A Case Study on Investigating the climate change impact on flooding in the Sittaung river basin

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Agriculture in Myanmar

Myanmar is one of the few developing nations to be a net exporter of food, which accounted for

- 20% of its foreign exchange earnings
- Agriculture generated roughly 2/3 of employment
- 42% of the recorded GDP

- Farmers rely on the monsoon season as their primary water source and are subject to the recent fluctuating/changing weather patterns.

- Eg. Rice crop was negatively affected by a record high rainfall during the prolonged 2011 monsoon season which resulted in a projected 10 percent drop in production.

- Addressing climate change and its impact on agriculture is one of the top most priority in Myanmar

[Image: Map of Myanmar showing land use and net sown area](http://dwms.fao.org/atlases/myanmar/downs/atlas/p025_netso wnarea_map.pdf)
History of Disasters

Major disasters:

- 2006 Apr Cyclone Mala
- 2008 May Cyclone Nargis
- 2010 Oct Cyclone GIRI
- 2011 Mar Tarlay Strong Earthquake
- 2011 JJA Heavy Rain & Floods
- 2011 Oct Pakokku Flash Flood
- 2012 JJA Lower/NE Myanmar Floods
- 2012 Nov Shwebo Strong Earthquake
- 2013 May Cyclone Mahasen
- 2013 J-O Heavy rain triggered secondary hazards.
- 2015 July Cyclone Komen, Heavy Rain & Floods
- 2016 July Heavy Rain & Floods
Investigating the impact of climate change on flooding in the Sittaung river basin

**Basin Characteristics**
- Catchment Area - 34,450 Km² (4th Largest River Basin in Myanmar)
- Main River Length - 422 km
- Population - 3.92 million (2014 Census)

**Objectives of the Study**
- To analyze hydrological responses of the past flood events (2012 - 2015) using RRI model
- To analyze change in precipitation and river flows under future climates
- To propose the development of the countermeasures
Investigating the impact of climate change on flooding in the Sittaung river basin (Contd.)

Present Conditions

- Global Topography Data (DEM, ACC, DIR)
- Observed Discharge
- MODIS Image

Future Conditions

- Global Climate Model (GCM)
- Downscaling & Bias-Correction

- Calibration/Validation
- RRI Model Setup and Simulation
- Observed Rainfall
- Flood Inundation Map

Change of Floods severity and occurrence between present and future climates

Countermeasure Structure & Non-structure

Effective Management for Floods in the Sittaung River Basin
Investigating the impact of climate change on flooding in the Sittaung river basin (Contd.) - Present Condition

Analysis of hydrological responses of the past floods (2012 - 2015) using RRI model

Comparison of simulated discharge with and without dam boundary conditions (2012 Flood)

Comparison of flood inundation (2015 Flood)

Flood Hazard Maps

10-year Flood

50-year Flood

100-year Flood

Madauk Station

Max. Rainfall-127mm
2 year return period

Discharge (m³/s)

Basin Average Rainfall - Observed Discharge (m³/sec) - Simulated Discharge (with boundary)(m³/sec) - Simulated Discharge(without boundary)(m³/s)

Myanmar Information Management Unit (MIMU)
Investigating the impact of climate change on flooding in the Sittaung river basin (Contd.) – Future Present Condition

Analysis of changes in precipitation and river discharge under climate change

Five GCMs output of CMIP5 (Coupled Model Inter Comparison Project) were selected for study:
(1) CNRM-CM5, (2) GFDL-CM2, (3) CanESM2.1, (4) MIROC5, (5) MPI-ESM-MR

- Present Climate: 1990-2005 (16 Years)
- Future Climate: 2046 to 2061 (16 Years)

Comparison of precipitation between several model outputs from CMIP5 (CMIP5: Coupled Model Intercomparison Project Phase-5)

Monthly corrected rainfall (Future)

Rainfall intensity will be increased in future

Comparison of simulated discharge at Madauk Station

Red-dashed line: Future Climate (2046-2061)
Black line: Present Climate (1990-2005)
Case-1: New embankment
- Construction of 3.0 m high embankment along the bank of river from Madauk Township to the river outlet

Case-2: New Dams
- Construction of dam near the Taungoo station in the upstream area and Shwegyin station

Assuming dam capacity:
- Dam-1 = 1006.5 x 10^6 m^3
- Dam-2 = 808.7 x 10^6 m^3
Theme 2: Climate change impacts on flood and drought and their consequences in agriculture.

Framework for Assessing Flood, drought & Climate Change Impacts on Agriculture

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• Two-dimensional model capable of simulating rainfall-runoff and flood inundation simultaneously
• The model deals with slopes and river channels separately
• At a grid cell in which a river channel is located, the model assumes that both slope and river are positioned within the same grid cell

WEB-RRI: Coupling Hydro-Sib-RRI with RRI Model

Energy and Water flux Balance

Vertical Soil moisture Profile

Lateral flow-2D Diffusion wave

River flow - 1D Diffusion wave

River Routing

Surface flow

Slope-River Interaction

GW-River Interaction

GW-Soil Moisture Interaction

Ground water Flow
Overview of simulation model of the SIMRIW model developed by Prof. Horie (1987)

SIMRIW predicts the potential yield that can be expected from a given cultivar under a given climate.
Framework for Assessments of Climate Change Impacts on Agriculture

Daily ground rainfall data
MODIS 8-daily LAI & FPAR data
Meteorological forcing data (JRA-55)
DEM, soil, and land-use data

Model Calibration & Validation using discharge data & Yield
PALSAR-2 & INAHOR

WEB-RRI Model Coupled with SIMRIW

Irrigation Practices
Rice Type
CMIP-5 Climate Projection Data
Past-Climate Data (Observation)

Simulated Rice Production for floods, drought, Climatology Change
Water Allocation Scenarios
Scenarios for Crop type/calendar

Climate Change & Adaptability Impacts on Economy

INternational Asian Harvest mOnitoring system for Rice (INAHOR)
Thank you for your kind attention !!!