Kaptai Lake watershed: Agro-ecosystem management constraint

DR. MD. RAFIQUL ISLAM

Actual implementation and adoption of the policies and resultant technologies for sustainable agriculture by the farmers is the most crucial and most difficult step. Community based natural resource management (CBNRM) and participatory land use planning (PLUP) approaches can be the better solutions in present situation where different entities i.e. resource, land owners (private or government), farmers and government could come together to consider each other's need and negotiate, discuss and agree on the use and management of resources in a sustainable manner.

IN spite of getting diverse interests of commissioning power plant at Kaptai in Chittagong Hill Tracts, its ecological consequences were manyfold. Firstly, the population pressure increased in the vicinity of the Kaptai lake for swallowing most of the best valley-bottom land and consequently there was an acute shortage of suitable cultivable land. Secondly, competition for jhum land increased so greatly that the fallow cycle has been reduced and the natural system of soil conservation became fragile. Thirdly, destruction of the forest exposed the ground surface to the rainwater and the traditional slash and burn techniques resulted in incessant soil loss, depletion of plant nutrient, competition from weeds and yield decline. Such widespread land degradation manifests itself in a declining rural income, fuel wood shortage and silting up of the Kaptai reservoir. The changes have also greatly increased the fire hazard, environmental pollution, wild life depletion, scarcity of safe drinking water. Therefore, the long-term sustainability of hill land agriculture in the watershed area of Kaptai lake is obviously threatened in terms of productivity and ecology.

Watershed area: Once the lake area was the part of undulating valleys, mostly suitable for crop cultivation. The adjacent hill soils are mainly deep, well-drained predominantly loams that have been weathered from tertiary sandstone and shale. About ninety percent of the hill slope is mainly very steep (>55% slope). Soil erosion is a hazard in the exposed areas of the hill slope. Except the Kassalong and Rankhiang reserved forests, the almost entire watershed area of the lake has been deforested by jhumias. As a result, the hill lands are now mostly covered with scrubs which include scattered trees of different species, bamboos, grasses and shrubs. The vegetative cover no-where in the hilly area is uniform and thick. For this reason, soil cover has been exposed and rainwater easily causes soil erosion during monsoon.

Pre-reservoir land use: The outstanding spatial feature of land use in the pre-reservoir period was the aerial predominance of scrubland and the shifting cultivation. These two categories occupied almost ninety percent of the total land area outside the reserved forests. Shifting cultivation represented a reasonable adjustment to the rainfall regime during pre-reservoir time. The sungrass and scattered shrubs and trees that re-established themselves after abandonment by jhumias had little or no direct economic value, but they provided a dense vegetative cover that served to control soil erosion. During the years just prior to the Kaptai development very little flat alluvial land was available for the resettlement of jhumias. Moreover, the extension, fertilizer and other services and facilities necessary for the successful establishment of permanent cultivation on the hill slopes simply did not exist at that time. So, the shifting cultivation had become a problem only in places where the natural population growth had increased the competition for land and shortened the period of land rotation.

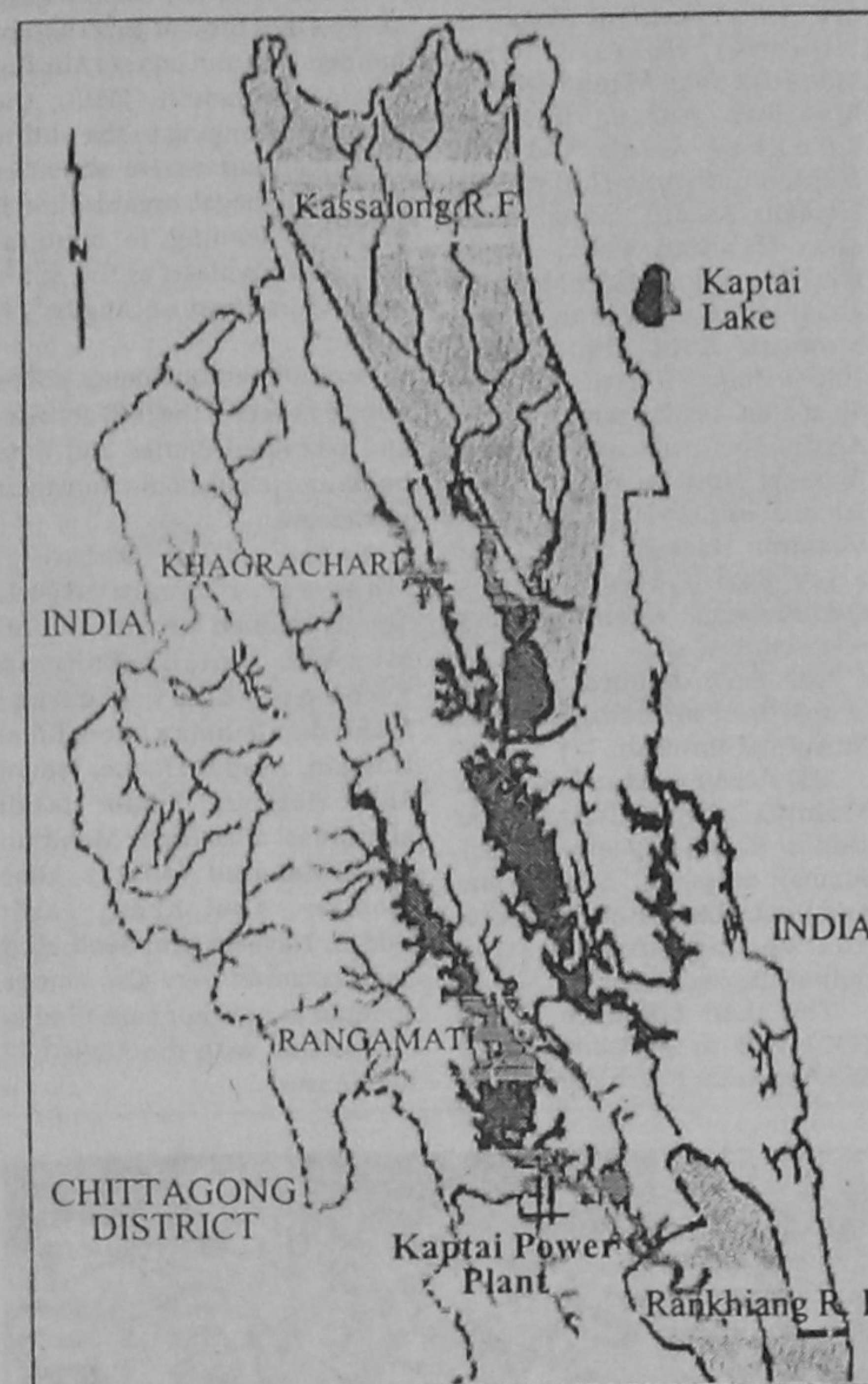
Aqua-terrestrial ecosystem: The important issues that are directly related to the characteristics of aqua-terrestrial area of Kaptai lake for changing agro-ecosystems and consequently for decision making can be distinguished as on-site and off-site. Apprehensive increasing population pressure coupled with shortage of suitable upland increases in the intensities of jhum cultivation resulting in over exploitation of natural resources due to lack of proper knowledge and inadequate conservation technologies and may be denoted as on-site effects, the ill effects of hill land agriculture. Increase in populations has placed great strain on the traditional jhum cultivation system in the sloping land of the area. Deforestation continues over time by clearing land for cultivation which also results in changing wildlife habitats into livestock areas. Deforestation rates are still higher than reforestation.

Factors responsible for accelerating soil erosion include improper management of sloping land, traditional jhum cultivation with short fallow period and deforestation in the area. The soil erosion causes land degradation and ultimately causes the silting up of the lake, which can be termed as serious off-site environmental effects. Sedimentation from erosion fills reservoir, significantly reducing its usefulness for navigation as well as flooding, hydroelectric power generation, fisheries and recreation facilities. Land degradation as on-site effect reduces crop productivity of soil causing low output that ultimately affect overall socio-economic environment of the area.

Soil erosion and fertility loss: The major factors which have contributed to the intensification of soil erosion are very extensive misuse and mismanagement of terrestrial land resource of Kaptai lake. Farmers frequently clean bush, follow slash and burning process for practicing jhum cultivation. The agronomic practices in jhum are dibbling, weeding, and followed gradual harvest. These practices result in severe soil loss and formation of gullies. The rate of soil erosion in the hilly areas of Bangladesh has been estimated 520 t/ha per year. The depth of top soil loss may be 0.2 to 5 cm and sediments deposited in drains and ditches are 9-130 cm depending on slope, soil type and cultivation practices. In contrast, at least 500 years are required for the formation of 2.5 cm of top soil from the tertiary sedimentary rock in the hills. It is now fact that water erosion removes the most fertile part of the soil containing available plant nutrients and organic matter with the result that the physical condition of the soil deteriorates. In general, soil erosion adversely affects the functioning of natural ecosystem, the production base and quality of the life of the people in the areas.

Sedimentation in the lake: Since the commissioning of the hydro-electric dam, the original bed of the reservoir is being silted up by the process of soil erosion from the adjoining hills. It was seen that water areas in the lake has shrunk considerably. The siltation from adjoining hills is reducing the reservoir capacity. During recent years the effect of siltation in the lake have so prominent that navigability has become difficult because of the low water level that remains so till the end of the dry season. The low water level during the peak of dry season is also creating adverse effect on the generation of hydro-electricity. The fish wealth in the lake is also being affected due to the reduction of water area and shallow depth of water. Obvious emergence of more and more fringe land out of the water during the dry season every year has become a regular phenomenon. The condition is deteriorating every year and the reservoir capacity is consequently reduced. If this trend continued, the effective life time of the reservoir as was anticipated at the time of its creation would diminish.

Conservation approach: The establishment of forest of fast growing timber species or bamboo must be undertaken as quickly as possible in all the very steep hill slopes where no field crop could be cultivated by the farmers. These forests should also be established on the head-waters of all major rivers and streams. Generally, the run-off reduces from almost sixty percent on clean cultivated slopes to less than five percent on slopes covered with a leguminous creeper. Similarly, the loss of soil is reduced from over eleven tons per acre to less than one-tenth of a ton. So, cover crops have shown as useful and necessary not only on open areas but also on terrace slopes and as an undergrowth plantation crop. Covering the soil with vegetable trash has proved as a successful method of combating erosion and preventing soil wash. Adding organic matter to the soil promotes greater infiltration rates and thus reduces run off as well as increases the fertility and moisture holding capacity of the soil. Waste vegetable materials such as banana leaves and rice straw make excellent mulch.



Watershed Area of Kaptai Lake

Minimum tillage can be widely practiced as a profitable means of reducing soil erosion in the area. Contour ploughing is the most effective erosion control measure and can be widely applied on the small portion of land which is relatively flat. Contour trenching would have application on steep slopes (30-55% slope) and contour planting of crops, trees and hedges will do much to stop erosion. Strip cropping and the practice of growing crops in rotation or together can in many cases are adapted to an area so that soil conservation is promoted. However, this brief review of selected technologies for sustainable agricultural production should be based on research. But unfortunately very few of these are quantified by research based on socio-economic condition of the area. Traditional method of soil conservation utilizes mechanical vegetative barriers to arrest soil movement, thus using the same principles as the more modern technologies. Many of these traditional methods are falling into disuse, possibly because they are too labour intensive and hence too expensive.

Sustainability evaluation: The physical, biological and socio-economic factors composed in the area are urgently needed for formulating development strategies for sustainable agriculture. To develop an approach of sustainable agriculture various physical parameters related to land qualities can be evaluated based on land utilization type. Biological factors e.g. productive, beneficial and destructive biota need to be studied through field investigation and exiting information. A spatial and temporal relationship of biological factors is also needed to be established for sustainability evaluation. Economic environment of farming systems is needed to analyze based on attributes related to economic factors e.g. resources, economic environment, attitude and complex quantities. Various social factors related to characteristics of land management can be assessed through socio-economic survey.

Finally, a relationship between complex and component attributes should be established to design a sustainable agriculture strategy in the area concerned. Here, emphasis should be given on the changes of agro-ecosystem over time due to environmental degradation and technological solutions for sustainable agriculture in the entire watershed area of Kaptai reservoir. Very little such solution have been developed and also stated here, more modern technologies are needed based on refinement and adaptation to the local socio-economic conditions.

Finally, actual implementation and adoption of the policies and resultant technologies for sustainable agriculture by the farmers is the most crucial and most difficult step. Community based natural resource management (CBNRM) and participatory land use planning (PLUP) approaches can be the better solutions in present situation where different entities i.e. resource, land owners (private or government), farmers and government could come together to consider each other's need and negotiate, discuss and agree on the use and management of resources in a sustainable manner. Overall, political will and government support are also crucial to the success of such efforts.

Dr. Md Rafiqul Islam is Assistant professor, Department of Agronomy, Bangabandhu Sheikh Mujibur Rahman (BSMR) Agricultural University, Gazipur.

Freshwater: A finite but renewable resource

KB SAJJADUR RASHEED

A good example of water predicament in megacities is Dhaka itself. With an estimated current population of over 12 million and at the daily average per capita demand of 160 liters, the city needs about 2,000 million liters of water per day. Dhaka WASA is unable to provide more than 80 percent of this requirement, some of which are also lost through pilferage and leakage (fancifully called 'system loss'.) By 2015, the city's population may exceed 20 million with a daily demand of about 3,200 million liters!

WATER, a critical component of the ecological cycles, is theoretically a renewable resource, made continually available -- through the water cycle -- by the constant flow of solar energy to the earth, which evaporates water from the ocean and redistributes it back to the globe as precipitation. As the world population increased, the water demand continued to rise and the per capita availability of freshwater continued to decrease. About 70 percent of the earth's surface is covered with water, but only 2.53 percent of that is freshwater, the rest being saline. Again, most of this freshwater is locked in ice and snow in glaciers and ice sheets. Only 0.26 percent of all freshwater stock (about 90,000 cubic km of water in absolute terms) is globally available to us for use -- from rivers, lakes, soil moisture and groundwater; apparently the quantity is not so small for a world population of 6.4 billion. In reality, however, we (humankind) are living at the mercy of the water cycle, which acts as the bloodstream of the biosphere.

As the world populations continue to increase, their expectations and water demand also rise, and the per capita availability of freshwater continues to diminish. Hence, the enormous amount of freshwater generated in the water cycle is being shared by more and more people, and is fast becoming a scarce commodity. Even though water is renewable, global stock of water is fixed, and hence, in real terms, freshwater is a finite resource. Moreover, as recognised in 1992 in the Dublin Conference on Water and Environment, freshwater is also an economic good. Assuming that water is a scarce economic commodity, water governance, therefore, is a crucial challenge for planners and managers. Water governance should essentially involve prudent development, optimal utilisation and efficient conservation of water resources.

Spatial imbalance

Owing to the unequal distribution of water resource in the planet and seasonal fluctuations in its availability, many countries are chronically water-stressed, while some countries -- like Bangladesh -- suffer from severe seasonal variations in water supply. Large inequality in the availability of water around the globe vis-a-vis population makes any assessment or statement on per capita water availability a meaningless exercise. For example, South America accounts for only six percent of the world population, though the continent is blessed with about a quarter of the global freshwater stock. On the other hand, 60 percent of the world's population live in Asia, yet the continent's water wealth is only around 36 percent of the global total.

Water and agriculture

Irrigated agriculture is by far the largest consumer of freshwater, withdrawing approximately 70 percent of annual renewable water resource, although domestic sector (safe water and sanitation) always claims the highest priority in water use. For some countries like Bangladesh, nearly 85 percent of water is used by the agriculture sector. This is not surprising because food production has been traditionally the main focus of agricultural pursuits; and for any country, the demand for food is 'not negotiable'. Water use (irrigation) in agriculture has turned many sunny, warm and fertile regions of the earth into important crop producing regions. Over two-thirds of the net sown area in Bangladesh is currently irrigated, making HYV boro rice the main rice crop of the year. With increasing use of irrigated water in agriculture, the productivity of agricultural land has certainly increased, as has the productivity of water usage in agriculture.

On the other hand, the lack of good governance in water-using crop production practices gives rise to unwanted social and environmental consequences. The list includes waterlogging and salinisation, aquifer depletion, wetland shrinkage as well as pollution (often irreversible). Worldwide, irrigation efficiency is still poor -- less than 40 percent; because much water is lost through evaporation/transpiration and drainage as a return flow; unfortunately a substantial part of it also picks up salts, pesticides and other toxic materials from the land, which return to the stream or the aquifer as pollutants. The water available for food production is closely linked to

soil surface, texture and structure of the soil profile. Another close relation is with the land management practices. It is worth bearing in mind that land -- like water -- is also a finite resource at the same time as population growth is causing a steady decline in the global per capita availability of arable land.

Water and urbanization

Water management challenges differ substantially depending on the type of human settlements. There have been significant trends worldwide towards the growth of urbanisation. In most Asian and African countries, there is a steady stream of migration from rural to urban settlements. This is most notable in the burgeoning populations in the peripheries as well as in the inner city quarters of the world's megacities. In the developing world, Latin America is significantly more urbanized than Asia or Africa, although some of the world's largest cities are in Asia. In fact, nearly 48 percent of the world's urban population lives in Asia -- up from 32 percent in 1950.

Almost half of the global population currently lives in urban areas, and expansion of large cities continues at an accelerating rate. The largest and the fastest growing cities are all situated in countries with a low Gross National Income (GNI), e.g., Dhaka, Jakarta, Lagos, Mexico City. The implication of this is clear in terms of the seemingly insurmountable hurdles in obtaining good governance in the water sector. Fast growing urbanization has compounded the problem of water shortage affecting safe water supply, sanitation and drainage. Urbanization is not just a problem of water stress or scarcity; a major part of national, regional and global pollution is more likely to be generated in urban areas.

A good example of water predicament in megacities is Dhaka itself. With an estimated current population of over 12 million and at the daily average per capita demand of 160 liters, the city needs about 2,000 million liters of water per day. Dhaka WASA is unable to provide more than 80 percent of this requirement, some of which are also lost through pilferage and leakage (fancifully called 'system loss'.) By 2015, the city's population may exceed 20 million with a daily demand of about 3,200 million liters! At present, the major part of Dhaka's water is harnessed from groundwater sources. Although there is no structural evidence of land subsidence in Dhaka from groundwater withdrawal -- at least not yet -- it is a wise decision by the city's water managers not to go for groundwater abstraction any further and plan to access surface water, even if the offtake points have to be located at long distances on the Jamuna river. (The waters of the Buriganga and the Sitalakhya are too polluted for domestic use). Mexico City, which depended on groundwater for the city's water supply three decades ago, now withdraws surface water from a distance of over 200 km.

In the coming years, the struggle to achieve the Millennium Development Goals for water and sanitation will have to focus more on urban centers. This is where much of the economic activities and industrial production are concentrated and where most critical governance decisions are made. The stark reality is that water challenges in this century are becoming increasingly urban in nature.

Upstream-downstream water users

Water flows without any regard for political boundaries or frontiers. International river basins stretch across more than one country, and the sharing and utilisation of the basin waters frequently generate concern and disputes. Nearly 60 percent of all land in the world belongs to international river basins. Africa has 57 international river basins, Asia 49, Europe 48, South America 36, North and Central America 33. Across the world, there are dozens of international conflicts emanating from disputes between upstream and downstream water resource users. The most common international water resource conflict concerns water quantity or availability for the downstream user.

When an upstream country starts to withdraw or divert large quantum of water for irrigation or urban use, it diminishes downstream water flow and creates acute water shortage in the lean season -- as it happens in Bangladesh. Some of the well known examples of transboundary water disputes are in the Ganges Basin (arising out of the construction of the Farakka Barrage), the Tigris-Euphrates Basin (between Turkey and Syria/Iraq following the construction of Ataturk Dam), and between Jordan and Israel (following the latter's withdrawal of water from Lake Tiberias).

The optimal approach to the problem of transboundary water issues is basin-wide cooperation (including full transparency of data and information) among all the stakeholders in the basin, i.e., all the riparian countries who are water users in the basin. The potential for conflict can be transformed into a potential for cooperation. This cooperation should be viewed as 'cooperation as opportunity', emphasizing the ways in which shared water-courses would ensure optimal benefits to all stakeholders. Water in a transboundary river is a common international resource and sovereignty over such shared resources is best expressed as cooperation. In spite of the absence of any legally binding framework regulating the sharing of international water courses, cooperation and agreement in such river basins are not totally absent.

In 1999, 10 countries sharing the Nile Basin have launched a joint effort to promote basin-wide cooperation, known as the Nile Basin Initiative. In north-eastern South Asia, there exist enormous potentials of cooperation among the countries sharing the basins of the Ganges, the Brahmaputra and the Meghna (GBM). Being the lowest riparian in all the above mentioned three river systems, Bangladesh is particularly concerned about water availability in its rivers during the lean season, especially because of numerous barrages, storage dams and diversion structures already constructed as well as being under-construction at upstream points in India. The immediate imperative, therefore, is to translate past promises of cooperation into reality, reaching equitable agreements of water sharing for all the common rivers between Bangladesh and India. Among the 54 transboundary rivers between the two countries, a sharing arrangement exists in respect to only one river -- the Ganges -- through the Ganges Treaty signed in 1996.

Since floods in Bangladesh are a common hazard, its management is not entirely possible without cooperation of the upstream countries. Such cooperation in the form of flood related data transmission from India to Bangladesh is in existence at an elementary level; however, data from more upstream stations on the GBM river basins would enable Bangladesh to forecast with a greater lead time, and thus enhance our flood preparedness capacity.

Besides agreements on water sharing and flood management, cooperation could also be effected through trilateral involvement (Bangladesh, India and Nepal) in constructing storage reservoirs in the Nepalese parts of the Ganges Basin. The northern and middle belts of Nepal (having a low population density) offer excellent sites for such reservoirs. These storages would not only help in flow augmentation in the Ganges during the dry season and flood moderation in the rainy season, but would also generate environment-friendly hydropower in Nepal for export to Bangladesh and northern India. (Nepal has a potential of 83,000 MW of electricity, of which 40,000 MW is economically feasible for development). Bangladesh could be involved in the implementation of these multipurpose projects through agreed formula for sharing costs and benefits.

The challenge of governance

In the backdrop of rising demands for water in the domestic, agriculture and urban sectors, and among the coriparians in the transboundary basins the key to good governance in water utilization is to follow a holistic vision of Integrated Water Resources Management (IWRM). IWRM is based on the perception of water as an integral part of the ecosystem and is defined 'as a process which promotes coordinated development and management of water and land in an equitable manner'. Water governance aims at decision making in an optimal framework, dealing with decisions on water quantity, water allocation, pollution level, and conservation for the next generation. It also determines the share of water between upstream and downstream water users -- especially ensuring the latter's right to sustainable livelihood.

The governance challenge might also include within its paradigm a concept, advocated by some hydrologists, which seeks to integrate land use with water management. Since land use modifies ecosystems, including water; a land use decision or choice is also a water use decision. Both the vital resources play a synergistic role and hence, a better strategy could be to develop a vision of 'Integrated Land and Water Resources Management' (ILWRM) in order to develop and manage two scarce natural resources -- water and land.

Dr. Rasheed, a former Professor of Geography and Environment, University of Dhaka, is currently teaching Water Resources Management at Independent University, Bangladesh.