Watershed Management in Changjiang River

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ABSTRCT: In this paper, we introduce the watershed management (WSM) in Changjiang river. The Changjiang river and Changjiang Water Resources Commission (CWRC) are introduced. Then the acheivements and problems of Changjiang river watershed management are discussed. Lastly, the challenge and task are prospected.

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1. INTRODUCTION

Changjiang is the largest river of China. It is about 6300 km long, has total land area of 1.8 million km^2. Chang-jiang, which means "Long River". The Chinese call the Yangtze River too. Changjiang River begins in the in the Kunlun Mountains, Tibetan Plateau and is fed by snow and ice melt from the surrounding mountains, where is in the southwestern section of Qinghai Province in China, and flows generally south through Sichuan Province into Yunnan Province, where, in the vicinity of Huize, it bends sharply to the northeast. Then, it flows generally northeast and east across central China through Sichuan, Hubei, Anhui, and Jiangsu Provinces to its mouth in the East China Sea, about 23 km north of Shanghai.

Although the river is known as the Yangtze River to foreigners, the Chinese apply that designation only to the last 480 or 645 km of its course, the portion traversing the region identified with the Yang kingdom. From Its upper reaches to Yibin, the river is called the Jinsha River (means Golden Sand) and various other names are applied in the provinces it traverses. The official name for the entire river is ChangJiang or Yangtze River.

There are over 400 branches whose area larger than 1000 km^2 in Changjiang river. And 8 branches of whose area larger than 80000 km^2, including: Yalong River, Mingjiang River, Jialing River, Wujiang River, Wanjiang River, Xiangjiang River, Hanjiang River and Ganjiang River. And there are many lakes in Changjiang River, the total area of the lakes is over 15200 km^2. Most of them are in the middle and lower reaches of Changjiang River. In which Poyang Lake and Dongting Lake are the two largest freshwater lakes in China.

Changjiang's climate is primarily controlled by the Asian monsoon. It has a wet subtropical climate. Changjiang has very rich water resources. The average annual precipitation is 1100 mm, and the total amount of

water is 975.5 billion m^3, 36% of the total amount in China. But the temperatures and precipitations in Changjiang are very uneven over space and time. Over 60% of runoff occurs in flood season from June to October. For example, seasonal rainfall was above average throughout southern China during 2002, with the largest surpluses of 300-500 mm observed in the Yangtze River Valley. Local seasonal totals ranged from 700-900 mm throughout this region exceeding 900 mm in the southwest. In the East these amounts were 150%-200% of normal, while they exceeded 200% of normal in parts of the West. For the region as a whole area-averaged rainfall totals during these three months reached almost 850 mm, double the climatological mean. The area-averaged totals exceeded 350 mm in June, while the totals approached 250 mm and exceeded the 90% in both July and August.

Changjiang is in the middle of china. With its numerous tributaries and feeders, the Changjiang river provides a great transportation network through the heart of some of the most densely populated and economically important areas in China. There are about 0.4 billion people live in Changjiang river watershed. Among the principal cities on the Changjiang, in addition to those cited in the foregoing, are Chongqing, Wuhan, Nanjing, and Shanghai.

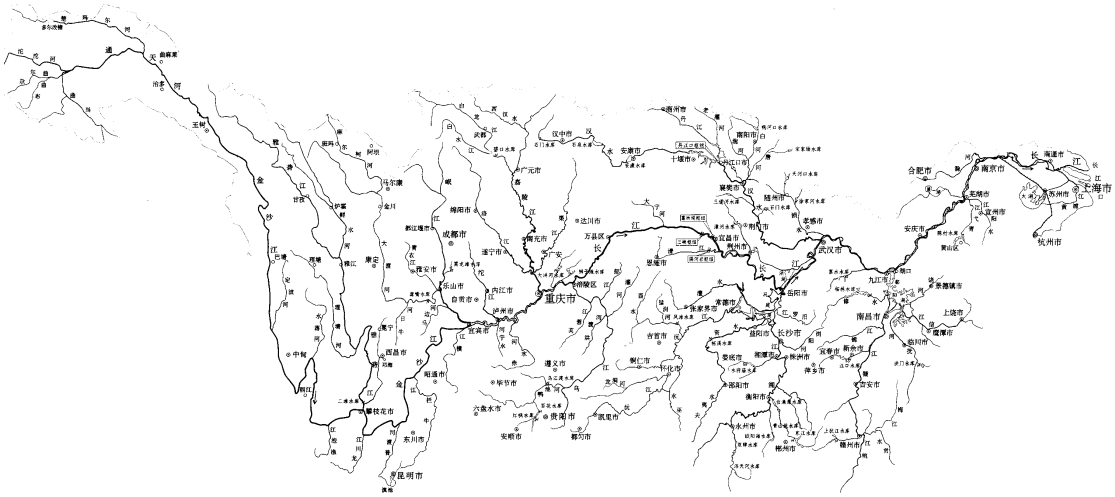

Fig.1 The River system of Changjiang river

2.THE FRAMEWORK OF WSM IN CHANGJIANG RIVER

In early years, the major tasks of watersheds management in China are flood control, water resources development and hydraulic power. Later, water environment protection has been taken into account, but flood control and water resources development were still given the priority. It is in recent years that the integrated watershed management for sustainable development has being adopted.

Watershed management demonstrates that the river should be studied and managed basing on the whole watershed. The tasks of management should be multi-objects. The study and management of river should be integrated, including law, government, public, science, economy, society etc.

In Sept.2002, the newly revised Water Act was issued in China. Some related Laws and administrative regulations have being checked too, under the Water Act. These include the Water Act (Issued in 1988, revised in 2002), the Flood Control Act (Issued in 1997), the Environment Protection Act (Issued in 1989), the Water

and Soil Conservation Act(Issued in 1991), the Water Pollution Prevention Act(Issued in 1984, revised in 1996). And Now the Changjiang Act has being prepared.

The authorities for WSM in China include the Ministry of Water Resources(MWR), Watershed Management Organizations and Local Water Management Organizations. MWR is the central government's authority of water affairs. Watershed Management Organizations is the water resources commissions of MWR are authorities in the defined larger watersheds or water systems that across province-level districts under the Water Act and other related law, regulations and authorization of MWR. Local Water Management Organizations are the water authorities of province, city and county governments are in charge of the sub-watersheds in their districts.

Changjiang Water Resources Commission (CWRC) is one of the Seven WSM organizations in China. It is addressed in Wuhan, Hubei province. It is an organization dispatched by the Ministry of Water Resources in the Changjiang river watershed and the southwest river valleys of China. It is authorized by the State to exercise water administrative management in the aforementioned scope; to provide overall management of water resources in the valley in accordance with the Water Law of the People's Republic of China; to take charge of the comprehensive, planning, harnessing, development, management and protection of the water resources in the entire valley; and to give instructions to, conduct examination, coordination and supervision on, and perform services for the regional water resources facilities. In figure 2, the office structure is showed.

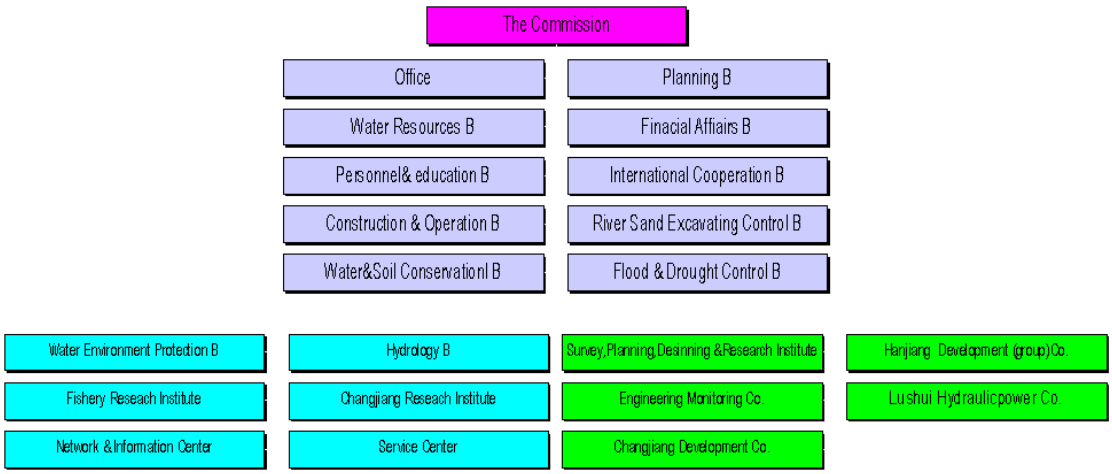

Fig 2 The Changjiang Water Resources Commission (CWRC)

3. ACHIVEMENT OF WSM IN CHANGJIANG RIVER

For over 50 years, there are many achievements of Watershed Management in Changjiang River in geological and hydrological investigation, surveying, water resources protection, water and soil conservation, planning and designing, and scientific research in the Changjiang valley. About 47,000 reservoirs with total storage capacity of over 140 billion m^3,most of them are multipurpose. The water projects with 137.5 billion m^3 water supply capacity. There are148 million ha irrigated farmland. Flood control system including 30,000 km dikes , protecting 75 million people and 90 million ha farmland. Installed hydropower capacity up to 33,6000Mw. In which18 stations' capacity is over 250MW. Most of them are in the up reach. Soil conservation projects that cover 75000 km^2 erosion area have completed. Water pollution monitoring systems for major waters are

constructed.

And the largest and famous achievements are the two projects: the Three Gorges project and the south-north water transfer project

3.1 The Three Gorges project

The Three Gorges project is the largest hydraulic hinge project in world for flood control, hydropower and navigation. The reservoir has water area with 1084 km^2, and storage capacity of 39.3 billion m^3. The main functions of Three Gorges project are regulating the floods from the upstream reaches in Sichuan Province to control the floods or relief the flood damage in middle and lower reaches of the Yangtze, especially in the Jinjiang reaches; developing the hydro-power resources in the Three Gorges reach to provide the central China, east China and the east Sichuan Province (now the city of Chongqing, the same as below) with huge amount of the electricity; improving the navigation condition of the reaches between Chongqing and Yichang.

3.1.1 Flood- control

The plain areas along the middle and lower reaches of the Changjiang boast highly developed industry and agriculture. Nevertheless these areas are most vulnerable to floods and water logging, because the flood level can be 6-17 meters higher than the ground level of the adjacent plains and they are protected only by the 33,000-kilometer- long dikes . Flooding has been very frequent since ancient times and the reoccurence interval is about 10 years. This is easy to understand because the flood-discharging capacity of the river channel from Jingjiang to Wuhan, which is only 60,000-70,000 m^3/s, is far too small to discharge the large floods as high as 110,000 m/s. The total storage capacity of the reservoir is designed as 39.3 billion m^3, of which 22.15 m^3 for flood control. After the completion of the Three Gorges project, the flood -discharging capacity of the Changjiang river would be 27,000 to 33,000 m^3 /s, thus the floods from the upstream reaches of the Changjiang river could be controlled and the middle and lower reaches of the river, especially in Jinjiang reaches could be regulated or relieved. The Three Gorges Dam can protect the downstream plain against the biggest flood in 100 years and prevent devastating disasters from occurring in case of the biggest flood in 1000 years, with the help of the flood diversion structure.

Three Gorges project will ensure the safety of lives and properties of more than 15 million people inhabiting the downstream areas and 1.53 million ha. farmland as well as the Beijing -Guangzhou and Beijing-Jiulong railroads.

3.1.2 The world's largest hydropower station

The total installed capacity of the Three Gorges Hydropower Station is 18,200 MW with an annual electricity output of 84.68 billion kw.h. After completion, the Changjiang river water will be used to produce electricity When completed, the power output will generate a yearly net value of 10 .5 billion yuan ($ 1. 2 billion) on the assumption that the price of electricity is 0.1 yuan ($0.0114) per kw.h. It should also be noted that the Project enjoys a very advantageous geographical position. It is expected to be the network junction for graphical position, being within 1, 000 km of many industrial centers. It is expected to be the network junction for all the power grids in the country. When the grid goes into operation, it will not only supplement the available thermal power, hydro-power and nuclear power in the country, but also upgrade the quality and efficiency of the grid, which will certainly make the project is the national nerve center - the electricity dispatching center.

3.1.3 Navigation improvement

At present, the 660 km waterway between Chongqing and Yichang cuts through hills and mountain gorges with a 120-meter drop and 139 dangerous shoals and rapids, 46 one- way sections, 25 locations where large

fully-loaded freighters need winching and the annual one- way shipping capacity is less than 10 million tons. The completion of the Three Gorges project will substantially improve the navigation conditions on the river above the dam, with the navigation channel broadened to an average of 1,100 meters, enabling 10, 000 tons to sail all the way from Shanghai to Chongqing. This improvement can lead to an annual increase in one-way shipping capacity to 50 million tons and a cut in the shipping cost by 37‰, creating conditions for boosting the economy of the Southwest, central as well as East China. For this purpose, the shiplift is designed as one stage vertical hoisting type with a maximum hoisting distance of 113 meters. the ship container of the shiplift is in a size of 120*18*3.5 m,capable of carrying 3,000 tons of passenger or cargo boat each time. It is the biggest and the most complicated shiplift in the world

3.1.3 The world's largest project with building scale workload

The total length of the Three Gorges dam axis is 2309.37 meters. The spillway section, which is located in the middle of the river course, is 483 meters long in total. There are 26 sets of turbine generator units in total, 700 MW for each. The shiplock is schemed out as a double-way and five-step lock. It is the world's largest water conservancy project with the world's largest project building scale. The earth-rock excavation of the main structure of the project is 134 million m^3 and the concrete placement is 27.94 million m^3. The installation of reinforcing bar and metal structure is 463 thousand ton and 256.5 thousand ton respectively. The concrete placement of the TGP in 2000 is 5.4817 million m^3, 550 thousands m^3 for each mont, which created a new world record.

3.1.5 The world's largest resettlement

The total number of the migrants to be resettled of the reservoir area of the Three Gorges project may reach 1.13 million by the end, It is the largest and the most arduous resettlement project in the world. According to the investigation, 846,200 people, including 361,500 rural people, 484,700 urban dwellers will be affected and need to be relocated. It is estimated that the affected population accounts for 0.04%~11% of the total population with the highest ratio of 16% for Zigui County, Yichang.

3.2 South-north water transfer project

Th south-north water transfer project is one of the largest water conservancy projects in China as well as in the world. It is to transfer the water from south of China to the droughty north. This project should be said started in 1950s. the preliminary study lasted 40 years for which intensive surveying, planning. designing and scientific research have been conducted. The feasibility study report on south-north water transfer project (middle route), jointly prepared by CWRC and departments, provinces and municipalities concerned in 1993, and examined by state Planning Commission and Ministry of water Resources, has been submitted to the State Council for decision making. There are three parts: East Line(under construct), Middle Line(under construct), West Line(plan). Will Transfer 45 billion m^3 water through the East Line and Middle Line.

The Changjiang River and Huanghe River are the two most important rivers in China. Both the Changjiang River basin and the Huanghe River basin are centers of China’s economic and cultural activity. Industrial and agricultural uses of water are bound to increase with the further development of the national economy. Taking into account the abundance of water in the Changjiang River basin and its deficiency in the Huanghe River basin and the northwest, and especially the serious water shortages there in the spring plus the extreme imbalance of water and land resources, the water conservancy department carried out studies on northward water diversion

from the upper reaches (West Route), the middle reaches (Central Route), and the lower reaches (East Route) of the Changjiang River.

Because of rapid economic growth and frequent drought. The south-to-north water transfer project is an important countermeasure adopted to deal with the unbalanced distribution of water resources in the country. The north China is facing a dire shortage of water resources, in addition with regional and seasonal distribution.

3.2.1 The middle line

The conveyance canal of the Middle Route Project (MRP) would begin at the Taocha water intake being built at the Danjiangkou reservoir. Then it would follow the southern and western edge of the Funiu and Taihang Mountains, and would terminate in Beijing's Yuyuantan Lake. In order to supply water to Tianjin, a canal would have to be constructed extending eastward from Xushui county in Hebei province across the Haihe river plain.

The water source of the middle route, the Danjiangkou Reservoir, has an annual natural inflow of 41.1 billion cubic meters from a drainage area of 155,000 square kilometers. The first-stage engineering works, which involve the construction of the 162 meter Danjiangkou dam with a total storage capacity of 17.45 billion cubic meters, have been completed. The second-stage engineering works, which have been approved, would raise the dam to 176.6 meters in order to increase the total storage capacity to 29.1 billion cubic meters.30. After the completion of the second stage engineering of the Danjiangkou reservoir, the mean annual quantity to be diverted will be 14.1 billion cubic meters, and 11 billion cubic meters for the dry year. The normal water level of Danjiangkou reservoir will be at 170 m. In accordance with the development level in 2020, some compensative projects will be built on the middle and lower Hanjiang to ensure the development of industry and agriculture, and the navigation and the environment of water exporting region.

Supplemental water may be pumped up to Danjiangkou from the reservoir created by the Three Gorges dam or from downstream Shashi. This water would flow "uphill" along the Hanjiang river into the Danjiangkou Reservoir, from which it would enter the main canal of the middle route. An alternative plan is to pump water diverted from the Hanjiang river at Xiangfan into a tributary, the Tangbai river, and then along the Bai river into the main canal. The main portion of the middle line is now at the primary design stage, with implementation likely to start in the near future. The middle line project will supply water for Tangbai river plain, and the middle and western parts of the Huang-Huai-Hai Plain. Because of the limited water quantity in Hanjiang River, the middle line can not meet all the requirements of the planned water supply areas it can only provide water for municipal and industrial use in Beijing, Tianjin Municipalities, and Hebei, Henan, Hubei Provinces, and give consideration to the agriculture and other use of water in some partial areas.

3.2.2 The eastern line

The northern part of the 1,789 kilometer Hangzhou-Beijing Grand Canal, built 1,400 years ago, will constitute the main body of the eastern line currently under construction. The eastern line would commence with the diversion of water from the main course of the lower Changjiang River at Sanjiangying in Jiangsu. Water would be diverted for use in Jiangsu, Shandong, Hebei, Tianjin and areas in the Huaihe River Basin located between the Bengbu water Gate and the banks of the Xinbian river. The line would pass through four lakes: the Hongze, Luoma, Nansi and Dongping. The water would then be pumped through tunnels under the Huanghe River at Weishan, and flow mainly along the reaches of the Grand Canal finally reaching the Beidagang reservoir south of Tianjin.

In March 1983, the State Council approved the first stage of the construction of the eastern route of the south-north water transfer project. Further progress has been suspended due to a conflict of interest between

Jiangsu and Shandong provinces. In particular, Jiangsu strongly pushed to keep more of the diverted water than it was allocated under a plan approved by the State Council. Early in 1962, before the eastern route was planned, Jiangsu built the Jiangdu pumping station to divert water from the lower Changjiang River to the province's north using the Grand Canal to send water as far as Xuzhou and the south Nansi Lake. The Jiangdu station can pump up to about 400 cubic meters per second, and would be a key structure in the eastern route transfer project. In addition, an experimental tunnel under the Huanghe River has been completed in Shandong. Because of these structures, some people think that the eastern route is much easier to construct than others. But poor water quality is a significant drawback, as are the large amounts of electricity necessary to pump water to the higher elevations north of the Changjiang River.

3.2.3 The western line

The western route would transfer water from the upper reaches of the Changjiang river to the upper reaches of the Huanghe River to provide water to north-western China. But a western line would be very ambitious, requiring the construction of 50,000 kilometers of canals with a diversion of 500 billion cubic meters of water from the big south-western river basins. Considering the engineering uncertainties of the complex geological conditions and the very high cost of construction, a western route is unlikely to be realized before the middle of the 21st century.

The three south-north water transfer lines do not conflict with each other in the sense that they serve different areas and provide commensurately diverse benefits. The conflict lies in funding priority. For instance, the middle route can supply higher quality water to the north by gravity, while the eastern route can bring lower quality water to the large industrialized cities of Tianjin and Beijing by pumping. Yet the construction cost of the former is higher than that of the latter, since the eastern route can make use of the existing Grand Canal.

4. MAJOR PROBLEMS AND CHALLENGES INCHANGJIANG RIVER

Although, there are problems and challenges in Changjiang river. The major problems and challenges include: flood and waterlog, Water shortage and drought, Ecological environment deterioration Weaknesses of Existing WSM Institution.

4.1 flood and waterlog

Yangtze River basin locates in the monsoon climate region of subtropics of Southeast Asia, where floods are mainly from rainstorms. From May to October, it is concentrated 70% of a whole year's rainfall, while is the corresponding time when flood occurs. From 206 B.C. to 1949, there has been occurred 1092 flood and 1056 drought disasters in China with frequency of both occurred in average two years. The flood in1998 especially, caused heavy loss.

There are mainly two types of catastrophic flood in Yangtze River drainage basin. The first is caused by full area widespread rainstorm, in the rainy seasons, trunk stream and tributaries of upper, middle and lower reaches overlap one another, floods encounter together, forming high flood peaks, especially large discharge, long duration huge flood. Examples are the floods of 1931, 1954, and 1998. Another is the kind of special high peak and large discharge flood formed by focused rainstorm in same place of the trunk stream and some large tributaries. Examples are floods of 1935, 1981, 1995 and 1996. Whichever floods brings the terrible menace to the plain of middle and lower reaches of Yangtze River, especially to Jing Jiang reach.

Although Flood control system has been initially setup, flood and waterlog disaster are still our most serious

hidden trouble and danger.

4.2 Water pollution

Water pollution along Changjiang river has been somewhat alleviated as major metropolises along the river. Sewage discharged to water bodies has increased to 19.9 billion tons(2002) . Among of 35,386 km rivers had been conducted a water resources quality assessment, the river lengths of Level Ⅰ, Ⅱ, Ⅲ, Ⅳ, Ⅴ account for 4.4%, 44%, 28.3%, 10%, 3.2% and 10%. The polluted rivers are mostly in urban areas.

Some cities, such as Shanghaiand and Wuhan, is constructing more sewage farms. However, owing to ballooning population and vigorous industrialand agricultural production, as well as speedy modernization, the Changjiang river still faces severe water pollution. According to the CWRC's communique, the water quality of the Changjiang failed to improve during the past year as the proportions of clean, drinkable and polluted water almost did not change. Moreover, some freshwater lakes attached to the Yangtze, such as Chaohu and Taihu, still suffer severe eutrophication, a problem of being rich in minerals but too shallow with not enough oxygen. And the population will continue to increase and the economy will further develop in future along the Yangtze, the river's water pollution problem will also continue.

4.3 Water shortage and Drought.

The total water use in Changjiang River Watershed up to 168.7 billion cubic meters in 2002, agriculture users, industrial users and domestic users respectively account for 55.6%, 31.74% and 12.7% of the total. However, water shortage is still a restrict for national economy and social development. Many large cities and people frequently suffer from water shortage in dry season.

4.4 Ecological Environment Deterioration

Total soil erosion area 0.74 million km^2, accounting for 41.1% of land area. And the quantity of sediment is about 2.24 billion tons. The largest erosion areas in upstream.

5.WSM IN 21st CENTURY

In the coming 21st century, many things should be done about WSM: adjusting strategies, laws and regulations construction, institution Reform, operation improving.

5.1 Adjusting Strategies

In early years, flood control, water resources development and hydraulic power were the major tasks of watersheds management. Later, water environment protection has been taken into account, still flood control and water resources development were given the priority. Recently, the integrated watershed management for sustainable development has being adopted.

5.2 Laws and regulations construction

Newly revised Water Act issued in Sept.2002. Some related Laws and administrative regulations have being checked under the new Water Act. Changjiang Act has being prepared.

Institution Reform purpose of the reform is to setup a more integrated, more authoritative and more efficient watersheds management institution. All departments in the commission will have to be reorganized three groups: administrative system, technical support & service system and enterprises.Some micro-water projects have being turn over to users groups.

5.3 Operation Improving

Optimizing water allocation, Water rights management and intaking permit system. Water distribution

planning; Water projects' operation. Enhancing Water demand control, Strengthening pollution control, Wastewater discharge permit system, pollution monitoring.. Water pricing, demand planning and water saving. Application of advanced technology, DDSS, OA and MIS based on the digital watersheds system,

Recent Major Actions include: Integrated water resources plan, Dams and dikes reinforcement program, Waters function zoning and pollution monitoring, South to north water transfer project, Water saving program, WSM information system.

6.CONCLUSION

Above all, there are many problem in Changjiang river. Many things should be done, and WSM is a good method to improve our work.

REFERENCE:

1. Kim, H.S. (2003). "Sustainable Development and the South-to-North Water Transfer Project in China." *Thesis of Central Connecticut State University*
2. Geoff Kite and Peter Droogers. (2000)."Integred Basin model." *Research Report of International Water Management Institute, Sri Lanka*
3. Peter Rogers, Ramesh Bhatla and Annette Huber.(1998) "Water as a Social and Economic Good: How to Put the Principle into Practice." Global Water Partnership/Swedish International Development Cooperation Agency, Sweden