent roles in upper sub-basins, but may also be strategically important in other sub-basins. Community forestry units under the jurisdiction of the Royal Forest Department (RFD) can also be very important in areas that are inside boundaries of the national reserved forest lands, but outside protected areas under the jurisdiction of agencies under the DNP. While data on state forest zone areas in Figure 2-5 help indicate their likely distribution among sub-basins, spatial datasets with specific unit locations and jurisdictional domains would be even more useful.

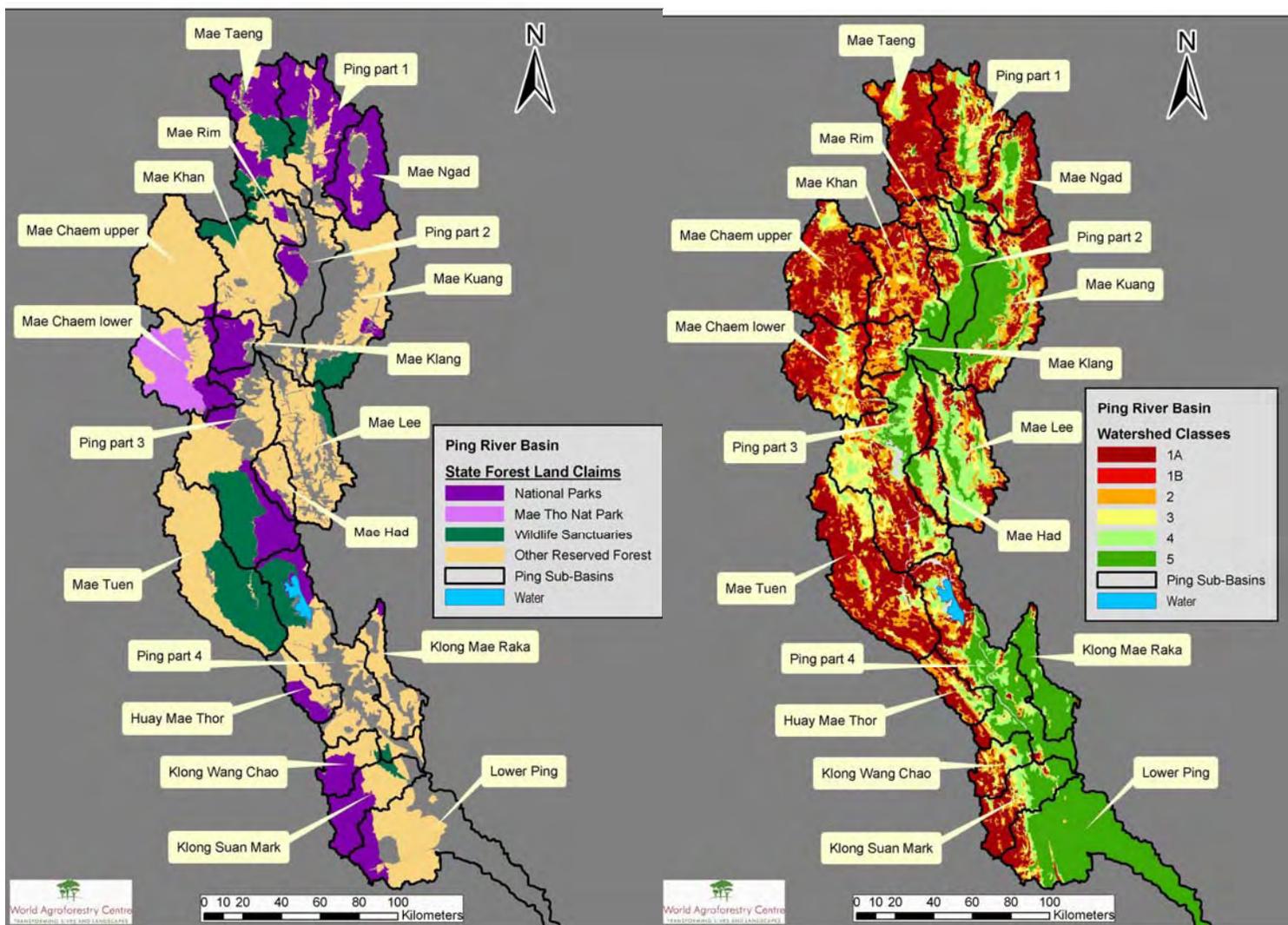
As discussed in the first part of this report, about 80 percent of the total land area of the Ping River Basin has been designated as state forest land, with various categories of forest land status legally restricting land use for other purposes. About 46 percent of the basin is designated as reserved forest land. Yet there are many villages and their associated agroecosystems that occupy portions of land in reserved forest zones, many of which (but not all) have been doing so since long before reserved forest status was established. Logging concessions in reserved forest land were a quite substantial source of local conflict between forestry interests and local communities in the past, but since logging concessions were revoked in 1989, logging conflicts have moved into the realm of entirely illegal activity. Similarly, there are various national parks and wildlife sanctuaries that cover about 34 percent of the Ping River Basin, for which there are very strong laws against other forms of land use. A relatively small but significant number of people are dependent on portions of these areas for their livelihoods.

Within the last 20 years, all land in the Ping River Basin has also been classified by its watershed characteristics, resulting in increasingly strong restrictions on land use according to watershed classification zones. These restrictions culminate in class 1 status wherein only undisturbed natural forest is viewed as an “acceptable” land use; about 37 percent of the Ping River Basin has been assigned class 1 status. As indicated in Figure 2-5, class 1 watershed lands are present in all sub-basins, but upper sub-basins account for nearly two-thirds of the total area. Moreover, all lands zoned as class 1 watershed that are not already within the boundaries of a national park or wildlife sanctuary have been quietly placed by forestry officials into the category of lands being “prepared” for protected conservation area status (*i.e.* national park or wildlife sanctuary). Local communities in these areas, which cover nearly 20 percent of the Basin’s total area, have virtually no input into, or usually even knowledge of, these processes prior to the formal announcement that their area has been declared a national park or wildlife sanctuary. Tensions and conflict in these areas are high.

Different government agencies are responsible for each of these types of forest land zones, and each considers themselves to be the guardian and manager, if not the “owner”, of land within that zone – any other land use conducted without specific written permission from higher level authorities in Bangkok is technically illegal, and those who engage in such practices are subject to expulsion and legal punishment at any time. While in reality, forestry officials often accept and work with many of the local communities in their area, this has long been dependent on the views of the individual officials involved, and thus subject to change as officials are reassigned or policies change in Bangkok. In areas where illegal logging still occurs, there are often influential people who finance, support, direct and benefit from it behind the scenes, whereas local villagers are often hired to do the work and take the blame if authorities catch them in the act.

In order to help assess how these factors affect stakeholder interests in different sub-basins, Figure 2-6 displays the spatial distribution of state forest land claims and watershed classification zones with sub-basin boundaries. Village reported data on their land holdings, including their legal and local status are presented in Figure 2-7. The relative proportion of agriculture in these village claimed areas is also given, and these data appear to be quite conservative in estimating the extent of non-agriculture land claims in upper sub-basins. As expected, the proportion of village claims located in state forest lands is far higher in upper sub-basins, where many are in protected or class 1 watershed areas. There is also a problem in a significant number (21 percent) of lower sub-basin villages, where it mostly involves reserved forest areas and many have SPK or STK certificates. Proportions of non-agricultural land are also higher in middle and upper sub-basins, while households renting additional agricultural land is highest in lower sub-basins.

Figure 2-6. Spatial Distribution of Forest Land Use Restriction Zones in the Ping Basin



Source: based on DNP spatial data obtained from Dr. Monthon of the Kasetsart University Faculty of Forestry

Figure 2-7. Village reported land holdings in Ping sub-basins, 2003

Sub-Basin	2003 Reporting			Claims	Agriculture share of land				Woodlots		Land legal status			Local land status		
	Villages reported	House-holds	Persons reported	holdings agr+fallow	percentage share of village land				planted tree zone		state forest	owner deed	SPK or STK	own only	own + rent	rent only
	unit: number	number	number	sq km	>90% % vill	75-90% % vill	50-74% % vill	<50% % vill	total % area	w/trees % area	% area	% area	% area	% hh	% hh	% hh
602 Ping part 1	90	12,595	46,651	505	30	30	13	26	8	7	44	18	9	74	15	11
603 Mae Ngad	100	11,276	38,717	591	27	49	16	8	6	4	56	34	1.9	68	12	19
604 Mae Taeng	52	6,155	26,725	228	23	35	23	19	3	2	37	19	4	78	6	15
608 Mae Khan	170	21,654	79,900	1,130	37	29	26	8	20	19	37	13	2.3	79	14	8
610 Mae Klang	41	6,234	24,389	478	22	29	34	15	6	5	17	11	0.5	80	13	7
612 Mae Chaem upper	51	4,323	25,122	1,373	16	10	29	45	16	13	96	0	5	95	3	2
613 Mae Chaem lower	76	7,190	32,443	588	13	38	36	12	10	7	76	3	4	91	6	2
615 Mae Teun	77	6,523	29,439	180	32	56	5	6	1	1	74	8	0.7	90	4	6
Upper Sub-Basins	657	75,950	303,386	5,074	28	35	22	15	12	10	60	11	4	80	11	9
605 Ping part 2	371	58,431	202,200	651	35	27	17	21	3	2	16	68	4	71	16	13
606 Mae Rim	56	7,161	25,869	347	13	30	30	27	7	6	24	23	1.2	64	18	18
607 Mae Kuang	494	71,676	249,368	1,482	23	36	20	21	6	4	21	56	7	75	14	10
609 Mae Lee	159	24,738	85,966	1,275	22	48	20	10	5	2	17	30	9	85	10	5
611 Ping part 3	233	35,623	126,305	1,134	33	35	17	14	4	1	14	37	6	82	12	6
614 Mae Had	31	4,470	14,787	199	29	39	10	23	2	2	5	14	27	87	8	5
Middle Sub-Basins	1,344	202,099	704,495	5,089	28	35	19	19	5	3	17	43	7	78	13	9
616 Ping part 4	181	24,420	92,251	1,944	15	33	31	20	5	4	27	29	9	76	16	8
617 Huay Mae Thor	12	1,664	6,703	324	58	33	8	-	0	-	1	41	1.6	84	11	6
618 Klong Wang Chao	17	1,823	7,749	298	41	18	29	12	18	17	36	0	13	70	25	5
619 Klong Mae Raka	45	6,068	23,848	746	16	40	27	18	4.2	3	24	30	10	75	17	8
620 Klong Suan Mark	50	7,758	30,305	406	46	28	16	10	0.3	0	32	13	12	66	26	8
621 Lower Ping	388	50,301	196,223	2,673	57	28	4	11	1	1	15	48	24	57	33	10
Lower Sub-Basins	693	92,034	357,079	6,390	42	30	14	14	3	3	21	35	15	64	26	9
Ping Basin	2,694	370,083	1,364,960	16,553	31	34	18	17	8	7	32	30	9	75	16	9

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พบบ.2ก) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

(d) Agriculture:

While agriculture uses an estimated 30 percent of the land area of the Ping River Basin and is, of course, present in all sub-basins, there is very substantial variation in its forms and relative extent. Major agricultural crops in the Ping River Basin and important lower-to-upper basin gradients in their distribution were presented in the first part of this report. Since this section looks at agriculturalists from a stakeholder point of view, emphasis here is on distribution of types of agriculture among Ping sub-basins, and the relative extent to which they are practiced by villages and households. Village reported farm land use data are summarized in Figure 2-8.

Paddy lands

A clearly major characteristic of lower sub-basins is the widespread distribution (95 percent of villages) of substantial paddy holdings (22 rai average field size), substantial portions of which have access to irrigation systems. In middle and upper sub-basins, paddy holdings are also reported in 80 to 90 percent of the villages, but average field size is only 5-6 rai. It is worth noting, however, that paddy lands are owned by only half of the households in lower and upper sub-basins, and by only one-third of households in middle sub-basins. This suggests considerable stratification among households with and without paddy lands in many communities in all sub-basins.

Intensification and commercialization of paddy-based agriculture, including increasing use of various types of agricultural chemicals, has been occurring for several decades in major valley areas. In lower sub-basins, well irrigated paddies are often planted to multiple crops of rice, whereas there is more of a trend toward non-rice crops planted after rice in the smaller holdings of middle sub-basins. In the more remote pockets of paddy land located in mountainous areas of middle and upper Ping sub-basins, single main season cropping of rice is the norm and fields often remain fallow for the rest of the year.

Commercial field crops.

For short-season field crops, maize and legumes are the most widely planted crops in the Ping Basin, and are reported by about 60 percent of villages in both upper and middle sub-basin groups, but only about 40 percent of villages in middle sub-basins. The percentage of households engaging in this production, however, is only about half of the number engaged in paddy, except in upper sub-basins where the ratio increases to 75 percent. Moreover, average field size in lower sub-basins is reported at four times the size of plantings in middle and upper sub-basins.

Production of long-season field crops is also widely reported in lower and upper sub-basins, but there is a great divergence in the types of activities involved. In lower sub-basins, more than half of the villages report plantings that are primarily sugarcane and cassava, with an average field size of about 30 rai. While long-season field crops are also reported in nearly half of upper sub-basin villages, upland rice is the main crop and average field size is only 7 rai. These fields are owned by about 20 percent of the households in both lower and upper sub-basins. Long-season field crops are much less common in middle sub-basins, where only 12 percent of the villages report fields of only 5 rai that are owned by only 4 percent of households – most of these are the relatively small proportion of households still cultivating upland rice.

Within sub-basins where it occurs, intensive commercial field crop production, which includes use of improved seed and agricultural chemicals, has been expanding largely in sloping lands above lowland paddy areas. And in many cases this is being conducted in association with contract farming arrangements between local growers and medium to large-scale agro-industrial firms.

Horticultural crops

Horticultural crop production is often strategically important because of the demands it places on irrigation water supplies. Locations vary, but are most common in paddy lands and nearby areas in all sub-basins, or in highland areas of middle and upper sub-basins where off-season or more temperate crops can be produced. There are three major types of horticultural enterprise observed:

Figure 2-8. Village reported agricultural farmland use in Ping sub-basins, 2003

Sub-Basin	2003 Reporting population			Paddy			Short field crop			Long field crop			Vegetables			Fruit orchards			Nursery-ornamental			Other Trees		
	Villages reported	House-holds	Persons reported	vill	hh	ave field area	vill	hh	ave field area	vill	hh	ave field area	vill	hh	ave field area	vill	hh	ave field area	vill	hh	ave field area	vill	hh	ave field area
	unit: number	number	number	% vill	% hh	rai/hh	% vill	% hh	rai/hh	% vill	% hh	rai/hh	% vill	% hh	rai/hh	% vill	% hh	rai/hh	% vill	% hh	rai/hh	% vill	% hh	rai/hh
602 Ping part 1	90	12,595	46,651	70	30	5	68	39	7	33	11	3	48	15	4	68	28	6	7	0.6	0.4	19	6	8
603 Mae Ngad	100	11,276	38,717	93	51	6	88	41	5	26	5	6	42	16	4	83	30	6	6	0.5	0.4	11	2	9
604 Mae Taeng	52	6,155	26,725	85	46	5	81	42	6	46	16	6	40	10	5	69	19	7	6	0.2	1.4	29	18	8
608 Mae Khan	170	21,654	79,900	96	49	5	55	17	3	35	13	4	51	18	4	81	34	4	6	1.4	0.6	5	1	6
610 Mae Klang	41	6,234	24,389	98	52	4	54	21	4	37	20	4	27	7	2	85	45	5	20	3.6	0.9	12	3	5
612 Mae Chaem upper	51	4,323	25,122	92	55	6	69	48	9	94	75	10	47	19	6	35	9	5	-	-	-	12	2	3
613 Mae Chaem lower	76	7,190	32,443	92	60	5	78	47	8	61	32	7	49	21	10	29	13	8	3	0.3	0.2	4	1	3
615 Mae Teun	77	6,523	29,439	81	42	7	25	14	5	65	39	9	44	25	4	10	1	4	1	0	0.1	6	1	9
Upper Sub-Basins	657	75,950	303,386	89	47	5	64	31	6	45	20	7	45	17	5	61	26	5	6	0.9	0.6	11	3	7
605 Ping part 2	371	58,431	202,200	67	18	6	43	9	5	5	1	3	44	8	3	79	27	4	13	1.4	0.6	3	1	4
606 Mae Rim	56	7,161	25,869	86	34	8	75	36	5	13	3	10	29	6	3	63	18	8	7	0.3	0.6	23	7	9
607 Mae Kuang	494	71,676	249,368	89	39	8	26	6	3	11	2	4	31	6	3	65	20	4	9	0.6	0.5	6	2	9
609 Mae Lee	159	24,738	85,966	75	43	6	73	43	8	24	9	5	33	8	4	80	51	9	2	0.7	0.5	9	9	3
611 Ping part 3	233	35,623	126,305	82	38	5	37	12	5	14	7	3	49	15	4	92	61	6	4	0.6	0.5	4	1	5
614 Mae Had	31	4,470	14,787	90	37	7	94	62	7	45	19	10	29	17	3	90	58	5	3	4.6	0.3	16	8	5
Middle Sub-Basins	1,344	202,099	704,495	80	33	6	42	15	6	12	4	5	38	8	3	76	34	6	8	0.9	0.5	6	2	6
616 Ping part 4	181	24,420	92,251	92	37	12	74	27	22	40	11	19	13	2	3	61	13	8	4	0.1	0.6	24	3	5
617 Huay Mae Thor	12	1,664	6,703	92	16	25	75	26	48	25	13	12	25	10	1	75	8	8	-	-	-	33	6	7
618 Klong Wang Chao	17	1,823	7,749	76	18	15	100	78	51	59	18	8	12	3	1	82	14	16	-	-	-	24	1	11
619 Klong Mae Raka	45	6,068	23,848	100	86	23	89	41	47	42	6	21	4	0.1	3	22	1	12	-	-	-	11	1	17
620 Lower Suan Mark	50	7,758	30,305	92	55	15	86	46	21	64	10	25	12	0.2	2	70	6	23	-	-	-	42	1	14
621 Lower Ping	388	50,301	196,223	97	54	27	45	16	16	64	25	35	16	2	3	47	5	14	17	5.2	0.5	28	2	18
Lower Sub-Basins	693	92,034	357,079	95	51	22	60	24	25	56	19	31	14	2	3	52	7	12	11	2.9	0.5	27	2	13
Ping Basin	2,694	370,083	1,364,960	86	40	11	52	21	12	32	11	17	34	8	4	66	26	6	8	1.4	0.5	13	3	7

Source: author's analysis using (1) Ping Basin Village-level Basic Data (๓๗๕.2๖) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

- For vegetable crops, a gradient of increasing production (and crop diversity) from lower to upper sub-basins is quite clear, but production in most lower sub-basins (except for Huay Mae Thor) is much less than the others. Except for Mae Chaem, where some highland villages have large households, average household vegetable field size is generally less than 5 rai.
- Fruit tree orchards are substantially more widespread among households in upper (26 percent), and especially middle (34 percent) sub-basins where the longan industry is centered. Average field size, however, is largest (12 rai) in lower sub-basins.
- Only a small minority of villages and households produce ornamentals in small plantings. While overall proportions of villages (11 percent) and households (3 percent) are highest in lower sub-basins, production appears to be concentrated in some sub-basins in all groupings.

Livestock husbandry

Livestock are another important part of agricultural production. While many households raise a few livestock for their own use, production of livestock for sale has increased along with commercialization of other aspects of agricultural production. Owners of livestock being raised for sale have their own set of natural resource needs and potential impacts. Thus, Figure 2-9 displays data on major types of livestock ownership in Ping sub-basins.

- Meat Cattle. While the distribution of villages where meat cattle are produced shows an overall increase along a lower-to-upper basin gradient, this is largely because of the influence of data from the lower Ping sub-basin, where production is highly concentrated in a few households with relatively large average herd size – it is considerably more distributed in other lower sub-basins. The most widespread ownership is in upper sub-basins, where much of the grazing is in forest areas. Indeed, relatively more distributed ownership of smaller herds is generally more common in middle and upper sub-basins, except for Mae Taeng, Mae Rim and Mae Had. But the highest level of participation is in the lower sub-basin of Klong Mae Raka, which is the only sub-basin where more than 5 percent of households report meat cattle ownership.
- Dairy Cattle. Distribution of dairy cattle ownership is far more concentrated, in terms of both location (middle sub-basins or those with relative good access to the Chiang Mai Valley), villages (0.2 percent overall), and households (less than 1 percent even in high producing areas).
- Buffalo. Ownership of buffaloes for sale follows a distributional pattern somewhat similar to that of meat cattle, but with lower levels of participation and herd size across the board. The only exceptions are the Ping part 1, Ping part 4 and Klong Mae Raka sub-basins, where buffalo herd size is greater than that of meat cattle, but even in these sub-basins buffalo ownership is far more concentrated than for meat cattle.
- Pigs. Production of pigs for sale is quite distributed, with 40 percent of all villages reporting its presence. Ownership is concentrated, however, in less than 10 percent of households, and average herd size varies quite widely among sub-basins in all three groups. Environmental impacts (externalities) of pig production can be substantial.
- Poultry. Participation in production of poultry for sale at both village and household levels varies widely among sub-basins in all three groups. Flock size is even more variable, with large average flock size presumably reflecting the presence of some substantial commercial chicken farms, which are usually linked with a medium-to-large scale agro-industrial firm.
- Fish Culture. Not surprisingly, there is a gradient of decreasing participation at both village and household levels from lower to upper sub-basins. While this is again an enterprise that involves a quite small proportion of villages, and a very small percent of households, its viability is closely linked with the supply and quality of available water resources.

Thus, except for dairy cattle and fish culture, there is a general overall tendency toward more distributed livestock ownership and smaller herd size in upper sub-basins, and toward largest herd sizes in lower sub-basins.

Figure 2-9. Village reported livestock husbandry in Ping sub-basins, 2003

Sub-Basin	2003 Reporting population			Livestock			Meat Cattle			Dairy Cattle			Buffalo			Pigs			Poultry			Fish culture		
	Villages reported	House-holds	Persons reported	raise to sell	pasture		vill	hh	head	vill	hh	head	vill	hh	head	vill	hh	head	vill	hh	head	vill	hh	ave area
	unit: number	number	number	% vill	%vill	rai/vill	% vill	% hh	hd/hh	% vill	% hh	hd/hh	% vill	% hh	hd/hh	% vill	% hh	hd/hh	% vill	% hh	hd/hh	% vill	% hh	rai/hh
602 Ping part 1	90	12,595	46,651	61	8	57	43	0.9	5	7	0.1	20	7	0.3	9	34	6	14	20	3	186	8	0.2	0.3
603 Mae Ngad	100	11,276	38,717	74	7	503	53	1.5	5	2	0.0	7	15	1	4	59	8	8	24	4	1,018	12	0.5	0.3
604 Mae Taeng	52	6,155	26,725	71	6	373	54	1.1	24	-	-	-	29	6	14	46	21	9	23	15	22	6	0.2	0.4
608 Mae Khan	170	21,654	79,900	76	4	336	59	2.4	5	9	0.4	12	22	3	5	55	11	6	31	17	83	2	0.1	0.1
610 Mae Klang	41	6,234	24,389	76	20	69	59	1.8	6	-	-	-	22	1	5	44	3	10	27	1	228	2	0.2	0.0
612 Mae Chaem upper	51	4,323	25,122	92	22	687	82	3.8	9	-	-	-	71	11	8	39	15	6	4	2	37	2	0.0	0.5
613 Mae Chaem lower	76	7,190	32,443	63	20	412	63	2.5	7	-	-	-	30	3	5	36	14	3	5	1	15	3	0.1	0.1
615 Mae Teun	77	6,523	29,439	74	5	158	64	4.0	7	-	-	-	27	5	5	44	20	4	5	1	16	-	-	-
Upper Sub-Basins	657	75,950	303,386	73	9	360	58	2.2	7	4	0.1	13	25	2.8	7	47	11	7	19	7	153	4	0.2	0.2
605 Ping part 2	371	58,431	202,200	68	2	44	40	0.6	4	8	0.2	11	5	0.1	6	33	2	16	42	7	183	9	0.5	0.2
606 Mae Rim	56	7,161	25,869	70	4	66	52	1.2	10	11	0.4	6	21	1.5	9	48	4	3	29	11	98	11	0.5	0.4
607 Mae Kuang	494	71,676	249,368	74	8	248	56	1.6	7	16	0.8	9	20	0.7	5	38	2	84	34	7	114	12	0.7	0.4
609 Mae Lee	159	24,738	85,966	50	1	19	30	0.8	6	5	0.1	34	8	0.3	5	34	5	7	9	2	232	1	0.1	0.1
611 Ping part 3	233	35,623	126,305	67	9	198	47	1.4	8	2	0.1	6	8	0.8	6	44	5	14	30	6	101	9	0.7	0.1
614 Mae Had	31	4,470	14,787	71	10	2,133	45	1.3	13	-	-	-	6	0.1	5	58	11	2	29	6	28	10	0.3	0.1
Middle Sub-Basins	1,344	202,099	704,495	68	6	272	47	1.2	7	9	0.4	10	12	0.5	6	38	3	28	32	6	134	9	0.5	0.3
616 Ping part 4	181	24,420	92,251	82	30	1,271	72	3.9	13	1	0.0	4	11	0.2	28	52	4	26	34	6	221	18	2.0	0.1
617 Huay Mae Thor	12	1,664	6,703	83	25	333	83	4.2	17	-	-	-	33	2.0	6	67	9	6	25	7	13	8	0.1	0.5
618 Klong Wang Chao	17	1,823	7,749	76	12	110	53	0.8	7	-	-	-	18	0.2	4	76	8	6	6	1	50	12	1.0	0.0
619 Klong Mae Raka	45	6,068	23,848	93	29	2,122	80	6.8	12	-	-	-	47	1.2	35	69	4	22	36	12	35	4	0.2	0.3
620 Klong Suan Mark	50	7,758	30,305	56	8	208	42	0.5	13	-	-	-	10	0.9	5	40	2	9	14	2	515	32	3.3	0.1
621 Lower Ping	388	50,301	196,223	44	3	246	23	0.2	22	1	0.0	9	8	0.2	17	26	1	12	21	3	339	16	1.8	0.6
Lower Sub-Basins	693	92,034	357,079	60	13	1,172	43	1.7	14	1	0.0	5	12	0.4	19	39	3	17	24	4	233	17	1.8	0.3
Ping Basin	2,694	370,083	1,364,960	67	8	643	49	1.5	9	6	0.2	10	15	1.0	8	40	5	16	27	6	157	10	0.8	0.3

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พชข.2ก) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Mountain Agricultural Systems

There are some particular issues and associated stakeholder groups that are specifically related to three types of agricultural systems in midland and highland zones that also deserve mention here:

Forest fallow. Especially in upper sub-basins with extensive lands in the midland zone, many ethnic minority villages have long conducted rotational forest fallow shifting cultivation of upland rice (and a mix of associated minor subsistence crops) to supplement their small areas of paddy, expansion of which is limited by terrain characteristics. As traditional forest fallow rotation cycles were usually 10 or more years in length, and fallow fields are mixed into a landscape that also includes patches of permanent forest managed for additional subsistence products, the overall amount of land required for these systems seems very extensive to lowlanders. The large difference in the nature of these practices compared to lowland systems, as well as the ethnic differences that are usually characteristic of those who employ them, have been associated with widespread lack of understanding, and a virtually total lack of acceptance of the “legitimacy” of these practices by government and much of lowland society. As a result, state forest land zones were designated over most of these areas without consideration of the existence of these systems. Thus, most are now categorized as “illegal encroachers” on state forest lands, regardless of their history in the area. Moreover, forestry and conservation interests interpret patches of permanent and regenerating forest, along with the use of fire to clear patches as they are prepared for crop cultivation, as indicators of degraded or deteriorated forest. The still ongoing expansion of national parks and wildlife sanctuaries aims to place most all of these areas under protected conservation forest status, and thereby force an end to such practices. Not surprisingly, tension, conflict, and resistance are increasing. Many villagers are being forced to reduce their forest fallow cycle length, and in some areas they have yielded to government pressure to convert to fixed field cultivation. This conversion has been associated with introduction of agricultural chemicals to replace the ecological functions formerly provided by forest fallow, and has thus also been accompanied by the commercialization of agriculture in these areas [Thomas 2004b]. Linkages with agro-industrial firms are growing, including contract farming practices.

“Miang” forest gardens. A somewhat parallel set of circumstances involves areas of sub-basins in the Ping River Basin where “miang” tea production has been a traditional practice. Ecological requirements for these production systems result in their clustering near the midland-to-highland transition zone. Practices involve interplanting of the *camellia* tree species into natural hill evergreen forest [Preechapanya 2001]. This results in the failure of many people not familiar with the systems to even realize they exist, and in very poor records and documentation about them. This “invisibility” has also resulted in their inclusion in reserved and protected forest land zones, which also places them in the category of illegal forest encroachers. Despite decreasing demand for “miang” associated with generational change, many of these systems still appear viable as new product forms and markets are found, and in some areas additional economic trees are mixed into their complex structures that often continue to mimic natural forest [Thomas 2004b].

Highland horticulture. Although highland horticulture has already been incorporated into previous discussions of diversity in agriculture, there are some special concerns of this stakeholder group that need to be mentioned here. Highland horticulture is most extensive in upper sub-basins, but is also present to some degree in middle and lower sub-basins that have minor portions of their area within the highland zone. These zones include areas where opium production was once a major activity, making them a central target for successive waves of opium crop substitution projects during the last 40 years. These projects and associated development programs have brought roads and a range of government services to many of these formerly very remote areas, and have successfully facilitated conversion of agricultural practices from pioneer shifting cultivation systems that included opium, into settled areas where intensive commercial production of horticultural products has expanded dramatically. Production has largely focused on temperate and sub-tropical zone crops that have an ecological comparative advantage in highland zones, and which have little or no direct competition in lowland zones. Both annual and tree crop production have been adopted (and adapted), with emphasis varying in different areas. And, as areas have become more integrated into mainstream economic systems, off-season production of crops produced in the lowlands is also becoming more common. Many of the ethnic minority

communities involved – most notably the Hmong – have proved to be very capable producers and entrepreneurs, and the profitability of their agricultural systems is often equal to or greater than those found in lowland zones of upper sub-basins [Thomas 2002]. Ethnic Thai producers are now also very active in various areas, with operations varying from small to quite large (by northern Thai standards) scale.

Probably not surprisingly, these highland systems have undergone very substantial and quite rapid expansion. This has made them a focus of much concern among forestry officials and lowland stakeholders who believe they are destroying hill evergreen forest in critical watershed headwater zones, and thus threatening the longer term sustainability of agricultural and natural resource systems upon which all those in the Ping River Basin depend. These concerns are accentuated by the use of substantial levels of agricultural chemicals and often sprinkler irrigation systems in intensive highland commercial systems, raising further downstream worry about chemical pollution of water resources and reduced dry season stream flow. Thus, even though those engaged in these types of highland agricultural practices often account for only a quite small percent of the area and people of a given sub-basin, their profile in natural resource management-related concerns is usually disproportionately large. During the initial field visits of the project team of ONEP staff and consultants, concerns over this type of agriculture were a very prominent feature of views expressed throughout the Ping River Basin.

Agricultural Production Constraints

Given the importance of agricultural production and the large number of stakeholders for whom it is a central livelihood concern, we also need to look at the key production constraints perceived by these stakeholders. Thus, Figure 2-10 displays data on agricultural constraints and locally perceived soil problems, while Figure 2-11 focuses more specifically on agricultural water use constraints and the distribution of dry season irrigated agriculture.

Crop profitability and water shortages are clearly perceived as major constraints for agriculture at many locations across all sub-basins. Lack of knowledge is also seen as an important constraint, and it is no doubt safe to assume that the most valuable knowledge would relate to more profitable crop alternatives, and better ways to access and manage water, especially during the dry season.

Figure 2-10. Village reported agriculture problems in Ping sub-basins, 2003

Sub-Basin	2003 Reporting population			Main agriculture constraints					Reported soil problems						chem fertilizer use
	Villages reported	House-holds	Persons reported	flood areas	water short	crop profits	info & knowl	insuffic labor	shallow soil	sand & gravel	eroded soil	acid soil	saline soil	low fertility	
	unit: number	number	number	% vill	% vill	% vill	% vill	% vill	% vill	% vill	% vill	% vill	% vill	% vill	
602 Ping part 1	90	12,595	46,651	13	41	50	47	28	20	19	23	22	18	23	68
603 Mae Ngad	100	11,276	38,717	4	62	26	14	12	14	20	22	17	7	24	65
604 Mae Taeng	52	6,155	26,725	8	46	35	37	15	13	21	13	8	8	19	43
608 Mae Khan	170	21,654	79,900	8	55	41	24	11	12	38	22	11	5	11	67
610 Mae Klang	41	6,234	24,389	12	51	49	39	5	22	32	24	17	15	32	43
612 Mae Chaem upper	51	4,323	25,122	2	73	45	27	20	10	37	41	14	4	31	84
613 Mae Chaem lower	76	7,190	32,443	11	67	41	33	11	20	18	54	7	5	47	78
615 Mae Teun	77	6,523	29,439	6	42	45	30	13	25	30	39	14	13	21	87
Upper Sub-Basins	657	75,950	303,386	8	54	41	29	14	16	28	29	14	9	23	66
605 Ping part 2	371	58,431	202,200	13	29	37	24	20	9	11	11	9	7	13	75
606 Mae Rim	56	7,161	25,869	13	52	55	43	38	20	27	23	16	16	20	59
607 Mae Kuang	494	71,676	249,368	14	42	42	30	24	14	24	16	12	10	17	67
609 Mae Lee	159	24,738	85,966	11	56	62	52	18	23	36	33	19	11	28	77
611 Ping part 3	233	35,623	126,305	24	45	52	33	18	19	32	21	18	14	20	66
614 Mae Had	31	4,470	14,787	19	68	68	65	19	19	52	32	19	23	23	82
Middle Sub-Basins	1,344	202,099	704,495	15	42	46	33	22	15	24	18	13	11	18	70
616 Ping part 4	181	24,420	92,251	20	52	48	28	30	29	38	25	15	15	23	72
617 Huay Mae Thor	12	1,664	6,703	0	58	42	17	8	17	17	33	-	-	17	71
618 Klong Wang Chao	17	1,823	7,749	12	76	24	41	18	18	29	59	6	6	18	95
619 Klong Mae Raka	45	6,068	23,848	38	78	49	44	29	36	51	36	24	29	47	74
620 Klong Suan Mark	50	7,758	30,305	14	34	36	18	8	32	24	26	12	12	20	82
621 Lower Ping	388	50,301	196,223	24	45	40	30	23	21	24	27	17	15	34	90
Lower Sub-Basins	693	92,034	357,079	23	49	42	30	24	25	29	28	16	15	30	84
Ping Basin	2,694	370,083	1,364,960	15	47	43	31	20	18	26	23	14	11	22	72.5

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พบบ.2๖) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Figure 2-11. Village reported agricultural water use constraints in Ping sub-basins

Sub-Basin	Agriculture constraint		Shortage all year			Dry season shortage			Dry season irrigated agriculture						shallow wells			Deep wells			
	flood areas	water shortage	vill	hh	area	using main water source			short field cp	Surface water irrigation			Ground water irrigation			exist in village	# per 100 hh	still can be used	exist in village	# per 100 hh	still can be used
	% vill	%vill	% vill	% hh	rai/hh	%vill	%vill	%vill	%hh	% vill	% hh	rai/hh	% vill	% hh	rai/hh	% vill	number	%wells	% vill	number	%wells
602 Ping part 1	13	42	19	14	6	17	-	13	92	51	25	3	3	0.7	2	90	56	95	67	3	88
603 Mae Ngad	4	62	32	21	8	19	-	21	98	53	28	4	-	-	-	94	64	90	83	6	74
604 Mae Taeng	8	46	27	17	6	15	-	31	98	35	14	4	-	-	-	92	30	90	56	1	78
608 Mae Khan	8	55	15	7	4	19	1.2	21	96	47	20	4	4	0.7	2	90	37	91	75	13	96
610 Mae Klang	12	51	22	13	7	29	-	34	99	46	14	4	-	-	-	76	5	93	54	6	98
612 Mae Chaem upper	2	73	22	15	9	20	-	47	100	27	8	10	-	-	-	63	5	87	12	0	53
613 Mae Chaem lower	11	67	7	5	7	20	-	54	85	29	10	5	-	-	-	72	12	95	43	2	84
615 Mae Teun	6	42	5	4	6	17	1.3	66	91	18	6	6	1	0.2	3	69	7	94	22	1	90
Upper Sub-Basins	8	55	18	12	7	19	0.5	33	95	40	18	4	2	0.3	2	83	34	92	57	6	92
605 Ping part 2	13	29	13	6	4	12	1.9	7	80	37	9	4	9	1.7	2	93	41	83	91	34	96
606 Mae Rim	13	52	43	18	6	13	1.8	25	95	48	21	5	4	0.6	3	98	41	87	73	8	93
607 Mae Kuang	14	43	17	7	6	5	0.4	26	79	20	5	3	4	0.7	3	95	38	87	90	21	97
609 Mae Lee	11	56	28	15	8	6	1.9	36	91	14	3	5	4	1.3	2	83	15	84	87	13	92
611 Ping part 3	24	45	30	19	8	7	1.7	18	82	18	6	6	10	1.2	4	79	13	66	91	25	95
614 Mae Had	19	68	58	43	8	-	10	23	96	10	3	3	19	9	12	77	12	85	84	7	65
Middle Sub-Basins	15	42	22	11	7	8	1.5	20	83	25	7	4	7	1.3	4	90	31	84	89	24	95
616 Ping part 4	20	52	25	13	19	4	8	29	92	12	2	11	15	3.2	9	81	14	92	79	16	95
617 Huay Mae Thor	-	58	-	-	-	17	-	50	100	17	2	2	-	-	-	83	14	89	67	2	86
618 Klong Wang Chao	12	76	29	28	32	-	6	59	98	6	5	13	6	0.4	3	94	23	87	65	2	76
619 Klong Mae Raka	38	78	58	43	17	7	-	33	92	18	1	4	2	0.1	1	98	17	94	93	7	90
620 Klong Suan Mark	14	34	38	25	21	14	2	14	99	38	15	12	18	5	14	92	44	92	88	13	94
621 Lower Ping	24	45	24	15	28	6	2	36	82	14	3	8	4	0.7	10	81	22	92	90	15	86
Lower Sub-Basins	23	49	27	17	24	6	3.5	33	91	15	3	10	8	1.7	10	83	21	92	86	14	90
Ping Basin	15	47	22	13	13	10	1.7	27	89	26	8	5	6	1.2	6	87	29	87	81	18	94

Source: author's analysis using (1) Ping Basin Village-level Basic Data (1976-20) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Insufficient labor is the next most important overall constraint on agriculture, and it follows a general gradient of decreasing general importance along a lower to upper sub-basin transect, although there is very considerable variation among individual sub-basins in each grouping. A similar overall gradient with substantial variability is seen regarding problems related to areas subject to flooding, but this problem is concentrated in a much smaller proportion of villages. This is no doubt a function of their relative position in the watershed landscape.

In terms of soil-related constraints to agriculture, upper sub-basins report most concern with coarse textured and eroded soils, followed by low soil fertility and shallow soils. In Middle sub-basins, problems with coarse-textured soils are most common, with shallow, eroded and low fertility soils basically in a tie for second place. In lower sub-basins, low fertility, coarse textured and eroded soils are most important, followed by shallow soils. Salinity is seen as a less widespread problem, but it is reported in some sub-basins with an overall frequency that follows a gradient of decreasing importance from lower to upper sub-basin groupings. Acidity appears to be a problem that is localized in a fairly small minority of villages in most sub-basins. Use of chemical fertilizers is widespread in all sub-basins, and is especially extensive in lower sub-basins.

In terms of dry season agriculture, between 80 to 100 percent of villages in all sub-basins report that field crops are the most widely planted type of crop. There are, however, some clear differences in patterns of water use among the three groupings of sub-basins. In lower sub-basins the ratio of villages relying mainly on surface water to those relying on groundwater is less than 2:1, and use of both shallow and deep wells is widespread. In middle sub-basins, the ratio of villages relying mainly on surface or groundwater jumps to about 3.6:1, but at the same time both shallow and deep wells are much more common. In upper sub-basins, however, the ratio of villages relying mainly on surface or groundwater shoots up to 20:1, and while shallow wells remain common, only only a very small minority uses deep wells. Thus, it is not surprising that villages in upper sub-basins reporting dry season shortages in water for agriculture almost all depend mainly on surface water resources, whereas the frequency of villages depending mainly on groundwater who are experiencing dry season shortages is highest in lower sub-basins, and lowest in upper sub-basins.

Villages reporting year-round shortages in agricultural water average about 20 percent, and involve between 10 to 20 percent of all households, in all three sub-basin groupings. Field size in water short areas, however, is more than three times larger in lower sub-basins than in middle or upper sub-basins, which corresponds to overall differences in agricultural holding field size.

(e) Private Business

With the rapid growth and restructuring that has occurred in the Thai economy, the role of the private business sector has expanded accordingly. Most all villages are now at least partially integrated into the market economy, through commercialization of agricultural production, local commerce and/or cottage industry, wage employment in industrial, trade and/or service sectors, wage employment by government organizations or projects, or other types of activity. Economic integration was especially rapid during the "boom years" of the Thai economy, when particularly rapid transformations of livelihoods and landscapes occurred in the Ping River Basin. There is now increasing recognition that most farmers are small business operators, and expanding operations of more successful farmers are becoming sources of employment and components of the agro-industrial system. Contract farming schemes are being operated by medium to very large scale agro-industrial companies, and merchants and agricultural processing industries provide important sources of information, technology and incentives for commercial production.

Tourism and recreation businesses of small to quite large scale are also important in a growing number of locations, as well as expanding cottage industry based on textiles, specialty foods, and handicrafts. In a few areas there are agricultural processing industries, or even industrial estates providing employment in electronics assembly and other non-agriculture sectors. Even local groups and communities are now organizing and operating private enterprise, including those facilitated by programs such as OTOP. In addition to the land they occupy, many of these operations are now competing for labor and water resources, and are clearly associated with natural resource and environment issues, including many linked with public health.

Yet despite its important and growing role in shaping livelihoods and landscapes in the Ping Basin, private business (at least beyond the farm enterprise level) usually remains relatively detached from efforts, organizations and institutions seeking to improve management of natural resources and the environment. Indeed, business is often portrayed by some as having sinister motives, and even as the 'enemy' causing most natural resource and environmental problems in sub-basins.

In order to help assess the distribution of impacts on local household livelihoods, and thus the relative importance of associated stakeholder groups in Ping sub-basins, Figure 2-12 displays the types of work within villages and local sub-districts (tambons) reported by village leaders.

Figure 2-12. Village reported work within local tambon, 2003

Sub-Basin	2003 Reporting population			Types of local work by household members					
	Villages reported	House-holds	Persons reported	hh agric enterprise	cottage industry	wage labor	business worker	factory worker	tourism work
	unit: number	number	number	%hh	%hh	%hh	%hh	%hh	%hh
602 Ping part 1	90	12,595	46,651	76	22	42	4	2	7
603 Mae Ngad	100	11,276	38,717	86	2	23	0.3	0.1	1
604 Mae Taeng	52	6,155	26,725	82	2	36	2	1	5
608 Mae Khan	170	21,654	79,900	82	9	37	6	2	6
610 Mae Klang	41	6,234	24,389	78	6	46	4	2	9
612 Mae Chaem upper	51	4,323	25,122	91	7	13	0.05	-	2
613 Mae Chaem lower	76	7,190	32,443	86	6	15	1	0.01	4
615 Mae Teun	77	6,523	29,439	80	2	21	-	-	-
Upper Sub-Basins	657	75,950	303,386	82	8	32	3	1	5
605 Ping part 2	371	58,431	202,200	51	4	48	14	4	3
606 Mae Rim	56	7,161	25,869	68	4	49	8	4	7
607 Mae Kuang	494	71,676	249,368	58	8	46	12	6	2
609 Mae Lee	159	24,738	85,966	79	5	36	1	1	1
611 Ping part 3	233	35,623	126,305	82	14	45	4	2	1
614 Mae Had	31	4,470	14,787	89	1	46	4	0.2	2
Middle Sub-Basins	1,344	202,099	704,495	64	7	45	10	4	2
616 Ping part 4	181	24,420	92,251	62	5	37	4	2	1
617 Huay Mae Thor	12	1,664	6,703	60	0.1	33	-	0.3	1
618 Klong Wang Chao	17	1,823	7,749	90	3	23	0.1	-	2
619 Klong Mae Raka	45	6,068	23,848	89	3	24	1	1	0.03
620 Klong Suan Mark	50	7,758	30,305	71	1	31	-	1	1
621 Lower Ping	388	50,301	196,223	74	2	29	4	3	0.2
Lower Sub-Basins	693	92,034	357,079	71	3	31	3	2	0.3
Ping Basin	2,694	370,083	1,364,960	69	6	39	7	3	2

Source: author's analysis using (1) Ping Basin Village-level Basic Data (กข๓๒๓) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources & Environment.

Household agricultural enterprise and wage labor are clearly the two most important sources of employment in all sub-basins. As would be expected, in the more densely populated and urbanized middle sub-basins, agricultural work is reported by a significantly lower percentage of households.

Local industry

While much of the industry in the Ping River Basin is associated with urban centers, there are also a few industrial estates, as well as industries located in or near smaller district towns. Some industries such as agricultural processors, wood products, and handicrafts have direct linkages with forestry and agriculture sectors. Others provide employment that affects wage labor rates and employment alternatives to land-based enterprise. There is also growing concern about impacts of industrial activity on consumption and pollution of water resources, as well as air pollution and waste disposal. Where present, they should be considered an important stakeholder. Work in local

factories is more common in middle sub-basins, and especially in sub-basins where many of the factories are located. The frequency of cottage industry work appears to vary greatly in some sub-basins, but is generally higher in upper and middle sub-basins.

Another relevant dimension of industrial activity that is frequently obscured by industry data such as that presented in Figures 2-5 and 2-12, is the outreach operations and/or broker functions that allow agro-industrial firms to engage in operations such as contract farming, even in relatively remote portions of the Ping River Basin.

Tourism

Tourism is an important and still growing and developing part of the economy in many sub-basins of the Ping River Basin, and data in Figure 2-5 does not yet capture information about how tourism activities are distributed among sub-basins. Data in Figure 2-12, however, indicate that local work in tourism is more common in upper sub-basins, and quite rare in lower sub-basins. Among middle sub-basins, tourism is relatively more important in Mae Rim, but given the relatively large populations of Ping part 2 and Mae Kuang, their percentages imply fairly substantial absolute numbers of households.

While tourism tends to be discussed as though it is a single set of activities, the tourism market has been moving toward increasing differentiation among a substantial range of types. Each type tends to have its own demands from and impacts on natural resources and the environment. Trade-offs among types are also increasingly common, wherein expansion of one type of tourism can undermine potential for the viability or expansion of other types. Both trade-offs and complementarities can appear among esthetics important for tourism and local residents. Yet, maintenance of esthetic components of rural landscapes and urban environments has a low priority, and there is no legal basis for damages incurred by activities or investments dependent on them. In any event, key stakeholders related to the operation and development of the various types of tourism services present in or envisioned in a sub-basin should definitely be included in pilot watershed management activities.

Local shops and services

Presence of local village shops offering goods and services for sale can be a useful indicator of the degree of economic integration that is occurring in local areas. Other useful indicators include connectivity with district market towns via roads and modes of transportation, as well as wider connectivity through telecommunications and internet access. Thus, Figure 2-13 presents data on these types of indicators reported by village leaders in Ping sub-basins.

The extent of integration of rural villages into the market economy is indicated by the reporting of an overall level of more than 50 shops per 1,000 households, and their wide distribution throughout all sub-basins. Most of these operations are, of course, very small and specialize in food or general basic necessities of day-to-day life, and are not the only source of income for the households who own them. Shops selling agricultural production inputs, selling and repairing agricultural tools, or selling electrical or electronic equipment are a very small sub-set of this number, but are still quite widely distributed. Shops selling petrol or selling and repairing vehicles have a more substantial presence in all sub-basins.

In terms of transportation connectivity with district market towns, upper sub-basins are generally handicapped by greater distances, much greater travel times, and less all-season access than their counterparts in most middle and lower sub-basins. Motorcycle ownership is reported as very extensive (90 to 100 percent) in terms of villages, but there is wide variation (30 to 85 percent) in the percentage of households in sub-basins who own motorcycles. A similar pattern is found with pickup trucks, with almost all villages reporting their presence, but actual ownership limited to 8 to 36 percent of households.

Electricity is available in more than 80 percent of the villages in all but four of the sub-basins, and those are all in the upper sub-basin group. And of the six sub-basins reporting that electricity reaches less than 90 percent of all households, five are upper sub-basins. In terms of telecommunications connectivity, household fixed line telephones vary widely (0.3 to 52 percent of households).

Figure 2-13. Village transportation, telecommunications & economic integration indicators, 2003

Sub-Basin	2003 Reporting population			District town		Transport		Motorcycles		Pickups		Electricity		Telecommunic			hh energy		Local commercial shops					
	Villages reported	House-holds	Persons reported	average travel distance	time	regular service all yr	dry seas	ownership village	family	ownership village	family	installed villages	hh's	Telephone line	Inter cell	-net	gas+ electr	charc wood	Petrol point	prod input	tool-eqt repair	vehic sell/rep	elec electron	other types
	number	number	number	km	minutes	% of villages		%vill	%hh	%vill	%hh	%vill	%hh	% of households			%vill	%vill	shop locations per 1,000 households					
602 Ping part 1	90	12,595	46,651	17	31	48	68	98	72	99	18	98	94	16	24	0.5	46	54	9	2	1	6	1	47
603 Mae Ngad	100	11,276	38,717	11	23	54	66	98	77	97	15	94	95	16	11	1.0	52	48	7	1	0.2	4	2	36
604 Mae Taeng	52	6,155	26,725	21	49	29	63	100	74	98	14	94	88	29	20	1.4	35	65	9	3	1.0	5	2	56
608 Mae Khan	170	21,654	79,900	16	32	31	46	99	81	99	26	96	95	30	35	2.0	53	47	6	3	0.7	7	2	42
610 Mae Klang	41	6,234	24,389	13	36	44	54	100	80	100	28	78	85	31	33	2.8	34	66	3	5	0.3	7	2	45
612 Mae Chaem upper	51	4,323	25,122	67	146	6	25	100	47	96	14	59	54	0.3	1.1	0.0	2	98	9	2	0.2	3	0	38
613 Mae Chaem lower	76	7,190	32,443	24	60	21	32	99	58	96	15	67	72	6	11	0.4	12	88	7	3	0.3	4	1	31
615 Mae Teun	77	6,523	29,439	44	109	16	17	91	31	83	8	57	52	1	1	0.3	8	92	6	0	0.0	2	0	30
Upper Sub-Basins	657	75,950	303,386	24	53	32	47	98	70	96	19	84	85	19	21	1.2	35	65	7	2	0.5	5	1	41
605 Ping part 2	371	58,431	202,200	8	17	43	56	100	80	100	36	99	99	52	45	4.3	93	7	4	2	0.6	8	3	43
606 Mae Rim	56	7,161	25,869	19	36	50	82	100	66	100	24	95	91	24	21	1.7	50	50	5	1	1.0	5	1	45
607 Mae Kuang	494	71,676	249,368	11	21	40	52	99	85	99	34	99	98	43	44	3.3	86	14	4	2	0.9	8	2	39
609 Mae Lee	159	24,738	85,966	15	24	36	50	100	75	99	24	98	95	14	21	1.0	35	65	7	3	0.3	6	1	34
611 Ping part 3	233	35,623	126,305	14	24	39	52	100	77	99	28	96	96	21	31	1.6	57	43	6	3	0.9	5	1	32
614 Mae Had	31	4,470	14,787	14	23	39	58	100	80	100	16	100	96	10	13	0.4	6	94	8	4	1.1	6	1	44
Middle Sub-Basins	1,344	202,099	704,495	12	21	41	54	100	80	99	31	98	97	37	38	2.9	74	26	5	2	0.7	7	2	39
616 Ping part 4	181	24,420	92,251	11	23	53	68	97	75	95	21	97	92	21	34	1.6	82	18	9	1	1.3	7	1	45
617 Huay Mae Thor	12	1,664	6,703	21	41	58	67	100	77	100	25	83	82	4	26	0.0	83	17	7	1	0.0	6	1	46
618 Klong Wang Chao	17	1,823	7,749	24	62	35	59	100	66	100	20	88	79	1	28	0.1	65	35	15	3	3.3	9	0	57
619 Klong Mae Raka	45	6,068	23,848	24	39	67	87	96	78	100	10	100	91	5	10	1.0	13	87	13	0	3.8	7	0	40
620 Klong Suan Mark	50	7,758	30,305	17	28	34	64	96	68	96	15	100	94	6	19	0.4	88	12	12	3	1.9	5	2	34
621 Lower Ping	388	50,301	196,223	15	26	38	61	97	74	99	16	99	93	13	38	0.7	95	5	14	3	1.9	5	1	46
Lower Sub-Basins	693	92,034	357,079	15	27	44	65	97	74	98	17	98	92	14	33	0.9	85	15	12	3	1.8	6	1.2	45
Ping Basin	2,694	370,083	1,364,960	16	30	39	55	99	77	98	25	98	94	27	33	2.0	67	33	7	2	1	6	2	41

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พบบ.2๓) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Cellular telephones are progressing toward filling the gap in various areas, however, and especially lower sub-basins. Internet usage appears highest in areas in or adjacent to the Chiang Mai Valley, but usage reported in 2003 averaged only 2 percent for the Ping Basin overall.

Private investors

Associated with the growth of the market economy has been the emergence of a range of types of private investors (*nai toon*) whose activities are also having impacts on livelihoods and landscapes in the Ping Basin. This category includes a diverse range of people and entities who have managed to accumulate capital through means that vary widely in their respectability and legality, and who have a similarly wide range of goals in making local investments within Ping sub-basins. While some are native or long-term residents within sub-basins, others operate from bases in other sub-basins, from bases in Bangkok or other areas of the country, or in association with investors from outside the country. Many are also capable of exerting considerable influence on government officials and administrative systems. While many of their activities are linked to investment in private business enterprise within Ping sub-basins, others are also heavily involved in activities such as acquisition of strategic and large parcels of land for speculation purposes, or even investments in illegal activities such as logging, hunting or drugs. In any event, they are clearly an important force to be reckoned with in many sub-basins.

(f) Urban Centers:

As data in Figure 2-5 confirm, urban centers with increasingly very intensive use of land and water resources for residential, commercial, service and industrial purposes have already become a major stakeholder in several lower and middle sub-basins of the Ping River Basin. While modest scale district towns are quite dispersed, many of the larger urban centers are located along the main channel of the Ping River itself, and have emerged from evolution of cultures that have focused much attention on river banks and adjacent lowland areas.

Given the weaknesses of land use planning, zoning or associated types of efforts to manage patterns of land use change during periods of rapid economic growth and social change, there are numerous problems associated with impacts of competing and conflicting forms of land use on the quality of urban life, as well as with development of systems to provide services related to provision of urban water supply, sanitation, wastewater treatment, and solid waste disposal services. As a result, urban centers are considered important sources of water pollution, waste, and sometimes air pollution that are public health concerns. Those located along main channel riverbanks have additional issues that have been discussed to a substantial extent by the CMU study team [CMU 2004]. Those located along smaller irrigation canals can be even worse, since they appear to be exempt from laws restricting construction along banks of natural streams; many are candidates to become similar to the 'black khlongs' in the vicinity of Bangkok.

At wider sub-basin levels, urban centers tend to have quite large spheres of influence in sub-basins where they are prominent, through the reach of their business, financial, trade, industry, tourism, and other sectoral bases, as well as through their roles as markets for agricultural and forest products, suppliers of agricultural inputs and consumer goods, bases for land speculators, sources of wage labor, centers of education, and other functions that penetrate into surrounding rural areas. Thus, key stakeholders in urban areas need to include leaders of both municipalities and the various sectoral groupings that are present.

In order to help explore the degree to which these spheres of influence have widespread impacts on village livelihoods, Figure 2-14 presents village reported data on employment outside of local tambons. Patterns emerging from this data differ significantly among sub-basin groupings.

- The strength of relationships between lower sub-basins and the Central Plains region of Thailand is underscored by the degree to which the Bangkok metropolis is the main location for distant labor for both men and women. While men tend to be employed as skilled workers more than factory workers, the opposite is true for women, and women also find more work in the service sector.

Figure 2-14. Village reported wage employment outside their tambon, 2003

Sub-Basin	2003 Reporting population			Men employed outside local area (tambon)							Women employed outside local area (tambon)														
	Villages reported	House-holds	Persons reported	Main type of work					Main location of work					Main type of work					Main location of work						
				farm work	fact work	skill work	serv work	other work	within dist	within prov	within reg	within cntry	Bangkok metrop.	other country	farm work	fact work	skill work	serv work	other work	within dist	within prov	within reg	within cntry	Bangkok metrop.	other country
	unit: number	number	number	% of total villages reporting type					% of total villages reporting location					% of total villages reporting type					% of total villages reporting location						
602 Ping part 1	90	12,595	46,651	19	8	33	9	6	11	44	9	6	3	1	19	19	6	21	10	10	42	7	4	10	1
603 Mae Ngad	100	11,276	38,717	10	6	33	1	6	8	26	3	2	14	2	7	13	16	12	7	7	26	4	3	11	4
604 Mae Taeng	52	6,155	26,725	13	6	27	13	15	6	56	2	10	2	-	8	6	6	38	17	4	46	4	13	8	-
608 Mae Khan	170	21,654	79,900	8	7	29	11	13	8	48	8	1	4	-	7	15	13	16	16	12	45	6	1	2	-
610 Mae Klang	41	6,234	24,389	20	22	20	7	12	32	34	12	2	-	-	17	37	2	10	15	27	34	17	2	-	-
612 Mae Chaem upper	51	4,323	25,122	16	6	4	12	2	4	25	8	-	2	-	22	2	-	14	2	6	27	6	-	-	-
613 Mae Chaem lower	76	7,190	32,443	4	3	16	12	21	9	38	7	1	-	-	3	5	-	25	22	9	38	4	3	-	1
615 Mae Teun	77	6,523	29,439	27	4	9	3	4	4	29	5	5	4	-	26	4	5	9	3	4	31	1	5	5	-
Upper Sub-Basins	657	75,950	303,386	13	7	24	8	10	9	39	7	3	4	0	12	12	8	18	12	10	37	5	4	5	1
605 Ping part 2	371	58,431	202,200	7	12	31	4	10	8	36	9	5	5	1	9	23	8	13	11	14	33	6	4	7	1
606 Mae Rim	56	7,161	25,869	11	18	21	11	9	9	48	4	4	5	-	9	23	9	11	18	9	48	4	2	7	-
607 Mae Kuang	494	71,676	249,368	7	24	28	2	9	11	44	7	5	3	0	5	35	7	7	16	13	43	6	5	4	0
609 Mae Lee	159	24,738	85,966	13	22	9	4	4	9	26	6	4	4	3	14	29	1	2	5	8	31	5	3	4	-
611 Ping part 3	233	35,623	126,305	19	30	15	3	11	10	51	7	2	7	1	17	39	3	7	12	12	50	10	3	3	1
614 Mae Had	31	4,470	14,787	19	29	23	3	13	6	16	16	-	45	3	23	32	10	13	10	6	19	13	3	45	-
Middle Sub-Basins	1,344	202,099	704,495	10	21	24	3	9	9	41	8	4	6	1	10	31	6	8	12	12	40	7	4	6	0
616 Ping part 4	181	24,420	92,251	12	22	47	3	5	13	9	3	11	46	8	17	31	26	3	12	19	14	2	10	44	1
617 Huay Mae Thor	12	1,664	6,703	8	25	50	8	8	8	8	-	8	75	-	8	42	42	8	-	8	8	-	8	75	-
618 Klong Wang Chao	17	1,823	7,749	6	6	76	-	-	-	-	6	6	76	-	-	29	53	6	-	-	-	6	6	76	-
619 Klong Mae Raka	45	6,068	23,848	2	31	53	-	2	-	4	-	2	80	2	4	42	40	-	2	-	4	2	9	71	2
620 Klong Suan Mark	50	7,758	30,305	10	6	72	2	-	10	10	2	10	50	8	10	20	56	4	-	12	12	4	10	48	4
621 Lower Ping	388	50,301	196,223	12	21	50	3	2	8	9	4	4	62	1	12	36	28	4	8	8	10	2	4	62	2
Lower Sub-Basins	693	92,034	357,079	11	20	52	3	3	9	9	3	6	59	3	12	34	31	4	8	11	10	2	7	58	1
Ping Basin	2,694	370,083	1,364,960	11	18	31	4	8	9	32	6	4	19	1	11	27	13	9	11	11	32	5	4	19	1

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พฐจ.2๖) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

- In middle sub-basins distant work is found mainly within provincial towns. Work for males is split quite evenly between skilled workers and factory workers. It is more common for women to find work in factories, and to a lesser extent in the service sector.
- Distant work for people in upper sub-basins is also found mainly within provincial towns, but the types of work differ from middle sub-basins. Men are most likely to find employment as skilled workers, or to a lesser extent in the service sector or in factories. Women most frequently work in the service sector or in factories.

In all three sub-basin groups, just over 10 percent of villages report farm labor as the main type of distant work, although there is substantial variation among individual sub-basins within each group, and patterns are similar for both men and women.

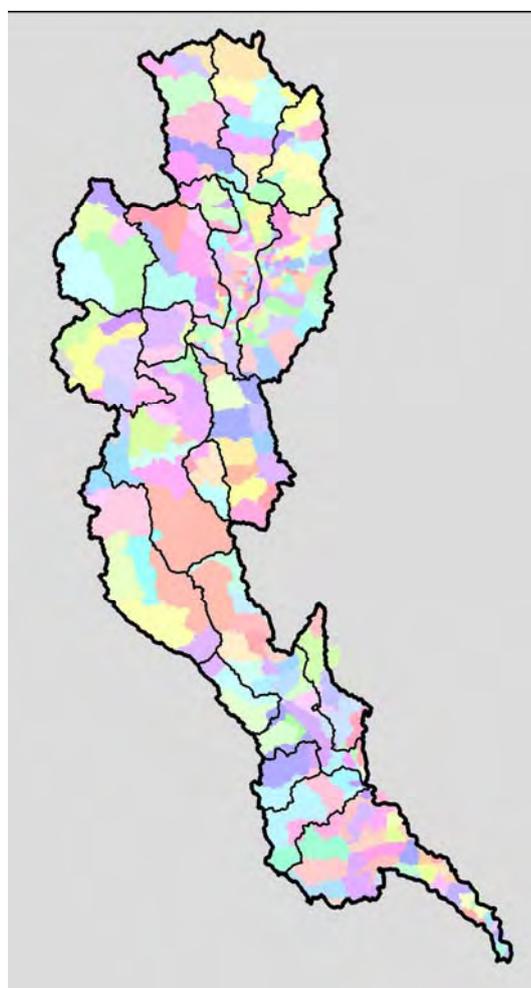
(g) Local government

During the series of governmental reform and restructuring efforts that began in the 1990's, a new form of more fully constituted local government has emerged at the sub-district (*tambon*) level (Figure 2-15). Known as the Tambon Administrative Organization (TAO), this is a fully elected body that has been delegated very significant and growing authority and responsibility. The TAO is a juristic entity (*nittibukon*) that is authorized to levy some forms of local taxation, and to issue approvals required before a wide range of activities can take place within their jurisdictions. More developed TAO and urban areas are eligible to be transformed into municipalities (*tessaban*). Both the spirit and the letter of the 1997 national constitution substantially strengthened roles of TAO and *tessaban*, and they are now the focus of many government programs.

Capacities of local governments to conduct the full range of activities that fall within their growing mandates vary substantially, and tend to be particularly weak in upper sub-basins where many of their constituents are ethnic minority communities who have only recently gained access to full participation in local governance processes, and where extensive legal restrictions on land use undermine their ability to raise revenues from property tax. Associations of TAO at least at provincial level are seeking to assist members facing some of these types of difficult situations, as are a number of other governmental, academic and non-governmental organizations.

Emphasis on development of elected local government at the sub-district (*tambon*) and municipality (*tessaban*) level, reflects the emergence of a newer line of effort to seek coordination and integration of government programs in Thailand. Given the extremely slow progress made by efforts to coordinate decentralized central government operations and programs, these are in essence efforts to turn the system upside down. Thus, coordination and integration and the many types of decisions that must be associated with such processes, are being vested in elected local governments that are accountable to local communities. At least in theory, the development planning process at this level determines priority needs that are then responded to through budget

Figure 2-15. Ping Basin tambon boundaries



source: author using spatial data from ONEP

allocations to both local governments and central agencies, as well as through local government budgets derived from local taxes. Central agencies can then proceed to provide their services through their line agency units, with perhaps less need for efforts to coordinate among themselves.

In order to help assess types and distribution of services currently available at tambon level, Figure 2-16 displays service access data reported by villages. Strong linkages between these services and central 'line' ministries with which they are associated, are indicated by the relative uniformity of patterns among sub-basins. Given their relatively high costs, hospitals show the most variability.

Since local governments now have substantial responsibility for directing development assistance in their jurisdictions, Figure 2-16 also includes data on general perceptions of village leaders about whether their village receives overall levels of development assistance that are relatively similar to other villages in the tambon, or feel they are receiving relatively more or less assistance than most. This data shows that the vast majority of villages in all sub-basins feel that they are receiving levels of assistance that are relatively similar to other villages. Of the seven sub-basins where more than 10 percent of villages receive less assistance than others, five of these are upper sub-basins.

Many responsibilities of local governments are directed toward managing programs and projects directed toward development at the village level. Thus, another approach to assessing progress of these efforts is to look at the availability of facilities and services at the village level. Figure 2-17 displays data reported by villages in each sub-basin that reflects the presence of various of the facilities and services that government agencies and development programs have sought to promote.

Overall, there is an impressively even distribution of these facilities and services across sub-basins, which is likely related to perceptions in most villages that development assistance is relatively evenly distributed among villages. Minor exceptions include relatively high frequency of rice banks in some upper sub-basins, and somewhat higher frequency of some public facilities in middle sub-basins. But, while presence or absence of village facilities and services is one type of indicator of performance of local government, we also need to look at processes employed by local leaders and the degree to which local participation is actually occurring. Thus, Figure 2-18 presents village reported data that relates to some of these issues.

Figure 2-16. Village reported access to services within their tambon, 2003

Sub-Basin	2003 Reporting population			Services available within tambon						Development equity			
	Villages reported	House-holds	Persons reported	Production		Health-safety		Schools		Other	Perceived share of assistance		
				agr ext center	co-op	hospital	police station	grade 1-9	grade 10-12	post office	more than others	same as others	less than others
	unit: number	number	number	Percent of villages						Percent of villages			
602 Ping part 1	90	12,595	46,651	48	24	21	44	83	39	37	6	92	2
603 Mae Ngad	100	11,276	38,717	79	15	3	24	72	33	42	4	82	14
604 Mae Taeng	52	6,155	26,725	75	29	21	40	77	31	42	8	81	12
608 Mae Khan	170	21,654	79,900	91	38	15	33	91	47	44	5	88	6
610 Mae Klang	41	6,234	24,389	90	20	7	59	80	17	24	10	63	27
612 Mae Chaem upper	51	4,323	25,122	73	29	-	31	92	88	27	6	78	16
613 Mae Chaem lower	76	7,190	32,443	91	37	18	24	96	42	62	-	96	4
615 Mae Teun	77	6,523	29,439	68	31	29	31	86	44	43	7	81	12
Upper Sub-Basins	657	75,950	303,386	78	29	15	34	85	43	42	5	85	10
605 Ping part 2	371	58,431	202,200	72	21	18	26	88	26	7	4	95	1
606 Mae Rim	56	7,161	25,869	70	18	-	23	84	43	21	11	89	-
607 Mae Kuang	494	71,676	249,368	70	27	20	28	72	23	22	4	94	2
609 Mae Lee	159	24,738	85,966	86	50	20	31	88	59	48	11	81	9
611 Ping part 3	233	35,623	126,305	73	30	23	36	83	45	29	4	91	5
614 Mae Had	31	4,470	14,787	42	26	16	35	77	19	42	-	100	-
Middle Sub-Basins	1,344	202,099	704,495	72	28	19	29	81	33	23	5	92	3
616 Ping part 4	181	24,420	92,251	86	28	9	39	81	52	30	3	96	2
617 Huay Mae Thor	12	1,664	6,703	75	-	-	42	25	17	8	-	100	-
618 Klong Wang Chao	17	1,823	7,749	100	76	-	88	100	88	94	-	82	18
619 Klong Mae Raka	45	6,068	23,848	58	31	7	33	71	44	56	2	96	2
620 Klong Sun Mark	50	7,758	30,305	86	16	4	8	92	52	36	16	78	6
621 Lower Ping	388	50,301	196,223	74	34	17	28	78	43	50	3	79	18
Lower Sub-Basins	693	92,034	357,079	78	31	13	31	79	47	44	4	85	11
Ping Basin	2,694	370,083	1,364,960	75	29	16	31	81	39	33	5	88	7

Source: author's analysis using (1) Ping Basin Village-level Basic Data (๓๗๓2๘) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural

Figure 2-17. Reported village-level facilities and services in Ping sub-basins, 2003

Sub-Basin		Village - level Facilities & Services																					
		Production support							Information & communication					Health maintenance					Education				
		agric storage	agric drying	rice Bank	buf/cattle bank	livestock care	co-op store	occup training	public infor	meeting hall	religious facility	reading room	village library	public phone	commity health	recreation rest area	sports facility	child care	play ground	nursery school	grade 1-9	grade 10-12	adult educ
<i>unit:</i>		Percent of villages							Percent of villages					Percent of villages					Percent of villages				
602	Ping part 1	9	4	27	11	34	20	9	83	39	96	63	37	79	80	24	78	47	38	43	61	22	21
603	Mae Ngad	9	4	42	18	49	9	9	85	38	85	64	34	67	95	20	67	32	41	36	64	14	10
604	Mae Taeng	4	2	40	4	23	15	15	88	52	94	58	25	63	90	33	71	42	37	42	60	8	19
608	Mae Khan	5	6	26	12	66	24	11	91	66	88	50	48	91	92	26	84	39	53	45	65	15	11
610	Mae Klang	12	5	41	10	27	34	5	80	61	83	49	22	71	80	20	56	54	37	44	56	24	15
612	Mae Chaem upper	6	4	75	6	27	8	4	71	45	94	22	24	53	63	8	61	63	25	57	59	24	6
613	Mae Chaem lower	1	-	64	8	24	9	4	78	39	84	62	41	64	87	18	58	37	46	66	67	13	17
615	Mae Teun	6	-	27	6	12	8	5	47	36	71	36	23	51	68	9	57	29	29	42	58	16	17
Upper Sub-Basins		6	4	39	11	39	16	8	80	48	87	52	35	72	84	21	70	41	41	46	62	16	14
605	Ping part 2	3	2	8	5	39	16	9	96	57	76	64	36	85	91	29	78	35	41	33	72	17	9
606	Mae Rim	7	5	30	13	59	21	11	80	71	91	66	38	80	89	11	79	43	36	50	61	20	14
607	Mae Kuang	7	4	11	11	48	17	7	93	51	81	73	34	81	91	23	73	32	39	40	59	13	10
609	Mae Lee	5	5	5	4	28	11	10	87	57	81	74	48	87	86	12	73	45	58	50	58	17	21
611	Ping part 3	6	5	17	9	34	12	7	92	61	84	73	41	90	91	17	77	44	53	57	61	16	14
614	Mae Had	16	6	23	10	55	10	16	87	87	68	74	35	81	77	19	87	39	45	65	55	13	10
Middle Sub-Basins		6	4	11	8	41	15	8	92	57	80	70	38	84	90	22	76	37	44	43	63	15	12
616	Ping part 4	1	3	6	6	45	17	14	87	43	77	59	40	78	91	19	73	22	48	54	47	19	10
617	Huay Mae Thor	17	25	17	-	67	17	-	92	58	75	25	75	92	100	42	100	33	83	83	17	8	-
618	Klong Wang Chao	-	-	-	6	24	6	18	94	65	88	47	59	76	88	24	88	18	41	41	47	12	6
619	Klong Mae Raka	18	9	42	18	60	27	7	82	56	84	78	51	82	84	16	67	29	44	64	60	16	22
620	Klong Suan Mark	2	2	12	-	24	4	2	82	42	74	60	32	72	80	16	80	20	52	50	70	30	30
621	Lower Ping	3	10	12	4	21	11	10	86	44	68	51	35	71	86	14	73	18	45	50	56	18	15
Lower Sub-Basins		4	7	12	5	31	13	10	86	45	73	55	39	74	87	16	74	20	47	53	54	19	15
Ping Basin		5	5	18	8	38	15	9	88	52	80	62	37	79	88	20	74	34	44	46	61	17	13

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พ.ร.บ. 25) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Figure 2-18. Reported aspects of village community management, 2003

Sub-Basin	2003 Reporting population			Community strengthening						Poor & disadvantaged					
	Villages reported	House-holds	Persons reported	share opinions	village meetings per year			Learning Center		Level of help			issue scale		
					none	1-6	>6	center exists	people benefited	Welfare Center activities			children	adults	
	unit: number	number	number	% total hh's	Percent of villages			% total villages	% total hh's	none	intermittant	regular	orphans	AIDS affected	homeless poor
										Percent of villages			per 10,000 persons		
602 Ping part 1	90	12,595	46,651	83	10	77	13	24	28	17	68	16	38	9	19
603 Mae Ngad	100	11,276	38,717	87	4	87	9	42	16	11	28	61	48	23	13
604 Mae Taeng	52	6,155	26,725	77	4	92	4	37	21	17	77	6	23	9	6
608 Mae Khan	170	21,654	79,900	95	4	87	9	25	15	12	48	40	40	29	7
610 Mae Klang	41	6,234	24,389	78	7	78	15	20	8	2	63	34	47	18	16
612 Mae Chaem upper	51	4,323	25,122	80	12	76	12	20	3	27	65	8	33	1	15
613 Mae Chaem lower	75	7,040	32,143	93	11	84	5	28	11	20	52	28	8	2	8
615 Mae Teun	77	6,523	29,439	79	23	69	8	30	7	23	64	13	28	2	26
Upper Sub-Basins	656	75,800	303,086	87	9	82	9	29	16	16	55	30	35	15	13
605 Ping part 2	371	58,431	202,200	86	7	82	11	19	10	7	57	36	32	15	6
606 Mae Rim	56	7,161	25,869	84	11	80	9	36	17	5	66	29	52	17	14
607 Mae Kuang	494	71,676	249,368	90	6	84	11	23	11	10	49	42	27	15	5
609 Mae Lee	159	24,738	85,966	93	8	80	13	23	6	9	56	35	20	6	4
611 Ping part 3	233	35,623	126,305	89	10	76	14	25	11	10	58	32	42	12	11
614 Mae Had	31	4,470	14,787	89	13	65	23	16	9	13	68	19	68	5	7
Middle Sub-Basins	1,344	202,099	704,495	89	8	81	12	23	10	9	55	37	32	13	7
616 Ping part 4	180	24,073	91,036	84	6	84	10	13	5	18	58	24	13	1	13
617 Huay Mae Thor	12	1,664	6,703	88	-	33	67	-	4	-	100	-	22	3	6
618 Klong Wang Chao	17	1,823	7,749	88	-	76	24	12	5	6	82	12	43	-	4
619 Klong Mae Raka	45	6,068	23,848	87	24	67	9	11	5	22	42	36	21	1	5
620 Klong Suan Mark	50	7,758	30,305	83	2	84	14	12	4	12	60	28	12	-	7
621 Lower Ping	388	50,301	196,223	79	10	75	14	14	8	15	65	20	28	2	21
Lower Sub-Basins	692	91,687	355,864	82	9	77	14	13	7	16	62	22	22	1	16
Ping Basin	2,692	369,586	1,363,445	86	8	80	12	22	10	12	57	31	30	10	10

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พ.ศ. 2546) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

With regard to local participation in governance processes, more than 75 percent of villages in 16 of 20 sub-basins report holding of 1 to 6 village meetings per year to serve as a forum for identifying and discussing problems, planning activities to address them, and discussing their progress. Villages holding more frequent meetings are somewhat more common in lower sub-basins, and least common in upper sub-basins, although there is substantial variability among individual sub-basins. A similar variability is present among the smaller minority of villages that hold no village meetings. Villages also report very high levels of households willing and able to share their opinions regarding problems and plans, although a bit of skepticism may be in order because it may be seen to be in the best interest of the village leaders who report these data to claim such high levels of participation.

In terms of self-help capacity building, there is an increase along the lower-to-upper sub-basin gradient in the proportion of villages that have established learning centers, as well as in the percentage of households believed to be beneficiaries of these centers. One indicator of community functional capacity is their efforts to assist the poor and disadvantaged. In this regard, most villages report welfare systems that are functioning at least intermittently, but the scale of some of the major issues they seek to address, such as orphans and AIDS-affected children, is considerably higher in middle, and especially upper sub-basins.

We have already seen that educational services appear to be a quite high priority, and local schools and school teachers are another important element of the social and institutional landscapes in rural areas. Teachers can and have been important resources and stakeholders in efforts to improve livelihoods, public health and management of natural resources and the environment. Thus, Figure 2-19 presents village reported data on the distribution of educational services among sub-basins, as well as some data on the educational attainment level of the adult population.

Well over half of all villages in 17 of 20 sub-basins report access to schools teaching grades 1 to 9 (the level of mandatory education in 2003), and the proportion rises to more than 70 percent with schools located within their tambon. Access to the remaining years of secondary education within the local tambon is also quite widespread. This implies a quite widespread cadre of teachers.

The degree to which teachers are motivated and able to contribute to and participate in activities related to the issues of central concern to sub-basin management organizations and this project, however, is likely to vary widely. Moreover, there is currently a high-profile protest by many teachers from around the country who do not want to proceed any further along the path toward decentralization of school system management to local governments. Words have often been harsh and many local leaders have been offended by apparently condescending attitudes toward them. It is not yet clear how much damage this may cause to local relationships, however, which are often more dependent on personal characteristics than on shouting in the political arena.

In terms of educational attainment in the general adult population, village reported data should be quite surprising to many by their indication that educational attainment in upper and lower sub-basins is not very different. If this is accurate, it reflects a major and impressive change during the last two to three decades. Before this time, even simple communication between lowland Thai and mountain minority groups could be very problematic for linguistic reasons, and very few mountain communities had access to the mainstream educational system. While it has been clear that strong emphasis on education in these areas have brought much change among the new adult generation, this data is striking. It should be noted, however, that this is one of the weakest areas of the national database from which this data was extracted, and the simple inconsistency of data from 360 villages required their elimination from these calculations. There were also a number of villages who did not submit their questionnaires in 2003. On an overall percentage basis, these gaps in the data are very small. But if there was a consistent bias related to the characteristics of the villages who either failed to report or had their data records excluded, there could be some distortion to this data. Nevertheless, there is no clear alternative source of data that is accessible at this level of spatial resolution.

Figure 2-19. Village reported educational levels and education access, 2003

Sub-Basin	Local education services									Work force educational levels							
	2003 Reporting population			village nursery school	Grades 1-9		Grades 10-12		village adult educ	2003 Reporting population			level of education completed				still student
	Villages reported	House-holds	Persons reported		village	tambon	village	tambon		Villages reported	House-holds	Persons reported	required educ	secondary equiv	vocational diploma	college degree	
unit:	number	number	number	Percent of villages					number	number	number	Percent of 15-60 year age group					
602 Ping part 1	90	12,595	46,651	43	61	83	22	39	21	85	11,984	44,400	43	4	1	1	5
603 Mae Ngad	100	11,276	38,717	36	64	72	14	33	10	74	7,785	27,169	67	5	2	2	9
604 Mae Taeng	52	6,155	26,725	42	60	77	8	31	19	48	5,725	25,224	27	4	1	1	5
608 Mae Khan	170	21,654	79,900	45	65	91	15	47	11	146	18,243	68,152	61	7	3	2	8
610 Mae Klang	41	6,234	24,389	44	56	80	24	17	15	39	5,818	23,189	58	5	4	3	7
612 Mae Chaem upper	51	4,323	25,122	57	59	92	24	88	6	51	4,323	25,122	39	5	1	1	5
613 Mae Chaem lower	76	7,190	32,443	66	67	96	13	42	17	72	6,777	30,713	65	7	3	1	9
615 Mae Teun	77	6,523	29,439	42	58	86	16	44	17	75	6,355	28,775	28	3	1	0.3	2
Upper Sub-Basins	657	75,950	303,386	46	62	85	16	43	14	590	67,010	272,744	51	5	2	2	7
605 Ping part 2	371	58,431	202,200	33	72	88	17	26	9	312	48,799	169,649	67	8	5	4	12
606 Mae Rim	56	7,161	25,869	50	61	84	20	43	14	45	5,509	19,962	58	7	3	2	6
607 Mae Kuang	494	71,676	249,368	40	59	72	13	23	10	421	61,317	213,215	54	9	5	3	10
609 Mae Lee	159	24,738	85,966	50	58	88	17	59	21	142	21,878	77,020	53	7	3	2	7
611 Ping part 3	233	35,623	126,305	57	61	83	16	45	14	205	31,088	111,006	51	7	3	2	8
614 Mae Had	31	4,470	14,787	65	55	77	13	19	10	29	4,331	14,308	23	3	1	1	18
Middle Sub-Basins	1,344	202,099	704,495	43	63	81	15	33	12	1,154	172,922	605,160	56	8	4	3	10
616 Ping part 4	181	24,420	92,251	54	47	81	19	52	10	146	19,875	74,656	57	10	4	2	7
617 Huay Mae Thor	12	1,664	6,703	83	17	25	8	17	-	12	1,664	6,703	11	3	2	3	6
618 Klong Wang Chao	17	1,823	7,749	41	47	100	12	88	6	16	1,682	7,161	74	9	1	1	7
619 Klong Mae Raka	45	6,068	23,848	64	60	71	16	44	22	37	5,374	20,427	65	5	1	1	8
620 Klong Suan Mark	50	7,758	30,305	50	70	92	30	52	30	50	7,758	30,305	29	9	1	1	5
621 Lower Ping	388	50,301	196,223	50	56	78	18	43	15	319	40,667	160,022	50	5	2	1	6
Lower Sub-Basins	693	92,034	357,079	53	54	79	19	47	15	580	77,020	299,274	50	7	2	2	6
Ping Basin	2,694	370,083	1,364,960	46	61	81	17	39	13	2,324	316,952	1,177,178	54	7	3	2	8

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พชข.2ก) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

(h) *Civil society and academia*

Another dimension of social change in Thailand has been the emergence and growth of civil society groups and institutions that are non-governmental in nature. Since this represents another potentially important group of stakeholders in Ping sub-basins, this section takes a brief look at some of the major types of groups that may be most relevant for sub-basin management efforts.

Non-governmental organizations (NGOs)

There has been a substantial surge in development of various forms of non-governmental groups and organizations, especially just prior to and since passage of the 1997 national constitution. In addition to the range of more longstanding groups, such as professional associations and charities, a range of “NGO’s” and “people’s organizations” has also emerged. During the earlier years of their recent emergence and evolution, NGO’s based in Bangkok or other major urban areas (such as Chiang Mai), or who were subsidiaries of international organizations, tended to play the most prominent non-governmental role in rural development, environmental, and natural resource management initiatives. A substantial range of variability among these organizations has emerged in relationship to environmental issues, and especially regarding management of the mountain areas that are particularly prominent features of upper sub-basins. Many have become advocates at national policy levels, contributing to different sides of often very strong public debates. Many also have various types of linkages at international levels.

During more recent years, however, there has been very distinct movement toward emergence of much more initiative by “people’s organizations” and networks, with “NGO” roles beginning to shift more to provision of various forms of organizational, technical, analytical, management, and in some cases policy advocacy types of support for local organizations and networks. A number of domestic, and a few international NGO’s are operating in sub-basins of the Ping River Basin, and although their views on various issues can differ substantially, most appear to be focusing their efforts on support for networks of communities, schools, women’s groups, producer groups, village volunteers, or other types of institutions or local organizations.

Local people’s organizations

Another effect of constitutional and local government reforms has been to allow space for emergence of a range of new types of non-governmental social organizations that are both formal and informal in nature. While initial growth of civil society institutions focused on groups within communities and very local areas, recent trends place much effort on building alliances among local groups through establishment of networks at various scales. Growth of these civil society institutions is encouraged and facilitated by similar types of organizations emerging at national and regional levels, as well as by various government agencies that are increasingly constrained from expanding their local field staff to implement local projects and programs. In relation to natural resource management, three generic types of civil society organizations are particularly relevant:

- *Agency-induced groups.* These include local organizations that may have begun under agency control but evolved into a more independent form, such as agricultural cooperatives, as well as recent efforts by agencies to encourage and induce formation of local groups, such as has been the case with many agriculture and forest conservation groups. Agency links with ‘village volunteers’, such as those working on public health, soil problems, and environmental issues for example, are a related approach. Various types of support for these groups have been provided by agencies, which most frequently includes training and any necessary equipment, often some type of uniform apparel, and sometimes compensation or a revolving fund. This has been an increasingly common tactic employed by various government agencies, resulting in varying degrees of success and impact.
- *Local initiative groups.* These include groups based in longstanding local traditions, such as the *muang fai* water user groups, more recent local initiatives such as growers associations, as well as the new generation of networks being formed at multiple levels. Since most are derived from local efforts to support group activity that is in the best interest of the membership of the group, many began with a relatively narrow focus on a particular type of function, activity or product. Networks providing linkages among such groups appear to be a still relatively informal, but

practical means of federating to increase the scale of coverage, mobilization capacity, economic and/or political bargaining power, and other types of attributes that are needed or useful from time to time. Various outside NGO, government and/or business actors often provide encouragement and support, which often includes training and sometimes revolving funds. The most recent wave of networks emerging in some areas can even be called ‘networks of networks’ as they seek to bring higher-level coordination and integration at various scales, which often correspond with watersheds. Where they exist and have developed enough capacity, they are likely to be important building blocks and prototypes for sub-basin management organizations envisioned under this project and Ping River Basin rehabilitation and management efforts more generally.

- **Cultural, religious and ethnic groups.** These groups can be organizationally quite similar to local initiative groups in many ways, but their membership is more specifically confined to particular groups who share specific ethnicity, or cultural or religious beliefs and traditions. Ideally, such groups can, and in many cases increasingly do, play a very important and useful supporting role in natural resource management activities. Caution needs to be exercised, however, especially in cases where competition, tension or conflict related to natural resource issues are among groups that coincide with ethnic or religious differences, that involvement of such groups does not increase divisiveness or conflict. In any event, the pilot project needs to at least avoid alienating such groups, as their opposition can often be quite powerful.

Although there are no data that can be used to directly assess the distribution of the full range of these various types of groups in Ping sub-basins, Figure 2-20 presents some relevant village reported data on group membership. According to these reports, about 75 to 95 percent of all households in all sub-basins are members of some type of local group. And, it is reported that in 13 of the sub-basins more than half of these group members receive some sort of funds for livelihood development or education through the group – and in the remaining sub-basins 25 to 50 percent receive such funds. Substantial portions of these group members (about 35-55 percent, except for Mae Teun) are also members of local agricultural groups, and a somewhat smaller portion are members of agricultural cooperatives. Thus, many if not most of the types of groups reported in this data appear most likely to be similar to agency-induced groups.

Figure 2-20. Village reported group membership and credit sources, 2003

Sub-Basin	2003 Reporting population			Group membership				Sources of producer credit						
	Villages reported	Households	Persons reported	all group members	also receive funds**	also members of agric group	also members of agric coop	producer savings group	co-op	BAAC	commerc bank	private lender	govt revolving fund	other
	number	number	number	% total hh's	% group member hh's			Percent of total households						
602 Ping part 1	90	12,595	46,651	84	44	35	31	12	7	17	4	1	61	1.6
603 Mae Ngad	100	11,276	38,717	92	78	62	59	38	34	40	4	2	74	0.9
604 Mae Taeng	52	6,155	26,725	74	47	43	43	23	23	32	0.2	2	55	0.7
608 Mae Khan	170	21,654	79,900	95	73	57	42	19	28	34	1	1	65	0.9
610 Mae Klang	41	6,234	24,389	77	60	54	74	10	13	32	7	1	62	-
612 Mae Chaem upper	51	4,323	25,122	83	90	47	43	6	11	11	-	3	76	0.0
613 Mae Chaem lower	75	7,040	32,143	93	87	45	27	5	8	11	0.6	4	83	0.2
615 Mae Teun	77	6,523	29,439	75	27	8	14	8	2	10	2	2	73	0.2
Upper Sub-Basins	656	75,800	303,086	87	65	48	42	17	19	26	2	2	68	0.7
605 Ping part 2	371	58,431	202,200	88	50	47	27	14	14	22	3	1	53	0.6
606 Mae Rim	56	7,161	25,869	87	60	39	30	28	7	16	3	3	59	1.0
607 Mae Kuang	494	71,676	249,368	91	44	47	36	24	18	26	2	1	53	1.2
609 Mae Lee	159	24,738	85,966	89	48	34	41	27	17	47	3	0.2	52	0.6
611 Ping part 3	233	35,623	126,305	92	59	59	52	19	14	44	2	1	61	2.0
614 Mae Had	31	4,470	14,787	86	81	51	44	15	22	25	3	1	58	-
Middle Sub-Basins	1,344	202,099	704,495	90	50	47	37	20	16	30	3	1	55	1.1
616 Ping part 4	180	24,073	91,036	81	55	38	26	22	4	24	2	4	57	1.1
617 Huay Mae Thor	12	1,664	6,703	83	33	39	22	20	0	16	2	-	54	-
618 Klong Wang Chao	17	1,823	7,749	86	87	52	30	36	4	46	13	39	79	-
619 Klong Mae Raka	45	6,068	23,848	81	62	40	41	43	4	31	5	0.2	44	0.2
620 Klong Suan Mark	50	7,758	30,305	82	33	30	25	33	9	43	2	7	72	-
621 Lower Ping	388	50,301	196,223	81	68	45	31	31	11	38	5	7	66	0.9
Lower Sub-Basins	692	91,687	355,864	81	61	41	29	29	8	34	4	6	62	0.8
Ping Basin	2,692	369,586	1,363,445	87	56	46	36	22	15	30	3	2	59	0.9

**received funds for livelihood development or education

Source: author's analysis using (1) Ping Basin Village-level Basic Data (๓๓๓.2๖) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Given the strong linkage of many of these groups with financial flows, Figure 2-18 also includes data on sources of credit intended for production activities of various sorts. It is interesting to note the general trend toward lower participation along a lower-to-upper sub-basin gradient for producer savings groups, the Bank for Agriculture and Agricultural Cooperatives (BAAC), and commercial banks alike. And this gradient would be even more clear if the Mae Ngad sub-basin is excluded from upper sub-basin averages. The only obvious compensating reverse gradient is in credit received through cooperatives. But the biggest current story in production credit is government revolving funds, which are providing credit for more than 50 percent of all households in all sub-basins except Klong Mae Raka (where it drops to 44 percent). Given the prominent role of rising household debt in public debate about rural poverty, it is difficult to know how much of this credit is actually being used for improving production, versus how much is being used to pay off previously incurred debts from other sources. One wonders, for example, what data on credit from private lenders would look like if there were no government revolving funds, as well as what will be the rate of repayment or default on government revolving funds. In any event, while members of various types of urban elites condemn these government policies for being 'populist' (which they apparently see as something bad), this data suggests they are clearly reaching many people.

In order to help explore potential for local groups that are not as likely to be induced by agencies or sources of household credit, Figure 2-21 presents data on the distribution of villages reporting the presence of local knowledge specialists in various types of topics. One of the first patterns evident in this data is the relatively lower proportion of villages in lower sub-basins that report the presence of any type of local specialist, which carries over into all the specific topic categories. The next most obvious pattern is the clear increase in villages reporting local specialists in natural resources and environment along the lower-to-upper sub-basin gradient. In comparing specialists in upper and middle sub-basins, there appears to be a concentration of artisans and foodstuffs specialists in middle sub-basins. Specialists in cottage industry, village finance, traditional medicine, and religion, tradition and rituals are quite equally widespread among both middle and upper sub-basins.

Figure 2-21. Villages reporting local knowledge specialists, 2003

Sub-Basin	2003 Reporting population			Village local knowledge specialists									
	Villages reported	Households	Persons reported	at least 1 village specialist	agric	natural resource environ	traditional medic	food-stuffs	cottage industry	artisans	lang culture	religion tradition rituals	village finance
	unit: number	number	number	Percent of villages									
602 Ping part 1	90	12,595	46,651	77	58	57	49	24	60	41	30	42	49
603 Mae Ngad	100	11,276	38,717	91	63	37	46	18	64	28	15	40	60
604 Mae Taeng	52	6,155	26,725	85	52	40	63	15	73	40	37	63	58
608 Mae Khan	170	21,654	79,900	96	74	40	48	29	67	36	32	64	66
610 Mae Klang	41	6,234	24,389	80	51	51	59	15	63	37	24	44	49
612 Mae Chaem upper	51	4,323	25,122	80	57	63	53	4	55	20	12	45	57
613 Mae Chaem lower	76	7,190	32,443	64	37	38	39	9	39	11	13	29	29
615 Mae Teun	77	6,523	29,439	49	34	22	12	6	31	12	3	26	32
Upper Sub-Basins	657	75,950	303,386	81	57	42	45	18	58	29	22	46	52
605 Ping part 2	371	58,431	202,200	87	60	25	44	36	62	44	32	57	61
606 Mae Rim	56	7,161	25,869	91	73	45	57	29	71	38	45	68	64
607 Mae Kuang	494	71,676	249,368	86	63	31	54	27	69	36	24	45	52
609 Mae Lee	159	24,738	85,966	74	49	28	48	16	58	31	21	33	41
611 Ping part 3	233	35,623	126,305	71	48	23	33	15	52	27	18	34	42
614 Mae Had	31	4,470	14,787	71	52	48	39	26	45	42	23	39	39
Middle Sub-Basins	1,344	202,099	704,495	82	58	28	47	26	62	36	25	46	52
616 Ping part 4	181	24,420	92,251	74	50	13	35	24	49	22	7	29	38
617 Huay Mae Thor	12	1,664	6,703	100	100	25	67	17	83	25	25	33	75
618 Klong Wang Chao	17	1,823	7,749	88	59	-	29	24	59	18	6	24	47
619 Klong Mae Raka	45	6,068	23,848	58	36	33	20	16	49	13	7	24	40
620 Klong Suan Mark	50	7,758	30,305	42	30	6	20	8	24	10	-	16	18
621 Lower Ping	388	50,301	196,223	55	41	8	29	11	36	17	7	20	23
Lower Sub-Basins	693	92,034	357,079	61	44	11	30	15	40	18	7	23	29
Ping Basin	2,694	370,083	1,364,960	76	54	27	42	21	56	30	20	40	46

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พชช.26) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

While the presence of these types of specialists does not necessarily imply the current presence of corresponding local groups, it may be an indicator of some of the human resources that are available in sub-basins who might help develop, or at least make valuable contributions to, locally-initiated groups. Accordingly, they may also be able to make important contributions to development of sub-basin organizations.

Given the training support that outside agencies and organizations have been providing for local groups, insights may also be gained from assessment of training activities that are occurring in local communities. Thus, Figure 2-22 presents summary data on the levels of training in different topics (trainees per 1,000 households) received from outside government and private groups in Ping sub-basins during the year prior to village reporting in 2003.

One clear trend in this data is the strong emphasis that has been put on conservation training in upper sub-basins, much of which has been associated with government-induced conservation groups. Training in agriculture has also been substantial, and probably involved various local agriculture groups, and it exceeded levels of conservation training in middle sub-basins. Health training emphasizing nutrition and mother and child care has been conducted at a lower level, but is quite consistently distributed across sub-basins. It is also likely that this involved government-induced groups or “volunteers”. While training in non-agricultural livelihoods has also been fairly well distributed, its relatively low levels are striking, and not at all well matched with the types of local employment data reviewed in this report. Indeed, all non-agricultural occupational training combined was at a lower level than either one of the two major types of health training. The data is not very clear about what types of topics were included in the ‘interest group’ training, which was presumably organized in response to interest in various special topics. But perhaps the most striking pattern in this data is the emphasis of training programs on addressing problems of narcotic drug use, which was a major government campaign during this period.

It is most unfortunate that there is no comparable data available on the presence, types or characteristics of informal local network groups and organizations. While their existence is widely known, information on their distribution and activities is at this point only anecdotal, so that no systematic assessment is possible. They will be, however, very important stakeholders in any effort to support development of sub-basin organizations.

Collectively, all three types of civil society institutions appear eligible to be considered *prachakhom*, which is a new and still quite vaguely defined set of groups or organizations that are gaining legitimacy as part of the governance system in Thailand. This is a particularly important point in terms of their role and sustainability, because of provisions in laws and regulations for relationships between TAO and *prachakhom* organizations. Indeed, TAO recognition of a local *prachakhom* organization can allow it to participate in local government proceedings relevant to the purpose of the organization, and it can even receive TAO support and funding for conducting approved activities. Since many local sub-basin management-related networks demonstrate potential for becoming important building block components of sub-basin management organizations, such links with TAO could prove to be an important means for integration and support at local levels.

Higher level academic institutions

Although most colleges and major universities have long been part of the national government system, many have functioned with a relative degree of independence that sets them apart from regular central and provincial line agencies. Moreover, recent years have brought a growing number of private universities and colleges, as well as institutional reforms under which government universities are moving toward a more parastatal type of status, along with official recognition of community service functions that are part of their official mandate. Various individuals and groups of faculty, staff and students, sometimes organized under institutes, centers or projects, are engaging with local institutions, groups and communities to facilitate and support activities quite relevant to this project. Support for such efforts is being provided by institutions like the Thailand Research Fund, as well as by a range of other public and private sources. Linkages with civil society organizations are also common. While these efforts have a relatively uneven distribution across Ping sub-basins and appear to occur on a relatively *ad hoc* basis, they are having significant impacts in some areas, and they may well be able to make significant contributions to sub-basin level organizations.

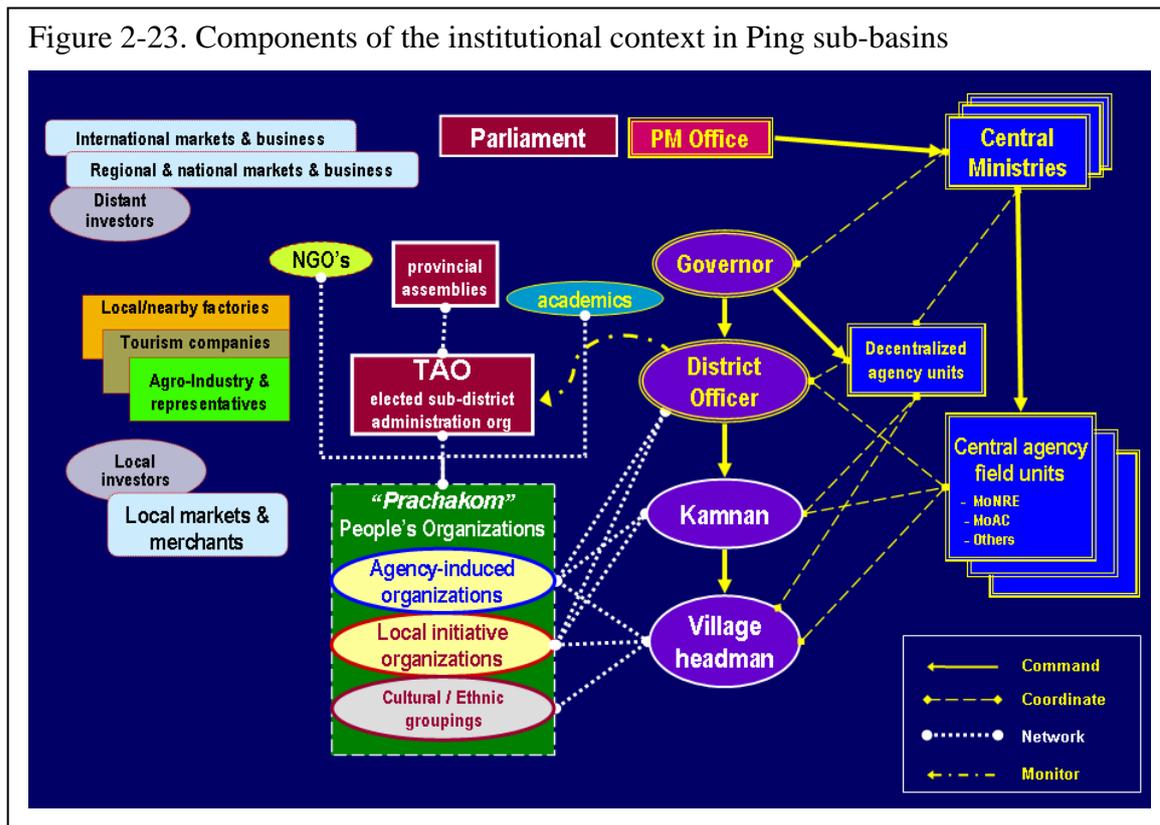
Figure 2-22. Village reported training provided by outside groups, 2003

Sub-Basin	2003 Reporting population			Training Organized by Outside Government & Private Groups												
	Villages reported	House-holds	Persons reported	Occupational					Educational					Health		
	number	number	number	agric	industry	service & trade	skills	other	character	conser- vation	drugs	interest group	other	nutrition	mother & child	other
<i>unit:</i>	number	number	number	Trainees per 1,000 persons												
602 Ping part 1	90	12,595	46,651	13	3	4	1	1	36	75	105	6	1	7	4	-
603 Mae Ngad	100	11,276	38,717	40	4	4	9	0.3	22	18	75	10	2	23	23	3
604 Mae Taeng	52	6,155	26,725	19	1	4	3	3	21	24	46	14	-	12	7	1
608 Mae Khan	170	21,654	79,900	37	3	6	4	1	34	31	95	12	1	18	13	0.2
610 Mae Klang	41	6,234	24,389	17	2	1	1	-	21	30	82	7	-	7	4	0.4
612 Mae Chaem upper	51	4,323	25,122	18	2	4	1	1	33	57	91	6	-	12	11	-
613 Mae Chaem lower	76	7,190	32,443	24	4	15	3	-	11	33	69	13	-	5	16	1
615 Mae Teun	77	6,523	29,439	20	3	-	3	2	34	44	111	21	2	19	23	-
Upper Sub-Basins	657	75,950	303,386	26	3	5	3	1	28	39	87	11	1	14	13	1
605 Ping part 2	371	58,431	202,200	23	3	4	4	2	22	16	73	8	1	15	12	4
606 Mae Rim	56	7,161	25,869	26	4	3	2	2	44	35	70	9	1	11	9	6
607 Mae Kuang	494	71,676	249,368	29	6	7	6	1	52	27	111	13	1	17	16	1
609 Mae Lee	159	24,738	85,966	16	3	2	6	0.4	12	18	52	7	0	9	11	0.1
611 Ping part 3	233	35,623	126,305	30	3	3	5	1	25	19	72	10	1	12	11	2
614 Mae Had	31	4,470	14,787	38	1	3	9	2	45	38	83	5	2	21	7	0.5
Middle Sub-Basins	1,344	202,099	704,495	26	4	4	5	1	33	22	84	10	1	14	13	2
616 Ping part 4	181	24,420	92,251	21	2	3	2	0.3	18	27	131	9	0.4	11	20	0.1
617 Huay Mae Thor	12	1,664	6,703	15	-	3	-	-	6	16	34	4	-	11	24	-
618 Klong Wang Chao	17	1,823	7,749	28	5	2	8	-	67	22	226	7	-	21	21	1
619 Klong Mae Raka	45	6,068	23,848	19	1	3	3	-	9	13	54	3	1	15	9	1
620 Klong Suan Mark	50	7,758	30,305	23	0.3	1	2	-	3	4	53	6	-	14	12	-
621 Lower Ping	388	50,301	196,223	38	2	3	3	1	22	22	133	11	2	17	15	-
Lower Sub-Basins	693	92,034	357,079	31	2	3	2	0	19	21	121	9	2	15	16	0
Ping Basin	2,694	370,083	1,364,960	27	3	4	4	1	28	25	94	10	1	14	14	1

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พชข.2ก) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

(i) Overall Context

Engagement with natural resource management issues in local sub-basin domains must continually be aware of how they may be interacting with local equity and power relations issues [Molle 2002, Neef 2004]. Components of the overall institutional stakeholder context currently found in Ping sub-basins are depicted diagrammatically in Figure 2-23. Various basic components of this diagram were conceived by a team of CMU graduate students studying resource governance institutions and issues in the Mae Chaem sub-basin [Thomas et.al. 2004b]. Although highly simplified, this diagram gives us somewhat of an overview of the institutional stakeholder complexities that sub-basin organizations must face – in addition to institutional factors introduced by the river basin organization system itself.



The role of members in the local administration hierarchy as brokers and coordinators among the complex set of government agencies, local governments and civil society institutions is quite noteworthy, but there are few tools to assure compliance or accountability, and their resources and power appear to be declining. TAOs (and *tessabans*) are seen as a key focus for improved local management in the future, but most do not yet have much capacity regarding natural resource and environment issues, their constituents have not yet pushed for action in these areas, and they have few laws or regulations and little enforcement authority to back them up. Moreover, they have no jurisdiction over stakeholders beyond the sub-district domain. Local civil society groups and sub-watershed management networks have considerable potential for serving as building block organizations and for playing key roles in sub-basin management organizations, and there is potential for stronger links between TAO and these groups and organizations through mechanisms available to provide for interaction with, and even funding for local *prachakom* organizations.

Private sector institutions, groups and individuals are important actors because of the direct impacts of their activities that compete for resources and affect the environment, as well as the more indirect impacts of their influence on livelihoods opportunities in local communities and economic integration and commercialization in the sub-basin.

Subsequent references in this report to major stakeholders and the land use change processes with which they are associated will rely on these discussions.

3. Logic of criteria reflecting current issues

The Ping River Basin project seeks to focus on pilot efforts to develop participatory approaches, methods and tools, and apply them in developing 'model' management organizations in three selected pilot sub-basins, as a prelude to their wider application in other sub-basins. In order to provide the most robust test of this approach as possible, these pilot efforts need to provide a reasonable representation of the conditions, stakeholders and issues discussed in previous sections.

It is both tempting and relatively easy to draft a very long list of selection criteria to consider the substantial range of often fairly complex conditions, actors and issues relevant to our task. It is far more challenging, however, (and no doubt more controversial) to articulate a quite brief list of practical selection criteria. Moreover, these criteria must be subject to assessment by indicators for which secondary data is immediately available for the entire area, and in a form that can be quickly aggregated at the sub-basin level. Considering the nature of much readily available secondary data this has been a very severe limitation on this current exercise.

It is also important to note that the objective of developing criteria and indicators for sub-basin selection is to seek to help inform the decision-making process. Since final decisions on sub-basin selection are intended to be derived from a participatory process among people in the Ping River Basin, it will ultimately be their choice to determine the degree to which these criteria and quantitative indicators play a role in that process.

Given these mandates and limitations, the following modest set of four major selection criteria are proposed, along with necessary sub-criteria required to allow development of indicators that can be implemented with readily available data. The overall structure and logic of the criteria are presented in this section, and summarized in Figure 2-24, whereas development of specific indicators is presented in following sections.

(a) Sub-basin groupings.

The first criterion to be applied in the site selection process provides the basis for logical and systematic assignment of sub-basins into lower, middle and upper sub-basin groups.

Criterion 1. Groupings of middle and upper sub-basins within the Ping River Basin should be made according bias in their relative distribution of land area among lowland, midland and highland zones.

The rationale for and role of this criterion has already been discussed in previous sections, along with a quantitative indicator for which data and calculations have been provided, and discussion of its implications for classifying sub-basins into three groups for further sample selection. It is listed here for completeness in clarifying the overall logic of the proposed pilot site selection criteria.

(b) Severity of natural resource Issues

The overall set of 3 pilot sub-basins needs to include representation of at least three types of key issues directly related to the status and physical condition of natural resources, as summarized in previous sections.

Criterion 2. Selected sub-basins should include conditions making it likely that issues will arise related to forest and land degradation, natural hazards, and water use.

In order to apply this criterion, three more specific sub-criteria are proposed to assess conditions associated with each of the key issues included in this criterion:

Forest and land resource degradation in the Ping River Basin is a major issue in the public policy arena. Moreover, it features prominently in all previous studies, and in the logic and arguments underlying the very existence of this project. Impacts are linked with biodiversity loss and impaired watershed services. Thus,

***Sub-Criterion 2.1.* Priority should be assigned to sub-basins where conversion of forest to agriculture and other uses is substantial, and where deterioration of remaining forest and soil erosion rates are relatively high.**

Natural hazards. Impacts of natural disasters are major concerns both among the general public and in the public policy arena. Floods and landslides make headlines in the media, and have provided major trigger events for revoking logging concessions in national forests (the “logging ban”), launching many emergency assistance programs, and driving new programs for prevention and early warning systems. The recent tsunami disaster is likely to help further intensify such concerns. Thus,

***Sub-Criterion 2.2.* Priority should be assigned to sub-basins where conditions indicate there are high risks of flooding and/or landslides.**

Water use. Competition for water is recognized as an important and growing concern, and it is likely that it will feature prominently among stakeholder negotiations and management tasks faced by all new sub-basin management organizations. Motivation for actions to more effectively manage water use is most likely where irrigated agriculture faces constraints on access to dry season stream flow and groundwater. Thus,

***Sub-Criterion 2.3.* Priority should be assigned to sub-basins where high proportions of irrigated agriculture are associated with low dry season stream flow and high rates of groundwater use. Highest priority should apply in selecting the middle sub-basin.**

(c) Severity of socio-economic issues

While socio-economic issues are (and should be) of major concern under this project, this is the area where constraints on the content and form of available data have been most difficult. Somewhat paradoxically, it is also the area where proliferation of criteria is most tempting and common, due largely to the complexity of many of the considerations involved. Given the focus articulated by this project on poverty and public health, as well as the focus on resource access and competition that includes mountain ethnic minority and urban communities:

***Criterion 3.* Selected sub-basins should include areas where poverty and health problems are relatively high, where land use is restricted and conflict is likely, and areas where upland minorities and/or urban populations should play significant roles.**

In order to apply this criterion, four more specific sub-criteria are proposed to assess conditions associated with each of the key issues included in this criterion:

Poverty. Reduction of rural poverty is a major theme of this project, as well as most major government development programs. Moreover, poverty is often associated with activities leading to environmental deterioration. While average income is one measure of poverty, it is also associated with other issues. Thus,

***Sub-Criterion 3.1.* Priority should be given to areas with relatively low incomes and overall conditions are indicative of economic and social difficulties.**

Land use access and competition. Interests associated with commercial agriculture, forest conservation, and various types of tourism are all seeking substantial expansion of their activities in the Ping River Basin. Especially in midland and highland zones, traditional subsistence-oriented agroecosystems are caught between these powerful expansionist forces, leading to transformations in livelihoods, landscapes and lifestyles. These forces and processes are very often associated with tension and conflict that will be a major challenge for many sub-basin management organizations. Thus,

***Sub-Criterion 3.2.* Priority should be given to areas where legal restrictions constrain local land-based livelihoods, and where agriculture is occurring in conflict with those restrictions. This priority should be highest for the upper sub-basin, but some presence would also be desirable in other sub-basins.**

Ethnicity, settlement density & urbanization. There is a substantial division within northern Thai society between lowland society dominated by ethnic Thai communities in relatively densely settled valley floors and urbanizing areas, and mountain society where more sparsely settled communities have been historically dominated by various ethnic minority groups usually referenced by a single common term (*chao khao*). Minority communities are a major component of the rural poor, and various of their livelihood and land use activities are often, and increasingly, cited as an important issue and cause of environmental deterioration. High settlement densities are associated with population centers where commercial, service and industrial sectors are driving agricultural intensification, urbanization, economic growth and restructuring, and other powerful forces associated with 'modernization' and changing patterns of natural resource use and abuse. More than 60 percent of mountain ethnic minority populations are located in upper sub-basins, whereas high settlement densities are primarily associated with middle and lower sub-basins. Thus,

***Sub-Criterion 3.3.* The upper sub-basin should give priority to areas with strong upland ethnic minority presence, and other sub-basins should give priority to densely settled areas.**

Health. Public health is a major element of concern related to environmental management issues generally, and it features prominently in the logic underlying development of this project. In the context of the Ping River Basin, the currently most commonly perceived aspects of public health that might be improved through basin management relate to illness associated with water-borne diseases or air pollution (including smoke), or with toxic effects from waste products and chemicals increasingly used in agriculture and industry. Thus,

***Sub-Criterion 3.4.* Priority should be given to sub-basins with relatively high levels of health problems associated with clean water supply, waste management, and use of toxic chemicals.**

(d) Local organizational capacity and administrative complexity

While it is clearly important to have representation of conditions under which a reasonable range of natural resource and socio-economic issues are likely to be key elements of pilot sub-basin management activities, it is also important to consider elements affecting the likelihood of significant progress being made under the project. We also need to consider how pilot sub-basins can best serve as role models for other sub-basins with similar overall characteristics. Thus,

***Criterion 4.* Selected sub-basins should have reasonable levels of local organizational capacities and relevant skills, but avoid areas where excessive administrative complexity may prevent adequate testing of model approaches within the project timeframe.**

In order to apply this criterion, three more specific sub-criteria are proposed to assess conditions associated with each of the key issues included in this criterion:

Local organizational capacity. Four components of local organizational capacity are likely to have a substantial effect on the outcome of this project. Of key importance will be the degree to which local governance processes have achieved high levels of participation in community activities, where communities have good experience with local civil society group organizations and networks, and where communities are actively engaged in efforts to learn from their experience and outside sources. If other conditions are relevant, progress in these areas could provide a powerful demonstration effect for areas where these factors are not yet as active. And, since longer term viability and sustainability of these efforts depend on linkage with local governments, it will also be helpful if local governments in pilot sites have a reasonable mix of capacities. Thus,

***Sub-Criterion 4.1.* Priority should be given to sub-basins where local communities have high levels of participation in community activities, where they are experienced with local group organizations, and where they are actively involved in community learning processes. A reasonable mix of capacities of supporting local (sub-district) government should be included.**

Local knowledge and relevant training. Local participation and relevant skills are likely to be very important in a pilot project such as this one. Relevant skills are likely to include a range of issues for which local knowledge and experience with local conditions will be highly relevant. At the same time, since collaboration among stakeholders representing both local interests and the inter-

ests of downstream and wider society are central to the project, it will also very relevant to have a reasonable number of people in the sub-basin who are familiar with the concepts, approaches and tools employed by relevant outside organizations and agencies. Thus,

***Sub-Criterion 4.2.* Priority should be given to sub-basins with relatively widespread presence of relevant local knowledge specialists, as well as a strong cadre of local people who have received relevant training from outside organizations and agencies.**

Administrative simplicity. Given the project's very short time frame, it seems to be wise to try to avoid sub-basins where mis-matches between administrative and watershed boundaries result in a complex set of administrative units that would require major coordination efforts before the project could progress. Thus,

***Sub-Criterion 4.3.* Priority should be given to sub-basins with relatively lower requirements for coordination across administrative units.**

Figure 2-24. Proposed sub-basin criteria and sub-criteria.

- 1 Groupings of Middle and Upper Sub-Basins within the Ping River Basin should be made according to the relative bias in distribution of land area among lowland, midland and highland zones.**
- 2 Selected sub-basins should include conditions where issues will likely arise related to forest and land degradation, natural hazards, and water use.**
 - 2.1 Priority should be assigned to sub-basins where conversion of forest to agriculture and other uses is substantial, and where deterioration of remaining forest and soil erosion rates are relatively high.
 - 2.2 Priority should be assigned to sub-basins where conditions indicate there are high risks of flooding and/or landslides.
 - 2.3 Priority should be assigned to sub-basins where high proportions of irrigated agriculture are associated with low dry season stream flow and high rates of groundwater use. Highest priority should apply in selecting the middle sub-basin.
- 3 Selected sub-basins should include areas where poverty and health problems are relatively high, where land use is restricted and conflict is likely, and areas where upland minorities or urban populations should play significant roles.**
 - 3.1 Priority should be given to areas with relatively low incomes and overall conditions are indicative of economic and social difficulties.
 - 3.2 Priority should be given to areas where legal restrictions constrain local land-based livelihoods, and where agriculture is occurring in conflict with those restrictions. This priority should be highest for the upper sub-basin, but some presence would also be desirable in other sub-basins.
 - 3.3 The upper sub-basin should give priority to areas with strong upland ethnic minority presence, and other sub-basins should give priority to inclusion of densely settled areas.
 - 3.4 Priority should be given to sub-basins with relatively high levels of health problems associated with clean water supply, waste management, and use of toxic chemicals.
- 4 Selected sub-basins should have reasonable levels of local organizational capacities and relevant skills, but avoid areas where excessive administrative complexity may prevent adequate testing of model approaches within the project timeframe.**
 - 4.1 Priority should be given to sub-basins where local communities have high levels of participation in community activities, where they are experienced with local group organizations, and where they are actively involved in community learning processes. A reasonable mix of capacities of supporting local (sub-district) government should be included
 - 4.2 Priority should be given to sub-basins with relatively widespread presence of relevant local knowledge specialists, as well as a strong cadre of local people who have received relevant training from outside organizations and agencies.
 - 4.3 Priority should be given to sub-basins with relatively lower requirements for coordination across administrative units.

4. Severity of natural resource issues

Biophysical dimensions of perceived natural resource degradation in the Ping River Basin are a central focus of concern regarding the sustainable provision of important environmental services, and especially biodiversity and watershed functions. In addition to their implications for maintenance of biodiversity and general ecosystem ‘health’, conservationists are linking deforestation and deterioration of forest quality with decreased infiltration of rainfall into natural soil water and groundwater storage reservoirs, and thus disruption of seasonal stream flows and increased downstream flooding and dry season water scarcity. They also believe changes in soil properties associated with deforestation and agriculture in sloping lands are resulting in increased soil erosion and landslides, with especially serious consequences in local sub-watersheds, but also in contributing to siltation of large reservoirs and water infrastructure at more distant downstream locations. Increased use of water for intensive agriculture and other human activities at various positions in watershed landscapes are seen as further exacerbating water scarcity problems by contributing to low dry season stream flows and groundwater depletion. Sub-basin management organizations will need to develop effective means for addressing these issues and concerns.

Thus, the overall guiding criterion under which sub-criteria and indicators related to natural resource issues are developed is:

Criterion 2. Selected sub-basins should include conditions making it likely that issues will arise related to forest and land degradation, natural hazards, and water use.

This criterion disaggregates overall logic underlying concern about biophysical changes in natural resources into three interrelated elements reflecting major issue areas advanced by components of the population of the Ping River Basin who believe they are suffering from, or are likely to suffer from negative impacts resulting from these changes. In order to implement this criterion, sub-criteria have been developed for each of the three major issue areas included in the overall criterion. They are articulated in the following sections, along with specific indicators that can be used to assess each sub-criterion. An overall picture of the sub-criteria and indicators is provided in Figure 2-25, along with indicator scores for Ping sub-basins where data is available from secondary sources. Overall scores are relative within sub-basin groupings, and relative weights are all 1.0.

(a) Forest and Land Resource Degradation

Forest and land resource degradation in the Ping River Basin is a major issue in the public policy arena, and it features prominently in all previous studies as well as in the logic and arguments underlying this project. Deforestation and forest deterioration are claimed by many to be major primary causes of negative impacts on biodiversity reserves, as well as hydrological regimes, natural disasters, and damage to downstream water resource infrastructure [Tomich 2004]. Thus, the specific sub-criterion related to forest and land resource degradation is:

Sub-Criterion 2.1. Priority should be assigned to sub-basins where conversion of forest to agriculture and other uses is substantial, and where deterioration of remaining forest and soil erosion rates are relatively high.

In order to assess Ping sub-basins according to this sub-criterion, three indicators have been developed, all of which employ a 3-point scale to indicate relative differences among Ping sub-basins. Preliminary calculation of sub-basin scores for each of these indicators can be made from data obtained from Panya and the CMU study. Calculations of indicator values using data from these sources are provided in Figure 2-26.

Indicator 2.1.1: Forest Conversion Score. This indicator provides a single value description of the relative degree to which land in a sub-basin has been converted from forest to ‘non-forest’ types of land use. Thus, a value of three indicates the sub-basin has the highest proportion of its land converted to ‘non-forest’ land cover, and smaller numbers indicate relatively larger proportions of land remain under some type of forest, scrub or grass vegetative cover. Data are derived from interpretation of remote sensing data, and the calculations in Figure 2-26 employ interpretations reported by CMU [2004].

Figure 2-25. Natural Resource Indicator Scoring for Ping Sub-Basins

Sub-Basin	2. Overall Natural Resource Issues		source:	2.1. Degradation			2.2. Hazards		2.3. Water Use		
	Score	weighted total		2.1.1.	2.1.2.	2.1.3.	2.2.1.	2.2.2.	2.3.1.	2.3.2.	2.3.3.
				Forest Conversion Score	Forest Deterior Score	Soil Erosion Score	Flooding Risk Score	Landslide Risk Score	Agric Irrigation Score	Groundwater Use Score	Low Dry Season Flow Score
<i>Upper Sub-Basins</i>				CMU	CMU	Panya	Panya	<<N/A>>	Panya	Panya	Panya
			<i>weight:</i>	0.4	0.5	1.8		-	1.8	0.1	1.4
602 Ping part 1	2.5	8	<i>weight:</i>	1.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0
603 Mae Ngad	2.7	8		0.6	2.4	1.6	1.4	-	0.7	0.0	1.4
604 Mae Taeng	3.0	9		0.6	0.3	1.6	1.2	-	2.3	0.1	2.2
608 Mae Khan	2.8	8		0.7	0.2	1.4	2.8	-	2.7	0.0	0.8
610 Mae Klang	1.9	7		0.5	0.4	1.8	1.4	-	3.0	0.5	0.7
612 Mae Chaem upper	*	*		0.5	0.5	2.3	1.6	-	1.5	0.0	1.0
613 Mae Chaem lower	0.0	6		*	*	*	*	-	*	*	*
615 Mae Teun	2.2	8		0.3	0.1	1.6	1.6	-	0.9	0.0	0.9
			0.2	0.4	2.3	1.3	-	1.1	0.0	2.4	
<i>Middle Sub-Basins</i>				1.0	0.9	1.0		-	1.9	1.3	1.8
			<i>weight:</i>	1.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0
605 Ping part 2	3.0	13	<i>weight:</i>	2.0	3.0	0.7	1.5	-	1.5	2.2	1.9
606 Mae Rim	1.2	8		0.6	0.6	3.0	1.1	-	1.7	0.1	0.8
607 Mae Kuang	2.9	13		1.3	1.1	0.9	0.8	-	2.5	3.0	3.0
609 Mae Lee	2.1	10		0.8	1.1	0.9	2.2	-	1.7	1.0	2.5
611 Ping part 3	0.0	5		0.5	0.4	0.6	0.6	-	1.1	0.2	1.2
614 Mae Had	0.8	7		0.8	0.6	2.8	0.9	-	1.6	0.1	0.0
<i>Lower Sub-Basins</i>				1.6	1.2	1.2	1.7	-	1.6	0.4	1.9
			<i>weight:</i>	1.0	1.0	1.0	1.0	0.0	1.0	1.0	1.0
616 Ping part 4	1.0	8	<i>weight:</i>	1.1	2.0	1.0	1.0	-	1.2	0.0	1.7
617 Huay Mae Thor	0.0	6		0.2	0.9	1.7	1.0	-	0.3	0.1	2.1
618 Klong Wang Chao	0.6	7		0.7	0.8	1.7	3.0	-	0.2	0.0	0.9
619 Klong Mae Raka	0.8	8		1.3	1.7	0.7	1.1	-	0.7	0.0	2.2
620 Klong Suan Mark	0.4	7		1.1	0.3	1.7	1.4	-	0.7	0.1	1.8
621 Lower Ping	3.0	12		3.0	0.3	1.1	2.2	-	2.0	0.6	2.3
Ping Basin				0.9	0.7	1.4	1.5	-	1.7	0.6	1.6

* combined with lower Mae Chaem data

Figure 2-26. Forest & Land Degradation Indicator Scores for Ping Sub-Basins

Sub-Basin	Land & Cover Areas				Soil	Ratios			Rate	Nat Res Degradation Scores		
	A	B	C	D	E	Forest	Forest	Soil	2.1.1	2.1.2	2.1.3	
	Total Area	Good Forest	Deteriorated Forest	Scrub & Grass	Soil Erosion	Conversion (a-b-c-d)/a	Deterioration (c+d)/b	Erosion e/a	Forest Conversion Score*	Forest Deterioration Score*	Soil Erosion Score**	
	km ²	km ²	km ²	km ²	tons/year			ton km ⁻² yr ⁻¹				
602 Ping part 1	1,978	1,263	392	6	5,698,469	0.16	0.31	2,881	0.56	2.39	1.58	
603 Mae Ngad	1,281	1,032	28	6	3,799,979	0.17	0.03	2,968	0.59	0.25	1.63	
604 Mae Taeng	1,954	1,548	45		4,873,823	0.19	0.03	2,494	0.65	0.22	1.37	
608 Mae Khan	1,808	1,479	36	43	5,912,140	0.14	0.05	3,269	0.49	0.41	1.79	
610 Mae Klang	615	489	19	15	2,527,393	0.15	0.07	4,112	0.53	0.52	2.25	
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*	
613 Mae Chaem lower	3,896	3,531	61	4	11,672,216	0.08	0.02	2,996	0.27	0.14	1.64	
615 Mae Teun	3,147	2,787	136	1	13,222,372	0.07	0.05	4,202	0.25	0.37	2.30	
Upper Sub-Basins	14,678	12,130	716	74	47,706,392	0.12	0.07	3,250	0.42	0.50	1.78	
605 Ping part 2	1,505	451	141	37	1,956,664	0.58	0.39	1,300	2.05	3.00	0.71	
606 Mae Rim	556	420	33		3,041,530	0.18	0.08	5,475	0.65	0.60	3.00	
607 Mae Kuang	2,688	1,464	156	58	4,277,070	0.38	0.15	1,591	1.32	1.11	0.87	
609 Mae Lee	2,082	1,407	118	77	3,299,319	0.23	0.14	1,585	0.81	1.05	0.87	
611 Ping part 3	3,317	2,683	53	90	3,425,324	0.15	0.05	1,033	0.52	0.40	0.57	
614 Mae Had	531	388	22	6	2,713,823	0.22	0.07	5,113	0.76	0.56	2.80	
Middle Sub-Basins	10,678	6,813	524	268	18,713,730	0.29	0.12	1,753	1.01	0.88	0.96	
616 Ping part 4	3,026	1,666	354	90	5,318,599	0.30	0.27	1,757	1.06	2.03	0.96	
617 Huay Mae Thor	645	542	61		1,998,545	0.06	0.11	3,099	0.23	0.85	1.70	
618 Klong Wang Chao	648	471	47		1,952,736	0.20	0.10	3,016	0.70	0.77	1.65	
619 Klong Mae Raka	989	518	93	19	1,216,566	0.36	0.22	1,230	1.27	1.65	0.67	
620 Klong Suan Mark	1,086	730	25	-	3,287,910	0.31	0.03	3,027	1.07	0.26	1.66	
621 Lower Ping	3,135	442	8	8	6,497,799	0.85	0.04	2,073	3.00	0.28	1.14	
Lower Sub-Basins	9,529	4,369	589	118	20,272,155	0.47	0.16	2,127	1.64	1.23	1.17	
Ping Basin	34,885	23,312	1,829	459	86,692,277	0.27	0.10	2,485	0.94	0.75	1.36	

* combined with lower Mae Chaem data

* calculated as (ratio / (max ratio value)) * 3

** calculated as (rate / (max rate)) * 3

That this is an indicator of ‘deterioration’ is a reflection of the widely-held perception that natural forest is the ‘best’ land use in the Ping Basin, and that anything less than large proportions remaining under natural forest will threaten the future environmental sustainability of the basin. As data in Figure 2-26 indicate, however, the most extensive amounts of forest conversion have occurred in middle and lower sub-basins where lowland irrigated agriculture and high density settlements are also common features. Conversion of lowland forest to agricultural and urban uses, however, is seen as the ‘highest and best use’ of land converted from forest, whereas it is perceived that the primary function of sloping land and highland areas should be to provide the reliable water supplies and other environmental services upon which lowland systems depend. Thus, foresters, environmentalists and natural resource management agencies advocate minimum percentage thresholds of natural forest cover required for natural resource sustainability at national, regional, and more recently river basin levels. And, with lowland areas already converted to other use and mountains seen as headwater areas, midland and highland zones are seen as the logical site for remaining natural forest to achieve minimum threshold targets. The basis for and accuracy of such targets may be a topic worthy of more careful assessment and consideration by basin management organizations as they mature in the future [Tomich 2004, Walker 2002, FAO-Cifor 2005].

Indicator 2.1.2: Forest Deterioration Score. This indicator provides a single value description of the relative degree to which remaining forest areas are considered to be in deteriorated condition, scrub or grassland. Thus, a value of 3.0 indicates the sub-basin has the highest proportion of its “forest” cover classified as deteriorated, scrub or grassland, whereas a value of zero indicates it has the highest proportion of its “forest” cover under relatively healthy forest status. These data are again derived from interpretation of remote sensing data, and calculations in Figure 2-26 employ data from CMU [2004]. There is very wide scope for improvement of this indicator, but limitations relate to availability of accurately and appropriately interpreted remote sensing data. In any event, deteriorated forest is seen as an indicator of conditions where negative impacts on the ability of natural forest ecosystems to provide environmental services are likely to be occurring, as well as ‘hot spots’ where further conversion of forest land to other uses may be very likely.

Indicator 2.1.3: Soil Erosion Score. This indicator provides a single value description of the relative rate of estimated soil erosion in a Ping sub-basin. Thus, a value of 3.0 indicates the highest rate of estimated soil erosion among sub-basins. While the basis for these gross estimates has substantial limitations, and differences follow from terrain and soil characteristics as well as land use patterns, this is probably the best readily available indicator for an issue that appears to carry substantial weight in public policy debate. Data on soil erosion estimates used in Figure 2-26 originates at the Department of Land Development, and was obtained from Panya.

In order to help point out some of the technical and methodological issues associated with this type of data, which many people in the policy arena tend to simply accept without question, Figure 2-27 provides an alternative calculation of soil erosion. This calculation is based on estimates of soil erosion made by Dr. Methi Ekasingh and colleagues at the CMU Multiple Cropping Center, using the modified Universal Soil Loss Equation (USLE), which were then aggregated using the summarized zone function in ArcGIS [Sangchyoswat & Ekasingh 2005]. Unfortunately, since this work was done in association with the pilot provincial decision support systems for agricultural resource planning and management they have developed for three provinces in the upper North, data are not available for Tak, Kamphaengphet or Nakhon Sawan.

A quick comparison of the score outcomes for upper and middle sub-basins in Figures 2-26 and 2-27 illustrates quite clearly why caution should be used in developing policy conclusions based on wide-scale aggregation of soil erosion data that is commonly circulated in Thailand. Since the DLD data from Panya is the only available dataset that provides coverage of all sub-basins in the Ping River Basin, it has been used in selection criteria calculations. Given the uncertainties involved, however, heavy weight will not be assigned to this variable in making overall calculations.

Figure 2-27. Soil erosion data from an alternative source

Year 2000		Distribution of Soil Erosion					Soil erosion point score	Alternative Relative Soil Erosion Score	
Sub-Basin	Total (ha)	CATEGORIES							
		very low (0 - 2 ton/rai)	low (2 - 5 ton/rai)	moderate (5 - 15 ton/rai)	high (15-20 ton/rai)	very high (> 20 ton/rai)			
		Area (square kilometers)							
		weight:	1	3.5	10	17.5	40		
602	Ping part 1	1,973	1,741	203	24	3	4	1.46	3.00
603	Mae Ngad	1,285	1,166	107	11	1	1	1.31	1.67
604	Mae Taeng	1,958	1,828	115	14	1	1	1.24	1.03
608	Mae Khan	1,833	1,773	52	6	1	1	1.13	0.01
610	Mae Klang	616	579	32	4	1	1	1.26	1.22
612	Mae Chaem upper	2,062	1,970	82	8	1	1	1.17	0.34
613	Mae Chaem lower	1,835	1,709	93	21	4	9	1.45	2.92
615	Mae Teun	-							
Upper Sub-Basins		11,563	10,763	684	88	10	18	1.29	1.46
605	Ping part 2	1,617	1,541	57	16	1	1	1.22	0.79
606	Mae Rim	508	494	11	3	0	0	1.13	-
607	Mae Kuang	2,734	2,630	77	21	2	4	1.21	0.71
609	Mae Lee	2,081	1,951	81	39	3	6	1.40	2.50
611	Ping part 3	3,451	3,351	67	23	3	7	1.20	0.68
614	Mae Had	521	506	7	5	1	2	1.27	1.30
Middle Sub-Basins		10,910	10,472	300	107	10	20	1.25	1.05
616	Ping part 4								
617	Huay Mae Thor								
618	Klong Wang Chao								
619	Klong Mae Raka								
620	Klong Suan Mark								
621	Lower Ping								
Lower Sub-Basins									
Ping Basin									

Source: Data from Sangchyoswat & Ekasingh 2005

(b) Natural Hazards

Impacts of natural disasters are major concerns both among the general public and in the public policy arena. Floods and landslides make headlines in the media, and have provided major trigger events for revoking logging concessions in national forests (the “logging ban”), launching many emergency assistance programs, and driving new programs for prevention and early warning systems. The recent tsunami disaster is likely to help further intensify such concerns. Thus, the specific sub-criterion focusing on natural hazards is:

Sub-Criterion 2.2. Priority should be assigned to sub-basins where conditions indicate there are high risks of flooding and/or landslides.

There are two types of floods that can have very important negative impacts on people and their assets in the Ping River Basin.

- **Main channel floods.** This type of flood occurs when levels of major streams and rivers rise beyond their usual channels to inundate adjacent flood plains and/or other low-lying areas. They are usually associated with fairly sustained and reasonably high rainfall patterns that occur during a similar period of time over a large portion of tributaries feeding catchments that approach the scale of sub-basins or river basins. Individual upper tributaries may be less directly affected, but the cumulative additions of flow from numerous upper tributaries increases the amount of inundation along more distant downstream main river channels. Thus, these types of floods are a more important concern in Middle Ping sub-basins; impact of such flooding is minimized in some Lower Ping sub-basins due to the river flow “buffering capacity” of the Bhumibol reservoir.
- **Flash floods.** This type of flood tends to be associated with more localized extreme rainfall events, combined with particular physical characteristics of local catchments and their spatial

terrain and drainage patterns. Especially when extreme rainfall events are preceded by rain that has already saturated soils in local catchments, flash floods can also be associated with landslides. Since such extreme events are usually rather localized, flash floods (and landslides) have their strongest impacts at scales that are smaller than most sub-basins. Except perhaps in the smallest sub-basins, this would correspond more closely with smaller sub-watersheds (tentatively termed *lumnamyoi* in this report) of tributaries that feed into the main streams and rivers of sub-basins.

Both types of floods can be disastrous for those who are in their path, and accounts in popular media often associate both types with headwater deforestation or other types of land use that are classified as “inappropriate”. Although accurate historical data appears to be quite spotty and scarce, there are popular perceptions that floods and landslides are increasing in frequency.

Unfortunately, this author has been unable to identify readily available data that could be used to develop an indicator of relative risk of flash flood conditions. Data have been identified, however, that could provide a basis for calculating two indicators of natural hazard risks in Ping sub-basins. Data availability, however, has limited implementation in this report to only the first of these two indicators. Calculations are displayed in Figure 2-28:

Figure 2-28. Natural Hazard Indicator Scoring for Ping Sub-Basins

2.2.1						unit: square kilometers				2.2.2			
Sub-Basin	Channel Flood Risk Score					Total	Area Distribution			Landslide Risk Score			Landslide Risk Score
	A	B	C	(b-c)/a	Flood Risk Score		Low or very low	medium	high	Low	Medium	High	
	Q _{ave} a. ave	Q _{max} b. high	Q _{min} c. low	ratio					Relative Weight multiplied by % of area				
									0.00	1.50	3.00		
602 Ping part 1	209	451	69	1.8	1.36	1,974				-	-	-	-
603 Mae Ngad	277	563	126	1.6	1.17	1,285				-	-	-	-
604 Mae Taeng	194	782	51	3.8	2.81	1,958				-	-	-	-
608 Mae Khan	201	441	63	1.9	1.40	1,833				-	-	-	-
610 Mae Klang	179	451	72	2.1	1.57	616				-	-	-	-
612 Mae Chaem upper	*	*	*	*	*	-				-	-	-	-
613 Mae Chaem lower	443	1,093	121	2.2	1.63	3,896				-	-	-	-
615 Mae Teun	249	520	101	1.7	1.25	2,896				-	-	-	-
Upper Sub-Basins						14,458	-	-	-	-	-	-	-
605 Ping part 2	174	398	56	2.0	1.46	1,616				-	-	-	-
606 Mae Rim	71	135	33	1.4	1.07	508				-	-	-	-
607 Mae Kuang	185	281	85	1.1	0.79	2,734				-	-	-	-
609 Mae Lee	170	530	23	3.0	2.22	2,081				-	-	-	-
611 Ping part 3	178	184	43	0.8	0.59	3,452				-	-	-	-
614 Mae Had	197	308	72	1.2	0.89	520				-	-	-	-
Middle Sub-Basins						10,911	-	-	-	-	-	-	-
616 Ping part 4	561	994	253	1.3	0.98	2,983				-	-	-	-
617 Huay Mae Thor	138	244	62	1.3	0.98	644				-	-	-	-
618 Klong Wang Chao	224	916	14	4.0	3.00	649				-	-	-	-
619 Klong Mae Raka	147	305	79	1.5	1.14	902				-	-	-	-
620 Klong Suan Mark	303	611	40	1.9	1.40	1,132				-	-	-	-
621 Lower Ping	879	2,715	127	2.9	2.19	2,980				-	-	-	-
Lower Sub-Basins	314	787	85	2.2	1.66	9,289	-	-	-	-	-	-	-
Ping Basin	237	557	73	2.0	1.52	34,659	-	-	-	-	-	-	-

* combined with lower Mae Chaem data

Indicator 2.2.1: Flooding Risk Score. This indicator provides a single value description of the relative risk of flooding from relatively larger main channels within Ping sub-basins. Its basic formulation and data used for its calculation are directly from Panya Consultants, who used it in their proposal to ONEP and in their earlier study for the Department of Water Resources. Its calculation is based on maximum, minimum and mean flows, as shown in Figure 2-28. Rather than using thresholds based on expert opinion, ratios are converted directly to a score relative to a maximum value of 3 for the sub-basin with the highest ratio. This appears to be the best readily available indicator for main channel flooding risk at this time. Further work is certainly warranted on developing indicators of relative risk of both flash floods and main channel floods.

Indicator 2.2.2: Landslide Risk Score. This indicator would provide a single value description of the relative extent and intensity of landslide risks within a sub-basin. Its calculation could be based on landslide risk maps prepared by the Department of Land Development, as illustrated in Figure 2-29 for their ‘region 6’ area in northern Thailand; similar maps are presumably available for ‘lower’ portions of the Ping Basin that are not included in this map. Considerations in develop-

ing this specific map appear to be based largely on terrain, geology and soil characteristics. Alternatively, landslide risk maps are being developed by other agencies of the Thai government, and any of them could be used if they could be made available in a suitable GIS format. Maps based on high resolution data such as in the slope map in Figure 2-30 would be far more useful at the sub-basin level than generalized maps commonly displayed in government agency offices and meetings. Maps need to be in a GIS spatial data format so that they can be combined with sub-basin boundaries to obtain proportions of land area in each sub-basin contained in each landslide risk class. Proportions are then weighted according to their degree of risk on a scale of zero to three. Thus, at the extremes, a value of 3.0 indicates all areas in a sub-basin are subject to high landslide risk, whereas a value of zero indicates all areas have a low or very low risk level. Since it has not yet been possible to obtain spatial data versions of DLD landslide risk maps, only the tabular format for calculating landslide risk scores is presented in Figure 2-28.

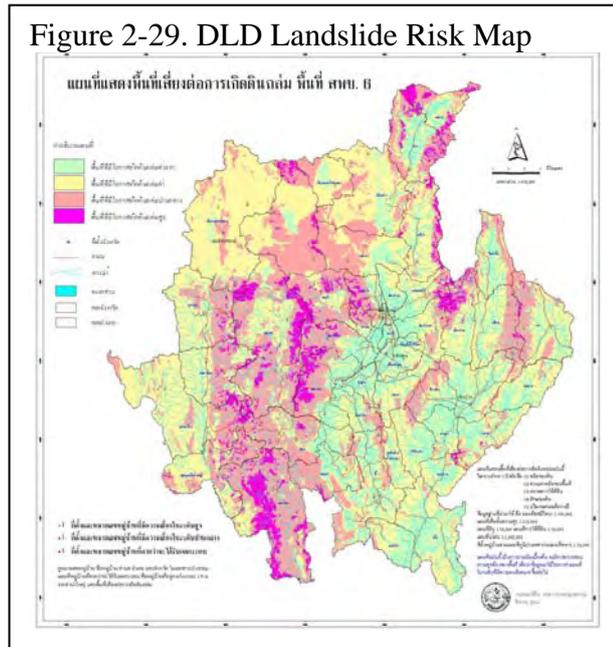
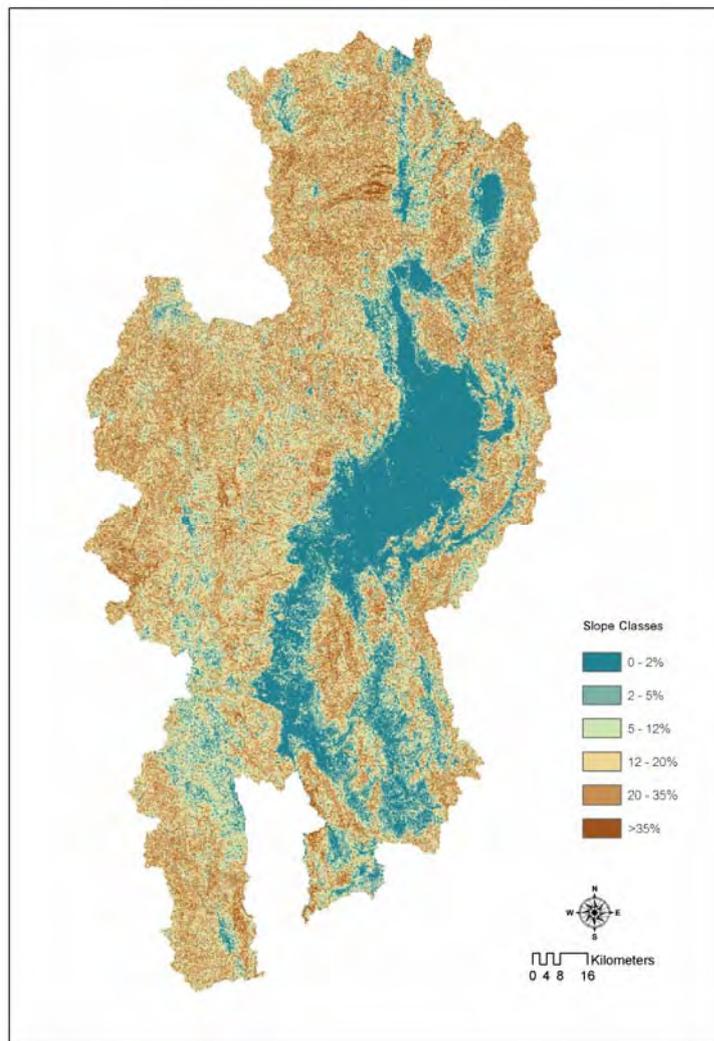


Figure 2-30. Detailed slope map of Upper Ping provinces



Source: Dr. Methi Ekasingh, CMU Multiple Cropping Center

(c) *Water use and competition*

Competition for water is recognized as an important and growing concern, and the threat of major drought conditions last year was an example of the type of conditions where calls for improved water management can become very strong. The government responded by formulating programs in the context of river basin management. It is likely that water use and competition issues will feature prominently among stakeholder negotiations and management tasks faced by all new sub-basin management organizations. Motivation for actions to more effectively manage water use is most likely where irrigated agriculture faces constraints on access to dry season stream flow and groundwater. Thus, the specific sub-criterion focusing on water use and competition is:

Sub-Criterion 2.3. Priority should be assigned to sub-basins where high proportions of irrigated agriculture are associated with low dry season stream flow and high rates of groundwater use. Highest priority should apply in selecting the middle sub-basin.

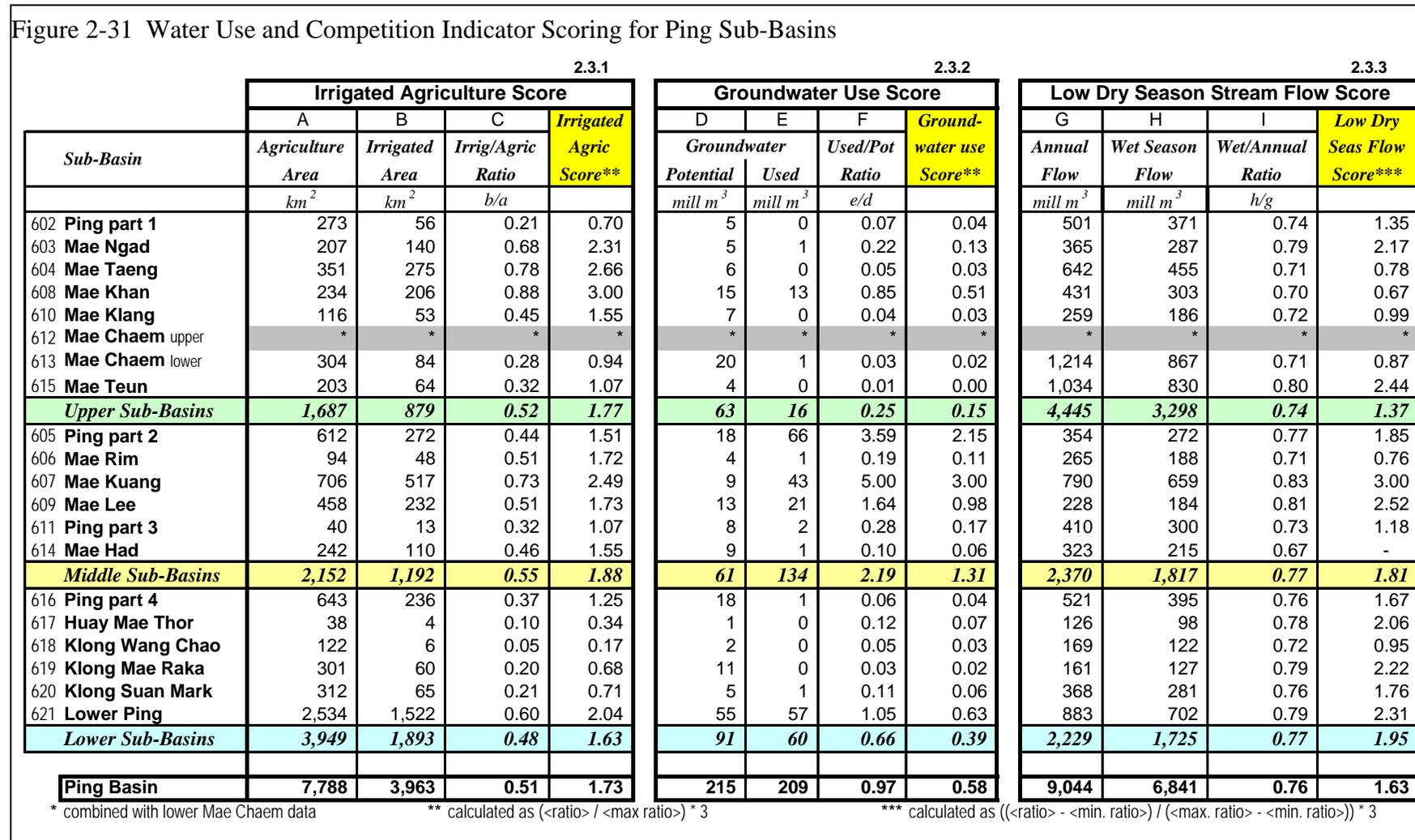
In order to assess Ping sub-basins according to this sub-criterion, three indicators have been adapted, all of which employ a 3-point scale to indicate relative differences among Ping sub-basins. Preliminary calculation of sub-basin scores for each of these indicators can be made from data obtained from Panya Consulting, which presumably originated in the Royal Irrigation Department and the Department of Water Resources. The main current weakness is the inability to separate data for Mae Chaem into the two sub-basins required by ONEP. And, the author suspects that it is quite unlikely that orchards or other areas under sprinkler irrigation are included in the area of irrigated agriculture. It is also unlikely that irrigation from small weirs and tanks outside official irrigation project service areas are included, especially when they are located in midland and highland areas. Similarly, it is not clear how comprehensive are the data on groundwater extraction, or what is the estimated margin of error regarding potential groundwater supply.

Indicator 2.3.1: Agriculture Irrigation Score. This indicator provides a single value description of the relative extent to which agriculture in a sub-basin is irrigated. It is based on the ratio of the area of irrigated agriculture to total agriculture area, relative to a value of 3 for the sub-basin with the highest ratio. Thus, a value of 3.0 indicates the sub-basin has the highest proportion of its agriculture under irrigation, and is therefore most likely to be utilizing a high proportion of its water resources for irrigation. The indicator is calculated in Figure 2-31 using data from Panya.

Indicator 2.3.2: Groundwater Use Score. This indicator provides a single value description the extractions of groundwater in a sub-basin relative to estimates of its potential supply. It is based on the ratio between estimates of groundwater use and supply, relative to a value of 3 for the sub-basin with the highest ratio. Thus, a value of 3.0 indicates the sub-basin with highest extraction of groundwater relative to estimates of groundwater supply, and is therefore most likely to be over-exploiting its groundwater resources. Indicator scores for Ping sub-basins are calculated in Figure 2-31 using data from Panya.

Indicator 2.3.3: Low Dry Season Streamflow Score. This indicator provides a single value description of the degree to which dry season stream flow is a small proportion of total annual stream flow from a sub-basin. Its calculation is based on the proportion of annual stream flow occurring during the wet season. Its value represents position of the sub-basin on a 3-point scale ranging between sub-basins with the highest and lowest ratios of wet season to total annual flow. Thus, a value of 3 indicates the sub-basin has the highest ratio of wet season to total annual flow, and therefore the lowest proportion of its annual flow occurring during the dry season; a value of 0 indicates the sub-basin has the greatest proportion of its total annual flow occurring during the dry season flow. Sub-basin indicator score values are calculated in Figure 2-31 using data from Panya.

All of these indicators are quite standard and were adapted from forms also used by Panya in its study. The main change here from calculations in the Panya study is only to eliminate the expert threshold component of their approach to interpreting the data, in favor of an approach that reflects actual relative values. Calculation tables are presented in Figure 2-31 for all three indicators.



5. Severity of socio-economic issues

Many of the social and economic dimensions of natural resource management, use and deterioration in the Ping River Basin that will need to be high priorities for sub-basin management organizations cluster around issues associated with the equitable social distribution of benefits and costs of natural resource use and management. Rural poverty is widely believed to be both a cause and an effect of resource degradation, and reduction of rural poverty is a very clearly stated major objective of both government policies in general, and this project in particular. Rural poverty is also linked with inequitable access to a range of types of resources and social and financial services, and secure access to use of the land upon which their livelihoods depend has come to the forefront of work with the rural poor around the world.

At the same time, however, there is also growing global recognition that the natural resource base is limited, and that sustainable provision of the environmental services upon which societies depend requires careful management and maintenance of many types of ecosystem functions that are being disrupted or threatened as humans seek to further increase the total amount of immediate benefits they can derive from natural resources. Moreover, different elements of society are developing different visions for the future, and competition is growing among the claims they are making on various components of the natural resource base. This competition is reflected in political and legal arenas and the human institutional arrangements they devise, establish and enforce to facilitate, regulate or restrict how resources may or may not be used.

Clearly, if sub-basin management organizations are to become, as this project envisions, an important means for improving both the equity and sustainability of natural resource use and conservation within their domain, they must be able to include the major elements of society among whom costs and benefits of improved management must be distributed [Tomich et.al. 2004]. As indicated in the general discussion of Ping River Basin stakeholders in section II.B.2., above, this means that ethnic minorities, who have often been marginalized, ignored, or demonized in the past, must be brought into these mechanisms, especially in upper sub-basins and other areas where their activities are believed to have substantial implications for natural resource management. It also means that densely settled cities and urbanizing areas need to have sufficient voice, especially in middle and lower sub-basins where their presence is most prominent.

Also from a social point of view, it is a major objective of improved river basin management is to improve the health and well-being of the people and communities living within their domain. Links between public health and environmental issues is currently an area of growing interest and study, but conclusive empirical analyses will require much more systematic data from monitoring key variables of both public health and environmental quality than are currently available.

Indeed, while socio-economic issues such as these are (and should be) of major concern under this project, this is the area where constraints on the content and form of available data are most severe. It is also the area where proliferation of criteria is most tempting and common, due largely to the complexity of many of the considerations involved. Efforts by organizations such as the National Economic and Social Development Board (NESDB) to develop quality of life and related indicators are an area worthy of further exploration for applications such as this, but the author has not yet seen such data in a format that would allow for aggregation at a sub-basin level in time for initial sub-basin assessments under this project. Some further directions are discussed in section II.B.5(e) on additional socio-economic data.

Therefore, for the purpose of this initial sub-basin selection process, a quite simple and focused criterion is proposed. Since considerable further exploration of socio-economic factors is to be conducted within selected pilot sub-basins, those findings need to be incorporated into the learning processes under the project. This can help assure that the most meaningful and appropriate criteria and indicators possible can be developed for application in adapting and implementing project approaches in other sub-basins and basins.

Thus, given the focus articulated by this project on poverty and public health, as well as the focus of resource access and competition that includes mountain ethnic minority and urban communities, we propose:

Criterion 3. Selected sub-basins should include areas where poverty and health problems are relatively high, where land use is restricted and conflict is likely, and areas where upland minorities or urban populations should play significant roles.

In order to apply this criterion, four more specific sub-criteria are proposed to assess conditions associated with each key issue areas included in this criterion. Sub-criteria and indicators are summarized in Figure 2-32. Overall scores are relative within sub-basin groupings and relative weights are all set to 1.0.

(a) Poverty

Reduction of rural poverty is a major theme of this project, as well as most major government development programs. And, poverty is frequently associated with activities leading to environmental deterioration. While average income is one measure of poverty, it would be much more insightful to have more disaggregated data according to smaller local units and/or sources of income. Data on income distribution would add obvious depth to this assessment. The degree to which the value of subsistence production is captured by income data also needs to be clarified.

Moreover, poverty is also associated with various other issues. Rice deficits have commonly been used as an indicator of poverty in this region. Material indicators of capitalization and wealth have also been used in some studies, and a variety of newer generation indicators are being developed. Information on debt and loan defaults might provide insight into aspects of poverty that are increasingly entering public debate in Thailand. Most all of these indicators, however, require data that are not captured by current monitoring systems, or that are not available in disaggregated enough form to be useful for sub-basin-level calculations.

In its proposal to ONEP, Panya [2004] proposed that the percentage of agriculture that is irrigated be used as a socio-economic indicator. Their own data, however, appears to indicate that this variable has a strong correlation with average income levels, and thus adds little additional information related to poverty. Moreover, we have already chosen to use this data as one of the indicators associated with water use.

Thus, given these considerations and the strong limitations on immediately available data, we propose that:

Sub-Criterion 3.1. Priority should be given to areas with relatively low incomes, and overall conditions indicative of economic and social difficulties.

In order to assess Ping sub-basins according to this sub-criterion using readily available data, two indicators are developed and implemented using data from Panya [2004] and Ekasingh [2005].

Indicator 3.1.1: Low Income Score. This indicator provides a single value estimate of the relative level of sub-basin average income, calibrated to a 3-point scale corresponding to the range between highest and lowest average income levels. Thus, a value of 3.0 indicates the sub-basin has the lowest average income, whereas a value of zero is assigned to the sub-basin with the highest average income level. Calculation of sub-basin scores for this indicator are shown in Figure 2-33.

Calculation of these scores was first implemented using data from Panya Consultants for all sub-basins, as indicated on the left side of Figure 2-33. The original source and method for deriving these data were obscure, and it was noted that these data estimate average per capita income in the 'wealthiest' sub-basin at just over US\$ 1.00 per day. As these appeared to be very low estimates, efforts were made to obtain some alternative sources for comparison.

The only data that were identified as reasonably credible and in a format that could be aggregated to a sub-basin level were again in the databases associated with Dr. Methi Ekasingh's pilot provincial decision support system. These are village-based data that can be stratified by income levels at sub-basin level. As seen in calculations on the right side of Figure 2-33, however, the coverage of this system limits data availability to middle and upper sub-basins, with the exception of Mae Teun.

Figure 2-32. Socio-Economic Indicator Scoring for Ping Sub-Basins

Sub-Basin	3. Overall Social & Economic Issues		source:	3.1. Poverty		3.2. Competition		3.3. Minorities & Urban		3.4. Health			
	Score	weighted total		3.1.1.	3.1.2.	3.2.1	3.2.2	3.3.1	3.3.2	3.4.1	3.4.2	3.4.3	
				Low Income Score	Village Low Development Score	Land Use Restriction Score	Agricultural Conflict Score	Upland Ethnicity Score	Population Density Score	Water Supply Score	Waste Management Score	Pesticide Poisoning Score	
			MCC / Panya	MCC - CDD	KUFF/onep	Panya/onep	ONEP, Panya	Panya	กขช.2ค / onep	กขช.2ค / onep	กขช.2ค / onep		
Upper Sub-Basins				1.6	1.433	2.8	2.3	0.8	0.3	1.4	1.6	0.6	
<i>weight:</i>				1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	
602 Ping part 1	3.0	15		0.8	2.4	2.6	2.2	0.8	0.3	2.8	2.2	0.9	
603 Mae Ngad	0.8	9		1.2	0.6	2.8	1.4	0.3	0.4	2.1	0.3	0.5	
604 Mae Taeng	1.8	12		1.4	2.2	3.0	2.8	0.7	0.3	1.3	2.2	0.1	
608 Mae Khan	0.0	6		1.0	0.4	2.3	1.5	0.5	0.4	0.3	1.6	0.4	
610 Mae Klang	2.3	13		2.2	3.0	2.8	2.6	0.8	0.5	1.2	3.0	0.4	
612 Mae Chaem upper	*	*		*	*	*	*	*	*	*	*	*	
613 Mae Chaem lower	2.7	14		3.0	1.8	2.9	3.0	1.5	0.2	1.9	2.5	0.6	
615 Mae Teun	1.6	11		2.8	0.0	2.9	3.0	1.3	0.1	0.8	1.6	0.9	
Middle Sub-Basins				0.6	0.4	1.8	0.7	0.2	0.8	0.8	1.7	0.4	
<i>weight:</i>				1.0	1.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0	
605 Ping part 2	0.8	6		0.4	0.0	1.0	0.4	0.0	3.0	0.7	1.6	0.6	
606 Mae Rim	2.0	8		0.6	1.2	2.3	1.4	0.0	1.2	1.4	1.9	0.3	
607 Mae Kuang	0.0	4		0.5	0.1	1.6	0.4	0.0	0.8	0.6	1.6	0.1	
609 Mae Lee	1.5	7		1.3	1.2	1.6	0.8	0.5	0.5	1.3	2.2	0.1	
611 Ping part 3	3.0	10		1.1	1.8	2.3	1.1	3.0	0.0	0.8	1.6	0.7	
614 Mae Had	1.4	7		0.0	2.2	2.0	1.6	0.1	0.6	0.4	1.8	2.0	
Lower Sub-Basins				1.5	0.0	1.6	1.0	0.1	0.5	1.7	0.9	2.0	
<i>weight:</i>				1.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
616 Ping part 4	0.6	6		2.1		1.7	0.9	0.1	0.4	0.8	0.8	1.1	
617 Huay Mae Thor	0.0	5		0.8		2.2	1.5	0.2	0.2	0.0	0.7	0.0	
618 Klomg Wang Chao	3.0	10		2.4		2.6	2.2	0.9	0.2	1.5	0.0	0.2	
619 Klomg Mae Raka	1.6	8		2.7		1.2	1.0	0.0	0.2	2.4	0.8	0.0	
620 Klomg Suan Mark	2.5	9		1.5		2.5	1.6	0.1	0.4	3.0	0.7	0.8	
621 Lower Ping	0.6	6		1.1		1.0	0.8	0.1	0.9	2.0	1.1	3.0	
Ping Basin													

* combined with lower Mae Chaem data

Figure 2-33. Low Income Indicator Scoring for Ping Sub-Basins

3.1.1(a)					3.1.1(b)						
Sub-Basin	Low Income Score				Total villages	Total Income distribution				Total low income Point Score	Relative Low Total Income Score
	A	B	b/a	Low Income Score**		Baht/Person					
	total population thous pers	total income thous baht	per capita income baht/pers			<15000	15000- 25000	25000- 35000	>35,000		
					No. of Villages						
					weight:	3.0	2.0	1.0	0.0		
602 Ping part 1	80	739,397	9,269	3.0	76	7	15	12	42	0.83	0.76
603 Mae Ngad	67	861,976	12,868	1.4	93	10	21	30	32	1.10	1.21
604 Mae Taeng	73	785,892	10,812	2.3	62	13	11	13	25	1.19	1.37
608 Mae Khan	106	1,364,536	12,868	1.4	139	13	32	29	65	0.95	0.96
610 Mae Klang	44	557,903	12,538	1.6	36	12	10	5	9	1.69	2.20
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*
613 Mae Chaem lower	96	1,240,193	12,864	1.4	113	52	39	12	10	2.18	3.00
615 Mae Teun	58	639,742	11,099	2.2	<i>estimated based on similarity with Mae Chaem:</i>						2.80
Upper Sub-Basins	524	6,189,639	11,812	1.9	519	107	128	101	183	1.31	1.55
605 Ping part 2	664	10,679,503	16,093	-	399	29	51	56	263	0.61	0.40
606 Mae Rim	85	1,090,705	12,868	1.4	41	2	7	9	23	0.71	0.56
607 Mae Kuang	291	4,031,909	13,856	1.0	429	43	52	61	273	0.69	0.52
609 Mae Lee	148	2,085,664	14,107	0.9	145	22	34	31	58	1.14	1.27
611 Ping part 3	21	252,920	12,129	1.7	99	7	28	27	37	1.05	1.13
614 Mae Had	45	541,019	12,099	1.8	27	-	2	6	19	0.37	-
Middle Sub-Basins	1,253	18,681,719	14,912	0.5	1,140	103	174	190	673	0.74	0.62
616 Ping part 4	172	1,960,130	11,403	2.1							
617 Huay Mae Thor	16	227,620	14,313	0.8							
618 Klong Wang Chao	20	210,334	10,560	2.4							
619 Klong Mae Raka	31	303,745	9,884	2.7							
620 Klong Suan Mark	65	829,308	12,667	1.5							
621 Lower Ping	378	5,104,147	13,498	1.1							
Lower Sub-Basins	682	8,635,285	12,661	1.5							
Ping Basin											

* combined with lower Mae Chaem data

Source: Panya Consultants

Source: Methi Ekasingh, using pilot provincial decision support system data

Thus, the best possible compromise is to use Dr. Methi's data for calculation of relative scores for middle and upper sub-basins, and to continue using Panya data to calculate relative scores for lower sub-basins, as indicated in Figure 2-33. Since the use of these indicators will be to rank sub-basins within each of the three groups, this approach should still not prejudice selection of a given sub-basin among their peers in the same group. This composite system did, however, require an estimate to be made for the Mae Teun sub-basin, which was done by considering its relative similarity to Mae Chaem in the context of other socio-economic data reviewed in previous sections of this report. While obviously far from the ideal, this approach appears reasonable under the circumstances and the purposes for which it is intended.

Indicator 3.1.2: Village Low Development Score. This indicator provides a single value estimate of the relative level of overall development of villages located within a sub-basin. The conceptual framework for this indicator comes from the Community Development Department's 'overall development need' index, which is a composite of 30 indices developed from variables contained in the 2003 national village-level basic database⁶. As this is the same data that were used for direct analyses by the author that presented in many tables in this report, a quick survey of those tables can give a flavor for the types of variables that were available for inclusion in CDD indices. While the precise composition of this CDD index is not known by this author, it is the product of a quite elaborate process that has been conducted under and approved by relevant technocrats and government agencies, and thus reflects the government's views and policies on development.

Initial efforts to develop sub-basin poverty indicators employed an overall economic and social weakness index based on assessments of data on labor, income, productivity and other considerations by a group of experts assembled for the CMU study of the Ping Basin for ONEP [CMU 2004]. According to the CMU report, the expert group considered data from a "wide range of sources" to assign a score that reflected the overall economic and social strength found in each sub-basin. However, as neither ONEP or this author were comfortable with either the ambiguous basis for these judgments, or the extremely limited range of variation that it displayed, this index has been rejected in favor of the CDD development index.

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Figure 2-34. Low Development Indicator Scoring for Ping Sub-Basins

Year = 2003		Level of Development			Level of Development Score				
Sub-Basin	Total (villages)	Index Distribution			Low	Medium	High	Point Score	Relative Low Development Score
		Low(1)	Medium(2)	High(3)					
		No. of Villages			Relative Weight multiplied by %				
		3.00	1.50	0.00					
602 Ping part 1	76	3	39	34	0.12	0.77	-	0.89	2.43
603 Mae Ngad	93	2	21	70	0.06	0.34	-	0.40	0.62
604 Mae Taeng	62	2	30	30	0.10	0.73	-	0.82	2.18
608 Mae Khan	139	-	31	108	-	0.33	-	0.33	0.36
610 Mae Klang	36	2	21	13	0.17	0.88	-	1.04	3.00
612 Mae Chaem upper									
613 Mae Chaem lower	113	3	49	61	0.08	0.65	-	0.73	1.84
615 Mae Teun	-	-	-	-					
Upper Sub-Basins	519	12	191	316	0.07	0.55	-	0.62	1.43
605 Ping part 2	399	-	63	336	-	0.24	-	0.24	-
606 Mae Rim	41	-	15	26	-	0.55	-	0.55	1.16
607 Mae Kuang	429	2	69	358	0.01	0.24	-	0.26	0.07
609 Mae Lee	145	2	49	94	0.04	0.51	-	0.55	1.16
611 Ping part 3	99	2	44	53	0.06	0.67	-	0.73	1.83
614 Mae Had	27	-	15	12	-	0.83	-	0.83	2.22
Middle Sub-Basins	1,140	6	255	879	0.02	0.34	-	0.35	0.43
616 Ping part 4									
617 Huay Mae Thor									
618 Klong Wang Chao									
619 Klong Mae Raka									
620 Klong Suan Mark									
621 Lower Ping									
Lower Sub-Basins									
Ping Basin	1,659	18	446	1,195					

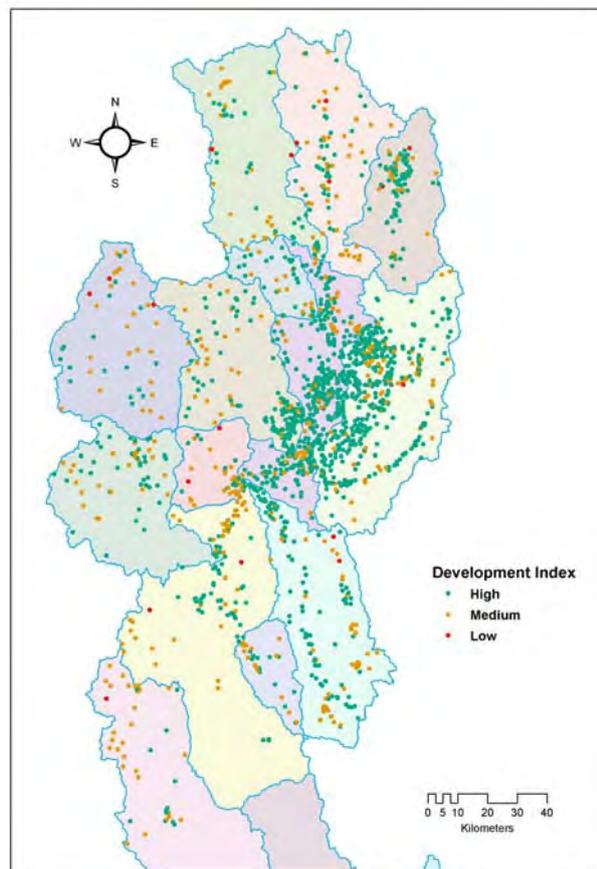
* combined with lower Mae Chaem data

Source: Methi Ekasingh, using CDD data in pilot provincial decision support system

The main problem with implementing this indicator is that the only place that could be identified where it is available in a spatially-linked format is again in Dr. Methi Ekasingh's pilot provincial decision support system. Thus, it is also only available for middle and upper sub-basins, with the exception of Mae Teun. The spatial distribution of available values is shown in Figure 2-35.

Thus, distribution of CDD development index values for villages within a sub-basin is used to calculate a relative low development score for middle and upper sub-basins, as indicated in Figure 2-34. For lower sub-basins where data are not available, this indicator will receive a weight of zero in the overall calculations where it is employed.

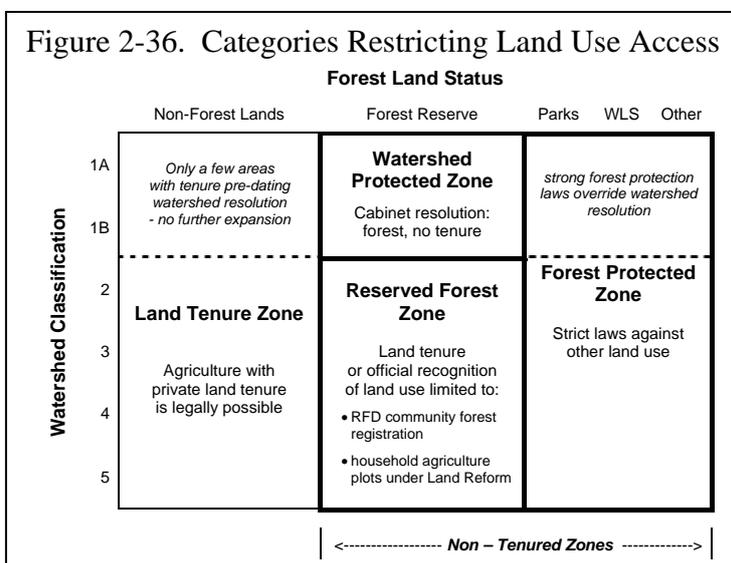
Figure 2-35 . Spatial distribution of village development values in sub-basins



Source: Methi Ekasingh [2005], based on 2003 data from Community Development Department

(b) Land use access and competition

This report has already touched at several points on different and often competing views of natural resource management that are emerging among different components of society. Important land use issues and conflicts are associated with legal and policy restrictions placed on land use in national parks, wildlife sanctuaries, class 1AB watersheds, and reserved forest lands that in aggregate account for 80 percent of the total land area of the Ping River Basin. How these land categories relate to each other are illustrated in Figure 2-36. The relative proportions of a sub-basin’s land area located within each of these categories indicate the potential for issues associated with these restrictions on land use access and security. A rough indication of the relative extent, importance and distribution of these land use restriction zones can be seen in the GIS maps in Figure 2-37.⁷ These maps are constructed using boundary data recently obtained from the Department of National Parks, Wildlife and Plant Conservation provided by ONEP and the Kasetsart University Faculty of Forestry.



Most data appear to be quite current, except that the set of most recently declared national parks, the final boundaries of which are still being negotiated locally, has not been included. As an example of new national parks in this category, the Mae Tho national park in Mae Chaem has been included using preliminary boundary data obtained from local officials and digitized by ICRAF. Many of these new parks are being overlaid on areas that include substantial numbers of local communities, so that local negotiations are often quite difficult and conflict is strong.

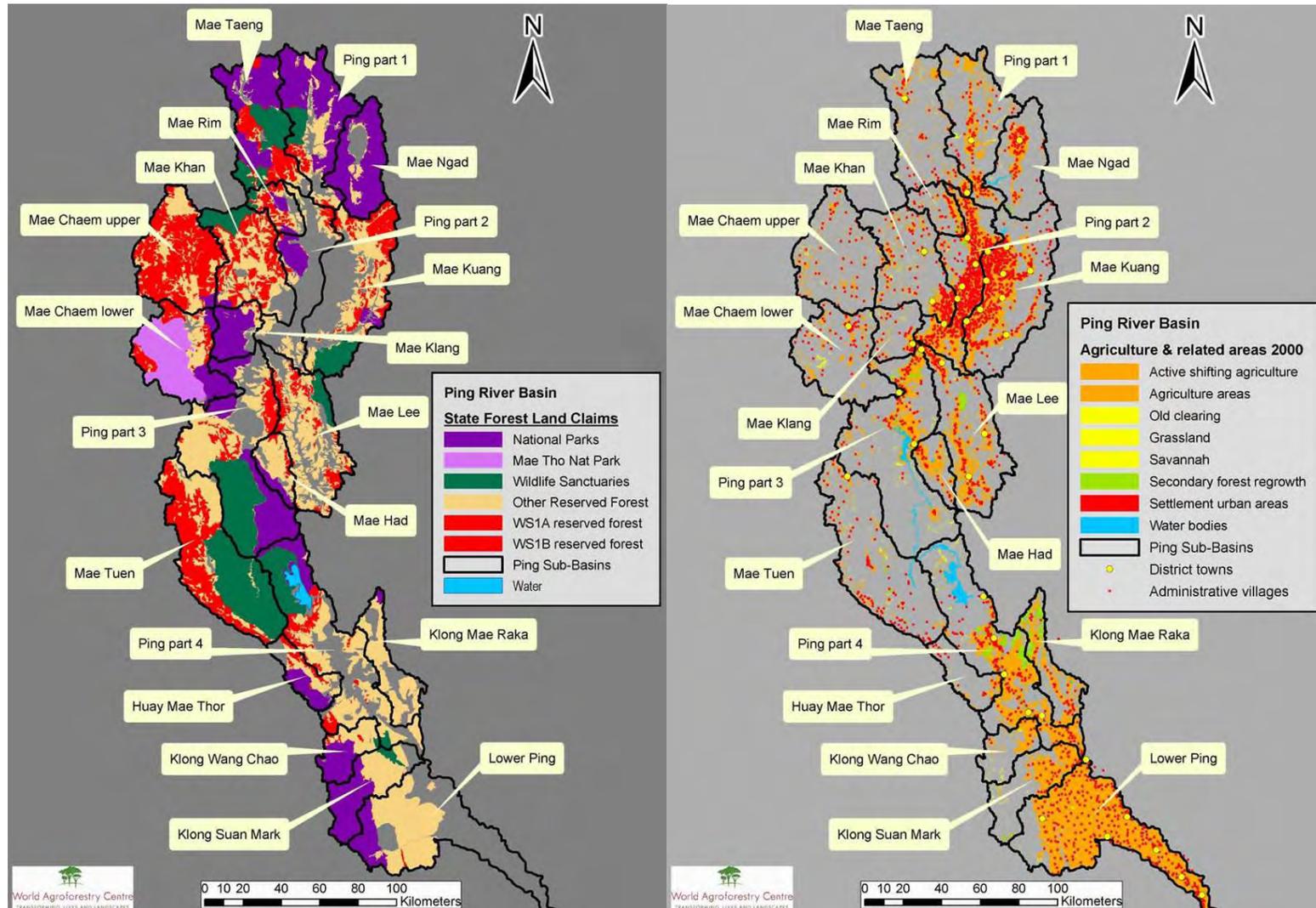
Contrasting views on what is ‘appropriate’ land use between national policy and local community levels is a major and still growing source of conflict in the Ping River Basin. One of the most important sources of conflict associated with land use restrictions imposed by government policies is the presence of agriculture in areas where policies proclaim it to be “inappropriate”. This is seen as an especially important issue in areas that the national land use policy decision making process has declared to be protected forest (national parks and wildlife sanctuaries). It is also an issue in class 1AB watersheds outside of protected areas but now under ‘preparation for protected area’ status, and perhaps to a bit lesser extent in Reserved Forest areas in other watershed classes. Indeed, an even more strongly restrictive category of “special” protected areas from which all people would be relocated without exception is now being proposed by the Minister of Natural Resources and Environment. These issues are strongest in upper sub-basins where, as we have already seen, these national policies seek to transform and very strongly constrain local land-based livelihoods of the majority of people. But they are also locally important in various middle and lower sub-basins where they affect significant and often relatively marginalized components of the population.

Thus, the specific sub-criterion related to land use access and competition is:

Sub-Criterion 3.2. Priority should be given to areas where legal restrictions constrain local land-based livelihoods, and where agriculture is occurring in conflict with those restrictions. This priority should be highest for the upper sub-basin, but some presence would also be desirable in other sub-basins.

⁷ For separate depictions of forest lands and watershed classes see Figure 2-6.

Figure 2-37. Indicators of Land Use Access Constraints and Agricultural Production Areas



Sources: (1) DNP data on forest lands (obtained from KUFF) and land cover (obtained from ONEP); (2) ONEP data on village locations & sub-basin boundaries

In order to assess Ping sub-basins according to this sub-criterion, two indicators are developed. Both indicators require spatial data on the forest land use restriction zones described above.

Indicator 3.2.1. Land Use Restriction Score. This indicator provides a single value estimate of the degree to which forest land use restrictions constrain land use in a given sub-basin. Proportions of the land area of a sub-basin classified in each type of restriction category are weighted according to the relative strength of restrictions applying to that category: National parks and wildlife sanctuaries (protected areas) are protected by strong laws and have a weight of 3. Class 1 watersheds outside national parks and wildlife sanctuaries are governed by cabinet resolutions and their temporary ‘under preparation for protected area’ status, so they have a value of 2. Areas of reserved forest not in either protected areas or class 1 watershed zones have a value of 1 because it is possible to request community forest recognition in these areas, some are already being considered for land reform, and land use restrictions are commonly perceived as less strenuous. Lands outside any of these forest zones are generally available for other types of land use, so they are assigned a weight of zero. Thus, at the extremes, an indicator value of 3.0 indicates all sub-basin land is under protected area status, whereas a value of zero indicates there are no forest land restrictions present.

Calculations of values for this indicator use data that originated in the Department of National Parks, Wildlife and Plant Conservation (DNP), which have been further processed by the author. Boundaries of forest reserves, national parks, wildlife sanctuaries and watershed classification were obtained in GIS shape file format from ONEP and Panya. They were then combined into a single shape file, together with the sub-basin boundaries used for this project, and areas were recalculated for all component polygons. The resulting data table then allows rather straightforward calculation of the Land Use Restriction Indicator Score, as indicated in Figure 2-38. A color coded map of this data is provided in the left side of Figure 2-37.

This land use restriction indicator is an important measure of the overall restrictions that national policy is placing on local land-based livelihoods. The remaining important question related to land use access and competition, however, relates to the degree to which land-based livelihoods of local communities are currently or potentially in conflict with these increasingly strict restrictions. The map of spatial distribution of policy restrictions is paired in Figure 2-37 with a the map showing the distribution of village and urban settlements, as well as agricultural areas detected in the DNP’s 2000 assessment of land use.

Data in the formats used to generate these maps allow us to develop at least a preliminary indicator of the degree to which agricultural dimensions of current local livelihood systems are in conflict, or will be in conflict with national conservation and land use restriction policies.

Indicator 3.2.2: Agriculture Conflict Score. This indicator provides a single value estimate of the degree to which agricultural land use in a sub-basin is currently in conflict with forest land use restrictions meant to constrain land use according to the restriction categories discussed above. Proportions of agricultural land area are weighted according to the strength of the type of restriction category where the conflict occurs. Thus, at the extremes, an indicator value of 3.0 indicates all agricultural land is located within protected areas, whereas a value of zero indicates all agriculture is outside restricted forest lands.

In order to provide data in the format required by these calculations, GIS shape file data processed for the land use restriction indicator were further combined with data on agricultural areas, as determined through interpretation of remote sensing data for the year 2000 by the Department of National Parks, Wildlife and Plant Conservation, which was obtained from ONEP. As indicated in the legend of the map in Figure 2-37, this included areas they identified as ‘agricultural areas’, as well as areas they believed to be ‘active’ (*i.e.* currently cropped) fields in shifting cultivation systems. Resulting polygons were again recalculated, thereby generating a data table from which aggregations could be made in a format compatible with data columns required for calculations in Figure 2-39, resulting in a weighted composite indicator of areas where agriculture is in conflict with the land use policy mandates for these zones.

Figure 2-38. Land Use Restriction Indicator Scoring for Ping Sub-Basins

Sub-Basin	Total	unit: square kilometers				unit: Percent				unit: Score				3.2.1	
		Land Use Restriction Category				Percentage Distribution				Land Use Restriction Score					
		Tenure Non-forest	Reserved Other Reserve	Watrshd IAB not park/wls	Protected Nat Park WL Sanct	Tenure Non-forest	Reserved Other Reserved	Watershed IAB not park/wls	Protected Nat Park WL Sanct	Tenure 0.00	Reserved 1.00	Watershed 2.00	Protected 2.00		Total Point Score
602 Ping part 1	1,974	189	399	111	1,275	10	20	6	65	-	0.20	0.11	1.29	1.61	2.65
603 Mae Ngad	1,285	156	93	4	1,032	12	7	0	80	-	0.07	0.01	1.61	1.68	2.78
604 Mae Taeng	1,958	99	153	392	1,314	5	8	20	67	-	0.08	0.40	1.34	1.82	3.00
608 Mae Khan	1,833	214	690	660	269	12	38	36	15	-	0.38	0.72	0.29	1.39	2.29
610 Mae Klang	616	54	78	21	463	9	13	3	75	-	0.13	0.07	1.50	1.70	2.80
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
613 Mae Chaem lower	3,896	57	859	1,667	1,311	1	22	43	34	-	0.22	0.86	0.67	1.75	2.88
615 Mae Teun	2,896	46	587	1,094	1,152	2	20	38	40	-	0.20	0.76	0.80	1.75	2.89
Upper Sub-Basins	14,458	815	2,860	3,949	6,815	5.6	19.8	27.3	47.1	-	0.20	0.55	0.94	1.69	2.78
605 Ping part 2	1,616	960	352	106	199	59	22	7	12	-	0.22	0.13	0.25	0.59	0.98
606 Mae Rim	508	67	161	147	134	13	32	29	26	-	0.32	0.58	0.53	1.42	2.34
607 Mae Kuang	2,734	996	803	576	352	36	29	21	13	-	0.29	0.42	0.26	0.97	1.60
609 Mae Lee	2,081	578	980	366	156	28	47	18	8	-	0.47	0.35	0.15	0.97	1.60
611 Ping part 3	3,452	429	922	298	1,696	12	27	9	49	-	0.27	0.17	0.98	1.42	2.34
614 Mae Had	520	56	287	55	123	11	55	11	24	-	0.55	0.21	0.47	1.23	2.03
Middle Sub-Basins	10,911	3,085	3,504	1,547	2,660	28.3	32.1	14.2	24.4	-	0.32	0.28	0.49	1.09	1.80
616 Ping part 4	2,983	702	1,071	339	680	24	36	11	23	-	0.36	0.23	0.46	1.04	1.72
617 Huay Mae Thor	644	119	180	114	231	19	28	18	36	-	0.28	0.36	0.72	1.35	2.23
618 Klong Wang Chao	649	4	259	32	353	1	40	5	54	-	0.40	0.10	1.09	1.59	2.62
619 Klong Mae Raka	902	282	587	6	27	31	65	1	3	-	0.65	0.01	0.06	0.72	1.19
620 Klong Suan Mark	1,132	93	391	4	644	8	35	0	57	-	0.35	0.01	1.14	1.49	2.46
621 Lower Ping	2,980	1,512	1,118	12	337	51	38	0	11	-	0.38	0.01	0.23	0.61	1.00
Lower Sub-Basins	9,289	2,712	3,606	508	2,271	29.2	38.8	5.5	24.5	-	0.39	0.11	0.49	0.99	1.63
Ping Basin	34,659	6,613	9,970	6,005	11,747	19	29	17	34	-	0.29	0.35	0.68	1.31	2.16

* combined with lower Mae Chaem data

Figure 2-39. Agricultural Conflict Indicator Scoring for Ping Sub-Basins

Sub-Basin	Total	unit: square kilometers				unit: Percent				unit: Score				3.2.2	
		Agricultural areas located in				Percentage Distribution				Agricultural Conflict Score					
		Tenure	Reserved	Watrshd	Protected	Tenure	Reserved	Watershed	Protected	Tenure	Reserved	Watershed	Protected		Total Point Score
Non-forest	Other Reserve	IAB not park/wls	Nat Park WL Sanct	Non-forest	Other Reserved	IAB not park/wls	Nat Park WL Sanct	Relative Weight multiplied by % of agric area							
								0.00	1.00	2.00	3.00				
602 Ping part 1	501	173	189	5	134	35	38	1	27	-	0.38	0.02	0.80	1.20	2.24
603 Mae Ngad	264	151	70	1	43	57	26	0	16	-	0.26	0.00	0.49	0.76	1.41
604 Mae Taeng	269	85	54	36	94	32	20	13	35	-	0.20	0.27	1.05	1.52	2.83
608 Mae Khan	411	181	162	38	30	44	39	9	7	-	0.39	0.18	0.22	0.80	1.49
610 Mae Klang	96	46	8	0	42	48	8	0	44	-	0.08	0.01	1.32	1.41	2.64
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
613 Mae Chaem lower	432	45	179	110	98	10	41	26	23	-	0.41	0.51	0.68	1.61	3.00
615 Mae Teun	190	29	57	67	37	16	30	35	19	-	0.30	0.70	0.58	1.58	2.96
Upper Sub-Basins	2,163	710	718	257	478	32.8	33.2	11.9	22.1	-	0.33	0.24	0.66	1.23	2.30
605 Ping part 2	1,005	821	153	6	26	82	15	1	3	-	0.15	0.01	0.08	0.24	0.45
606 Mae Rim	128	60	49	11	9	47	38	8	7	-	0.38	0.17	0.20	0.75	1.40
607 Mae Kuang	1,156	918	216	5	16	79	19	0	1	-	0.19	0.01	0.04	0.24	0.45
609 Mae Lee	697	412	269	5	12	59	39	1	2	-	0.39	0.01	0.05	0.45	0.84
611 Ping part 3	563	355	141	3	65	63	25	0	12	-	0.25	0.01	0.35	0.61	1.13
614 Mae Had	206	49	145	2	11	24	70	1	5	-	0.70	0.01	0.15	0.87	1.63
Middle Sub-Basins	3,756	2,614	973	31	138	69.6	25.9	0.8	3.7	-	0.26	0.02	0.11	0.39	0.72
616 Ping part 4	1,022	565	427	15	14	55	42	2	1	-	0.42	0.03	0.04	0.49	0.91
617 Huay Mae Thor	84	44	25	2	13	53	29	3	16	-	0.29	0.05	0.47	0.81	1.52
618 Klong Wang Chao	169	4	148	1	16	2	87	1	9	-	0.87	0.02	0.28	1.17	2.19
619 Klong Mae Raka	372	184	184	2	2	49	50	0	1	-	0.50	0.01	0.02	0.52	0.98
620 Klong Suan Mark	411	89	302	1	19	22	74	0	5	-	0.74	0.00	0.14	0.88	1.64
621 Lower Ping	2,501	1,442	1,054	1	3	58	42	0	0	-	0.42	0.00	0.00	0.43	0.80
Lower Sub-Basins	4,557	2,328	2,140	22	67	51.1	47.0	0.5	1.5	-	0.47	0.01	0.04	0.52	0.98
Ping Basin	10,476	5,652	3,831	310	683	54	37	3	7	-	0.37	0.06	0.20	0.62	1.16

* combined with lower Mae Chaem data

While this indicator is a useful preliminary estimate of these types of social conflict conditions, there are at least four limitations in this data that should be noted: (1) field verification ('ground-truthing') of this land use data has been quite limited; (2) various types of agroforestry practices that maintain substantial tree cover (e.g. *miang* agroforests or rotational forest fallow fields) are not detected as agriculture or secondary forest regrowth, especially in midland and highland zones; (3) local livelihoods in many areas, but especially in midland and highland zones, include substantial land-based components other than the currently cropped fields detected by remote sensing (see Figure 2-7 for conservative estimates reported by village leaders); and (4) land use claims by various interests – including lowland land speculators and tourism interests – are not detectable by this type of remote sensing. Thus, while this indicator is useful for distinguishing relative differences among Ping sub-basins, it should be viewed as a very conservative indicator of the absolute level of conflict between local livelihoods and policies restricting land use in national forestland zones.

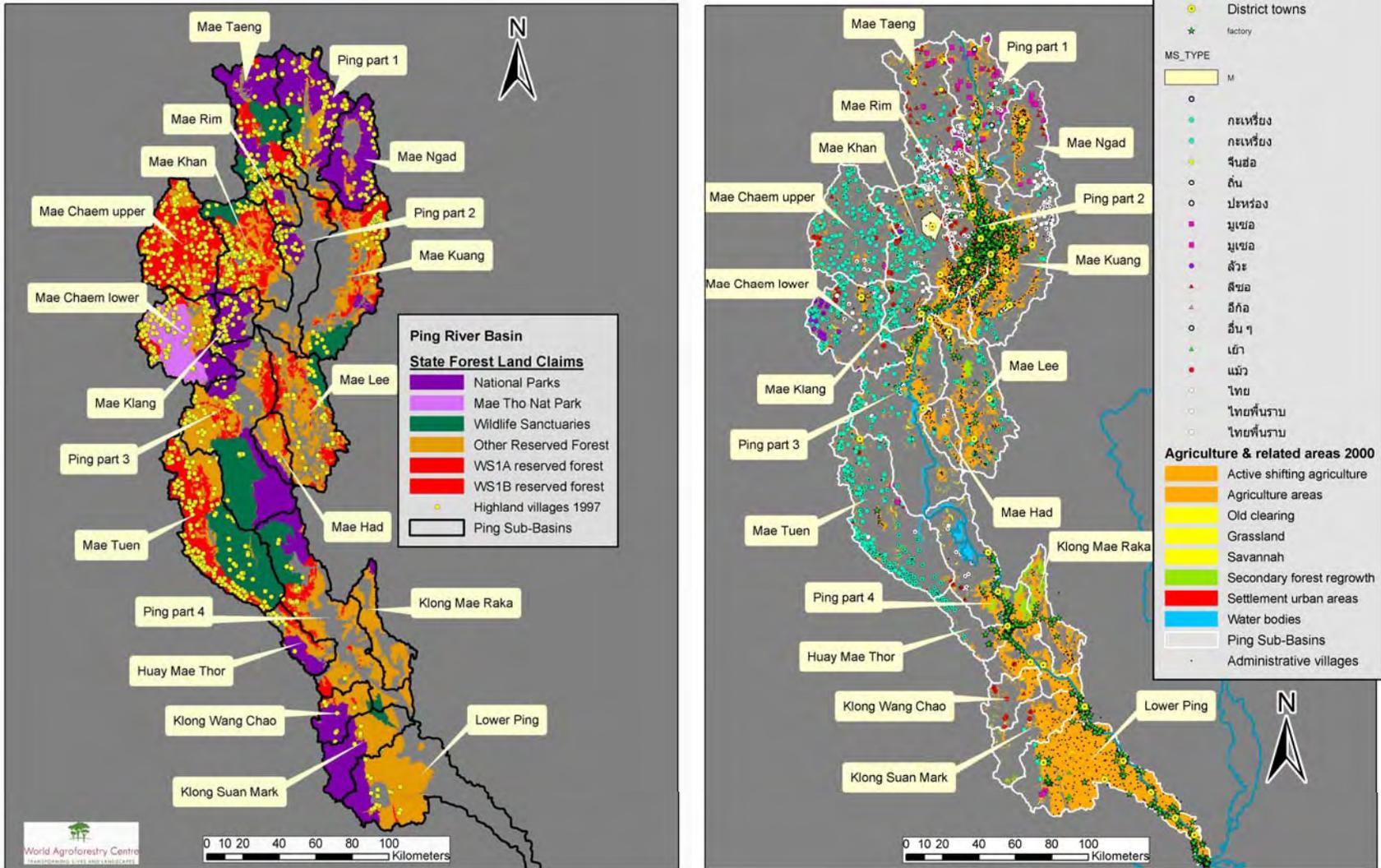
In the longer term, considerations under a category such as this should expand to include agricultural crops or practices that are seen as "inappropriate" in ways that are not reflected in the above indicator. For example, certain types of tree crops and/or conservation farming practices are seen as the only "appropriate" type of land use for areas classified as watershed class 2 or 3. At this time, however, the author is not aware of any spatial datasets that are capable of distinguishing these types of crops or practices in a reliable and systematic manner. If such data could be obtained in the future, however, it could easily be crossed with the watershed classification spatial dataset to identify where 'hotspots' of inappropriate land use exist. A similar approach could be taken for other types of land use considered as "inappropriate" for various types of zones that have been or may be mandated by public policy at various levels. Development of datasets required to implement such an approach could help sub-basin management organizations move beyond the aggregated tables of generalized data that currently dominate discussion of such issues, to being able to identify exactly where and why such discrepancies exist.

(c) *Ethnicity, settlement density and urbanization*

Cultural diversity is an important characteristic that features in most descriptions of northern Thailand, including the Ping River Basin, and a very large portion of this diversity has long been contributed by mountain ethnic minority communities. Historically, the Thailand nation state has taken an approach that excluded most of these communities from direct involvement in mainstream society and its governance institutions, including assignment of citizenship and recognition of their land use systems. Responsibility for these communities was assigned to the Department of Public Welfare and other agencies under special 'highland development' policies. But during the last 15 years, and especially since approval of the 1997 national constitution and associated decentralization and devolution policies, there has been dramatic change in many areas of the Ping Basin. Most communities now have citizenship and official registration, and their communities are incorporated into new village and sub-district local governance mechanisms with status equal (at least in principle and in law) to that of any other citizen of Thailand.

While these changes are promising, there is still substantial division within northern Thai society between lowland society dominated by ethnic Thai communities in relatively densely settled valley floors and urbanizing areas, and mountain society where more sparsely settled by communities historically dominated by mountain minorities referenced by the single term *chao khao*. To help see the distribution of these issues, upland villages and their ethnicity are mapped in Figure 2-40, and ethnic distributions in sub-basins are listed in Figure 2-41. Various livelihood and land use activities of some mountain minorities are often, and increasingly, cited as an important issues and causes of environmental deterioration. Particular focus is directed toward highland communities who have transformed their agriculture to intensive commercial production of horticultural crops, often in response to opium crop substitution programs. A somewhat less, but still quite important target of lowland concern and 'development' programs are midland ethnic minority communities dependent on livelihoods that employ any form of shifting cultivation. Many of these midland communities are also seen as comprising a major component of the rural poor. Given the role of these communities as a special target of poverty and environmental concerns, as well as an important new voice (and vote), especially in upper sub-basins, they clearly need to be included as an important stakeholder in sub-basin management activities.

Figure 2-40. Upland villages, ethnicity, agriculture & forest lands



Sources: (1) DNP data on forest lands (obtained from KUFF) and land cover (obtained from ONEP); (2) ONEP data on village, town & factory locations & sub-basin boundaries

Figure 2-41. Upland population (<500 masl) of sub-basins by ethnic group, 1998

		Upland total	Thai	Haw	Htin	Lawa	Karen	Hmong	Lisu	Lahu	Akha	Yao	Mixed /other
Upper Part of Mae Ping	persons	23,339	5,646	4,071	380	93	1,445	1,017	2,871	6,975	681		160
	households	4,750	1,570	621	62	18	271	126	532	1,395	135		20
	settlements	108	45	2	1	1	12	1	11	31	3		1
Mae Ngad	persons	4,200	352	296			357		1,794	611	790		
	households	817	92	54			78		322	120	151		
	settlements	40	11	1			6		8	8	6		
Mae Taeng	persons	18,552	6,142	1,676			2,176	650	5,236	2,102	451	119	
	households	3,606	1,534	235			393	79	877	387	79	22	
	settlements	125	52	8			21	2	26	13	2	1	
Mae Khan	persons	18,646	3,476			10	11,983	2,809	368				
	households	3,470	824			4	2,215	364	63				
	settlements	132	26			1	91	12	2				
Mae Klang	persons	9,188	151				6,875	2,162					
	households	1,529	43				1,215	271					
	settlements	55	3				49	3					
Upper Part of Mae Chaem	persons	23,545	2,783				17,497	2,797	431	37			
	households	3,706	624				2,774	239	59	10			
	settlements	137	6				119	10	1	1			
Lower Part of Mae Chaem	persons	19,371	1,521			3,989	11,955	1,589	317				
	households	3,425	345			708	2,137	205	30				
	settlements	142	14			20	98	9	1				
Mae Teun	persons	22,101	591				19,641	639	195	1,035			
	households	3,988	118				3,600	73	32	165			
	settlements	154	3				144	3	1	3			
UPPER SUB-BASINS	persons	138,942	20,662	6,043	380	4,092	71,929	11,663	11,212	10,760	1,922	119	160
	households	25,291	5,150	910	62	730	12,683	1,357	1,915	2,077	365	22	20
	settlements	893	160	11	1	22	540	40	50	56	11	1	1
Second Part of Mae Ping	persons	13,170	6,721					4,614	1,217		588		30
	households	2,350	1,572					506	163		99		10
	settlements	49	36					9	2		1		1
Mae Rim	persons	8,297	4,677				2,094	1,291	69	106		60	
	households	1,696	1,137				391	128	13	21		6	
	settlements	68	46				16	3	1	1		1	
Mae Kuang	persons	8,142	4,421				3,721						
	households	2,121	1,201				920						
	settlements	87	69				18						
Mae Li	persons	22,600					22,600						
	households	4,766					4,766						
	settlements	52					52						
Third Part of Mae Ping	persons	18,977	932				17,487	558					
	households	3,966	244				3,660	62					
	settlements	89	6				82	1					
Mae Had	persons	2,146	838				1,308						
	households	547	215				332						
	settlements	7	2				5						
MIDDLE SUB-BASINS	persons	73,332	17,589	-	-	-	47,210	6,463	1,286	106	588	60	30
	households	15,446	4,369	-	-	-	10,069	696	176	21	99	6	10
	settlements	352	159	-	-	-	173	13	3	1	1	1	1
Fourth Part of Mae Ping	persons	3,827	1,902				20	1,804	101				
	households	691	451				4	218	18				
	settlements	15	10				1	3	1				
Huai Mae Tho	persons	1,148					1,148						
	households	222					222						
	settlements	12					12						
Khlong Wang Chao	persons	4,057	454				233	3,069	301				
	households	462					45	353	64				
	settlements	9					1	7	1				
Khlong Mae Raka	persons	-											
	households	-											
	settlements	-											
Khlong Suan Mak	persons	725					237	460	28				
	households	117					49	64	4				
	settlements	4					1	2	1				
Lower Part of Mae Ping	persons	6,692					666	1,241	262	921		3,602	
	households	979					125	160	37	156		501	
	settlements	22					4	1	1	3		13	
LOWER SUB-BASINS	persons	16,449	2,356	-	-	-	2,304	6,574	692	921	-	3,602	-
	households	2,471	451	-	-	-	445	795	123	156	-	501	-
	settlements	62	10	-	-	-	19	13	4	3	-	13	-
Ping River Basin	persons	228,723	40,607	6,043	380	4,092	121,443	24,700	13,190	11,787	2,510	3,781	190
	households	43,208	9,970	910	62	730	23,197	2,848	2,214	2,254	464	529	30
	settlements	1,307	329	11	1	22	732	66	57	60	12	15	2

note: includes some settlements in Maehongson Province located within Ping River sub-basins

source: tabulation by author from 1998 highland village survey and GIS boundaries of sub-basins, both provided by ONEP

Yet another dimension of cultural diversity has been emerging in various major lowland areas of middle and lower sub-basins of the Ping River Basin, where relatively high density settlements are giving rise to processes of urbanization closely linked with national and international markets, information, ideas and world views. These areas are increasingly associated with population centers where commercial, service and industrial sectors are driving agricultural intensification, urbanization, economic growth and restructuring, and other powerful forces associated with ‘modernization’ and changing patterns of natural resource use and abuse, as discussed in earlier sections of this report. This is another important component of Ping River Basin society that cannot be excluded if pilot sub-basin management organizations are to have wider relevance.

Thus, since more than 60 percent of mountain ethnic minority populations are in upper sub-basins, whereas high settlement densities are primarily associated with middle and lower sub-basins:

***Sub-Criterion 3.3.* The upper sub-basin should give priority to areas with strong upland ethnic minority presence, and other sub-basins should give priority to inclusion of densely settled areas.**

In order to assess Ping sub-basins according to this sub-criterion, two indicators are proposed as sufficient for the purposes of this project:

Indicator 3.3:1. Upland Ethnicity Score. This indicator provides a single value estimate of the degree to which issues associated with upland ethnic minority communities are likely to play an important role in sub-basin management activities. It is calculated by assigning a relative upland ethnicity weight to different ethnic components of the sub-basin population. For these purposes, the unitary notion of *chao khao* is replaced by grouping of ethnic components of the population on a basis similar to longstanding practices in Laos that associate ethnic groups with the zones where their cultures and livelihoods were primarily evolving (*Lao loum*, *Lao theung*, *Lao soung*), at least at the beginning of the current era of ‘modernization’, which in Thailand was about 1960. Thus, northern Thai and ‘Haw’ Chinese are combined in the group with lowland traditions, while ethnic Lua, Karen and Htin are combined into a midland traditions group. The highland traditions group includes other ethnic minorities, such as the Hmong, Lisu, Akha, Lahu and Yao. Estimates of the relative magnitude of populations of these groupings in each of the Ping sub-basins from Figure 2-41 are used in the calculations in Figure 2-42.

Although these groupings may at first glance appear to duplicate geographical altitude zone data that was used to group Ping sub-basins under criterion 1, they are fundamentally different in that they are based solely on people and their ethnicity. While it is likely there would have been a strong correlation with geographical altitude zones in the past, these correlations are weakening as lowland Thai communities are established in midland and highland zones, and as various midland and highland groups settle in other zones, sometimes as a result of government policies and programs, and sometimes at their own initiative.

Calculations in Figure 2-42 employ weights for each of these three groupings, meant to indicate the relative intensity of their association in public policy debate with issues linked to natural resource management (see sections I.A.6 and II.B.2). Given the high profile of ethnic groups with highland traditions in environmental and natural resource issues, and their close association with headwater hill evergreen forest areas, a weight of 3 is assigned for these groups. Ethnic minority groups with midland traditions receive a weight of 2, whereas ethnic populations with lowland traditions receive a weight of zero. These weights can be adjusted according to consensus or expert opinion.

Since population data from regular mainstream sources in Thailand do not specify ethnicity, calculation of values for this indicator uses rough estimates constructed by the author by combining data from different sources. Since one essential component is disaggregated demographic data that includes ethnicity, ethnic minority populations have been estimated from a 1997 survey of highland communities in 20 provinces of Thailand [DPW 1998], which was made available in spreadsheet format by Panya and ONEP. Since this data includes ethnicity, village population and point coordinates locating each village, a GIS shape file was constructed, which was then clipped to the Ping River Basin and combined with sub-basin boundaries from ONEP. This allowed aggregation of population by ethnicity, but only for ‘highland community’ components of sub-basin populations.

Figure 2-42. Upland Ethnicity Indicator Scoring for Ping Sub-Basins

		unit: persons			unit: Percent			3.3.1				
Sub-Basin	Traditions: Total	Population Ethnicity			Percentage Distribution			Upland Ethnicity Score			Relative Upland Ethnicity Score	
		Lowland Thai, Haw	Midland Karen, Lua, Htin	Highland Hmong, Lisu Akha, etc	Lowland Thai, Haw	Midland Karen, Lua, Htin	Highland Hmong, Lisu Akha, etc	Lowland	Midland	Highland		Point Score
							Relative Weight multiplied by % of persons					
							0.00	2.00	3.00			
602 Ping part 1	79,771	66,149	2,078	11,544	83	3	14	-	0.05	0.43	0.49	0.83
603 Mae Ngad	66,986	63,434	357	3,195	95	1	5	-	0.01	0.14	0.15	0.26
604 Mae Taeng	72,687	61,953	2,176	8,558	85	3	12	-	0.06	0.35	0.41	0.71
608 Mae Khan	106,041	90,871	11,993	3,177	86	11	3	-	0.23	0.09	0.32	0.54
610 Mae Klang	44,497	35,460	6,875	2,162	80	15	5	-	0.31	0.15	0.45	0.78
612 Mae Chaem upper (with lower)	-	-	-	-	-	-	-	-	-	-	-	*
613 Mae Chaem lower	96,408	57,796	33,441	5,171	60	35	5	-	0.69	0.16	0.85	1.46
615 Mae Teun	57,642	36,132	19,641	1,869	63	34	3	-	0.68	0.10	0.78	1.33
Upper Sub-Basins	524,032	411,795	76,561	35,676	79	15	7	-	0.29	0.20	0.50	0.85
605 Ping part 2	663,600	657,151	-	6,449	99	-	1	-	-	0.03	0.03	0.05
606 Mae Rim	84,761	81,141	2,094	1,526	-	-	-	-	-	-	-	-
607 Mae Kuang	290,988	287,267	3,721	-	99	1	-	-	0.03	-	0.03	0.04
609 Mae Lee	147,846	125,246	22,600	-	85	15	-	-	0.31	-	0.31	0.52
611 Ping part 3	20,852	2,807	17,487	558	13	84	3	-	1.68	0.08	1.76	3.00
614 Mae Had	44,716	43,408	1,308	-	97	3	-	-	0.06	-	0.06	0.10
Middle Sub-Basins	1,252,763	1,197,020	47,210	8,533	96	3.8	0.7	-	0.08	0.02	0.10	0.16
616 Ping part 4	171,896	169,971	20	1,905	99	0	1	-	0.00	0.03	0.03	0.06
617 Huay Mae Thor	15,903	14,755	1,148	-	93	7	-	-	0.14	-	0.14	0.25
618 Klong Wang Chao	19,918	16,315	233	3,370	82	1	17	-	0.02	0.51	0.53	0.91
619 Klong Mae Raka	30,731	30,731	-	-	100	-	-	-	-	-	-	-
620 Klong Suan Mark	65,470	64,745	237	488	99	0	1	-	0.01	0.02	0.03	0.05
621 Lower Ping	378,141	371,449	666	6,026	98	0	2	-	0.00	0.05	0.05	0.09
Lower Sub-Basins	682,059	667,966	2,304	11,789	98	0.3	1.7	-	0.01	0.05	0.06	0.10
Ping Basin	2,458,854	2,276,781	126,075	55,998	93	5.1	2.3	-	0.10	0.07	0.17	0.29

* combined with lower Mae Chaem data

source: tabulation by author from 1998 highland village survey and GIS boundaries of sub-basins, both provided by ONEP

These data were then combined with sub-basin total population estimates from Panya, which are more recent, and the difference between the totals was assumed to consist of lowland ethnic groups not covered by the highland village survey. Given the two different sources and dates for each data set, this is very likely to be somewhat of an underestimate of the absolute numbers of mountain ethnic minorities.⁸ Since the methodology was consistent across all sub-basins, however, comparison of relative proportions across sub-basins should still be valid. Thus, this approach is deemed suitable for the purpose of relative sub-basin assessment at this stage of the project.

There are two additional issues associated with these data and calculations. The first is that comparison of upland ethnic minority populations have some minor differences with calculations derived from Dr. Methi's provincial decision support system database (Figure 2-43). A preliminary rapid assessment of these differences indicate they are associated with higher resolution boundary files and more careful screening of village point locations and data records in Methi's system, as well as with the exclusion of all villages outside Chiang Mai and Lamphun provincial boundaries. The difference in the Lawa population in Mae Chaem, for example, relates largely to several villages that are within the Mae Chaem sub-basin boundaries (according to ONEP data), but within the boundaries of Mae Hong Son province, rather than Chiang Mai.

Figure 2-43. Upland minority data from pilot provincial decision support system.

Year 1999		Distribution of Population Ethnicity													
Sub-Basin	Total persons	Lowland population	Total upland population	Upland Villages											
				Thai	Haw	Htin	Lawa	Karen	Hmong	Akha	Lisu	Muser	Yao	mixed	
1 Ping part 1	46,797	27,673	19,124	2,138	4,071	380	93	1,018		1,017	681	2,731	6,840	-	155
2 Mae Ngad	35,683	31,680	4,003	352	296	-	-	357		-	790	1,462	575	-	171
3 Mae Taeng	23,150	6,989	16,161	4,125	1,676	-	-	2,237		650	451	4,801	2,102	119	-
7 Mae Khan	59,271	42,612	16,659	1,391	-	-	-	11,477		2,809	-	368	-	-	614
9 Mae Klang	23,688	15,436	8,252	-	-	-	-	6,090		2,162	-	-	-	-	-
11 Mae Chaem upper	22,145	-	22,145	2,103	-	-	-	16,131		2,797	-	431	-	-	683
12 Mae Chaem lower	27,586	11,027	16,559	1,272	-	-	1,923	11,096		1,032	-	-	-	-	1,236
14 Mae Teun	-	-	-	-	-	-	-	-		-	-	-	-	-	-
Upper Sub-Basins	238,320	135,417	102,903	11,381	6,043	380	2,016	48,406		10,467	1,922	9,793	9,517	119	2,859
4 Ping part 2	237,885	227,341	10,544	5,257	-	-	-	-		4,614	-	643	-	-	30
5 Mae Rim	17,220	9,935	7,285	3,845	-	-	-	1,894		1,417	-	69	-	60	-
6 Mae Kuang	225,272	220,720	4,552	3,594	-	-	-	958		-	-	-	-	-	-
8 Mae Lee	73,384	62,160	11,224	-	-	-	-	11,224		-	-	-	-	-	-
10 Ping part 3	58,116	46,274	11,842	48	-	-	-	11,236		558	-	-	-	-	-
13 Mae Had	13,195	13,195	-	-	-	-	-	-		-	-	-	-	-	-
Middle Sub-Basins	625,072	579,625	45,447	12,744	-	-	-	25,312		6,589	-	712	-	60	30
15 Ping part 4	-	-	-	-	-	-	-	-		-	-	-	-	-	-
16 Huay Mae Thor	-	-	-	-	-	-	-	-		-	-	-	-	-	-
17 Klong Wang Chao	-	-	-	-	-	-	-	-		-	-	-	-	-	-
18 Klong Mae Raka	-	-	-	-	-	-	-	-		-	-	-	-	-	-
19 Klong Suan Mark	-	-	-	-	-	-	-	-		-	-	-	-	-	-
20 Lower Ping	-	-	-	-	-	-	-	-		-	-	-	-	-	-
Lower Sub-Basins	-	-	-	-	-	-	-	-		-	-	-	-	-	-
Ping Basin	-	-	-	-	-	-	-	-		-	-	-	-	-	-

Source: Dr. Methi Ekasingh, CMU Multiple Cropping Center

The second issue, which will also be relevant to the next indicator, is the author's concern about the total sub-basin population values obtained from Panya. An obvious example for this author is the Mae Chaem sub-basin, where Panya lists a total of more than 96,000 people. When compared with Methi's data (or other data that ICRAF has acquired), there appears to be a discrepancy than is more than what one would expect from some minor boundary differences. Nevertheless, overall population from Panya has continued to be used for consistency sake in calculating the relative rankings of sub-basins for the purposes of this report.

While none of these differences are likely to be significant enough to affect the overall outcome of considerations in which they are being used here, this is a cautionary note that underscores the need for carefully checked common databases that are made available to different stakeholders so that they can avoid misunderstandings resulting from conflicting data obtained from different sources.

Discussions of ethnicity also provide a link with the cultural heritage of each ethnic group, as well as the common heritage of cultural diversity. Since these can relate to visions of preferred future land use and livelihood options, they may also be worthy of further study and learning. The report

⁸ More recent data from 2002 exist, but we have not yet been able to gain access to it.

by CMU [2004] was able to draw on a range of qualitative, localized and often anecdotal data to put together a strong and very informative discussion of river life, culture and problems of primarily lowland Thai communities living in close proximity to main channels of the Ping River. Similar treatment for other groups in the basin could bring additional balance, and perhaps serve as background and resource material for consideration by pilot sub-basin management organizations. Indeed, it is precisely the directions of development and change that are occurring in various high density settlement areas of major lowland valleys that give rise to the second indicator under this sub-criterion.

Indicator 3.3.2: Population Density Score. This indicator provides a single value estimate of the relative population density of sub-basins in the Ping River Basin. Its calculation is straightforward, as indicated in Figure 2-44, based on the ratio between estimates of total population provided by Panya (which should be regarded as tentative) and total land area of each sub-basin as provided by ONEP. Ratio values for each sub-basin (persons per square kilometer) is converted to a 3-point scale of relative population density, wherein the sub-basin with highest population density is assigned a value of 3.0.

Figure 2-44. Population Density Indicator Scoring

3.3.2				
Sub-Basin	Population Density		Population Density	Relative Population Density Score
	People	Land		
	Population	Land Area	per/sq km	
	persons	sq km	per/sq km	
602 Ping part 1	79,771	1,974	40.4	0.30
603 Mae Ngad	66,986	1,285	52.1	0.38
604 Mae Taeng	72,687	1,958	37.1	0.27
608 Mae Khan	106,041	1,833	57.8	0.42
610 Mae Klang	44,497	616	72.2	0.53
612 Mae Chaem upper	(with lower)	(with lower)		*
613 Mae Chaem lower	96,408	3,896	24.7	0.18
615 Mae Teun	57,642	2,896	19.9	0.15
Upper Sub-Basins	524,032	14,458	36.2	0.26
605 Ping part 2	663,600	1,616	410.5	3.00
606 Mae Rim	84,761	508	166.8	1.22
607 Mae Kuang	290,988	2,734	106.4	0.78
609 Mae Lee	147,846	2,081	71.1	0.52
611 Ping part 3	20,852	3,452	6.0	0.04
614 Mae Had	44,716	520	85.9	0.63
Middle Sub-Basins	1,252,763	10,911	114.8	0.84
616 Ping part 4	171,896	2,983	57.6	0.42
617 Huay Mae Thor	15,903	644	24.7	0.18
618 Klong Wang Chao	19,918	649	30.7	0.22
619 Klong Mae Raka	30,731	902	34.1	0.25
620 Klong Suan Mark	65,470	1,132	57.8	0.42
621 Lower Ping	378,141	2,980	126.9	0.93
Lower Sub-Basins	682,059	9,289	73.4	0.54
Ping Basin	2,458,854	34,659	70.9	0.52

* combined with lower Mae Chaem data

Relative sub-basin values of this indicator can also be compared visually with the distribution of administrative villages and municipal areas shown in the map on the right side of Figure 2-37. That figure also indicates the location of district towns, in which significant portions of local populations are concentrated. Although the lower Ping sub-basin has the second largest total population, it is distributed more widely among more dispersed settlements than is the case in middle sub-basins with high overall population densities. And in midland and highland areas of upper sub-basins, populations tend to be even more dispersed than indicated by the distribution of administrative villages, since in these areas administrative villages tend to be composed of multiple small settlements of the same or different ethnic groups (see Figure 2-40). In any event, it is important to emphasize that high-density settlement and urban areas often have a range of important stakeholders in sub-basin management, as discussed in earlier sections of this report, and there are usually multiple sectors that will need to be represented in an effective sub-basin management organization.

(d) Health

Public health is a major element of concern related to environmental management issues generally, and it features prominently in the logic underlying development of this project. In the context of the Ping River Basin, the currently most commonly perceived aspects of public health that might be improved through basin management would include those related to illness linked to sanitation and water-borne diseases associated with water pollution, respiratory illnesses associated with air pollution (including smoke), or illness due to toxic effects from chemicals increasingly used in agriculture and industry. Indeed, agricultural, domestic/urban, and industrial uses of water are seen as the primary causes of decreasing water quality that threatens aquatic and ecological health, as well as the health and well-being of downstream human populations. Thus,

Sub-Criterion 3.4. Priority should be given to sub-basins with relatively high levels of health problems associated with water or air pollution, or use of toxic chemicals.

In order to assess Ping sub-basins according to this sub-criterion, several preliminary health problem indicators were tentatively developed, and very substantial effort was made to identify suitable data sources that could allow them to be implemented. Given the units of aggregation in which readily available health data are reported, however, this has proved to be a daunting task.

Thus, it has proved useful to again turn to data extracted from the national rural development database (၂၀၀၅.၂၈) to identify village-level health data that could be aggregated to sub-basin level. Review of the potentially relevant variables resulted in the data presented in Figure 2-45, as well as data on health care, maintenance and training, as displayed in Figure 2-46. Variables in Figure 2-45 include cases of AIDS, and levels of poultry for sale are an indicator of risk of exposure to avian influenza (bird flu). While there are some interesting patterns of diversity and uniformity in these data, none of the data available directly address the prevalence of water-borne or air pollution disease, or of poisoning from consuming water polluted with toxic substance from agricultural or industrial sources.

There are, however, data that indicate various conditions under which people would be at higher risk of having health problems associated with some of these issues, and data on cases of applicator poisoning from agricultural chemicals. Thus, 3 sub-indicators are developed for purposes here:

Indicator 3.4.1: Village Water Supply Problem Score. This indicator provides a single value description of levels of problems associated with having year-round supply of clean water for drinking and domestic purposes in Ping sub-basins. Its implementation is based on data in Figure 2-44 on households without access to piped water systems, or year-round supplies of clean water for drinking or domestic use. Sub-basin values for each of these component indicators are assigned a weight that can be adjusted according to expert opinion or consensus. Initial calculations assign a weight of 1.0 to piped water, 2.0 to domestic water, and 3.0 to clean drinking water. Weighted values are summed and converted to a 3 point scale. Calculations are presented in Figure 2-47.

Indicator 3.4.2: Village Waste Management Problem Score. This indicator provides a single value description of wastewater and solid waste (trash and garbage) management deficiencies in Ping sub-basin villages. Implementation is based on data in Figure 2-44 on village reported perceptions of whether a problem exists or not, and if it exists whether current management efforts are sufficient to address the problem. Values used to calculate this indicator reflect only conditions where a problem is seen to exist in a village, but where current management efforts are seen as inadequate. The same approach is taken for both wastewater and solid waste and a relative weight can be assigned to each. Initial calculations use a weight of 2.0 to solid waste and 3.0 to wastewater, assuming risk of health problems related to wastewater are somewhat more likely. Weighted values are summed and converted to a 3 point scale. Calculations are presented in Figure 2-47.

Indicator 3.4.3: Pesticide Poisoning Score. This indicator provides a single value description of the relative incidence of cases of poisoning from agricultural chemicals in the sub-basin. Implementation is based on data in Figure 2-44 related to cases of pesticide poisoning per 10,000 persons in the general population. As these levels have already been calculated in Figure 2-44, those values are simply converted to a 3 point scale. Calculations are presented in Figure 2-47.

Figure 2-45. Village reported data related to environmental health issues, 2003

Sub-Basin	2003 Reporting population			Water Supply						Pollution				Work Safety			Major Illness						Risk
	Villages reported	House-holds	Persons reported	Piped		Drinking		Domestic		Wastewater		Garbage		Work Injury	Pesticide Poisoning		teta-nus	hepa-titis B	T.B.	epi-lepsy	AIDS	other ***	poultry for sale
				not in village	hh not using	not clean all year	not enough all year	problem exists	insuffic mgmt	problem exists	insuffic mgmt	# per 10k pers	% of villages		# per 10k pers								
	number	number	number	% vill	%hh	% vill	%hh	% vill	%hh	Percent of villages				sick persons per 10,000 overall population						% vill			
unit:	number	number	number	% vill	%hh	% vill	%hh	% vill	%hh	Percent of villages				sick persons per 10,000 overall population						% vill			
602 Ping part 1	90	12,595	46,651	32	42	1.1	21	1.1	20	14	12	48	32	23	14	17	-	0.9	1	3	23	25	20
603 Mae Ngad	100	11,276	38,717	25	35	-	18	1.0	15	2	2	10	4	15	18	10	0.5	0.5	2	6	20	53	24
604 Mae Taeng	52	6,155	26,725	4	17	1.9	17	1.9	15	19	17	50	29	11	6	2	1.1	0.4	9	5	16	7	23
608 Mae Khan	170	21,654	79,900	6	11	1.8	10	0.6	6	4	1	36	28	13	6	7	-	0.1	5	4	32	50	31
610 Mae Kiang	41	6,234	24,389	17	21	4.9	13	4.9	14	15	12	59	46	20	10	8	-	0.8	1	5	21	9	27
612 Mae Chaem upper	51	4,323	25,122	20	27	2.0	17	-	11	12	10	53	43	91	10	15	-	0.8	2	2	5	14	4
613 Mae Chaem lower	76	7,190	32,443	13	29	2.6	24	2.6	16	-	-	8	5	9	12	9	-	0.6	1	2	7	3	5
615 Mae Teun	77	6,523	29,439	5	10	7.8	23	-	5	5	5	29	25	33	9	17	1.4	-	2	3	2	3	5
Upper Sub-Basins	657	75,950	303,386	15	24	2.4	17	1.2	12	7	6	33	24	23	11	10	0.3	0.5	3	4	19	27	19
605 Ping part 2	371	58,431	202,200	19	29	0.5	4	0.3	4	16	9	39	23	21	10	11	-	0.9	3	2	28	50	42
606 Mae Rim	56	7,161	25,869	20	28	-	13	-	12	4	2	48	32	10	5	5	-	-	-	2	29	108	29
607 Mae Kuang	494	71,676	249,368	12	22	0.4	6	0.8	6	13	11	39	23	20	5	3	0.1	0.3	3	2	18	35	34
609 Mae Lee	159	24,738	85,966	32	40	1.3	6	0.6	3	9	8	45	35	19	4	3	-	0.1	1	3	8	28	9
611 Ping part 3	233	35,623	126,305	16	23	1.3	8	-	6	6	6	39	25	33	14	12	0.2	0.3	4	4	16	21	30
614 Mae Had	31	4,470	14,787	10	14	-	10	-	5	6	6	48	29	135	23	34	-	-	5	7	17	9	29
Middle Sub-Basins	1,344	202,099	704,495	17	26	0.7	6	0.4	5	12	9	40	25	25	8	7	0.1	0.4	3	2	20	38	32
616 Ping part 4	181	24,420	92,251	14	27	0.6	6	0.6	5	4	4	18	12	69	14	19	-	2.5	2	5	3	18	34
617 Huay Mae Thor	12	1,664	6,703	8	9	-	6	-	5	8	8	8	8	55	8	1	-	-	3	4	9	31	25
618 Klong Wang Chao	17	1,823	7,749	24	45	-	5	-	5	-	-	-	-	4	18	5	-	-	3	-	1	5	6
619 Klong Mae Raka	45	6,068	23,848	36	61	2.2	6	-	7	9	2	22	13	10	4	1	-	-	-	5	3	7	36
620 Klong Suan Mark	50	7,758	30,305	40	53	2.0	17	4.0	18	4	4	10	10	9	12	14	-	0.7	2	2	2	9	14
621 Lower Ping	388	50,301	196,223	26	39	2.8	13	2.8	13	10	7	22	15	64	29	51	0.2	2.5	2	5	3	25	21
Lower Sub-Basins	693	92,034	357,079	24	38	2.0	11	2.0	10	8	6	19	13	55	22	34	0.1	2.1	2	5	3	20	24
Ping Basin	2,694	370,083	1,364,960	18	29	1.4	9	1.0	8	10	7	33	22	32	12	15	0.1	0.9	3	3	15	31	27

***especially diabetes, cancer, heart disease

Source: author's analysis using (1) Ping Basin Village-level Basic Data (Table 2.6) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Figure 2-46. Village reported health care services, local knowledge & training, 2003

Sub-Basin	2003 Reporting population			Health care services				Village health maintenance				Outside training			
	Villages reported	House-holds	Persons reported	village health service	tambon hospital	travel time to nearest hospital		trad medic spec	children		exercise - rest		nutri-tion	mother & child	other
	number	number	number	Percent of villages				Percent of villages				trainees per 1,000 persons			
602 Ping part 1	90	12,595	46,651	80	21	44	12	49	47	38	78	24	7	4	-
603 Mae Ngad	100	11,276	38,717	95	3	13	3	46	32	41	67	20	23	23	3
604 Mae Taeng	52	6,155	26,725	90	21	48	27	63	42	37	71	33	12	7	1
608 Mae Khan	170	21,654	79,900	92	15	39	15	48	39	53	84	26	18	13	0
610 Mae Klang	41	6,234	24,389	80	7	34	17	59	54	37	56	20	7	4	0
612 Mae Chaem upper	51	4,323	25,122	63	-	92	80	53	63	25	61	8	12	11	-
613 Mae Chaem lower	76	7,190	32,443	87	18	55	30	39	37	46	58	18	5	16	1
615 Mae Teun	77	6,523	29,439	68	29	75	61	12	29	29	57	9	19	23	-
Upper Sub-Basins	657	75,950	303,386	84	15	47	26	45	41	41	70	21	14	13	1
605 Ping part 2	371	58,431	202,200	91	18	13	-	44	35	41	78	29	15	12	4
606 Mae Rim	56	7,161	25,869	89	-	59	20	57	43	36	79	11	11	9	6
607 Mae Kuang	494	71,676	249,368	91	20	30	3	54	32	39	73	23	17	16	1
609 Mae Lee	159	24,738	85,966	86	20	23	1	48	45	58	73	12	9	11	0
611 Ping part 3	233	35,623	126,305	91	23	29	3	33	44	53	77	17	12	11	2
614 Mae Had	31	4,470	14,787	77	16	6	3	39	39	45	87	19	21	7	0
Middle Sub-Basins	1,344	202,099	704,495	90	19	25	3	47	37	44	76	22	14	13	2
616 Ping part 4	181	24,420	92,251	91	9	34	4	35	22	48	73	19	11	20	0
617 Huay Mae Thor	12	1,664	6,703	100	-	33	17	67	33	83	100	42	11	24	-
618 Klong Wang Chao	17	1,823	7,749	88	-	82	35	29	18	41	88	24	21	21	1
619 Klong Mae Raka	45	6,068	23,848	84	7	40	9	20	29	44	67	16	15	9	1
620 Klong Suan Mark	50	7,758	30,305	80	4	46	-	20	20	52	80	16	14	12	-
621 Lower Ping	388	50,301	196,223	86	17	38	4	29	18	45	73	14	17	15	-
Lower Sub-Basins	693	92,034	357,079	87	13	39	5	30	20	47	74	16	15	16	0
Ping Basin	2,694	370,083	1,364,960	88	16	34	9	42	34	44	74	20	14	14	1

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พชพ.2ก) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Figure 2-47. Health Problem Indicator Scoring for Ping Sub-Basins

Sub-Basin	Total Households	3.4.1 Village Water Supply					3.4.2 Village Waste Management					3.4.3 Chemical Poisoning									
		unit: number	water system	drinking water	domestic water	Water supply problem Point Score	Relative Water Supply Problem Score	Total Villages	waste water	solid waste	Waste management problem Point Score	Relative Waste Management Problem Score	Total Population	agricultural chemical poisoning (pesticide)	Relative Pesticide Poisoning Score						
																percent of households			Problem exists but management absent or inadequate	Waste management problem Point Score	cases per 10,000 persons
																no piped water	not clean all year	not enough all year			
weight:		1.0	3.0	2.0		3.0	2.0				thousands of persons										
602 Ping part 1	12,595	42	21	20	13.65	2.75	90	12	32	11.41	2.21	47	17	0.93							
603 Mae Ngad	11,276	35	18	15	11.19	2.09	100	2	4	1.50	0.29	39	10	0.53							
604 Mae Taeng	6,155	17	17	15	8.15	1.28	52	17	29	11.32	2.19	27	2	0.06							
608 Mae Khan	21,654	11	10	6	4.55	0.31	170	1	28	8.35	1.62	80	7	0.37							
610 Mae Klang	6,234	21	13	14	7.76	1.17	41	12	46	15.48	3.00	24	8	0.42							
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*	*	*	*							
613 Mae Chaem lower	11,513	28	21	14	10.45	1.89	127	4	43	13.12	2.54	58	11	0.61							
615 Mae Teun	6,523	10	23	5	6.31	0.79	77	5	25	8.02	1.55	29	17	0.93							
Upper Sub-Basins	75,950	24	17	12	8.67	1.42	657	6	24	8.03	1.56	303	10	0.55							
605 Ping part 2	58,431	29	4	4	6.14	0.74	371	9	23	8.24	1.60	202	11	0.56							
606 Mae Rim	7,161	28	13	12	8.72	1.43	56	2	32	9.58	1.86	26	5	0.25							
607 Mae Kuang	71,676	22	6	6	5.56	0.58	494	11	23	8.40	1.63	249	3	0.08							
609 Mae Lee	24,738	40	6	3	8.22	1.30	159	8	35	11.47	2.22	86	3	0.09							
611 Ping part 3	35,623	23	8	6	6.29	0.78	233	6	25	8.34	1.62	126	12	0.67							
614 Mae Had	4,470	14	10	5	4.82	0.39	31	6	29	9.49	1.84	15	34	2.00							
Middle Sub-Basins	202,099	26	6	5	6.28	0.78	1,344	9	25	8.78	1.70	704	7	0.37							
616 Ping part 4	24,420	27	6	5	6.22	0.76	181	4	12	4.02	0.78	92	19	1.06							
617 Huay Mae Thor	1,664	9	6	5	3.38	-	12	8	8	3.85	0.75	7	1	0.01							
618 Klong Wang Chao	1,823	45	5	5	9.16	1.55	17	-	-	-	-	8	5	0.24							
619 Klong Mae Raka	6,068	61	6	7	12.30	2.39	45	2	13	4.23	0.82	24	1	-							
620 Klong Suan Mark	7,758	53	17	18	14.58	3.00	50	4	10	3.58	0.69	30	14	0.78							
621 Lower Ping	50,301	39	13	13	10.86	2.00	388	7	15	5.56	1.08	196	51	3.00							
Lower Sub-Basins	92,034	38	11	10	9.87	1.74	693	6	13	4.76	0.92	357	34	1.99							
Ping Basin	370,083	29	9	8	7.66	1.15	2,694	7	22	7.56	1.47	1,365	15	0.84							

* combined with lower Mae Chaem data

(e) Additional socio-economic data

A very wide range of additional socio-economic, cultural and historical data could conceivably be added to the list of sub-criteria and indicators listed in this section. Indeed, data on a range of other variables has already been presented in various tables, and ONEP staff have suggested data related to crime and drugs. In order to help some of these additional lines of possibilities, Figure 2-48 presents village reported data on several variables related to social problems, including people with disabilities, broken families, violence (both self-inflicted and directed toward others), and crimes associated with drug use. Figure 2-49 increases the focus on drug use patterns and social problems associated with them. Various patterns of diversity and uniformity in these data are, indeed, very interesting and could help provide insights on issues that could quite possibly be important for various sub-basin management organizations, as well as for efforts to develop sub-basin support programs or activities at higher levels. The same is true for a considerable range of variables already presented, such as those related to public health (Figures 2-45, 2-46), local knowledge (2-21), education (Figure 2-19), group membership (Figure 2-20), community-level functions (Figure 2-18), employment (Figures 2-12, 2-14), indicators of economic integration (Figure 2-13), and possibly others. A few of these data will contribute to local capacity indicators in the next section.

However, this author does not feel that that inclusion of further issues is practical for inclusion in sub-basin selection criteria in this section at this stage. The most important reason is that the list of sub-criteria and indicators is already perhaps too long to be useful and easily understood. Thus, some difficult decisions are required to establish priorities. Moreover, many of these variables are likely to have substantial co-variance with differences in levels of urbanization, prominence of lowland or upland areas, diversity of ethnic groups, or other factors that various selected sub-criteria and indicators are already seeking to capture. We also need to not lose sight of the fact that many variables will have variation among locations within a sub-basin that is likely to be as great or greater than variation among sub-basins.

Thus, it would appear more appropriate at this stage to view these additional issues as topics for further consideration at the individual sub-basin level. If sub-basin stakeholders and leaders see them as important, such issues could be explored through more detailed assessments conducted in their sub-basin, as well as through discussion with and by emergent sub-basin management organizations in the context of their relevance for consideration and activities under specific conditions and at specific locations. Village level data such as those used in analyses in this report could help provide a starting point for such efforts at sub-basin level.

Figure 2-48. Village reported data related to disabilities and social problems, 2003

Sub-Basin	Disabilities						Broken families	Violence				Social problems due to narcotics users						
	sight	hearing	limbs	psycho-logical	retarded	+home-less		self-injury	suicide	assaults	killings	theft	extortion of users	brawls	disturb-ances	growth center	rape immoral	other
unit:	disabled persons per 10,000 overall population						%hh	cases per 10,000 overall population				Percent of villages						
602 Ping part 1	12	14	34	4	10	6	8	0	2	15	4	9	2	11	18	11	4	11
603 Mae Ngad	10	24	20	9	27	8	8	0	3	3	5	1	2	6	8	6	2	2
604 Mae Taeng	8	9	15	2	10	4	10	3	2	5	1	17	8	10	29	27	4	8
608 Mae Khan	17	20	29	11	25	3	9	0	8	8	1	8	2	4	5	6	2	3
610 Mae Klang	11	23	16	14	16	5	11	3	3	22	3	24	5	27	29	20	2	10
612 Mae Chaem upper	4	16	14	3	19	11	6	0	3	2	1	4	2	2	10	10	0	4
613 Mae Chaem lower	2	2	6	4	5	2	5	1	1	6	4	3	1	1	5	4	1	0
615 Mae Teun	8	19	16	8	10	5	8	0	6	6	-	9	5	5	14	12	3	8
Upper Sub-Basins	10	16	21	7	17	5	8	1	4	8	2	8	3	7	12	10	2	5
605 Ping part 2	9	13	25	7	15	2	12	1	3	10	1	8	2	8	19	12	2	3
606 Mae Rim	22	17	26	7	25	5	12	1	1	38	1	14	5	18	25	14	5	7
607 Mae Kuang	11	12	26	9	16	4	12	0	5	8	1	3	1	6	10	5	0	2
609 Mae Lee	16	14	25	9	15	5	12	1	2	6	1	4	1	4	11	3	1	3
611 Ping part 3	11	15	31	11	17	5	9	1	3	23	3	8	3	11	15	11	3	6
614 Mae Had	15	28	20	16	30	11	9	0	3	55	5	0	0	3	3	0	0	0
Middle Sub-Basins	12	14	26	9	16	3	11	1	3	13	1	6	2	8	14	8	1	3
616 Ping part 4	14	9	33	15	21	3	11	1	2	19	2	7	2	6	12	8	1	6
617 Huay Mae Thor	15	39	36	7	18	7	13	6	3	4	9	0	0	0	0	0	0	0
618 Klong Wang Chao	28	13	40	12	32	1	14	1	4	14	3	12	0	0	18	35	0	29
619 Klong Mae Raka	14	16	26	6	15	8	11	1	11	13	3	2	2	0	2	2	2	2
620 Klong Suan Mark	14	21	32	14	16	7	6	0	4	20	1	12	2	8	10	8	2	6
621 Lower Ping	14	14	38	11	18	11	10	1	5	14	2	5	2	5	7	4	2	4
Lower Sub-Basins	14	14	36	12	19	8	10	1	4	16	2	6	2	5	8	6	1	5
Ping Basin	12	14	28	9	17	5	10	1	4	13	2	6	2	7	12	8	2	4

Source: author's analysis using (1) Ping Basin Village-level Basic Data (พิกัด.2ก) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

Figure 2-49. Village reported data related to drug use, 2003

Sub-Basin	Scale			Known users by type of drug						Known users by occupation						Drug Prevent	trend last year		
	Problem exists	social impacts	Estimated users	Heroin	Opium	Ganga	Amphet- amines	Inhalant	Other types	student	farmer	wage labor	workers	jobless	others	programs present	less	same	more
	Percent of villages		# per 10k pers	Percent of known users						Percent of known users						%vill	% of villages		
602 Ping part 1	50	31	184	7	6	-	87	-	-	12	33	42	10	3	1	96	93	4	2
603 Mae Ngad	49	8	130	0	18	1	81	0	1	3	42	37	11	6	1	100	92	8	-
604 Mae Taeng	62	42	159	2	18	-	78	1	1	3	22	47	6	11	11	98	100	-	-
608 Mae Khan	56	14	99	2	4	-	94	0	-	15	35	33	3	11	3	99	94	5	1
610 Mae Klang	56	37	145	-	6	-	93	1	-	-	10	64	20	6	-	100	91	4	4
612 Mae Chaem upper	37	14	132	3	63	5	29	-	-	-	37	53	-	5	4	100	74	21	5
613 Mae Chaem lower	43	7	108	-	14	-	86	-	-	10	67	13	11	-	-	97	70	27	3
615 Mae Teun	29	18	70	-	59	1	40	-	-	-	31	47	-	5	18	99	100	-	-
Upper Sub-Basins	49	19	126	2	14	0	83	0	0	8	35	39	8	6	3	99	91	8	2
605 Ping part 2	61	24	109	1	1	1	93	3	1	8	6	53	11	21	2	100	96	4	-
606 Mae Rim	64	36	186	-	3	-	93	3	1	11	14	55	13	7	-	100	86	14	-
607 Mae Kuang	43	13	59	1	0	0	92	5	2	15	7	50	4	22	2	99	93	7	-
609 Mae Lee	30	13	58	-	-	1	97	2	-	7	38	43	7	3	1	97	96	2	2
611 Ping part 3	52	24	108	0	1	4	93	2	-	15	30	32	2	17	5	98	91	4	4
614 Mae Had	6	3	18	-	-	-	100	-	-	-	-	100	-	-	-	100	100	-	-
Middle Sub-Basins	48	19	86	1	1	1	93	3	1	11	14	48	8	18	2	99	94	5	1
616 Ping part 4	34	15	73	-	2	10	87	1	-	5	46	42	3	3	1	99	92	8	-
617 Huay Mae Thor	8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	-
618 Klong Wang Chao	71	41	363	-	-	1	99	-	-	-	90	8	-	-	2	100	100	-	-
619 Klong Mae Raka	7	4	10	-	-	67	29	4	-	-	100	-	-	-	-	78	100	-	-
620 Klong Suan Mark	26	16	44	-	-	5	94	2	-	-	7	62	-	32	-	100	92	8	-
621 Lower Ping	26	10	51	-	0	3	93	2	2	10	33	44	4	7	3	96	96	-	2
Lower Sub-Basins	28	12	59	-	1	6	91	1	1	6	45	38	3	5	2	96	94	3	1
Ping Basin	43.0	17	87.8	1	5	2	90	2	1	9	26	43	7	12	2	98	93	6	1

Source: author's analysis using (1) Ping Basin Village-level Basic Data (๓๗๖.2๓) for 2003 (2546) extracted from the national database; (2) a linked GIS file of village point locations; (3) a GIS file of sub-basin boundaries for the Ping Basin. All data provided by ONEP, Ministry of Natural Resources and Environment.

6. Local capacity and administrative complexity

While it is clearly important to have representation of conditions under which a reasonable range of natural resource and socio-economic issues are likely to be key elements of pilot sub-basin management activities, it is also important to consider elements affecting the likelihood of significant progress being made under the project. We should also consider how other sub-basins will view the relevance of project activities in terms of the capacity of their local governments and communities to provide essential support for sub-basin activities. Thus,

Criterion 4. Selected sub-basins should represent a reasonable mix of local organizational capacities and relevant skills, but avoid areas where excessive administrative complexity may prevent adequate testing of model approaches within the project timeframe.

In order to apply this criterion, three more specific sub-criteria are proposed to assess conditions associated with each key issue included in this criterion: Sub-criteria and indicators are summarized in Figure 2-50, where overall scores are relative within sub-basin groupings and relative weights are all set to 1.0.

(a) Local organizational capacity

Two components of the organizational capacity of local institutional actors depicted generally in Figure 2-23 are likely to have a substantial effect on the outcome of this project. Of key importance will be the degree to which very local groups and watershed and/or natural resource management networks have begun to emerge within a given sub-basin. Progress is likely to be most rapid where such groups and networks have emerged as a result of local initiative, where appropriate skills exist based on local knowledge and experience as well as training from outside public and private sources, and where groups have reached the point where they are seeking to build alliances that can allow them to work at a wider level. If other conditions of such sub-basins are relevant, progress in such areas could provide a powerful demonstration effect for areas where such networks are not yet active. Since the longer term viability and sustainability of multi-level networking efforts depends on linkage with local governments, whether with TAOs through the “*prachakhom* window” or through other mechanisms, it is also important that pilot project experience includes sites where capacity of local governments are currently at both low and relatively higher levels. Thus,

Sub-Criterion 4.1. Priority should be given to sub-basins where local communities have high levels of participation in community activities, where they are experienced with local group organizations, and where they are actively involved in community learning processes. A reasonable mix of capacities of local (sub-district) government should be included.

In order to assess Ping sub-basins according to this sub-criterion, four indicators have been developed to capture a few key characteristics. Unfortunately, however, data for three of these indicators is only readily available at this point for middle and upper sub-basins

Indicator 4.1.1: Local Government Capacity Score. This indicator provides a value that reflects the overall composite capacity of local government units in a sub-basin, as characterized by their status as a municipality (*tessaban*) or their TAO rating assigned and monitored by units of the Ministry of Interior (MOI) responsible for monitoring and supporting TAO development.

MOI assigns a rating to all TAO’s in the country, on a scale of 1 to 5, based largely on their overall annual budget; with Class 1 TAO’s having the largest annual budget. The overall annual budget of a TAO reflects its ability to collect local taxes, which in turn reflects a combination of the economic activity and land values of areas under their jurisdiction, as well as the ability of the TAO to levy and collect local taxes. The classification level of the TAO also reflects the number and type of permanent staff positions that the TAO has available to it, which directly affects its ability to handle issues and activities within its mandate. Thus, persistently low TAO ratings reflect some combination of a low level of economic activity, ineffective local leadership, and/or conditions that undermine TAO ability to raise local funds, such as the inability of TAO’s in upper tributary watersheds to collect land taxes in areas zoned to any type of forest land status.

Figure 2-50. Organizational and Administrative Indicator Scoring

Sub-Basin	4. Overall Local Org Capacity & Simplicity		source:	4.1. Capacity				4.2. Specialist Knowledge		4.3. Simplicity	
	Score	weighted total		4.1.1.	4.1.2.	4.1.3	4.1.4	4.2.1.	4.2.2.	4.3.1.	
				Loc Govt Capacity Score	Community Participation Score	Group Organization Score	Community Learning Score	Local Specialists Score	Project-related Training Score	Admin Simplicity Score	
			MOI / onep	MCC - CDD	MCC - CDD	MCC - CDD	กขช.2ค / onep	กขช.2ค / onep	Panya, ONEP		
Upper Sub-Basins				0.5	1.9	1.9	1.7	2.3	2.1	2.6	
<i>weight:</i>				1.0	1.0	1.0	1.0	1.0	1.0	1.0	
602 Ping part 1	1.5	13	<i>weight:</i>	1.1	0.0	1.3	2.7	2.9	2.4	2.5	
603 Mae Ngad	2.0	14		0.0	1.6	2.4	1.9	2.2	3.0	2.8	
604 Mae Taeng	0.7	11		0.2	2.7	0.3	1.9	2.9	0.8	2.4	
608 Mae Khan	3.0	16		1.2	3.0	3.0	1.6	2.6	2.5	2.2	
610 Mae Klang	0.0	10		1.7	1.7	0.0	0.0	2.9	0.3	3.0	
612 Mae Chaem upper	*	*		*	*	*	*	*	*	*	*
613 Mae Chaem lower	1.2	12		0.4	1.9	2.1	1.4	2.1	2.1	2.3	
615 Mae Teun	0.5	11		0.0	1.9	1.9	1.4	0.3	2.5	2.7	
Middle Sub-Basins				1.1	2.3	2.0	1.3	2.1	1.6	1.8	
<i>weight:</i>				1.0	1.0	1.0	1.0	1.0	1.0	1.0	
605 Ping part 2	1.3	12	<i>weight:</i>	3.0	2.5	2.0	1.2	2.0	1.2	0.0	
606 Mae Rim	2.9	14		0.2	1.9	1.6	3.0	3.0	1.8	2.7	
607 Mae Kuang	2.1	13		1.8	2.1	2.1	1.5	2.4	2.3	0.6	
609 Mae Lee	0.0	10		0.5	2.2	1.9	0.4	1.9	0.5	2.5	
611 Ping part 3	0.6	11		0.2	3.0	1.4	1.3	1.3	1.4	2.2	
614 Mae Had	3.0	14		0.2	3.0	2.0	1.1	2.3	2.8	3.0	
Lower Sub-Basins				0.8				0.7	1.5	2.4	
<i>weight:</i>				1.0	0.0	0.0	0.0	1.0	1.0	1.0	
616 Ping part 4	1.5	5	<i>weight:</i>	0.8				1.1	1.4	1.8	
617 Huay Mae Thor	3.0	7		0.1				2.8	0.6	3.0	
618 Klong Wang Chao	2.5	6		0.2				0.7	2.2	2.9	
619 Klong Mae Raka	0.5	4		0.0				1.0	0.4	2.7	
620 Klong Suan Mark	0.0	4		0.8				0.0	0.0	2.8	
621 Lower Ping	1.6	5		1.5				0.5	2.0	1.2	
Ping Basin				0.8				1.8	1.7	2.3	

* combined with lower Mae Chaem data

In order to implement this approach, lists of TAO ratings for 2002 were obtained from the MOI's Department of Provincial Administration website [<http://www.dopa.go.th/local/abt.htm>]. GIS shape files of TAO and municipality boundaries for the Ping Basin were then obtained from ONEP. TAO ratings were manually inserted into the database of the TAO boundary files, which was then combined with shape files of municipality boundaries and sub-basin boundaries. This resulted in a database file that could yield data on the areas covered by TAO under each of the rating levels, as well as municipalities. An area, rather than population, basis is seen as more suitable for assessing capacities related to management of natural resource and environment issues, and the ONEP watershed committee agreed. Thus, suitably aggregated data was inserted into appropriate columns of the calculation table in Figure 2-51, and weights were assigned to each of the category columns.

Given the substantial presence in all sub-basins of local governments in the lowest capacity category (class 5), a mix of capacities is best represented by the relative presence of local governments with higher capacity status. Thus, since requirements for establishment of municipalities (*tambon*, *muang* or *nakhon*) are all already quite high, and their responsibilities are even greater than class 1 TAOs, they were assigned a weight of 3.0. Class 1 to 5 TAOs were assigned weights intended to reflect the declining capacity of each category. Thus, the resulting score yields a depiction of the overall proportion of local government capacity across the entire landscape of the sub-basin.

The other three indicators are all derived from indices developed by the Thai government's Community Development Department, which employ data from the national village-level rural development database⁹ analyzed by the author in preparing many of the sub-basin data tables in this part of the report. Since these indices are computed from variables in this database, index values for each village are apparently only available in tabular format. As with the CDD development index used as one of the poverty indicators in the previous section,¹⁰ the only known source for these data in a spatial format is Dr. Methi's pilot provincial decision support system, where they are only available for middle and upper Ping sub-basins located in Chiang Mai and Lamphun provinces. Thus, implementation of these indicators suffers from the same limitations. Distributions of available village values for these three indices are displayed in Figure 2-53.

Indicator 4.1.2: Community Participation Score. This indicator provides a single score value that reflects the relative distribution of the degree to which households in a sub-basin participate in community and local governance affairs. Implementation is based on the CDD community participation index, which classifies participation by households into three relative categories (high, medium and low), for which relative weights of 3, 2 and 1, respectively, are assigned in the calculations presented in Figure 2-52.

Indicator 4.1.3: Group Organization Score. This indicator provides a single score value that reflects the relative distribution of the degree to which households in a sub-basin are members of active local groups. Implementation is based on the CDD group organization index, which classifies household group activity into three relative categories (high, medium and low), for which relative weights of 3, 2 and 1, respectively, are assigned in the calculations presented in Figure 2-52.

Indicator 4.1.2: Community Learning Score. This indicator provides a single score value that reflects relative distribution of the degree to which households in a sub-basin actively engage in community learning processes. Implementation is based on the CDD community learning index, which classifies households into three relative categories (high, medium and low), for which relative weights of 3, 2 and 1, respectively, are assigned in the calculations presented in Figure 2-52.

In the future, it would be very useful for Ping basin and sub-basin management to build a catalogue of data such as these for the entire set of sub-basins. And it would be even more useful to also include more direct data on presence and strength of local networks, as well as efforts and activities conducted by NGOs and government agencies to provide various types of support for local networks and emerging alliances or federations of networks.

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¹⁰ Derivation of the development index includes the 3 indices here, plus 27 additional ones.

Figure 2-51. Area-Based Indicator Scoring for Local Government Capacity

		unit: square kilometers						unit: Percent					4.1.1										
Sub-Basin	Total Area	Local Government Classification						Percentage Distribution					Area-Based Local Gov't Capacity Score										
		Tessaban	elected sub-district government					Tssbn	elected sub-district govt					Relative Weight of capacity by multiplied by % of land area						Point Score	Relative Capacity Score		
			TAO Classification Level						TAO Classification Level														
		1	2	3	4	5	1	2	3	4	5	3.00	2.50	2.00	1.50	0.75	0.25						
		sq km																					
602	Ping part 1	1,974	42	-	-	14	921	997	2	-	-	1	47	51	0.06	-	-	0.01	0.35	0.13	0.55	1.13	
603	Mae Ngad	1,285	6	-	-	-	0	1,278	0.5	-	-	-	0	100	0.01	-	-	-	0.00	0.25	0.26	0.04	
604	Mae Taeng	1,958	16	-	-	-	146	1,795	1	-	-	-	7	92	0.03	-	-	-	0.06	0.23	0.31	0.22	
608	Mae Khan	1,833	139	-	-	-	438	1,257	8	-	-	-	24	69	0.23	-	-	-	0.18	0.17	0.58	1.24	
610	Mae Klang	616	18	-	-	29	376	193	3	-	-	5	61	31	0.09	-	-	0.07	0.46	0.08	0.70	1.68	
612	Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
613	Mae Chaem lower	3,896	102	-	-	-	261	3,532	3	-	-	-	7	91	0.08	-	-	-	0.05	0.23	0.36	0.39	
615	Mae Teun	2,896	3	-	-	-	-	2,893	0.1	-	-	-	-	100	0.00	-	-	-	-	0.25	0.25	-	
Upper Sub-Basins		14,458	327	-	-	43	2,142	11,946	2	-	-	0.3	15	83	0.07	-	-	0.00	0.11	0.21	0.39	0.52	
605	Ping part 2	1,617	168	90	21	277	467	594	10	6	1	17	29	37	0.31	0.14	0.03	0.26	0.22	0.09	1.04	3.00	
606	Mae Rim	508	-	-	-	-	58	450	-	-	-	-	11	89	-	-	-	-	0.09	0.22	0.31	0.21	
607	Mae Kuang	2,734	296	32	2	198	401	1,805	11	1	0.1	7	15	66	0.32	0.03	0.00	0.11	0.11	0.17	0.74	1.85	
609	Mae Lee	2,081	36	-	-	0	393	1,651	2	-	-	0	19	79	0.05	-	-	0.00	0.14	0.20	0.39	0.53	
611	Ping part 3	3,452	27	-	-	1	299	3,125	1	-	-	0	9	91	0.02	-	-	0.00	0.06	0.23	0.31	0.24	
614	Mae Had	520	8	-	-	-	14	498	1	-	-	-	3	96	0.04	-	-	-	0.02	0.24	0.30	0.19	
Middle Sub-Basins		10,911	534	121	23	477	1,632	8,124	5	1	0	4	15	74	0.15	0.03	0.00	0.07	0.11	0.19	0.54	1.10	
616	Ping part 4	2,983	108	-	-	174	189	2,512	4	-	-	6	6	84	0.11	-	-	0.09	0.05	0.21	0.45	0.77	
617	Huay Mae Thor	644	-	-	-	-	34	610	-	-	-	-	5	95	-	-	-	-	0.04	0.24	0.28	0.09	
618	Klong Wang Chao	649	-	-	-	-	80	569	-	-	-	-	12	88	-	-	-	-	0.09	0.22	0.31	0.22	
619	Klong Mae Raka	902	-	-	-	6	9	887	-	-	-	1	1	98	-	-	-	0.01	0.01	0.25	0.26	0.04	
620	Klong Suan Mark	1,132	4	-	-	-	477	651	0.3	-	-	-	42	58	0.01	-	-	-	0.32	0.14	0.47	0.83	
621	Lower Ping	2,980	197	-	-	-	1,215	1,568	7	-	-	-	41	53	0.20	-	-	-	0.31	0.13	0.64	1.45	
Lower Sub-Basins		9,289	309	-	-	180	2,004	6,796	3	-	-	2	22	73	0.10	-	-	0.03	0.16	0.18	0.47	0.84	
Ping Basin		34,659	1,170	121	23	700	5,778	26,866	3	0.3	0.1	2	17	78	0.10	0.01	0.00	0.03	0.13	0.19	0.46	0.79	

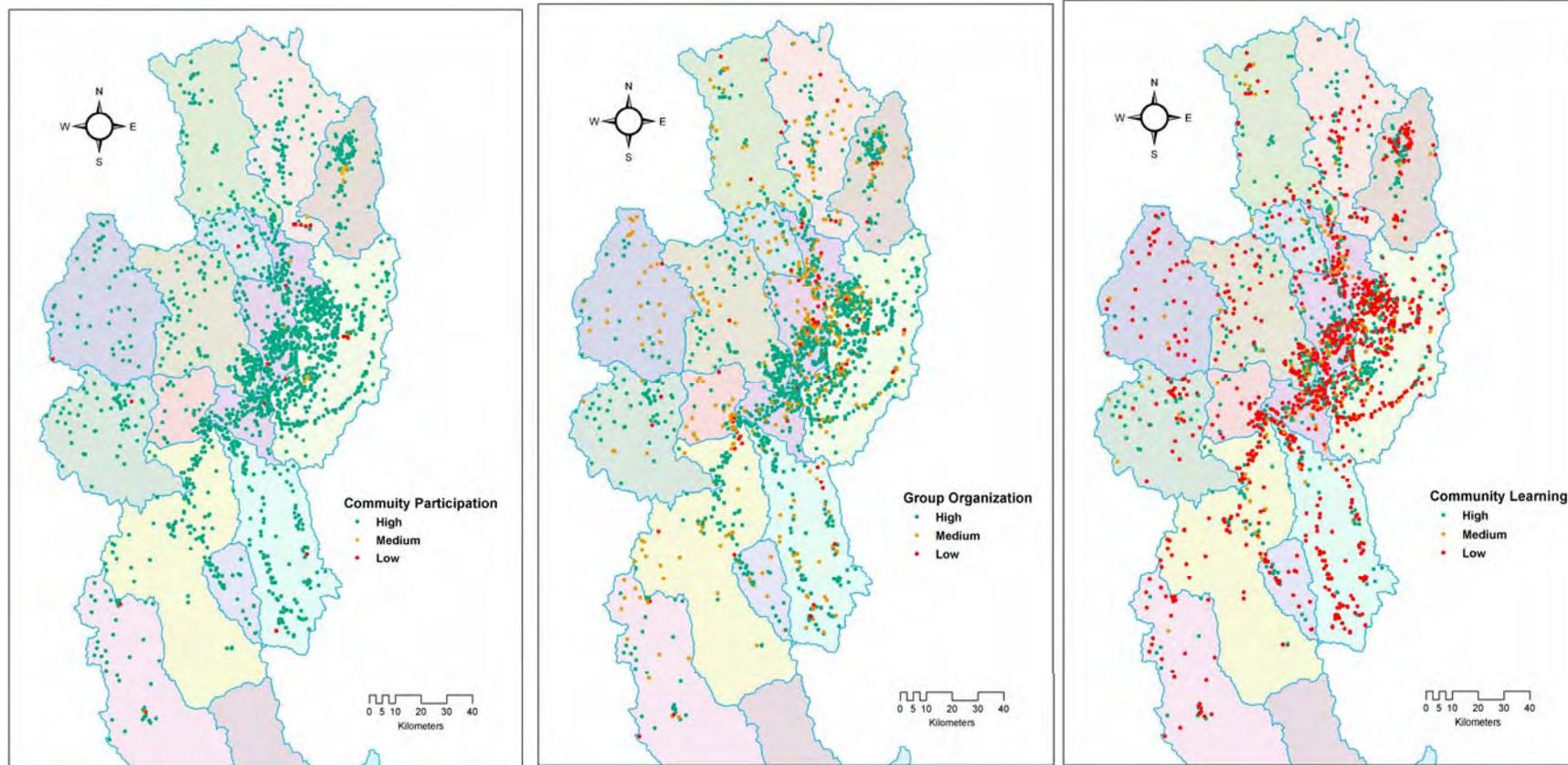
* combined with lower Mae Chaem data

Figure 2-52. Indicator Scores for Strength of Local Communities

Year = 2003		4.1.2					4.1.3					4.1.4				
		Distribution of community strength indicator					Distribution of community strength indicator					Distribution of community strength indicator				
Sub-Basin	Total Households	Community participation			Sum of weight proportions	Relative Comm Partic Score	Group organization			Sum of weight proportions	Relative Group Organiz Score	Community learning			Sum of weight proportions	Relative Comm Learning Score
		Low (1)	Medium (2)	High (3)			Low (1)	Medium (2)	High (3)			Low (1)	Medium (2)	High (3)		
		No. of Households			No. of Households			No. of Households			No. of Households					
		1	2	3	1			1			1					
602 Ping part 1	11,552	729	197	10,626	2.86	-	909	4,702	5,941	2.44	1.26	5,364	444	5,744	2.03	2.71
603 Mae Ngad	10,504	-	680	9,824	2.94	1.64	397	1,775	8,332	2.76	2.42	5,634	252	4,345	1.83	1.94
604 Mae Taeng	7,130	-	110	7,020	2.98	2.68	1,850	2,249	3,031	2.17	0.28	3,651	1,134	2,345	1.82	1.91
608 Mae Khan	17,545	-	-	17,545	3.00	3.00	93	1,274	16,178	2.92	3.00	10,157	1,735	5,653	1.74	1.64
610 Mae Klang	5,685	-	362	5,323	2.94	1.67	931	3,325	1,429	2.09	-	4,612	425	648	1.30	-
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
613 Mae Chaem lower	10,663	276	-	10,387	2.95	1.92	429	2,756	7,478	2.66	2.07	6,502	1,110	3,051	1.68	1.39
615 Mae Teun		estimated based on similarity with Mae Chaem:			1.90		estimated based on similarity with Mae Chaem:			1.90		estimated based on similarity with Mae Chaem:			1.35	
Upper Sub-Basins	63,079	1,006	1,351	60,728	2.95	1.89	4,610	16,083	42,392	2.60	1.85	35,921	5,102	21,789	1.77	1.73
605 Ping part 2	68,131	707	373	67,051	2.97	2.45	4,410	15,941	47,780	2.64	1.99	42,883	8,101	17,147	1.62	1.19
606 Mae Rim	4,491	121	-	4,370	2.95	1.87	117	1,853	2,521	2.54	1.62	1,785	426	2,280	2.11	3.00
607 Mae Kuang	64,040	1,069	570	62,401	2.96	2.11	3,176	14,132	46,732	2.68	2.14	37,392	7,768	18,880	1.71	1.52
609 Mae Lee	23,278	424	-	22,854	2.96	2.24	1,643	5,664	15,971	2.62	1.91	17,667	1,580	4,031	1.41	0.41
611 Ping part 3	15,139	-	-	15,139	3.00	3.00	2,216	3,622	9,301	2.47	1.38	9,128	2,024	3,969	1.66	1.32
614 Mae Had	3,861	-	-	3,861	3.00	3.00	-	1,346	2,515	2.65	2.04	2,727	-	1,134	1.59	1.06
Middle Sub-Basins	178,940	2,321	943	175,676	2.97	2.35	11,562	42,558	124,820	2.63	1.97	111,582	19,899	47,441	1.64	1.26
616 Ping part 4																
617 Huay Mae Thor																
618 Klong Wang Chao																
619 Klong Mae Raka																
620 Klong Suan Mark																
621 Lower Ping																
Lower Sub-Basins																
Ping Basin																

* combined with lower Mae Chaem data

Figure 2-53. Spatial distribution of community strength indicators, 2003



Source: Methi Ekasingh [2005], based on 2003 data from Community Development Department

(b) Project-related local knowledge and training

Local participation and relevant knowledge, experience and skills are likely to be very important in a pilot project such as this one. Knowledge and skills particularly relevant to the central themes of efforts under this project would relate to natural resources and the environment, public health and livelihood development. These subject areas are likely to include a range of issues for which local knowledge and experience with local conditions will be highly relevant. Moreover, it is likely to be only at the local level where local knowledge and experience can be effectively integrated with additional knowledge and information from outside sources to develop more innovative and effective approaches to addressing local problems than have been possible in the past.

At the same time, since collaboration among stakeholders representing both local interests and the interests of downstream and wider society are central to the project, it will also be very relevant to have a reasonable number of people in the sub-basin who are familiar with concepts, approaches and tools employed by relevant outside organizations and agencies. We have already seen that substantial numbers of people have received training, and much of it is focused on particular groups, and especially on many that are government-induced in nature. Thus,

Sub-Criterion 4.2. Priority should be given to sub-basins with relatively widespread presence of relevant local knowledge specialists, as well as a strong cadre of local people who have received relevant training from outside organizations and agencies.

In order to assess Ping sub-basins according to this sub-criterion, two indicators have been developed to capture and synthesize key information.

Indicator 4.2.1: Local Specialist Score. This indicator provides a single value that depicts the overall degree to which there is widespread presence of local knowledge specialists in sub-basin

Figure 2-54. Indicator Scores for Project-related Local Knowledge and Training

Sub-Basin	4.2.1					Relative Local Specialist Score	4.2.2				Relative Project-related Training Score
	Project-related local knowledge & training indicators						Outside Training ²				
	Total Villages	Local Specialists ¹			overall weighted average		conser- vation	health	occupa- tional	overall weighted average	
		nat res environ	traditional medicine	liveli- hoods ³							
unit: weight:	number	percent of villages				1.0	1.0	1.0			
602 Ping part 1	90	57	49	46	50	2.92	75	12	22	37	2.36
603 Mae Ngad	100	37	46	43	42	2.23	18	48	58	41	3.00
604 Mae Taeng	52	40	63	45	50	2.85	24	19	30	24	0.79
608 Mae Khan	170	40	48	51	47	2.60	31	31	51	38	2.49
610 Mae Klang	41	51	59	41	50	2.91	30	11	21	21	0.32
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*
613 Mae Chaem lower	127	48	45	28	40	2.09	43	22	37	34	2.07
615 Mae Teun	77	22	12	21	18	0.29	44	42	28	38	2.54
Upper Sub-Basins	657	42	45	40	42	2.26	39	27	38	35	2.13
605 Ping part 2	371	25	44	50	40	2.03	16	30	36	27	1.18
606 Mae Rim	56	45	57	53	51	3.00	35	26	36	32	1.82
607 Mae Kuang	494	31	54	49	44	2.43	27	33	48	36	2.29
609 Mae Lee	159	28	48	39	38	1.92	18	21	28	22	0.47
611 Ping part 3	233	23	33	35	31	1.31	19	26	43	29	1.39
614 Mae Had	31	48	39	41	43	2.29	38	29	53	40	2.79
Middle Sub-Basins	1,344	28	47	46	40	2.08	22	29	41	31	1.58
616 Ping part 4	181	13	35	36	28	1.11	27	31	29	29	1.38
617 Huay Mae Thor	12	25	67	56	49	2.82	16	35	18	23	0.60
618 Klong Wang Chao	17	-	29	40	23	0.68	22	42	43	36	2.25
619 Klong Mae Raka	45	33	20	28	27	1.02	13	25	25	21	0.36
620 Klong Suan Mark	50	6	20	18	15	-	4	25	26	18	-
621 Lower Ping	388	8	29	26	21	0.52	22	32	47	34	2.00
Lower Sub-Basins	693	11	30	29	23	0.71	21	31	38	30	1.54
Ping Basin	2,694	27	42	40	36	1.77	25	29	40	31	1.69

* combined with lower Mae Chaem data

¹ from data in Figure 2-21² from data in Figure 2-22³ average of agriculture, cottage industry, foods & artisans

villages. It is implemented using data on specific variables present in the national village-level rural development database, which are available for all sub-basins as displayed in Figure 2-21. The percentage of villages reporting presence of local knowledge specialists in natural resources and environment, traditional medicine, and key livelihood skills (agriculture, cottage industry, foodstuffs, artisans) are assigned a weighted average value, and resulting totals are converted to a 3.0 point scale, as shown in the calculations in Figure 2-54. All weights have are set at 1.0 at this point.

Indicator 4.2.2: Project-related Training Score. This indicator provides a single value that reflects the relative level of local participation in training in subjects related to natural resources and environment, public health and livelihood development during the year immediately preceding preparation of 2003 village reports. It is implemented using data on specific variables present in the national village-level rural development database, which are available for all sub-basins as displayed in Figure 2-22. Numbers of trainees reported per 1,000 persons in these subject areas are used to calculate a weighted average across the three general subject areas, and resulting totals are converted to a 3.0 point scale. Calculations are shown in Figure 2-54, with all weights set to 1.0 at this point.

(c) Administrative complexity

Given the very short project time frame, it seems wise to try to avoid sub-basins where mismatches between administrative and watershed boundaries result in a complex set of administrative units that would require major coordination efforts before the project could progress. Thus,

Sub-Criterion 4.3. Priority should be given to sub-basins with relatively lower requirements for coordination across administrative units.

In order to assess Ping sub-basins according to this sub-criterion, an indicator has been developed to capture and synthesize key information.

Indicator 4.3.1: Administrative Simplicity Score. This indicator provides a single value that depicts the overall proliferation of administrative units in a sub-basin, and provides for relative weights that can reflect levels of difficulty and time delay in coordination among multiple units of the same general type. The overall score is on a scale of 3 relative to other sub-basins. Thus, a score of 3.0 indicates the sub-basin has the greatest administrative simplicity among Ping sub-basins, whereas lower scores indicate proportionately greater administrative complexity.

Calculation involves a two-step process, as reflected in the calculation table shown in Figure 2-55. The first step is to simply catalog the various relevant administrative units for each sub-basin according to the column heading categories in the left side of the table. The types of units considered follow from the general types of units depicted in Figure 2-23. The second step is then to assign weights according to the simplicity (or ease) of coordination with and among that type of unit. For example, preliminary tentative weights already in the table reflect the hypothesis that it is relatively difficult to coordinate among provinces, and least difficult to coordinate among local forestry units. Broader experience, especially at local levels, should be drawn upon to ascertain whether such hypotheses are valid or not, and how the weighting regime could be further refined.

Figure 2-55. Administrative Simplicity Indicator Scoring for Ping Sub-Basins

Sub-Basin	unit: number of admin units						unit: Score						Admin Simplicity Score**
	Administrative Units						Administrative Simplicity Score						
	DOLA		Local Govt		MoNRE		Province	District	Loc Govt	Watershed	Conserv	Weighted Complexity Total	
Province	Districts	Tambon	Munic	Watrshd units	Parks & WLS	Relative Coord. Difficulty Weight multiplied by number of units							
						3.0	2.5	2.0	1.0	1.5			
602 Ping part 1	1	5	13	3	3	4	3.0	12.5	26.0	3.0	6.0	50.5	2.5
603 Mae Ngad	1	2	11	1	2	1	3.0	5.0	22.0	2.0	1.5	33.5	2.8
604 Mae Taeng	1	3	14	1	8	4	3.0	7.5	28.0	8.0	6.0	52.5	2.4
608 Mae Khan	1	5	19	3	8	2	3.0	12.5	38.0	8.0	3.0	64.5	2.2
610 Mae Klang	1	1	5	1	3	2	3.0	2.5	10.0	3.0	3.0	21.5	3.0
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	*	*	*	*
613 Mae Chaem lower	1	3	14	2	19	4	3.0	7.5	28.0	19.0	6.0	63.5	2.3
615 Mae Teun	2	2	9	1	8	2	6.0	5.0	18.0	8.0	3.0	40.0	2.7
Upper Sub-Basins	1.0	3	11	2	6	2	3.0	6.6	21.3	6.4	3.6	40.8	2.6
605 Ping part 2	2	13	76	13	3	1	6.0	32.5	152.0	3.0	1.5	195.0	-
606 Mae Rim	1	3	9	-	4	3	3.0	7.5	18.0	4.0	4.5	37.0	2.7
607 Mae Kuang	1	10	63	13	1	2	3.0	25.0	126.0	1.0	3.0	158.0	0.6
609 Mae Lee	1	5	16	4	-	1	3.0	12.5	32.0	-	1.5	49.0	2.5
611 Ping part 3	3	7	17	2	3	3	9.0	17.5	34.0	3.0	4.5	68.0	2.2
614 Mae Had	2	2	5	1	-	1	6.0	5.0	10.0	-	1.5	22.5	3.0
Middle Sub-Basins	1.7	7	31	6	2	2	5.0	16.7	62.0	1.8	2.8	88.3	1.8
616 Ping part 4	2	7	30	2	1	3	6.0	17.5	60.0	1.0	4.5	89.0	1.8
617 Huay Mae Thor	1	2	4	1	1	2	3.0	5.0	8.0	1.0	3.0	20.0	3.0
618 Klong Wang Chao	2	4	4	-	-	2	6.0	10.0	8.0	-	3.0	27.0	2.9
619 Klong Mae Raka	2	5	9	-	-	1	6.0	12.5	18.0	-	1.5	38.0	2.7
620 Klong Suan Mark	1	3	9	1	-	3	3.0	7.5	18.0	-	4.5	33.0	2.8
621 Lower Ping	2	7	49	8	-	2	6.0	17.5	98.0	-	3.0	124.5	1.2
Lower Sub-Basins	1.7	5	18	2	0.3	2	5.0	11.7	35.0	0.3	3.3	55.3	2.4
Ping Basin	1.4	4	19		3	2	4.2	11.1	37.6	3.2	3.2	59.4	2.3

* combined with lower Mae Chaem data

** calculated as $[(\text{max total}) - \text{total}] / [(\text{max total}) - \text{min total}] * 3$

7. Putting it all together

Most of these criteria and indicators were proposed in the inception report so that, to the extent they were seen as useful, the project consultant team could include them in formulating their proposal for at least a pair of candidate sub-basins for each of the lower, middle and upper sub-basin groupings. Their findings were to be submitted for consideration by basin stakeholders at to the water forum discussed in the next section of this report.

As indicated in previous sections, the author has been able to obtain data to quantify 23 of the 24 natural resource, socio-economic, and organizational indicators proposed in this report. For four of these indicators, however, data were not available in a suitable form for lower sub-basins. To help provide a visual overview of the results, sub-basin values of score calculations before application of relative indicator weights are summarized by bar charts in Figure 2-56. There do not appear to be obvious biases in this data for or against any particular sub-basin

In order to help facilitate consideration of these criteria and indicators, as well as any future assessments of diversity and priorities among sub-basins that may find these analyses useful, this section summarizes indicator calculations and presents an example of how to use provisions for deriving weighted overall values for each sub-basin.

(a) Criteria summary tables and weighted calculations

It is important to note that Figures 2-25, 2-32 and 2-50 are summary tables for each of the sets of sub-criteria and indicators associated with a major guiding criterion. Results of calculations for each individual indicator have been entered into the summary table for their overall guiding criterion. These tables contain provision for transparent methods of assigning two additional types of weights:

- In deriving overall values for each criterion, relative weights can be applied to different sub-criteria and each of their indicators, in order to reflect different levels of importance or priority they are seen to have in the decision-making process. As indicated in those tables, weights are all set to the default value of 1.0, which implies an equal weight for each.
- Summary tables include separate lines for these weights under each of the sub-basin groupings (lower, middle, and upper). Since discussions of each indicator in this report suggest that it may be appropriate to assign higher priority to some sub-criteria or indicators under conditions specific to one sub-basin grouping or another, this provision allows different weighting regimes for each sub-basin grouping.

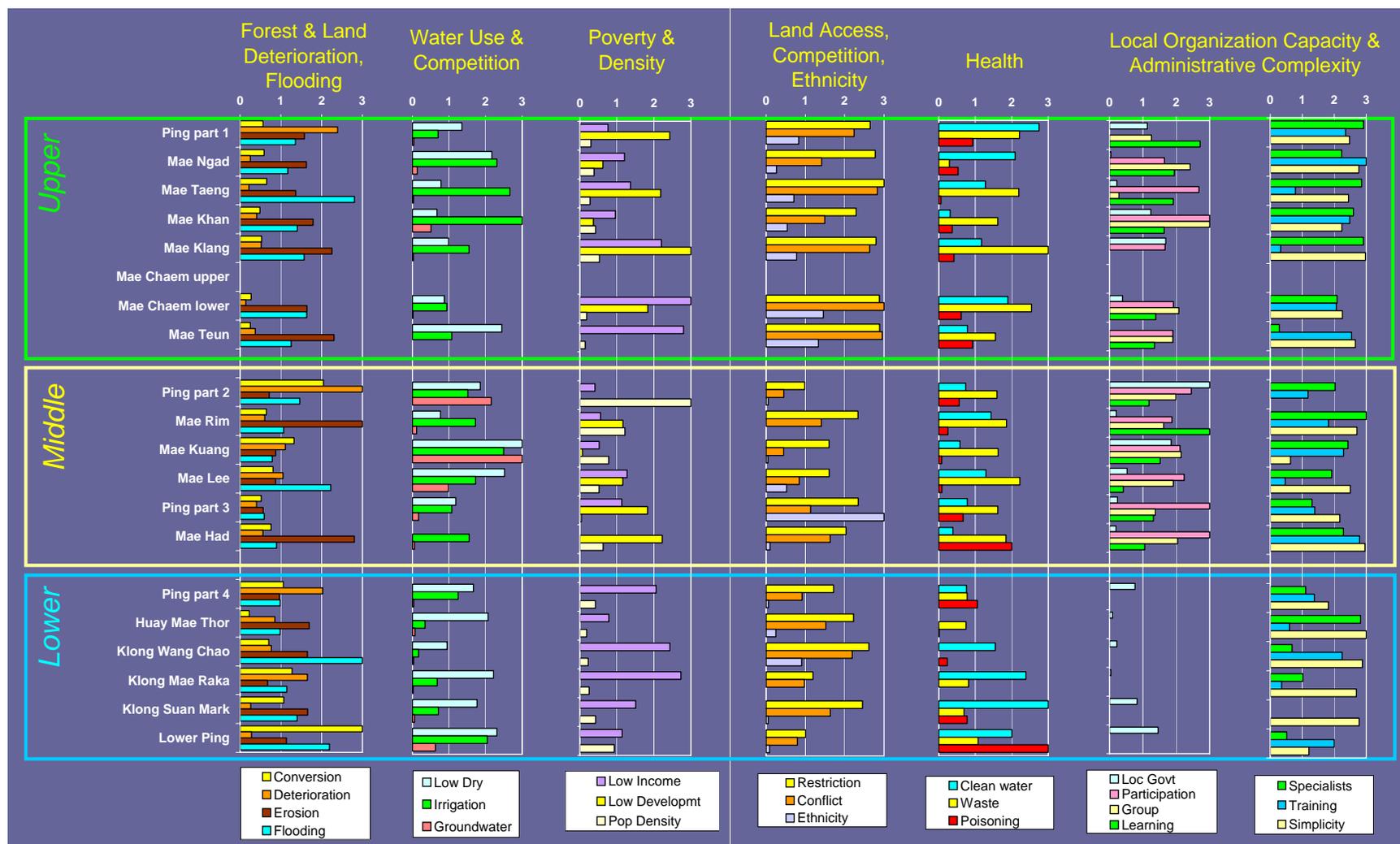
Again, these weightings can be used as a transparent method for reflecting expert opinion, they can be derived through stakeholder consensus, and/or they can be used to conduct a simple sensitivity analysis on indicator or sub-criteria aggregations. In any event, the weightings are optional, and if they are not seen as useful or necessary, or if they appear to over-complicate matters, they can simply be ignored.

(b) Overall summary table

As a final step toward closure in drawing conclusions from this set of criteria and indicators, Figure 2-57 introduces an overall summary table that summarizes overall values derived in the data tables for each major guiding criterion. This table again has provision for assigning different weights for each of the major criteria, and weighting regimes can be different for each of the sub-basin groupings. In this case weights have been assigned to give greatest weight to socio-economic issues (3.0), followed by natural resource issues (2.5), and local organization (1.5).

While this table applies the same weighting regime across all sub-basin groupings, the values for each individual criterion are derived through calculations that have used weighting regimes that reflect differences among sub-basin groups. These weight assignments follow reasoning presented for each sub-criterion and indicator in previous sections of this report, and are presented in the following tables as an example of how the weighting system can be implemented.

Figure 2-56. Bar Charts of Un-weighted Indicator Scores for Ping Sub-Basins



Note 1: Data for lower and upper Mae Chaem are combined into one value listed under lower Mae Chaem

Note 2: Indicators for natural hazards, population density, ethnicity and administrative simplicity were integrated into other charts to enable a single page display.

Figure 2-57. Overall Summary of Weighted Indicator Scoring for Ping Sub-Basins

		Summary Overall Weighted Scores		1. Grouping		2. Overall Natural Resource Issues		3. Overall Social & Economic Issues		4. Overall Local Org Capacity & Simplicity	
<i>Sub-Basin</i>		Score	weighted total	Lowland Zone Bias		Score	weighted total	Score	weighted total	Score	weighted total
Upper Sub-Basins				1.88		2.50		3.00		1.50	
602	Ping part 1	3.0	119	2.24	<i>weight:</i>	3.0	13	2.3	24	0.6	10
603	Mae Ngad	1.9	96	2.27		1.9	11	0.7	17	1.7	12
604	Mae Taeng	1.9	109	1.59		1.9	11	1.9	23	0.5	10
608	Mae Khan	2.1	89	1.95		2.1	11	0.0	14	3.0	13
610	Mae Klang	1.9	114	1.87		1.9	11	2.3	24	0.0	9
612	Mae Chaem upper	*	*	1.43		*	*	*	*	*	*
613	Mae Chaem lower	2.8	117	1.88		0.0	8	3.0	27	0.7	10
615	Mae Teun	2.4	114	1.93	1.9	11	2.2	24	0.9	10	
Middle Sub-Basins				2.54		2.50		3.00		1.50	
605	Ping part 2	3.0	95	2.80	<i>weight:</i>	2.4	18	3.0	12	0.0	9
606	Mae Rim	1.4	78	2.32		0.8	11	2.5	11	2.9	12
607	Mae Kuang	2.0	84	2.63		3.0	21	0.0	6	0.2	9
609	Mae Lee	1.8	82	2.59		1.8	15	1.7	10	1.2	10
611	Ping part 3	0.3	67	2.33		0.0	7	2.7	11	1.4	10
614	Mae Had	0.0	64	2.73		0.3	8	1.1	8	3.0	12
Lower Sub-Basins				2.80		2.50		3.00		1.50	
616	Ping part 4	1.5	58	2.81	<i>weight:</i>	0.9	11	1.1	8	1.0	3
617	Huay Mae Thor	0.0	44	2.54		0.1	9	0.0	6	0.7	3
618	Klong Wang Chao	2.1	64	2.53		0.0	8	3.0	13	1.0	3
619	Klong Mae Raka	2.0	62	2.99		0.8	11	2.1	11	0.0	3
620	Klong Suan Mark	2.1	63	2.55		0.4	9	2.3	11	3.0	4
621	Lower Ping	3.0	72	2.94		3.0	17	1.0	8	2.4	4
Ping Basin				2.33							

* combined with lower Mae Chaem data

(c) Example weighted criteria calculations

Natural Resources Issues. Weighted indicator scoring calculations for the natural resource issue criterion are shown in Figure 2-58. Values displayed in columns under each indicator are the same values obtained in calculation tables for each of those indicators presented in previous sections. Thus, the differential weighting regime used is entirely reflected by values entered into cells with background colors associated with sub-basin groupings in this table. This application is quite simple, and is based on two notions: (1) Since land and forest degradation indicators are seen as especially critical in upper sub-basins, a weight of 2.0 has been assigned to appropriate cells. (2) As water use and water quality indicators are seen as having especially high importance in middle and lower sub-basins, a weight of 2.0 has been assigned to those cells to reflect these priorities.

Socio-economic Issues. In the case of socio-economic issues, weighted calculations are shown in Figure 2-59. Four major considerations were used in applying weights: (1) Given the importance of poverty to this project, a weight of 2.0 was applied to the low income score for all 3 sub-basin groups. (2) Given the special importance of land use access and competition in upper sub-basins, a weight of 3.0 was assigned to land use restrictions and 2.0 to agricultural conflict indicators for the upper basin grouping. (3) Roles and representation of upland ethnic groups is very important in upper sub-basins and was applied a weight of 2.0, whereas inclusion of urbanizing population centers is especially important in middle (assigned 3.0), and lower sub-basins (assigned 2.0). (4) Due to the special importance of waste management in middle sub-basins, it was given a weight of 2.0.

Local Capacity and Complexity. Weighted calculations of the local organization criterion are presented in Figure 2-60, where weights are assigned following two lines of consideration: (1) Local government capacity was assigned a weight of 2.0 in middle and lower sub-basins because strong local government would be an advantage in seeking to establish a sub-basin management organization as quickly as possible under conditions that often involve substantial numbers of people and some rather complex social situations. For upper sub-basins this weight was left at 1.0 because work with relatively low capacity local governments will be necessary in order to provide a context that is reasonably representative of upper sub-basins, where such conditions are normal.

Figure 2-58. Natural Resource Issues Weighted Indicator Scoring for Ping Sub-Basins

Sub-Basin	2. Overall Natural Resource Issues		source:	2.1. Degradation			2.2. Hazards		2.3. Water Use		
	Score	weighted total		2.1.1.	2.1.2.	2.1.3.	2.2.1.	2.2.2.	2.3.1.	2.3.2.	2.3.3.
				Forest Conversion Score	Forest Deterior Score	Soil Erosion Score	Flooding Risk Score	Landslide Risk Score	Agric Irrigation Score	Groundwater Use Score	Low Dry Season Flow Score
				CMU	CMU	Panya	Panya	<<N/A>>	Panya	Panya	Panya
Upper Sub-Basins				weight:	0.4	0.5	1.8	-	1.8	0.1	1.4
602 Ping part 1	3.0	13	weight:	2.0	2.0	2.0	1.0	0.0	1.0	1.0	1.0
603 Mae Ngad	1.9	11		0.6	2.4	1.6	1.4	-	0.7	0.0	1.4
604 Mae Taeng	1.9	11		0.6	0.3	1.6	1.2	-	2.3	0.1	2.2
608 Mae Khan	2.1	11		0.7	0.2	1.4	2.8	-	2.7	0.0	0.8
610 Mae Klang	1.9	11		0.5	0.4	1.8	1.4	-	3.0	0.5	0.7
612 Mae Chaem upper	*	*		0.5	0.5	2.3	1.6	-	1.5	0.0	1.0
613 Mae Chaem lower	0.0	8		*	*	*	*	-	*	*	*
615 Mae Teun	1.9	11	0.3	0.1	1.6	1.6	-	0.9	0.0	0.9	
Middle Sub-Basins				weight:	1.0	0.9	1.0	-	1.9	1.3	1.8
605 Ping part 2	2.4	18	weight:	1.0	1.0	1.0	1.0	0.0	2.0	2.0	2.0
606 Mae Rim	0.8	11		2.0	3.0	0.7	1.5	-	1.5	2.2	1.9
607 Mae Kuang	3.0	21		0.6	0.6	3.0	1.1	-	1.7	0.1	0.8
609 Mae Lee	1.8	15		1.3	1.1	0.9	0.8	-	2.5	3.0	3.0
611 Ping part 3	0.0	7		0.8	1.1	0.9	2.2	-	1.7	1.0	2.5
614 Mae Had	0.3	8		0.5	0.4	0.6	0.6	-	1.1	0.2	1.2
Lower Sub-Basins				weight:	1.6	1.2	1.2	1.7	1.6	0.4	1.9
616 Ping part 4	0.9	11	weight:	1.0	1.0	1.0	1.0	0.0	2.0	2.0	2.0
617 Huay Mae Thor	0.1	9		1.1	2.0	1.0	1.0	-	1.2	0.0	1.7
618 Klong Wang Chao	0.0	8		0.2	0.9	1.7	1.0	-	0.3	0.1	2.1
619 Klong Mae Raka	0.8	11		0.7	0.8	1.7	3.0	-	0.2	0.0	0.9
620 Klong Suan Mark	0.4	9		1.3	1.7	0.7	1.1	-	0.7	0.0	2.2
621 Lower Ping	3.0	17		1.1	0.3	1.7	1.4	-	0.7	0.1	1.8
Ping Basin				3.0	0.3	1.1	2.2	-	2.0	0.6	2.3

* combined with lower Mae Chaem data

Figure 2-59. Socio-Economic Issues Weighted Indicator Scoring for Ping Sub-Basins

		3. Overall Social & Economic Issues		3.1. Poverty		3.2. Competition		3.3. Minorities & Urban		3.4. Health		
				3.1.1.	3.1.2.	3.2.1	3.2.2	3.3.1	3.3.2	3.4.1	3.4.2	3.4.3
Sub-Basin	Score	weighted total	source:	Low Income Score	Village Low Development Score	Land Use Restriction Score	Agricultural Conflict Score	Upland Ethnicity Score	Population Density Score	Water Supply Score	Waste Management Score	Pesticide Poisoning Score
				MCC / Panya	MCC - CDD	KUFF/onep	Panya/onep	ONEP, Panya	Panya	กขช.2ค / onep	กขช.2ค / onep	กขช.2ค / onep
Upper Sub-Basins				1.6	1.433	2.8	2.3	0.8	0.3	1.4	1.6	0.6
<i>weight:</i>				2.0	1.0	3.0	2.0	2.0	1.0	1.0	1.0	1.0
602 Ping part 1	2.3	24		0.8	2.4	2.6	2.2	0.8	0.3	2.8	2.2	0.9
603 Mae Ngad	0.7	17		1.2	0.6	2.8	1.4	0.3	0.4	2.1	0.3	0.5
604 Mae Taeng	1.9	23		1.4	2.2	3.0	2.8	0.7	0.3	1.3	2.2	0.1
608 Mae Khan	0.0	14		1.0	0.4	2.3	1.5	0.5	0.4	0.3	1.6	0.4
610 Mae Klang	2.3	24		2.2	3.0	2.8	2.6	0.8	0.5	1.2	3.0	0.4
612 Mae Chaem upper	*	*		*	*	*	*	*	*	*	*	*
613 Mae Chaem lower	3.0	27		3.0	1.8	2.9	3.0	1.5	0.2	1.9	2.5	0.6
615 Mae Teun	2.2	24		2.8	0.0	2.9	3.0	1.3	0.1	0.8	1.6	0.9
Middle Sub-Basins				0.6	0.4	1.8	0.7	0.2	0.8	0.8	1.7	0.4
<i>weight:</i>				2.0	1.0	1.0	1.0	1.0	3.0	1.0	3.0	1.0
605 Ping part 2	3.0	12		0.4	0.0	1.0	0.4	0.0	3.0	0.7	1.6	0.6
606 Mae Rim	2.5	11		0.6	1.2	2.3	1.4	0.0	1.2	1.4	1.9	0.3
607 Mae Kuang	0.0	6		0.5	0.1	1.6	0.4	0.0	0.8	0.6	1.6	0.1
609 Mae Lee	1.7	10		1.3	1.2	1.6	0.8	0.5	0.5	1.3	2.2	0.1
611 Ping part 3	2.7	11		1.1	1.8	2.3	1.1	3.0	0.0	0.8	1.6	0.7
614 Mae Had	1.1	8		0.0	2.2	2.0	1.6	0.1	0.6	0.4	1.8	2.0
Lower Sub-Basins				1.5		1.6	1.0	0.1	0.5	1.7	0.9	2.0
<i>weight:</i>				2.0	0.0	1.0	1.0	1.0	2.0	1.0	1.0	1.0
616 Ping part 4	1.1	8		2.1		1.7	0.9	0.1	0.4	0.8	0.8	1.1
617 Huay Mae Thor	0.0	6		0.8		2.2	1.5	0.2	0.2	0.0	0.7	0.0
618 Klong Wang Chao	3.0	13		2.4		2.6	2.2	0.9	0.2	1.5	0.0	0.2
619 Klong Mae Raka	2.1	11		2.7		1.2	1.0	0.0	0.2	2.4	0.8	0.0
620 Klong Suan Mark	2.3	11		1.5		2.5	1.6	0.1	0.4	3.0	0.7	0.8
621 Lower Ping	1.0	8		1.1		1.0	0.8	0.1	0.9	2.0	1.1	3.0
Ping Basin												

* combined with lower Mae Chaem data

Figure 2-60. Local Organization Weighted Indicator Scoring for Ping Sub-Basins

Sub-Basin	4. Overall Local Org Capacity & Simplicity		source:	4.1. Capacity				4.2. Specialist Knowledge		4.3. Simplicity
	Score	weighted total		4.1.1.	4.1.2.	4.1.3	4.1.4	4.2.1.	4.2.2.	4.3.1.
				Loc Govt Capacity Score	Community Participation Score	Group Organization Score	Community Learning Score	Local Specialists Score	Project-related Training Score	Admin Simplicity Score
			MOI / onep	MCC - CDD	MCC - CDD	MCC - CDD	กชช.2ค / onep	กชช.2ค / onep	Panya, ONEP	
Upper Sub-Basins				0.5	1.9	1.9	1.7	2.3	2.1	2.6
<i>weight:</i>				1.0	1.0	1.0	1.0	2.0	2.0	3.0
602 Ping part 1	1.9	23	1.1	0.0	1.3	2.7	2.9	2.4	2.5	
603 Mae Ngad	2.6	25	0.0	1.6	2.4	1.9	2.2	3.0	2.8	
604 Mae Taeng	0.4	20	0.2	2.7	0.3	1.9	2.9	0.8	2.4	
608 Mae Khan	3.0	26	1.2	3.0	3.0	1.6	2.6	2.5	2.2	
610 Mae Klang	0.0	19	1.7	1.7	0.0	0.0	2.9	0.3	3.0	
612 Mae Chaem upper	*	*	*	*	*	*	*	*	*	
613 Mae Chaem lower	0.9	21	0.4	1.9	2.1	1.4	2.1	2.1	2.3	
615 Mae Teun	0.0	19	0.0	1.9	1.9	1.4	0.3	2.5	2.7	
Middle Sub-Basins				1.1	2.3	2.0	1.3	2.1	1.6	1.8
<i>weight:</i>				2.0	1.0	1.0	1.0	2.0	2.0	3.0
605 Ping part 2	0.1	18	3.0	2.5	2.0	1.2	2.0	1.2	0.0	
606 Mae Rim	2.7	25	0.2	1.9	1.6	3.0	3.0	1.8	2.7	
607 Mae Kuang	1.1	21	1.8	2.1	2.1	1.5	2.4	2.3	0.6	
609 Mae Lee	0.0	18	0.5	2.2	1.9	0.4	1.9	0.5	2.5	
611 Ping part 3	0.1	18	0.2	3.0	1.4	1.3	1.3	1.4	2.2	
614 Mae Had	3.0	26	0.2	3.0	2.0	1.1	2.3	2.8	3.0	
Lower Sub-Basins				0.8				0.7	1.5	2.4
<i>weight:</i>				2.0	0.0	0.0	0.0	2.0	2.0	3.0
616 Ping part 4	1.0	12	0.8				1.1	1.4	1.8	
617 Huay Mae Thor	3.0	16	0.1				2.8	0.6	3.0	
618 Klong Wang Chao	2.5	15	0.2				0.7	2.2	2.9	
619 Klong Mae Raka	0.5	11	0.0				1.0	0.4	2.7	
620 Klong Suan Mark	0.0	10	0.8				0.0	0.0	2.8	
621 Lower Ping	0.8	12	1.5				0.5	2.0	1.2	
Ping Basin			0.8				1.8	1.7	2.3	

* combined with lower Mae Chaem data

(2) A weight of 2.0 is assigned to the two specialist knowledge indicators in all sub-basin groupings, because of its potential importance in providing support for sub-basin management organizations; (3) Due to the need to minimize bureaucratic difficulties in the short time available for the project, a weight of 3.0 was assigned to administrative simplicity in all sub-basin groupings.

The “bottom line” results of applying these weights to the indicators proposed in this report can be seen in the summary overall weighted scores shown in the left column of the table in Figure 2-57. The highest score (3.0) for each sub-basin grouping is highlighted by red fonts. Similar relative values for each of the major criteria are listed in other columns.

(d) Example weighted criteria calculations

Thus, under these weighting regimes, sub-basins have been ranked as proposed candidate sites for the project for each of the sub-basin groupings. Results are displayed in Figure 2-61. Of course, other weighting regimes could yield different results. This is why considerable effort has been made to make all weightings explicit and transparent, so that they can be adjusted to accommodate different rationales.

Figure 2-61. Example Calculated Sub-basin Rankings

<i>Rank</i>	<i>Sub-basin</i>	<i>Score</i>
Upper Sub-Basins		
1	Ping part 1	3.0
2	Mae Chaem combined	2.4
3	Mae Klang	2.0
4	Mae Teun	1.8
5	Mae Taeng	1.6
6	Mae Ngad	0.7
7	Mae Khan	0.0
Middle Sub-Basins		
1	Ping part 2	3.0
2	Mae Kuang	2.3
3	Mae Rim	1.8
4	Mae Lee	1.5
5	Mae Had	0.5
6	Ping part 3	0.0
Lower Sub-Basins		
1	Lower Ping	3.0
2	Klong Wang Chao	2.7
3	Klong Mae Raka	1.7
4	Klong Suan Mark	1.3
5	Ping part 4	1.1
6	Huay Mae Thor	0.0

8. Data and information used in analysis and application of selection criteria.

Data required to assess each of the indicators proposed in previous sections of this report were obtained from a range of sources. Indeed, data continued to be acquired after submission of the author's inception report, resulting in several modifications that have been incorporated into this final report. Many of these changes have been associated with questions, suggestions and requests from ONEP staff and those who they have asked to review reports under this project. Others have resulted from access to additional data that the author believes improves the quality, range and/or depth of the analysis.

Thus, sources of data used for analysis and implementation of selection criteria presented in this final report include

Office of Natural Resource & Environmental Policy & Planning (ONEP)

Staff at ONEP directly provided data on sub-basin boundaries and highland villages. They also provided the author with data originating from other sources:

- Chiang Mai University: data from a study conducted for ONEP [CMU 2004], including spatial data files on interpretation of land use from remote sensing analysis, digital boundaries of provinces, districts, tambons and municipalities, and village point locations.
- Department of National Parks, Wildlife and Plant Conservation: Classification of forest and land use from remote sensing interpretation (2000), and digital watershed classification boundaries.
- National village-level rural development database (see notes below)

Panya Consulting

Staff at Panya provide data on stream flows, ground water, and irrigated agriculture area obtained through their earlier work with water resource management agencies, erosion rates believed to have come from the Department of Land Development, and population and income data from unspecified sources.

Kasetsart University Faculty of Forestry

Staff of the Forestry Faculty associated with this project provided copies of data originally from the Department of National Parks, Wildlife and Plant Conservation on boundaries of national parks, wildlife sanctuaries and forest reserve lands, as well as a second data set on highland villages.

Multiple Cropping Center, Chiang Mai University

Dr. Methi Ekasingh and his colleagues have kindly provided data from their pilot provincial decision support system databases for Chiang Mai and Lamphun province on population by ethnicity, distribution of income from agricultural and non-agricultural sources, soil erosion, and spatial distribution of indices developed by the Community Development Department on village development, community participation, group organization, and community learning. They have also provided high-resolution images on agricultural land use, sloping lands, and two pilot sub-basins.

ICRAF Chiang Mai

Data provided by ICRAF included a medium resolution (100 m) digital elevation model constructed data from the Thailand Environment Institute together with additional data digitized by ICRAF staff, and digitized preliminary boundaries of the new Mae Tho National Park. ICRAF also provided legal versions of all computer software used in these analyses.

Ministry of Interior

Data was obtained from a Ministry of Interior website on classification of Tambon Administration Organization (TAO) capacity rankings.

National village-level rural development database

During discussion of the first draft of the author's inception report with ONEP staff, the author suggested that one potentially interesting and useful source of socio-economic data might be available from the national village-level rural development database, with its biennial village reports conducted through the Community Development Department. It was proposed that if this data were linked with georeferenced point locations for each administrative village, it would allow the data to be combined with polygon shape files such as sub-basin boundaries (or any other units that can be spatially mapped), so that aggregations of village level data could be assessed at a sub-basin level. Subsequently, ONEP staff provided the author with a version of 2003 data extracted from the national database for villages in the Ping Basin, which had been linked to ONEP's shape file of administrative village locations by a consultant they contracted. Although it was initially very difficult to work with this data due to the complexity and structure of the large database file, the author made a major investment of time in developing an analytical approach that allowed its extensive use in this report. One hopes that this can help serve as an example of why village-level data is very important, and how it can be used in future analyses and assessments.

Some notes on data quality

In terms of data coverage, there were two limitations: (1) Since various data could not be disaggregated for upper and lower Mae Chaem sub-basins due to the non-standard nature of this division of the physical catchment, indicator calculation tables all aggregate calculations for Mae Chaem into a single unit. (2) Since data obtained from databases of Dr. Methi's pilot provincial decision support system are only available for Chiang Mai and Lamphun provinces, implementation was only possible for middle and upper sub-basins, and values for Mae Teun had to be estimated.

Regarding more specific quality issues the following observations are offered:

- **General.** A considerable number of often minor, and sometimes major differences were encountered in comparing datasets on similar variables from different sources. There are, of course a wide range of technical, definitional, and interpretational reasons for many such differences, and many others have encountered similar problems. While the author has found ways to deal with these issues at the level of relative sub-basin comparisons that should not prejudice the outcome of the results of this analysis, coping with differences at a much more local level are often far more problematic. Moreover, this is frequently cited by local leaders as a significant problem that they face. Such issues are one of the major motivating forces that have driven Dr. Methi and his colleagues to pour an enormous amount of effort into developing their pilot provincial decision support systems, which provide a very high resolution and high quality platform for screening, matching, and maintaining data from a wide variety of sources. And since it is designed to be accessible at all levels from province to village, and from river basin to very small local levels of sub-watersheds, it is a potentially extremely useful tool for use in sub-basin management programs, and a wide range of other uses.
- **Population.** The author remains somewhat skeptical about some of the population figures obtained from Panya Consulting for reasons such as the data for Mae Chaem, which appear quite high. As this was the only dataset available for the entire set of sub-basins, however, the author assumes that any errors in these estimates are similar across the Ping basin, and thus should not greatly affect efforts to assess relative differences among them.
- **Income.** Data obtained from Panya Consulting on income levels also appear to be questionable, as indicated by comparison between these values and values obtained from Dr. Methi's database, as illustrated in Figure 2-33. Thus, Methi's data were used for middle and upper sub-basins, while use of Panya data was continued for lower sub-basins due to the lack of any readily available alternative source that could be aggregated at sub-basin level.
- **Soil erosion.** Sub-basin rankings based on data from Panya Consulting (presumed to have originated at the Land Development Department) also show considerable divergence from

results using data from Dr. Methi's system, as illustrated in Figures 2-26 and 2-27). But since only Panya data was available for all sub-basins, they were used in final calculations.

- Discarded indicators. Some indicators employed in the author's inception report were discarded. Major examples include: (1) An overall indicator of local economic and social strength/weakness drawn directly from the CMU [2004] report was rejected because of the very ambiguous nature of this index and lack of specific information on how it was derived, as well as the lack of variability among sub-basins that it was able to capture. In middle and upper sub-basins it was replaced by the CDD index of village development. (2) Water quality index from Panya Consulting was also very ambiguous in terms of how it was derived, while the wastewater score from CMU [2004] seemed fairly arbitrary and unclear about how these judgements were made. Thus, they were both replaced by indicators calculated from variables in the national village-level rural development database, and moved to become part of the health indicator section (see Figures 2-47 and 2-45).
- National village-level rural development database¹¹. There are five particular issues associated with this database that the author observed while conducting these analyses:

(1) There are some overall problems revealed by some simple data consistency checks that indicate fairly little effort has been put into preventing or screening out errors that may result from data entry (such as transposed numbers or order of magnitude errors). Some quick scans conducted by the author indicate such errors are present in only a quite small minority of data records, so that it is quite unfortunate that database managers at the national level have apparently not made the small additional investment that would be required to more effectively minimize these problems.

(2) Data on local knowledge reflect a difference of understanding among village leaders making their reports, which appears to be related to the lack of clear explanatory information in the questionnaire. As a result, the author feels the data on magnitudes of local knowledge specialists in individual villages is unusable in their present form. However, it does appear that the fact that village leaders believe local knowledge specialists are present in some subject areas but not others, provides a basis for assessing how widespread are different types of specialists on a village presence/absence basis. This is the approach used in Figures 2-21 and 2-54.

(3) Data on education appear to be (perhaps somewhat ironically) among the weakest in this database. This appears to be related to the very unclear and often convoluted nature of how questions were asked in the original questionnaire. It almost seems like the questions were written by lawyers, and definitely not pre-tested before being implemented in the national system. In the author's attempts to salvage data for at least a few key variables, reports from another 370 villages were eliminated because of impossible internal inconsistencies in their reports. This at least allowed the construction of workforce educational attainment levels, as displayed in Figure 2-19, but a number of other potentially very interesting variables still remained unusable. This is another very unfortunate shortcoming that should have been avoidable through a fairly modest amount of effort at the national level.

(4) In analyzing data collected through this type of system, it is always useful to consider what the village leaders reporting this information may consider to be incentives to answer particular types of questions in one way or another. Questions on the degree of household participation in community affairs could be one example, wherein it would generally not be in the best interest of a village leader to report low participation rates. One approach to avoiding problems that might result in the use of particular variables is to construct an index that combines data on various related variables. This has been the approach of the Community Development Department, and we have been able to employ some of the results in areas where Dr. Methi has put CDD results into a spatially explicit format. Another

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more future-oriented approach might be to increase transparency in these types of information systems by making reports such as this more available to the general public, and especially to members of the village about which the report is concerned.

(5) Regarding the coverage of this data, completed 2003 data records are available for 2,694 villages out of the 2,966 villages contained in the ONEP village location file. Thus, the question arises as to whether there might be a systematic bias resulting from the types of villages for which there is no report for 2003. In order to help clarify this issue, Figure 2-62 displays a map that indicates the locations of villages that reported and did not report data for 2003. It appears most of the non-reporting villages are associated with relatively densely-populated lowland areas, and many may actually be located within municipal areas. Only an extremely small number are located elsewhere, and all the non-reporting villages are quite well distributed among the various sub-basins. Thus, the author feels it is safe to assume that non-reporting villages was not a source of systematic bias.

One final note is that during the period when the author was discussing with ONEP the potential benefits of working with this data, the author was still not aware that Dr. Methi and his colleagues were already incorporating this approach into their pilot provincial decision support databases. Subsequent discussions with Dr. Methi revealed our parallel efforts, as well as the extensive work they have put into data screening and quality control, as well as into providing much easier accessibility to the variables in the database. The author truly hopes their approach does represent the future for how these data can be more effectively managed, maintained, and – most importantly – used for a wide range of creative purposes.

Figure 2-62. Map of 2003 village reporting status

