Water-Resources Management in the Upper Inderagiri River Basin, West Sumatra, Indonesia

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Introduction

The area of the West Sumatra Province falls into six river basins. One of these is the Inderagiri river basin that, according to the Public Works Ministerial Decision on the division of the river territories, is under the authority of the Ministry of Public Works because the basin is located in two provinces. The upper part of the Inderagiri river basin is located in West Sumatra, while the lower part is located in the Riau Province.

The construction and operation of a hydroelectric power plant (HEPP) at Singkarak lake in late 1997 diverted (transferred) water from the Singkarak lake to the Anai river subbasin, from which the water flows to the west coast of Sumatra. Water was diverted to the Anai river to obtain sufficient head to generate power. In the Anai area the altitude is around 10 m above sea level. The diversion changed the water supply for the Ombilin river and affected users along the river. Since then water management in the Ombilin river has become a concern for various stakeholders.

This paper discusses some of the issues involved in the management of the Upper Inderagiri basin, particularly along the Ombilin river. The next sections describe the subbasin, and how the interbasin transfers have affected water availability. The section that follows these two sections analyzes socioeconomic and institutional issues, focusing on the impact of interbasin transfers and developing the framework for water licensing and basin-management organizations. The final section presents an agenda for the development of institutions for integrated water resources management (IWRM) in the context of national policies and activities in West Sumatra.

The Upper Subbasin of Inderagiri River Basin and Its Hydrology

Demography and Employment

The total population occupying the subbasin area in 1997 was 662,425, with an average population density of 408 persons per square kilometer. The urban-rural population ratio is 0.28. This implies that water supply for urban needs will be an important issue in the near future. In 1997, there were 150,466 households in the basin area with an average household size of 4.59 persons. It is estimated that only around 12.56 percent (or some 18,898) households

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are served by pipe-borne water. Many households still need to be served with piped water in the future. Aside from households, there are also some industries, offices and social facilities that are served by piped water.

With regard to employment, around 68 percent (or 94,508 out of 139,831 households) were categorized as farm households. Since more recent data were not available, data from a 1993 agricultural census were used to estimate the number of households engaged in agriculture and nonagriculture sectors. Assuming that the percentage of people engaged in both sectors is the same as before, the number of farm households in the basin area for 1997 would be about 98,000. This number indicates that the majority of the households in the basin area are engaged in agriculture as their main occupation. It is reasonable enough to expect that water demand for agriculture-related activities will be one of the major issues in the basin area.

The Subbasin and Its Area

The Inderagiri river originates from the highlands of West Sumatra and flows to the east coast of Sumatra Island. The upper subbasin of the Inderagiri river basin in the West Sumatra Province consists of three major rivers, Lembang/Sumani, Sumpur, and Ombilin, and two lakes, Danau Dibawah and Singkarak, as figure 1 shows. The altitude in the upper subbasin rises from 164 m above sea level at the lowest point (near the confluence of the Ombilin and the Sinamar rivers) to 1,200 m at the point where the Lembang river originates from the Dibawah lake, which is about 363 m above sea level. Water from the Lembang/Sumani and Sumpur rivers flows into the Singkarak lake, while the Ombilin river originates from the Singkarak lake and flows eastward to the Inderagiri river.

The total area of the upper Inderagiri subbasin was estimated at 3,060 square kilometers. The basin area includes 400 *desa* (villages) within three districts and three municipalities. Of these villages, the majority (around 87%) are categorized as rural.

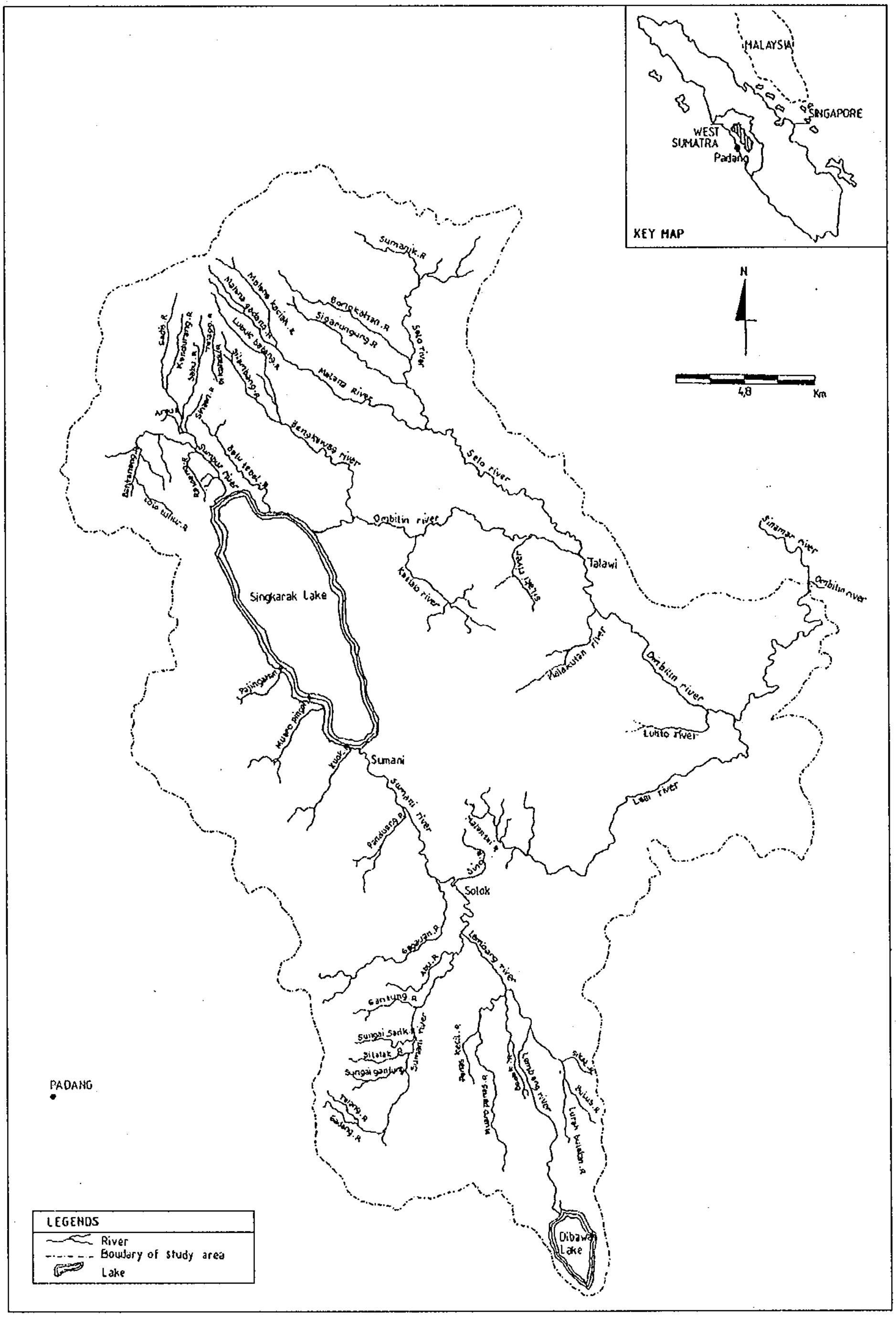
The distribution of this area within each individual basin of the rivers in the subbasin is approximately as follows: 43 percent in the Lembang/Sumani river subbasin, 14 percent in the Sumpur river subbasin, and 43 percent in the Ombilin river subbasin.

Climate and Rainfall

The basin area generally falls under the typical humid, tropic climate covering almost all of Sumatra. An agro-climatic map of West Sumatra (Oldeman et al. 1978) shows five climatic zones, composed on the basis of consecutive wet and dry months, in the basin area. Much of the subbasin areas of the Lembang/Sumani and Sumpur rivers belongs to the wettest zone, while the vast majority of the subbasin area of the Ombilin river is in the driest zone, constituting around one-third of the subbasin area. Consequently, changes in the outflows from the Singkarak lake have an important impact on water availability for the subbasin area under the Ombilin river.

Rainfall patterns in the basin area match the abovementioned agro-climatic zones. Average rainfall in the subbasin area was 2,026 mm/yr. The subbasin area of the Sumpur river is the wettest, with average rainfall of 24,843 mm/yr. This is slightly higher than the Lembang/Sumani river subbasin with an annual average of rainfall of 2,201 mm. The Ombilin river subbasin is the driest, with an annual average of rainfall of 1,789 mm.

Figure 1. Layout map of Lembang/Sumani, Sumpur and Ombilin basin.



Changes in Outflow from Singkarak Lake

In order to fulfill water requirements for power generation by the Singkarak Hydro Electric Power Plant (HEPP), the outflow from the Singkarak lake to the Ombilin river was regulated to 2–6 m^3/s. This was a significant reduction from the earlier average outflow of around 49 m^3/s. the Ombilin river (especially along the 70-km length of the river under study), water is used for irrigation, industry, electric power generation and domestic water supply. The operation of the Singkarak HEPP has affected the availability of water for various uses along the Ombilin river, which indicates the competition between the Singkarak HEPP and water users along the Ombilin river.

Water Accounting of Ombilin River

Water accounting is an art and procedure "to classify water-balance components into water-use categories that reflect the consequences of human intervention in the hydrologic cycle" (Molden 1997). Water-accounting procedures are developed based on a water-balance approach. This classification would enable the analysis of water uses, depletion and productivity in a water-basin context. There are three main components of the classification:

- inflow (which consists of gross inflow and net inflow)
- committed water (the part of outflow reserved for specific uses)
- available water is the difference between net inflow and committed water

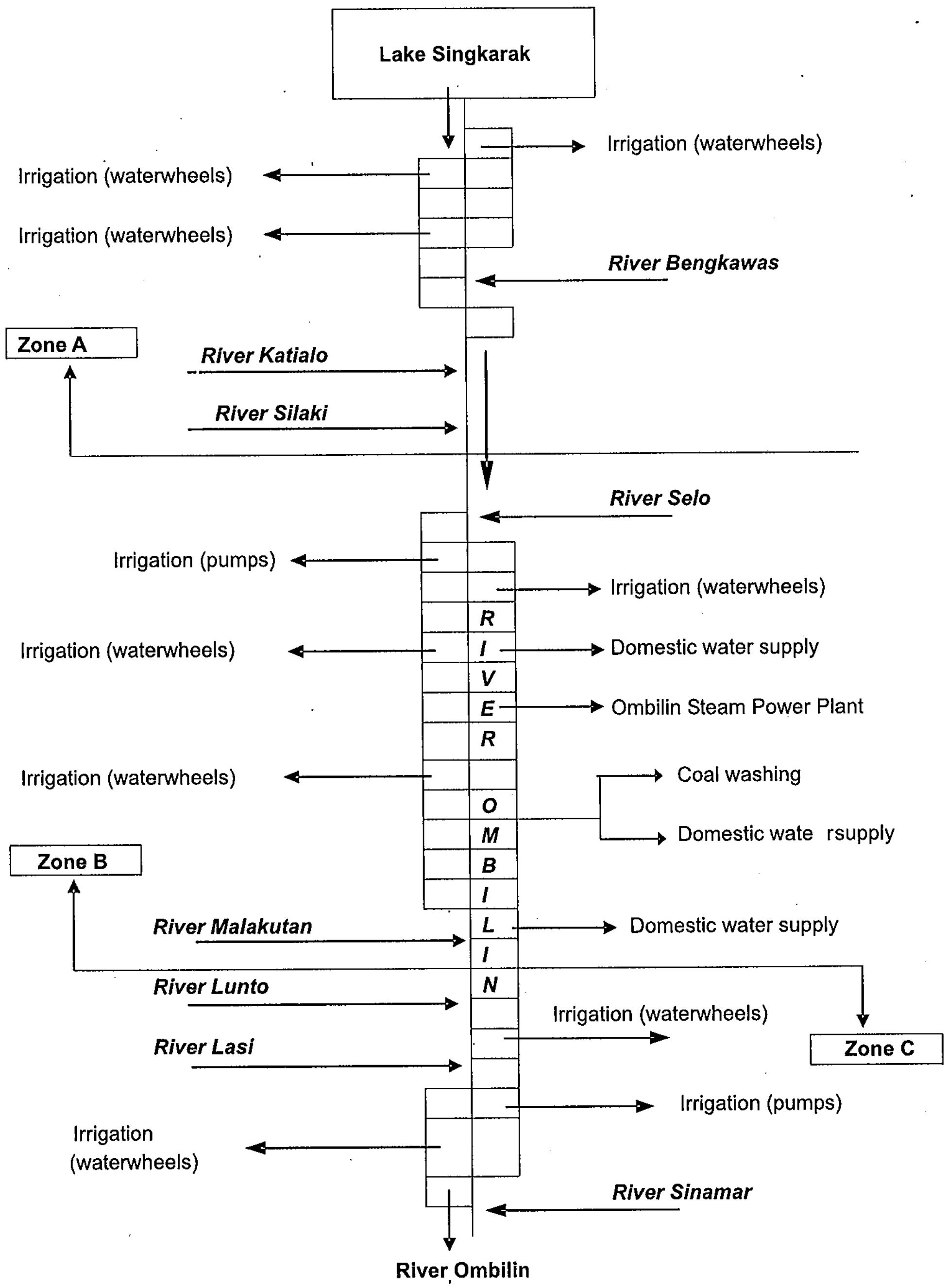
Inflows. There are seven major rivers flowing in to the Ombilin river, as shown in figure 2. Among these rivers, the Selo river has the biggest inflow into the Ombilin river, while the lowest is from the Silaki river. Figure 2 shows the activities dependent on the rivers.

Zoning of subbasin and water uses. Based on the type of water use, the Ombilin river can be divided into three zones: Zone A (upstream), Zone B (midstream) and Zone C (downstream).

Zone A is from the Singkarak outlet to the confluence with the Selo river. In this zone, the use of water is mainly for irrigation where water is lifted by using waterwheels. Three rivers flow into the Ombilin river in this zone: Bengkawas river, Katialo river, and Silaki river. The study found 58 waterwheels in this zone of which currently only 30 are still functioning.

Zone B is from the confluence of the Selo river with the Ombilin river down to the confluence with the Malakutan river,. There are three types of water use in this zone: irrigation, domestic and industrial. From the inventory, 77 waterwheels for irrigation were found, with only 38 still functional. In addition to the waterwheels, five pumping stations for irrigation are also found in this zone. For domestic and industrial purposes, there are two pumping stations for drinking water and one pumping station for coal washing.

Figure 2. Inflows, water uses and zoning of part of the Ombilin river.



Zone C includes the confluence with the Lunto river, and the confluence with the Sinamar river. In this zone, water use is mainly for irrigation by waterwheels and there are 231 waterwheels for irrigation, of which only 116 are still functioning. In addition, nine pumping stations for irrigation were found in this zone.

Water balance and water accounting. The results of water-balance computations for each zone showed that the discharge flow in each zone is still higher than the outflows or water uses for different purposes (see table 1). In Zone A, Zone B, and Zone C only about 5.4 percent, 30.6 percent, and 12.7 percent, respectively, of the water is being used. The data suggest that pressure on water resources is highest in Zone B, followed by Zone C and Zone A.

Table 1. Results of the water balance computation for the Ombilin river.

Items	Zone A		Zone B		Zone C		Water flowing downstream
	Inflow	Outflow	Inflow	Outflow	Inflow	Outflow	
	m³/det	m³/det	m³/det	m³/det	m³/det	m³/det	
Singkarak lake	3.33	-					
Bengkawas river	1.19	-					
Katialo river	2.97	-					
Silaki river	0.07	-					
Irrigation	-	0.41					
Water balance	7.56	0.41	7.15				
Selo river			3.96				
Irrigation			-	0.92			
Talawi Domestic Water Supply Company			-	0.04			
PLN thermal power plant			-	0.01			
Thermal power plant			-	1.90			
Coal washing			-	0.14			
Rantih pump station (Domestic Water Supply)			-	0.40			
Water balance			11.11	3.41	7.71		
Malakutan river					1.32	-	
Lunto river					0.64	-	
Lasi river					2.02	-	
Irrigation					-	1.49	
Water balance					11.69	1.49	10.20

Water Management under Stress

There are four issues related to water management in the subbasin: a) interbasin water transfer; b) impacts of the construction of the Singkarak Hydro Electric Power Plant (HEPP) on irrigated agriculture and other users; c) lack of a framework for water rights licensing and water charges; and d) lack of an organization for river-basin management.

Interbasin Water Transfer

As mentioned earlier, the water used by the Singkarak HEPP does not return to the Ombilin river (which flows to the east coast of Sumatra). In order to gain sufficient head, the water is channeled (by a tunnel through the mountain range) to the Anai river, which flows to the west coast of Sumatra. This transfer to the Anai river reduces the availability of water for the users along the Ombilin river. The fragmentation of water-management responsibilities among a number of government agencies makes coordinated action among them a constraint. The tendency is that when any particular government agency has developed any particular water source, the control of water uses is assumed to be in that agency's hand. Other users are expected to adjust themselves to the changes in water availability.

Impacts of the Singkarak Hydroelectric Power Plant

Impacts on Irrigated Agriculture

The impacts on irrigated agriculture mainly concern waterwheel irrigation systems. Waterwheels lifted water from the Ombilin river for irrigation. Recently, diesel pumps also began to be used to lift water from the river. No surface-irrigation systems were found along the Ombilin river. Diesel pumping began to be used because of the difficulties farmers faced in operating waterwheels under low discharge flows in the Ombilin river. There are surface-irrigation systems on the tributaries of the Ombilin river, but these irrigation systems were not affected by the operation of the Singkarak HEPP.

Reduction in the number of waterwheels and irrigated area. Farmers feel that waterwheels and pumps constitute the most suitable system under the physical conditions along the Ombilin river. The limited rice fields available, their locations scattered over the narrow flat area along the river, and the average width of the river of around 50 m would make the construction of weirs for surface irrigation very costly. Furthermore, the porous soil requires continuous flows of irrigation water.

The field inventory found some 184 waterwheels serving 333 hectares and 463 farmers. On average, a waterwheel served an area of 1.8 hectares, with 2.5 farmers involved. Pump-irrigation technology has just begun to be used in the last few years. This was especially true for those whose land could no longer be served by waterwheel irrigation systems. At the time of the field inventory, 14 pump irrigation units were found along the Ombilin river, with a total command area of 138.5 hectares involving some 200 farmers.

Irrigation has been severely affected by reduced discharge in the Ombilin river. Looking at the number of waterwheels, command area, and number of farmers served during the period after the development of the Singkarak HEPP, it can be concluded that the number of waterwheels has declined markedly. The number of currently existing waterwheels is only around half of that in 1996 before the operation of the Singkarak HEPP started. Current irrigated area is approximately 61 percent of that in 1996. Table 2 below shows changes in the number of waterwheels, service area, and farmers at the Ombilin river during the last 5 years (1996–1999).

Table 2. Number of waterwheels, service area, and farmers in the Ombilin river from 1996 to 2000.

Year	Number of waterwheels	Total service area	Total number of farmers involved
1996	366	549	729
1997	296	470	621
1998	237	405	556
1999	195	343	478
2000	184	333	463

Source: Field inventory.

Increased O&M costs of waterwheel irrigation systems. For owners and operators of waterwheels, reduction in the water discharge to the Ombilin river has caused several problems in system operation and maintenance (O&M). First, the current discharge flows of the Ombilin river, especially in the dry season are, often, not sufficient to rotate the waterwheels, or only allow a very low rotation per minute (rpm). Consequently, operators have to lengthen the traditional weirs as a way of increasing water depth and directing water toward the wheel, so as to make it rotate faster. Another way of continuing the operation of waterwheels under such a condition is to reduce the number of water tubes so the waterwheel becomes lighter and easier to move. Nevertheless, the consequence of both choices is an increase in the workload and cost of O&M of the system, and a reduction in the capacity of waterwheels to supply water, which means a decrease in the area of land that can be irrigated and less reliability of irrigation water.

Increased intensity of damage to traditional weirs and waterwheels is due to drastically increased river discharges resulting from sudden opening of the gate at the Singkarak outlet. According to the farmers, the gatekeeper usually opens it during the rainy season to avoid flooding of the settlements and irrigated areas in the lowland surrounding the Singkarak lake. Consequently, the Ombilin river discharges increase during the rainy season, because of the additional inflow coming from the Singkarak lake.

For the owners and operators of waterwheel irrigation systems, increased damage means more labor and capital costs if systems are to be repaired. Results of the socioeconomic survey show that, on average, the intensity of waterwheel damage increased from once per season before the operation of the Singkarak HEPP to 2.5 times per season (table 3).

Table 3. Damage intensity, and average rehabilitation costs of waterwheels and weirs before and after development of the Singkarak HEPP.

	Before HEPP	After HEPP	% increase
Frequency of damage (times per season)			
Waterwheels	1	2.5	150
Weirs	1	4.5	350
Rehabilitation costs			
Waterwheels	Rp 150,000	Rp 1,100,000	633
Weirs	Rp 50,000	Rp 425,000	750

Source: Socioeconomic survey.

Unreliability of irrigation water and decline in rice yield. Higher intensity of damage to waterwheels has created problems for irrigation water supply. Most farmers reported that their irrigation water supply has been unreliable after the development of the Singkarak HEPP due to the abovementioned problems in system O&M. As a result, the growth and yield of rice on land irrigated by waterwheels declined markedly. Some farmers reported a lighter effect while some others noted a considerable decline. The socioeconomic survey showed that as a whole, yields of rice dropped from an average of 4.2 tons per hectare in the period before the development of the Singkarak HEPP to 3.1 tons per hectare in 1999.

Performance of irrigated agriculture. The performance assessment suggested that irrigated agriculture has declined during the last 5 years. Seven indicators measured performance: (1) output per unit of cultivated area; (2) output per unit of command area; (3) output per unit of irrigation water; (4) output per unit of available water; (5) relative water supply; (6) relative irrigation supply; and (7) financial self-sufficiency. Most performance indicators for waterwheel irrigation systems have declined. Relative water supply and relative irrigation supply declined sharply, which in turn brought about reductions in output. The main factor that caused the declines was the reduction in the total water supply at the field and in the irrigation supply at the field. As a result, the overall performance of irrigated agriculture declined markedly. This condition can be attributed to the lack of effective water-management institutions in the Ombilin river subbasin under conditions of growing inter-sectoral competition for water. With regard to irrigation water management, a major point is that the existing irrigation technology (particularly traditional waterwheels) is no longer suited to the recent condition of water scarcity. Opportunities remain to increase the performance of irrigated agriculture in the area of Ombilin river subbasin by establishing institutions for managing water in the basin, and by improving irrigation technology to cope with the problem of increased water scarcity.

Impacts on Industry and Domestic Water Supply

The reduction in the Ombilin river flows also affected both the water supply of the pump station for coal washing and the quality of domestic water supplies. However, the coal-washing company only experienced problems initially. The company operating the Singkarak HEPP built a weir to improve the water level, which solved that problem.

The decline in the water quality in the Ombilin river brought about some problems for the domestic water suppliers and consumers. The pollution comes from the Selo river, which transported sediment especially during the rainy season, and from coal washing. Water quality in the downstream portion of the Ombilin river declined after the operation of the Singkarak HEPP began. This is shown by an increase in electric conductivity. When records in 1994 and 2000 are compared, it is seen that soluble solid material has risen from 104 mg per liter to 176 mg per liter, pH from 7.2 to 8.4, nitrate content from 0.26 mg per liter to 0.35 mg per liter, chloride from 4.62 mg per liter to 8.4 mg per liter, and sulfate from not detected to 10.3 mg per liter.

The decline in water quality increased O&M costs of the domestic water suppliers. The manager of a water company estimated that water treatment cost increased by almost 100 percent. However, at the time when raw water quality is very low, the domestic water suppliers do not perform water treatment since it would not yield any improvement in the quality of water. Under such conditions, the domestic water company distributes raw water directly to the customers without treating it.

Frameworks for Water-Rights Licensing and Water Charges

According to national laws and regulations, water rights are to be given in the form of use rights and allocated by the government through the mechanism of licensing. Since water and source of water are considered to embody social functions, there are uses of water that require licenses, and others that do not. Tapping water for noncommercial drinking water and other individual domestic uses is allowed without a license as long as it does not harm the source of water and other water users' interests. According to Ministerial Regulation No. 48/PRT/ 1990, a government license is required for uses such as domestic water supply, municipality and real estate, irrigation, animal husbandry, plantation, fishery, industry, mining, energy, navigation and waste disposal.

The Minister of Public Works and the provincial governors are authorized to issue licenses for water use rights within basins under their authority. Licenses for groundwater use are to be issued by the Minister of Mines and Energy. Licenses for water use may be given to individuals or groups of individuals or any legal entity. A group holding a license to use water is authorized to arrange water distribution among its members based on government regulations. Those granted licenses must pay fees to the ministry or to the governor. According to Ministerial Regulation No. 48/PRT/1990, the fee is to be used for financing O&M of water structures and maintaining the sustainability of water sources. Every license for water use has a limited duration depending on the kind of use. The fee is supposed to be set every 5 years.

Article 18 of Ministerial Regulation 48/PRT/1990 states that giving up a water license or selling it to other parties may be allowed if the issuing agency license gives its permission. However, the regulation is not explicit on how this would occur. Formal water use rights and allocation are hardly implemented, except to a limited extent in two basins on Java managed by publicly owned companies. Problems concern not just gaps and inconsistencies in the formal regulations, policies and organizations. A lack of consensus on some key concepts (Pusposutardjo 1996) and the lack of hydrological data in most of the basins (Hehanusa et al. 1993) make it impossible for the government to make basin-level planning or even to make the right decisions on whether or not new uses of river water are justifiable.

Regulations stipulate that licenses for water uses, which potentially affect water balances, must be based on general basin-level plans on development, protection and utilization of the basin water. In cases where such plans have not been made, the issuance of the licenses must be based on consensus made in the coordinating body, the Provincial Water Management Committee. However, it is not clear what the basis for such a consensus would be.

In practice, for most basins, water allocation is governed by whatever local communities accept as rules. In predominantly agricultural basins, *adats* (traditional customary rights) may govern water allocation. For the Ombilin river, there were no local rules for water allocation since the challenge was lifting water from the river. In the context of waterwheel irrigation, the results of water accounting showed that, in aggregate, the water supply is sufficient but the problem is the water level required to operate the waterwheels.

Where nonagricultural sectors have exerted their interests, claims over water may be based on political or economic power leading to transfer of water from the agriculture sector (Bruns et al. 1996). Nevertheless, government wields, and is capable of exercising, the authority in water allocation, including interbasin water transfers. Transferring water from the Ombilin river to the Anai-Sialang basin is an example. Apparently, the decisions on this transfer were made on the basis of studies done by the government. The original water users must adjust to the new situation. One of the impacts of the government action on farmers along the Ombilin river is that it has affected the operation of their waterwheels in supplying water to their paddy fields due to lower river flows. Moreover, the lower flow has also made domestic pollution more felt in the downstream areas of the Ombilin river. This underlines the importance of formalization of irrigation water rights in order to protect the interest of the poor and small farmers.

Absence of an Organization for River-Basin Management

As mentioned earlier, the incorporation of the idea of river-basin management into policy and action is relatively new to Indonesia. Furthermore, the management framework is not yet developed except in two basins on Java Island that are managed by publicly owned corporations. These are the Brantas river basin in East Java under the management of Jasa Tirta Public Corporation One, and the Citarum river basin in West Java under Jasa Tirta Public Corporation Two (formerly called the Jatiluhur Authority).

In other provinces of Indonesia, the idea of river-basin management has been newly introduced. As the responsibility for water management is fragmented between several government agencies, a provincial water management committee (in Indonesian language abbreviated as PTPA) is supposed to be set up in each province. In West Sumatra the PTPA was set up in 1994. The characteristics of this committee are as follows:

- Its main function is to assist the governor in coordinating water management at the provincial level.
- Its specific tasks are a) data collection, processing and preparation of materials to be used to formulate provincial policy on water-management coordination, and b) to provide considerations and/or advice to the governor on matters related to water supply, wastewater drainage and flood control.
- The members of the committee are the staff from agencies related to water management (other stakeholders were not included as the members of the committee).

There was no specific budget allocated for this committee, so its activity was on an ad hoc basis. When there were problems related to water supply, drainage or flood, a meeting of provincial staff would be held, but it was not very clear whether the meeting was a PTPA meeting or just a meeting related to the performance of general government tasks.

The government regulation related to the provincial PTPA also had articles stating that the governor could set up basin-level water-management committees (PPTPA) to assist the PTPA in performing its tasks. However, up until now such a committee has not been set up in any of the six river basins located in the West Sumatra Province. As the conflicts over water allocation and use increase in West Sumatra, as illustrated with the case of the Ombilin river, clearly, there is a need to develop a framework for improvement of river-basin management in the province. The case of the Ombilin river can be used as the pilot activity to develop the framework and capacity for integrated water resources management (IWRM) at the basin level in West Sumatra.

Toward Effective Institutions for IWRM in a River-Basin Context

Agenda for West Sumatra

The preceding sections showed the need to develop effective water management institutions. Based on study activities, an agenda for improving water management in the upper subbasin of the Inderagiri river basin (especially in the Ombilin river subbasin) is discussed below.

The first, short-term agenda would deal with the impacts of operation of the Singkarak HEPP on the downstream users. The options that can be considered are as follows.

In the short term, especially during the dry season, the problems faced by the users need to be solved by reviewing the existing water-allocation rules and releasing more water from the Singkarak lake to the Ombilin river. For this purpose, the handling of water-allocation matters needs to be done systematically. The affected users along the Ombilin river have proposed that a kind of water board, which would consist of all of the stakeholders, be set up and given authority to regulate water allocation from the Singkarak lake.

The technology for lifting water for irrigation, both with waterwheels and diesel pumps, needs to be adjusted given the changes in the water level at the Ombilin river and the cost of operation of the pumps. The soil porosity is high, so a 24-hour water supply is needed.

Waterwheels are very well suited for this environment, but the water level in the river is no longer sufficient to continue operating efficiently with the current technology. With regard to the pumps, the farmers indicated that they have difficulties with the cost of pump O&M and are thinking about using electric pumps for lifting water from the river. Farmers proposed that the electricity company provide a special discount for electricity to the domestic water-supply company and the farmers who use electric pumps for irrigation, as a "good neighbor policy."

Second, for the long term, the government needs to set up a coordinating committee (PPTPA or a kind of water-management committee) at the subbasin level. The main task of this body would be to regulate and enforce the water-allocation rules effectively, in accordance with the basis provided by the national water-resources policy. The long-term action plan to improve water management would consist of several activities.

All the water-related laws and regulations at the provincial level should be reviewed and adjusted in accordance with the direction of the new national water policy. This would include laws and regulations related to water rights; strengthening the water resources management coordinating committee at provincial level (PTPA); establishing water-resources management coordinating committees at basin and subbasin levels; and reviewing the possibility of charging a tax for using surface water, and using the income generated from this to finance the operation of the coordinating bodies, and for river and watershed maintenance. In the preparation for setting up coordinating and/or operating bodies for the management of other rivers (subbasins) the officials concerned could benefit from using the Ombilin river subbasin as a pilot site.

National Policies

The Government of Indonesia is currently reforming its water resources and irrigation management policy. The reforms have four objectives (BAPPENAS 2000):

1. Improving the national institutional framework for water resources development and management.
2. Improving the organizational and financial framework for river-basin management.
3. Improving regional water-quality management regulatory institutions and implementation.
4. Improving irrigation management policy, institutions and regulations.

Among these objectives, the first and second are closely related to the improvement of water allocation from the source and river-basin management. One of the five sub-objectives of the first objective clearly mentions the involvement of stakeholders (including the private sector) in river-basin management and decision making. The proposed reforms in this sub-objective cover three areas, namely:

- Issuing a government regulation that puts emphasis on the participation of stakeholders (public agency institutions, community and private sector) in water-resources development and management.

- Amending the ministerial regulation to i) include stakeholder representatives in provincial- and basin-level water-management coordination committees, and ii) merging provincial water-management committees with provincial irrigation committees.

- Establishing functional, provincial- and basin-level water-management committees with stakeholder representation in key river basins in 12 provinces.

The second objective contains three sub-objectives, one of which is the improvement of provincial regulatory frameworks for river-basin and aquifer management. This will be a basis for the development of effective water-management institutions at the provincial and basin level.

Progress Achieved in West Sumatra

Improvement of water management in West Sumatra requires continuous and consistent efforts to lay down necessary foundations. The Provincial Water Resources Management Agency has started taking initiatives. The agency has held a series of stakeholder dialogues in order to prepare a draft provincial water regulation. This regulation attempts to address the problems and challenges of water management by referring to the national water-policy reforms and the principles and frameworks for IWRM. Approval has been given to set up technical implementation units for river-basin management (as a preliminary body or embryo for River Basin Organizations). Better water management would also require improvement of provincial water-resources information and decision-support systems.

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