Ayeyarwaddy River Basin

Khin Maung Nyunt (Myanmar)

Introduction

Myanmar has four distinct topographic regions,the western Rakhine and Chin and Kachin Nothern Hills, the Eastern Shan plateau, the Central Belt and Rakhine/Tanintharyi Coastal regions. There are three parallel chain of forested mountain ranges run north to south, and those are the Rakhine and Chin range, The Bago Yoma range and the Shan plateau which separated the country into four river systems namely The Ayeyarwaddy, the Chindwin, the Sittaung and the Thanlwin. Although there are many small rivers, only which are important for the national are mentioned

The central belt is bounded by mountainous region, on the west, north and east and Andaman Sea on the south. The central belt can be divided into the Central Myanmar Basin and the Delta Region. The Central Myanmar Basin has a complex topography including the Ayeyarwaddy and Sittaung river valleys separated by mountain ranges. The Ayeyarwaddy delta is about 160 by 240 Km wide and forms a flat and feature less plain.

The Central Myanmar Basin and Ayeyarwaddy Delta

Depending on the localities and rainfall on the area, the country may be roughly divided into three agro-ecological zones,

a- The"Wet Zone" in the southern coastal and deltaic areas, including Yangon, Ayeyarwaddy and Bago Divisions (28 % of the land)

b- The "Dry Zone " of Central Belt, including Mandalay, Magwe and Sagaing Divisions (40% of the land) and

c- Other area of an intermediate nature covering (32%)of the land

Mandalay Division, Sagaing Division and Magwe Division of Dry Zone and Ayeyarwaddy Division of Ayeyarwaddy Delta are situated in Central Myanmar Basin and Ayeyarwaddy Delta are commercially very important for Myanma economy. Agricultural products which contribute more than 40% of national GDP and export earnings are from those regions. Rice and beans from flood protected areas from the delta and rainfed and irrigated areas from the dry zones. At present only about 20% of cropped areas have been irrigated and 80% of cropped area depends on unreliable rainfall.

Ayeyarwaddy river after passing through Mandalay the last capital of Myanmar kings and turn to the right and joins with its largest tributary the Chindwin river. The flood plain formed by those two rivers after rainy season become very important for the poor people in the dry zones. Livelihoods of those people depend on the floodplains and on the islands. Some suitable land on the river sides are irrigated by river pumping projects. However the river discharges in those rivers in rainy season and dry season is very significant, and water level is very low in summer. Formation of sand bars and river meandering is a serious problem for river pumping stations.

In the delta area sea water intrusion is also a problem for summer paddy cultivation although large potential paddy area which can be cultivated during rainy season existed. Most of the paddy cultivation areas are protected by embankments and drainage sluices.The total area for paddy cultivation in those area is 728750 hectares.

In the year 1980 master plan for " Ayeyarwaddy Basin Integrated Agricultural Development " was studied with the assistant from JICA in the delta area. The studied covered 17 dam projects on the left side of the delta and 16 dam projects on the right of the delta. Between 1988 and 2007, 15 dam projects on the left side were implemented and now irrigating 186100 ha and on the right 8 dam projects were implemented on the right side and irrigating about 21900 ha now.

Ayeyarwaddy and Chindwin River Basins

The principal river of the South East Asia country of Myanmar and its important, commercial water way is the Ayeyarwaddy River. The Ayeyarwadd river starts in Kachin State, at the confluence of Mali Kha and Mai Kha rivers. The Mali Kha branch arises from the end from the end of the southern Himalayas, north of Putao Town situated in the northern part of Myanmar. The high mountain in the northern part of Myanmar and foothills and valleys to the south are in the Priority Corridor of the biodiversity value of the country. The Northern Mountain Forests Complex contains two large protected areas: Hkakaborazi National Park; and Hponkanrazi Wildlife Sanctuary. The main threats to biodiversity in the Corridor are shifting cultivation, hunting and timber extraction.

The Ayeyarwaddy River totally covers the catchments area of 288785 sqkm out if which approximately 193214 sqkm is configured as the upper Ayeyarwaddy river basin being defined from its source to the river confluence with the Chindwin River. The Ayeayarwaddy River from its origin to the Andaman Sea passes through extraordinary topographical diversity and regions of different diversity. Different geomorphology along the route of the river complex reaches are formed especially spectacular landscape like three defiles. After passing through third defile IUCN red list, the rare and endangered Irrayaddy Dolphins live. The dolphins helped the fishermen of those areas during fishing. After Ayeyarwaddy passes, Mandalay, Ava and Bagan the old capital cities of Myanma King, the Chindwin River joins it. Shweli river and Myitnge river are also large tributaries which join the Ayeyarwaddy river from the east side. Shweli hydropower project on Shweli river and Yeywa Hydropower project on Myitnge river are under implementation.

The portion just lying below confluence with Chindwin river is known as the lower Ayeyarwaddy river basin and occupies about 95571 sqkm down to the river mouth. The total length of the river is about 2000 km. It allows easy transportation of goods up and down of the country. The Ayeyarwaddy river bisects the country from north to south and empties through a nine (Bassein, Thetketaug, Ywe, Pyamalaw, Pyinzalu, Ayeyarwaddy, Bogale,Thande) armed delta into the Indian Ocean.

The apex of Ayeyarwaddy delta is situated near Seiktha village at which the maximum and the minimum discharges of 63900 meter per seconds 1306 cubic meters per second was recorded in the

year 1877 .The granary of Myanmar or the Ayeyarwaddy delta is situated below Seiktha village and the total area protected by embankment with a length of 2160 kilometers is about 728750 ha.

Chindwin River

The Chindwin river is configured with tremendous segments of rivulets, streamlets and it is the largest tributary of the well known Ayeyarwaddy river.The upper segments of Chindwin river is known as Tanai Hka that flows in north direction in its upper reach before entering into the Hukaung Valley, the Upper Chindwin Lowlands. Lower Chindwin river and the Uyu river originate from Indawgyi lake, a major tributary of the Chindwin is in the priority corridors of the key biodiversity of the eight Priority Corridors of the Country. Very clearly, rapids and water falls could often be seen along the river stretch within the 850 km water course from origin to Mawlaik. After that, the river alter its direction and runs West-North-West direction and the directional aspect changes to the South while traversing for approximately 1200 km before joining with the Ayeyarwaddy river near Myingyan situated in the central dry zone.The catchments area is 43475 sqkm comprising a portion of the catchments area for 6392 sqkm which lies in the north-eastern Indian states namely Manipur and Nagaland.

The watershed of Chindwin comprises intact forests including Tamanthi Wildlife Santuary and Hukaung Tiger Reserve along with natural forests at head waters and on both side of Chindwin River. Some of the vital habitats of diverse wildlife species especially globally endangered large mammals like tigers, elephants, etc. and endemic Burmese Roofed Turtle are in the catchments area. The Chindwin valley is isolated area, and less populated than the land along the Ayeyarwaddy, and even in this country of old traditions, the people of Chindwin live very conservatively and contentedly along this great river.

Some large tributaries joining the upper reach of Chindwin river system are Tawang Hka, Tarung Hka, Lanung Hka, Taby Hka, Sakse Hka, Samip Hka, Nampuk Hka, Nantaikeile Hka, and Nam Weon the right segment and Nawayu Hka, Tumri Hka, Taqum Hka, Nam Tommjun, Nam Pagan, Nam Kwaidaing on the left segment. Myittha river with its source in India joins the Chindwin river near Kalewa which is the trading post between Myanmar and India.

Average annual rain fall at Hkamti, Tamanthi, Tazon and Homalin are 3847 mm, 3262mm, 2432mm and 2314mm respectively at the aforementioned climatic stations all being lying in accord with the flow direction from up stream to downstream of the Chindwin river. The Chindwin river has floods several times in a year from the onset of rainy season to the end of the monsoon. Most of the flooding in the Lower Ayeyarwaddy and the delta is by the Chindwin river and when it coincides with upper Ayeyarwaddy floods , severe flooding occurs in the delta.

Institutions and legislation in Basin Management

Myanmar is a country endowed with a wealth of natural resources. Ayeayarwaddy river basin is 60% of Myanma total area. The upstream of the river basin is rich in natural resources such as forests minerals, jades, gold, platinum and gas and others. The upper reaches of an Ayeyarwaddy and its tributary Chindwin River are rich in biodiversity. The Northern Mountain Forests Complex and Chin

hills of the basin comprises part of the Eastern Himalayas Endemic Bird Area. Sanctuaries for Tigers and Elephants and wet land area for fishes and birds are in the catchments of Chindwin .

The catchments and up stream area are faced with a number of threats to biodiversity such as dredging for gold which pollutes the river, degradation of forests through timber, rattan, and bamboo extraction, logging, hunting for wildlife trade, mining for other minerals and jades, slash burns and human settlement, large scale conversion of forests to commercial plantation, and over exploitation of non timber forest products.

In the rivers people used drift gill nets, fixed gill nets, cast nests, stationary lift nets, stationary bamboo fish filter traps, drop door traps and hook and lines in fishing. Some people use electric fishing also.

To protect the forests and wildlife in the basins the Forest act (1902) and Wild Protection Act (1936) were an acted by the government The old forest law of 1902 had been replaced by the forest law , which was enacted in November 1995. Like wise, the new Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law, replacing the old Burma Wildlife Protection Act 1936 was enacted by the government in June 1944.

Protection of the terrestrial forest biota and habitats is the responsible of the Forest Department, under the Ministry of Forestry. Nature and Wildlife Conservation Division (NWCD) within the Forest Department take care of wildlife conservation protected area management and University of Forestry and Forestry Research Institute assist in forestry research work.

Ministry of Forestry, Ministry of Livestock and Fisheries and Ministry of Agriculture and Irrigation manage the protected non-forest habitats, including river habitats. Government institution has to rely on other institutions such as the police, armed forces and judiciary, to effectively discharge their responsibility. The NGO such as FREDA, BANCA and MBNS are partners of Forest Department in the conservation activities.

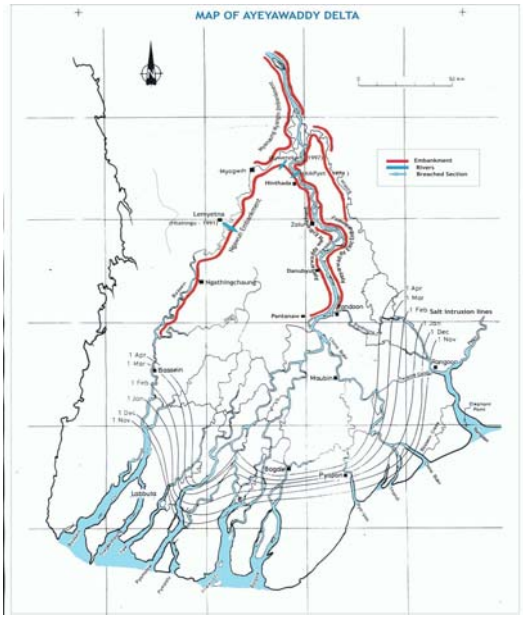
Agriculture Mechanization Department assists the mountain tribes in construction of terraces, to reduce slash bund cultivation.

International Center for Integrated Mountain Development (ICIMOD) is involved in conservation of the Eastern Himalayas and Hkakaborizi mountain ecosystem.

Under the "Environmental Conservation Committee", seven special task forces are formed to conserve several biodiversities such as mountains, rivers, agriculture etc; and Deputy Ministers are the responsible leader and officials from different ministries are members and officials from the Forest Department under the Ministry of the Forestry are the Secretaries. The responsibilities of the special task forces are,

1. to implement greening of the area and to protect degradation of forests
2. to protect soil erosion
3. to manage the catchments area
4. to prevent slash burn cultivation
5. to protect illegal logging and mining which will block water ways and sediments inflow in the reservoirs
6. to conserve other activities which will impact the environments

Every year taskforces visit the assigned area as necessary, and inspected the assigned area and necessary actions are taken and also suggestions are given to the local staff and NGO. The task force also suggests the laws, regulations and rules to the Committee for issuing the Environmental Law.



Flood Protection Embankments

In the Ayeyarwaddy river basin, farm land, towns and cities situated in the low lying area are protected by embankments from flooding. Protection of paddy land from Ayeyarwaddy flood was started in 1880-1881 in lower delta area. Protection of west bank and east bank of Ayeyarwaddy river in the delta was completed in 1929-1930. At the same time important towns and cities are also protected by embankments. In the year 1909, the Burma Embankment Act, covering the whole of Myanmar ,was an Acted. At the same time manual on care and maintenance of embankment released. The heights of embankment are designed to protect 20 years return period only.

In the year 1974 about 90 years return period flood reaching the height of 47,5 ft at Hinzada on the left bank of Ayeyarwaddy occurred and vast area of land and towns along the river were flooded and many crop areas in the delta were inundated. Again in the year 1991 Hteinngu embankment which was constructed in the year 1871-1872 on the Ngawun river a branch of Ayayarwaddy river was breached between mileage 19/6 and 19/7 near Hteinngu village.The impact of the damage was so disastrous that (2831350 acres of paddy land; (167520 acres of other crops, (67306) houses;(74674) draught animals; (326926) people from (269) villages from (8) townships were affected. Detailed study was made the causes of failure and in the year 1992 the embankments in the delta were redesigned keeping the free board 5 foot higher than the original design and using heavy equipments the embankment constructed. In the year 1997, flooding of Ayeyarwaddy River occurred again and water level rose to 47.6 which was 0.1 ft lower than 1974 flood level. During that flood Ngawun embankment near Kywetekone, the head reach was breached even after the strengthening of the embankment.

Several lessons were learned from those failures such as weakness in management, training the staff and local people, the engineer lack of knowledge and experience was assigned to manage and control the embankment during flooding, allowing the voluntary group without going under training of flood fighting technique.

Strengthening Institution and Capacity Building

Capacity building of the officer and staff, carried out by given several basic engineering courses and related subjects for junior engineers and assistant engineers, pre-service training, in-service training specialized subject training are conducted at Irrigation Technology Center.

Hydrology, Geology, Canal Act Embankment Acts, Care and Maintenance of Embankments, Account Code, Department Code and Administration etc. are taught in the training.

Irrigation Department also established another Irrigation Technology Centre at Mandalay, where pre-service and in-service are given. Apart from ITC, the department established Mechanical Training Centre (MTC) in Yangon, where operation and maintenance, and repairs of heavy Machinery.

Basic courses like GPS, Remote Sensing were conducted. Special training courses for subordinated field staff such as canal and drainage inspectors from state and division are also given by irrigation department experienced senior officers. Some senior engineers also attended the Disasters Management Training given by the Ministry of Health. Up to now, more than 9000 officers and other staff undergo training.

People Participation in Flood Protection

Every year in the Delta flood prevention committee was formed and head quarter is based at Henzada. About 770 surveillance group are formed, 44 groups are staff from all department from the Division. Some groups stationed at front camps are equipped with wireless sets to communicate with base camp as well as each other. Other groups are people from protected area.

Before flood season, a flood protection method, care of embankment, surveillance procedure, reporting method and assigning specific duty and reach to take care and drilling exercise is conducted by Irrigation Department Engineers to the people in the protected area.

For awareness and knowledge building, pamphlet emphasizing flood prevention and where to report when they discover boils, slips and subside etc.

To overcome disasters in the future Irrigation Department Engineers conduct practical training to local people who co-ordinate during flood season. Up to the year 2003, 16 dam projects were completed on the tributaries of the Myitmakha River. Because of those dams the flood water from the Myitmakha catchments area was reduced and also active participation of local people in flood fighting, and as a result, Ayeyarwaddy flood more than 45 days in July and August 2004 occurred and Henzada water level reached to 47.6 ft but no serious flooding and damage were occurred in the Myitmakha flood plain and no flood damage was occurred along Hinthada-Ngawun embankment.

In After 1997, more attention was given post flood season inspection of the embankment. A team comprising expertise from various professions, local division engineers, and assisting by the villagers inspected the embankments condition according to the "Flood report prepared by the Division officer during flooding period inspection findings". Sections that need ordinary repair and special repair and new prevention work were recommended by the inspection team. Repair and maintenance work were done according to the instruction and require budget was sectioned by the head office.

Every year before flood season, "Flood Prevention Committee" was formed in the respective division along Ayeyarwaddy river and Chindwin river. All government officers became a member of the committee. Chairman is the Chairman of the Division Commander and Secretary is the Director of the Irrigation Department of that Division. Township and village authorities and people living in the protected area actively participated and carried out assigned duties during flooding period.

Every year before flood season the following action plans are drawns;

- Pre-Flooding preparation program
- Management program during flooding period

- Post flooding repair and maintenance work

A Special Management Team

Ministry of Agriculture and Irrigation has a flood management team headed by the Deputy Minister with the assistant from Engineers of different trade usually go to the problem area when water level in the river continuously rise and near to the critical level.

Before departure to the site the following logistic supports are arranged and send to the sites.

(1) Earth moving equipments such as Bulldozer, Backhoe, Loaders and Trucks
(2) Gunny bags, river shingles, sand
(3) A number of gunny bags are filled with soil and dump near the suspected sites
(4) Checking whether the people are ready for emergency case, their assigned duty and reach to be under taken, and questioners are make about their knowledge of flood fighting etc
(5) Guidance and instructions are given as required

At the site, the team usually divided into groups with the local staff and people and inspected,

(1) Camp facilities
(2) Emergency materials collected
(3) Daily report of embankment situation, rate of rise of water levels
(4) Warning systems
(5) Wireless communications systems

Myanmar has many years of experience in flooding in the country. Most of the flooding are caused by rainfall due to Cyclones in the bay of Bengal or Indian ocean in August and September of every year, Usually flesh flood occurred in small basin by storms. Large river basin like Ayeyarwaddy, rise and fall of water level by the rain fall in the up-stream catchments area or middle reach catchments area, is slow due to longer of concentration time at delta apex and nature of river at the delta.

Stability of the embankment become critical due to,

(1) Slow rising and falling period
(2) Longer period at high water level
(3) Water level rise twice within week or a forth-night

In this period safety of the embankment is in the hand of the surveillance group. Continuous checking of the embankment behavior and checking whether boiling of sand are at the toe even up to 400-500 feet is essential. Naturally embankments are founded on the sandy bank of the river susceptible to liquefy by shaking or impact by boats, so anchoring of boats are strictly prohibited.

Irrigation Department is key player in combating flood along Ayeyarwaddy river and its delta and it is the concerned of the departments, for the safety of the embankments. The improvement in strengthening of the embankment and continuous maintenance of the flood protection facilities will remain the task of Irrigation Engineers. The continuous growth of economic and environment and aquatic ecosystem in the delta area will sustain only by coordination and corporation of the people. Now in connection with this, drainage control committee at village tract level are formed to protect the

drainage channel being blocked the water way for spawning of fishes and prawns and also retard the flood water discharge when heavy rain occurred.

The Engineers are confident that capacity building in knowledge and systematic preparation will reduce the risk of flood disasters.

Left Side Right Side Conflict

The lower reach of the Ayeyarwaddy River passes the Central Dry Zone where the diversity is totally different from up stream. The area is sheltered from south-west and north-east monsoon by a horseshoe shape of mountain ranges, has an extreme dry and seasonal climate. In this region farmers hardly get enough rain to grow dry crops. The Ayeyarwaddy and its sandbars and islands are veins for them and their livelihood depend on it. They get the protein that is fishes from the river and fishing in also their livelihood.

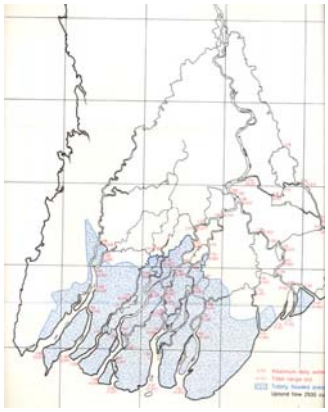
Sometimes river course changed due to flooding and as a consequence scour occurs in one side and deposition occurs in other side. New fertile islands also formed in the river. When river water started subsiding people from the west side and east side tried to occupy the land for cash crop cultivation. During that period conflict started occurs for the ownership of the new land. Sometimes it turned from simple arguments to furious fighting between them and murder case occurs. Police forces, Township Authorities, Village Authorities interrupt to stop the conflict first. Settlement and Land Record Department of the Ministry of the Agriculture and Irrigation and Directorate of Water Resources and Improvement of River Systems coordinated with the conflict resolution party taking measurement of the thalweg and finally local authorities decide the ownership of the new island.

Similar manner, but more difficult situation occurs in the west bank and east bank of Ayeyarwaddy River in the delta. In the year 1881-1882 farmers in the left of the river constructed low embankment to protect paddy fields. In the year 1929 government constructed embankments keeping the height lower than right bank for emergency spill section to reduce some volume of flood to save west bank protected area. During that time the area of east bank is in between Ayeyarwaddy and Myitmakha river where few people are living and no ongoing development work are there. After 1988 towns such as Monyo and Sagargyi are connected with Yangon-Pyay high way and railway line, and since then, those area become developed. Moreover since the low lying areas in the east bank are given right to the private sectors, those areas are developed with low land rice cultivation field and fish ponds. At the same time gas is found in the area and it become commercially important. Management of the flood is not simple as before. Safety of the east bank is the concerned of Yangon Division and Bago Division and the west bank is the concerned of Ayeyarwaddy Division. Continuous report on flood levels have to be sent to the head office and the Ministry. Incase of emergency to breach the spill section the decision is made by SPDC.

Scientists Concern of Myanmar on Climate Change

The Scientists said climate change caused by global warming is likely to havoc country lying in the coastal area. Climatologist said South East Asia, with its tropical weather and long coastlines will be one of the hardest-hit regions in the world. Because of the climate change global temperature rise up

1.4 and 5.8 degrees Celsius and sea level could rise by as much as one meter and Ayeyarwaddy Delta as a low lying region endangered by rising sea level. If the sea pushes inward on the Ayweyarwaddy and other deltas flooding from storm surges will contaminate the soil, drinking water and permanent land loss and millions people will be displaced. The region like Dry Zone will hit-hard and many rivers will be below critical level. Sections of upper Myanmar's dry zone that already receive less than 30 centimeters of rain per year could reduce to less than 10 centimeters. According to local meteorologist the effects of climate are already felt here. Average rainy day is reduced from 145 to110.



In the year 1980 Irrigation Department during implementation of Lower Myanmar Paddy Land Development Project, a model study was made to determine the height of embankment of the polders.During model study 1974 flood which is about 1 in 100 years return and magnitude is abut 48000 cumecs over a period of 9 days, and also a cyclone surge model of the Bay of Bengal by which flooding occurs in the Ayeyarwaddy Delta. Some of the areas flooded are cultivable waste land, fallow land, and mangrove forest land, some fisherman villages. They are very friendly with flood and they stay on long post bamboo houses. Hydrology Division of Irrigation Department installed some gauging stations in the delta region. Water level measurements are taking regularly and at the end of rainy season and saline intrusion line is measuring up till April, the end of summer paddy season.

The Country does not have any fund or technical assistance to combat disaster caused by climate change. Irrigation Engineers are aware of the affects that water level in the rivers will be reduced due to draught and water level in the Delta Region will rise due to the change of sea level. People in the Dry Zone will suffer water shortages. Irrigation Department is Implementing three dams project in the tributaries, Myittha Hydropower Project, Manipu Hydropower Project and Yarzagyo dam project impounding capacity of three dams is1800 million cubic meters. On the main river Chindwin, Tamanthi Hydropower Project is already studied and National Dialogue on EIA, social impact, possible increase in river flow and increased in water level in the main river and effect of pushing back of saline instruction line to the sea, reduction of water level in the Delta Region in the delta due to impounding of rainy season flow in those dams is already finished. Possibility of irrigation of 242000 hacters of land in the dry zone areas and as well as for drinking water for people their draught animals. Cost benefit study was study done. Now some of the lift irrigations are already implemented.

Conclusion

The Ayeyarwaddy river basin management is very important and all the people in the country must safeguard all it resources for the sustainable developments of the country and its generation, from the Hkakaborazi to the delta. The total basin area is 60% of the country area and the catchments lies in Kachin State, Shan state, Chin State, Sagaing Division, Mandalay Division, Magwe Division, Bago Division, Yangon Division and Ayeyarwaddy Division. Management of the river, in the head reach, middle reach and the delta is different. Ministries concerns assigned officers and staff specialized in the field to take part in managements. Concerning with the water resources development work, Irrigation Department is the main institution and it is always coordinated with Department of Hydroelectric Power, Forest Department, Department of Meteorology and Hydrology.

Limited budgets, shortage in trained staff and facilities, so that necessary guidance, logistic support, and security etc; are given by the Chairman of the concerned division. Township and village authorities and village elderly persons give necessary assistance in their village tracts. However they have no knowledge on conservation of natural resources, value of biodiversity, environmental impact by forests degradations etc; so that capacity development up to grass root should be carried out by the Ministry concerned. Irrigation Department is the focal department for water resources, and it is conducting IWRM training in the country with the assistance from GWP-SEA and with its own budgets. Other departments also give training their staff and communities in their relevant subjects. Because of the present situation neither ODA nor technical assistants from the banks are available except GWP-SEA, SEA-Cap Net and now AguaJaring.

Concerning with the Global Climate Change, Myanmar have not been thoroughly studied yet. Study in other parts of the world suggested that the impact of climate change has already being experienced in some regions, and Delta and Dry Zones of Myanmar will hit hard. People already aware and felt the rise of temperature so Irrigation Department is implementing several small village tanks in the Dry Zone of Myanmar. Several tube wells are driven in many villages including Dry Zone. With the assistant from JICA, MAS is studying ground water irrigation projects in Dry Zone.

FERDA has already started the 2 years program from 2007 – 2008 restoration of forests along head reach of Ayeyarwaddy to Delta by the aid from DEA (Diekonie Emergency Aid). The program of DEA Project includes cultivation fruit trees, herbs, and pastures, grazing ground for cattle's, wild elephants etc In the Ayeyarwaddy delta, FREDA grows 1155 hectare of mangrove forest.

Problems are many, what the Country can do is limited, however capacity development of the people can sustain the resources in Ayeyarwaddy River Basin for the new generation and participate in combating the Global Climate Change together with other countries in the Asia Regions.

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