CONTENTS

MYANMAR NATIONAL WATER POLICY

CHAPTER - 1
INTRODUCTION

1.1 Water is a natural resource, fundamental to life, livelihood, and food security and sustainable development as well as human dignity and cultural values. It is also a finite resource with spatial and temporal variations. Myanmar is endowed with abundant water resources, which possesses 12 percent of the whole Asia's freshwater resource and 16 percent of the ten ASEAN nations. However, wide range of spatial and temporal variation of rainfall dictates water scarcity in the Dry Zone, central Myanmar. There are further limits on utilizable quantities of water during the dry season across the country owing to uneven distribution over time and space. In addition,

there are challenges of frequent floods and droughts in many parts of the country. Population growth , rising needs of economic activities to feed the nation as well as the given indications of the impact of climate change, availability of utilizable water will be under further strain in future with the possibility of deepening water conflicts among different user groups.

1.2 Moreover, recent political and economic reforms also point to the urgent needs of clear communication and legal instruments for fair and peaceful water sharing among regional and state governments with the approval of the Republic of the Union of Myanmar Government. Low consciousness about the scarcity of water and its life sustaining and economic value results in its mismanagement, wastage, and inefficient use, as also pollution and reduction of flows below minimum ecological needs. In addition, there are inequities in distribution and lack of a unified perspective in planning, management and use of water resources, i.e. little or no knowledge about the Integrated Water Resources Management (IWRM) except in the domain of water professionals. The whole country needs to be aware of IWRM principles and participatory approach. *The objective of the*

National Water Policy is to take cognizance of the existing situation, to propose a framework for creation of a system of laws and institutions and for a plan of action with a unified national perspective including the Myanmar National Water Framework Directive.

1.3 The present scenario of water resources and their management in Myanmar has given rise to several concerns, important amongst them are:-

(i) Large cities and towns of Myanmar have already become water stressed. Rapid growth in demand for water due to population growth, urbanization, industrial zones development, special economic zones development, changing lifestyle in the largest cities pose serious challenges to water security;

(ii) Issues related to water governance have never been addressed adequately. Mismanagement of water resources for long time has led to a critical situation in many parts of the country;

(iii) There is wide temporal and spatial variation in availability of water, which may increase substantially due to a combination of climate change, causing deepening of water crisis and incidences of water related

disasters, (i.e., floods, droughts, cyclones, landslides and alteration of sedimentation processes, increased erosion and increased frequency of droughts, etc);

(iv) Climate change may also increase the sea levels. This may lead to salinity intrusion in groundwater aquifers /surface waters (already having to witness that effect in some rivers in the Delta region) and increased coastal inundation in coastal regions, adversely impacting habitations, agriculture, roads, rails and industry in such regions;

(v) Access to safe drinking water and basic sanitation and other domestic needs still continues to be a problem in many areas. Skewed availability of water between different regions and different people in the same region and also the intermittent and unreliable water supply system has the potential of causing social unrest. Especially at present Myanmar peoples become very much concerned with their right to safe drinking water and basic sanitation as recognized by the United Nations General Assembily in September 2010;

(vi) Water quality data, prevailing in both surface water and groundwater in use is to be stored up in the data bank of NWRC on basin-wise basis. Drinking water standards

including standards for crops are to be enforced by NWRC, through government agencies concerned and remedial measures suggested;

(vii) Contamination and pollution of water bodies (rivers also) and sediment deposition are on the rise in Myanmar due to various reasons and causes and NWRC should pinpoint and control in cooperation with government authorities. Effluent discharge without proper treatment is one of the causes of pollution and must be controlled by NWRC in conjunction with authorities;

(viii) Groundwater, though part of hydrological cycle and a community resource, is still perceived as an individual property and is exploited inequitably and without any consideration to its sustainability leading to its over-exploitation in several areas. Some visible damages had already been done. Overlapping mandate and authority of various waterauthorities also need to do Clearing House Activity by the National Water Resources Committee;

(ix) Effective use of marine water as well as marine water pollution is serious issue. Prevention of pollution from land-based sources and activities, vessel pollution, ocean dumping, coral reefs degradation, and offshore marine environment are as important as those of freshwater

resources. National and international marine water protectionpolicy should be included in the agenda of the National Water Resource Committee;

(x) "Water Quality Standards" should be set by relevant Ministries under the direction of the NWRC for the purpose of both 'domestic and industrial' and 'economical use and their discharges' to prevent surface, ground and marine waters;

(xi) Water resources projects, though multi-disciplinary with multiple stakeholders, are being planned and implemented in a fragmented manner without giving due consideration to optimum utilization, environment sustainability and holistic benefit to the people;

(xii) Inter-regional, inter-State, intra-State, as also inter-sectorial disputes in sharing of water, strain relationships and hamper the optimal utilization of water through scientific planning on basin/sub-basin basis;

(xiii) Grossly inadequate maintenance of existing irrigation infrastructure has resulted in wastage and under-utilization of available resources. There is a widening gap between irrigation potential created and utilized. Dam safety and siltation are issues of concern;

(xiv) Natural water bodies and drainage channels are being encroached upon, and diverted for some other purposes without much attention to authorities. Groundwater recharge zones are never heard of in Myanmar and need to address;

(xv) Growing pollution of water sources, especially through industrial effluents, gold mining and other mineral mining, fish and shrimp farming, etc., various economic activities, is affecting the availability of safe water besides causing environmental and health hazards. In many parts of the country, large stretches of rivers are both heavily polluted and devoid of flows to support aquatic ecology, cultural needs and aesthetics;

(xvi) Access to water for sanitation and hygieneis an even more serious problem. Inadequate sanitation and lack of sewage treatment are polluting the water sources;

(xvii) Low public consciousness about the overall scarcity and economic value of water results in its wastage and inefficient use;

(xviii) The lack of adequate trained personnel for scientific planning, utilizing modern techniques such as mathematical modeling, space technology and analytical capabilities incorporating information technology constrain

good water management and good decision support systems;

(xix) A holistic and inter-disciplinary approach at water related problems is missing. For example, relationship between urban development and environmental issues need to be seriously addressed. Rapid growth of urbanization induced man-made floods. Digging the foundation and basement for high rise buildings disturbed the groundwater table. However, adequate action was not taken in terms of financial and technical stipulations. It is imperative to avert the significant adverse effects of urbanization to protect people property, public safety and environmental damage as well. In fact every building to be erected shall generally be subject to green building codes. Low carbon urbanization, that does not disturb and/or pollute the fresh water resources, marine and land environment, is achievable;

(xx) The public agencies in charge of taking water related decisions tend to take these on their own without consultation with stakeholders, often resulting in poor and unreliable service characterized by inequities of various kinds;

(xxi) Characteristics of catchment areas of streams, rivers and recharge zones of aquifers are changing as a consequence of land use and land cover changes, affecting water resource availability and quality. Watershed management and 'land and water' management should also be promoted; and

(xxii) Erosion is the natural process of the streams, rivers and coastal areas of the Ocean. Erosion not only causes hardship to the people's livelihood but also instability and regimes of the rivers and coastline. So far, adequate undertaking using competent technique and budget to combat against rivers and coastal erosion was not practiced in this river-packed country. Specific polices should be introduced to protect loosing of valuable nation's lands.

CHAPTER-2
MYANMAR NATIONAL WATER POLICY

2.1 General

The goal of the national integrated water resources management policy is to develop, share and manage the water resources of Myanmar in an integrated, holistic and socially inclusive manner, to contribute significantly to the poverty alleviation, to the green growth and sustainable development of the nation, by providing access to water of equitable quantity and safe quality for all social, environmental and economic needs of the present and future generations. The policy covers two broad areas:-

(i) **Water resources management**: covers the management framework including policy objectives, principles and strategies for the monitoring, assessment, allocation and protection of the resources; and

(ii) **Water resources use**: covers the policy objectives, principles and strategies for the development and use of water for people [domestic and drinking water supply, water for cultural use and religion], water for Food Security [agriculture], water for industry and other water uses such as hydropower, recreation, Non-Revenue-Water (fire hydrants and trucks) and water for maintenance of productive ecosystems. Water reservoirs should be located in every community for supplementary use. The water policy shall be a dynamic instrument. It will be re-assessed from time to time to ensure that it is effectively responding to new experiences and changed circumstances.

2.2 The vision

Our vision is "in 2040 Myanmar will become water efficient nation with well developed and sustainable water resources based on fully functional integrated water resources management system". The entire populace will benefit from gradually increasing income, better quality of life, greener environment, peace and stability due to efficient use of water and fair, transparent and inclusive allocation of water to many competing functions such as agriculture, forestry, mining, manufacturing, power generation, recreation, tourism as well as

protection of water resources such as groundwater recharge and environmental flow in rivers.

2.3 Mission

To provide various levels of government, which include all Organs of States, Regions and Union Territories, with the most needed overarching national water policy to perform and co-operate with each other in mutual trust and good faith by implementing such policy and further development of respective rules, regulations, procedure and legislation on their own.

2.4 Objectives

(i) Prepare and propose an overarching national water policy based on national water needs and national development policy.

(ii) Realization of a sector apex body and strengthening of inter- ministerial cooperation, communication and information sharing.

(iii) Invest in water sector by the government to properly manage the country's overall water resources and priority river basins, including development of physical infrastructure, institutions and capacity building.

(iv) Increase the efficiency and accountability of service providers in the water supply, sanitation and hygiene, hydropower and irrigation sectors.

(v) Disseminate knowledge and create awareness, develop responsible behaviors and create enabling environment for sustainable water use.

(vi) Provide national policy and stand point on use of shared water resources and develop cooperation among riparian countries.

(vii) Enhance water information, knowledge, know-how, technology, cooperation, consultation and partnerships.

(viii) Invest in water, sanitation and hygiene education, vocational training, capacity building, monitoring and enforcement, and learning.

2.5 Guiding Principles

The guiding principles are:-

(i) Planning, development and management of water resources need to be governed by common integrated perspective considering local, regional, state and national context, having an environmentally sound basis, keeping in view the human, social and economic needs;

(ii) Principle of equity and social justice must inform use and allocation of water. Both in water supply and storm water management programs, ample opportunity should be given to the community to participate in the development and implementation of the programs;

(iii) Good governance through transparent informed decision making is crucial to the objectives of equity, social justice and sustainability. Meaningful intensive participation, transparency and accountability should guide decision making and regulation of water resources.

(iv) Water needs to be managed as a common pool community resource held, by the state, under public trust doctrine to achieve food security, support livelihood, and ensure equitable and sustainable development for all.

(v) Water is essential for sustenance of eco-system, and therefore, minimum ecological needs should be given due consideration.

(vi) Water, after meeting the pre-emptive needs for safe drinking water, sanitation and high priority allocation for other domestic needs (including needs of animals), achieving food security, supporting sustenance agriculture and minimum eco-system needs, may be treated as

economic good so as to promote its conservation and efficient use.

(vii) All the elements of the water cycle, i.e., evapo-transpiration, precipitation, runoff, river, lakes, soil moisture, and groundwater, sea, etc., are interdependent and the basic hydrological unit is the river basin, which should be considered as the basic hydrological unit for planning.

(viii) Given the limits on enhancing the availability of utilizable water resources and increased variability in supplies due to climate change, meeting the future needs will depend more on demand management, and hence, this needs to be given priority, especially through

(a) evolving an agricultural system which economizes on water use and based on water-efficient irrigation technologies currently available around the world, and

(b) bringing in maximum efficiency in use of water and avoiding wastages.

(ix) Water quality and quantity are interlinked and need to be managed in an integrated manner, consistent with broader environmental management approaches inter-alia including the use of economic incentives and penalties to reduce pollution and wastage.

(x) The impact of climate change on water resources availability must be factored into water management related decisions. Water using activities need to be regulated keeping in mind the local geo-climatic and hydrological situation.

2.6 Strategies

The main strategies are as follows:-

(i) Government to assume the role as an enabler in a participatory and demand driven approach to development and use of the national water resources;

(ii) To ensure proper land resources planning and management;

(iii) To establish appropriate bodies responsible for water resources management;

(iv) To develop and enhance human resources and national technological capacities;

(v) Integrated and sustainable development and management of water resources for all sectors to guarantee socio-economic growth;

(vi) Ensuring the efficient means of Domestic Water supply in Myanmar;

(vii) The protection of all water resources. (e.g.: Wetlands);

(viii) Regulatory controls to be developed in response to needs and at enforceable levels;

(ix) Water demands to be given priority in the following order and shall be based on economic, social and environmental values of the water determinants:

(a) Drinking Water, domestic use, water for people

(b) Water for Urban and Rural Sanitation

(c) Water for Food security

(d) Water for other uses (industries, hydro-power, beautifications, firefighting, etc...);

(x) The "polluter pays principle" to be enforced; and

(xi) To ensure efficient and proper disposal of solid and liquid wastes including human and animal excreta.

CHAPTER - 3
WATER FRAMEWORK DIRECTIVE

3.1 Even while it is recognized that Regional and State governments have the right to frame suitable policies, laws and regulations on water; there is a felt need to evolve a broad overarching national legal framework of general principles on water to lead the way for essential legislation on water governance in every Region and State of the Union and devolution of necessary authority to the lower tiers of government to deal with the local water situation.

3.2 Such a framework directive must recognize water not only as a scarce resource but also as a sustainer of life, public goods and ecology. Therefore, water needs to be managed as a community resource held, by the state, under public trust doctrine to achieve food security, livelihood, and equitable and sustainable development for all. Existing Laws and Acts may have to be modified accordingly in as much as it appears

to give proprietary rights to a land owner on groundwater under his/her land. Inventory and review of all water related existing laws, acts, and regulations have to be done as a priority issue.

[Myanmar National Water Framework Directive is an umbrella statement of general principles governing the exercise of legislative and/or executive (or devolved) powers by the Union, the States and Regions, and the local governing bodies. Please refer to Myanmar National Water Framework Directive and its public consultation process.]

3.3 There is a need for comprehensive legislation for optimum development of *inter-State rivers* (for example Ayeyarwady) and river valleys to facilitate inter-State coordination ensuring scientific planning of land and water resources taking basin/sub-basin as unit with unified perspectives of water in all its forms (including precipitation, soil moisture, ground and surface water) and ensuring holistic and balanced development of both the catchment and the command areas. Such legislation needs, inter alia, to deal with and enable establishment of basin authorities with appropriate powers to plan, manage and regulate utilization of water resource in the basins.

CHAPTER - 4
FAIR WATER ALLOCATION

4.1 Water is required for domestic, agricultural, hydro-power, thermal power, navigation, recreation, etc. Utilization in all these diverse uses of water should be optimized and an awareness of water as a scarce resource should be fostered.

4.2 The Union, the Regions and States, and the local bodies (governance institutions) must ensure access to a minimum quantity of potable water for essential health and hygiene to all its citizens, available within easy reach of the household.

4.3 Ecological needs of the river should be determined, through scientific study, recognizing that the natural river flows are characterized by low or no flows, small floods, large floods, etc., and should accommodate developmental needs. A portion of river flows should be kept aside to meet ecological needs ensuring that the low and high flow releases are proportional to the natural flow regime, including base flow contribution in the low flow season through regulated groundwater use.

4.4 In the water rich northern, north western and north eastern regions of Myanmar, the water use infrastructure is weak and needs to be strengthened in the interest of food security. In the Ayeyarwady Delta, the different kind of water-infrastructure may also need and most importantly, navigability of the mighty Ayeyarwady River to develop its potential to become a world class water highway may contribute significantly to the country's economy in sustainable way.

4.5 Community should be sensitized and encouraged to adapt first to utilization of water as per local availability of waters, before providing water through long distance transfer. Community based water management should be institutionalized and strengthened not only for water utilization but also for technology transfer, for example aggressive rain water harvesting campaign in the Dry Zone, Central Myanmar and across the country.

4.6 Primary utilization of the country's vast water resources consists of agricultural, domestic and industrial needs and hydro-electric energy production. Auxiliary uses of the water resources include transportation, fisheries and sociological purposes. As such, water resources projects' planning needs to be comprehensive enveloping all above aspects for the whole nation. Marine water is as important as river basins.

Exhaustive project scenarios should also be considered to achieve maximum benefit of the stakeholders.

CHAPTER - 5
ADAPTATION TO CLIMATE CHANGE

5.1 Climate change is likely to increase the variability of water resources affecting human health and livelihoods. Therefore, special impetus should be given towards mitigation at micro level by enhancing the capabilities of community to adopt climate resilient technological options.

5.2 The adaptation strategies could, inter alia, include increasing water storage in its various forms, namely, soil moisture, ponds, groundwater, small and large reservoirs, and their combination, which provides a mechanism for dealing with increased variability because of climate change.

5.3 The adaptation strategies could also include better demand management, particularly, through adoption of compatible agricultural strategies and cropping patterns and improved water application methods, such as land leveling and/or drip / sprinkler irrigation as they enhance the water use efficiency, as also, the capability for dealing with increased variability

because of climate change. Similarly, industrial processes should be made more water efficient.

5.4 Stakeholder participation in land-soil-water management with scientific inputs from local research and academic institutions for evolving different agricultural strategies, reducing soil erosion and improving soil fertility should be promoted.

5.5 Planning and management of water resources structures, such as, dams, flood embankments, tidal embankments, etc., should incorporate coping strategies for possible climate changes. The acceptability criteria in regard to new water resources projects need to be re-worked in view of the likely climate changes.

5.6 During some studies on the existing dams under the Irrigation Department (ID), irregular performances of many reservoirs influenced by impending climate change were observed yielding huge volume of water to the waste. Up to now, more than hundred of reservoirs have been constructed at the cost of thousands of billion kyats from the public fund. Upgrading of the existing reservoirs after rigorous studies would optimize the water usefor apprehendingmore irrigated lands to enhance the livelihood of the grassroots level farmers and to meet the nation's goal of poverty alleviation.

5.7 Most water resources projects are designed and operated based on the historical pattern of hydrological parameters to estimate water availability, based on the historical records by assuming that same cyclical order or constant climatic behavior may occur. This assumption is no more applicable under the climate change impacts. The present and future trends of hydrological and meteorological parameters under new climate conditions can be investigated and appropriate adaptation strategies have to be implemented.

CHAPTER - 6
ENHANCING WATER AVAILABLE FOR USE

6.1 The availability of water resources and its use by various sectors in various basin, Regions and States, in the country need to be assessed scientifically and reviewed at periodic intervals, say, every five years. The trends in water availability due to various factors including climate change must be assessed and accounted for during water resources planning.

6.2 The river basin characteristics in Myanmar are quite variable due to the differences in Physiographic features. The principal watercourses flowing separately in Myanmar comprise four major rivers, the Ayeyarwady, Sittaung, Thanlwin, Chindwin, plus their major tributaries such as the Myittha, Mu, Zawgyi, Panlaung, Samon, Myitnge, Mone, Man, Salin, Yaw and Mindon. Their drainage area is spread widely over the country, amounting to the annual internal renewable freshwater resource 1,082 cubic kilometer of water volume

per annum. Of this, only about 3 to 5% of the nation's water wealth is utilizable through the present strategies, financial and technological capabilities. Thus, the availability of water is limited but the demand of water is increasing rapidly due to growing population, rapid urbanization, rapid industrialization and economic development. Therefore, availability of water for utilization needs to be augmented to meet increasing demands of water. Direct use of rainfall and avoidance of inadvertent evapo-transpiration are the new additional strategies for augmenting utilizable water resources.

6.3 There is a need to map the aquifers to know the total available quantity and quality of groundwater resources (replenishable as well as non-replenishable) in the country. This process should be fully participatory involving local communities. This may be periodically updated.

6.4 Declining groundwater levels in over-exploited areas need to be addressed, arrested by introducing improved technologies and understanding of water-use-knowledge, incentivizing efficient water use and encouraging community based management of aquifers. In addition, where necessary, artificial recharging projects should be undertaken to ensure that extraction is less than the recharge. This would allow the

aquifers to provide base flows to the surface system, and maintain ecology.

6.5 Integrated Watershed development activities with groundwater perspectives need to be taken in a comprehensive manner to increase soil moisture reduce sediment yield and increase overall land and water productivity. To the extent possible, existing traditional water collection techniques may be used by small holder farmers to harvest rain water using farm ponds and other soil and water conservation measures.

CHAPTER - 7
DEMAND MANAGEMENT AND WATER USE EFFICIENCY

7.1 A system to evolve benchmarks for water uses for different purposes, i.e., water footprints, and water auditing should be developed to promote and incentivize efficient use of water. The "project" and the "basin" water use efficiencies need to be improved through continuous water balance and water accounting studies. An institutional arrangement for promotion, regulation and evolving mechanisms for efficient use of waterat basin/ sub-basin level will be established for this purpose at the national level.

7.2 The project appraisal and environment impact assessment for water uses, particularly for industrial projects, should, inter-alia, include the analysis of the water footprints for the use.

7.3 Recycle and reuse of water, including return flows, should be the general norm.

7.4 Project financing should be structured to incentivize efficient and economic use of water and facilitate early completion of ongoing projects.

7.5 Water saving in irrigation use is of paramount importance. Methods like aligning cropping pattern with natural resource endowments, micro irrigation (drip, sprinkler, etc.), automated irrigation operation, evaporation transpiration reduction, etc., should be encouraged and incentivized. Recycling of canal seepage water through conjunctive groundwater use may also be considered.

7.6 Use of very small local level irrigation through small bunds, field ponds, agricultural and engineering methods and practices for watershed development, etc., need to be encouraged. However, their externalities, both positive and negative, like reduction of sediments and reduction of water availability, downstream, may be kept in view.

7.7 There should be concurrent mechanism involving users for monitoring if the water use pattern is causing problems like unacceptable depletion or building up of groundwaters, salinity, alkalinity or similar quality problems, etc., with a view to planning appropriate interventions.

CHAPTER- 8
WATER PRICING

8.1 For the pre-emptive and high priority uses of water for sustaining life and ecosystem for ensuring food security and supporting livelihood for the poor, the principle of differential pricing may have to be installed. Over and above these uses, water should increasingly be subjected to allocation and pricing on economic principles.

8.2 A Water Regulatory Authority (WRA) should be established under each Regional or State Government. The Authority, inter-alia, will fix and regulate the water tariff system and charges, in general, according to the principles stated in this National Water Policy in an autonomous manner. Such tariff will be periodically reviewed.

8.3 In order to meet equity, efficiency and economic principles, the water charges should preferably as a rule be determined on volumetric basis.

8.4 Recycle and reuse of water, after treatment to specified standards, should also be incentivized through a properly planned tariff system.

8.5 Water Users Associations (WUAs) should be given statutory powers to collect and retain a portion of water charges, manage the volumetric quantum of water allotted to them and maintain the distribution system in their jurisdiction. WUAs should be given the freedom to fix rates subject to floor rates determined by WRAs.

8.6 Unbalanced pricing of electricity incompatible with water pricing may lead to wasteful use of both electricity and water. This needs to be examined and carefully formulated. As an alternative, where limited groundwater use for agriculture at a subsidized cost is considered desirable, separate electric feeders for such a use should be considered.

CHAPTER - 9
CONSERVATION OF RIVER CORRIDORS, WATER BODIES AND INFRASTRUCTURE

9.1 Conservation of river corridors, water bodies and infrastructure should be undertaken in a scientifically planned manner through community participation. The storage capacities of water bodies and water courses and/or associated wetlands, the flood plains, ecological buffer and areas required for specific aesthetic recreational and/or social needs may be managed to the extent possible in an integrated manner to balance the flooding, environment and social issues as per prevalent laws.

9.2 Encroachments and diversion of water bodies (like rivers, lakes, tanks, ponds, etc.) and drainage channels (irrigated area as well as urban area drainage) must not be allowed, and

wherever it has taken place, it should be restored to the extent feasible and maintained properly.

9.3 Urban settlements, encroachments and any developmental activities in the protected upstream areas of reservoirs/water bodies, (potential) key aquifer recharge areas that pose a potential threat of contamination, pollution, reduced recharge and those endanger wild and human life should be strictly regulated.

9.4 Environmental needs of aquatic eco-system, wet lands and embanked flood plains need to be recognized and taken into consideration while planning.

9.5 Sources of water and water bodies including marine water should not be allowed to get polluted. System of third party periodic inspection should be evolved and stringent punitive actions be taken against the persons responsible for pollution.

9.6 Quality conservation and improvements are even more important for groundwaters, since cleaning up is very difficult. It needs to be ensured that industrial effluents, local cesspools, residues of fertilizers and chemicals, etc., do not reach the groundwater.

9.7 The water resources infrastructure should be maintained properly to continue to get the intended benefits. A suitable

percentage of the costs of infrastructure development may be set aside along with collected water charges, for repair and maintenance. Contract for construction of projects should have inbuilt provision for longer periods of proper maintenance and handing over back the infrastructure in good condition.

9.8 Legally empowered dam safety services need to be ensured in the States and Regions as well as in Union level. Appropriate safety measures, including downstreamflood management, for each Dam should be undertaken on top priority.

9.9 When the situation calls for crucial need of detention storage to flood water at the upstream of a critical region such as massive business area, early warning notify by the local authorities is required to save the valuable assets at the downstream.

9.10 Local government may need to notify the scopes of river reserves identified by hydraulic and social requirements such as for flood plain management and ecological corridor.

9.11 During the past years, significant numbers of river crossing structures as bridges and culverts were washed away causing disruption of transportation due to infrequent floods. It is important to notify relevant design flood magnitudes for drainage crossing structures that must be undertaken by the

responsible departments or private entities to prevent from such kind of infrastructure damage.

9.12 Sea water and coastal water, with their related natural activities are part of national water resources and should be tackled by a specialist group of experts of NWRC including international dealing.

CHAPTER - 10

PROJECT PLANNING AND IMPLEMENTATION

10.1 Considering the existing water stress conditions in Myanmar and the likelihood of further worsening situation due to climate change and other factors, water resources projects should be planned as per the efficiency benchmarks to be prescribed for various situations.

10.2 Being inter-disciplinary in nature, water resources projects should be planned considering social and environmental aspects also in addition to techno-economic considerations in consultation with project affected and beneficiary families. The integrated water resources management with emphasis on finding reasonable and generally acceptable solutions for most of the stakeholders should be followed for planning and management of water resources projects.

10.3 Considering the heavy economic loss due to delay in implementation of projects, all clearances, including

environmental and investment clearances, be made time bound.

10.4 Concurrent monitoring at project, Region and State, and National levels should be undertaken for timely interventions to avoid time and cost over-runs.

10.5 All components of water resources projects should be planned and executed in a *paripassu* manner so that intended benefits start accruing immediately and there is no gap between potential created and potential utilized.

10.6 Local governing bodies like WRAs, Municipalities, Corporations, etc., and Water Users Associations, wherever applicable, should be involved in planning of the projects.

10.7 All water resources projects, including hydropower projects, should be planned to the extent feasible as multi-purpose projects with provision of storage to derive maximum benefit from available topology and water resources.

10.8 Big infrastructure projects must establish "Ecosystem Compensation Fund", in addition to social compensations, to be used for ecosystem management, freshwater protected areas and flood control measures in the areas altered or impacted by the large scale projects.

CHAPTER - 11
MANAGEMENT OF FLOOD, DROUGHT AND EXTREME-WEATHER EVENTS

11.1 While every effort should be made to avert water related disasters like floods and droughts, through structural and nonstructural measures, emphasis should be on preparedness for flood/ drought with coping mechanisms as an option. Greater emphasis should be placed on rehabilitation of natural and urban drainage systems.

11.2 Land, soil, energy and water management with scientific inputs from local, research and scientific institutions should be used to evolve different agricultural strategies and improve soil and water productivity to manage droughts. Integrated farming systems and nonagricultural developments may also be considered for livelihood support and poverty alleviation.

11.3 In order to prevent loss of land eroded by the river, which causes permanent loss, revetments, spurs, embankments, etc., should be planned, executed, monitored and maintained on

the basis of morphological studies. This will become increasingly more important, since climate change is likely to increase the rainfall intensity, and hence, soil erosion. Peoples who lost their houses due to river bank erosion should be given a new place to live and helped by livelihood development trainings.

11.4 Flood forecasting is very important for flood preparedness and should be expanded extensively all across the country and modernized using real time data acquisition system and linked to forecasting models with the aid of GIS remote sensing technologies. Efforts should be combined with field studies for various basin sections, which should be linked to each other and to medium range weather forecasts to enhance lead time.

11.5 Operating procedures for reservoirs should be evolved and implemented in such a manner to have flood cushion and to reduce trapping of sediment during flood season. These procedures should be based on sound decision support system.

11.6 Protecting all areas prone to floods and droughts may not be practicable; hence, methods for coping with floods and droughts have to be encouraged. Frequency based flood inundation maps should be prepared to evolve coping strategies, including preparedness to supply safe water during

and immediately after flood events. Communities need to be involved in preparing an action plan for dealing with the flood/drought/cyclone situations.

11.7 To increase preparedness for sudden and unexpected flood related disasters, dam and/or embankment break studies, as also preparation and periodic updating of emergency action plans / disaster management plans should be evolved after involving affected communities. In hilly reaches, glacial lake outburst flood and landslide dam break floods studies with periodic monitoring along with instrumentation, etc., should be carried out.

CHAPTER - 12
WATER SUPPLY AND SANITATION

12.1 There is a need to remove the large disparity between stipulations for water supply in urban areas and in rural areas. Efforts should be made to provide improved water supply in rural areas with proper sewerage facilities. Least water intensive sanitation and sewerage systems with decentralized sewage treatment plants should be incentivized.

12.2 Urban domestic water supplies should preferably be from surface water. Where alternate supplies are available, a source with better reliability and quality needs to be assigned to domestic water supply. Exchange of sources between uses, giving preference to domestic water supply should be possible. Also, reuse of urban water effluents from kitchens and bathrooms, after primary treatment, in flush toilets should be encouraged.

12.3 Urban domestic water systems need to collect and publish water accounts and water audit reports indicating leakages

and pilferages, which should be reduced taking into due consideration social issues.

12.4 In urban and industrial areas, rainwater harvesting and de-salinization, wherever techno-economically feasible, should be encouraged to increase availability of utilizable water. Implementation of rainwater harvesting should include scientific monitoring of parameters like hydrogeology, groundwater contamination, and growth of vectors, pollution and spring discharges.

12.5 Urban water supply and sewage treatment schemes should be integrated and executed simultaneously. Water supply bills should include sewerage charges.

12.6 Industries in water short regions may be allowed to either withdraw only the makeup water or should have an obligation to return treated effluent to a specified standard back to the hydrologic system. Tendencies to unnecessarily use more water within the plant to avoid treatment or to pollute groundwater need to be prevented.

12.7 Subsidies and incentives should be implemented to encourage recovery of industrial pollutants and recycling / reuse, which are otherwise capital intensive.

CHAPTER -13

INSTITUTIONAL ARRANGEMENTS

13.1 There should be a forum at the national level to deliberate upon issues relating to water and evolve consensus, co-operation and reconciliation amongst party Regions and States. A similar mechanism should be established within each Region and State to amicably resolve differences in competing demands for water amongst different users of water, as also between different parts of the Region or State.

13.2 A permanent Water Disputes Tribunal at the Union Level under the auspices of National Water Resources Committee should be established to resolve the disputes expeditiously in an equitable manner. Apart from using the "good offices of the Union or the Regional and State Governments, as the case may be, the paths of Arbitration and Mediation may also to be tried in dispute resolution.

13.3 Water resources projects and services should be managed with community participation. Wherever the Regional or State Governments or local governing bodies so decide, the

private sector can be encouraged to become a service provider in public private partnership model to meet agreed terms of service delivery, including penalties for failure.

13.4 Integrated Water Resources Management (IWRM) taking river basin / sub-basin as a unit should be the main principle for planning, development and management of water resources. The departments / organizations at Union/ Regional or State Governments levels should be restructured and made multi-disciplinary accordingly.

13.5 Appropriate institutional arrangements for each river basin should be developed to collect and collate all data on regular basis with regard to rainfall, river flows, area irrigated by crops and by source, utilizations for various uses by both surface and groundwater and to publish water accounts on the daily basis every year for each river basin with appropriate water budgets and water accounts based on the hydrologic balances. In addition, water budgeting and water accounting should be carried out for each aquifers.

13.6 Appropriate institutional arrangements for each river basin should also be developed for monitoring water quality in both surface and groundwaters.

13.7 Regions or States should be encouraged and incentivized to undertake reforms and progressive measures for innovations, conservation and efficient utilization of water resources.

13.8 NWRC should be a legislative body in national water sector and should have authorization of the government to play a significant role in any national/state level water use (scheme or programme) of consumptive or non-consumptive nature. Water laws, regulations, and standards need to be complemented by legislations related to environmental sanitation.

13.9 NWRC will have to liaise (officially) with local NGOS, INGOs, national and international governmental agencies and organizations for close cooperation in water resources and related affairs.

CHAPTER - 14
TRANSBOUNDARY RIVERS AND INTERNATIONAL COOPERATION

14.1 Even while accepting the principle of basin as a unit of development, on the basis of practicability and easy implement ability, efforts should be made to enter into international agreements with neighboring countries on bilateral basis for exchange of hydrological data of international rivers on near real time basis.

14.2 Negotiations about sharing and management of water of international rivers should be done on bilateral basis in consultative association with riparian States keeping paramount national interests. Adequate institutional arrangements at the National (Union) level should be set up to Implement international agreements.

14.3 Since Myanmar shares Border Rivers and Tran boundary Rivers with neighboring countries, Myanmar must observe

the International Water Laws and so also NWRC must make available itself whenever necessary.

14.4 Myanmar should play an active role in international water conventions, treaties and water cooperation.

CHAPTER - 15
DATABASE AND INFORMATION SYSTEM

15.1 All hydrological data, other than those classified on national security consideration, should be in public domain. However, a periodic review for further declassification of data may be carried out. National Water Informatics Center (or National Hydro informatics Center) should be established to collect, collate and process relevant hydrologic and water resources data regularly from various data sources such as DMH (Department of Meteorology and Hydrology), Irrigation Department, etc., conduct the preliminary processing, and maintain in open and transparent manner on a GIS platform.

15.2 In view of the likely climate change, much more data about snow and glaciers, evaporation, tidal hydrology and hydraulics, river geometry changes, erosion, sedimentation, etc. needs to be collected in addition to the usual data collection by the Department of Meteorology and Hydrology

under the Ministry of Transportation. A programme of such data collection needs to be developed and implemented.

15.3 NWRC should take up the role of a watchdog body and do check and balance in use of both surface and groundwaters. NWRC, in handling such water management will face complicated situation(s) since private sector is involved on a major scale in water use.

15.4 NWRC, in anticipation of such tight water situation, should start making water allocation laws governing water use of both public and private sectors by consumptive or non-consumptive ways. Detailed current situation of water use by both sectors, including river basins and sub-basins and groundwater basins, must be known by NWRC, collected as relevant databanks.

15.5 All water related data, like rainfall, snowfall (around HkakaboRazi mountain), geo-morphological, climatic, geological, surface water, groundwater, storm surges, water quality, sea levels, ecological, water extraction and use, irrigated area, glaciers, etc., should be integrated with well defined procedures, formats and data architecture compatible with international standards to ensure online updating and transfer of data to facilitate development of database for

informed decision-making in the effective management of water.

15.6 In order to promote efficient planning and implementation of water resources development projects, an IWRM (Integrated Water Resources Management) related water data banks in structured categories should be established inside the National Water Informatics Center (or National Hydroinformatics Center), which is the decision support system pillar of the NWRC. The other two pillars are the national level water Advisory Group of the NWRC and the Secretariat of the NWRC. The National Water Informatics Center should be placed under the focal ministry of NWRC, however, directly sponsored by the President Office and National Water Resources Committee (NWRC). The aim is to provide reliable and relevant water resources data through hydro informatics and web-based technology. The Hydroinformatics Center will be the real-time water operation center and control room to support various decision makers to reach well-informed, science-based decisions over and on top of political and economic considerations.

CHAPTER - 16
RESEARCH AND CAPACITY DEVELOPMENT NEEDS

16.1 Continuing research and advancement in technology shall be promoted to address the issues in water sector in a scientific manner. Innovations in water resources sector should be encouraged, recognized and awarded. Research in water policy should also be conducted to evaluate impacts of policy decisions and to evolve policy directives for changing scenario of water resources.

16.2 Research topics related to physical and socio-economical impacts of climate change in Myanmar with special focus on water resources should be addressed. It is necessary to research the socio-economic impacts of climate change through the analysis of impacts on agriculture, food security, health, hygiene and sanitation, water balance situation, hydropower and ecosystems sustainability. Flood hazard mapping is very instrumental in saving lives and properties against flood disaster.

16.3 It is necessary to give adequate grants to the Regions and States to update technology, design practices, planning and management practices, preparation of annual water balances and accounts for the site and basin, preparation of hydrologic balances for water systems, and benchmarking and performance evaluation.

16.4 It needs to be recognized that the field practices in water sector in advanced countries have been revolutionized by advances in information technology and analytical capabilities. A retraining and quality improvement programme for water planners and managers at all levels in Myanmar, both in private and public sectors, needs to be undertaken.

16.5 To meet the need of the skilled manpower in the water sector, regular training and academic courses in water management should be promoted. These training and academic institutions be regularly updated by developing infrastructure and promoting applied research, which would help to improve the current procedures of analysis and informed decision making in the relevant Ministries, line agencies and departments, and by the community.

16.6 A national campaign for water literacy needs to be started for capacity building of different stakeholders in the water sector in line with the education sector reform in Myanmar.

16.7 National Water Informatics and Operation Center (Hydroinformatics Center) should undertake the responsibility of the tasks mentioned in Chapter 14 and 15.

CHAPTER -17
IMPLEMENTATION OF
MYANMAR NATIONAL WATER POLICY

17.1 National Water Expert Group (National Water Think Tank) should prepare a plan of action based on the National Water Policy, as approved by the National Water Resources Committee, and to regularly monitor its implementation.

17.2 The State Water Policies may need to be drafted, and time to time revised, in accordance with the National Water Policy keeping in mind the basic concerns and principles as also a unified national perspective.

17.3 Every implementation should be executed with the spirit that every citizen has a right to national water and long term sustainability of Myanmar National Water(s) should be considered with appropriate safeguards and measures.