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

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Agriculture in Myanmar

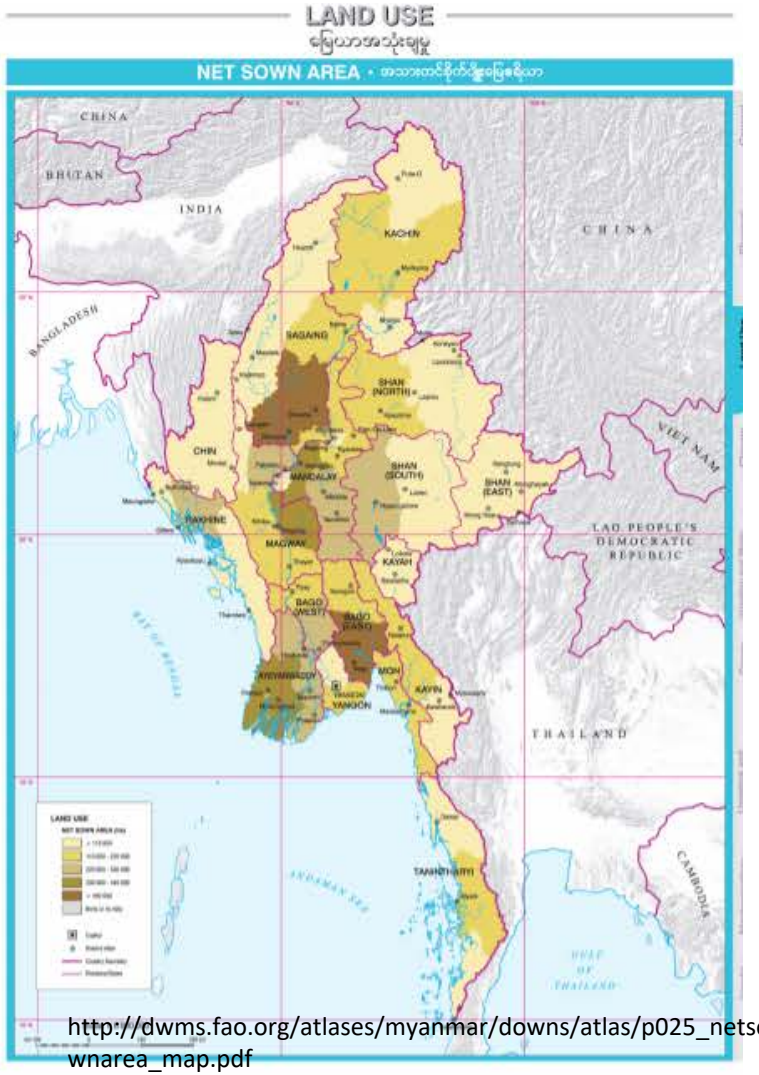
Myanmar is one of the few developing nations to be a net exporter of food, which accounted for

- ✓ **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.**

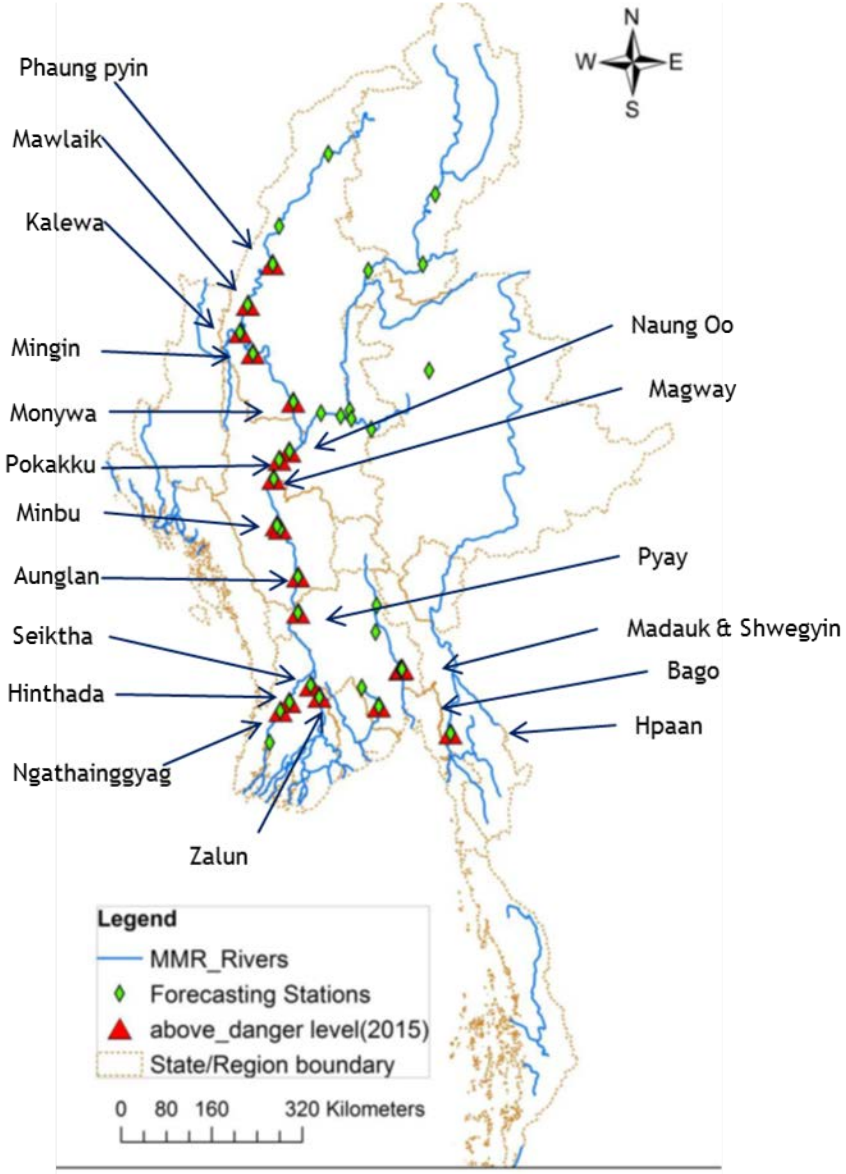
- ✓ **Eg. Rice crop was negatively affected by a record high rainfall during the prolonged 2011 monsoon season which resulted in a projected 10 percent drop in production.**

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



http://dwms.fao.org/atlases/myanmar/downs/atlas/p025_netsownarea_map.pdf

History of Disasters



Map of disaster prone areas

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

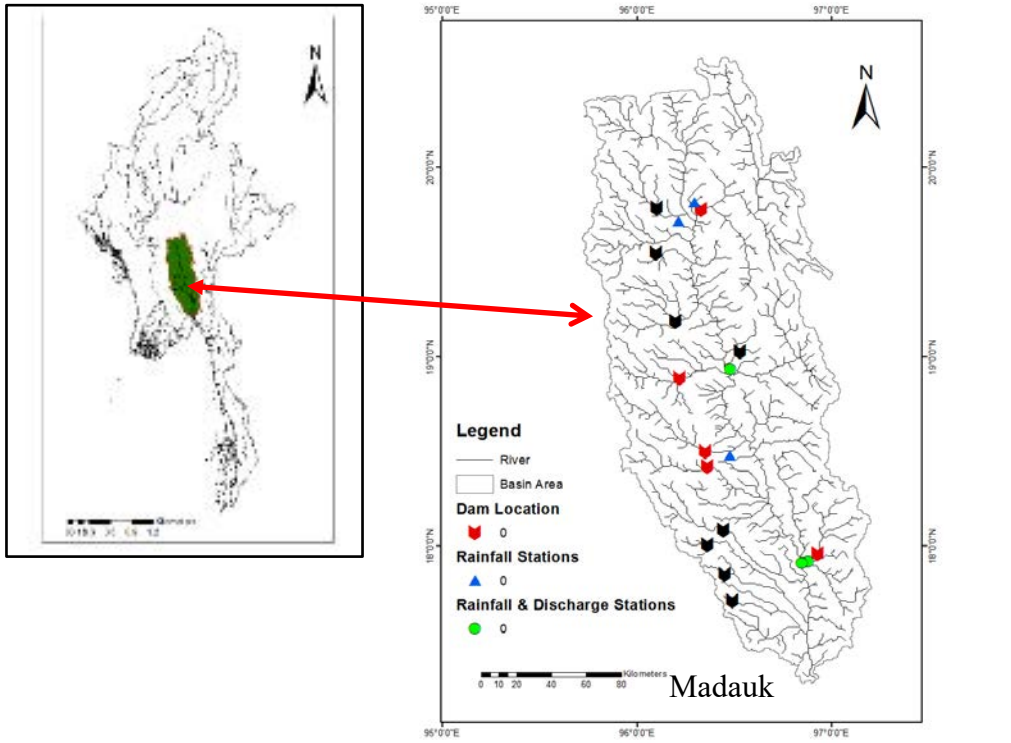
Basin Characteristics

Catchment Area - 34, 450 Km^2

(4^{th} Largest River Basin in Myanmar)

Main River Length - 422 km

Population - 3.92 million (2014 Census)

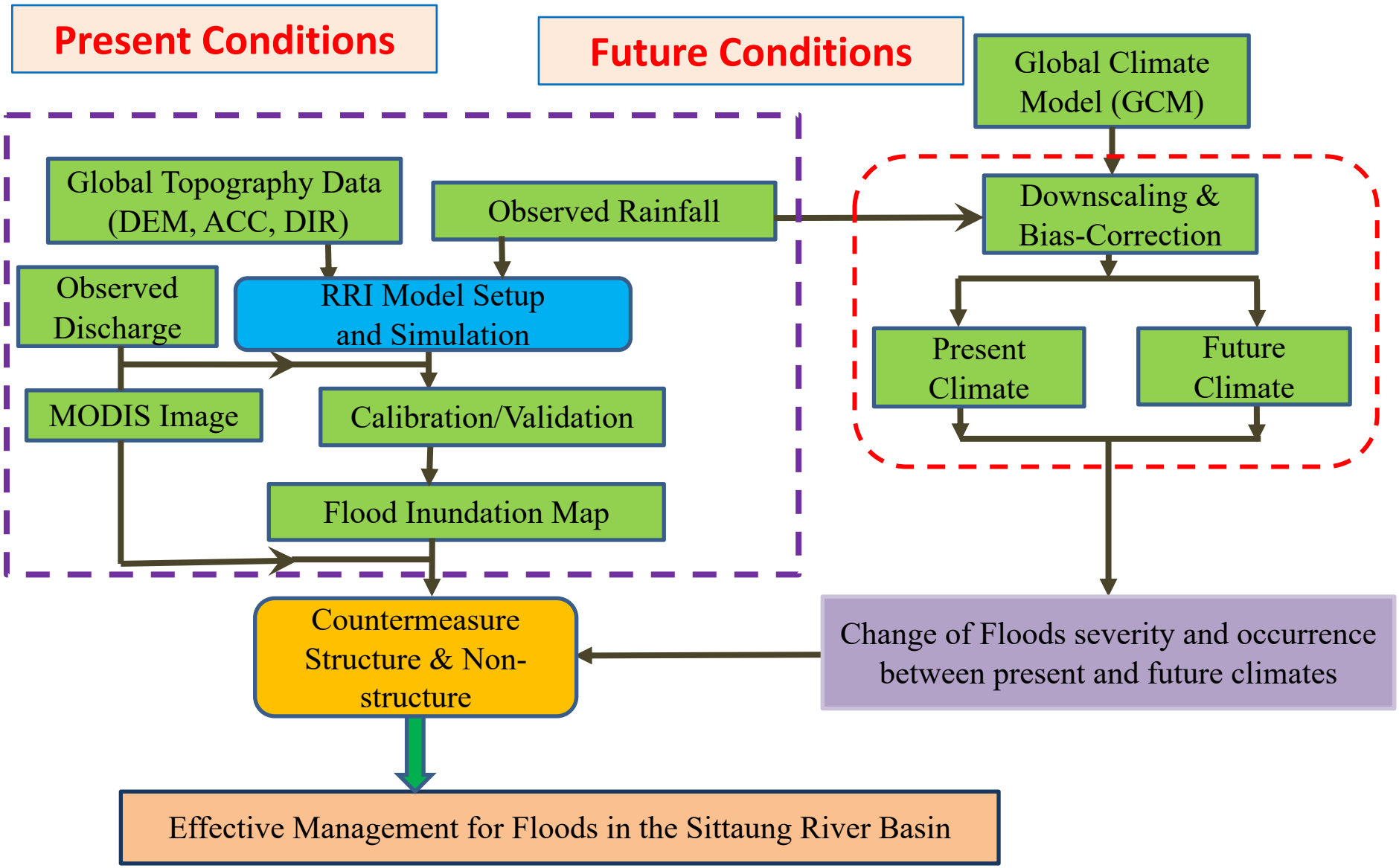


Sittaung River Basin
(Dams and Hydro-Met stations)

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

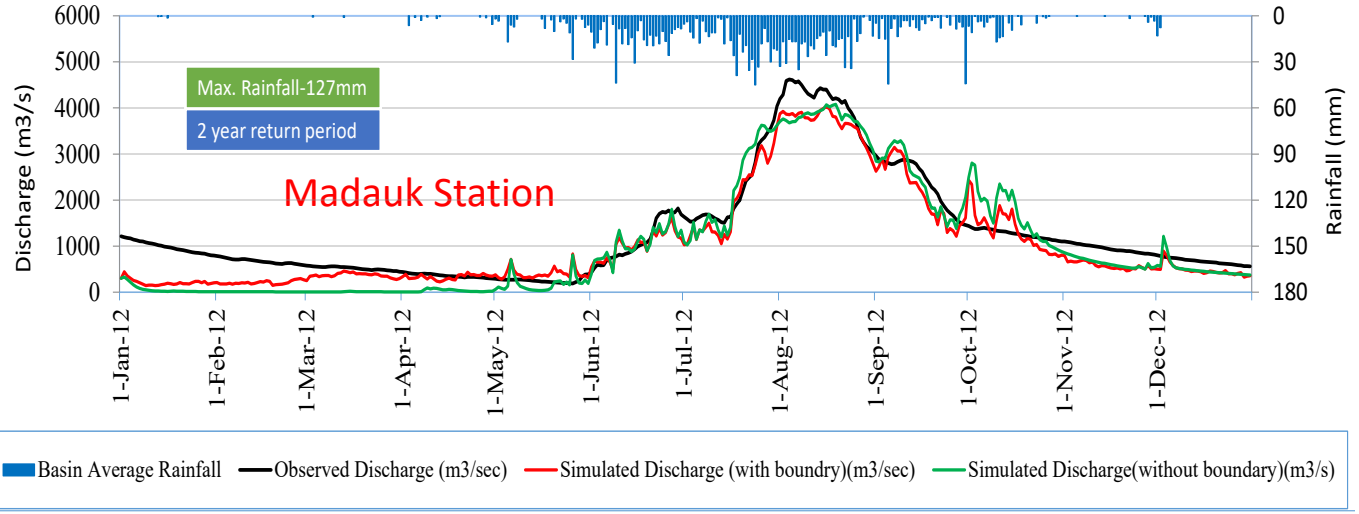
Investigating the impact of climate change on flooding in the Sittaung river basin (Contd.)



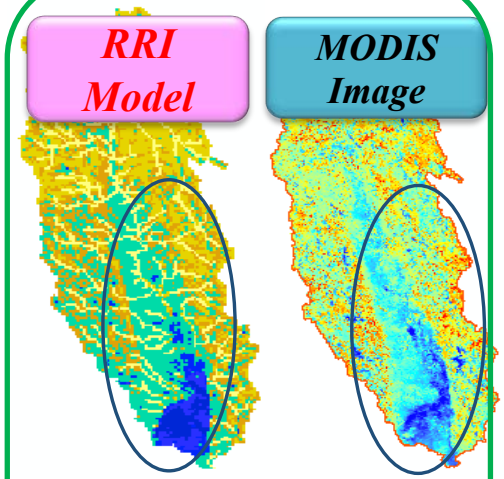
Investigating the impact of climate change on flooding in the Sittaung river basin (Contd.) - Present Condition

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

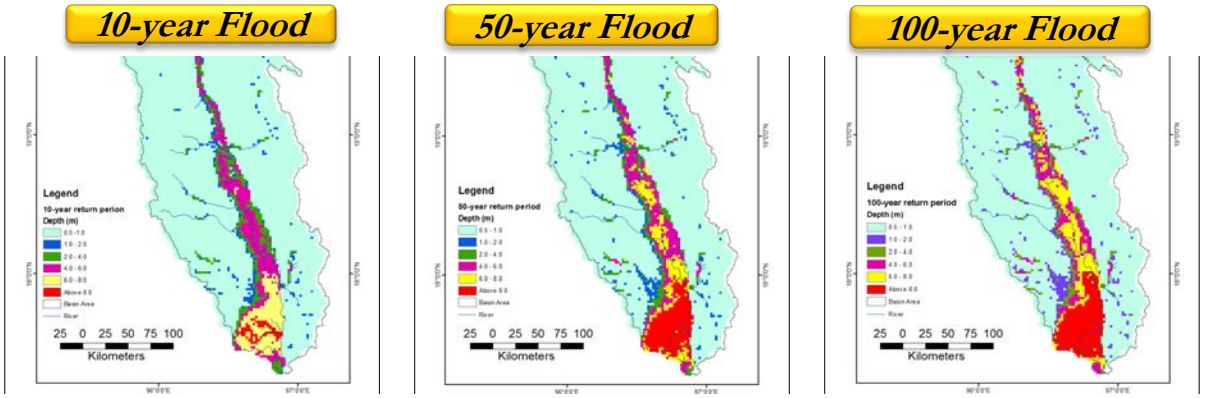
Comparison of simulated discharge with and without dam boundary conditions (2012 Flood)



Comparison of flood inundation (2015 Flood)



Flood Hazard Maps



Myanmar Information Management Unit (MIMU)

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

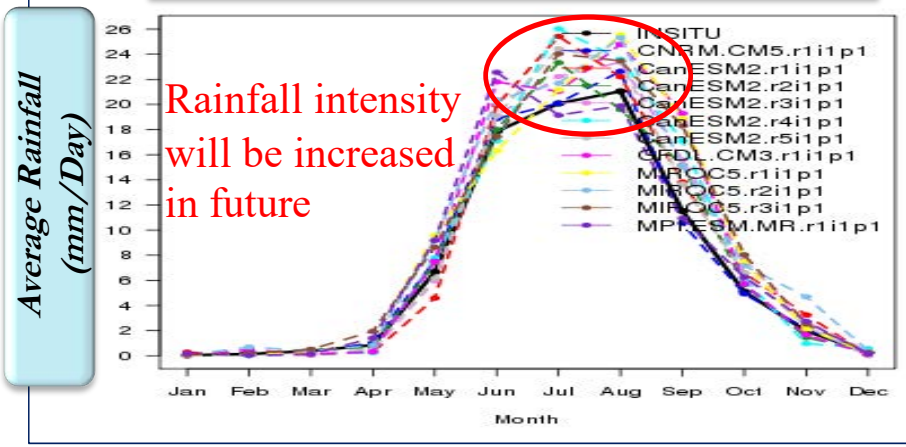
Analysis of changes in precipitation and river discharge under climate change

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

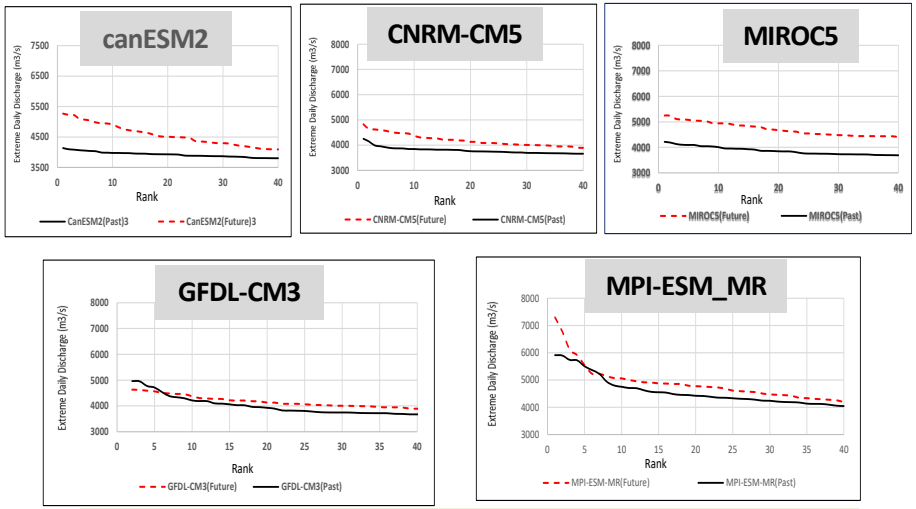
- Present Climate: 1990-2005 (16 Years)
- Future Climate: 2046 to 2061 (16 Years)

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

Monthly corrected rainfall (Future)



Comparison of simulated discharge at Madauk Station



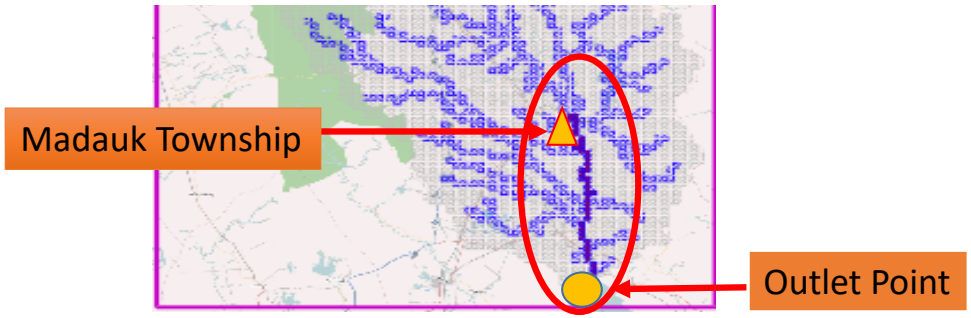
Red-dashed line: Future Climate(2046-2061)
Black line: Present Climate (1990-2005)

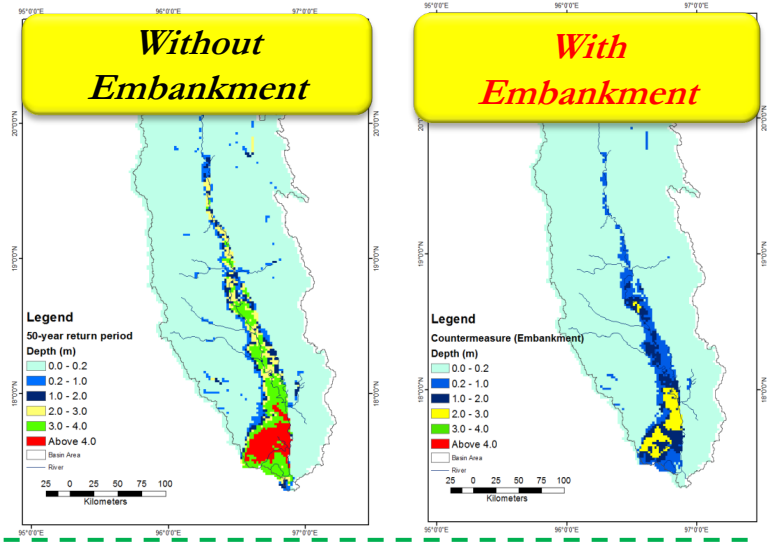
Investigating the impact of climate change on flooding in the Sittaung river basin (Contd.)

Analysis of effectiveness of structural countermeasures (Dam, Embankment) using RRI model

Case-1: New embankment

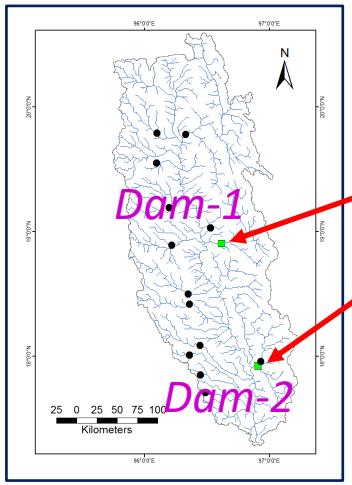
- Construction of 3.0 m high embankment along the bank of river from Madauk Township to the river outlet





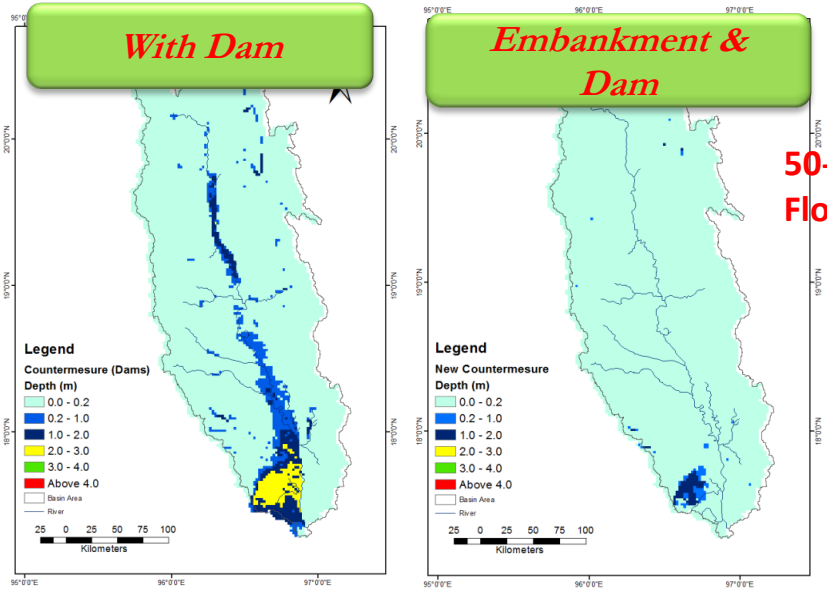
Case-2: New Dams

- Construction of dam near the Taungoo station in the upstream area and Shwegyin station



Propose Dam Locations

Assuming dam capacity:
Dam-1= 1006.5x 10^6 m3
Dam-2 = 808.7 x 10^6 m3



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

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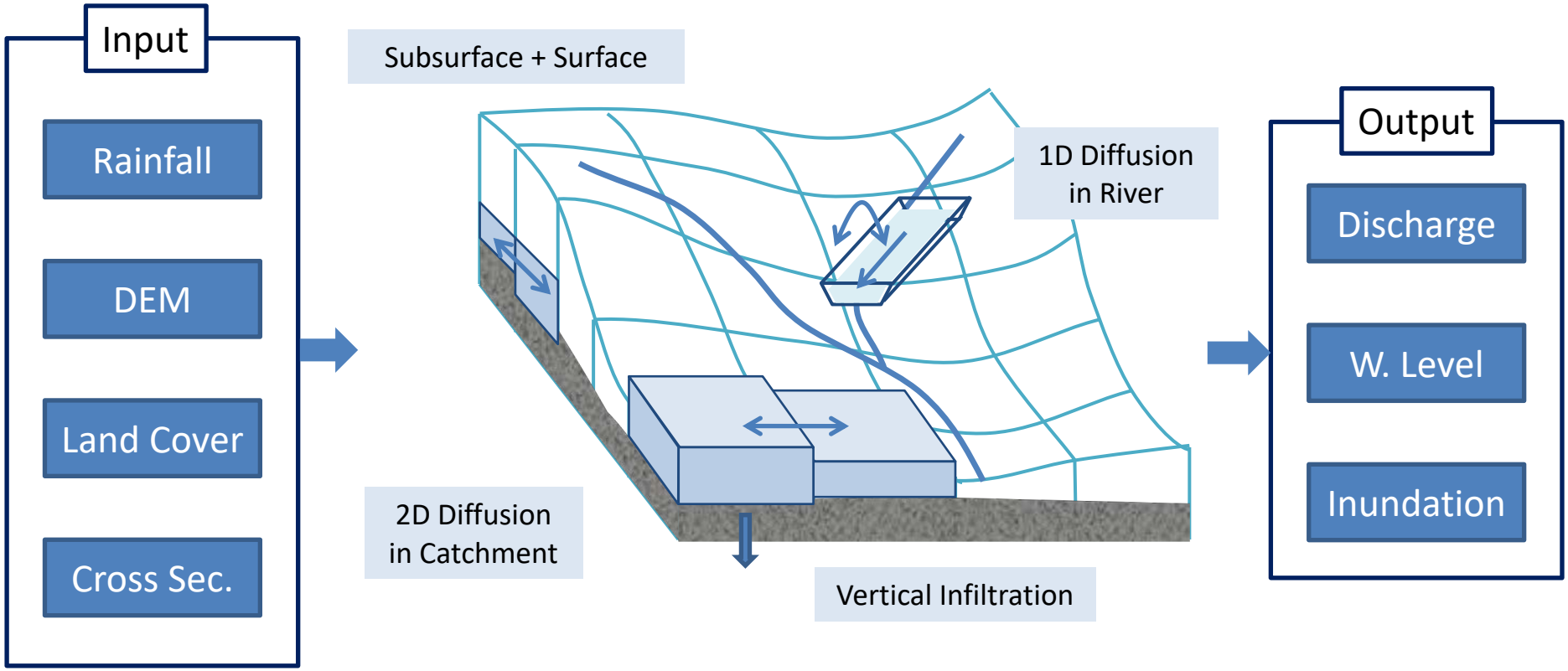
PWRI/ICHARM

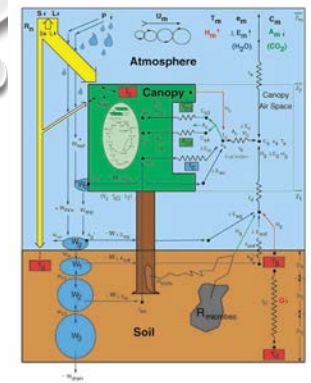
Structure of RRI Model



- 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

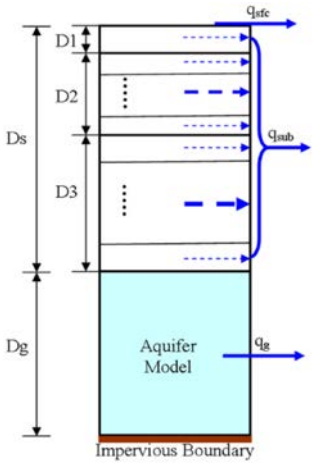
Sayama, T. et al.: Rainfall-Runoff-Inundation Analysis of Pakistan Flood 2010 at the Kabul River Basin, *Hydrological Sciences Journal*, 57(2), pp. 298-312, 2012.

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

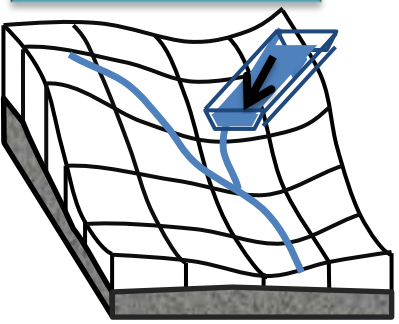


Energy and Water flux Balance

Vertical Soil moisture Profile



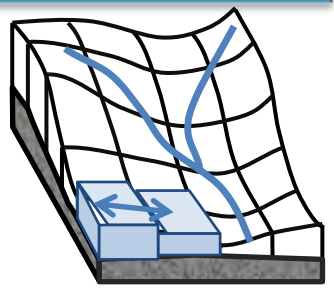
River Routing



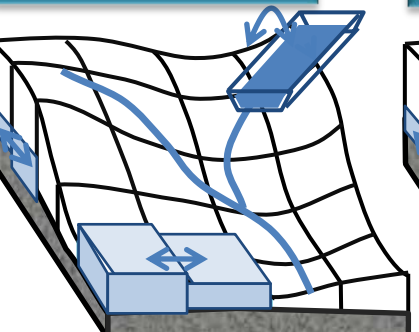
River flow - 1D Diffusion wave

Lateral flow-2D Diffusion wave

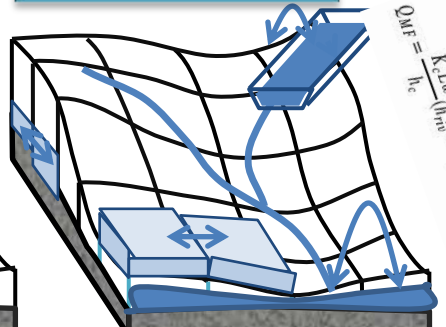
Surface flow



Slope-River Interaction

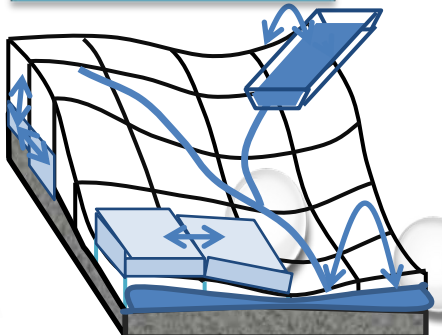


GW-River Interaction

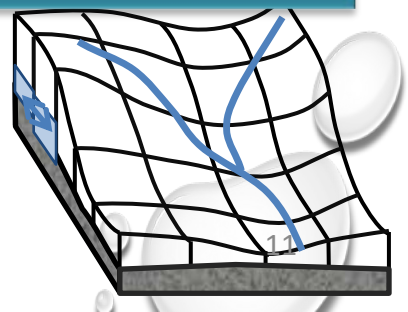


$$Q_{MF} = \frac{K_c L_W}{h_c}(h_{riv} - h) = C_{rid}(h_{riv} - h) \quad (1)$$

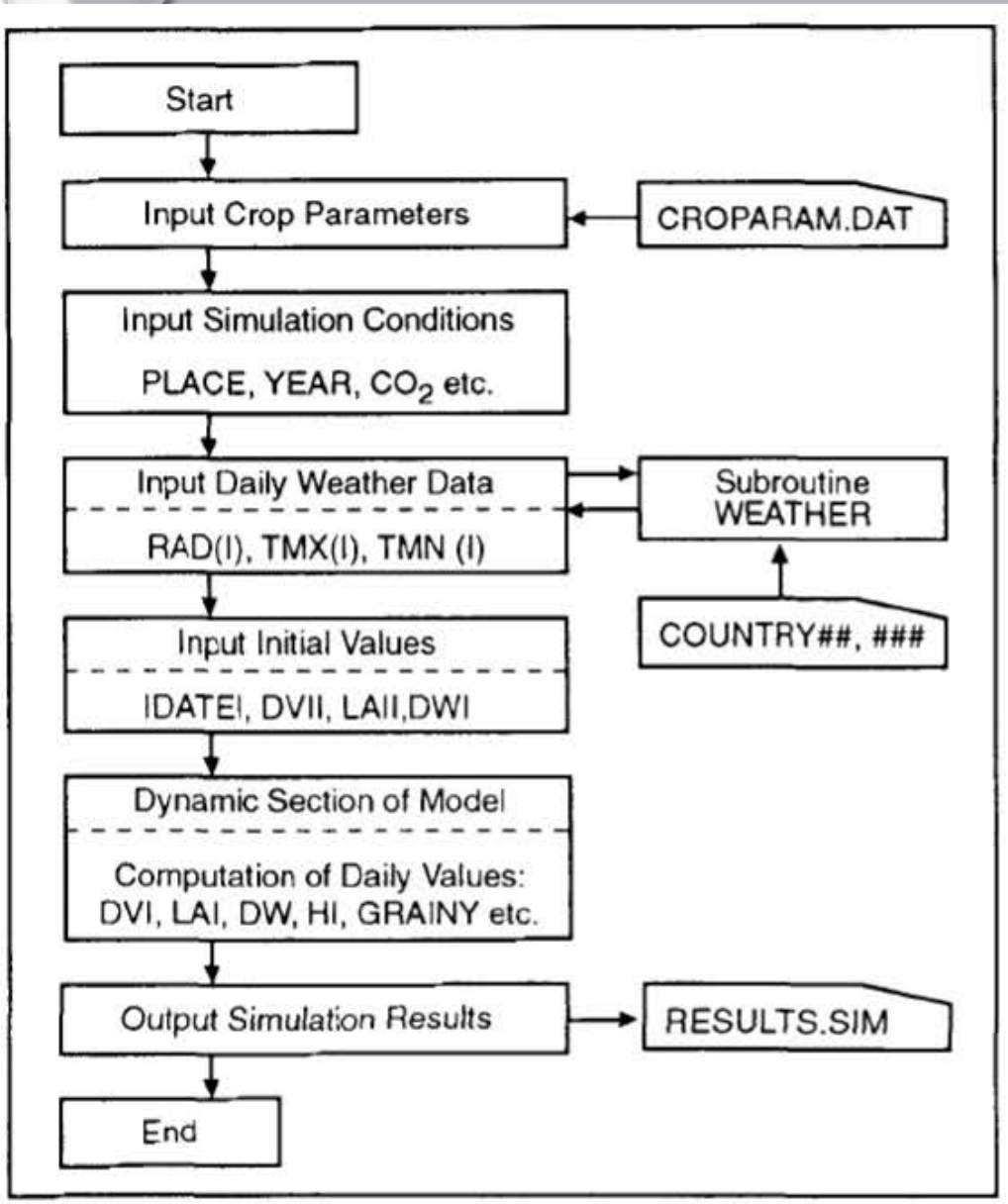
GW-Soil Moisture Interaction



Ground water Flow



Simulation Model for Rice-Weather Relations

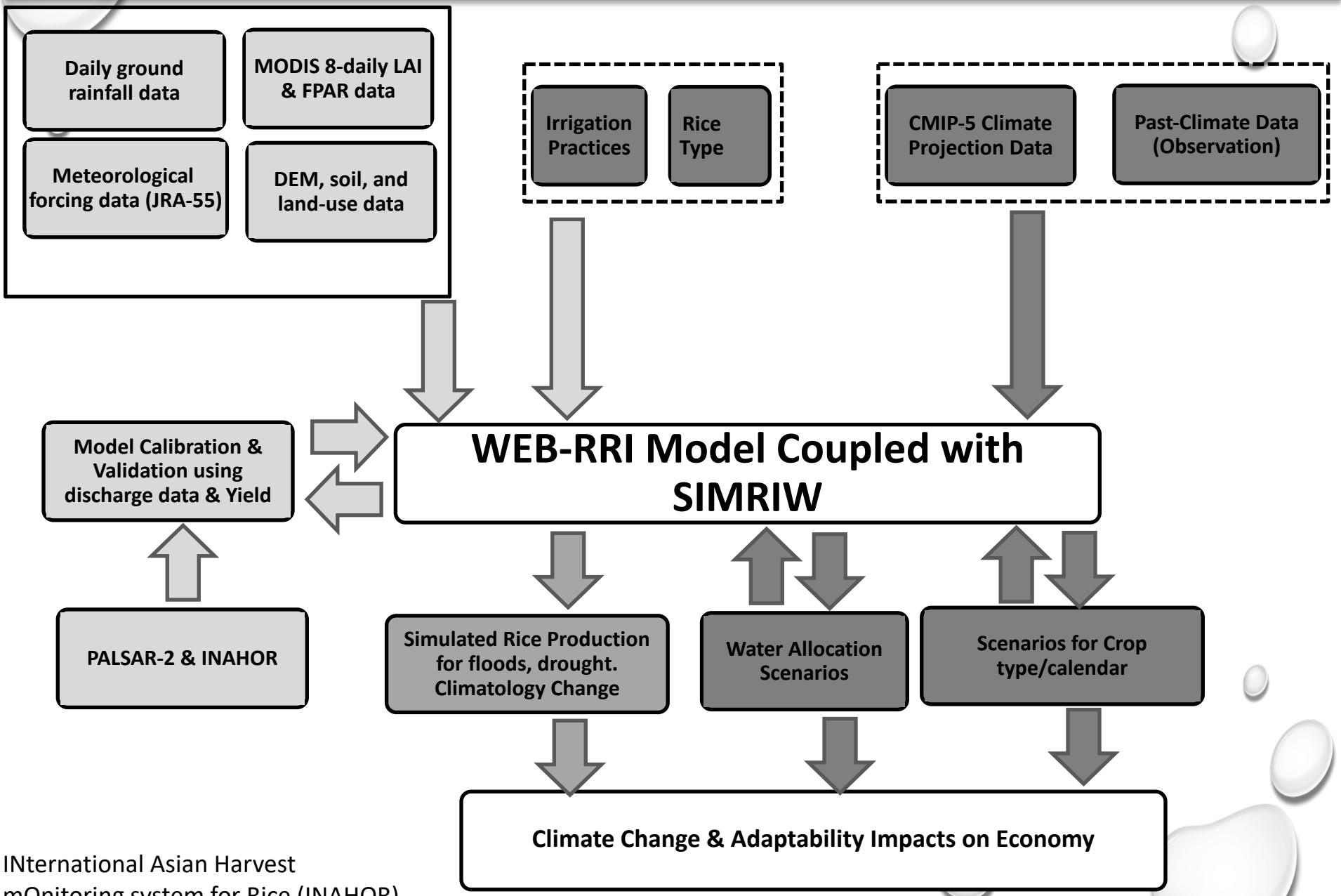


4.7. Flow chart of the SIMRIW program.

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



INternational Asian Harvest mOnitoring system for Rice (INAHOR)

Thank you for your kind attention !!!