HighNoon

HighNoon Final report Figures and Tables

Annex to the Final report Main S&T results

FIGURES

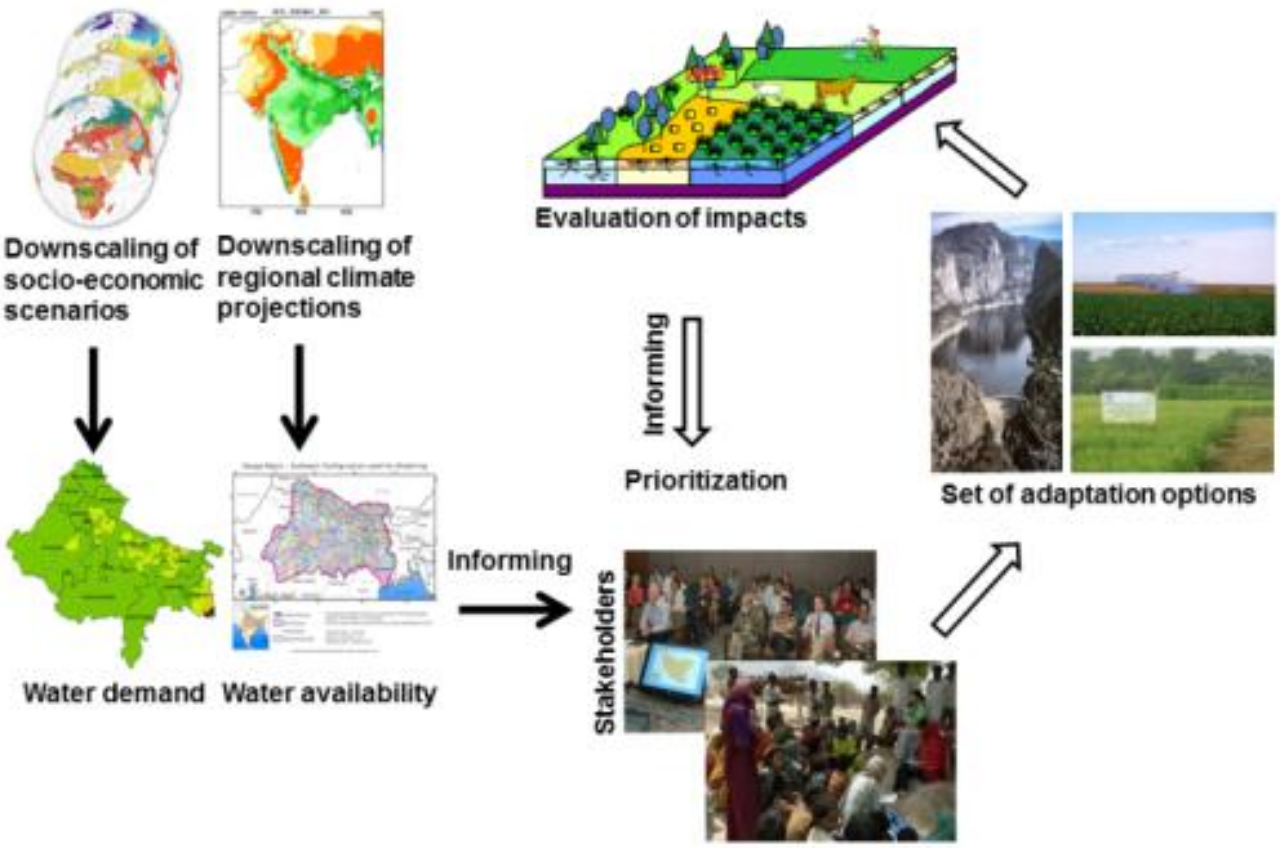


Figure 1.0 The transdiciplinary HighNoon approach

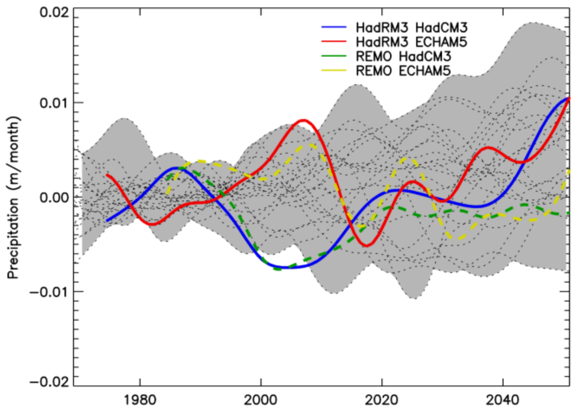


Figure 1.1 Change in annual precipitation relative to 1971-2000 simulated by the IPCC AR4 Models (Grey) and the HighNoon Regional Climate models under the SRES A1B scenario. The data are smoothed to show the decadal climate variability.

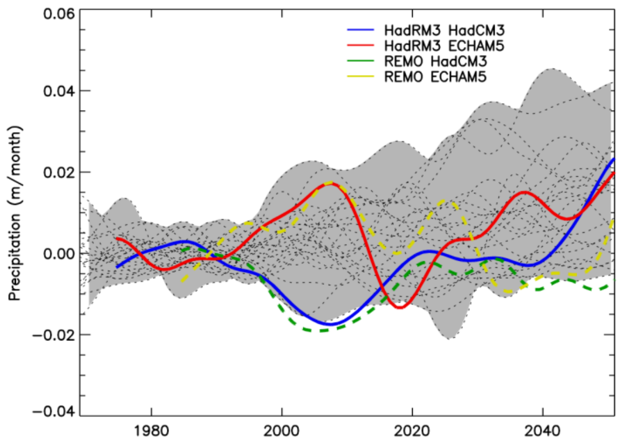


Figure 1.2 Change in Monsoon season precipitation relative to 1971-2000 simulated by the IPCC AR4 Models (Grey) and the HighNoon Regional Climate models under the SRES A1B scenario. The data are smoothed to show the decadal climate variability.

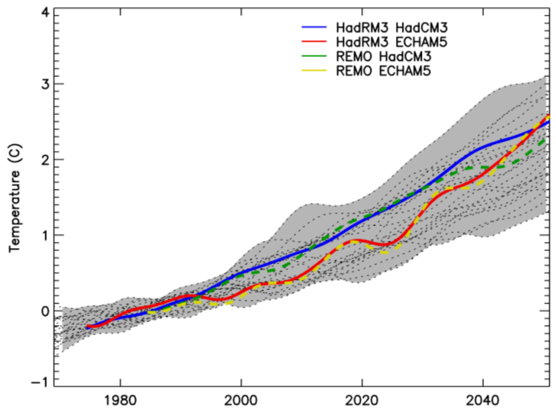


Figure 1.3 Change in annual mean temperature relative to 1971-2000 simulated by the IPCC AR4 Models (Grey) and the HighNoon Regional Climate models under the SRES A1B scenario. The data are smoothed to show the decadal climate variability.

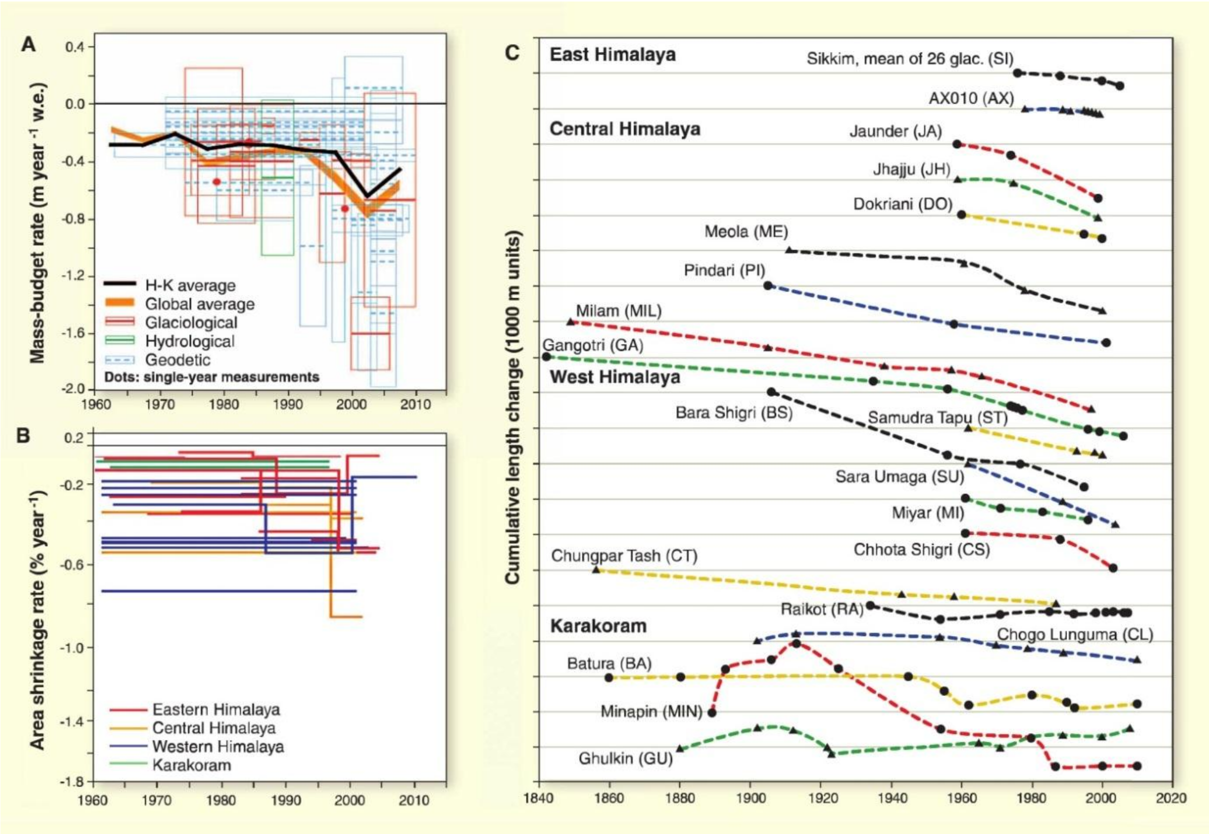


Figure 2.1 Area Shrinkage, mass budget rates and cumulative length changes for the Himalayas

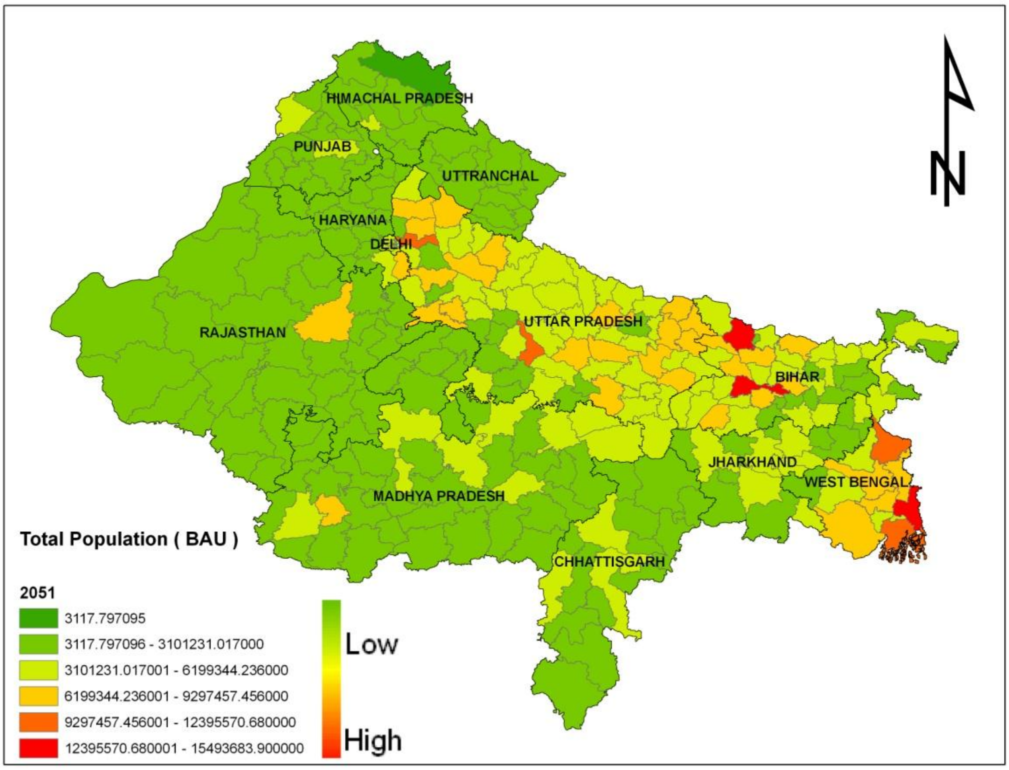


Figure 3.1 Example of the distribution of total populations in 2050 according to the 'business as usual' scenario.

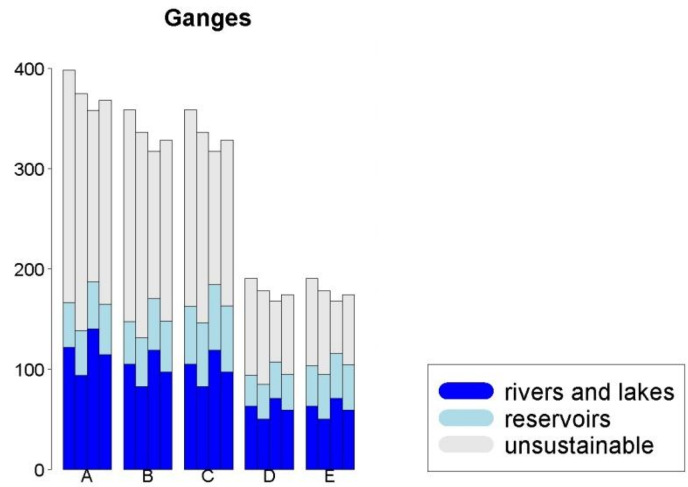


Figure 3.3 Contribution of water sources to fulfill irrigation water demand. Mean annual gross irrigation demand in km3 and its sources of supply. Results are shown for present (i.e. 1971-2000) climate and year 2000 landuse (A), and for the future (i.e.2036-2065 climate and 2050 land use) for the baseline situation without adaptation (B), doubled reservoir capacity (C), improved efficiency (D) and a combination of the two latter (E). Four adjacent bars show the results simulated by four RCMs (REMO-Echam, REMO-HadCM3, HadRM3-Echam and HadRM3-HadCM3, respectively.

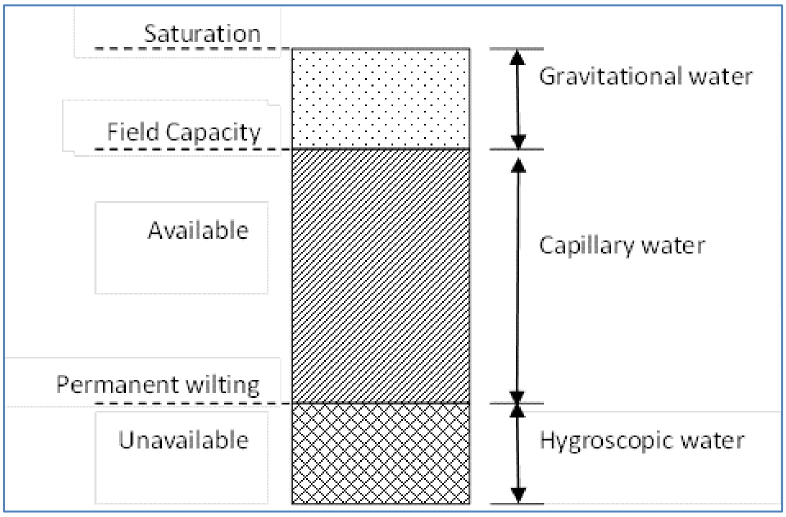


Figure 5.1 Classes and availability of water (Soil moisture movement)

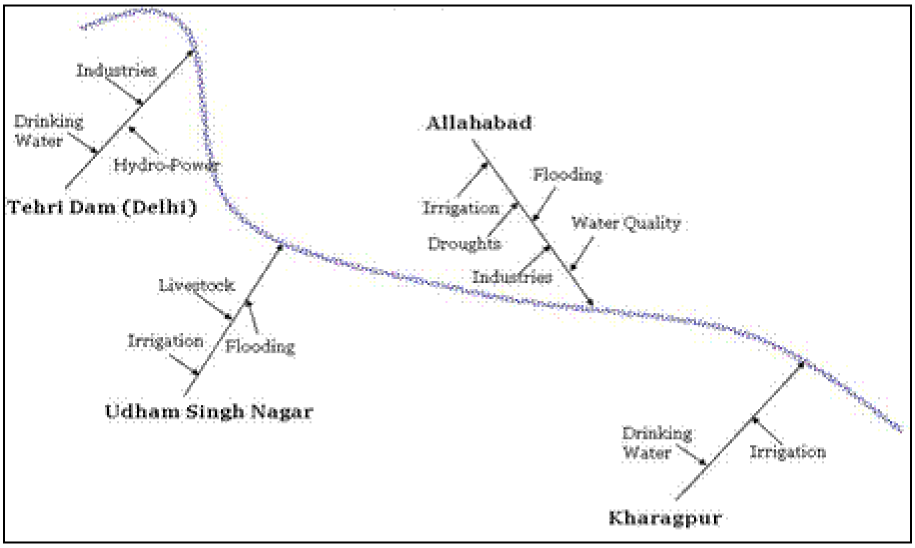


Figure 6.1 Relative locations of the 4 selected case study sites in the basin and some existing key issue in these sites.

FORMULAS

Formula 5.1

$$ET_{rel} = \frac{ET_a}{ET_p}$$

TABLES

Table 5.1 Classification of relative evapotranspiration

ETrel range	Interpretation
1.0-0.8	water scarcity of the plant is only theoretical, because the water supply to the plants is continuous and not limited
0.8-0.5	The water demand is still continuous, but it is getting increasingly restricted
0.5-0.3	Water scarcity is high, the water supply to the plants is periodical and restricting, therefore water-stress develops
<0.3	Strong water stress occurs, causing considerable biomass and yield deficiency, and when this stage lasts long also the death of the plant

Table 5.2 Characteristics of the Blue Water Flow and Green Water (Flow + Storage)

Type of water	Blue	Green
Sources	rivers, lakes, reservoirs, ponds, aquifers	water that is stored in the unsaturated soil and can be used for evapo-transpiration
Mobility	highly mobile	highly immobile
Substitution of sources	possible	impossible
Competitive uses	many	few
Conveyance facilities	required	not required
Cost of use	high	low

Table 5.3 Indicators for case study sites

Indicators / Case Study Site	**Short Description of Indicators**	**Ramganga - Udham Singh Nagar District**	**Tons - Meja Block of Allahabad District**	**Kangsabati - Bankura, Purulia Districts**
Case Study Site Description		The Ramganga basin represents the upper part of the Ganga basin. • Major Landuse - agriculture, forest and urban. • Soil - mainly clay and clay loam • Main crops - rice, wheat, corn, Bajra, sugarcane, potato and are irrigated. Rainfed crops include mung bean and wheat. • Average annual rainfall varies from 1000 – 1500 mm.	Tons basin represents the middle part of the Ganga basin. • Major Landuse - agriculture, forest and urban. • Soil - highly fertile alluvial • Main crops – wheat, rice and pulses like Arhar, Urad and Chana. • Average annual rainfall varies from 900 – 1000 mm	The Kangsabati basin represents the lower part of the Ganga basin. • Major Landuse - agriculture • Soil - red loamy, non-calcareous and lateritic • Main crops - rice, pulses (moong, blackgram and pigeon pea), wheat and groundnut. • Average annual rainfall varies from 1000 - 1600 mm
Indicators / Case Study Site	**Short Description of Indicators**	**Ramganga - Udham Singh Nagar District**	**Tons - Meja Block of Allahabad District**	**Kangsabati - Bankura, Purulia Districts**

Agricultural water stress **Scale Taken** ETrel range <0.3 – Severe Water Stress 0.5-0.3 – High Water Stress 0.8-0.5 – Moderate Water Stress 1.0-0.8 – Low/ No Water Stress	Agricultural water stress is relative evapotranspiration (ETrel) on seasonal basis. It is ratio of Actual Evapotranspiration to Potential Evapotranspiration.	**Agricultural water stress** • Severe water stress - January to March and December • High water stress - April to June, and October to November. • Moderate water stress – July to September.	**Agricultural water stress** • Severe water stress February to mid June and October to December. • High water stress - January, later part of June, and later part of September. • Moderate water stress –July to September.	**Agricultural water stress** • Severe water stress - December to Mid April. • High water stress - October to November • Moderate water stress – Later April to July. • No water stress - August to September.
Irrigation Requirement / Crop Water Deficit *	Crop Water Deficit is seasonal crop water requirement over and above rainfall. It is water required for irrigation. Negative value indicates that the area needs more water than what is available in the area.	**Irrigation Requirement status** • High– Pre Monsoon seasons • Low - Winter, Post monsoon and monsoon seasons	**Irrigation Requirement status** • High – Pre Monsoon seasons • Moderate – Winter and partial monsoon seasons • Low – Post monsoon	**Irrigation Requirement status** • Moderate – All seasons
Indicators / Case Study Site	**Short Description of Indicators**	**Ramganga - Udham Singh Nagar District**	**Tons - Meja Block of Allahabad District**	**Kangsabati - Bankura, Purulia Districts**

Blue Water Flow / Natural Water Resources	Blue water Flow or Natural Water Resources is Internal renewable water resource, quantified as the sum of the water yield and the deep aquifer recharge. It represents the water that can be withdrawn for irrigation, drinking, industrial use or water that is available for in-situ water use like navigation.	**Natural Water Resources Available** • High - monsoon season • Moderate – Post Monsoon and Partial Winter • Low – Partial Winter and Pre Monsoon	**Natural Water Resources Available** • High - monsoon season • Moderate – Post Monsoon • Low – Winter and Pre Monsoon	**Natural Water Resources Available** • High - monsoon season • Moderate – Post Monsoon • Low – Winter and Pre Monsoon
Indicators / Case Study Site	**Short Description of Indicators**	**Ramganga - Udham Singh Nagar District**	**Tons - Meja Block of Allahabad District**	**Kangsabati - Bankura, Purulia Districts**
Green Water Flow / Crop Water Requirement	Green Water Flow or Crop Water Requirement is sum of the actual evaporation (the non-productive part) and the actual transpiration (the productive part).	**Crop Water Requirement** • High - monsoon season • Moderate – Pre Monsoon • Low – Post monsoon seasons and Winter seasons	**Crop Water Requirement** • High - monsoon season • Moderate – Post monsoon and winter season. • Low - Pre monsoon seasons	**Crop Water Requirement** • High - monsoon season • Moderate – Post and Pre monsoon seasons. • Low – Winter

Green Water Storage / Soil Moisture	Green Water Storage is available soil moisture. The green water storage can potentially benefit the agriculture in months with little or without precipitation. More precisely, green water storage is the portion of rainfall which is held in the soil and is available for plants' consumption.	**Available Soil Moisture** • High - monsoon seasons and winter seasons. • Moderate – Pre and Post monsoon seasons	**Available Soil Moisture** • High - monsoon seasons and post monsoon season. • Moderate - winter, • Low - Pre monsoon season	**Available Soil Moisture** • High - monsoon seasons and post monsoon seasons. • Moderate - Pre monsoon and winter seasons

Table 6.1 Four phases of the Stakeholder Interaction Process in WP 6

Phase	Core Activities	Level and sequence
I	Preparatory/First consultation phase: Stakeholder identification, first consultation round and selection of study sites	1. State 2. District
II	Participatory vulnerability analysis and listing a first set of adaptation strategies	1. State 2. District/ Block 3. Community
III	Prioritizing adaptation strategies by stakeholders and identifying no regret strategies	1. State 2. District/ Block 3. Community
IV	Organizing feedback from stakeholders on the (modelled) effects of the adaptation strategies and define adaptation strategies of high priority	1. State 2. District/ Block 3. Community

Table 6.2 Perception of Hazards

	USN	Allahabad	Paschim Medinipur
Community	▪ Increase in temperature ▪ Increase in high intensity rainfall events ▪ Shifts in monsoon period ▪ Negligible winter rainfall ▪ More intense flood events ▪ Decline in total quantity of rainfall	▪ Increase in summer temperatures ▪ Shorter winter seasons ▪ Decrease in winter rainfall ▪ Persistent drought conditions	▪ Increase in temperature ▪ More severe winters ▪ Delays in Monsoons ▪ Uneven distribution of rainfall ▪ Decrease in rainfall, especially in winter
District	▪ Increase in temperature, especially at night ▪ More severe winters ▪ Uneven rainfall leading to high intensity precipitation events and flooding ▪ Increased variability in the onset of monsoons ▪ Decrease in winter rainfall ▪ Recurring flood events ▪ Increased variability in frequency and intensity of extreme events ▪ Occurrence of droughts	▪ Increase in summer temperatures ▪ Shorter and more severe winters ▪ 25% rainfall reduction in past 15 years; adverse effects on groundwater recharge ▪ Delayed onset of monsoons ▪ Lesser winter rainfall ▪ Changes in distribution of monsoon across district	▪ Increase in temperature ▪ Reduced winter rainfall ▪ Increase in high-intensity, short duration rainfall events ▪ Increase in range of diurnal temperature ▪ Reduced winter rainfall ▪ Dilution in distinction between seasons
State	▪ Increase in temperature ▪ Shift in peak of rainfall season ▪ Shrinking rainfall period in the *Kharif* season	▪ Increase in summer temperatures ▪ Reduced rainfall ▪ Frequent delays in onset of monsoons ▪ Higher incidences of floods and droughts	▪ Increase in temperature ▪ Late onset of monsoons ▪ Increase in rainfall related extremes ▪ Scanty rainfall in recent years

Table 6.3 Perceptions of stakeholders on their vulnerability

	USN	Allahabad	Paschim Medinipur
Community	• Inundation of cultivable land due to floods • Loss of productive land and property • Progressive decline in farm income	• Scarcity of water for drinking and irrigation • Migration • Lack of resource and income	• Decline in water availability for domestic uses (drinking and sanitation) • Migration is not an option, but a necessity during dry season, especially for landless labourers

	USN	Allahabad	Paschim Medinipur
District	• Landless laborers and the poor are the most vulnerable groups • Habitats closer to flood plains and more prone to extremes • Higher rate of land fragmentation adds to vulnerability		• Rain fed subsistence agriculture practitioners are most vulnerable being entirely monsoon dependent • Insufficient and variable irrigation water supply from the reservoir has increased vulnerability of irrigation dependent farmers
State	• Increase in demand and scarcity of water in the future • Depletion of groundwater resources • Hilly districts more vulnerable due to dependence on fragile ecosystems compounded by remote accessibility • Reduced energy generation from reservoir-based hydropower plants	• Lesser food production • Disenchantment with agriculture as a livelihood option • Changing crop cultivation response due to bio-physical stresses	• Decreased adaptive capacity of landless labourers due to forest degradation and lack of access to forest products • Less groundwater availability for drinking and irrigation in regions with hard pan sub surface geology

Table 6.4: Prioritized adaptation options

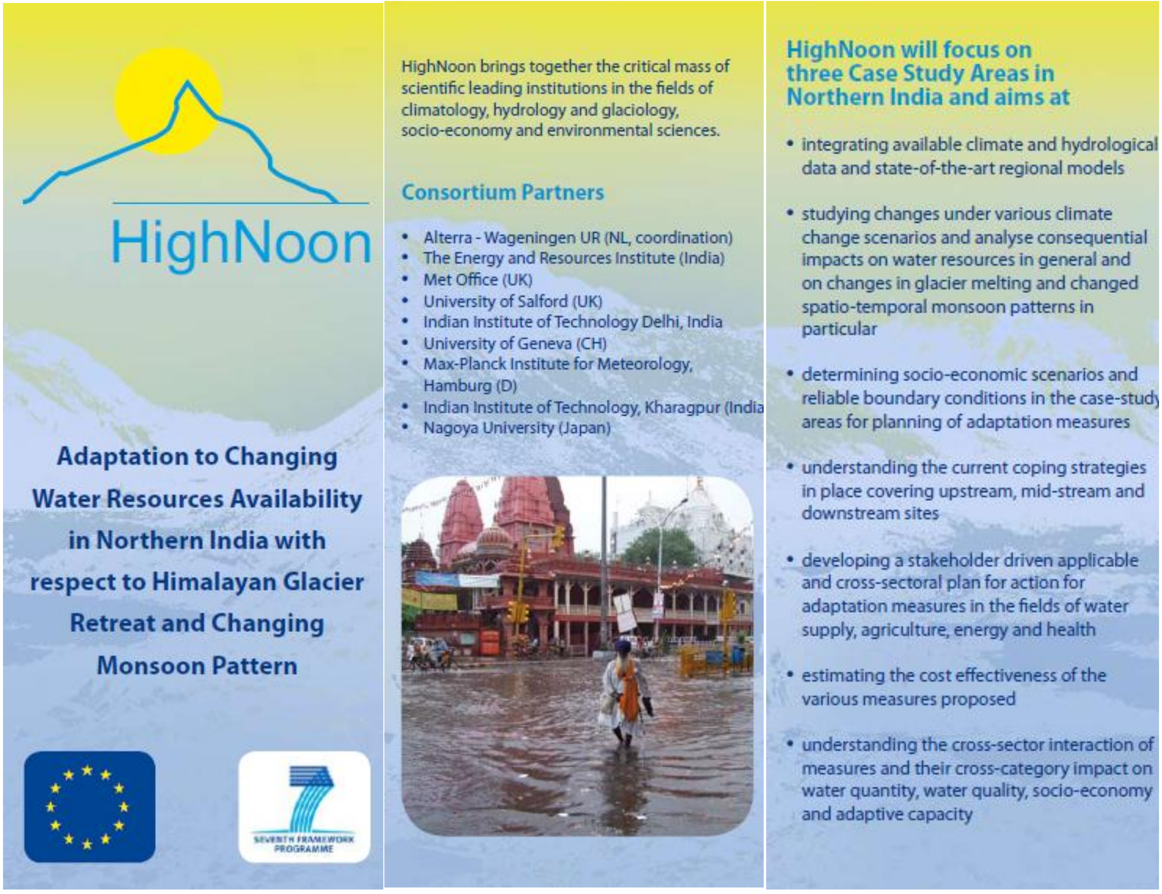
	USN	Allahabad	Paschim Medinipur
Community	1. Monitoring of sand mining from river banks (Anticipatory) 1. Construction of stone embankments (Preventive) 2. Afforestation 3. Livelihood diversification 4. Capacity building for more efficient farming practices	1. Water harvesting structures like ponds/ water storage 2. Drip/Sprinkler Irrigation systems 3. Agro-forestry 4. Crop diversification 5. Afforestation	1. Awareness camps 2. Rain water harvesting 3. Organic farming 4. Integrated farming 5. Short duration varieties 6. Afforestation 7. Deep tube-wells

	USN	Allahabad	Paschim Medinipur
District	1. Public awareness 2. Monitoring sand mining from river banks 3. Better forecasting systems 4. Limiting cultivation of summer rice 5. New varieties under crop insurance schemes 6. Livelihood diversification 7. Strengthening of embankments 8. Promotion of agro-forestry 9. Afforestation with less economically viable trees 10. Relocation of people from flood plains	1. Afforestation or large scale plantations 2. Promoting new technologies like sprinkler irrigation with demonstration 3. Field-bunding 4. Use of heat-tolerant and drought-tolerant crop varieties 5. Lining of canals in water scarce areas 6. Construct soak-pit around all hand pumps	1. Check dams 2. Surface water bodies 3. Field bunding 4. Crop diversification 5. Integrated farming 6. Organic farming
State	1. Participatory Integrated watershed management* • Increasing storage structures (village ponds, tanks, reservoirs) • Creation of markets for agribusiness development • Capacity building of communities and local governments 2. Increasing green cover through afforestation (*Uttarakhand State Watershed Management Directorate)	1. 1. Increasing storage capacities 2. 2. Livelihood diversification, for 3. example through agro-forestry 4. 3. Improved crop varieties 5. 4. Afforestation 6. 5. Lining of canals	1. Better crop varieties 2. Wastewater reuse 3. Increasing forest cover and intensity 4. Artificial groundwater recharge 5. Weather information forecasting 6. Small and distributed check dams 7. Traditional rainwater harvesting structures

PICTURES AND OTHER GRAPHICS

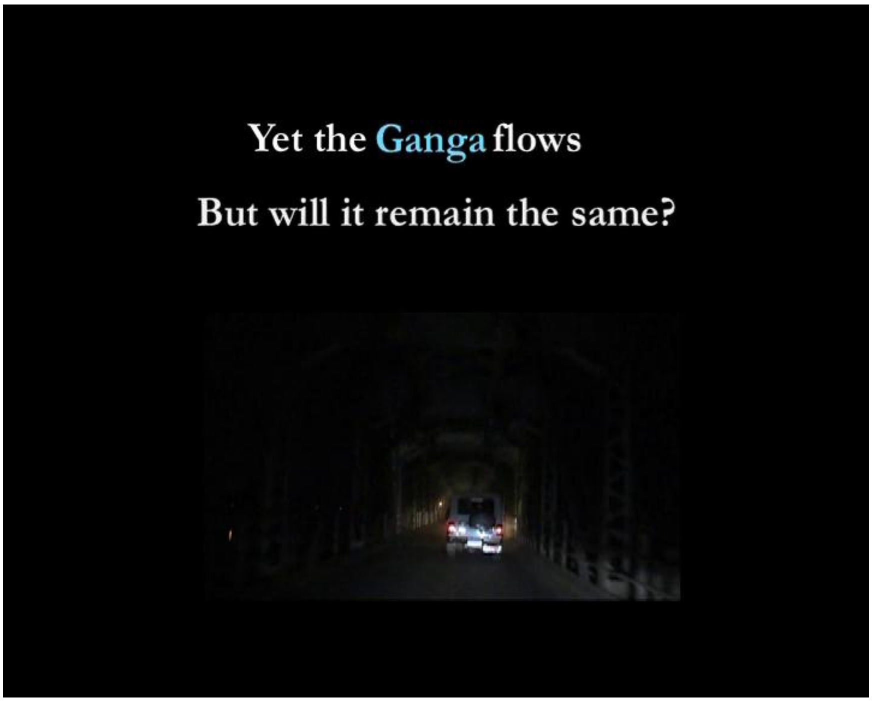
Pictures Presentation at district level in progress

HighNoon Flyer



Open Science Policy Seminar

Screen shot from the video documentary: Ganga Dairies



Stakeholder workshop at Delhi

BENEFICIARIES

Beneficiary Number *	Beneficiary name	Beneficiary short name	Country
1(coordinator)	Stichting Dienst Landbouwkundig Onderzoek, ALTERRA	ALT	The Netherlands
2	The Energy and Resources Institute	TERI	India
3	MET OFFICE	MET OFFICE	United Kingdom
4	The University of Salford	USAL	United Kingdom
5	Indian Institute of Technology Delhi	IITD	India
7	Max-Planck-Gesellschaft	MPG	Germany
8	Indian Institute of Technology, Kharagpur	IITK	India
9	Nagoya University	UN	Japan
10	Universite de Geneve	UNIGE	Switzerland

CONTACT DETAILS

Dr E.J. Moors
ALTERRA
Wageningen University and Research Centre,
P.O. Box 47
6700 AA Wageningen
The Netherlands
Phone: 0031 317 486 431
Email: eddy.moors@wur.nl