CRBOM Small Publications Series No. 25

Java's water security

by

Isnugroho

Center for River Basin Organizations and Management,
Solo, Central Java, Indonesia

July 2010

The *'Small Publications'* are intended for knowledge-sharing and dialogue. In some cases they may present facts, information and lessons learnt. In other cases, they provide news, opinions, ideas or open questions for discussion.

They express the opinions of the author(s) and not those of CRBOM.

They can be freely copied and disseminated.

Contributions are most welcome - in English or in Bahasa Indonesia.

The author:

Ir. Isnugroho
Executive Director, CRBOM
isnugroho@crbom.org

CRBOM
Center for River Basin Organizations and Management,
Solo, Central Java, Indonesia
www.crbom.org
info@crbom.org

Contents

Summary

Java covers 7 percent of Indonesia's land area but is home to 60 percent of the country's population. With only 4-5 percent of the country's water resources, the island represents 70 percent of the country's irrigated area and 75 percent of its water demand for industry.

The present paper provides a summary of the agenda for Java's water security and applied modalities for its management. Challenges include

- water for households;
- sanitation and wastewater disposal;
- water for production and livelihoods;
- flood management (including urban drainage) and climate proofing;
- sediment control;
- land subsidence;
- saline intrusion; and
- groundwater depletion.

Causes and effects interact. At best, various development initiatives can add value to each other by supporting each other's intended benefits.

The water resources management is characterized by decentralization and expanded stakeholder participation. RBO benchmarking is routinely applied.

There is a strong need for expansion of the knowledge base, improved knowledge management, human resources development, and institutional capacity-building.

Good progress has been made towards improved water security, such as for example:

- Basin-level management and RBO performance;
- functional public participation modalities with proven benefits;
- comprehensive capacity-building efforts in support of good governance in general and decentral management in particular;
- responsive maintenance, rehabilitation and expansion of flood protection infrastructure and irrigation systems;
- flood warning systems, including operational warning systems;
- expansion of storage capacity, including multi-purpose reservoirs;
- land use development in headwater areas;
- responsive development of irrigation technology and cultivation systems; and
- cultivation adjusted to predictable climate variability related to the El Niño-Southern Oscillation cycle.

Acronyms and abbreviations

BBWS:	Balai Besar Wilayah Sungai, a type of RBO under the central government (DG of Water Resources, Ministry of Public Works), managing national river basin districts
BWS:	Balai Wilayah Sungai, a type of RBO under the central government (DG of Water Resources, Ministry of Public Works), managing river basin districts within a province
CRBOM:	Center for River Basin Organizations and Management, Solo, Central Java
DUWRMT:	Dissemination Unit for Water Resources Management and Technology
IWRM:	Integrated water resources management
NARBO:	Network of Asian River Basin Organizations
PJT1, PJT2:	Jasa Tirta (1 and 2) Public Corporations, undertaking basin-level water management, including infrastructure, raw water supplies, flood protection and water quality management
RBO:	River basin organization
RPJM:	Rencana Pembangunan Jangka Menengah, medium-term (5-years) development plan
RPJP:	Rencana Pembangunan Jangka Panjang, long-term (20-years) development plan
TKPSDA:	Tim Koordinasi Pengelolaan Sumber Daya Air, *'Water Resources Management Coordination Team'*
WSS:	Water supply and sanitation

Map of Java

Headlines


DRY SEASON
Drought threatens agriculture, power supplies
Forecasting inaccuracy slowing down harvests
CLIMATE CHANGE
Yogyakarta groundwater surface dropping 30cm a year
Sri Wahyuni
THE JAKARTA POST/YOGYAKARTA
Residents warned of river overflows
ELECTRICITY
Power plants stop operating during drought in Central Java
Most parts of Semarang inundated, airport closed
Agus Maryono
Mangrove damage reaches 97% in C. Java
'20 years' work needed to restore Citarum basin
Farmers still facing serious water problems
Adianto P. Simamora
THE JAKARTA POST/JAKARTA
Heavy floods and landslides ravage C. Java over weekend
Raw water reaching new pollution-level highs
Central, West Java face water crisis, harvest failure
Agus Maryono and Nana Rukmana
THE JAKARTA POST/BANYUMAS/CIREBON
Hundreds of homes flooded in Java, Sumatra
Water crisis starts hitting provinces
LAND SUBSIDENCE
Jakarta sinking up to 10 cm per year
Irawaty Wardany
Key river suffers upstream, downstream pollution
Water crisis overshadows Jakarta
Eroding riverbanks threaten flash floods in East Java

1 Introduction

Water and water security make good headlines, because of the social significance of access to water for households, production, power generation and livelihoods.

Depending on the conditions in each river basin, *water security* covers aspects such as safe water (and, hereby, sanitation) to households; water for food production, livelihoods, industries and power generation; disaster preparedness; and healthy river basins.

Guiding vision for water security

1 Satisfy household water and sanitation needs in all communities
2 Support productive economies in agriculture and industry
3 Develop vibrant, livable cities and towns
4 Restore healthy rivers and ecosystems
5 Build resilient communities that can adapt to change

Source: Arriens (May 10), quoting the Asian Water Development Outlook 2010 Team

Water security is determined by a variety of factors, some of which are natural, and most of which can be managed, at least to some extent.

Java has an area of 132,200 km2 (7 percent of Indonesia's land area) and a population of some 130 million (2006) (60 percent of the country's population) - but only 4-5 percent of the country's water resources. The island is home to 70 percent of the country's irrigated areas, and 75 percent of its water demand for industry.[1] It is evident that water security is important.

The present paper provides a summary of the agenda for Java's water security and applied modalities for its management.

2 Concern and challenges [2]

2.1 Water for households

Access to safe water, sanitation and electricity is a major challenge. 77 percent of Indonesia's households apply an *'improved water source',* but due to raw water contamination, this is only one step towards *'safe water'* (which today is available to 55 percent of the households) (while only 17 percent have piped water supply) (2004). Both surface waters and groundwater are polluted, and most households must boil their water, or rely on bottled water for drinking.

Unsafe drinking water is a major cause of diarrhea, which is the second leading killer of children under five in the country and accounts for about 20 percent of child deaths each year. Every year, at least 300 out of 1,000 Indonesians suffer from water-borne

---

1 WWC (Feb 03)

2 Most of this chapter has been extracted from Isnugroho (May 10) and ADB and CRBOM (Jun 10)

diseases, including cholera, dysentery, and typhoid fever, according to Ministry of Health.

Water supply and sanitation (WSS) investments were around 2 USD per person per year until recently, which is inadequate. In June 2010, however, three state-owned banks pledged a funding of 3.7 trillion Rp (400 million USD) for expanded urban water supplies by public utilities (Perusahaan Daerah Air Minum, PDAMs).

2.2 Sanitation and wastewater disposal

In Indonesia as a whole, 55 percent of households have *'improved sanitation',* while only 2 percent - all in urban areas - are connected to a sewer system (2004).

Orderly disposal of wastewater is an escalating challenge, due to the general economic development, urbanization, increased demand of water, and increased waste production from households and industries.

'UNICEF found that only 53 percent of the country's population obtained water from sources that were more than 10 meters from a waste disposal site. And in Jakarta alone, fecal coliform was found in all but 16 percent of shallow well samples'. [3]

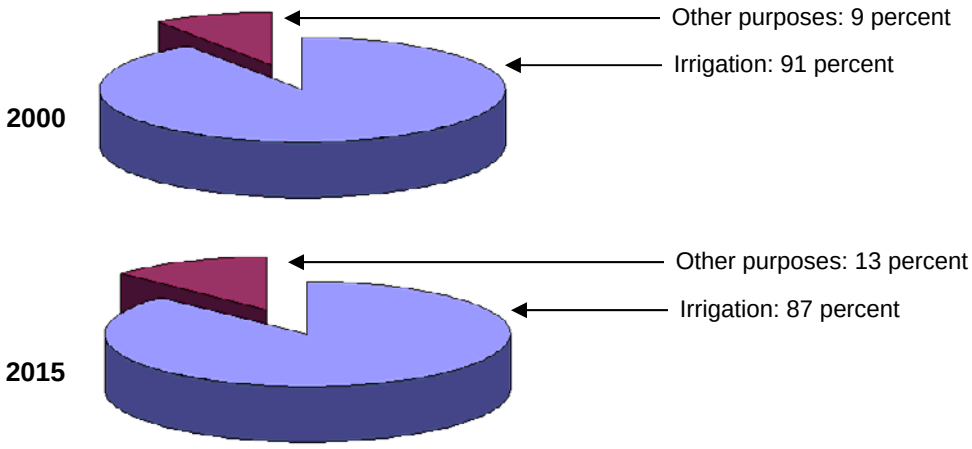
Management options include sewer systems and treatment capacity (including on-site treatment of industrial effluents); wider use of septic tanks, and improved operation of existing ones; upgraded operation and maintenance of storm water drains; and sustainable solid waste disposal practices.

A different issue is the use of agricultural pesticides.

2.3 Water for production and livelihoods

On Java, as elsewhere in Indonesia and in other countries, there is a demand pressure from off-stream water uses other than irrigation. According to the figure below, the demand for industries and domestic uses is expected to increase by 50 percent from 2000 to 2015 - an estimate that could turn out to be on the low side.

Figure 1: Water utilization for irrigation and other purposes



Data: Java and Bali, WWC (Feb 03)

[3] Asia Society (Apr 09) quoting www.unicef.org/indonesia/wes.html

Surface waters are most readily accessible, and widely used, but also groundwater is often used for both irrigation, industries and urban supplies.

2.4 Flood management and climate proofing [4]

From 1985 to 2009, there were 154 flood events in Indonesia - more than 6 per year - and clearly escalating over the period. 54 of these floods were classified as severe; and more than 40 of the floods occurred in Java. There were severe floods in Jakarta in early 2007; and in the Bengawan Solo Basin in December 2007/January 2008, and again in early 2009.

The flood exposure in urban areas is affected by drainage issues: Coverage, capacity, operation and maintenance, and irregular solid waste disposal.

Climate proofing in Java

Java is exposed to a number of factors that affect the flood risk and flood vulnerability, such as (in random order): ENSO (El Niño-Southern Oscillation) (mesoscale) climate oscillations; global climate change; volcanic eruptions and earthquakes; changed land use; land subsidence related to groundwater abstraction; sand mining; river regulation; and general development of the physical infrastructure. With land slides as a related calamity, serious (and apparently escalating) consequences to human lives, crops, properties and infrastructure have occurred in recent years.

Flood proofing measures are in progress or are being planned at the national, province, regency/municipality and community level of administration. They include flood storage capacity; dykes; flood channels; drainage (flow) capacity maintenance and enhancement; land conservation in headwater areas; erosion control (terracing, re-greening, reforestation and sediment control); flood hazard mapping; public awareness; and forecasting and operational warning.

Source: Fahmi Hidayat (Oct 09)

On Java, climate change impacts include droughts, floods, landslides, and sea level rise (that enhance the flood risk and the saline intrusion into fresh surface and groundwater bodies)). A large part of the population depends on water for their livelihoods and/or food and/or electricity. Java is the most densely populated island in the region, with a large population living in areas exposed to coastal or inland floods.

A study reported by Yusuf and Fransico (Jan 09) rated Jakarta as the area in Southeast Asia that is most vulnerable to climate change: [5]

'Moreover, the areas in western and eastern Java are also vulnerable using the regional standard. Central Jakarta ranks first in the overall vulnerability assessment even though it has the highest adaptive capacity index. This is because this district is the intersection of all the climate-related hazards, except tropical cyclones. It is frequently exposed to regular flooding but most importantly, it is highly sensitive because it is among the most densely-populated regions in Southeast Asia. Areas in western Java are also highly vulnerable due to exposure to multiple hazards (namely, floods and landslides) as well as having high population densities.'

---

4 This section is quoted from Fahmi (Oct 09)

5 This study evaluated vulnerability on the basis of (1) exposure to hazards; (2) population density; and (3) adaptive capacity (or *'disaster preparedness').* Even with a fair disaster preparedness, Java is highly vulnerable, due to a high exposure and a high population density

2.5 Sediment control

Sedimentation takes place in rivers and reservoirs, partly for natural reasons and partly due to changed land use. The sedimentation increases the flow resistance of flow channels, hereby adding to the flood risk, and reduces the precious live storage capacity in reservoirs.

In places, sand mining in river beds affect the morphological stability of the rivers, which can in turn add to the flood risk as well as to saline intrusion in downstream reaches.

Many rivers in Java are exposed to occasional volcanic eruptions that can abruptly change their planform, flow resistance, and entire morphological balance.

Figure 2: Maintenance dredging in the 440 million m3 Wonogiri Reservoir

Photo: April 2010. The reservoir is located in the Bengawan Solo Basin, Central Java

A variety of mitigation measures are being implemented, including control of land use, alternative routing of flows with high sediment loads, and dredging in reservoirs.

Rehabilitation of critically degraded lands is supported by Ministry of Agriculture by promotion of land rehabilitation, soil conservation, and support to sustainable income generation.

2.6 Land subsidence

Land subsidence is observed in several major Javanese towns, including coastal towns, such as Jakarta, where the typical rate is 1-15 cm/year (between 1982 and 2008), and up to 20-25 cm/year at certain locations and over shorter periods.[6] This is due to a combination of natural causes and groundwater abstraction. The subsidence will interact adversely with a rising sea level.

The subsidence is irreversible but can be halted by relocating the groundwater abstraction.

In Semarang, on the north coast of Java, a Dutch type polder is being built to protect a part of the town against frequent flooding. It covers an area of 55 ha with a population

---

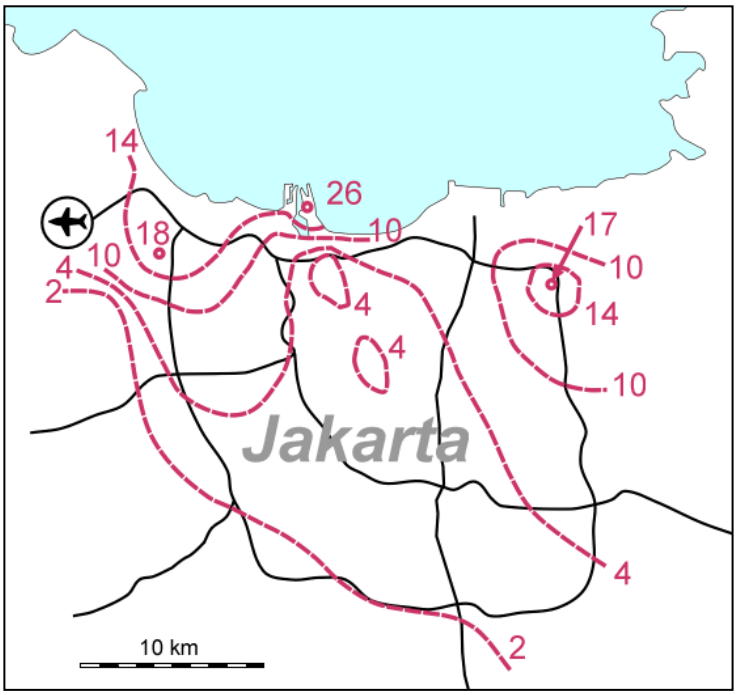
6 Abidin and others (Oct 09)

of 84,000 inhabitants. The investment is estimated at 7 million USD and the net present value is estimated at 5.5-9 million USD.[7]

Figure 3: Land subsidence in Semarang

Photo from June 2009

Figure 4: Land subsidence in Jakarta



Numbers are subsidence in cm/year, recorded by GPS from Sep 07 to Aug 08
Source: Abidin and others (Oct 09)

[7] For additional information, please refer to Mondeel, Herman and Hermono S Budinetro (Jan 10)

2.7 Saline intrusion

Saline intrusion into lower reaches of the rivers occurs during low flows and can impede irrigation. The extent can be enhanced by dredging of bed materials. Also, in places, groundwater bodies near the coast are affected by salinity.

2.8 Groundwater depletion

Groundwater extraction takes place by public as well as private operators, and data are fragmented and inaccurate. Although solid evidence is lacking, there is evidence that some groundwater reservoirs are being depleted because withdrawals exceed the recharge.

WWC (Feb 03) notes that *'the heavy reliance on groundwater to serve industrial and domestic needs in large urban areas cannot continue indefinitely. This is particularly true for the northern coastal cities of Java where groundwater is being abstracted at greater than replenishment rates, leading to saltwater intrusion and land subsidence - with attendant increases in floods and water logging which, in turn, aggravates groundwater pollution from septic tanks and leaching pits'.*

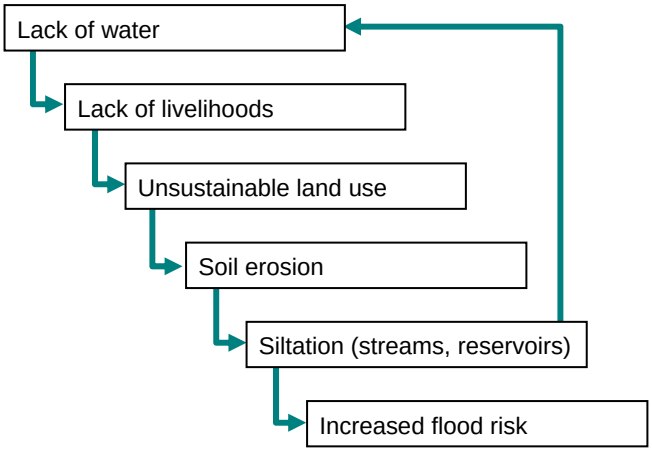
A raw water fee for groundwater is in place, serving as a *'green tax',* but there is a scope for improved enforcement.

3 Interaction between causes and effects

Causes and effects interact. This is important to keep in mind in connection with development planning. At best, various development initiatives can add value to each other by supporting each other's intended benefits.

'In Jakarta, public utilities providing freshwater serve only 46% of the city's population, requiring the remainder to extract water from underground sources to meet their daily needs. This extraction [causes] reduced water levels, increased salinity, and growing subsidence rates ... . This has greatly increased the vulnerability to flooding during high tides - and climate change - induced sea-level rise - and is preventing the implementation of flood control measures'. [8]

Figure 5: Example of cause-effect relationships



[8] Asia Society (Apr 09)

4 Basin-level governance

Indonesia is divided into 133 river basin management districts. These can be hydrologically delineated basins, or clusters of such basins, or a basin with some coastal areas included, or an island.

There are several types of river basin organizations (RBOs), as follows:

Public corporate RBOs (Perum Jasa Tirta, PJT)

There are two such corporations in Java: PJT1 covers the Brantas and Bengawan Solo basins, while PJT2 covers the Citarum Basin. They are responsible for water allocation and for operation of water-related infrastructure, as well as several related tasks. They are owned and governed by the State (Ministry of Public Works). They operate on a commercial basis and recover some (but not all) of their costs.

Central government RBOs (Balai Besar Wilayah Sungai, BBWS/Balai Wilayah Sungai, BWS)

The government has established 12 Balai Besar Wilayah Sungai (BBWS) and 19 Balai Wilayah Sungai (BWS) to manage water resources in 67 particular basins. The management is not only limited to operation and maintenance but also covers river basin planning and development related to water resources conservation, utilization, and prevention of water-related hazards. These organizations are fully funded by the central government.

Provincial government RBOs (Balai PSDA)

At the province level, the local governments can set up permanent Basin Management Units (Balai PSDA) to implement basin-level water resources management. The Balai PSDAs are placed under the Provincial Public Water Resources Service (Dinas PSDA). Their roles and responsibilities cover water allocation, management of rivers, reservoirs, lakes and ponds, flood control and drought management, swamps, in-stream pollution control, river mouth maintenance, and inter-district irrigation systems. They are funded by the provincial government budget (which is limited). Among the 33 provinces in Indonesia, only 15 have basin management units.

Province/regency/municipal water resources services[9]

Such units have been established under province/regency/municipal government regulation. Their tasks and responsibilities are mainly operation and maintenance of small rivers and irrigation systems under 1,000 ha. A prominent problem is limited budgets.

Water councils (TKPSDA)

Water councils were established in 2009 on a pilot basis, initially for the Bengawan Solo and the Brantas Basins. By mid 2010, there are around 20 such councils - province-level or basin-level (inter-province) - most of which are in an early state of consolidation. They have an equal participation by governmental and non-governmental bodies (including the RBOs of the basin). They are responsible to the Minister Public Works for water-related development planning.

---

9 Indonesia has 33 provinces (including 2 special regions and 1 special capital city district); around 397 regencies; and around 98 municipalities (new regencies and municipalities are formed from time to time, while others are being merged)

The Bengawan Solo Water Council (TKPSDA)

The *'Water Council'* of Bengawan Solo Basin (or TKPSDA Bengawan Solo) was established in February 2009 as a platform for stakeholder liaison and an advisory body for water-related, basin-level development. It has 64 members, representing agencies, organizations and bodies that are in some way involved in water resources management in the basin, at the national, province, or de-central level. Half of these - 32 - are governmental, and the other half are non-governmental. Among the members are the two river basin organizations of the Bengawan Solo Basin.

The Council has three committees, covering conservation; water utilization; and water-related calamities (such as floods and land slides). Two supporting committees cover data information and public participation.

The Council submitted its draft strategic development plan *(pola)* to the Minister in late 2009, and the plan was approved in May 2010.

Early experience indicates that the Council serves its purpose well, providing practical and useful guidance, in a functional, active collaboration with stakeholders.

Source: Sudarsono (Sep 09)

3.1 Prospects for basin-level management

A large variety of challenges from one river basin to another is reflected by different approaches and institutional arrangements. Some river basins in Java are managed by several RBOs with different responsibilities. In other cases, one RBO can manage two or more river basins.

Basin-level water resources management spans across disciplines and sectors, and requires expertise as available with different institutions. A comprehensive and integrated (IWRM-based) management requires a shared or coordinated management planning, involving the various agencies and stakeholders.

Indonesia has a history of basin-level master planning. The 2004 Water Law prescribes basin-level planning by a two-step approach:

- A ***pola,*** or strategic plan, with development goals and supportive development interventions. The pola is expected to cover (i) water conservation; (ii) water utilization; (iii) water-related calamities; (iv) knowledge base; and (v) public participation. The pola defines development goals, scoping and priorities as a basis for
- a ***rencana,*** or management plan - a sort of a multi-sector master plan, with specific development initiatives recommended for implementation.

Until now, only the first step of the process has been completed, with the first polas approved by the Minister for Public Works in mid 2010. The second step may take some years.

3.2 Stakeholder participation

Active stakeholder participation is explicitly prescribed in the 2004 Water Law, and implementation is in a healthy state of progress.

Indonesia's Law No. 7/2004 on Water Resources - stakeholder participation

Article 85

(1) Water resources management covers inter-sector and inter-regional interests that require integrated actions to maintain the sustainability of the functions and benefits of water sources and resources.

(2) Water resources management ... should be conducted through a coordination by integrating the interests of various sectors, regions, and stakeholders in water resources.

Article 86

(1) Coordination ... should be conducted by a coordination institution under the name of water resources board or by any other name.

(2) The coordination institution ... has the main task of preparing and formulating water resources policies and strategies.

(3) The members of the coordination institution ... consist of a balanced number of state and non-state elements based on the principle of representation.

3.3 Decentralization

A comprehensive decentralization was promoted in 1999 by Law 22/1999 on Local Governance. In 2004, further momentum was provided by a new law that aims at decentralization of many government functions.

Selopuro Village

Selopuro Village is located in Wonogiri Regency, Central Java. It is home to 400 households. Its raw water is drawn from a spring some 3 km away, and the villagers used to spend a lot of time fetching water. Water shortages were frequent, because the spring became irregular due to deforestation in its hilly catchment area.

Since 1998, the villagers have worked together to clear rocks around the spring, and to restore and protect the forest. After considering several options, they built an elevated reservoir with water pumped from the spring. The regency contributed 40 million Rp (4,400 USD) in support. Today, the system provides reliable access to water for the connected households. It is managed by the villagers themselves. At a fee of 2,000 Rp (0.2 USD) per m3 and some active participation by the beneficiaries it is financially self-sustainable.

The ready access to water has released resources for other purposes, such as growing vegetables and raising livestock. The village has developed visibly. In the past, only a few children completed junior high school, but today, many youths go to university.

Slamet Susanto, The Jakarta Post, 8 July 2010

3.4 RBO benchmarking

An RBO benchmarking is a structured assessment of its performance relative to *'best practices',* considering its stated responsibilities and operation, and made for the sake of improving its performance. Benchmarking can describe an RBO's ability to do what it is expected to do (or wants to do), and hereby provide a starting point as well as directions for performance upgrading. Also, a benchmarking can facilitate a structured sharing of experience and inspiration between participating RBOs. Typically, the associated costs are moderate.

Today, RBO benchmarking is routinely applied in Indonesia. [10]

[10] For details, please refer to Sungguh (Dec 09)

3.5 Capacity-building

The ever-present need of human resources development and institutional capacity-building is enhanced by two circumstances:

- The inter-sector and multi-disciplinary character of integrate water resources management (IWRM); and
- the ongoing decentralization, shifting many responsibilities from the ministries to provinces, districts and regencies.

Water-related capacity-building and leadership training is conducted by Bappenas (the national planning agency) and by Ministry of Public Works, often in collaboration with development partners. CKNet (supported by IHE-UNESCO) is an organization that promotes networking and knowledge-sharing among universities, related to water resources management. PJT1 operates a national training facility near Malang, East Java. A new Dissemination Unit for Water Resources Management and Technology (DUWRMT) (in Solo, Central Java) (supported by Jica) provides training in contemporary water resources management and technology at all levels, from lower to upper grade: Operators, technicians, engineers, and management staff.

5 Knowledge base and knowledge management

Perfect knowledge is an utopian ideal. Knowledge-building takes time and costs money, and predictions are inherently uncertain. Timely and appropriate decisions must be based on *'the best knowledge available at the time when the decision must be made'.*

Knowledge is required about

- present conditions;
- trends, challenges and opportunities - including markets, technology, monitoring;
- cause-effect relationships - natural and socio-economic;
- management options; and
- impacts - positive and adverse.

A substantial part of this knowledge is available, but it is sometimes fragmented and not always readily accessible. This is for example the case for basic information about surface and groundwater availability, present and future demands, and actual water utilization.

The knowledge base can be consolidated and expanded by contemporary tools for monitoring, data management and decision-support, by broad inter-agency collaboration; and by an active environment for professional networking across traditional disciplines.

6 Progress towards improved water security

Progress towards improved water security is characterized by several achievements:

- Basin-level management and RBO performance;
- functional public participation modalities with proven benefits;
- comprehensive capacity-building efforts in support of good governance in general and decentral management in particular;
- responsive maintenance, rehabilitation and expansion of flood protection infrastructure and irrigation systems;
- flood warning systems, including operational warning systems;
- expansion of storage capacity, including multi-purpose reservoirs;
- land use development in headwater areas;
- responsive development of irrigation technology and cultivation systems; and
- cultivation adjusted to predictable climate variability related to the El Niño-Southern Oscillation cycle

References and literature

Aart Van Nes and Arlene Inocencuo (08): RBO performance bench marking in six RBOs in Indonesia. Paper published by DHV, Deltares, MLD in Cooperation with NARBO

Abidin, Hasanuddin Z, H Andreas, I Gumilar, M Gamal, Y Fukuda and T Deguchi (Oct 09): Land subsidence and urban development in Jakarta. 7th FIG Regional Conference on Spatial Data Serving People: Land governance and the environment – building the capacity. Hanoi, Vietnam

ADB and CRBOM (Jun 10): IWRM implementation in Indonesia. Draft working paper 11, prepared under RETA 6470: *'Managing water in Asia's river basins - charting progress and facilitating investment'*

ADB (May 08): Indonesia: Country environment analysis. Asian Development Bank

Agus S K and others (Jul 09): Policy on implementing integrated water resources management in Indonesia. Country paper prepared by Agus Suprapto Kusmulyono, Suharto Sarwan, Rahardjanto (DG WR), and Budhi Santoso, presented at the Conference on *'New Thinking on Water Governance',* Singapore

Arriens, Wouter Lincklaen (May 10): Water governance challenges in Asia's river basins. Slide presentation

Arriens, Wouter Lincklaen (Apr 10): Knowledge networking for water security in the 21st century. Slide presentation

Asia Society (Apr 09): Asia's next challenge: Securing the Region's water future

Fahmi Hidayat (Oct 09): Floods and climate change - observations from Java. CRBOM Small Publications Series no. 10, Center for River Basin Organizations and Management, Solo, Central Java

Graita Sutadi (09): The Bengawan Solo Water Council. Paper published by BBWS-BS

Isnugroho (May 10): Improving water security in Indonesia. Discussion paper for a study visit in Spain organized by ADB, NARBO, Tecniberia, and Ministerio de Economía y Hacienda, Government of Spain

Ministry of Environment (Nov 07): National action plan addressing climate change

Mondeel, Herman and Hermono S Budinetro (Jan 10): The Banger polder in Semarang. CRBOM Small Publications Series no. 16, Center for River Basin Organizations and Management, Solo, Central Java

Sudarsono (Sep 09): The Bengawan Solo Water Council - providing insight and directions. CRBOM Small Publications Series no. 5, Center for River Basin Organizations and Management, Solo, Central Java

Sungguh, Harry M (Dec 09): RBO benchmarking. CRBOM Small Publications Series no. 15, Center for River Basin Organizations and Management, Solo, Central Java

WWC (Feb 03): Water resources management towards enhancement of effective water governance in Indonesia. Country report for the For the 3rd World Water Forum, Kyoto. World Water Council

Yusuf, Arief Anshory and Herminia A Francisco (Jan 09): Climate change vulnerability mapping for Southeast Asia. Economy and Environment Program for Southeast Asia (EEPSEA)

Appendix A: National IWRM implementation milestones

Quoted from ADB and CRBOM (Jun 10)

1982: Government Regulations on Water Governance and on Irrigation and Drainage

1982: Law 4/1982 on Environmental Management, (later replaced by the Environmental Management Law 23/1997)

1990: Establishment of PJT1; the organization became ISO certified in 1997

May 98: Completion of the Water Resources Sector Reform Program

2001: National Coordination Team for Water Resources Management established by Presidential Decree with representatives of 12 ministries involved in water resources management

Dec 01: National water policy formulated by Ministerial Decree of Ministry for Economic Affairs

Aug 02: 4th amendment to the 1945 Constitution promulgates public ownership of water and natural resources

2004: Indonesia's Law on Water Resources (No. 7/2004). The law focuses on water conservation, infrastructure and its management. It targets surface and groundwater and has opened the door for public participation

2004: Presidential Regulation on Water Resources Councils, which regulates the establishment and mechanism of participatory water resources councils at the national, provincial, and regency/municipal levels

2006: Ministry of Public Work Regulation on River Basins, defining 133 river basin districts in the country

2006: Ministry of Public Works Decree on establishment of 31 RBOs under the central government (BBWS and BWS) to manage water resources in 67 river basins

2006-08: First 7 Indonesian RBOs completed a performance benchmarking guided by NARBO

Nov 07: National climate change action plan

2008: Regulations on water resources management and on groundwater

2008: National Water Resources Council

Center for River Basin Organizations and Management,
Solo, Central Java, Indonesia
www.crbom.org, info@crbom.org