First Priority Level Sector's top Priority Adaptation Projects for implementation in Myanmar

Sector/Theme	Priority Adaptation Project Title
FIRST PRIORITY LEVEL SECTORS: Agriculture, Early Warning Systems and Forest	
AGRICULTURE	**First priority:** Enhanced rice production through farm mechanisation and breeding new rice varieties to ensure food security in areas most vulnerable to climate change.
	Second priority: Increased climate change resilience of rural and subsistence farmers in the Dry and Hilly Zones through legume crop diversification and climate-resilient varieties.
	Third priority: Increasing the climate change resilience of Dry Zone communities by diversifying and intensifying home-gardens through solar-power technology, high-income fruit crops and climate-smart agriculture approaches.
	Fourth priority: Reducing the vulnerability of livelihoods in agro-ecological zones to climate change through the transfer of a wide range of high-yielding and climate-resilient rice varieties.
EARLY WARNING SYSTEMS	**First priority:** Improving weather observation capacity through a mobile/deployable weather radar system for providing early warning systems against extreme weather events.
	Second priority: Developing a flood early warning system for reducing the vulnerability of local communities to climate change impacts.
	Third priority: Assessing the hydrological impact of climate change on river systems.
	Fourth priority: Developing a drought early warning system for reducing the vulnerability of local communities to climate change impacts.
FOREST	**First priority:** Building the resilience of degraded/sensitive forest areas to climate change impacts through reforestation.
	Second priority: Community-based reforestation for climate-resilient ecosystems and rural livelihoods in degraded watershed areas of the Central Dry Zone.
	Third priority: Community-based mangrove restoration for climate-resilient ecosystems and rural livelihoods in vulnerable and degraded coastal regions.
	Fourth priority: Enhancing the climate change resilience of rural livelihoods through community-based restoration at the Indawgyi and Inle Lake watershed areas in the Northern Hilly Region.

Report of Assessment on Integration Water Security and Climate Resilience Aspects to Myanmar National Water Policy

(Prepared by Working Group of WACDEP Myanmar)

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Myanmar National Water Policy to Integrate Water Security and Climate Resilience Aspects

1. Background Information

There are 3 activities to be carried out by Working Group of WACDEP Myanmar for the year 2014. They are:

(1) Assessment of the "Current Situation of Water Security and Climate Resilience Aspects in Myanmar",

(2)To develop a draft report of "Assessment on Myanmar National Water Policy to Integrate Water Security and Climate Resilience Aspects" and

(3)To finalize the above mentioned draft assessment report.

The information suggested by GWP in its letter received in August 2014 is:

(a) To investigate the present water policy having in mind its general objectives and recommend any suggestions considered appropriate

(b) To make recommendations as to the value of integrating water security and climate resilience

(c) To develop draft assessment plan as to how the activities should be shared between the government departments and other interested agencies of the water sector, and

(d) To formulate water security plan taking into account with a program of climate resilience that would make maximum benefit to the state.

In view of the significance of abundant water resources in Myanmar, we would like to emphasize the need for their assessment to derive the maximum benefit from them. Human resources development and gender mainstreaming are highlighted to ensure that the appropriate personnel are recruited, adequately trained,and then retained. It is hoped that this assessment would be of some value to Myanmar water sector.

THIRD PRIORITY LEVEL SECTOR: Coastal Zone	
ENERGY AND INDUSTRY	**First priority:** Enhancing the resilience of water supplies in the face of climate change for rural communities through solar powered water purification and irrigation pumping systems.
	Second priority: Enhancing the resilience of sanitation in the Shan Region to climate change impacts through solar powered aerobic septic tanks.
	Third priority: Increasing climate change resilience of rural communities in the Sagaing, Mandalay and Ayeyarwady Regions by increasing livelihood opportunities through renewable solar electricity systems.
	Fourth priority: Increasing climate-resilience of harvested seed/grains through heated-air mechanical drying technologies.
BIODIVERSITY	**First priority:** Buffering marine habitats and sustaining fish populations under climate change conditions through community-based MPA management and ecosystem sensitive fishery practices at the Sister Group Islands of the Myeik Archipelago.
	Second priority: Mainstreaming ecosystem-based climate change adaptation for buffering rural communities against climate change impacts into policy, planning and relevant projects.
	Third priority: Buffering marine habitats and sustaining fish populations under climate change conditions through community-based MPA management and ecosystem sensitive fishery practices at WetthayChaing (bay) coastal area.
	Fourth priority: Buffering marine habitats and sustaining fish populations under climate change conditions through community-based MPA management and ecosystem sensitive fishery practices at the Thameehla Island, Ayeyarwady Region.

SECOND PRIORITY LEVEL SECTORS: Public Health and Water Resources	
PUBLIC HEALTH	**First priority:** Adaptation to climate change through climate-resilient health facilities in the Rakhine State and Ayeyarwady Region.
	Second priority: Integrating climate change adaptation strategies into the prevention of heat- related disorders in agricultural and industrial workers.
	Third priority: Supporting Intensive Care Units (ICU) in hospitals to treat heat-related disorders.
	Fourth priority: Reducing the vulnerability of local communities to climate-induced water-related health hazards through the provision of safe water supplies and sanitary latrines.
WATER RESOURCES	**First priority:** Assessing the status of dams for providing sustainable water supplies and withstanding flood risks under future climate change.
	Second priority: Constructing small-scale water impoundments in Naypyidaw for flood control and increasing water supplies for local communities.
	Third priority: Protecting human life and property against climate extremes in the Ayeyarwady river system through channel improvement and adaptation structures.
	Fourth priority: Estimating regional rainfall-runoff relationships for supporting the development of flood early warning systems and ensuring sustainable water management.
THIRD PRIORITY LEVEL SECTOR: Coastal Zone	
COASTAL ZONE	**First priority:** Adaptation to climate change through Integrated Coastal Zone Management (ICZM).
	Second priority: Community-based mangrove reforestation for building climate-resilient ecosystems and rural livelihoods in degraded coastal areas in the Rakhine State.
	Third priority: Community based eco-friendly aquaculture systems (e.g. mudcrab, clam, shrimp and tilapia) for enhancing the climate change resilience of rural livelihoods and supporting the recovery of mangrove forest ecosystems.
	Fourth priority: Small-scale aquaculture and mangrove buffers demonstration sites for transferring adaptation technologies to Mon and Tanintharyi coastal communities.

This assessment was supported by GWP and information for the assessment was gathered and written during August & September 2014.

The draft assessment is primarily in 2 parts: (1) contains the review of data and reports of relevant departments in conjunction with the relation between water and climate change of the country and (2) covers the "Draft Report of Assessment on Myanmar National Water Policy (MNWP) to Integrate Water Security and Climate Resilience Aspects".

Myanmar Water Partnership (MmWP) has to be held several consultative meetings with the associated partners to accomplish the target up to the end of this year. With the aid of these meetings, WACDEP (Water, Climate and Development Program) objectives will be accomplished as much as possible.

Action plan will be presented in 2015 based on all the aspects depend upon the great magnitude and significance of the water resources of the country and the current state of its development.

During the course of the assessment, a draft proposal for a water security issues and strategies will also be presented.

The various Agencies and Departments being engaged in water sector are as follows:

(1) Irrigation Department (ID) under Ministry of Agriculture and Irrigation MoAI: responsible for the construction and maintenance of irrigation, flood protection and drainage works. Responsible also for collection of climatologic and hydrologic data for project oriented basis.

(2) Water Resources Utilization Department (WRUD) under Ministry of Agriculture and Irrigation MoAI: responsible for implementation of pump, sprinkler and drip irrigation. Also responsible for irrigation with surface water (river water), ground water and spring sources, sinking of tube wells for drinking purpose in rural areas.

(3) Department of Meteorology and Hydrology (DMH) under Ministry of Transport MoT: responsible for the provision of weather forecasting and collection of hydrological data of main rivers for water level prediction.

(4) Directorate of Water Resources and Improvement of River Systems (DWIR) under Ministry of Transport MoT: responsible for the water resources, river training and navigation purposes.

(5) Department of Human Settlement and Housing Development (DHSHD) under Ministry of Construction MoC: responsible for design and construction of water supply for government building of the towns and responsible also for ground water extraction rules and regulation.

(6) Department of Health (DoH) under Ministry of Health MoH: responsible for drinking and domestic water quality assessment and responsible for rural sanitation program.

(7) Department of Hydropower Implementation (DHPI) under Ministry of Electric Power MoEP: responsible for construction of dams with hydropower generation.

(8) Environmental ConservationDepartment (ECD) and Forest Department (FD) under Ministry of Environmental Conservation and Forestry MoECaF: responsible for environmental concerned and watershed management.

(9) Department of Rural Development (DRD) under the Ministry of Livestock, Fishery and Rural Development MoLFRD: responsible for rural water supply.

Some importantCommittees related to water sector are briefly summarized as follows:

(1) National Adaptation Programs of Action (NAPA) to climate changewas launched in 2009 with the funding of UNEP and published a report in 2012.

(2) National Commission on Environmental Affairs under Ministry of Foreign Affairs was renamed as Environmental Conservation Department and transferred to a new Ministry which is known as Ministry of Environmental Conservation and Forestry (previously it was Ministry of Forestry) in 2012. Myanmar Environmental Conservation Law was formulated in 2012.

The adaptation measures for various sectors;

Sector/Theme	Priority Adaptation Project Title
FIRST PRIORITY LEVEL SECTORS: Agriculture, Early Warning Systems and Forest	
AGRICULTURE	**First priority:**Reduced climate change vulnerability of rural and subsistence farmers through locally relevant technologies, climate-resilient rice varieties, and ex/in-situ conservation of plant genetic resources.
	Second priority: Increased climate change resilience of rural and subsistence farmers in the Dry and Hilly Zones through legume crop diversification and climate-resilient varieties.
	Third priority: Increasing the climate change resilience of Dry Zone communities by diversifying and intensifying home-gardens through solar-power technology, high-income fruit crops and climate-smart agriculture approaches.
	Fourth priority: Reducing the vulnerability of livelihoods in agro-ecological zones to climate change through the transfer of a wide range of high-yielding and climate-resilient rice varieties.
EARLY WARNING SYSTEMS	**First priority:** Improving weather observation capacity through a mobile/deployable weather radar system for providing early warning systems against extreme weather events.
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	Second priority: Community-based reforestation for climate-resilient ecosystems and rural livelihoods in degraded watershed areas of the Central Dry Zone.
	Third priority: Community-based mangrove restoration for climate-resilient ecosystems and rural livelihoods in vulnerable and degraded coastal regions.
	Fourth priority: Enhancing the climate change resilience of rural livelihoods through community-based restoration at the Indawgyi and Inle Lake watershed areas in the Northern Hilly Region.

Appendix

(3) Myanmar National Committee on Large Dams (MNCOLD) was established under the focal Ministry of Agriculture and Irrigation and Ministry of Electric Power in 2013.

(4) Myanmar Engineering Council was established with the Ministry of Construction as a focal institution in 2013.

(5) National Water Resources Committee (NWRC) was established with the consent of the Government in 2013 with the Ministry of Transport as focal. NWRC published the Myanmar National Water Policy (MNWP) in February 2014.

(6) A unified water law is not yet established. There are several laws, acts and regulations related to water sector. Most of them are not relevant and need to be reviewed and amended to become a unified law to meet the present day situation. There are many deficiencies in water sector such as limited manpower, insufficient financial resources, lack of appropriate monitoring facilities, proper and systematic upkeep of records, regular monitoring of groundwater quantity and quality, surveillance study for water retaining structures and so on. All these weakness should be reviewed for the materialization of the unified water law. Initiation of unified water law is in progress using the way of introducing the National Water Framework Directive. It is being carried out by NWRC.

(7) Myanmar became a member of Extractive Industries Transparency Initiatives (EITI) in 2014. EITI included the study of extraction of gas, oil and minerals.

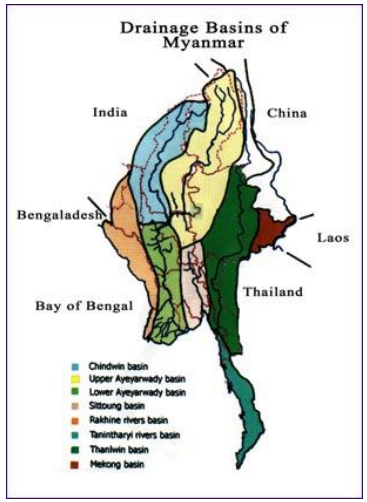
(8) Launching of “Myanmar Land Use Policy” underLand Use Allocation and Scrutinizing Committee of Ministry of Environmental Conservation and Forestry is in progress.

The Myanmar National Water Policy was illustrated the importance of the present scenario of water resources and their management in Myanmar, has given to coverforseveral sectors related with water such as livelihood, food security, water scarcity and pollution, integrated water resources management (IWRM), disasters, irrigation, fishery, energy and so on.

The present assessment will be addressed and highlighted the Myanmar National Water Policy focusing mainly to integrate Water Security and Climate Resilience Aspects.

2.**Introduction, Goal, Vision, Mission and Objectives**

The introduction of MNWP is covering a wide range of water related subjects to a cognizance of the existing situation to propose a frameworkfor creation of a unified water law together with lots of facts and information of water. The MNWP described the country profile, goal, vision and mission briefly, and presented the main objectives in detail.



It is suggested that there are some points like a brief country description about Myanmar should be presented together with climate, number of basins and water resources potential such as:

Myanmar has tropical monsoon climate with three distinct seasons namely summer, rainy and cold seasons. About 90% of the rain received during rainy season. Annual rainfall ranges from 750 mm in the central dry zone to 1500 mm in the eastern and western mountains and 4000 mm to 5000mm in the coastal regions. It has the total area of about 700,000 km^2. It extends 2090 km from north to south and 925 km from east to west at its widest point. Myanmar shares international borders with Bangladesh, India, China, Laos and Thailand.

(1) There are 8 major river basins and the catchment area of these basins cover about 90% of the country's territory. These basins contribute 1082 km^3 of surface water, 495km^3 of ground water potential and 28 km^3 of renewable ground water annually in Myanmar.

- "Background paper for development policy options in Myanmar-Agriculture development Issues and Strategies", UNDP and ARDC, 2011
- "Regional CSOs Dialogue on Water Resources Management and Climate Change Adaption in the Mekong Basin", Bangkok, 2012
- "Vulnerability and Resilience Assessment of Ayeyarwady Delta, Myanmar", Delta Alliance Report, December 2013
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- "Myanmar's perspectives on IWRM " by U Khin Maung Nyunt, Advisor, MoAI, 2006
- "National Water Policy for Cambodia", ADB, 2001
- "India National Water Policy, 2002", International Commission on Irrigation and Drainage, India, 2002
- "Myanmar Millennium Development Goals Report" 2005, Union of Myanmar
- "Myanmar Agenda 21", NCEA, Yangon, 1997
- "Children and Women in Myanmar, A Situation Assessment and Analysis 1999", UNICEF,1999

(2) Nowadays, Myanmar has reached a serious turning point in the use of water resources in an effective, efficient and equitable manner.

(3) Women participation should be upgraded in water sector. Women play an important role in providing, managing and safe guarding water. Gender mainstreaming efforts should be provided in water management.

*The MNWP stated the **Goal** is to apply IWRM and develop, share and manage in sustainable manner. The **Vision** is that Myanmar will become a water efficient nation based on IWRM by the year 2020. The **Mission** is to implement Water Policy to all the Agencies of water sector to further develop respective rules and regulations. The **Objectives**covered8 numbers with 10 guidelines principles and 11 strategies.*

*The MNWP vision statement is based on short term arrangement and there was a Myanmar Water Vision which was formulated with long term strategy in 2003 in cooperation with UN-ESCAP, FAO and Irrigation Department with the participation of all the stakeholders. The following points are suggested to incorporate long term **Vision** together with the **Principles**.*

"By the year 2030, the country will have an attainment of sustainability of water resources to ensure sufficient water quantity of acceptable quality to meet the needs of people of country in terms of health, food security, economy and environment".

The fundamental principles to achieving the Vision are:

- Water is a prime natural resource, a basic human need and a pr**e**cious national asset.
- All water and water resources, and the beds and banks of watercourses and water bodies, wet lands are vested in the state.
- Drainage basins and aquifers are the fundamental units of water resources management, because these are where water naturally collects and flows. Water as a resource is one and indivisible: rainfall, river waters, surface ponds and lakes and ground water are all part of one system.

- Fresh water is a finite and vulnerable resource, essential to sustain all life forms, human development and the environment.
- Where it is naturally available, all people have the right to sufficient water for drinking, hygiene, and growing their food.
- High quality water is an increasingly scarce commodity, and it should be recognized and managed as an economic goods. Planning, development and management of water resources need to be governed by national perspective.

3. Climate Change and Global Warming

The MNWP indicated that climate change is likely to increase the variability of water resources affecting human health and livelihoods. Special impetus should be given towards mitigation at micro level by enhancing the capabilities of community to adopt climate resilient technological options.

A UN panel on climate change at Copenhagen in November 2014 stated that Climate Change is caused by human activities, which is related with global warming. Continued emission of Greenhouse Gas (GHG) adversely effects to global warming and long-lasting changes in all components of the climate system. Under this heading there is not much to be discussed, but GHG emission concerning with global warming is suggested as follow:

(1) Major sources of GHG cover carbon dioxide (CO_2), methane (CH_4) and nitrous oxide(N_2O). The main source of GHG is fossil fuel combustion.
Deforestation and forest depletion processes may become increasing of carbon emissions. Forests should be properly managed for carbon sink and to get more for carbon credit.
It was learnt that carbon dioxide (CO_2) content in the beginning of 19th century was 270 ppm. Annual report issued by World Meteorological Organization (WMO) on 9th September 2014 stated that CO_2 content in the atmosphere had reached 396 ppm in 2013, which is the highest value after 30 years of study period.

12. Conclusion

(1) To ensure water security, the activities such as water related disaster risks reduction,good water governance, promoting Green Economy and Green Growth through IWRM should be carried out.

(2) All kinds of Myanmar natural resources have been depleting due to many ways of exploitation. To prevent this, Myanmar submitted application to become a member of Extractive Industries Transparency Initiative (EITI) in May 2014. Now Myanmar has been recognized as the 45th candidate country by EITI board on 2nd July 2014. Now Myanmar has to use EITI to ensure that these natural resources such as gas, oil and minerals are developed and managed in a transparent manner for the sustainable benefit of the people. The extraction of these natural resources could harm the quantity and quality of water in one way or the other.

(3) The adverse impacts of the climate change have also sped up the disruption of livelihoods of the people who are dependent on forestry, agriculture, fishery and live stocks all of which are very vulnerable to climate extremes.

(4) As adaptation programmes, promoting of intensive reforestation, fostering agriculture research activities, enhancing livestock management, switching from fossils fuel to renewable energy sources such as hydro, solar and wind power should be intensified.

(5) There are limitations in term of resource sharing, human resource development, institutional capabilities and public awareness, are important issues to overcome.

(6) Both for short term and long term Action Plan should be prepared, considering issues and strategies for MNWP focusing on Water Security and Climate Resilience.

With the participation of resource persons and Myanmar water partnership member agencies, the projects mentioned in NAPA should be prioritized and they are attached as an appendix of this report.

(4) Urbanization and Water Security

(a)Reliable source of water supply should be investigated in advance to get the solution for cities of future expansion.

(b)Cities of the future will experience difficulties in managing scarce and unreliable water supplies.

(c)To initiate water for reuse and recycling

(d) Urban water development Master Plan should be carried out for cities like Yangon and Mandalay highlighting water supply, sanitation, pollution control and urban drainage.

(5) Ecosystem and Water Security

(a)To protect rainforests effectively because they play an essential role for ecosystem, regulate flows, purify water, replenish water, modulate climate, protect soils and reduce the risks of water related disasters.

(b) To protect mangrove forests is also important for the ecosystem in coastal zone and to deter storm surge and Tsunami threat.

(c) To conserve forests and prevent degraded ecosystem for the reduction of impact on both water availability and water quality.

(6)Trans-boundary Water Security

Unpredictable risks caused by climate change and environmental degradation with scarce water resources those flow in trans-boundary nature can grow tension over riparian countries. The following points should be considered.

(a) Benefits of trans-boundary watercourses are to be shared equitably among riparian nations.
(b) International water laws should follow among nations if there is a conflict especially over fresh water which is essential and limited.
(c) Conflicts should be solved with mutual respect and understanding. It could lead countries to clash for a project on prioritization components such as hydroelectric power and irrigation.

GHG removal in Myanmar is showing constant decline because of forest degradation and the trend of GHG emission is increasing both in the short term as well as in the long run.

(2) The importance of forestry sector should not be ignored. The forest cover throughout the country is degradation with an alarming rate. Forest cover status in 2010 was 47% with the participation of 20% full canopy cover. Legal or illegal logging should be restricted with law enforcement program. Log Export Ban (LEB) was enacted by the Government since 1st April 2014. Afforestation and reforestation activities are to be ensured and strengthened. (Ref:- Mirror Daily Newspaper dated 27th April 2014)

(3) Development of wood-base industry should be strictly followed the rules and regulations to promote more value-added commodities in order to augment Foreign Exchange earnings.
   (a) It is important to achieve Sustainable Forest Management (SFM) program and to foster communication between foresters, water professionals, decision makers and public.
   (b) Improvement of tree species and stands, natural regeneration, conservation of natural forests, community forestry, agro-forestry, private forest plantation and use of forest products on sustained basis should be upgraded.

4. Water Allocation,Water Sector Profile and Water Pricing Policy

(1) Water Allocation and Water Sector Profile

The MNWPhas highlighted to keep environmental flows in the river system and water harvesting campaign should be strengthened throughout the country.

(a) A portion of river flow (environmental flow) should be kept aside to meet ecological needs.

(b) The different kinds of water infrastructure may also need for the navigability of Ayeyarwady River.

(c) Rain water harvesting campaign should be strengthened across the country.It also stated the allocated water in the following order of priority:

i. Drinking water
ii. Water for urban and rural sanitation
iii. Water for food security
iv. Water for other uses

After assessing the MNWP water allocation study, it is suggested that the following points are to be considered prioritizing on sector wise basis.

1. Presently, water allocation of the country's vast water resources are prioritized in order as drinking and domestic water, agriculture, industrial needs including hydropower generation and other needs such as transportation, recreation, etc. as per "30 years Agricultural Master Plan" by MoAI in 2000. Allocation should be re-scrutinized and well defined by the Government and required to review from time to time to prioritize the allocation with sector wise basis.
2. 2003 study for water sector profile indicated that about 90% of the water use is from agriculture, 6% from domestic consumption, 3% from industry and some percentage for other uses could have been provided. Reassessment should be undertaken to register the withdrawals by different sectors.

(2) Water Pricing Policy

The MNWPexpressed broadly to fix water tariff system locally both for irrigation and drinking water as shown below:

(a) The principle of differential pricing may have to install for drinking and domestic water supply. Water should be allocated on economic principle for other use.

(b) A Water Regulatory Authority (WRA) should be established under each regional or State Government to fix water tariff system. Such tariff should be periodically reviewed.

(c) Water charges should be determined on volumetric basis.

(2)Energy and Water Security

The power demand has increased year after year due to development ofindustrial sector. The installed capacity in 2013-14 is 2,919 MW and it is projected to increase 23,594 MW by the year 2030. National electrification target is to meet the coverage for all households by 2030. According to the plan, there are altogether 53 numbers of hydropower projects with installed capacity of 41,675 MW throughout the country. The following points are to be considered between energy and water security.

(a)Energy is required for pumping water, desalination processes, and water treatment plants. Demand should meet the supply.

(b)Integration of food security with the water and energy nexus will be essential.

(c)To generate energy and nutrients from wastewater.

(3)Health and Water Security

(a)People have enough, safe and clean water to lead a healthy and productive life.Adequate water supply and proper sanitation are essential to public health.

(b)The incidence of water-borne pollution and related infectious diseases such as malaria or dengue shouldbe prevented by integrating measures with adequate water and sanitation facilities.

(c) Industrial zones should be set apart from residential and commercial areas. Improper use of chemical, pesticides, fertilizers, industrial effluents and other contaminants should be addressed and restricted. Inland water, coastal water andgroundwater can be polluted and become hazardous.

(d) There is no water quality standard to use as a basis for enforcement. Myanmar water quality standard should be developedto address safe and adequate water and pollution prevention and control.

So it is important for Myanmar to link Water Security and Climate Resilience strategies into NWPM followed by development of Action Plan.

Water is the key to all aspects of development and it is important to integrate water security initiations related also in the following areas.

(1)Food and Water Security

Food production could come into serious to meet the demand of an increasing of the population. The situation can get worse in near future. The path way towards water security will need to address water use, water treatment, pollution control etc., by finding the ways of balancing today's needs with those of future generations to come. The following points are to be considered for food and water security.

(a) To make ready for the impact of extreme climate events such as floods and droughts, etc., on food security.

(b) To make wastewater safe to reuse.

(c) To study flood tolerant rice in delta and drought tolerant rice in central Myanmar.

(d) Drainage water, treated waste water can be used in agriculture, especially in dry zone areas.

(e) To use efficient water management practices in irrigation works. Many farmers are facing large losses in crop failure and decrease of production due to drought.

(f) Focus on the links between groundwater and land use in order to reduce groundwater pollution, decline in water quality, and soil degradation that result from land use changes.

(g) Rising temperature will increase evaporation. To initiate protection works for the reduction of evaporation losses from lakes and ponds.

(d) Recycle and reuse of water, after treatment to specified standards through a properly planned tariff system.

(e) Water User Association (WUA) should be given power to collect and retain a position of water charges and to manage the water allotted to them within their jurisdiction. WUA should fix the rates subject to floor rates determined by WRAs.

(f) Limited ground water use for agriculture at a subsidized rate is considered desirable.

In order to link with the Action plan a fair and consistence pricing policy should be applied for different water use. The suggestions to be considered are as follow:

(a) Water is an economic commodity. Present water rates are different under different ministries. The rates are classified under drinking & domestic water use, irrigation and industry water use. Existing pricing policy need to be reviewed together with the use communities.

(b) Taxing water providers, users and polluters, exemption given to the needy on social ground should be established.

(c) Water supply services for a specified area, ownership will be placed under the management of community-based organization as a part of the empowerment program. The beneficiary groups are expected to collaborate in matters such as planning of water needs, water distribution, collect tariff, organize repair works and resolve conflict among members.

5. Management of Extreme Weather Events

The MNWP stated in subheads under this heading such as Management of flood, drought and extreme weather events and they could be summarized as follow:

(1) Non-structural measures should be on preparedness for water related disasters.

(2) Soil erosion due to increase of rainfall intensity likely people lost their houses, should be given new places to live.

(3) Flood forecasting is important for flood preparedness and should be expanded extensively all across the country.

(4) Communities need to be involved in preparing an action plan for dealing with the natural disaster situation.

(5) Dam break study should be prepared with periodic updating action plan. Landslides and flood study in hilly areas should be carried out with modern techniques.

The MNWP consists of several sub-heads but suggested to include the following points.

Climate change increases uncertainties of weather conditions and the risk of extreme events. There are more frequent high temperature, floods, droughts, cyclones and localized high intensity rainfalls leading to severe flash floods, sea level rise and salineintrusion.

(a) High temperature will lead to lower rice yields as a result of a shorter growing period. It can get less food due to rice production falls and rice shortages.

(b) Flash flood events throughout the country should be recognized. Repetitive events such as Man Chaung flash flood in 1987, Shwegyin flash flood in 1997, Wundwin flash flood in 2001, Kyangin flash flood in 2006, Pakokku (Shwechaung) flash flood in 2011 etc. should pay awareness due to climate change.

(c) The Desertification in the dry zone of Myanmar should not be underestimated. Preparedness for desertification should be upgraded.

(d) Integrated Flood Management Concept should be disseminated. A river system for example Bago should be selected to study with the technical and financial assistance from appropriate organizations.

(e) Sea level rise can be threatening to inundate the Ayeyarwady Delta, damaging agriculture lands and displacing the people.

(c) A more comprehensive and effective legal framework should be formulated. Coordination and cooperation among them is necessary, to enhance capacity building, to strengthen partnership plan, to formulate networking system and to create enabling environment. In this case,"Ministry of Water Resources" should be formulated in future with the combination of all the agencies of water sector.

(d) In order to move from fragmented sector water management to a holisticmanagement system, a sustainable water resources management approach should be identified and approved. Myanmar has to strengthen the capacity building of water sector together with the development of projects in water supply, irrigation and hydropower generation.

(e) Legal support for polluters pay is badly needed for implementation. It should go to the people who suffered the areas and places seriously damaged by that pollution.Legal support should be considered as a priority, considering the participation of both public and private sectors.

11. Climate Resilience and Water Security

It is suggested that Climate Resilience and Water Security should be incorporated according to the following sub-headings.

Climate change is intensifying the global water cycle and threatened the world's population to significant water-related hazards.

In Myanmar, floods, droughts, flash floods, unpredictable rainfall patterns, extreme temperature, sea level rise and saline intrusion are expected to increase in severity over time. These changes not only affect the ecosystem and livelihoods of vulnerable people, they also pose a major impediment to economic and social development of the country.

To get water security is to allocate water resources among many competing and often conflicting demands.

10. Legal and Institutional Framework

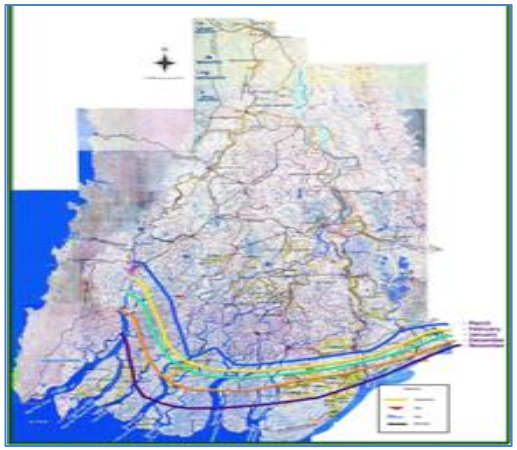
The MNWPhas stated several sub- headings comprising of activities for NWRC such as:

(a) There should be forums both at national and regional / state levels to deliberate upon issues relating to water.
(b) A permanent water dispute tribunal at the union level under the auspices of NWRC should be established to resolve the disputes in an equitable manner.
(c) PPP should be encouraged to carry out water resources projects.
(d) Appropriate institutional arrangement for each river basin should be developed to collect data on regular basis both surface and ground water with appropriate water budgets and water accounts.
(e) Water quality monitoring both surface and groundwater for each river basin should be developed.
(f) NWRC should be a legislative body in national water sector and play a significant role in any water use program.
(g) NWRC can liaise officially with national and international organizations for close cooperation in water resources and related affairs.

It is suggested that the following points should also be considered and integrated.

(i) Legal and Institutional Context of Water Resources

(a) Even though there are many laws, acts, legislations and regulations related to water sectors, most of them are not relevant and need to be reviewed and amended to overcome present day problems. There is an urgent need for the development of unified water law for proper management of water resources.
(b) Old laws mentioned little about consumer rights but very serious about consumer responsibilities. People had no chance for participation in decision making. It is essential to promote better coordination among water users and different water related agencies to attain appropriate legal measures for water resources management.



Saline Front Measurement

Sea Level Rise in SEA

Damage of Bridge in Sagaing Region

6. Water Supply and Sanitation

The MNWP stated with sub-heads and they could be summarized as follow:

(1) Efforts should be made to provide improved water supply in rural areas with proper sewage facilities.

(2) Water source with better reliability and quality need to be assigned to domestic water supply.

(3) Urban domestic water system needs to collect and publish water accounts and water audit reports.

(4) In urban and industrial areas, rain water harvesting and de-salinization should be encouraged to increase availability of utilizable water.

(5) Urban water supply and sewage treatment schemes should be integrated and executed simultaneously.

(6) Industrial water should be discharged to the drain after treated to a specified standard.

(7) Subsidies and incentive should be implemented to encourage recovery of industrial pollutants and recycling.

It is suggested that the up to date background activities for water supply and sanitation should be included as follows:

(1) Ministry of Health is initiating for the development of the water quality standard cooperating with several UN Organizations. The Ministry had organized several workshops and forums on water quality issues. The WHO standard was adopted as a reference for the present moment. Water quality control measures are being taken as case-wise practices especially for bottled drinking water production. Arsenic and other parameters are also tested in collaboration with WRUD, General Administration Department (GAD) and UNICEF.

(ii) Monitoring of Quantity and Quality of Water

(a) Mining, construction activities and deforestation at upper reaches of the river basin cause serious erosion problems in the watershed area and storage capacity of downstream reservoirs are being decreased by the transported sediment. On the other hand, the dams constructed at upper reach could disturb the flow regime and pollution at downstream.

LONGYANG CONCRETE ARCH DAM ON SHWELI RIVER AT CHINA SIDE ABOUT 25 km NORTH OF MYANMAR-CHINA BORDER

(b) Myanmar should monitor possible conflicts or violations against international laws initiated by neighboring countries. The border control committee as in the case of Myanmar and Thailand will become a platform for the reduction in the number of conflicts with mutual understanding.

(c) Attention should be given to monitor water levels and water qualities, inside Myanmar territory, for trans-boundary watercourse whose sources are inside the neighbouring countries. Immediate actions should be taken for sudden rise or fall of water level, expecting to exceed or recede the danger level of the area, by informing to concerned authority. The concerned authority should release an alarming notice to the affected area at downstream side to prevent from losses of lives and properties. The same procedure should be applied where there is an incident ofdeterioration of the quality ofwater. These kinds of problems should be solved between two countries based on mutual respect and understanding.

(3) Myanmar should play an active role in international water conventions, treaties and water cooperation.

It is suggested that the following points should be considered and incorporated under the Trans-boundary Context heading.

(1) Myanmar has many shared rivers and streams with the neighboring countries. These rivers and streams should be classified under 3 categories such as (1) national rivers (2) international rivers and (3) trans-boundary watercourses.

(2) Ayeyarwady River, river in Myanmar's owned water asset is one of the few remaining free-flowing rivers of the world. The value of free-flowingriver has increasingly been recognized and a number of protection mechanisms should be adopted.

(3) International river like Thanlwin now plans for large scale development at upper reach of the river are moving ahead. Other trans-boundary watercourses located at the eastern Myanmar may have water sharing problems in future. It might be judicious to handle the legal environment and economic aspects with fact and wisdom, avoid conflicts, on bilateral or multilateral understanding.

(i) Benefits Sharing with Mutual Respect and Understanding

(a) Since Myanmar is one of the rich water resources nations among the ASEAN countries and according to present water utilization, Myanmar can share its water resources in annual basis for selling power and distribution of drinking and irrigation water if there produce an optimum benefits.

(b) So far no problems have been surfaced with respect to shared rivers with the neighboring countries. But with the anticipated IWRM in future, it might be judicious to handle the accompanying legal environment and economic aspects with fact and wisdom on bilateral or multilateral understanding. Late consideration for harnessing the shared rivers of which the sources are inside Myanmar must be considered riparian right, uses of domestic and irrigation water for many years by the neighboring countries.

(2) An access to safe drinking water and adequate sanitation coupled with personal and environmental hygiene should receive high priority. The assessment indicated that it has progressed up to 71% for safe drinking water for national level based on WHO/UNICEF report in 2010. Target 10 of MDG is to halve the proportion of people without sustainable access to safe drinking water by the year 2015. To get more reliable data, Ministry of Health in cooperation with UNICEF should conduct periodical survey. Irrigation and other multipurpose projects should include a drinking water component whenever possible.

(3) Water supply services for a specified area ownership will be placed under the management of community-based organization as a part of the empowerment program with the coordination of YCDC. The beneficiary groups are expected to collaborate in matters such as planning of water needs, water distribution, organize repair works and resolve conflict among members.

(4) Groundwater seminar was organized by DHSHD in August 2014 to formulate a ground water law. It should be launched with the cooperation and coordination of MNWP.

7. Vulnerability and Adaptation to Climate Change

The MNWP although not highlighted V&A assessment but broadly explained adaptation to climate change as follow:

(1) To enhance the capabilities of community to adapt climate resilient technological options. One option is to increase water storage in various forms namely ponds, small and large reservoirs.

(2) The adaption strategies could include better demand management. Water application methods such as Drip or sprinkler irrigation could enhance the water use efficiency. Similarly, industrial water use should be made water efficient.

(3) Land-soil-water management with scientific inputs should be promoted.

(4) The criteria in regard to new and old water resource structures need to re-work in view of likely climate changes.

(5) Many reservoirs under Irrigation Department should be upgraded to optimize the water use to attain more irrigated lands.

(6) Water resources projects should be designed and operated based on present and future trends of hydro-meteorological parameters under climate change scenarios.

Climate Change is too aggressive to ignore and it is recognized that Climate Change has impacted the livelihoods and water security in all parts of Myanmar. Adaption to climate change is crucial and needs to be urgently addressed with prioritized sectors/themes.

Myanmar now becomes a country as one of the most vulnerable to the effect of climate change. Vulnerability and Adaptation (V&A) assessment provide information regarding the programs that include measures to facilitate adequate adaptation to climate change.

There are some suggestions and recommendations to be incorporated under this heading.

V&A assessment and NAPA report prepared by DMHare to be taken into account for the formation of Action Plan focusing on water security and climate resilience as follow:

(1) Vulnerability and Adaptation (V&A) Assessment – The V&A assessment of INC (MoECaF) team indicated that cyclone and strong winds, flood and storm surge, intense rain, extreme day temperature, drought, and sea level rise are the six natural hazards identified in Myanmar. The potential hazard levels for climate change impacts due to global warming may assume a pattern which is presented in Figure below.

There are six key socio-economic sectors, namely agriculture, public health, water resources, forestry, coastal zone and biodiversity of fish species. Vulnerability Level (VL) and its "Criteria and Scores" for States and Regions were judged as three levels of High (H), Medium (M) and Low (L).

Land Use Changes and Forestry Sector- Forestry mitigation measures include forest protection,afforestation, and reforestation, improvement of tree species and stands, natural regeneration, conservation of natural forests, community forestry, agro-forestry, and use of forest products on sustained basis.

In forestry sector, the mitigation strategies include mainstreaming climate change concerns into forest policy and legislations, improved forest management, habitat management for wildlife and wild plants, forest protection and reduced firewood cutting. Promoting carbon trading is also a promising mitigation strategy.

It is to be fostered communication between foresters, water professionals, decision makers and the public to achieve Sustainable Forest Management (SFM).

It should be expedited to develop and implement of National Land Utilization Policy to sustain permanent forest estate.

Waste Sector - In Myanmar, approaches such as waste disposal, waste recycling, and wastereduction are being employed in managing waste. Under the current domestic sewage system, wastewater is discharged into sewer using huge amount of treatment water. In Myanmar, both municipal waste and industrial waste have been increasing rapidly. In waste management, waste production, waste distribution and waste consumption are involved. Recycling of plastic wastes, and reuse and recycling of woodand agricultural residues should be promoted. Use of "waste to energy" plants should be developed.

9. Trans-boundary Context

The MNWP has spelled out in several subheads and could be summarized as follow:

(1) Myanmar should enter into international agreements with neighboring countries on bilateral basis for exchange of data of international rivers on near real time basis.

(2) Negotiations about sharing and management of water of international rivers should be done on bilateral basis. Adequate institutional arrangements at the National level should be set up to implement international agreements.

12. to prepare Disaster Preparedness Programme in advance at village, township and national levels.
13. to collaborate and cooperate with international organizations, INGOs and NGOs for relief and resettlement work after the disaster has abated.
14. up to now, very limited activities on adaption to climate change have been carried out in Myanmar. Myanmar needs adaption measures in various sectors.
15. monitoring and evaluation (M&E) program should be carried out according to the sectors/themes mentioned in NAPA report. The projects/programs should be reviewed and prioritized with the present day resource mobilization and human resource development focusing on water security and climate resilience aspects.

8. Mitigation Measures and Strategies

The MNWP do not highlight the mitigation measures and strategies. It is suggested to consider the following points.

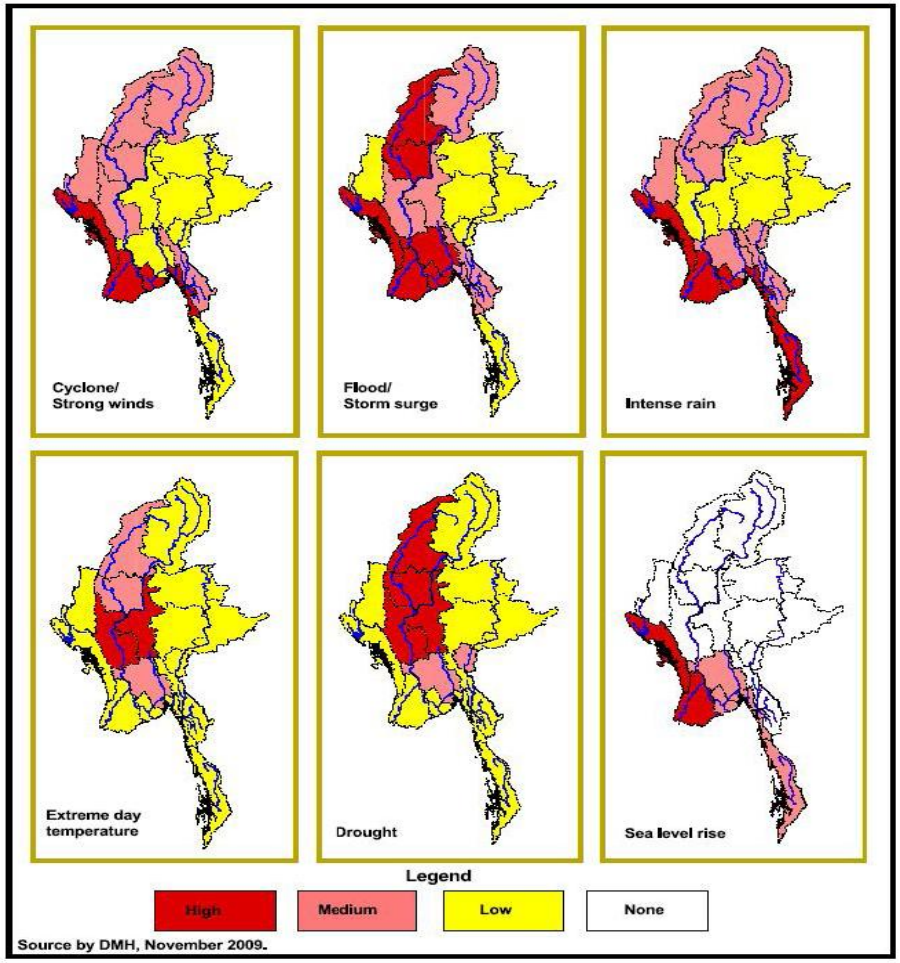
One of the mitigation options is reduction of GHG emission for the key socio-economic sectors. Myanmar is under no obligation to quantify reduction of GHG emission. However, GHG emission mitigation options should be carried out and strategies were developed.

Energy Sector-CO_2 emission reduction from the energy sector should be focused on promoting new and renewable sources of energy. In Myanmar,it can be done by increased utilization of hydropower, increased use of solar and wind power, use of electricvehicle, etc.

Agriculture and Livestock Sector- GHG emission mitigation in agriculture can be affected through (i) mitigation of CO_2 emissions from crop lands, biomass, crop residues and by-products, (ii) mitigation of CH_4 emissions through fertilizer management, water management, and (iii) mitigation of NO_2 emissions from agricultural soils through the use by developing organic farming.

The potential hazard level for cyclones, sea level rise with strong winds may be classified as “High” along Rakhine coastal areas and Ayeyarwady delta. A central part of the country is vulnerable to drought.

Extreme day temperature is experienced in dry zone of Myanmar. The potential hazard level for intense rains may be classified as “High” for the region having long exposure to monsoon from east and west of the country.



(2) National Adaptation Programs of Action (NAPA) was launched in 2009 with the funding of UNEP and submitted a report in 2012.

- NAPAs emerged from the multilateral discussions on adaptation measures within the UN Framework Convention on Climate Change (UNFCCC).
- Myanmar's NAPA therefore specifics several priority activities referred to as Priority Adaptation Projects for effective climate change adaptation for 8 prioritized sectors/themes namely (i)Agriculture (ii)Early Warning System (iii)Forestry (iv)Public Health (v)Water Resources (vi)Coastal zone (vii)Energy and Industry and (viii)Biodiversity.

  The future implementation projects/programs are indicated under each and every prioritized sectors/themes.

Sectors in which Priority Adaptation Projects should be implemented as follows:

(a) Agriculture, Early Warning Systems and Forestry (First Priority Level Sectors).
(b) Public Health and Water Resources (Second Priority Level Sectors).
(c) Coastal Zone (Third Priority Level Sectors).
(d) Energy & Industry and Biodiversity (Fourth Priority Level Sectors).

In this case, Forest degradation, water resources deterioration, etc., lead to fragile ecosystem. Coastal zone is also vulnerable to climate-related hazards due to its geographical position.

Regarding the climate change adaptation measures, Natural Disaster Preparedness Central Committee (NDPCC) was formed at national, stateand regional levels. The following points are to be considered for adaptation of climate change in Myanmar.

1. to prepare for forth coming storms according to past experiences such as Cyclone Nargis, Mala and Giri, and to prepare hazard maps.

2. to reconsider the cropping calendar and water requirement for major crops and types of crops according to the changes of rainfall pattern in specific areas, and also to identify the drought tolerant crops.
3. to review the height of embankment in coastal and delta areas for protection due to rising of water levels.
4. to review the low flow in rivers for extreme conditions especially during drought period.
5. to review and analyze urban drainage facilities and drainage situated in agriculture lands with changing of rainfall intensity and patterns accordingly.Reconsider the previous design of drainage module and existing facilities together with present rainfall intensity in the network systems.
6. to substitute slash-and-burn practice of cultivation in hilly region with terrace farming, slopping agriculture at medium slopping areas. To introduce contour cultivation techniques to protect top soil erosion and sedimentation problem.
7. to strengthen and renovate the rain harvesting ponds and tanks in dry zone area to increase storage capacity of reservoirs for local community for more domestic and agriculture uses.
8. to find out new groundwater resources as for domestic and agricultural uses at available regions.
9. to install communication and information network properly for effective and easy access for the community and to use the media as an important tool for enhancing awareness.
10. to establish road network properly for transportation and emergency measures.
11. to establish early warning system and to install sea water level gauges for necessary preventive measures and monitoring purpose.