Chapter 9

Formulation of an Integrated River Basin Management Plan

The ecological, economic and aesthetic integrity of the Dhansiri (South) River Basin is threatened as a result of various anthropogenic activities. An integrated basin approach is considered appropriate for this basin. It is widely accepted today as a sound, practical operating approach that implies management of water alongside the management of codependent natural resources, namely soil, forest, air, biota etc., taking river basin as the basic planning and development unit (Goswami, 2010). Thus the "integrated river basin management (IRBM) is the process of coordinating conservation, management and development of water, land and related resources across sectors within a given river basin, in order to maximize the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems" (*Adapted from Integrated Water Resources Management,* Global Water Partnership *Technical Advisory Committee Background Papers, No. 4, 2000).*

The IRBM entails a system approach to manage land and water resources in balance with human, industrial, and environmental needs. In this approach the conservation and development of the hydrological, pedological and biological resources are planned and executed in addition to the overall development of the people dependent on the basin. It helps in guiding and organizing land and water resources and services without adversely affecting soil and water. Thus the deterioration of natural resources in an area can be contained and the total resources properly developed only by adopting the basin approach. In this approach, development is not just confined to

agricultural land but it also covers the area, starting from the highest point of the area (ridge line) to the outlet of the natural river or stream. It recognizes the linkages between highland-lowland, upstream-downstream interaction processes effecting the life and livelihood of people and ecological balance in the region. This involves the implementation of ameliorative measures on barren hill slopes, marginal lands, privately owned agricultural lands and badly cut streamlets and the river courses. It would also directly focus on the nature of biotic pressures and resources to be protected. It would facilitate development of sustainable management solutions to current land and water degradation problem. The whole approach is the process of guiding and organizing land and water resources and services without adversely affecting soil and water.

9.1 Landuse Planning

Land is one of the most important resource and life supporting system which man have been using, overusing and even abusing since time immemorial. In a predominantly agricultural country like India, land comes first. Good soil is the foundation of good farming and good living. An understanding of good farming begins with understanding of the soil. In fact careless use of land can cause soil erosion and nutrient loss degrading the river basins and catchments.

In the Dhansiri (south) river basin, agriculture is the main landuse and the backbone of its economy. It suffers as a result of gross underutilization of existing water resources and the impact of flood and erosion hazard (Goswami, 2003). So improved agricultural practices should be followed in order to increase the production and subsequently meet the demands of the growing population. As flood is the most recurrent natural hazard damaging croplands during summer, there is a need to adjust

the crop calendar by increasing the emphasis on winter crops like mustard, vegetables and wheat. The farmers of the area must be made aware of the advantages of double or multiple cropping systems over single cropping system.

The farmers should made use of high yielding variety of crops and organic manure in tune with other modern methods of farming so that they can increase their production with available lands. A combination of organic residues and chemical fertilizers provide a synergistic effect increasing crop yield. Farmers can combine organic materials like crop residues, agroforestry litter, animal wastes and compost with modest levels of inorganic fertilizers and increase production by simultaneously maintaining and improving soil quality. Agroforestry systems should integrate the use of fast growing, nitrogen fixing woody species which shows great promise in increasing the supply of plant nutrients and in enhancing their cycling in the soil-plant system. This practice improves plant productivity and soil quality.

In the hills shifting cultivation is practiced by the tribal people. This causes degradation of the fragile and organically rich forest soil consequently increases the potentiality of floods in the plains. In the first year, production of crops are fruitful but in later years production decreases due to soil erosion and runoff. As such people shift their cultivation to other areas by clearing forest cover and repeat the process. Appropriate strategy for controlling shifting cultivation should be taken by adopting the following measures:

i) Cultivation of perennial crops such as rubber, coffee and black pepper according to the suitability of situation.

ii) Alternative farming systems such as wholly agricultural, livestock based, horticultural, agri-horticultural, agri-horti-silvi pastoral or silvi-pastoral etc. Mixed landuse has also been found effective, economic and acceptable to farmers. The decision of the type of alternate farming system to replace jhumming will depend on specific situation.

iii) Large scale demonstrations even with mini watersheds under irrigated or unirrigated situations

iv) Regeneration of degraded jhumming lands through planting of appropriate trees and other such measures

v) Improved approaches to shifting cultivation such as contour bunds or vegetative barriers, improved varieties of crops, growing of different crops in separate strips should be introduced

A massive awareness programme, survey for scientific land use along with well-conceived watershed management projects should be taken up simultaneously. Creation of awareness through orientation, demonstration, training and exposures will be necessary. Such programmes should be specifically developed for village heads, clan chiefs, leaders, district councilors etc. who are the agents of decision making in the hill areas (Borthakur, 1989).

Proper planning of fruit plantation particularly in the hilly terrains and slopes may reduce the huge extent of shifting cultivation, thus putting a check on soil erosion and nutrient loss. The ICAR Research Complex conducted an extensive proramme on the problem of jhum and its alternatives at Burnihat from the year 1976 onwards. The Silvipastoral horti-agriculture system is found to be a suitable system for hill slopes from soil conservation and soil productivity points of view. Inclusion of forests forage

and horticultural plants in the system besides food crops assured the inherent capacity of the system to meet timber, fuel, fodder, cash (from selling of horticultural crops) and food requirements of the rural population (Shadeque, 1989). Gosh and Ram Babu (1977) reported that run off plots at 11% slope under tree cover of the tree species namely strawberry, pineapple and pomegranate indicated the superiority of pineapple as an erosion checking type. In addition they should switch to terrace and contour cultivation practices in order to check soil erosion and run off.

9.2 Conservation of Biodiversity

The Dhansiri (south) river basin is endowed with vast forest resources. The basin includes biodiversity rich areas such as the Nambor Reserve Forest, Part of Dayang and Rengma Reserve Forests, Garampani-Doigurung Wild Life Sanctuary and the Kaziranga National Park. Thus it is one of the important biodiversity rich centre of the north east India. So proper planning is essential for conserving the richness in terms of its floral and faunal species. Thus keeping in view of the population increase and the increased need for goods and services, there is an urgent need for insulating genetic and ecological diversity for future needs and also utilization of still unknown species for human welfare. The conservation of biodiversity cannot be done in isolation from humans. Therefore for successful and sustainable biodiversity conservation, involvement of local communities near biodiversity rich areas is essential as most biodiversity is found near countryside where farming is practiced. It is therefore indispensable to integrate conservation into farming practices. In other areas of the world, livelihood and development priorities of local communities are taken into account if the conservation measures are to be sustainable. Thus for sustainable biodiversity conservation in the river basin, community based natural resource

management programmes which involve grass root level institutions in the decision making process and those who have the rights to manage and control their environment must be incorporated.

Economic development involving building of roads and railways for improving better communication systems for the people of the basin must be planned keeping an eye on proper conservation plans. The construction of roads and railways may lead to habitat fragmentation of native animal species and restrict their movement in search for food or other needs. Thus the animal corridors must be taken into consideration while executing such plans.

The traditional knowledge system also plays an important role in biodiversity conservation and sustainability. Thus village communities residing near protected areas must be involved while making biodiversity conservation plans and can be helpful in assessing the biodiversity of the basin and record the importance of different species.

9.3 Conservation of Water Resources and Management

A review of the status of water resources availability and use in the Dhansiri river basin is extremely vital to know the current pattern of underutilization and wastage of this valuable resource and the alluring future prospects for sustainable utilization. There appears to be considerable scope for water harvesting from the runoff to create waterbodies for irrigation and fishery etc. Technology is available for development of safe earthen bunds utilizing indigenous resources which are economic and ecofriendly without any need for use of cement and concrete bunds. Such programmes should be given priority as it helps in conserving ecology as well as improving production (Borthakur, 1989). The wetlands which possess tremendous ecological significance as

unique habitats for an exquisite variety of flora and fauna must be conserved properly and used for development of fisheries, irrigation facilities and flood moderation.

Flood and bank erosion are the most recurrent event in the river basin. In order to combat the fury of flood, short term structural measures, mainly embankments are presently used in an ad hoc manner. This further aggravates the problem as breaching of embankments has been identified to intensify the flood hazard. Thus non-structural measures like erection of multipurpose reservoirs, adoption of sound watershed management practices in the upstream, landuse regulation and zoning practices would help in reducing the intensity of flood hazard and stabilizing the productivity of agriculture. Appropriate disaster management techniques with respect to floods, provision of adequate outlets for flood waters and proper maintenance of the existing flood and erosion control structures are the areas that should be attended to alleviate the flood hazard. To control bank erosion, erosion control structures should be properly planned by identifying vulnerable areas. During field visit, the villagers are seen to plant banana tree all along the embankment of the river to prevent them from breaching. These non-structural methods should be more widely used to combat the erosion problem. Plantations should be done on hill slopes to control the top soil erosion. A judicious mix of structural and non-structural measures with emphasis on the latter should form the core of the water resource conservation and management (Goswami, 2003).

Thus a comprehensive flood management policy is required which would incorporate scope of research for the development of flood management strategies, evaluate the socio economic and environment impacts, prepare accurate flood hazard

zone maps on a large scale for flood prone areas, develop early disaster warning system and contains strategies for rehabilitation of post disaster reconstruction. These can be achieved by making use available high resolution satellite imageries and good geomorphologic understanding of the rivers which can be immensely useful in producing these maps and use them for policy making (Kale, 2006).

9.4 Development of Infrastructure

The Dhansiri (South) River Basin is an interstate basin spreading over parts of Golaghat , Karbi Anglong and Dima Hasao districts of Assam; Kohima, Wokha, Mokokchung, Zunheboto and Phek districts of Nagaland and Senapati district of Manipur. This peculiar geopolitical location has led to inter-state border issues and conflict between the states of Assam and Nagaland since the formation of Nagaland in 1963. The frequency of border related disputes has been rising since the last decade. The instability and violence in the interstate border areas have affected the growth and development of the concerned states. So border dispute problems must be properly addressed by the Government authorities and the areas of common interest should be given priority in development. During field work it was clearly realized that people residing in areas like parts of Karbi Anglong district live in constant fear of violence by militant groups. Their apprehensions must be contained by creating awareness among them about their fundamental rights and empowering them with proper literacy and education. For this the different social organizations, franchises and NGO's must come up. The dwellers of the remote hill areas should be encouraged to send their children to schools. Media should play an active role for infrastructure development. Corporate social responsibility activities of different organization and industries can also help in

the developmental process of the region. The people of the basin must also be provided with better health and education facilities and with surface and river navigation systems.

The formulation of the IRBMP for the Dhansiri (south) river basin must encourage the involvement of the tribal people and create confidence among them about the plan to be executed. The Government authorities and other local bodies must prepare a basin wise plan based on the available resources and a separate monitoring agency must look after the proper implementation of projects under the IRBMP and their functioning.

The IRBMP requires the effective participation of all concerned departments of the government ensuring transparency and popular participation in the decision making process starting from the planning stage to the implementation and follow up stages. Since it is an agreed policy of our government to take up developmental initiatives in all river basins on the basis of an integrated basin plan, the plan suggested above will conform to the accepted policy parameters of the government.

Chapter 10

Summary and Conclusion

It is a major south bank tributary of the Brahmaputra River covering an interstate basin area of 12,240 sq.km spreading over parts of Golaghat , Karbi Anglong and N.C.Hills districts of Assam; Kohima, Wokha, Mokokchung, Zunheboto and Phek districts of Nagaland and Senapati district of Manipur. According to the Strahler's method of ordering the Dhansiri (South) River basin is a 6th order basin. During the study the drainage density and stream frequency in the study area is found to be 1.59 km/km² and 0.5 km/km² respectively and a bifurcation ratio of 4.52. These parameters are indicator of the linear scale landform elements that reflect permeability, rock type and local relief (Thingo, 1994). They also exhibit important characteristic that controls the speed of runoff following a spell of heavy shower. The results show that the basin is comparatively of finer texture where the soils and rocks have poor internal drainage and therefore develop high surface runoff.

Forest and Agriculture provide the main source of livelihood to the people of the basin, most of them belonging to various ethnic communities The basin also includes a number of important biodiversity rich areas such as the Nambor Reserve Forest, Part of Dayang and Rengma Reserve Forests, Garampani-Doigurung Wild Life Sanctuary and the Kaziranga National Park .The Landuse/Landcover change analysis indicate that the Areas under agricultural land in the plains have decreased from 19.43% in 1999 to 16.83% in 2008. Areas under rural settlement and homestead garden and urban settlement have increased from 15.33% and 0.27% in 1999 to 20.57% and 0.41% in 2008 respectively. The area under wetland class also shows a reduction from 0.68% in

1999 to 0.60 % in 2008. Though the change in area is negligible, however it can also be attributed to increase of settlement area in 2008. Area under tea gardens shows a positive change from 2.88% in 1999 to 3.05% in 2008.

The sinuosity of the river channel varies from 1.22 to 4.91. Thus the river Dhansiri may be termed as an intensely meandering river with extremely high channel sinuosity based on the classification suggested by Leopold and Wolman (1957). The meandering nature of the river is responsible frequent course change of the river as it flows through the plains of Assam. This leads to heavy loss of land due to erosion by the river channel. It has been found that the total area lost as a result of erosion is 13.13834 sq km and the total area gained as a result of sediment deposition along its bank is15.15894sqkm. The geotechnical investigations of soil samples also reveal their variable composition from clays and silts of low plasticity to silts and clays of high plasticity. They are characterized by poor stability, are susceptible to liquefaction and have poor drainage characteristics. A study conducted by Kotoky et.al 2011 has reported that Kaolinite is the dominant clay fraction associated with the sediments of the Dhansiri River channel. They are always in a state of open packing, on disturbance they are weakened and likely to flow plastically. These types of soil sediments thus become highly susceptible to erosion during rise of water level in the channel.

The erosion risk map is found to be strongly related with slope and geology. The results show that high risk zones are generally present on the steep slopes and hilly terrains of the river basin along with its presence in and around the banks of the river channel. These areas fall under Karbi Anglong District of the river basin where the hill tribes practice shifting cultivation. Some isolated zones of the very high risk zones are also found to occur along the bankline of the river channel of the basin. This is because

of the presence of sandbars formed as a result of deposition of sediments. These are composed of extremely younger alluvial soil, hence very prone to erosion. The moderate risk zones are areas of agricultural croplands practiced by the people in plains, settlement areas and concentrated along the eastern boundary. Slight erosion risk zones comprise of forested areas and those under tea plantations. The areas under different soil erosion risk is calculated and are as follows: 225.108 sq.km under very high erosion risk zone, 1325.71 sq.km under high, 2257.25 sq.km under moderate and 715.89 sq.km area is vulnerable to slight erosion in the river basin. It has been observed that in Golaghat district, areas around Dhansirimukh, Dhansiri Temeragaon, Salmora, Mohorkhuti, Barchaporigaon, Napamua, Dhodanggaon, Bagariani Chapori gaon, Dhansiripar, Hahsora, Da-chamua, Barpathar, Katkatia gaon, Goghat town, Behora, Numaligarh, Kuruarbahi, Moinapara, Butalikhowa, Keduguri, Barguria gaop, Maranbil gaon, Kuruabahi Rajgarh, Nepaligaon, Bardihing, Thengal gaon, Habihowa, Bholaguri, Koibarta gaon, Mudaichuk, Thorajan gaon and Golampatty and in Karbi Anglong district area around Gharial Dubi, Phanse, Kamarkro gaon, Dukurumteron Basti, Sarupathar, Silanijan, Kamarangigaon, Terang gaon, Gunamara basti, Gutibari, Tarjan gaon, Godam gaon and Bukhial gaon, have undergone severe erosion posing a threat to the population in the vicinity.

The flood frequency analysis has been done by taking 24 years data of High Flood Level from 1982 to 2005. It reveals that the recurring interval of flood of the lowest intensity is 1.5 years. The flood inundation map shows that 687.75 sq.km areas suffers inundation which covers 276 villages in the revenue circle of Golaghat district. Thus it leads to heavy toll of loss to life and property almost every year.

Thus we can conclude that the people residing in the Dhansiri (South) River Basin suffers from the problems of deforestation and land degradation, flood inundation and soil erosion. The problem of flood in the lower reach of the basin is recurring. One of the major causes of these land degradation and deforestation is shifting cultivation that has been practiced by the hill tribes of this region. Shifting cultivation practice results in soil erosion and flood problems on the lower reaches of the basin. Moreover the river is intensely meandering nature which causes frequent shifting of its banklines leading to bank erosion and flooding in the adjoining flood plains. This causes heavy loss of agricultural production, loss of livestock and human lives too. The soils of the study area are also characterized by poor stability, are susceptible to liquefaction and have poor drainage characteristics. . Other reasons include growing population which leads to conversion of agricultural lands and filling up of wetlands to settlement area. The basin includes a number of important biodiversity rich areas such as the Nambor Reserve Forest, Part of Dayang and Rengma Reserve Forests, Garampani-Doigurung Wild Life Sanctuary and the Kaziranga National Park. Thus it needs an efficient basin management plan so that the sub original people residing in the basin can have optimum utilization of its resources and they can opt to the hazardous situations with minimal loss to their life and property. For efficient basin management an Integrated River Basin Management (IRBM) plan have been worked out. In this approach it implies the conservation and development of the hydrological, pedological and biological resources in addition to the overall development of the people dependent on the basin. It would facilitate development of sustainable management solutions to current land and water degradation problem.