CONCLUSION OF THE 2004 TASAE

OVERVIEW

The 2004 TASAE was held on 9-15 November 2004 and had participants, country representatives, each of whom delivered their respective country reports. The representatives were Mr. S. Sharif Shobair (Afghanistan), Dr. Md. Shahid Ullah Talukder (Bangladesh), Dr. Xingmin Mu (China), Dr. Weiwen Zhang (China), Dr Hendrayanto (Indonesia), Dr. Seung Woo Park (Korea), Dr. Jesda Kaewkulaya (Thailand), Dr. Phong The Dang (Vietnam), and Dr. Minjun Shi (Japan). The topic was "Present situation on the water resources supply and efficient utilization for the human survival and bio-production, and the role of agro-environmental education".

PRESENT SITUATION

Present situation on the water resources supply and efficient utilization for the human survival and bio-production, and the role of agro-environmental education in each of the participating countries can be summarized as follows:

Afghanistan

This paper focuses on the impact of the recent drought and the armed conflict on water availability for different uses and users in Afghanistan. To solve the negative consequences due to calamities there is a need for a series of strategies such as holistic river basin approach; policies on irrigation, water resources, environment and drought assessment, preparedness and mitigation and other agriculture related policies. These recommendations should have emphasis on law enforcement, extension activities in agriculture/ irrigation sectors, and introduction of rainwater harvesting along with other appropriate water saving technologies including construction of small and medium reservoirs.

Afghanistan is a strategic land locked mountainous country, located in arid and semi arid zone of the world. Total estimated population of Afghanistan is around 22.5 million and the total area is 652000 km2. It has an average precipitation rate of around 300mm, low humidity; (mainly lower than 50%), high evapotranspiration, (in some cases up to 18 mm/day.) Only 12% of Afghanistan's territory is irrigable and currently only less than 5% is under irrigation. Total irrigated land before the war was 3.2 million ha, however, at present there is only 1.7 million ha. Most of the irrigation schemes are traditional which were built centuries back. These schemes constitute 90% of all irrigated area in the country, nevertheless most of them lack engineering infrastructure.

Afghanistan was self-sufficient on wheat/crops before the war and a major exporter of fresh and dry fruit including other agricultural product in the region. The recent consequences of droughts and more than twenty five years turmoil have imposed negative impacts on all aspect of life; including water availability causing considerable effects on agriculture. As a result, illicit crops production is introduced among the farmers, drinking water has become scarce and the environment has been degraded significantly; mismanagement of on-farm and out-farm water is visible all over the country. The lack or proper policies, strategies and low capacity of the government institution fortify these problems. Shortage of data and institution for data collection is another burden/problem of the country.

The analysis of recent and previous available data show significant reduction in surface and ground water availability for all water users. Environmental degradation has brought sharp changes in land ecology: desertification of pastoral land is expanding and at the same time they are being converted to rain fed agricultural land, drying up of wet lands that were the best net for Siberian migratory birds; pistachio, almond and evergreen forests are cut and the bare soil is eroded; the timbers are smuggled out of the country. Air pollution and dust storm has threatened parts of the country. Social conflict on the resources such as water and land is growing. Displacement and migration of the communities due to war and drought are the main concerns which are connected with the turmoil in Afghanistan.

Bangladesh

Supply and utilization of water resources for bio-production in Bangladesh emphasizing crop production, development of animal resources and development and production of fishery resources have been elaborately discussed in this paper.

Bangladesh is located in the low lying delta of one of the world's largest and three mighty river systems- the Ganges, the Brahmaputra and the Meghna (GBM) and is subjected to alternating annual periods of extreme excesses and deficits in rainfall and river flow combined with recurring floods and cyclonic storms. The major portions of the water resources are available during the monsoon (mostly June to September) causing flooding over about 57 percent of the total area of the country.

Irrigation from the surface water for crop production is not feasible for most of the areas of Bangladesh during winter (October to April). Thus groundwater is the only constant source of water supply for the successful cultivation of winter crops and as a result huge number of shallow tube wells (STW) and deep tube wells (DTW) have been installed in the country. Total cultivable land in the country is 8.42 Mha out of which 4.48 Mha (53 percent) is now under irrigation. Contribution of groundwater irrigation to total irrigated area is 73 percent while that of surface water is 27 percent. Shallow tube well technology covers 56 percent of the total irrigated area.

About 59 percent of the total land is used for agriculture. Out of the total area under cultivation rice alone occupies 75.35 percent and cereal as a whole about 81.14 percent. Total cereal production is 28.21 million metric ton (MT) for 2003-2004, which is adequate to feed her population. The projected demand of rice estimated for 2025 is 32.10 MT. The cropping intensity during 2000-2001 was about 177.

The inland water bodies are highly productive and the capture and culture total catch under inland fisheries were 35.50 percent and 42.89 percent, giving an inland total fish production of 78.39 percent. Marine fisheries contributed only 21.61 percent of the total catch indicating that inland fisheries played a significant role in the total catch for consumption and export. Fisheries sector contributes 5.26 percent in country's agricultural production and 4.76 percent of the foreign exchange earning. At present the annual per capita fish demand is 18 kg and annual total fish demand is 2.4 MT. Annual growth rate of fish production varied from 5.70 to 8.15 during 1996-97 to 2002-03.

The livestock contributes 16.13 percent in country's agricultural production, 3.12 percent in national economy and 20 percent in full time self- employment. The contribution of livestock from hide and skin in foreign exchange earning is 3.46 percent as estimated in 2001- 02. The annual production of egg (in million), milk (MT) and meat (MT) and products of hide & skin (million sq.m) from livestock are 4424, 1.78, 0.78 and 17.35 respectively. An annual average growth rate of 20 percent has been achieved in the poultry sector in the past decade. Thus, it may be inferred that proper supply and efficient utilization of water resources is a prerequisite for bio-production in Bangladesh.

China

Agricultural practices are considered the largest contributor to surface water quality degradation in terms of sediment, runoff of nutrients (such as nitrate and phosphorus), and leaching of chemicals. Among the list of environmental damages, the nitrogen (N) is reported to be the primary source of impairment to fresh water bodies. Excessive nitrates (NO3-) in drinking water have been linked to methemoglobinemia disease (blue baby) in animals and infants (Bower). At high levels, nitrogen in water can be toxic to humans and animals, and nitrogen in ammonia can kill or injure fish.

The water supplying Tai Lake valley China, is mainly for living survival, agriculture and industry. Rapid step of urbanization in Tai Lake valley has brought forward more and more water resources requirements, not only in quantity but also in quality. Whereas, the fact is that the water quality of Tai Lake valley descended one grade, from grade II to III, during the period of early 1980s and late 1990s. Meanwhile, accelerated eutrophication of water ascended two grades, which resulted in the fact that the water quality in Tai Lake valley was mainly in the eutrophic environment. Consequently, how to solve this conflict is among the most important and difficult problems facing water quality managers today.

Although the technologies to control agricultural NPS pollution have taken shape in the testing area, they haven't been applied in practice by most of the farmer. There is little literature in China to guide the design of agricultural NPS pollution control policies. The economic analysis of farmer activities involving NPS pollution is lacking too.

A linear programming (LP) model was developed to simulate four alternative policies under the objective of farmer net income (NI) maximization. The LP model was applied in Xindai Town, Pinghu County, Zhejiang province, south edge of Tai Lake Valley. Four policy scenarios include: (1) a tax on nitrogen fertilizer, implemented as a tax equal to 50% of the cost of nitrogen; (2) a ban of spring fertilizer applications to reduce summer runoff; (3) a requirement for use of CA fertilizer, a kind of new fertilizer; and (4) per unit land subsidy for using manure, implemented by land rent free or paying 100 to 200 RMB subsidy per mu ($667m^2$).

Apparently, input taxes of 50% of the price of nitrogen fertilizer (S1) reduce nitrogen applications; meanwhile the farmers' net income has increased a little. Compared with the S1, a ban of spring fertilizer applications to reduce summer runoff (S2) is more effective to control the nitrogen runoff; however farmers' net income goes down rapidly at the same time. The effect of S3 (a requirement for use of CA fertilizer) is close to but not as good as S1. S4 is the most effective policy both in abating pollution and increasing farmers' net income. But except for S1, all the other three N-runoff control measures have high monitoring difficulty and implementation costs. Since inclusion of transaction costs in policy evaluation is very important, input taxes is a relatively effective and feasible policy as a whole.

China

Water resources in the Yellow River Basin are of primary importance in comprehensive national development. But there are three serious problems on the water resource, namely shortage in water resources, quality shortage that is caused by worse quality and water consumption primarily due to sediment. The area of the Yellow River Basin is 8.3% of the area of China. Its average annual total runoff is 5.80×10^{10} m^3, or 2% that of China. Water resources per capita in the Yellow River basin are 527 m^3, or 20% of China's per capital amount. For climate change, soil and water conservation, and water usage of agriculture and industry, the condition of water resources are worse. The water resources volume varies greatly between different years and seasons. Soil loss is severe in the Yellow River Basin with average sediment content of 37.6 kg m^{-3}. 30% of flow, or approximately 1.50×10^{10}~$2.0 \times 10^{10} m^3$ annually, is lost due to flushing sediment from the lower riverbed to the sea. The sources of sediment and water are different and the sediment and water coming from the middle reaches of the Yellow River Basin account for 10% and 70% of the whole basin. A reduction of one ton of sediment erosion results in about a 3.19 to 16.15m^3 reduction in water yield, but when flushing one ton of sediment; about 33 to 60 m^3 of water is needed. This shows that soil and water conservation practices can result in a relative increase in water resource. From 1970 to 1996, soil and water conservation practices reduced soil loss by an average of 1.495×10^8t annually in the section between Hekou and Longmen of the Yellow River Basin. If the water used that have to flush this sediment is considered, the water resources have increased by $4.88 \times 10^9 m^3$.

Indonesia

Indonesia is blessed with abundant rainfall and has approximately 6 percent of the world's fresh water resources equivalent to about 2,500 km3 of annual renewable water resources. However, the rainfall transformation into run-off has increased through time due to the decreasing function of land system to regulate the appropriate water balance. Recent situation figures about 60% of the rainfall become run-off water.

Forest degradation that is driven by population growth, forest utilization policy, and improper land management are the dominant factors that caused the decreasing function of land system. Forest degradation has started since the implementation of forestry policy to exploit the natural forest resources in the seventies and has accelerated since the reformation era and since the formation of a decentralized government. The rate of deforestation on the average is 2 million ha per year.

Decreasing land system function, global climate changes and the properties of rainfall spatial distribution in Indonesia have caused considerable decrease in water supply. However, water use is increasing through time about 6.7% for irrigation, 6.7%, and 12.5% for domestic and industrial uses respectively.

The figures showing the water supply decreasing, water use increasing, and irregularity in climate greatly influence/affect the bio-production. The paddy field areas about more than 100.000 ha is disturbed by flood, drought and sometimes remain idle every year.

The degraded land rehabilitation programs are more focused on direct reduction of surface run-off and erosion through physical measures/approaches, but less attention is given to find out and solve the root problems that cause the deforestation and the inappropriate land uses itself. The weakness of the system or unavailable incentive system that provides reward for the successful agents and punishment or disincentive for the failure or attractiveness scheme to practice agricultural conservation are needed. More attention is equally necessary to create the initiatives to protect/maintain productive land and rehabilitate the degraded land. The development of water supply infrastructures and water (bodies) management also often proceed partially even without considering the sustainable programs for maintenance. This rehabilitates the upland regions that greatly influence water and the infrastructures for storage and distribution of water.

Agro-environmental education is necessary and important to understand the eco-system behavior in relation to resources utilization to produce bio-products. Agro-environmental education for undergraduate and masters degree levels where the graduates are being prepared to be a middle manager or to share in decision making, should incorporate the natural approaches and social (economy, policy) approaches to give more comprehension in understanding the underlying factors of a natural phenomena.

Korea

The Republic of Korea (Korea) like many countries in the Asia-Pacific Regions has faced continuing challenges for securing more water resources and efficiently utilizing them for sustainable bioproduction. The total amount of water uses for agriculture was estimated to be 15.8 billion m^3, or 48 percent of the total uses. It has increased during the past three decades of the economic development at such a remarkably rapid rate that the water uses now are 3.5 times greater than that in 1965. Most of the agricultural water is being used for paddy irrigation for rice, the stable food of Korea, and water demands for vegetable cropping and other bio-production are also increasing.

It is reported that nearly 45% of Korea's renewable water resources are now in use; in a level that sustainable water resource development is no longer possible without significantly deteriorating water environments and ecosystems. Efforts should be made to control water demands and to utilize the valuable resources more efficiently in all sectors. It is no exception for agriculture; water saving efforts should be made by improving irrigation efficiencies or by any other means. Yet, the total volume of water demands for bio-production is increasing, since more acreage of paddy and upland areas is converted and irrigated for vegetable and cash crop farming. And the irrigation periods are extended to whole year. Additional water resources for the domestic use and animal husbandry in rural areas are also needed. This requires a substantial change in water resource development and management in rural regions.

Some positive results from water savings and improved irrigation systems in on-farm and irrigation district levels have been recently observed. In some irrigation districts where repair and rehabilitation projects for the water resources and irrigation facilities had been implemented, the water supply capacities during peak demand periods of mechanized rice transplanting were enhanced, and the conveyance losses decreased. Networking of adjacent water resources was found to help supplement the resources allocation in more efficient ways. The automation of water intake valves for individual plots improved the on-farm irrigation efficiencies. And decision support system technologies for irrigation management demonstrated to improve reservoir operations more timely and efficiently. More uniform water allocation among irrigation blocks contributes to improving irrigation efficiency. Initial results from an ongoing research on the wastewater re-uses for agriculture show that the alternative water resources may be beneficially used for expanding paddy irrigation without additional water withdrawal from streams and rivers, which may endanger fragile ecosystems.

Education and professional career development programs are certainly playing major roles of the advancement of irrigation technologies in Korea. Research and development are also important to improving irrigation technologies. Following the institutional change in water management organizations, a large number of well-trained engineers are now involved in irrigation system operation and management along with experienced local operators. Though the effects of institutional consolidation have not been documented, it would help more efficiently operate and manage the irrigation systems in the long run. And the impact of education and professional training becomes more imminent to the better agricultural water utilization.

Thailand

In 1993 approximately 70,770 mcm of water was kept in various sizes of surface water resource development projects all over the country. The water demand for irrigable areas and other uses was estimated to be 68,000 mcm/yr and it is estimated to be 86,000 mcm/yr in 2006. Hence, the nation is facing serious water supply constraints at an increasing rate. This is due to the various impact problems in the water resource development schemes. The ground water is also another water source, which serve almost 70% of the domestic water use especially in the villages and urban areas.

The cabinet approved the National Water Vision as well as the National Water Policy, in 2000 that would be the guide to formulate the strategic plan of the national water resource development and management.

The concept of integrated water resource development had been included. The River Basin Committee had been established with different models as pilot case studies and these committees have been planned for all the 25 river basins, which, will operate within 2006. An agro-environmental education was mentioned on the 6th National Water Policy, which would include water related topics at all levels of the educational curriculum.

Vietnam

The Red River Delta, situated in the North of Viet Nam, is the second largest delta of the country, after the Mekong Delta in the South. It's a region characterized by the high population density and the dominance of agriculture. Cultivation together with water resources utilization of the delta has been practiced for centuries. However, the extensive introduction of modern technologies for water control began only during the French colonial occupation and developed recently, in the late 50's, in an effort to ameliorate the agricultural production conditions. The hydraulic of the delta is marked by two principal works: the embankment of rivers with dikes to protect the delta from flooding and the construction of hydraulic systems for irrigation and drainage of areas inside the dikes, defined as the polders.

Physical facilities and institutional arrangements in independent polders actually represent one typical style for water resources utilization for delta areas. Irrigation and drainage of polders is carried out firstly by one primary gravity network, supplied by the main intake gate in the upstream and drained by the main sluice in the downstream. In general situation, available waters in the primary gravity network have to be elevated to field level by a large number of irrigation pumping stations. In drainage period, excess waters in numerous drainage units are discharged into the primary gravity network by pumping or by gravity if water level permits it. Operation and maintenance tasks for polders exploitation is assigned to different actors at different echelons who operate concerned elements of the system independently.

Although contributing to agricultural production development, experiences from the last 50 years of polders exploitation show that the above-mentioned arrangement for water resources utilization unfortunately encounters some obstacles that restrict its potential service capacity. There are still unsolved technical, economical and institutional problems that challenge the sustainability of the systems. In general, problems are associated with the complexity of the system which originated from the alternative utilization for irrigation/drainage and the division of polders into a large number of units, which function in integrations but may have differentiated, contradictory and competitive demands. As a consequence, the operational principles, the system's organization as well as the institutional framework for water resources utilization should be radically reconsidered, taking into account specific technical and socio-economical constraints.

Japan

Water resource management and environmental conservation in marginal lands is facing the following problems: (1) Conflict between limited supply and increasing demand of water resource with rapid population growth and economic development; (2) Incompatibility between efficient utilization of water resource and technical, financial, and institutional constraints to smallholders; (3) Tradeoffs in water resource allocation for human survival, bio-production and environmental conservation.

Some research issues on water resource management and land degradation prevention in marginal land can be listed up for Japan's institutions as topics of international cooperative research in the future. (1) What is the principle and the method to allocate the right of water resource use in marginal land; (2) How to develop the mechanism of transaction of right (quota) of water resource use; (3) How to account economic and ecological values of water resource in marginal land; (4) How to establish institutional and organizational scheme of participatory water resource management in marginal land.

KEY ISSUES AND RECOMMENDATIONS

1. <u>Shortage of water resources</u>

1.1. Water is a limited and scarce resource that becomes costly in some regions.

1.2. Shortage of adequate water resources in time and space may cause conflict, disputes, displacement, diseases, and wars in some regions.

1.3. Water shortages reduce crop production and result in food insecurity and poverty in some regions. Poor people tend to have less accessibility to water.

1.4. Water resources are often allocated in an imbalanced way. Some regions/sectors would get/use more water, while others suffer from the shortage of water.

1.5 Some usable water resources are not being utilized. Rain /snow water can be beneficially used in some regions where water resources are scarce.

16.Wastewater is not often reclaimed for beneficial use in some regions.

Recommendations

1.1. Water resources should be handled in a proper way to preserve the quantity and quality of the available water. Effective and efficient utilization of the water resources in all sectors such as agriculture, domestic, industry, livestock, fishery, forestry and environment are important to preserve those resources.

1.2. Water should be allocated in such a way as to eradicate poverty, reduce waterborne diseases through appropriate sanitary measures, and to be shared more reasonably among stakeholders including neighboring countries.

1.3. Higher priorities in water allocation need to be given to agricultural sectors in some regions. Food insecurity at regional levels may be an important political issue. Poorer people should be given appropriate accessibility to water for betterment of their lives.

1.4. Holistic water resources and watershed management need to be adopted to fulfill all shortcomings in the water sectors and to balance the existing resources among stakeholders.

1.5. Construction of small and medium scale regulating dams (reservoirs) to store excess water and promote rainwater and flood water-harvesting techniques should be implemented where applicable.

1.6 Safe recycling of waste/drain water for purposes such as agriculture, industry, etc. may be an alternative resource to ease the water shortage problems in some regions.

2. <u>Efficient Utilization of Water</u>

2.1. Water resources are not well managed and properly used in many regions. The water use efficiencies in agricultural sectors have often been given a lower priority than other sectors.

2.2. Hydrologic data have not been well communicated and shared among neighboring countries. This may be a significant limiting factor for water allocation and for flood control in upstream or downstream countries.

2.3. Less priority is given to research and development projects on water issues in some countries.

Recommendations

2.1 Introduction and promotion of appropriate and simple water saving technologies and methods need to be implemented to reduce water losses and increase water use efficiency. Drought resistant crops and plants may be introduced to water deficit areas. The modernization/ rehabilitation of traditional/old irrigation schemes and introduction of participatory approaches to irrigation water management are well justified for reducing water losses and improving irrigation efficiencies.

2.2. Sharing of hydrologic data and information between different countries need to be encouraged.

2.3. Research activities and studies on water resources development and management need to be encouraged and promoted.

3. <u>Environmental Conservation Issues</u>

3.1. Over exploitation of groundwater may cause ecosystem deterioration in streams and rivers and adversely affect the supply of dependable drinking water.

3.2. Land degradation, over grazing and deforestation may cause significant adverse impacts on water resources.

3.3. Soil erosion and sedimentation are important factors degrading water quality and reducing water availability for beneficial uses, and endanger fragile ecosystems.

3.4. Greater input into agricultural practices will definitely produce higher yield, but certainly create more pollution of downstream water bodies.

3.5. Untreated wastewater significantly degrades the quality of water in many regions.

3.6 Desertification has been accelerated in some marginal lands, and poor water allocation may be responsible for this acceleration.

Recommendation:

3.1. Excessive groundwater exploitation needs more attention, and appropriate measures to regulate or control groundwater usage are needed.

3.2. Land use planning should be based on land capacity and suitability, involving key related stakeholders, and the final results should be publicly accessible.

Improvement of land functions by rehabilitation of degraded lands with suitable methods is recommended.

3.3. Appropriate soil and water conservation practices such as sound cropping systems, mulching, terracing, and settling basins need to be implemented to reduce excessive soil erosion and sediment transport, and to conserve soil water for agricultural production.

3.4. Over-usage of chemical fertilizers in cultivated lands needs to be controlled, and more usage of slow release fertilizers and organic fertilizers/manure is recommended.

3.5. Wastewater effluents from cities, industries and other sources need to be adequately treated.

3.6. Adequate water allocation and efficient water use are particularly important in marginal lands where water is scarce and limited for human survival.

4. **Social, Economic and Institutional Issues**

4.1. Lack of farmer involvement in the planning, design and implementation stages of irrigation projects is one reason that farmers do not feel they have ownership in the irrigation systems.

4.2. Lack of coordination among stakeholders in a river basin context may lead to mismanagement and ineffectiveness in utilizing natural resources.

4.3. Water right systems have not been well established in some countries leading to excessive application and water shortages in the river basins from place to place.

4.4. Lack of cooperation concerning international rivers leads to unfair allocation of water and catastrophes such as floods and drought especially in the up/downstream countries.

4.5. Some technologies seem to offer more benefits to environmental issues, but less benefit to farmer's prosperity.

4.6. Limitation of funds for irrigation infrastructures is a constraint in improving facilities and applying new methods and technologies to increase irrigation efficiency.

Recommendations:

4.1. Participatory planning is necessary. Farmers should participate during the processes of planning, design and implementation of irrigation projects.

4.2. Experiences with integrated river basin management need to be shared among countries.

4.3. Water right systems based on water laws should be introduced to reach stable water allocation by assuring and controlling the water intake.

4.4. Efforts are needed among international bodies to solve the long lasting political issues concerned with international rivers.

4.5. Due compensation in the form of government subsidies to farmers concerned may be needed when they experience economic losses resulting from the implementation of new technologies.

4.6. Larger budgets need to be allocated for the development, rehabilitation and improvement of irrigation facilities.

5. Future tasks heading towards sustainable management and efficient utilization of water resources

5.1. Institutional, socio-economical and educational issues concerning water resource management need to be addressed in depth in the coming years.

5.2. Technical transfer among countries is important for better understanding and more efficient utilization of water resources in all regions. International cooperation should be promoted in the coming years.

5.3 Gender issues in some regions are believed to result from water shortage. Such issues may be included in future conferences and seminars.

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