JCP Bangladesh Metamodel

Expert reflection session (Agriculture)

July 9th, 2020

JOINT COOPERATION PROGRAMME
Bangladesh Netherlands
Knowledge development for a prosperous delta

Program

Objective : (i) Advice for data gap (ii) Feedback for model improvements

Time	Presentation	Presenter	Institute
15.00 - 15.05	Opening by chair	Motaleb Hossain Sarker	CEGIS
15.05 - 15.10	Introduction to metamodel JCP	Kymo Slager	Deltares
15.10 - 15.20	Metamodel - Engine and Dashboard	Morsheda Begum	IWM
15.20 - 15.35	Agricultural Water Demand	Mohammad Abdur Rashid	CEGIS
15.35 - 15.50	Agricultural Production	Judit Snethlage	WUR
15.50 - 16.05	Food Security	Saeed Moghayer	WUR
16.00 - 16.30	Discussion	Tiaravanni Hermawan	Deltares

Introduction to Metamodel and JCP

JCP Bangladesh Metamodel

JCP: Joint Cooperation Program between CEGIS, IWM, Deltares and Wageningen University & Research sponsored by the Embassy of the Kingdom of the Netherlands

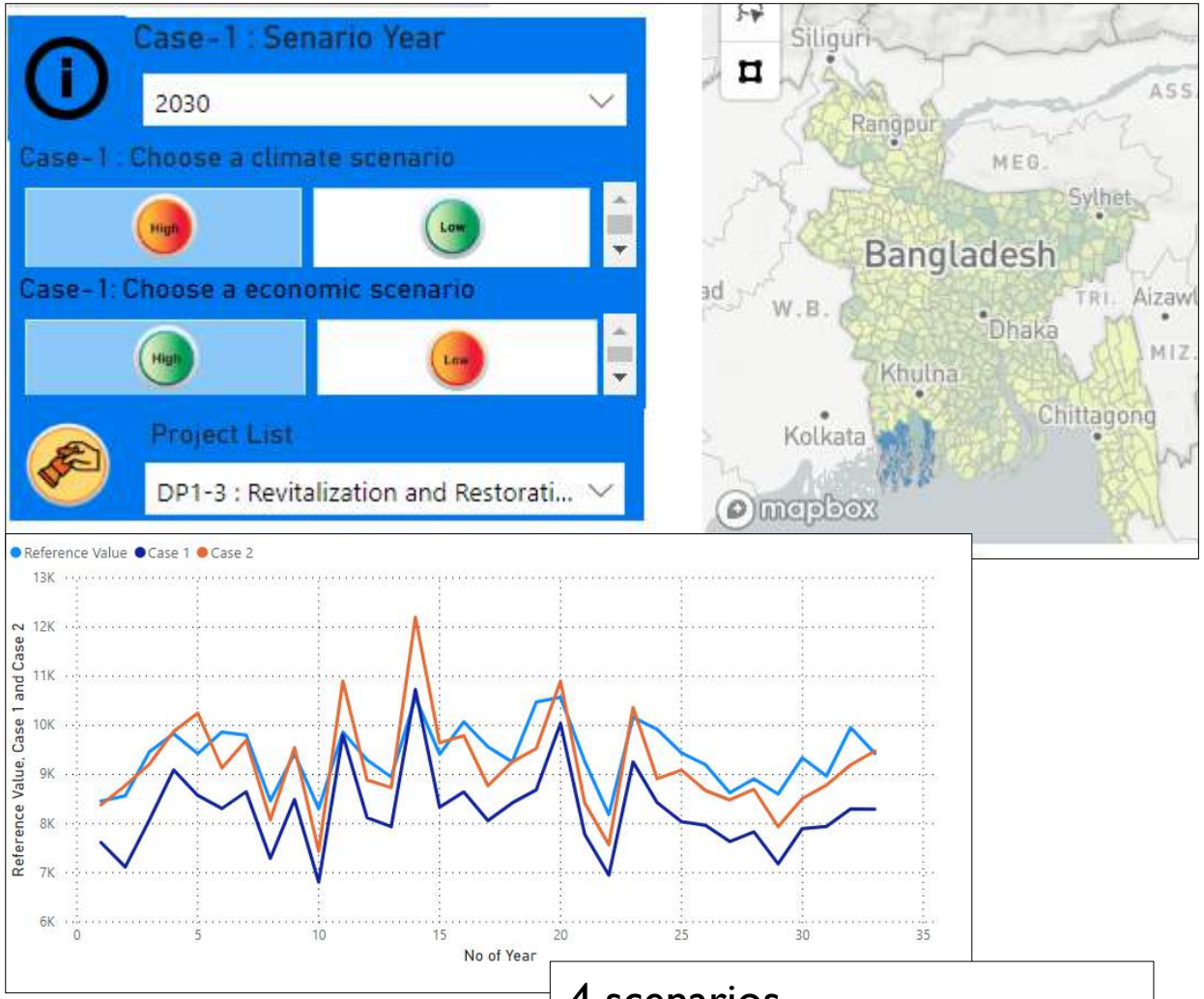
Goal: Long term **knowledge sharing and capacity building**, between Bangladesh and the Dutch knowledge institutes, in support of improved Integrated Water Resources Management (IWRM), Integrated Coastal Zone Management (ICZM), flood and drought management

Bangladesh Metamodel aims to provide **quantitative** decision support information to decision-makers regarding the **investment (project) plan for BDP2100**

What is a Metamodel?

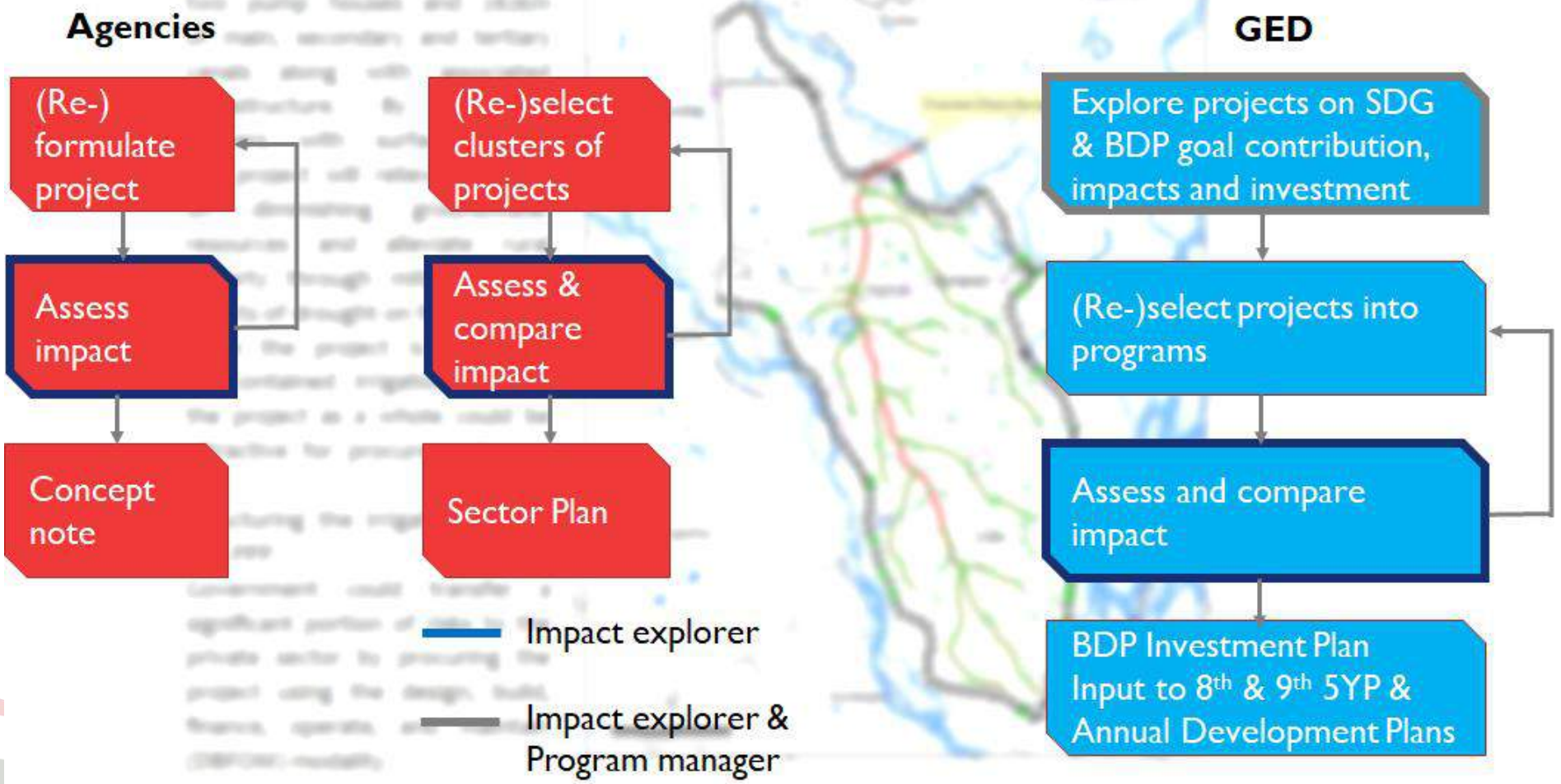
- Simplified simulation → Short calculation time
- Wide scope (national, integrated) → Based on results of detailed, sectoral models
- Less detail and accuracy in results → not a replacement for detailed models

Follow our progress
http://jcpbd.nl/bdpMetaModel.php



4 scenarios
BDP projects
30 years
>500 upazilas
All will be included in
>10 modules

Example of use of Metamodel for an investment project



Important definitions

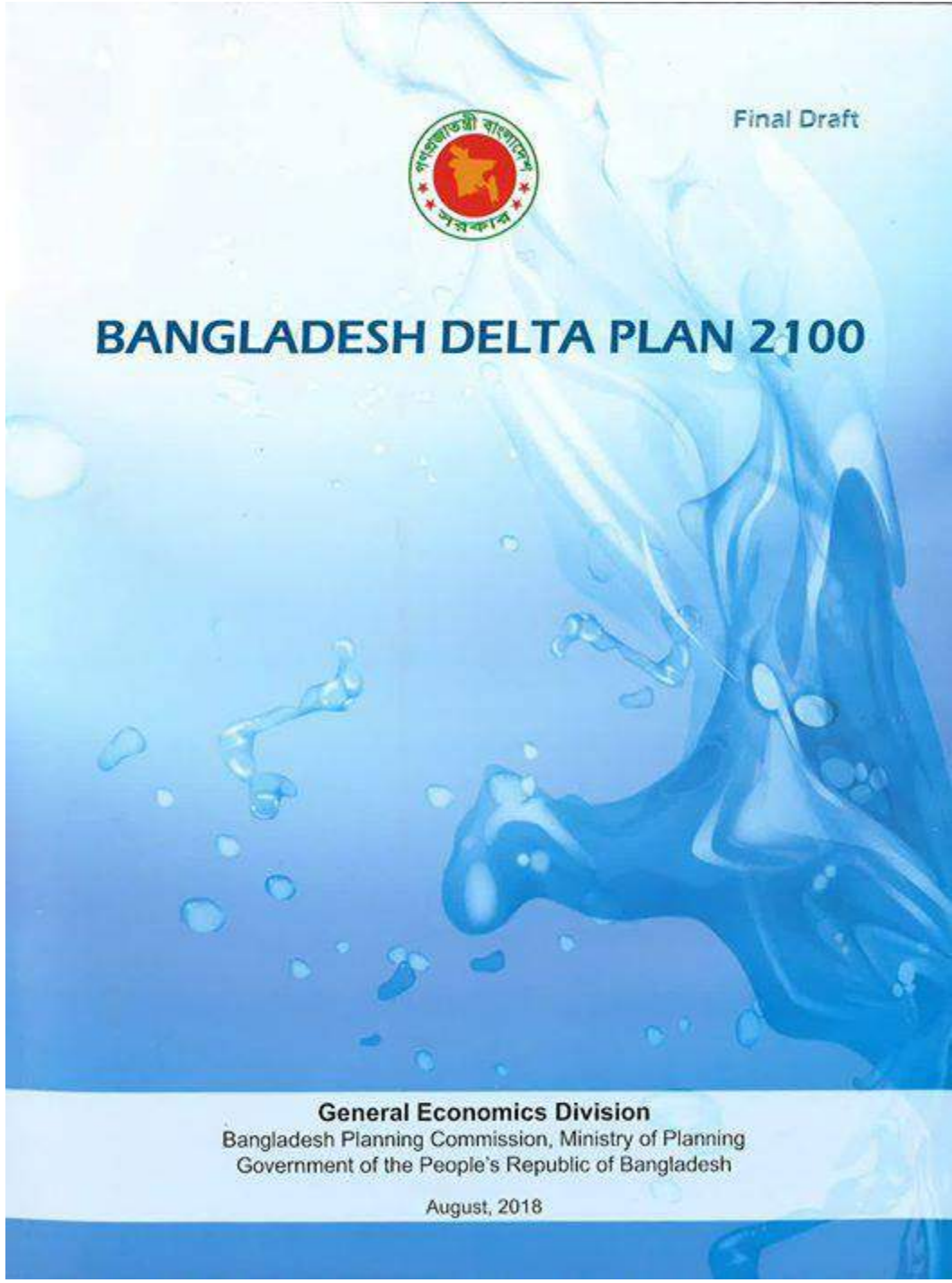
Goal: what is to be achieved, used for project prioritization
*6 BDP2100 Goals (*Safety from disasters, water security, integrated river-estuaries, ecosystems conservation, governance, IWRM)

Scenario: exogenous developments to the water system under consideration that cannot be controlled
4 BDP scenarios (Resilient, Productive, Moderate and Active)

Project: intervention or action taken to achieve a goal

Program: logical combination of individual project

Indicator: measurement or value that helps assessing if the goal(s) is achieved or not

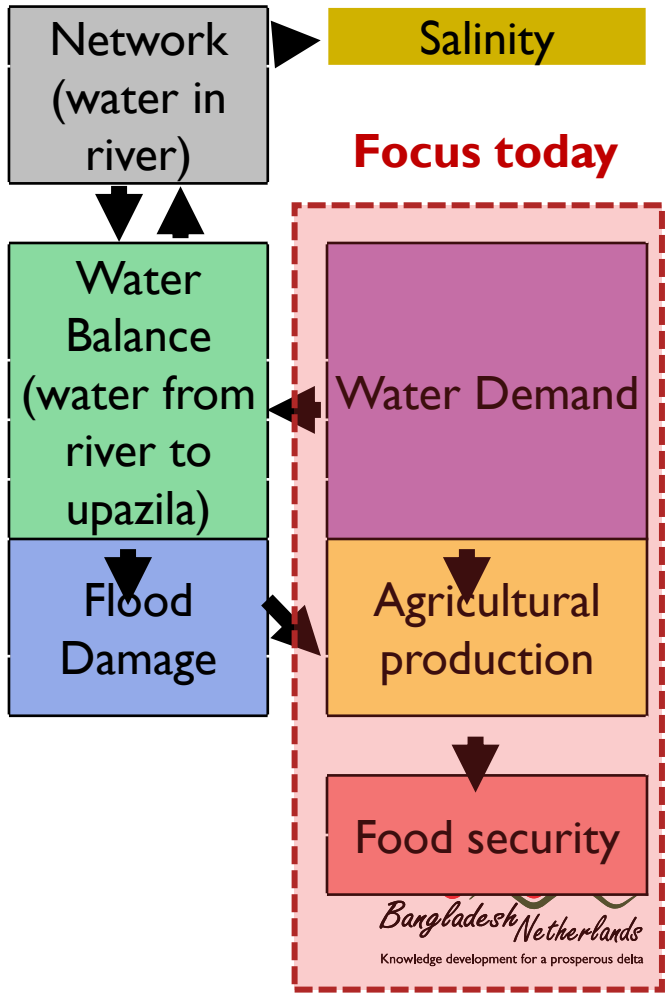


Indicators

All decision support indicators are linked to the SDGs and the BDP2100 Goals
Color represent modules
* Results in progress

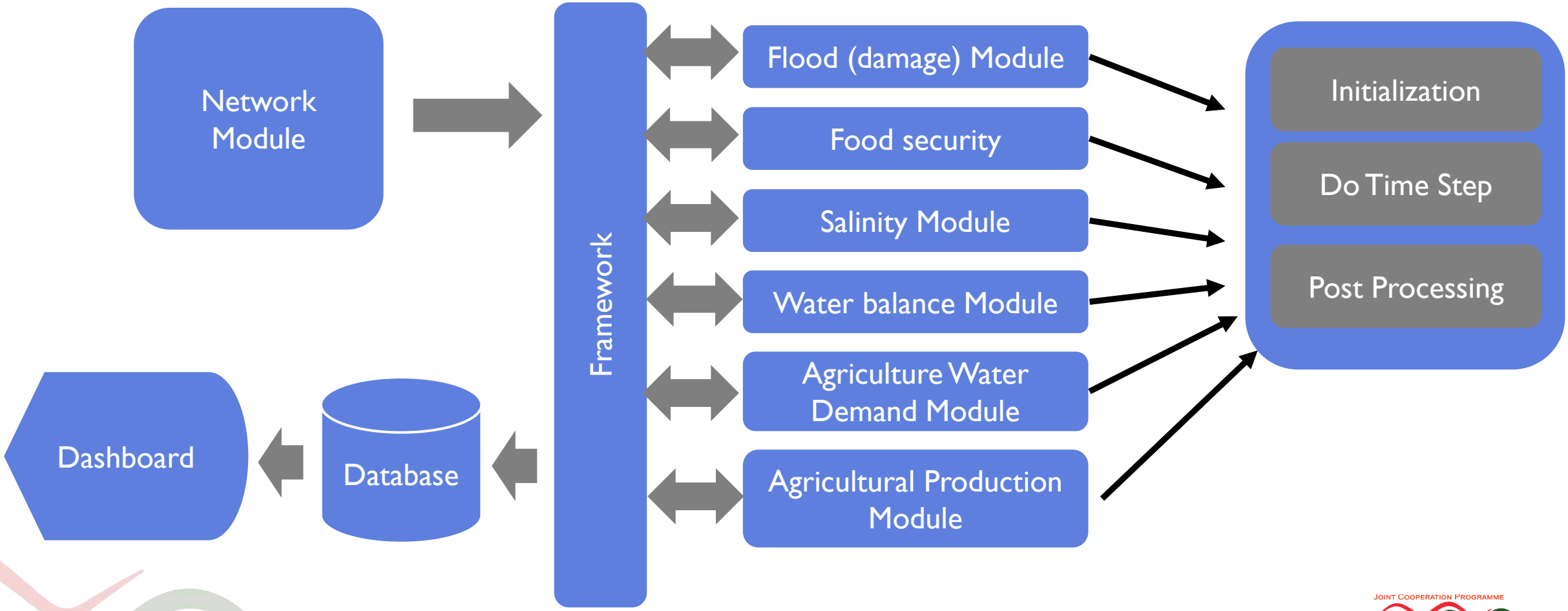
State Indicators	Decision Support Indicators
Environmental flow (m^3/s)*	Annual rainfall damage (Taka)
Dry season river flow (m3/s)	River navigability (km/class)*
Annual flood extent (km^2)	Rural access to safe drinking water (%)
Annual flood duration (month)	Habitat area suitable for protective species (km^2)
Extreme flood extent (km^2)	
Waterlogged area (km^2)	
GWL at end of dry season (m)	
Flood damage (Taka)	Poor households affected by droughts, floods and salinity (%)
	Displaced people due to disasters (%)
	Rice production (Ton)
	Food security for the poor (%)
Area affected by salinity (km2)*	Cost of project implementation (Taka)

Metamodel engine module workflow



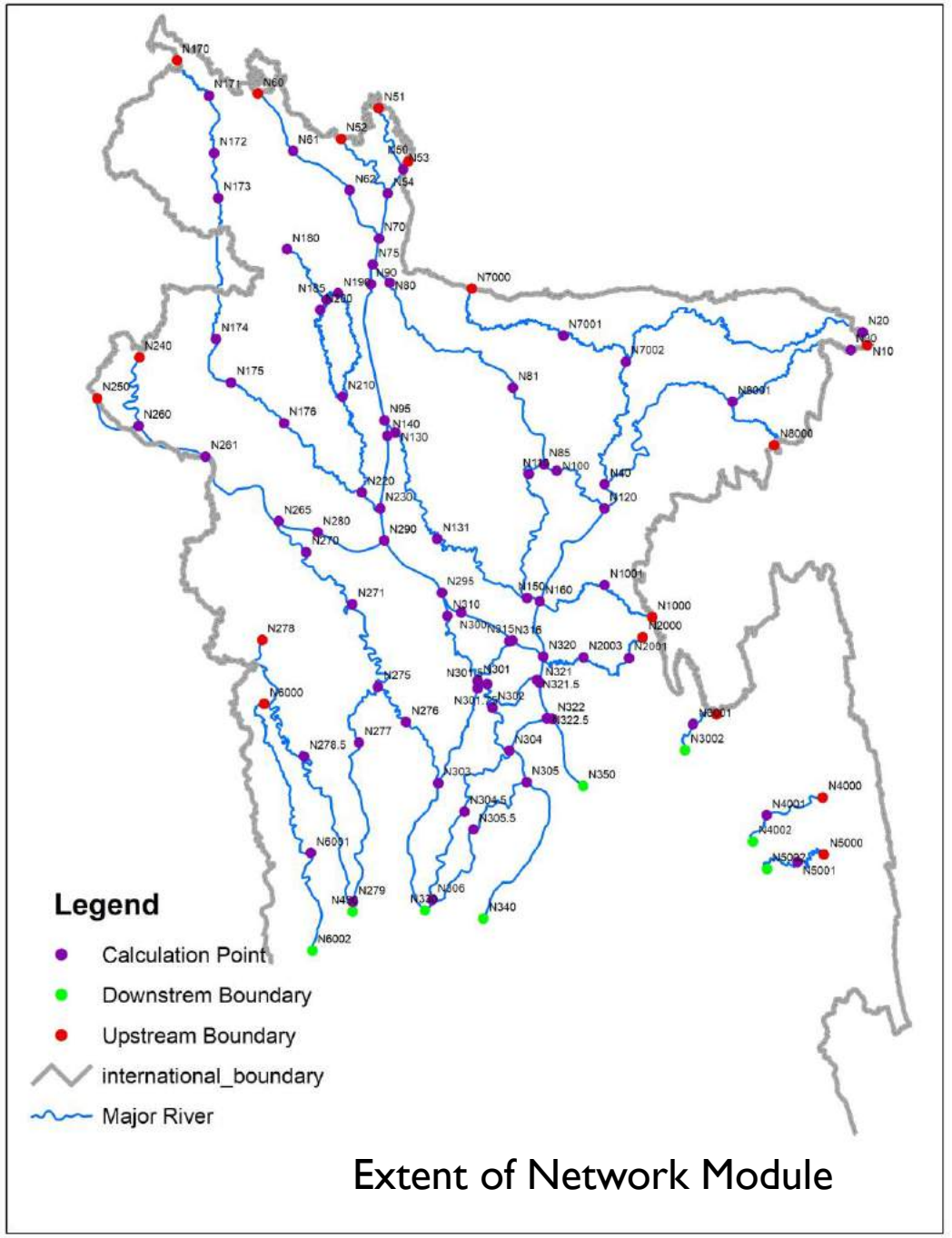
Model Engine & Dashboard

Model engine



Network Module

- *To generate necessary output for Water Balance module and parameter which gives inputs to Agricultural Production module & Flood Damage Module*
- *To describe transport of water through the major rivers of Bangladesh;*
- *To calculate decadal discharge, water level, tidal range and salinity (based on detailed IWM MIKE-11 models)*



Extent of Network Module

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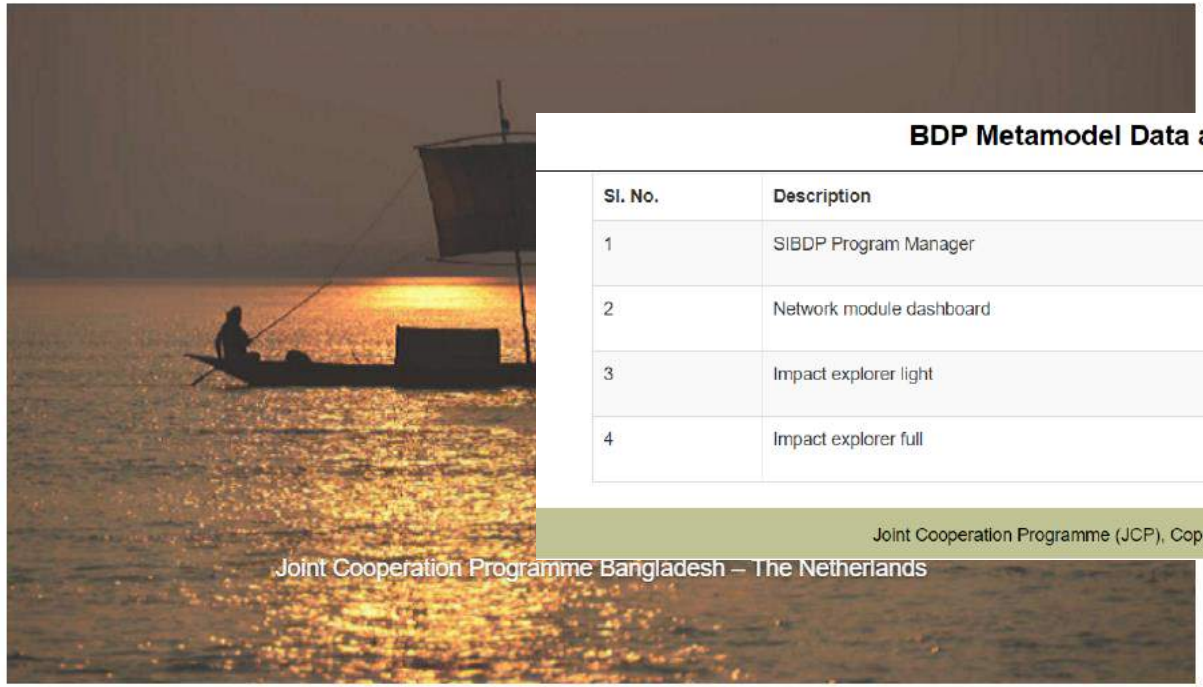

BDP Metamodel Data and Dashboard

Sl. No.	Description	Data	Dashboard
1	SIBDP Program Manager	Data	Dashboard
2	Network module dashboard	Data	Dashboard
3	Impact explorer light	Data	Dashboard
4	Impact explorer full	Data	Dashboard

Welcome to Joint Cooperation Programme (JCP)

JCP News

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Impact explorer

- Main interface to BDP Metamodel results
- To support GoB agencies to evaluate and compare calculated impacts of projects and programs on water and society.
- Used for viewing model results for future decision-making
- Development of Metamodel Engine and Database is under development; we now make use of dummy values to be able to discuss the main elements of the Metamodel

Program Manager

- Idea developed together with SIBDP to support the preparation of programs (= cluster of project)
- By showing:
  - Implementation pathway
  - Total cost
  - Annual cost
  - Funding sources
  - Contribution to BDP Goals

No new information, but combination and visualization of information from the BDP2100 investment plan

Water Demand Module

Water Demand

Objective

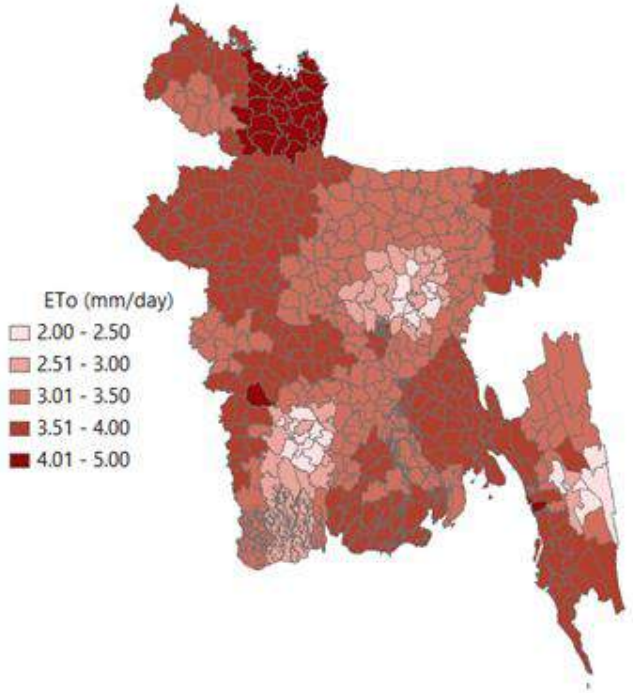
To estimate amount of water needed to meet water loss through evapotranspiration from crop land, forest land, fallow land, settlements and waterbodies.

Specific objectives :

1. crop water demand per crop per upazila on decadal basis.
2. loss of water through evapotranspiration from forest land, fallow land, settlement and waterbodies by upazila on decadal basis.

Crop water demand (m^3/decade)

1. Crop Water Demand (CWD) = (10*ETo$_i$ * Kc$_i$)/1000 *Acrop*10000 = ETo$_i$*Kc$_i$*Acrop*100
2. *Penman-Monteith (FAO, 1988):* Estimation of Decadal ETo (36 BMD station) and station data interpolated to Upazila by IDW (*Inverse Distance Weighting) method.*
3. BARI, 2018, MPO,1987: Crop coefficient (Kc)
4. Crop data (district) from Yearbook of Agricultural Statistics-2018



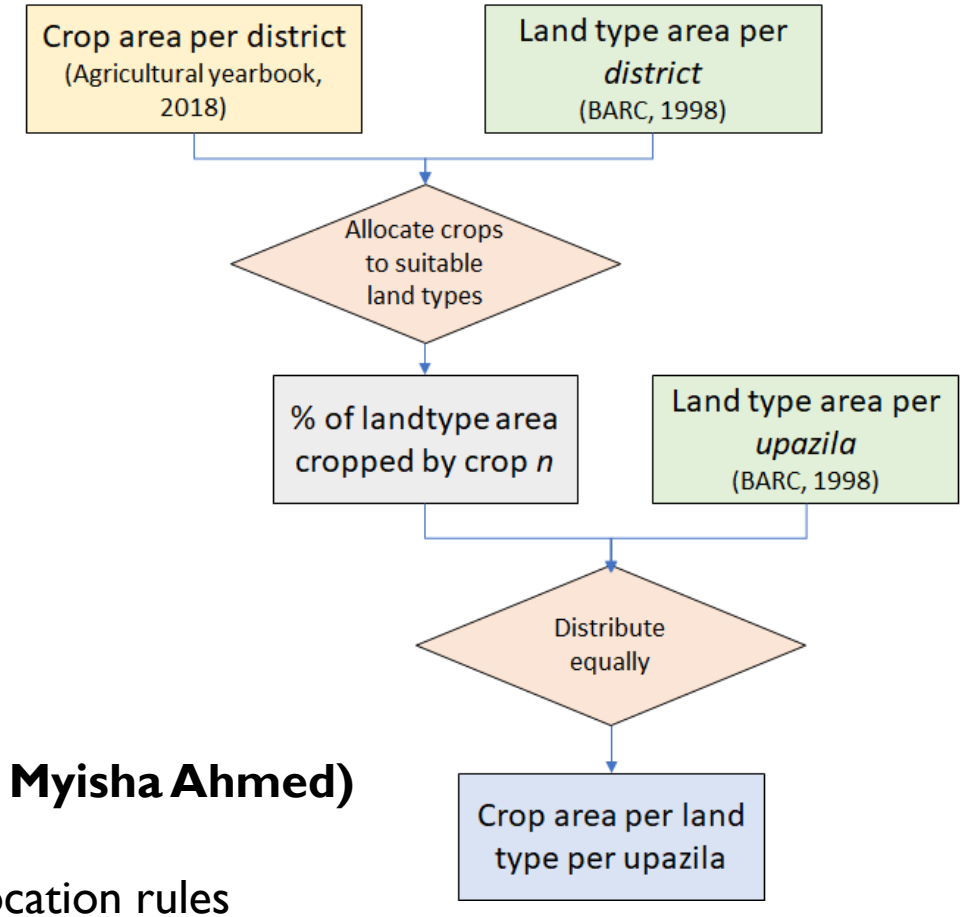
Crop coefficient
(BARI, 2018, MPO,1987)

Land type (F)
BARC, 1998

Per season:
Area per crop per landtype in an upazila →
Total water demand

Documentation available: http://jcpbd.nl/bdpMetaModelDocs.php

Results: Crop distribution (District to Upazila)



Crop Name	Land Type F0	F1	F2	F3	F4	Season	Implemented Suitability
Aus	2	1	3			2	1,0,2,3,4
T Aman	2	1	3			3	1,0,2,3,4
B Aman		2	1	3		3	2,1,3,0,4
Boro	5	3	2	1	4	1	*
Wheat	1	2	3	4		1	0,1,2,3,4
Pulses	1	2	3	4		1	0,1,2,3,4
Maize_Rabi	1	2	3	4		1	0,1,2,3,4
Maize_Kharif	1	2				2	0,1,2,3,4
Jute	1	2	3			2	0,1,2,3,4
Spices	1	2	3			1	0,1,2,3,4
OilSeeds	1	2	3	4		1	0,1,2,3,4
Potato	1	2	3	4		1	0,1,2,3,4
Sugarcane	1	2				4	0,1,2,3,4
Vegetables_S	1	2				2	0,1,2,3,4
Vegetables_W	1	2	3			1	0,1,2,3,4

*Upazila data from Satellite Images

Suitable	
Moderately Suitable	
Not Suitable	

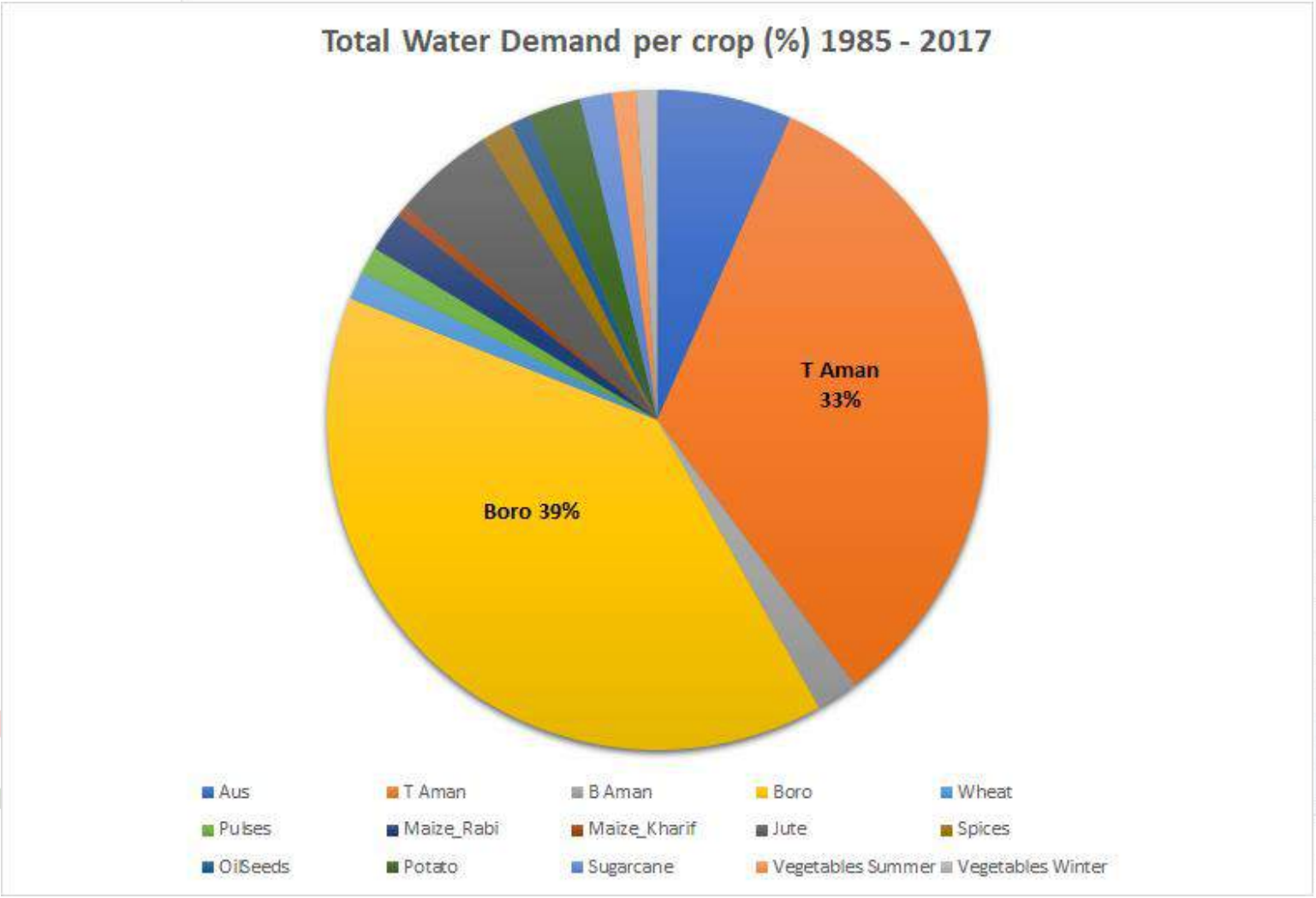
Input for the Metamodel (Colomn Suitability 1 = highest and 4 lowest)

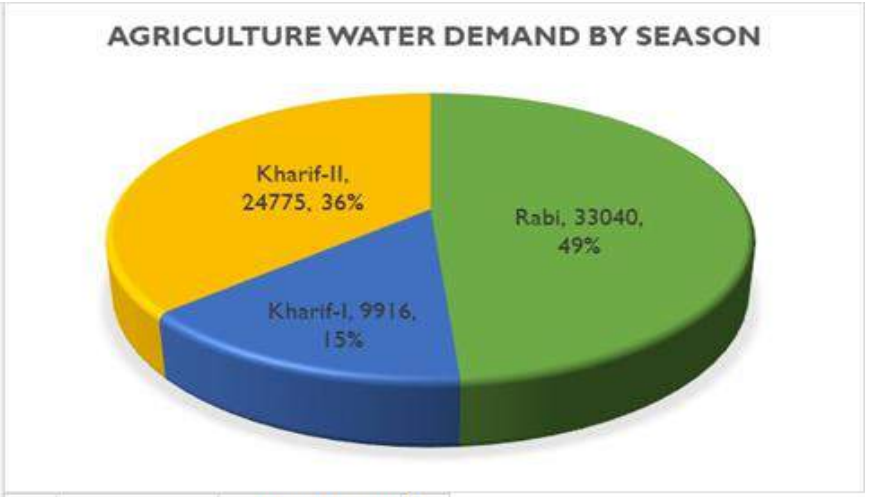
Under development (MSc Myisha Ahmed)

I. Include crop rotation in allocation rules
II. Test for adaptations or alternative crop rotations

Results: Water Demand

from meta-model engine





SL	Crop Name	Water Demand (Million Cubic Meter)
1	Aus	4,477
2	T Aman	23,626
3	B Aman	1,520
4	Boro	26,746
5	Wheat	781
6	Pulses	717
7	Maize_Rabi	1,210
8	Maize_Kharif	342
9	Jute	3,217
10	Spices	788
11	OilSeeds	523
12	Potato	1,406
13	Sugarcane	1,167
14	Vegetables_S	731
15	Vegetables_W	480
	Total	67,731

Agricultural production module

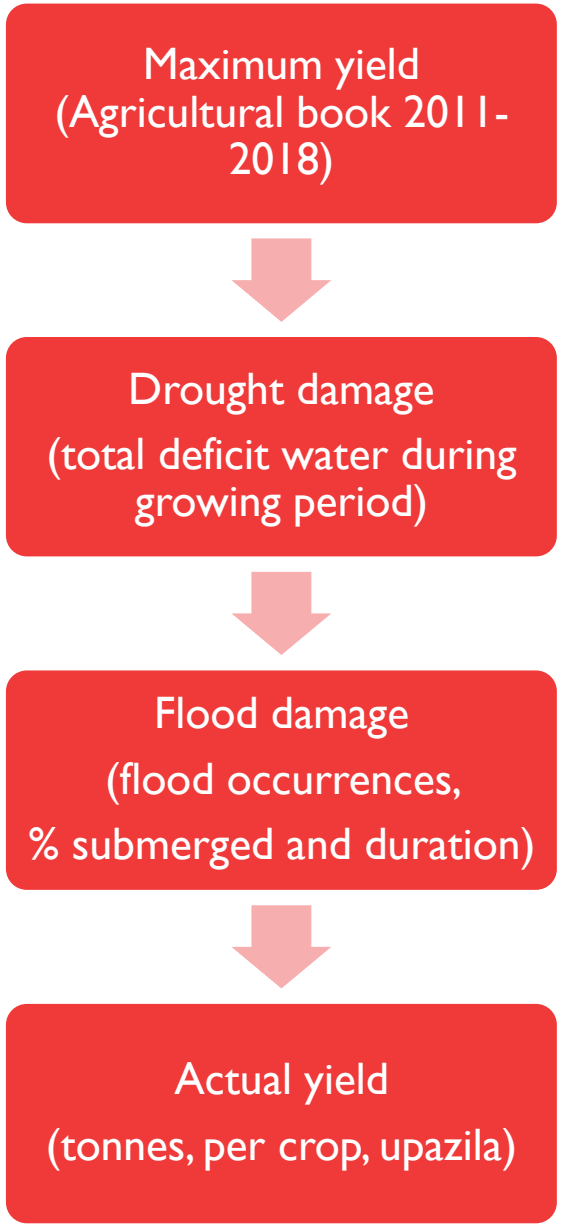
Agricultural production

Goal

Actual crop yield of 15 crops

Agricultural production (Important considerations)

1. Input from other modules water demand (water demand, cropping area) and water balance (water supply, flooding depth)
2. The potential yield is reduced by flooding and drought damage (FAO, 2012)
3. Calibration: Crop yield (district) from Yearbook of Agricultural Statistics-2011 – 2018 (include damage from flood events)



Documentation available: http://jcpbd.nl/bdpMetaModelDocs.php

Agricultural production

Data

Agricultural yearbook:

- Chapter 3. Potential yield (63 districts, 7 years, 10 crops) ~4000 data inputs
- Chapter 4. Crop damage due to events ~300 data inputs

Drought damage

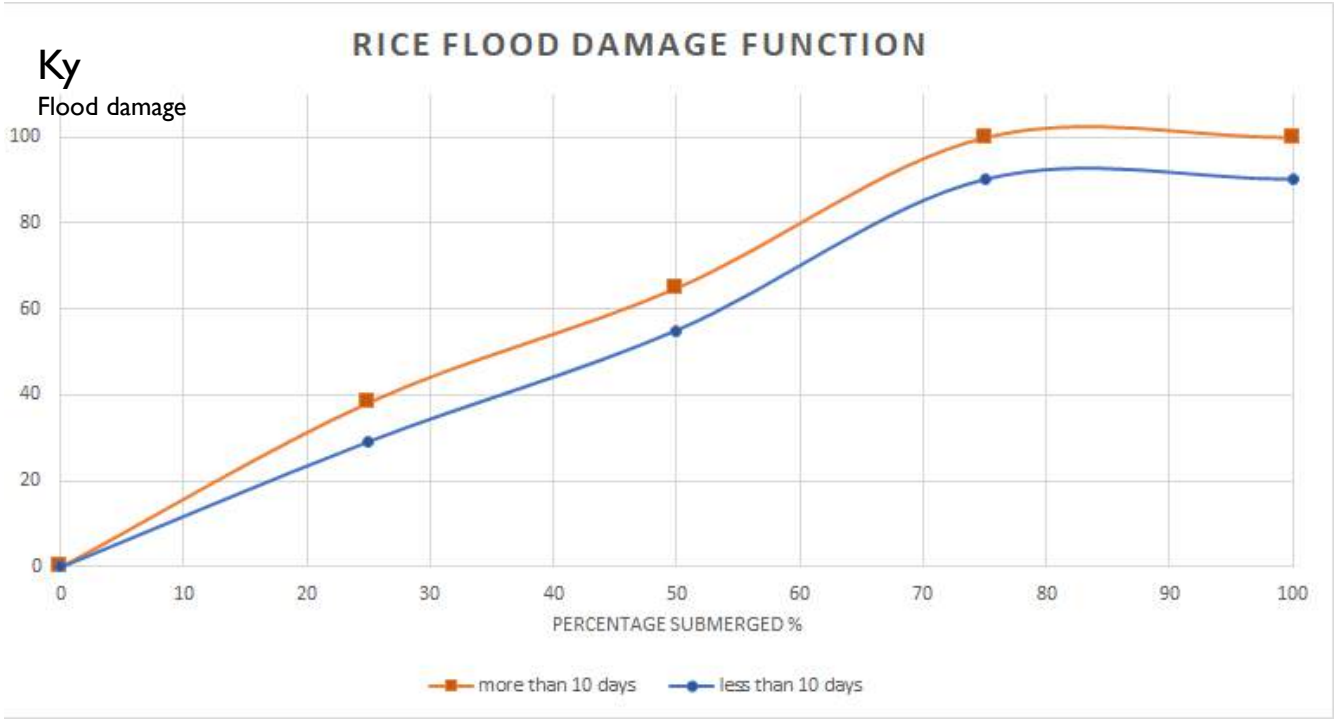
Coefficient Kd = Total deficit / Total demand

Flood damage

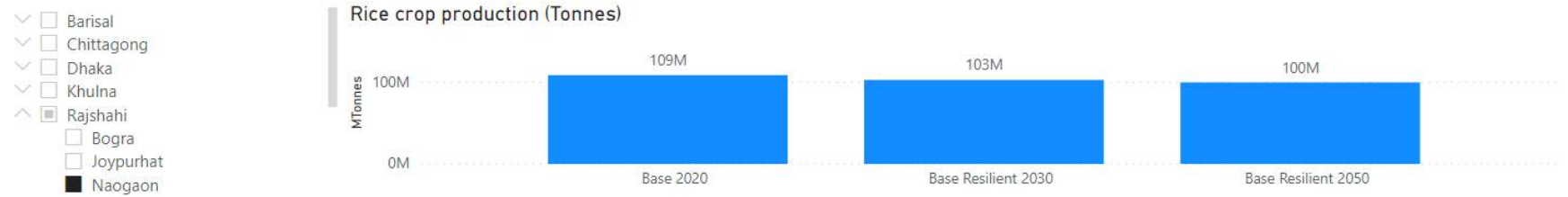
Coefficient Kf, damage function. This depends on days of submerged and % submerged

Rice plants height ~1.2 m

(developed from: Hussain, 1995)



Results: Agricultural production



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Expert's Opinion for future development metamodel

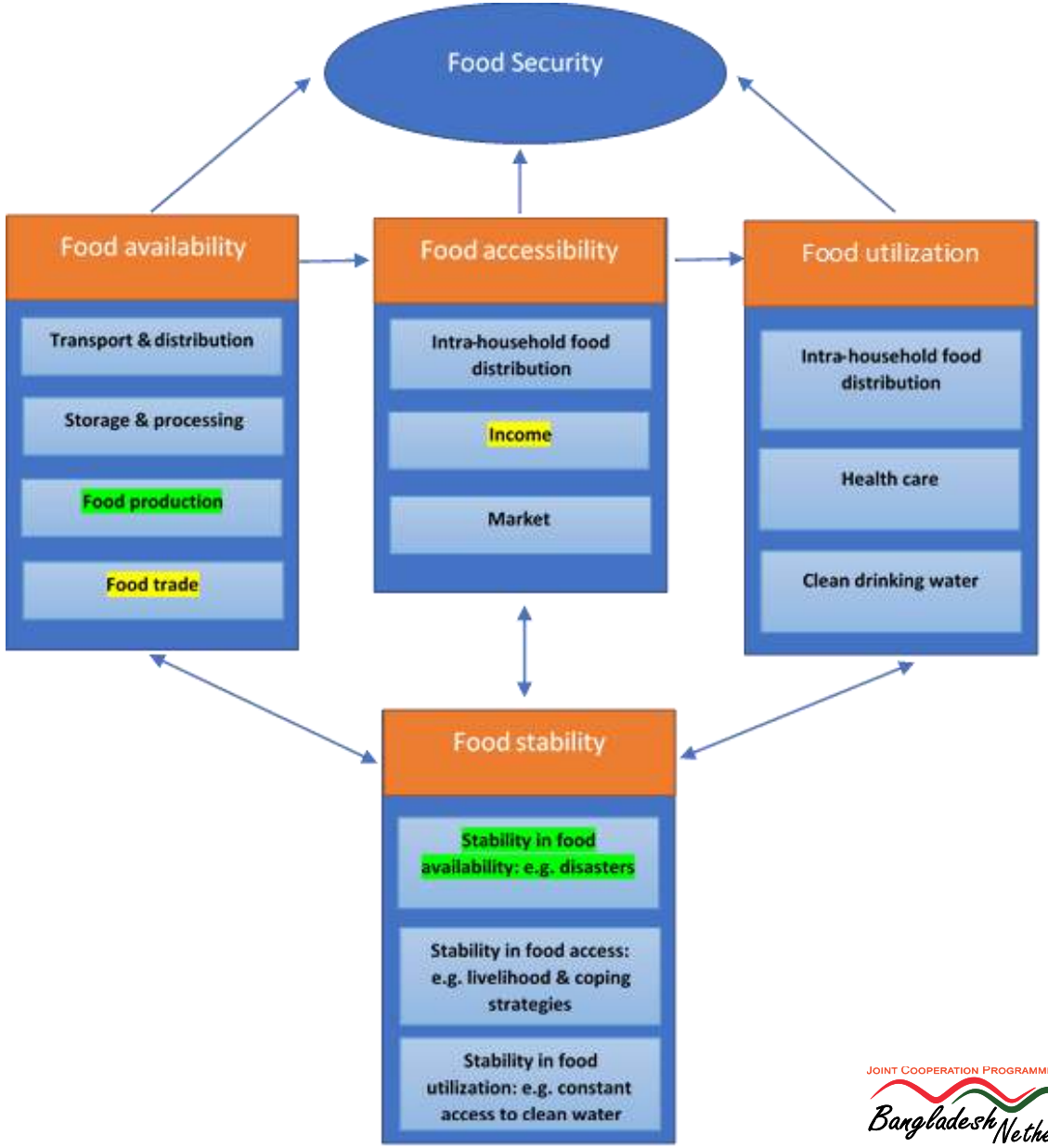
- How can we improve the damage data for drought?
- How can we include the damage calculations(and data) for salinity?

Food security module

Food Security: FAO framework

- "Food Security exists when all people at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (FAO 2000)

- The FAO definition has widely established the four pillars of food security: availability, accessibility, utilization and stability.



Food Security: our approach

Goal

Average Dietary Energy Supply Adequacy (ADESA) for the lowest income (lowest 20% income quantile)

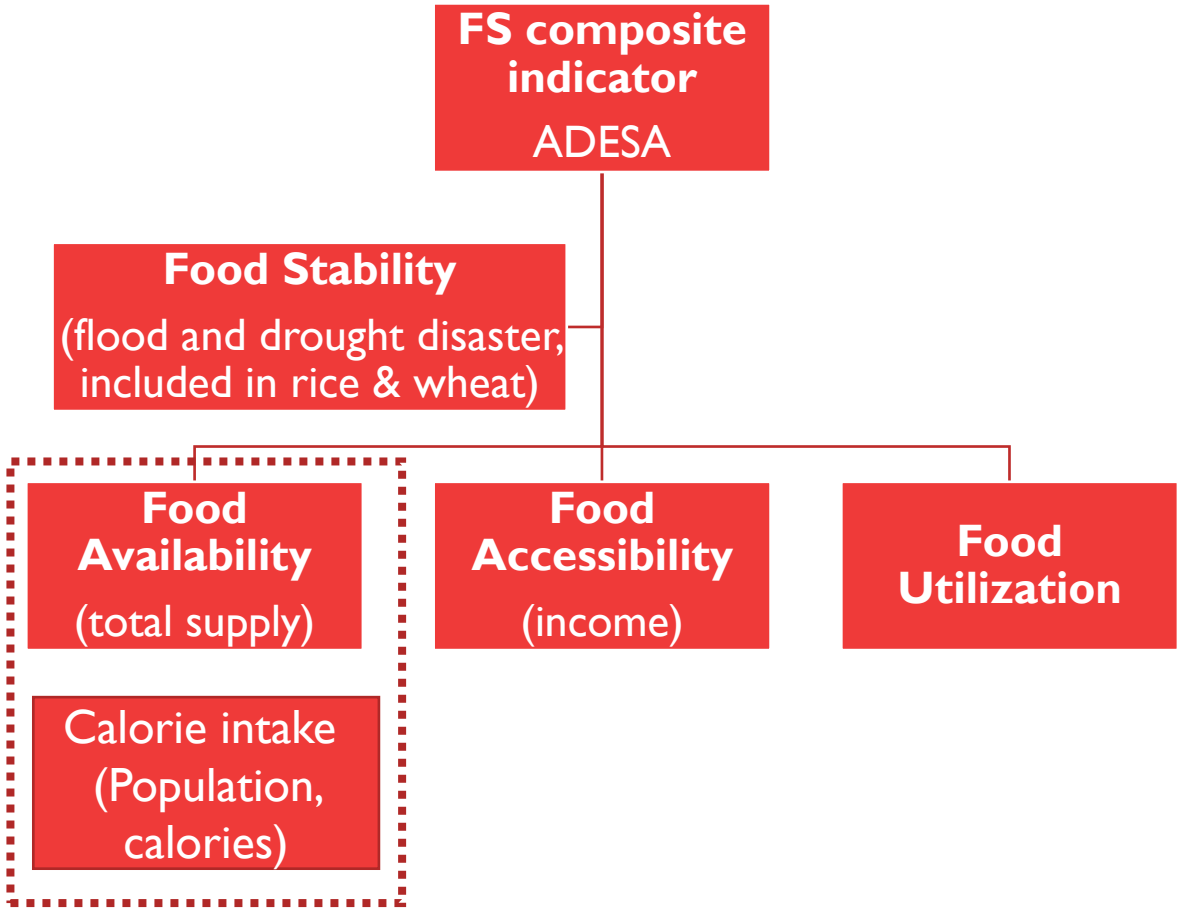
Pillars of food security

- *Availability* Total supply (import & production, rice and wheat from modules, others (meat, milk, and others from data) translated to calorie intake per capita per day
- *Accessibility* Income
- *Stability* Reduced wheat and rice production due to disasters

ADESA: expected calorie intake for lowest income quantile combining all the above pillars

Developments

- Income & production at district level?
- Scenario projections: population, income, food import, other agricultural productions?



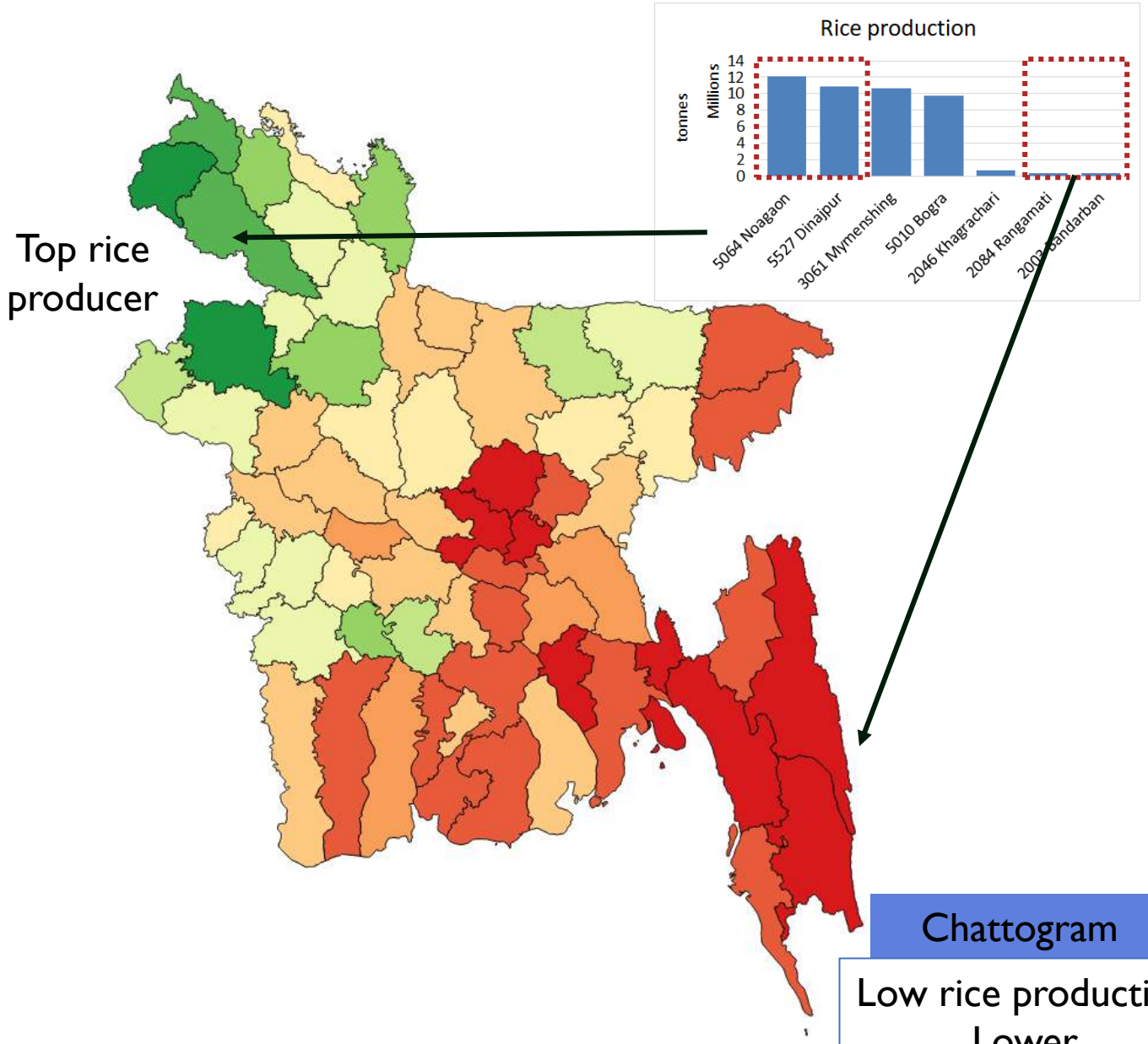
Documentation available: http://jcpbd.nl/bdpMetaModelDocs.php

Results: Food security

Food security composite indicator (ADESA) for the 20% lowest income quantile

Red = Lower food security
Green = Higher food security

Low food security is an impact of
low rice production in combination with
lower income per capita
(e.g. Chattogram)



Discussion

Next Steps (Plans for future)

- Calibration for other area – currently only North-West region
- Calculating the impact of BDP 2100 investment projects
- Add missing data !
- New modules (e.g. fisheries, salinity)
- Get end-user feedbacks and modify the dashboard based on that

Lessons learned

- Rapid prototyping and feedback sessions on dashboards with clients are essential
- Continuous tuning with SIBDP and GED key to optimal use of Metamodel in their process
- Good and fruitful cooperation between Bangladeshi and Dutch technical experts
- Online working sessions are going very well (COVID19)
- Challenges in calibration (low data availability & sources data)
- Assumptions must be made to develop new projects or test ongoing projects, much more detailed information required!