IMPACT OF ANTHROPOGENIC DEVELOPMENT AT UPSTREAM OF THE RIVER BRAHMAPUTRA

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IIT GUWAHATI, ASSAM

CAUSES OF WATER RELATED HAZARDS

- ✓ Growth in population
- ✓ Urbanization/ Unplanned urbanization
- ✓ Poverty/Unplanned settlement
- ✓ Industrialization
- ✓ Dams and reservoirs
- ✓ Over exploitation of groundwater

- ✓ Increase in imperviousness
- ✓ Environmental degradation (Deforestation)
- ✓ Filling up of depression
- ✓ Increase in bare land
- ✓ Change in rainfall pattern and flow pattern
- ✓ Depletion of groundwater table
- ✓ Leaching of natural contamination
- ✓ Leaching from waste disposal site
- ✓ Leakage from septic tank

- ✓ Increase in surface runoff
- ✓ Reduction in infiltration
- ✓ Reduction in water storing capacity
- ✓ More erosion
- ✓ Reduction in time of concentration
- ✓ Reduction in initial abstraction
- ✓ Contamination of groundwater

Flood, Erosion, Drought and Contamination


03/07/2006

DAMS ON YARLUNG TSANGPO

ENGLISH.GOV.CN
THE STATE COUNCIL
THE PEOPLE'S REPUBLIC OF CHINA

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Tibet's largest hydropower station becomes partly operational

Updated: Nov 24,2014 6:45 AM Xinhua

VIDEOS

Lacquer art strengthens cultural vitality

WHAT PREMIER SAYS

The old attitudes of fear surrounding the topic of AIDS must be abandoned and AIDS patients need more care.

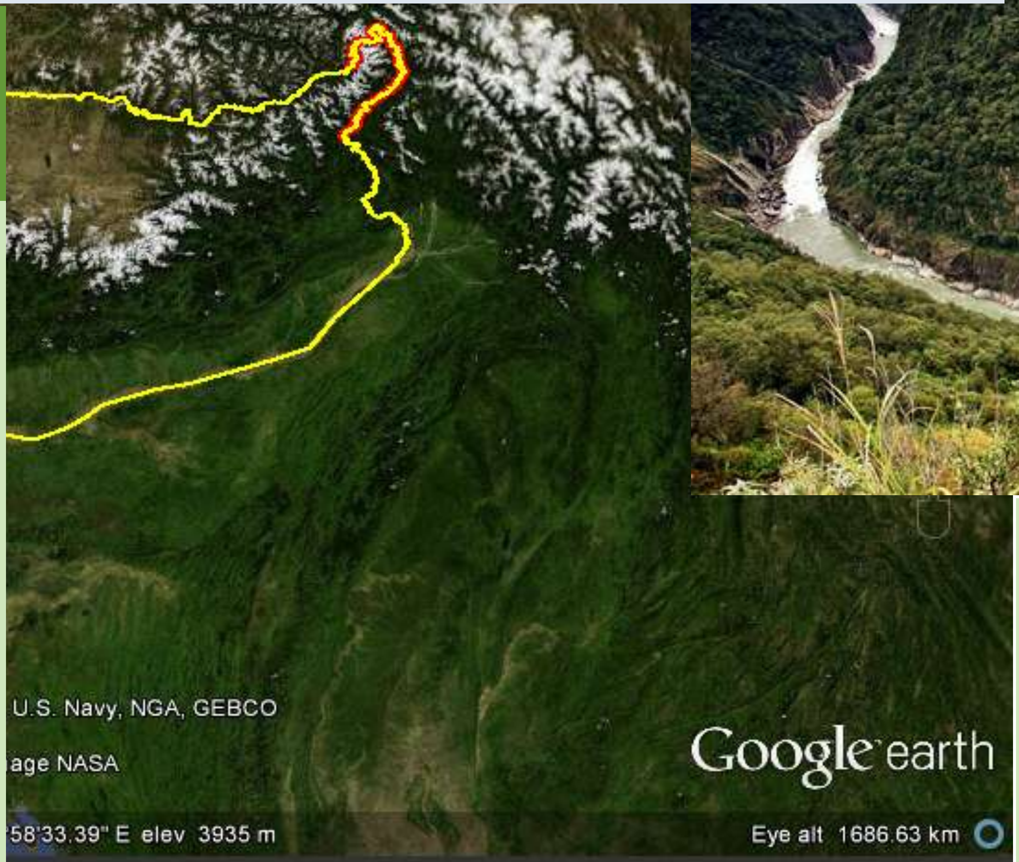
ZANGMU HYDRO ELECTRIC PROJECT

- OPERATIONAL SINCE 23 NOVEMBER 2014
- ROR PROJECT
- LOCATED AT LHOKHA, 140 KM SOUTHWEST OF LHASA
- INSTALL CAPACITY IS 510 MW (85 MWX6 TURBINES)

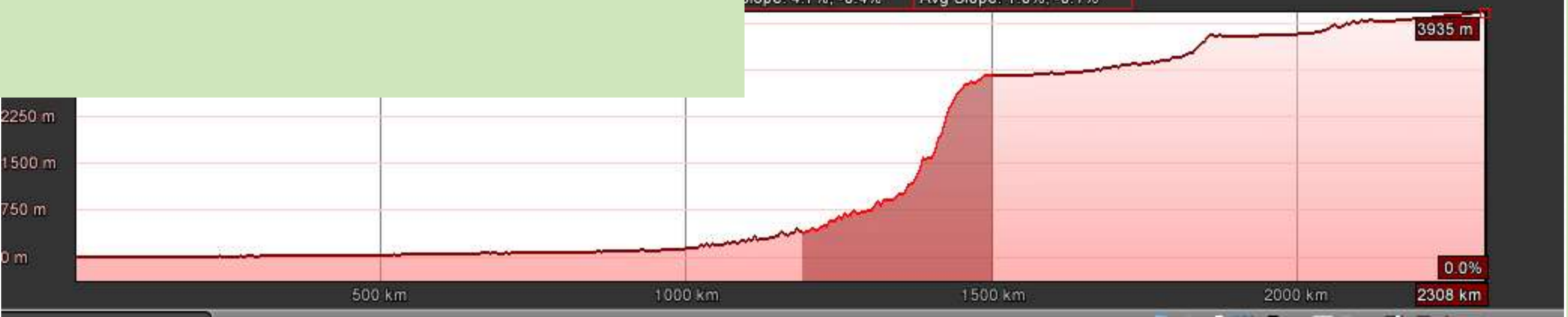
Potential hydro-power project sites

MEGA HYDRO ELECTRIC PROJECT AT GREAT BEND

- MEGA PROJECT WITH HUGE STORAGE
- CAN STORE WATER FOR LONGER PERIOD
- INSTALLED CAPACITY OF 40,000 MW, ALMOST DOUBLE THE THREE GORGE PROJECT

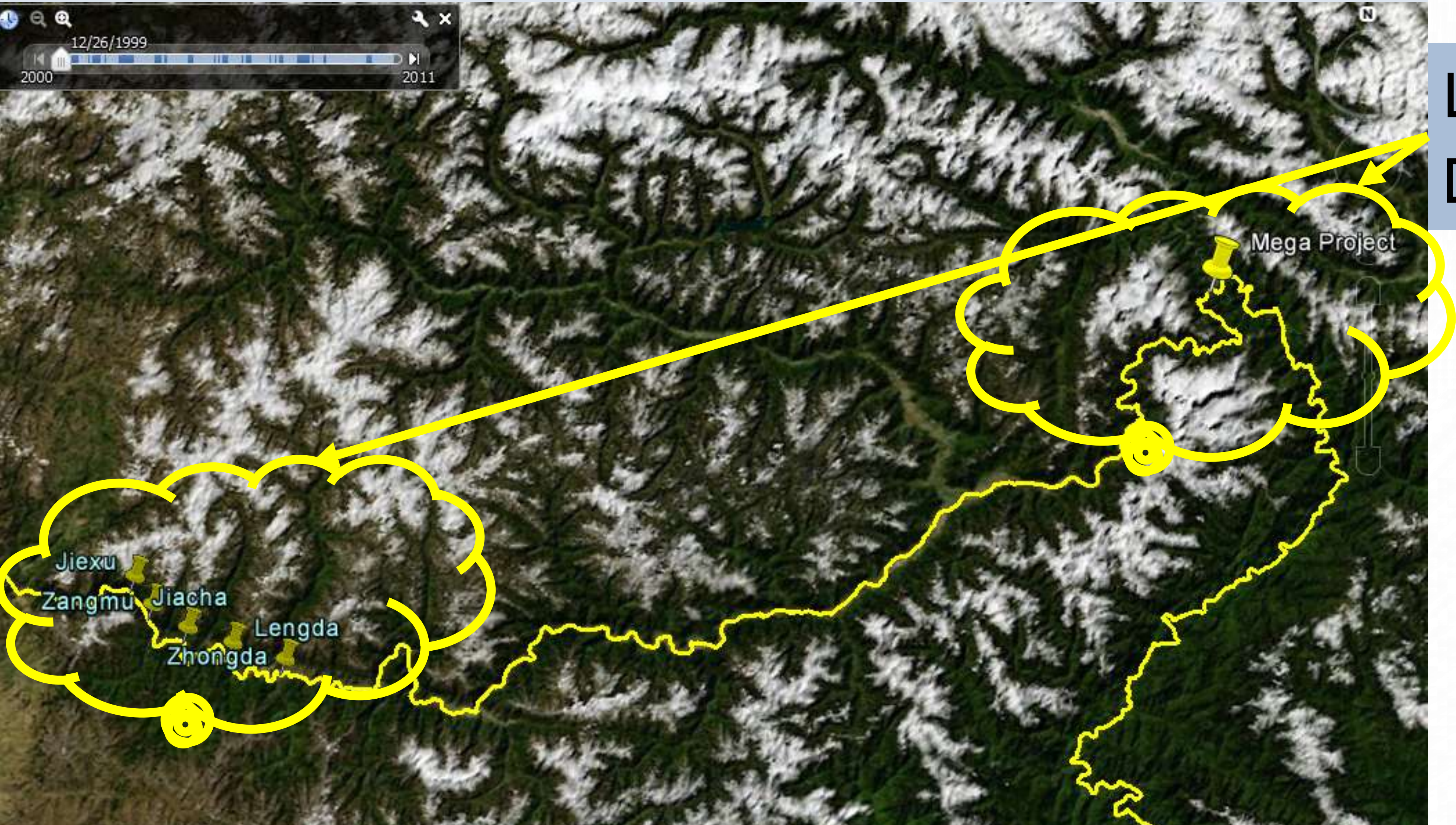


GREAT BEND



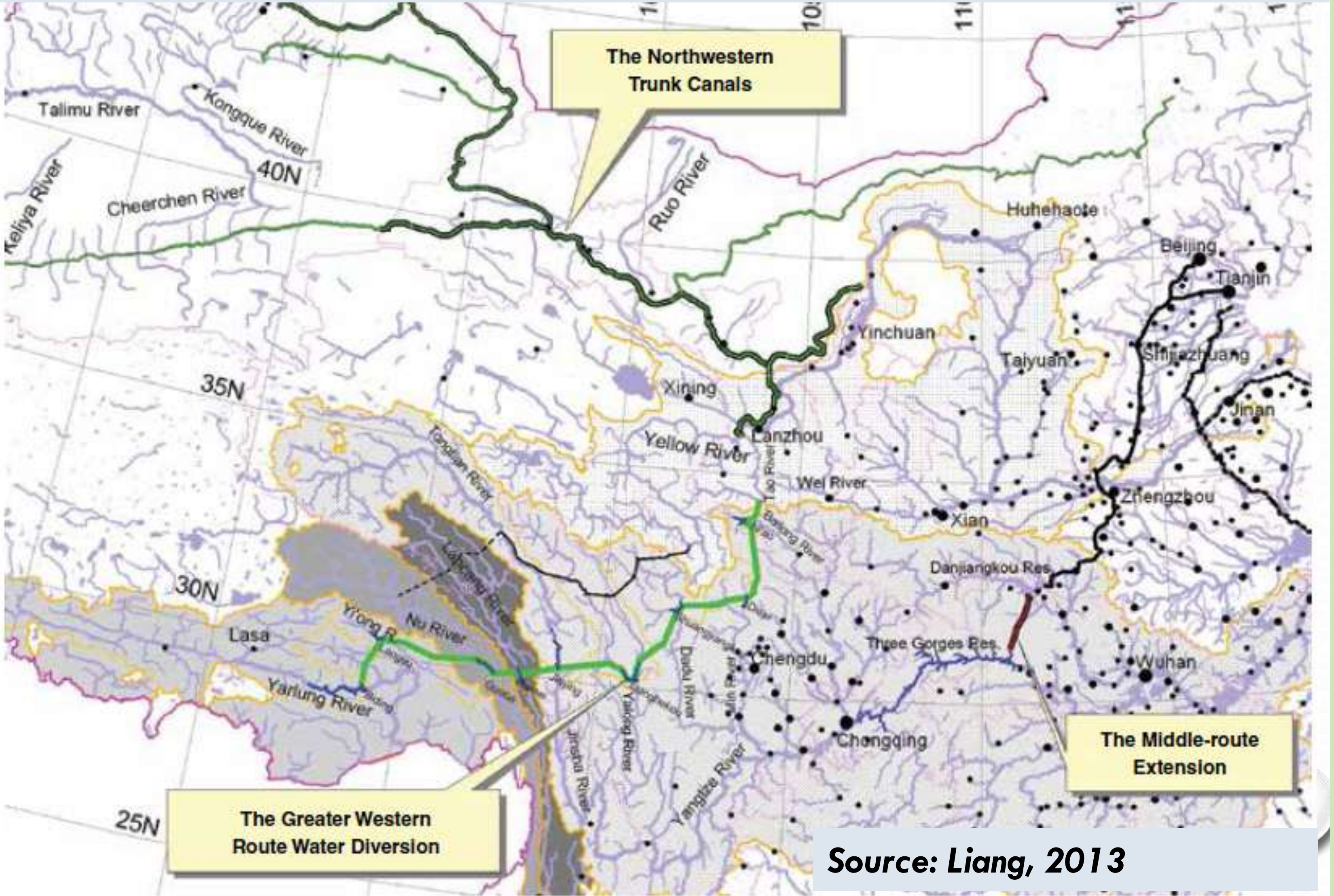
Elevation difference between two ends of the red line is around 2299 m

DAMS ON YARLUNG TSANGPO



LOCATIONS of DAMS

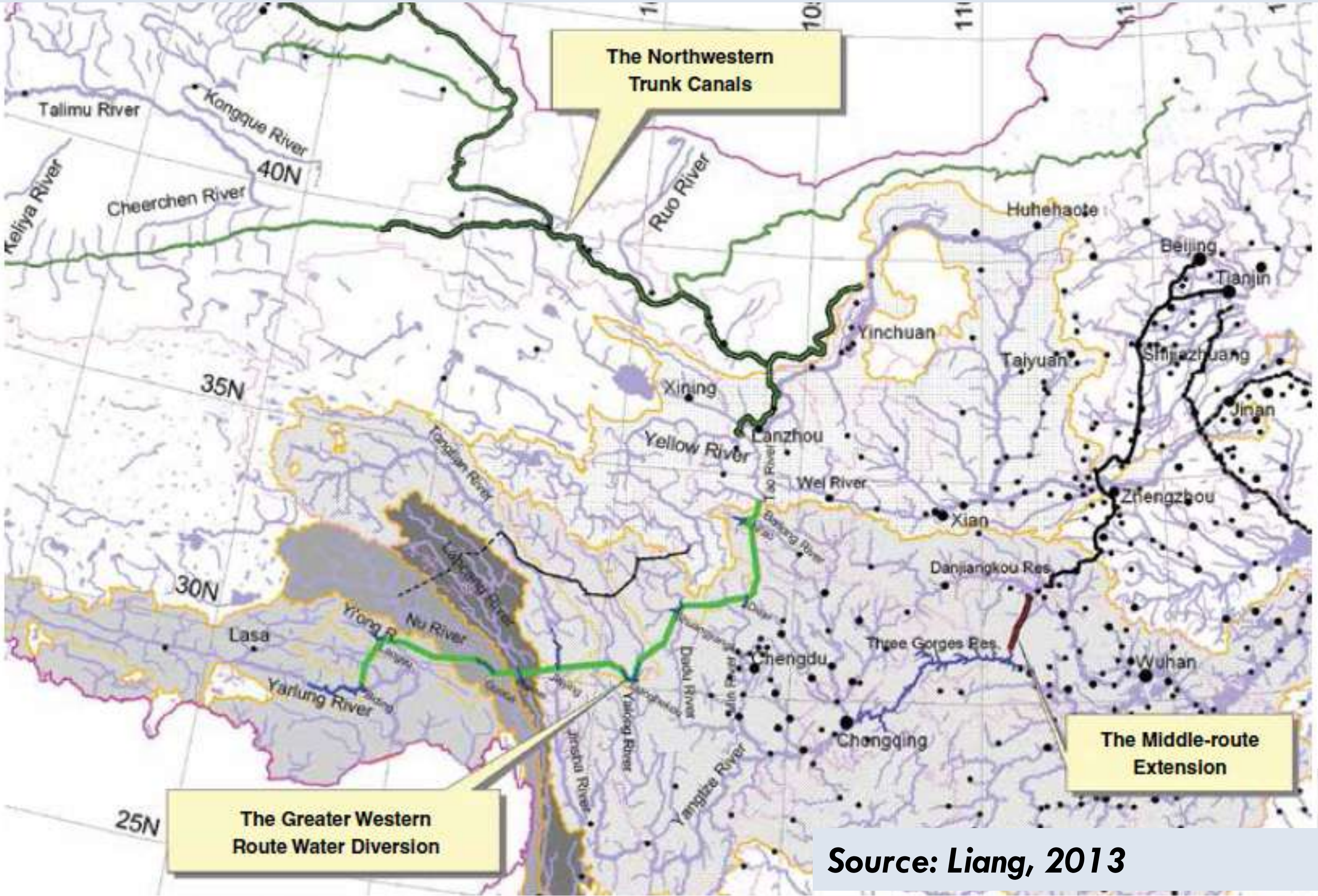
WATER DIVERSION PROJECT OF CHINA



Source: Liang, 2013

- CAN DIVERT 57 BCM WATER

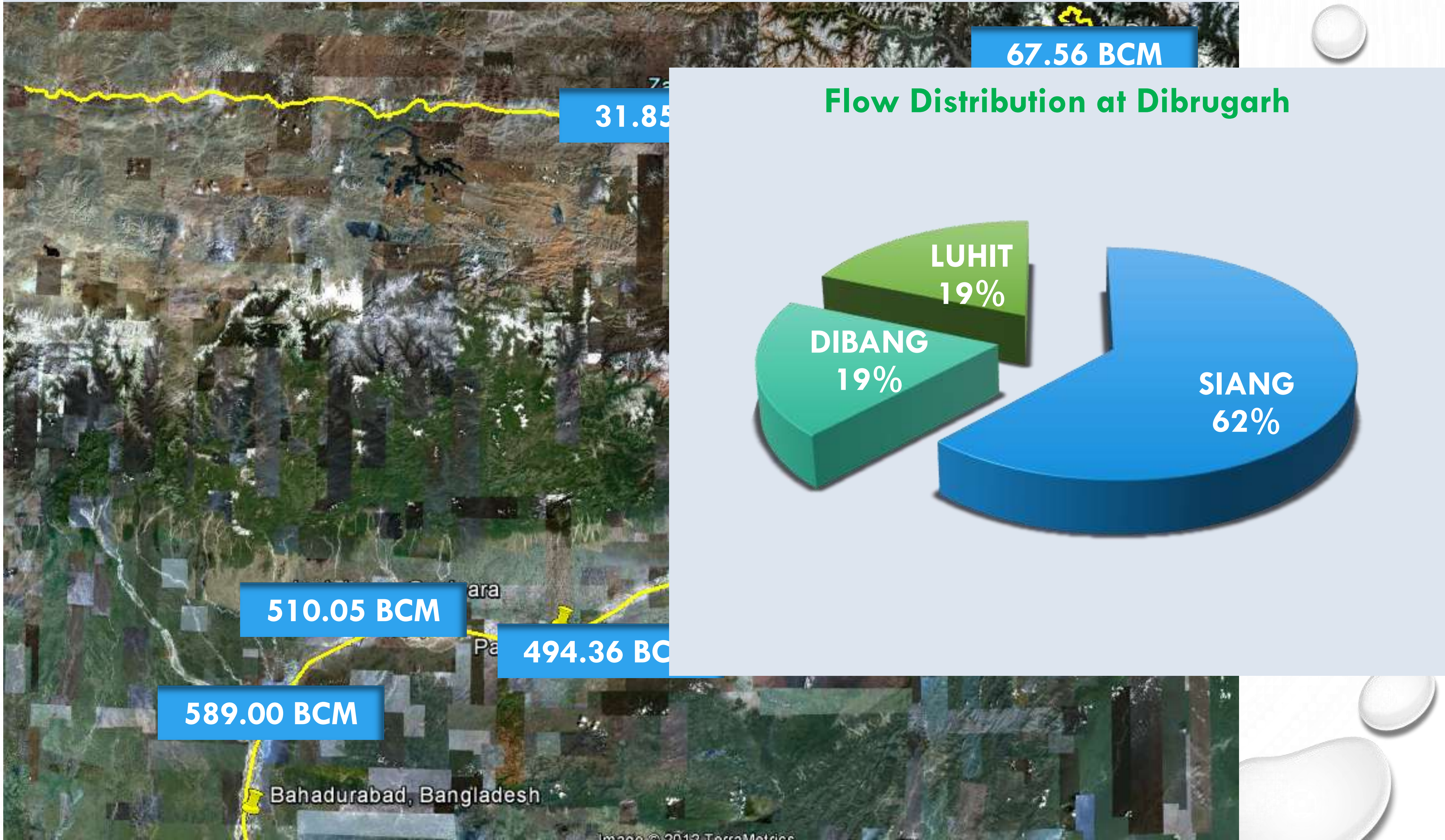
WATER DIVERSION PROJECT OF CHINA

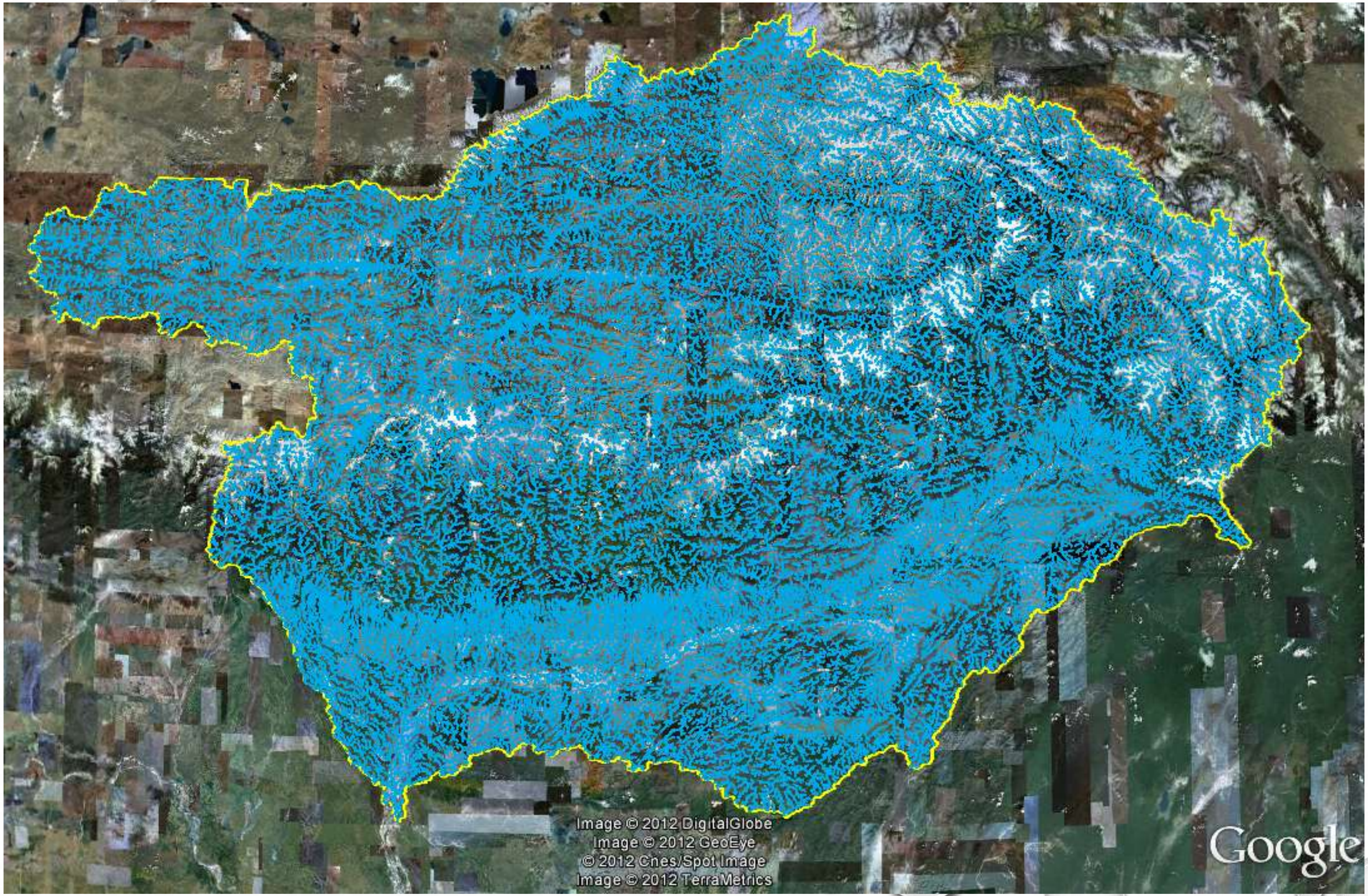


Source: Liang, 2013

- THREE WAYS TO IMPLEMENT THE PROJECT
  - ONLY HYDROPOWER GENERATION
  - DIVERT WATER DURING MONSOON
  - DIVERT WATER THROUGHOUT THE YEAR

Average annual water availability

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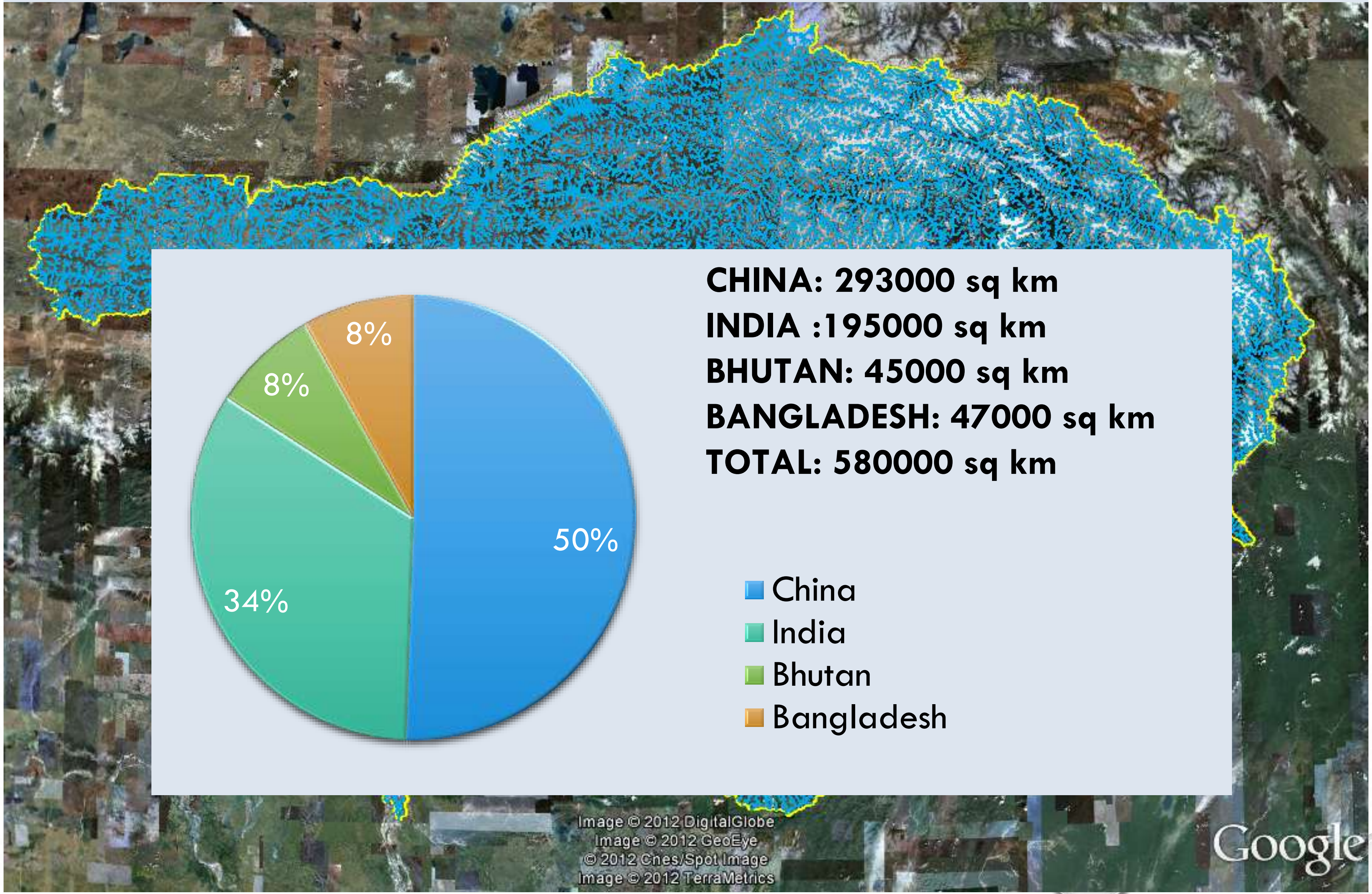
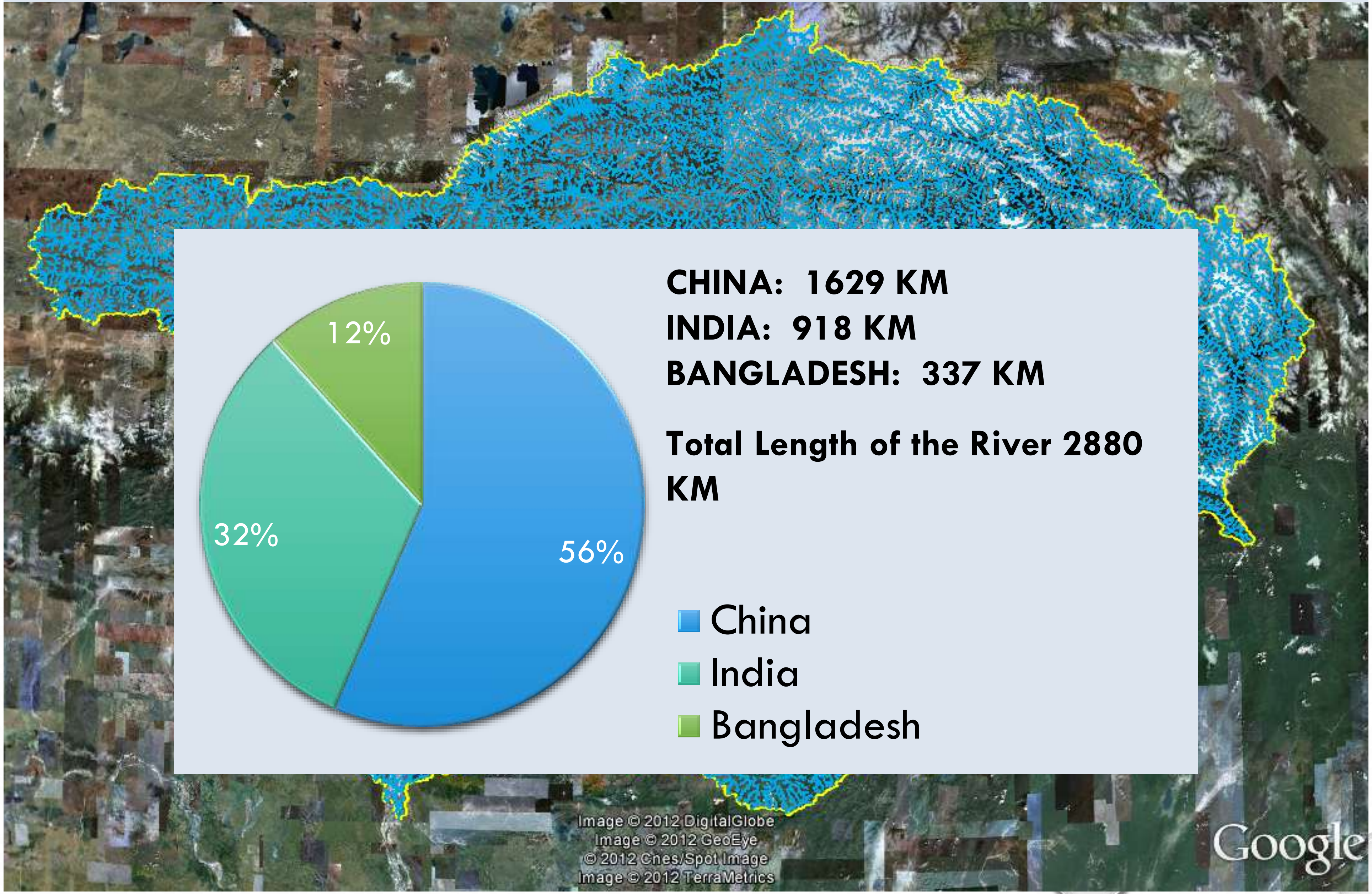
Sharing of Catchment Area



CHINA: 293000 sq km
INDIA :195000 sq km
BHUTAN: 45000 sq km
BANGLADESH: 47000 sq km
TOTAL: 580000 sq km

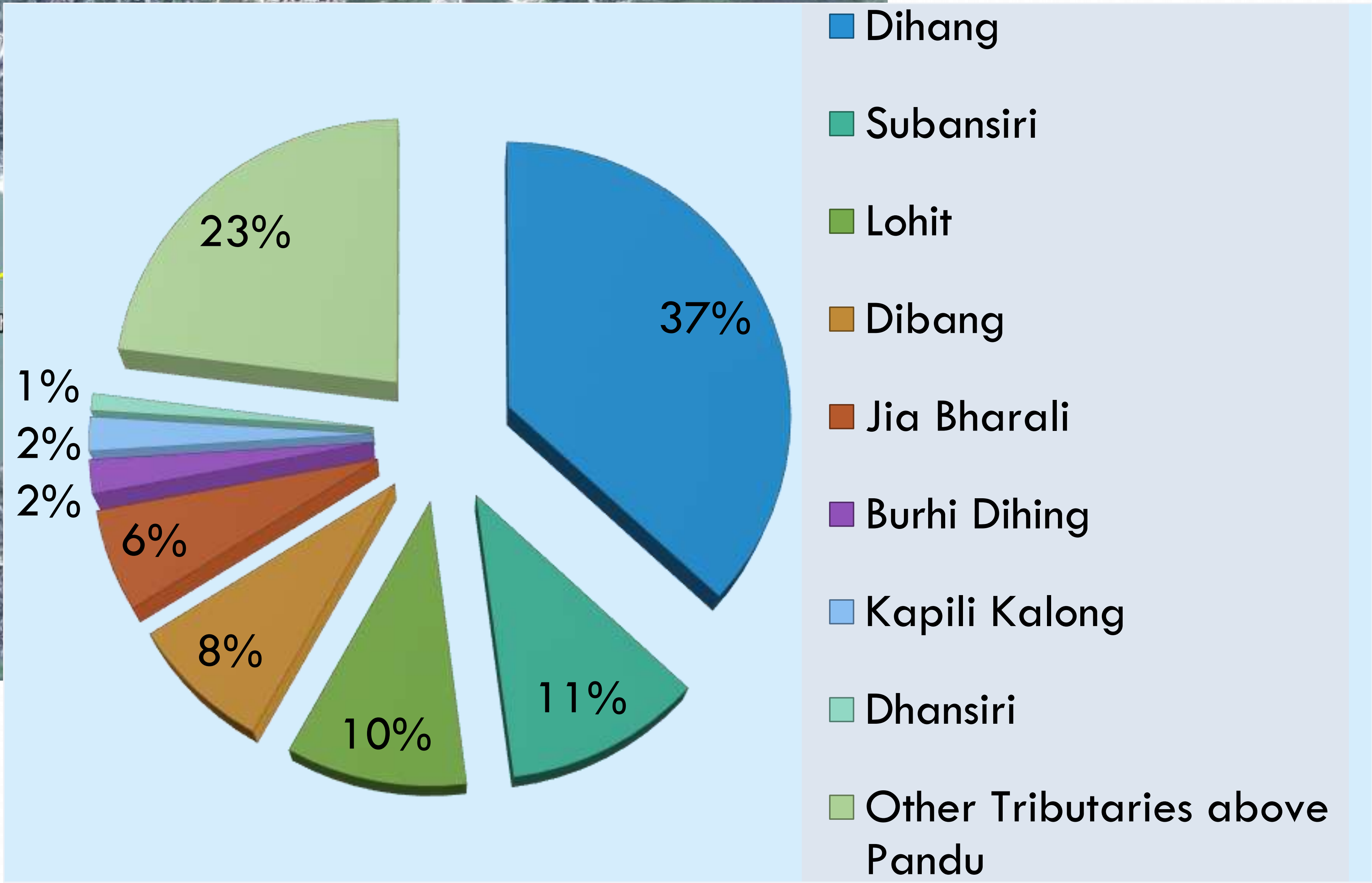
Sharing of Length



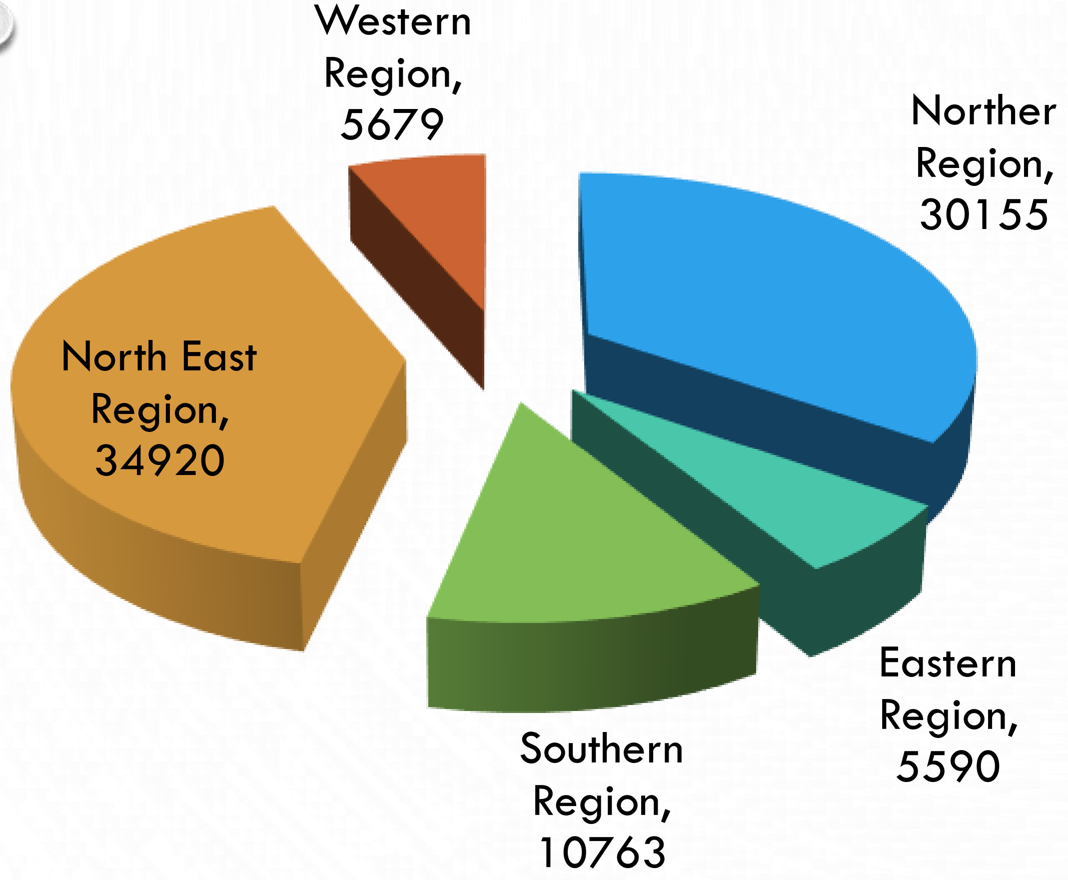
CHINA: 1629 KM
INDIA: 918 KM
BANGLADESH: 337 KM

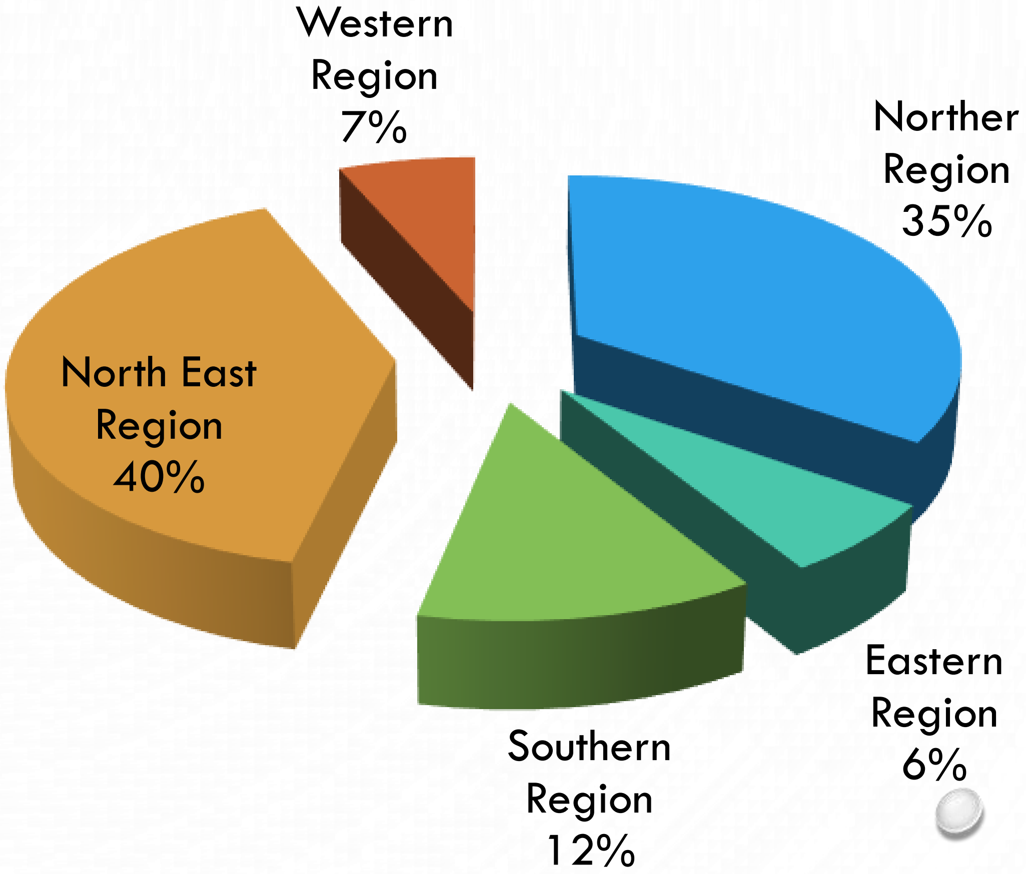
Total Length of the River 2880 KM

Flow distribution at Pandu, Guwahati



HYDROPOWER POTENTIAL DISTRIBUTION OF INDIA





PROPOSED PROJECTS IN NE REGION

Sl/ No	Name of Scheme River Basin/State	Installed Capacity(MW)
1	Siang Upper Dihang-Dibang/Ar.Pr.	11000
2	Etalin Dihang-Dibang/Ar.Pr.	3045
3	Demwe Luhit/Ar. Pr.	3000
4	Oju-II Subansiri / Ar.Pr.	2580
5	Kalai Luhit/Ar. Pr.	2550
6	Teesta High Dam Tista/WB	2505
7	Upper Subansiri Subansiri / Ar.Pr.	2500
8	Middle Subansiri Subansiri / Ar.Pr.	2000
9	Lower Subansiri Subansiri / Ar.Pr.	2000
10	Oju-I Subansiri / Ar.Pr.	1925
11	Siang Lower Dihang-Dibang/Ar.Pr.	1700
12	Tipaimukh Barak & Others/Man	1500

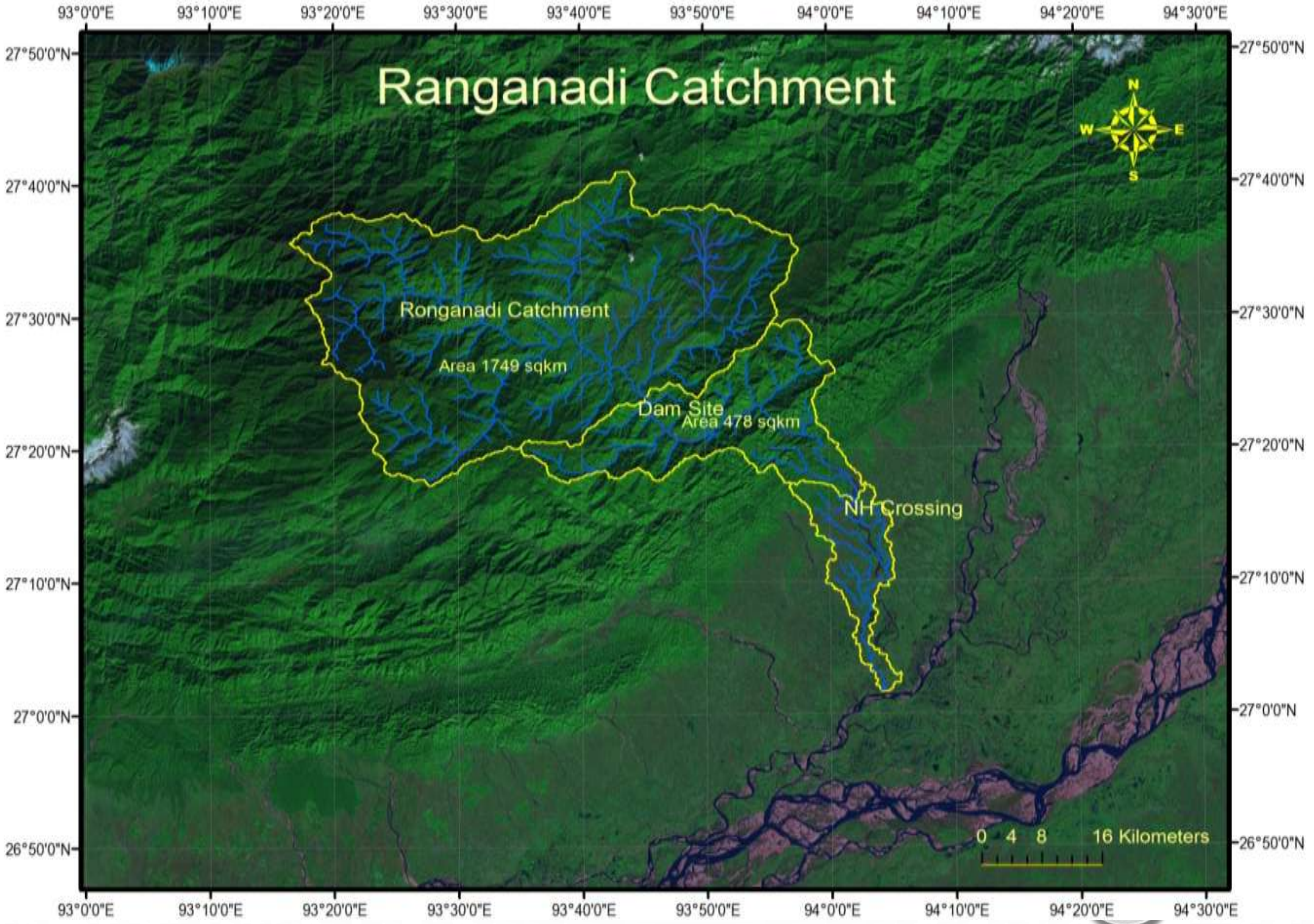
PROPOSED PROJECTS IN NE REGION

Sl/ No	Name of Scheme River Basin/State	Installed Capacity(MW)
13	Niare Subansiri / Ar.Pr.	1405
14	Naba Subansiri / Ar.Pr.	1290
15	Kameng Kameng/Ar. Pr.	1100
16	Dibang Dihang-Dibang/Ar.Pr.	1000
17	Hutong Luhit/Ar. Pr.	950
18	Emra-II Dihang-Dibang/Ar.Pr.	870
19	Siang Middle Dihang-Dibang/Ar.Pr.	700
20	Lunglang Stor. Barak & Others/Miz	690
21	Boinu Stor. Barak & Others/Miz	635
22	Kaldan Stor. Barak & Others/Miz	545
23	Kimi Kameng/Ar. Pr.	535
24	Teesta St. IV Tista / Sikkim	495

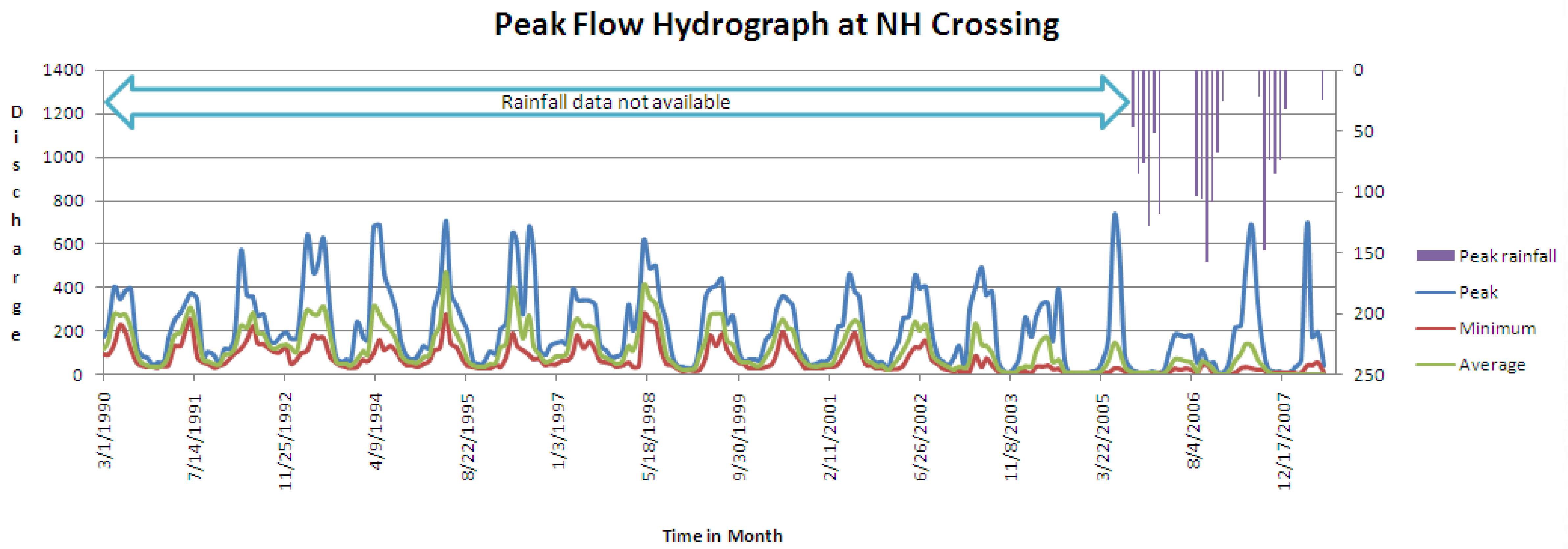
PROPOSED PROJECTS IN NE REGION

Sl/ No	Name of Scheme River Basin/State	Installed Capacity(MW)
25	Naying Dihang-Dibang/Ar.Pr.	495
26	Dikhu Dam P.H. U.Brahmaputra/Naga.	470
27	Teesta St. II Tista / Sikkim	450
28	Tizu Barak & Others/Nag	365
29	Teesta St. VI Tista / Sikkim	360
30	Tato-II Dihang-Dibang/Ar.Pr.	360
31	Malinye Dihang-Dibang/Ar.Pr.	335
32	Bhareli Lift Dam-II Kameng/Ar. Pr.	330
33	Teesta St. I Tista / Sikkim	320
34	Emini Dihang-Dibang/Ar.Pr.	295
35	Kynshi-I Stor. Barak & Others/Megh	295
36	Emra-I Dihang-Dibang/Ar.Pr.	275

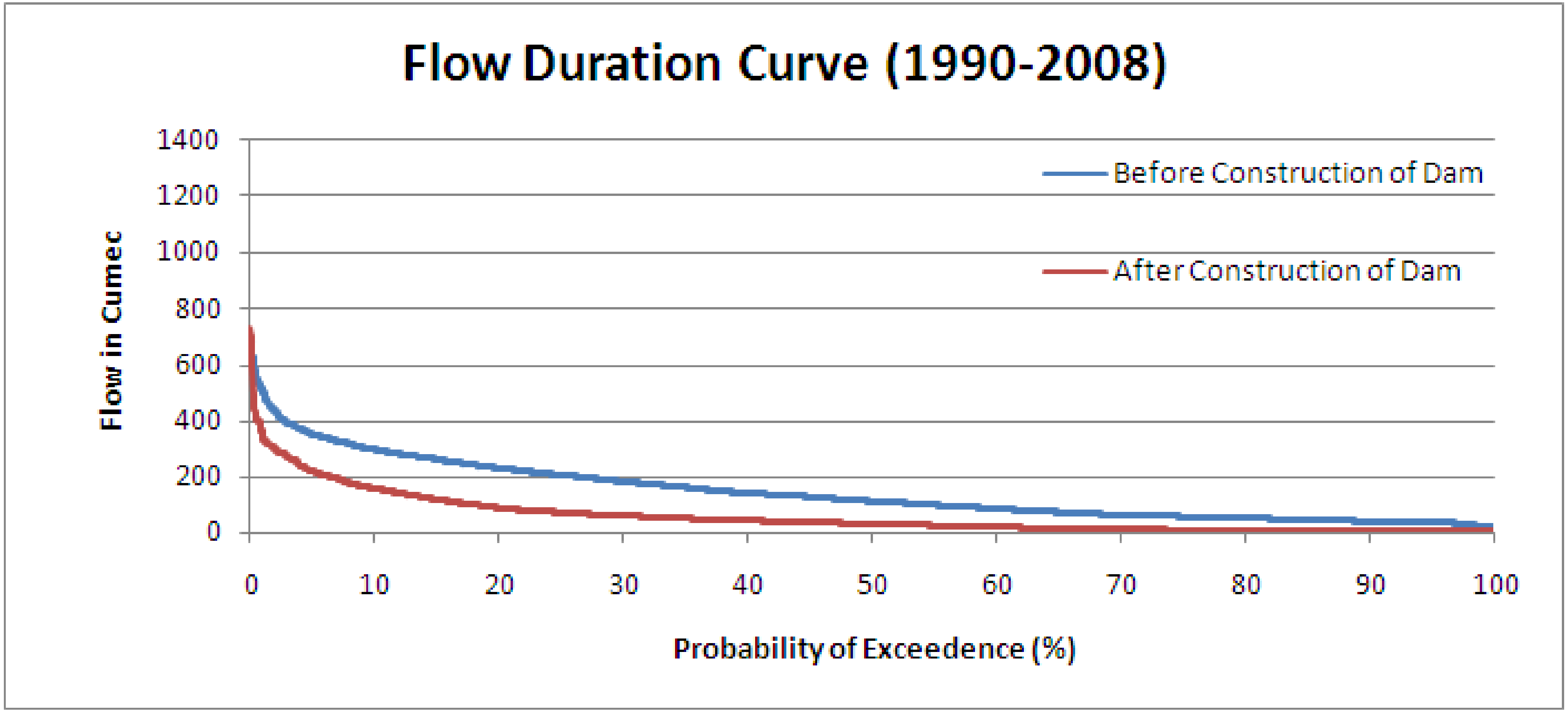
DOWNSTREAM IMPACT ANALYSIS



Peak Discharge analysis

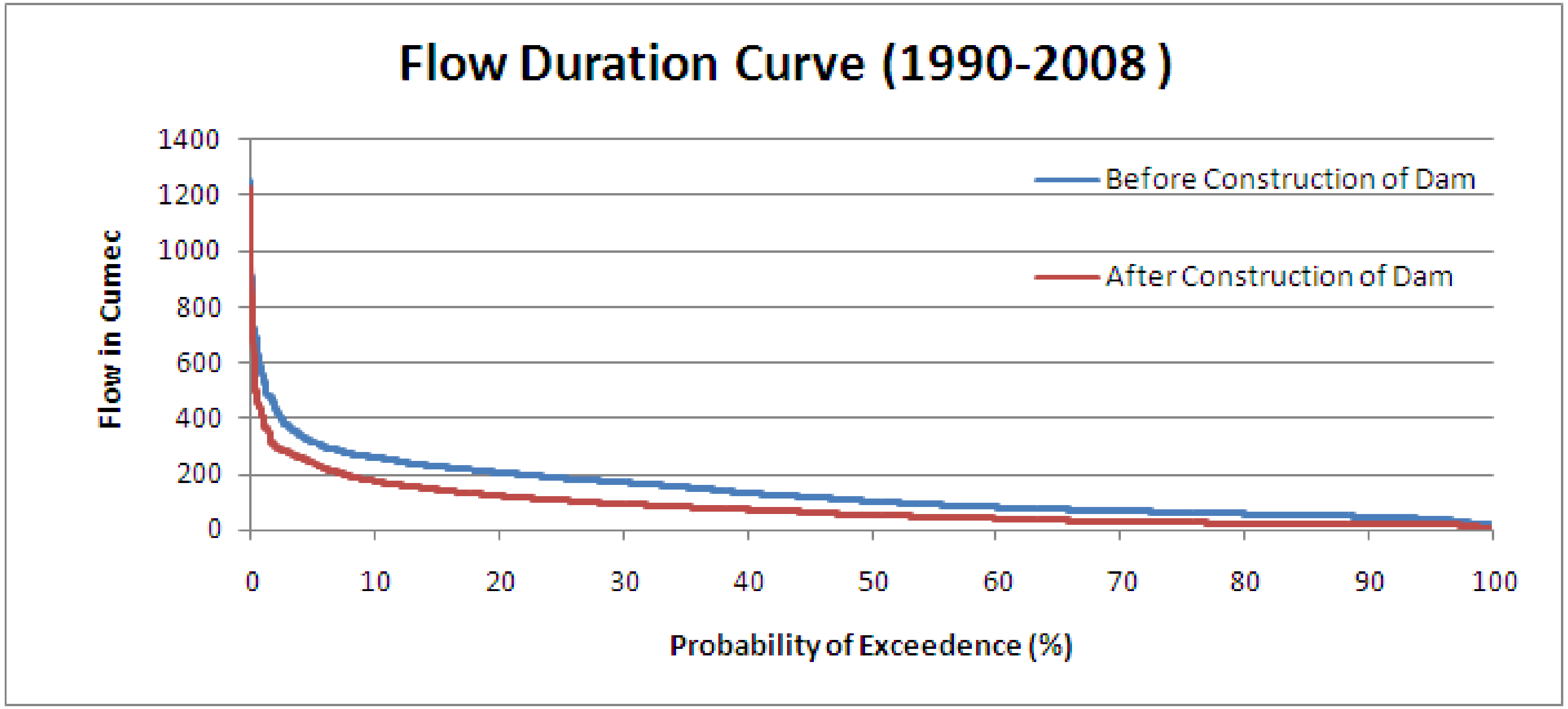


Flow duration curve



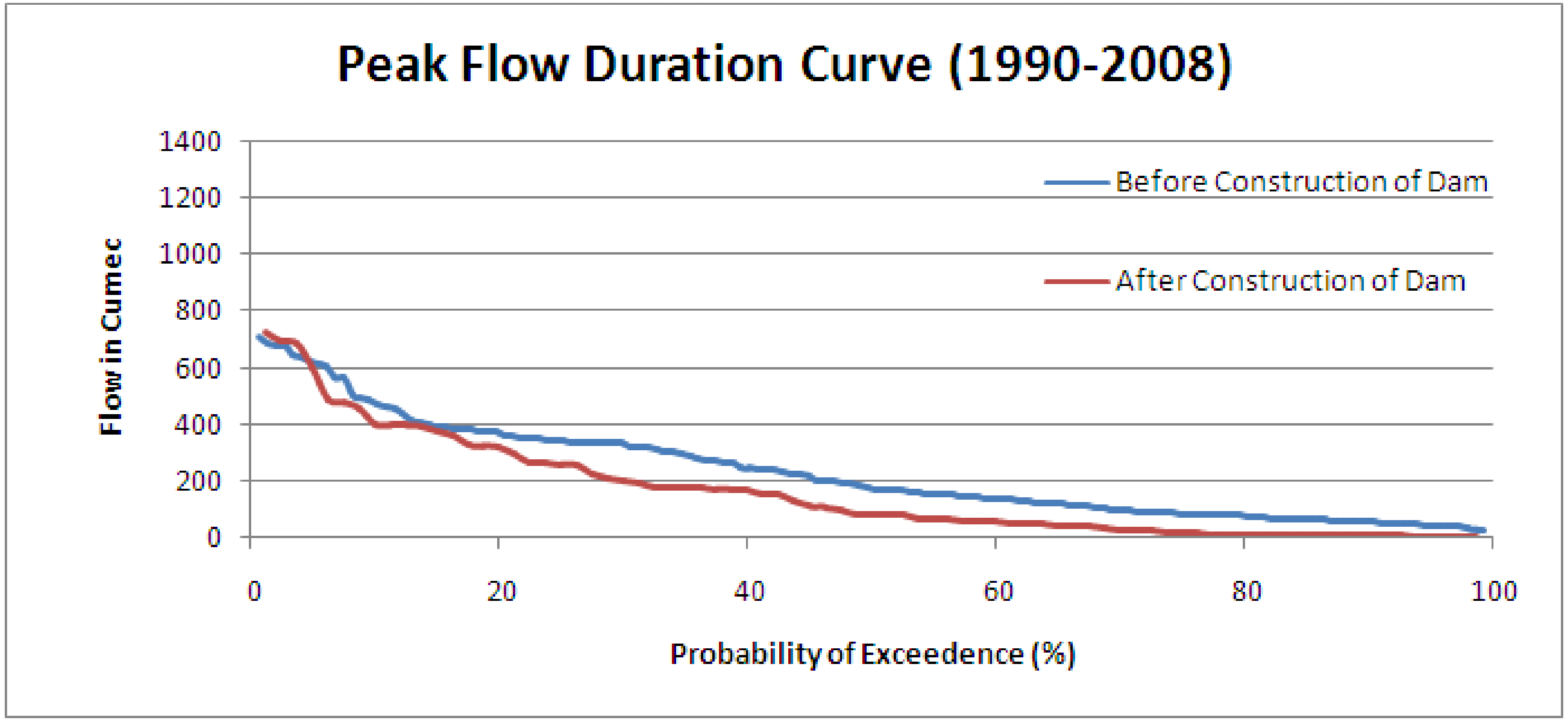
Flow duration curve before and after construction at NH crossing

Flow duration curve



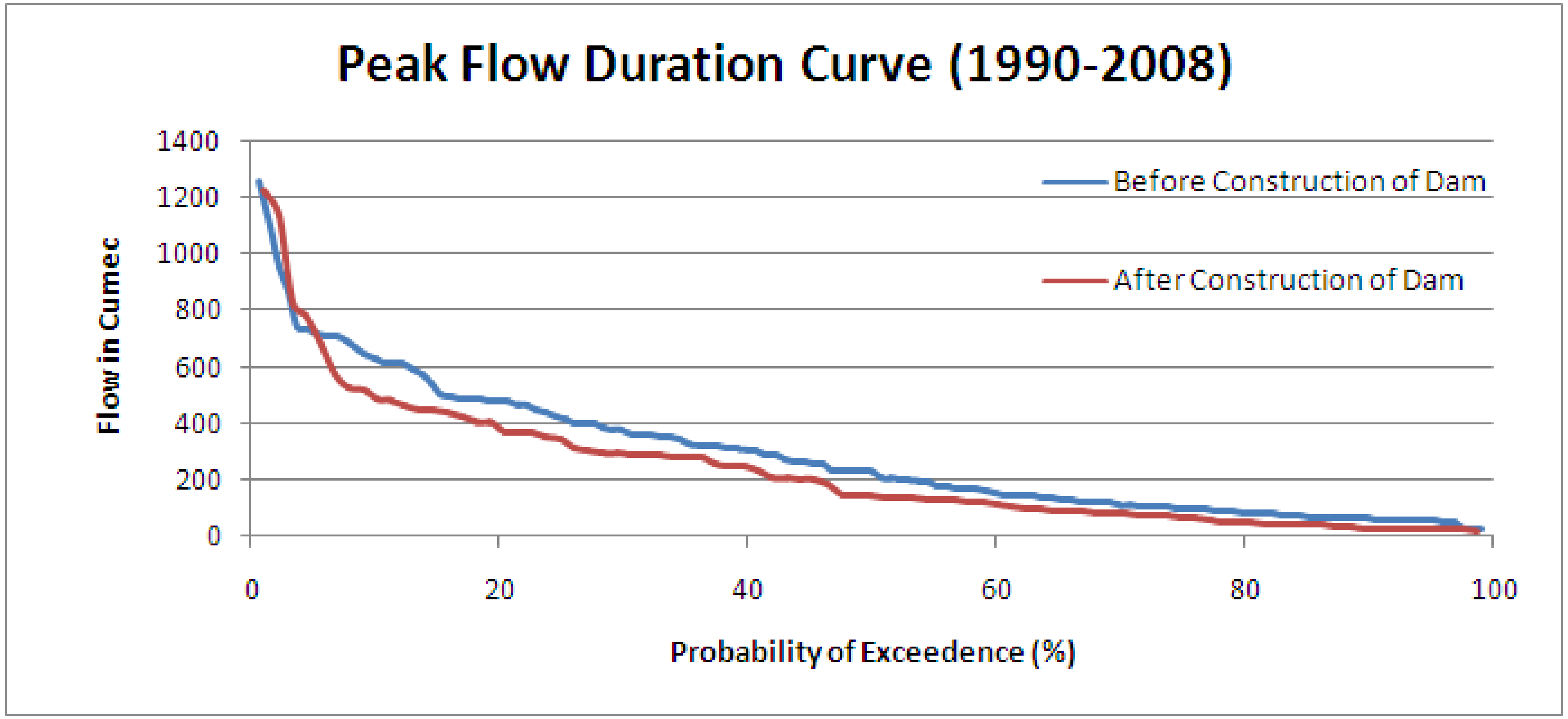
Flow duration curve before and after construction at Dam site

Peak flow duration curve



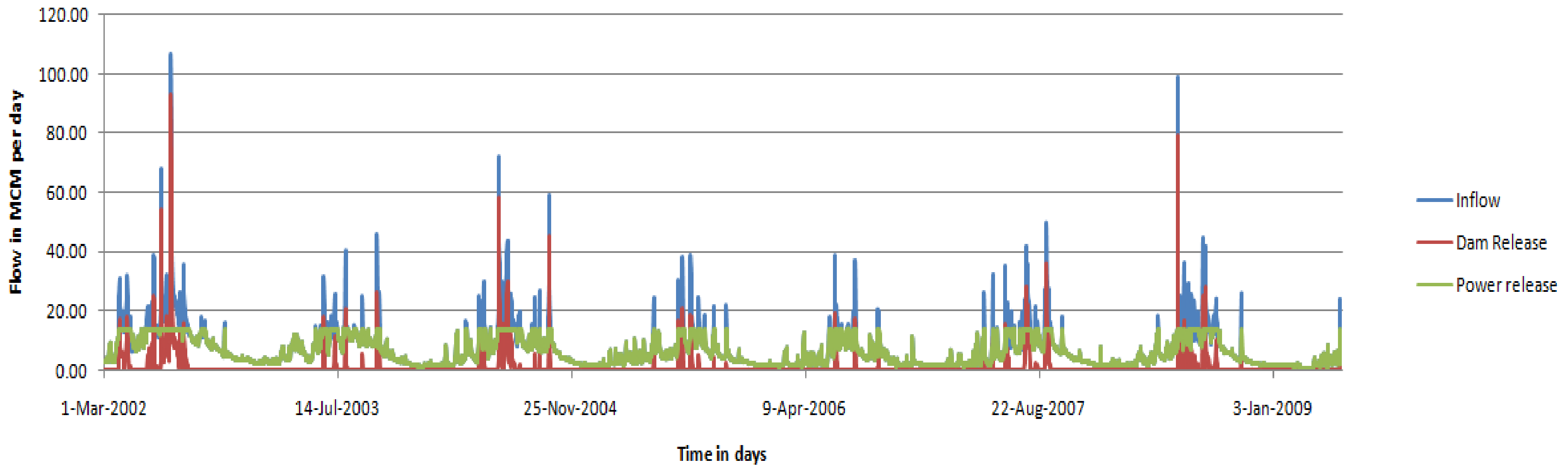
Monthly peak flow duration curve before and after construction at NH crossing

Peak flow duration curve



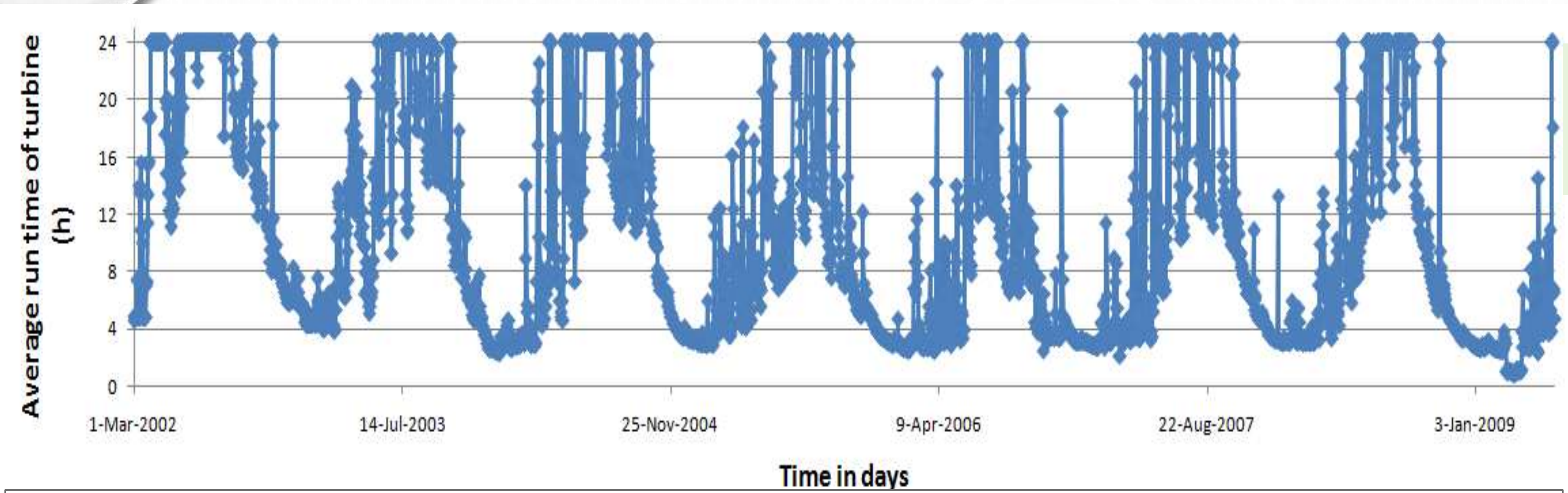
Monthly peak flow duration curve before and after construction at Dam site

RESERVOIR SIMULATION

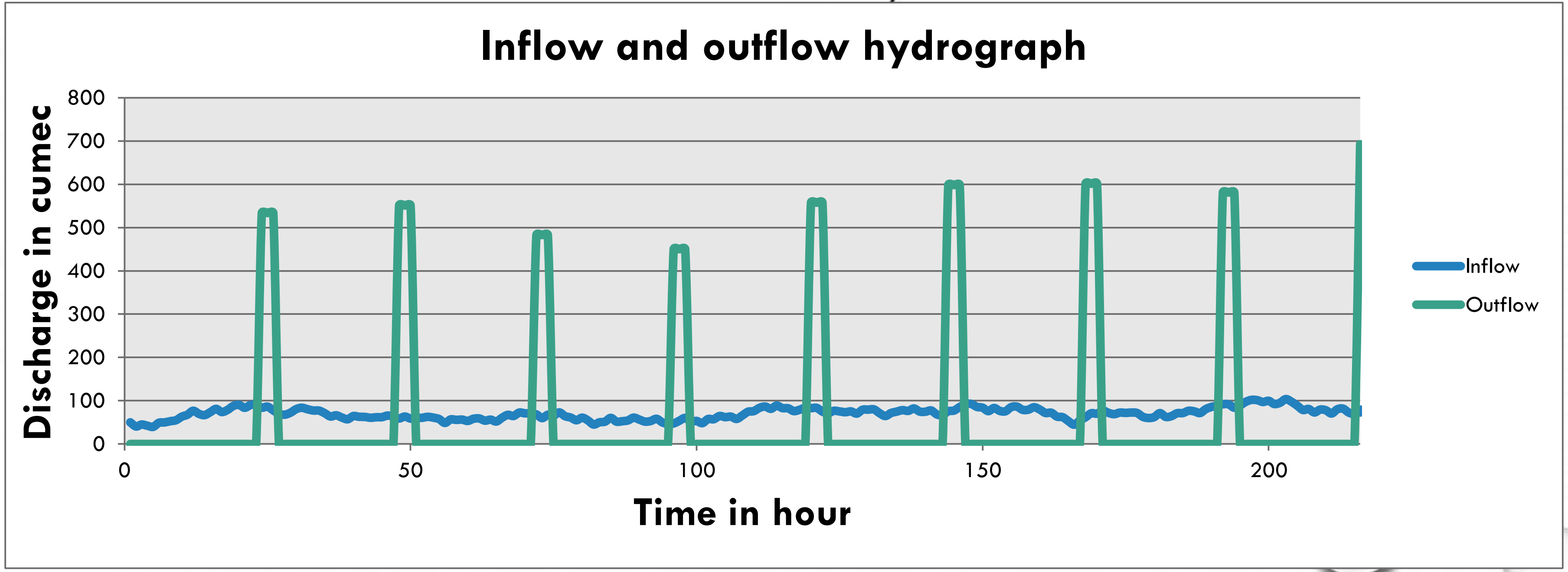


Reservoir inflow and flow at d/s of the reservoir

RESERVOIR SIMULATION



Run time of turbine of RHEP-II



DAILY VARIATION (EXAMPLE ONLY)

SOME KEY ISSUES OF FLOOD DISASTER MITIGATION

STRENGTHENING MONITORING, FORECASTING AND EARLY WARNING CAPACITIES	Monitoring hazards is an essential component. Efficient early warning system should deliver accurate information on the likely events in a timely manner.
ENHANCING PUBLIC AWARENESS PROGRAMMES	Introduction of formal educational programmes including curricula revision, social awareness programme, teacher training and development of resource centres.
UNDERSTANDING RISK AND VULNERABILITY	Risk and vulnerability assessments involving all sections of society to be done to identify the areas at greatest risk.
IMBALANCE BETWEEN PREVENTION AND RESPONSE RESOURCES	It is always cheaper to invest in longer-term prevention, mitigation and preparedness than in post disaster emergency response.
FRAGMENTED INSTITUTIONAL STRUCTURES	Lack of coordination among institutions at national and local levels is a major constraint to implement effectively disaster risk reduction. This has resulted in narrow, sectoral approaches and poor planning.

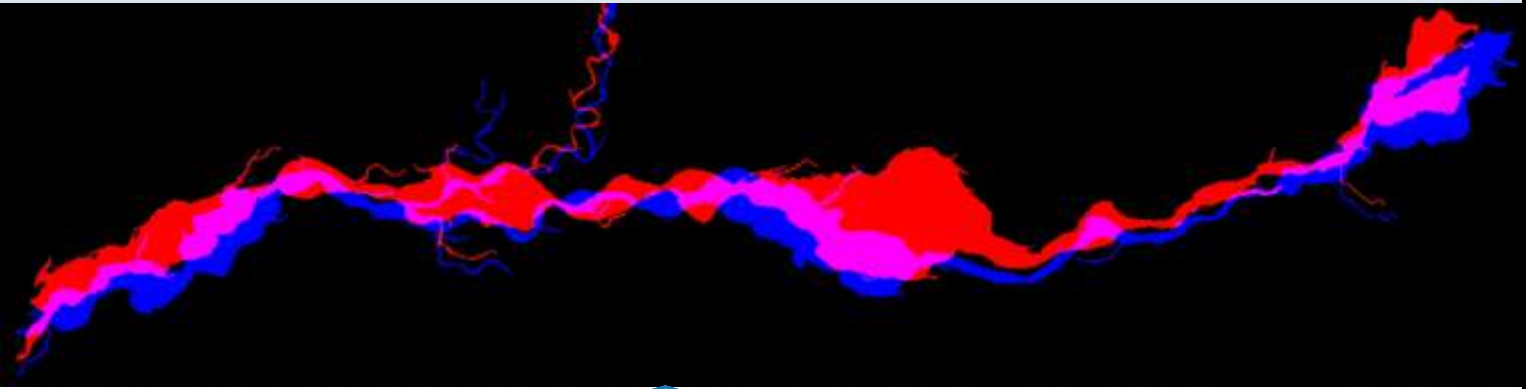
INTEGRATED PLANNING

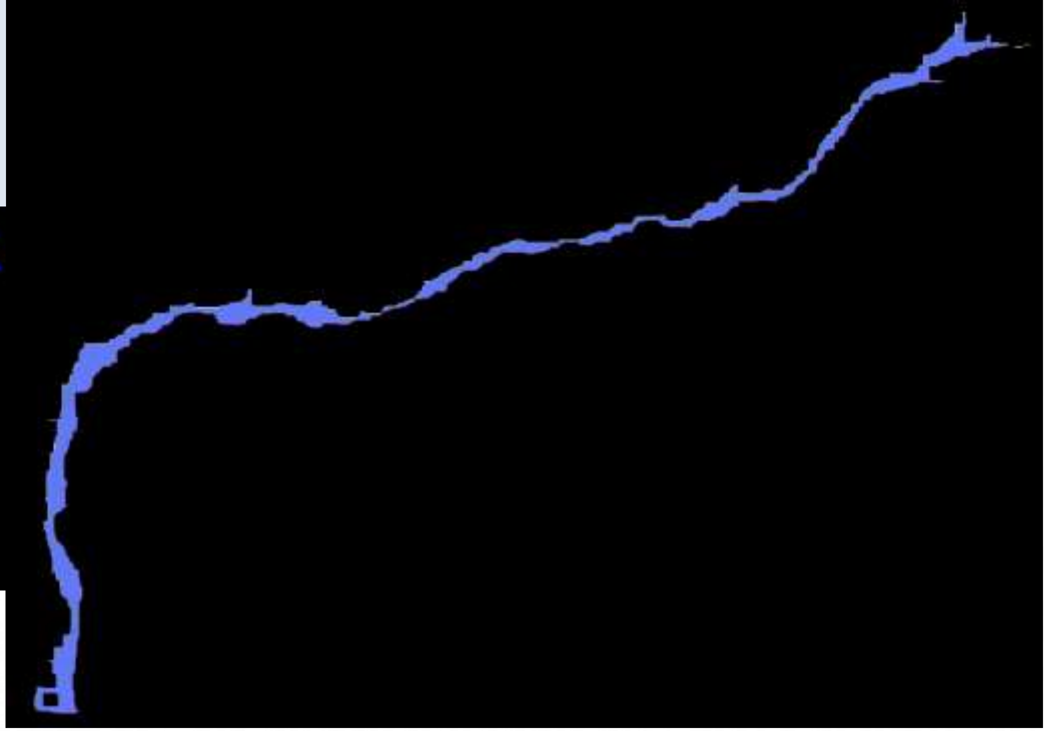
- ASSESSMENT OF THE FUTURE WATER DEMAND CONSIDERING
  - SEASONAL WATER NEED IN ALL SECTORS
  - SOCIO-CULTURAL CONSIDERATION AND ECOLOGICAL NEED
  - REGIONAL AND NATIONAL DEMAND
- MULTIPURPOSE RESERVOIRS TO MEET WATER DEMAND AND TO REDUCE FLOOD
  - JUDICIOUS USE OF RESERVOIR TO REDUCE SPATIOTEMPORAL VARIATION OF THE AVAILABLE WATER TO HAVE BETTER WATER UTILIZATION
  - WIN-WIN POLICY FOR ALL THE INVOLVED STATES/COUNTRIES
  - TO HAVE FLOOD CUSHIONING TO REDUCE FLOOD
  - TO TAKE UP INNOVATIVE MEASURES TO MAINTAIN ECOLOGICAL WATER NEED
  - FLOW FORECASTING MODEL AND INFRASTRUCTURE FOR BETTER OPERATION

WAY FORWARD FOR HOLISTIC PLAN

- STRUCTURAL AND NON STRUCTURAL MEASURES FOR MITIGATING FLOOD AND EROSION.
  - ECOLOGICAL MANAGEMENT PRACTICES (EMPS) FOR LIMITING SEDIMENT YIELD AND PEAK DISCHARGE FROM THE UPPER CATCHMENTS
  - WATERSHED MODELING AND RIVER MODELING CONSIDERING SPECIAL CHARACTERISTICS OF THE BASIN LIKE EXISTENCE OF PIEDMONT ZONE
  - LINKED-SIMULATION OPTIMIZATION MODEL TO DETERMINE OPTIMAL PROTECTION MEASURES IN A VULNERABLE RIVER REACH OF BRAHMAPUTRA RIVER
  - FLOW FORECASTING MODEL AND INFRASTRUCTURE
  - FLOOD PLAIN ZONING BY DELINEATING POTENTIAL FLOOD PRONE AREA THROUGH MODEL STUDY AND FIELD INFORMATION AND DECLARING INSURANCE PACKAGE ETC ACCORDINGLY.

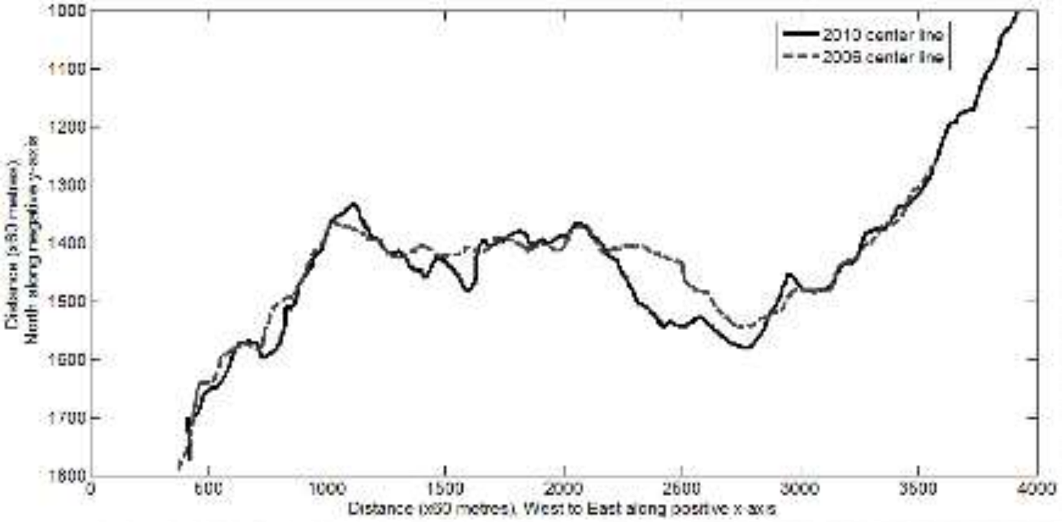
RIVER MONITORING SYSTEM





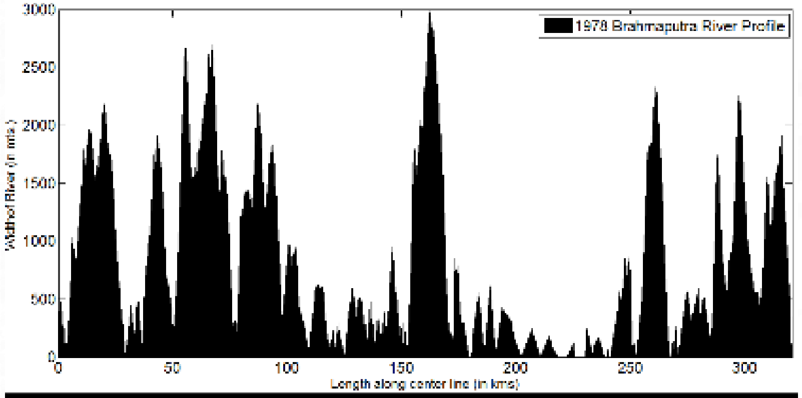
River migration study

Delineation of Floodplain



Centerline migration study

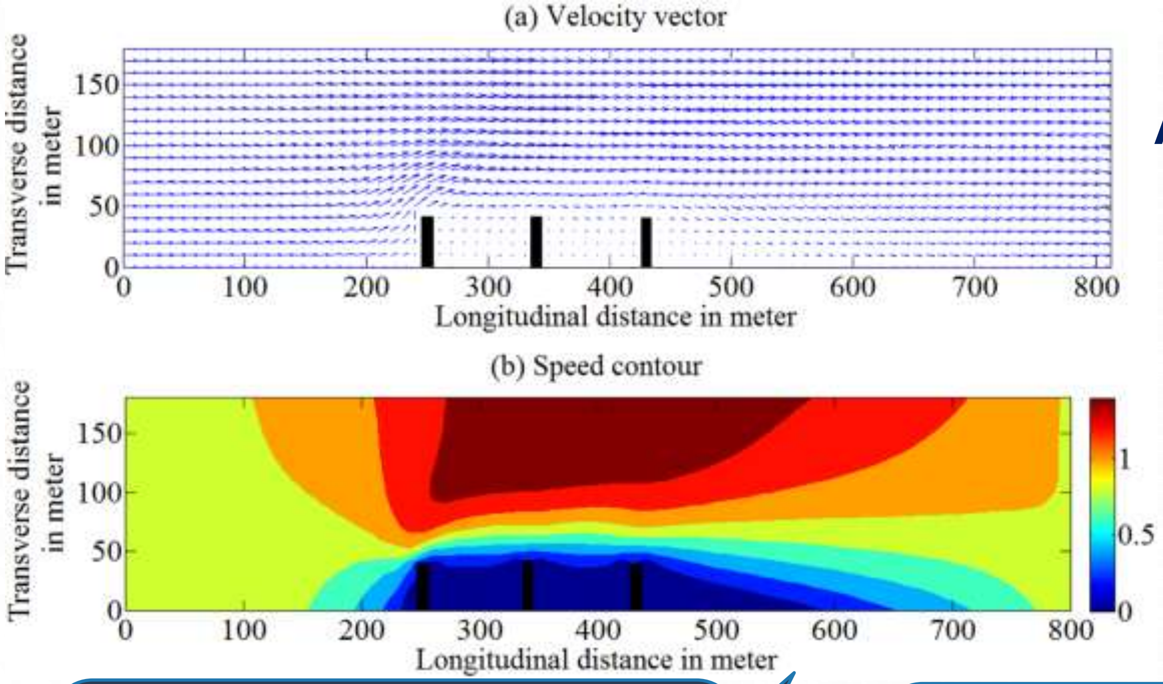
Determination river width



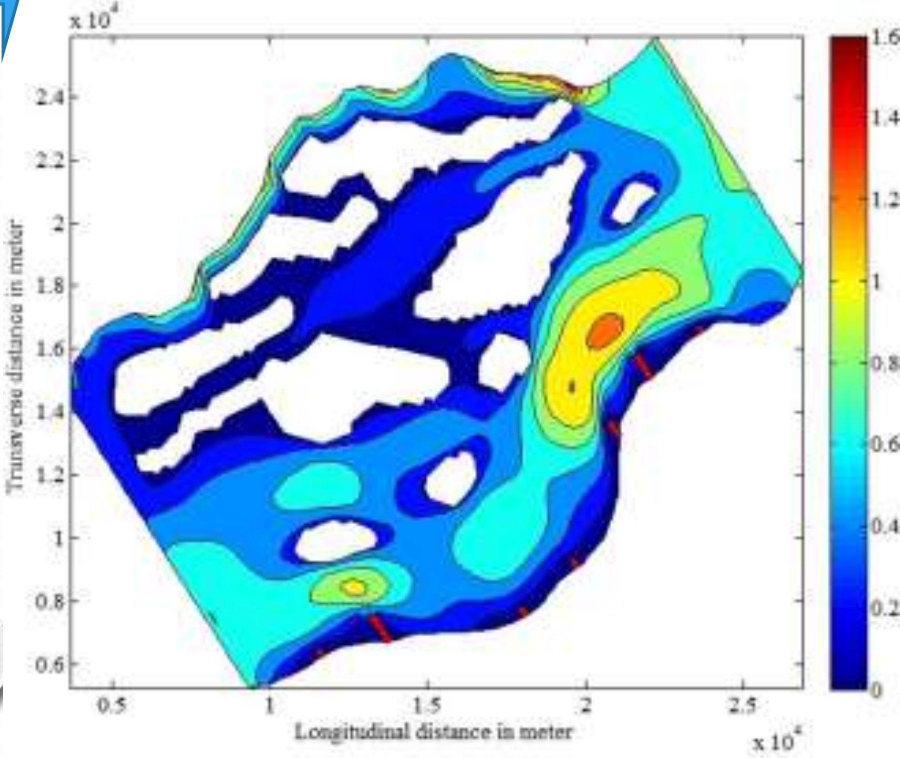
Dey Aveedibya, and **Bhattacharjya Rajib Kumar** (2013), "Monitoring River Center Line and Width - A Study on River Brahmaputra", *Journal of the Indian Society of Remote Sensing*, 42(2),475-482.

RIVER MODLING AND MANAGEMENT SYSTEM

Simulation-optimization based model to find obtain cost effective combination of river training works



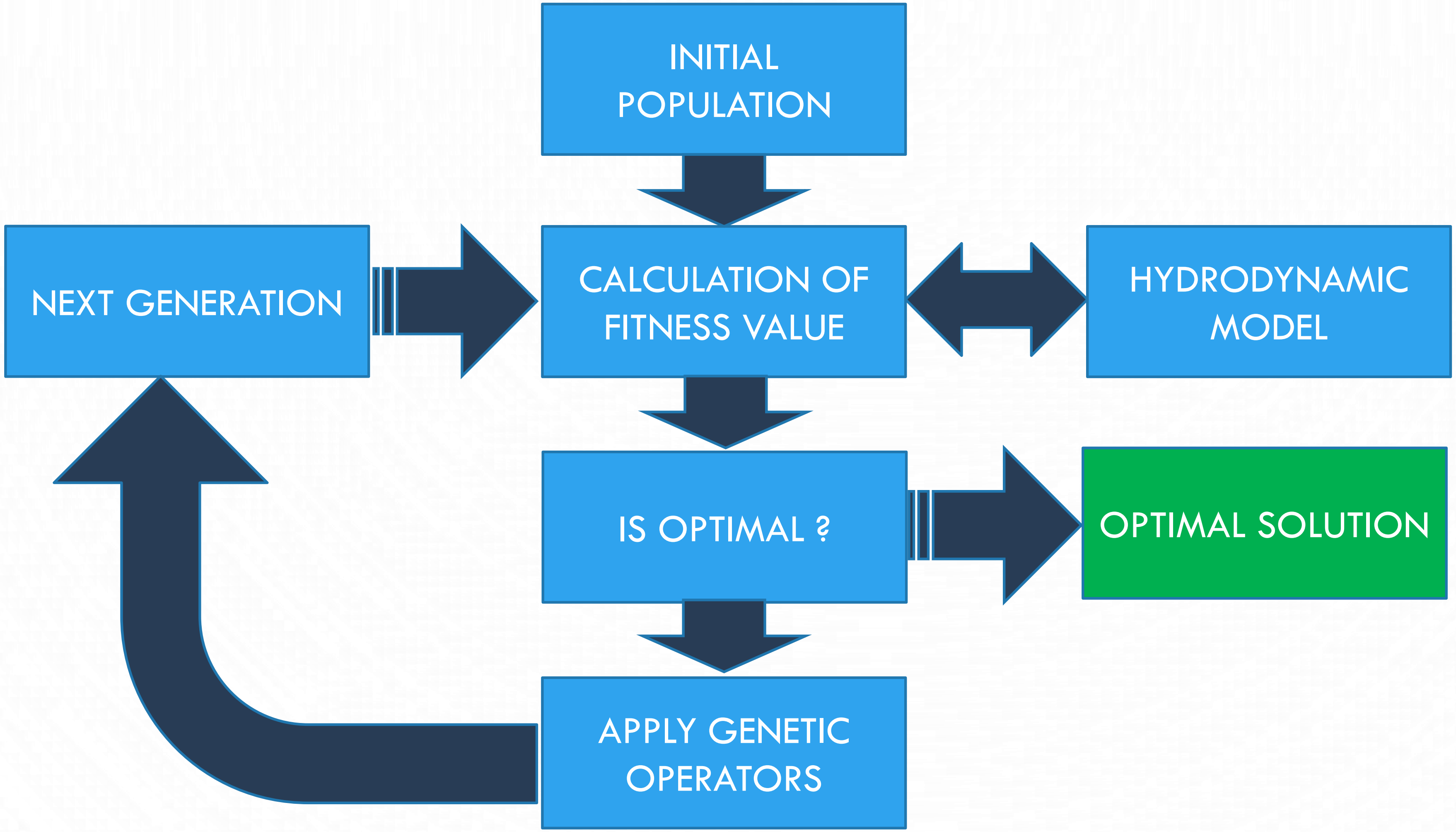
Applied on River Brahmaputra



Kalita H.M., Sarma A.K., and Bhattacharjya R.K, ***Evaluation of Optimal River Training Work using GA Based Linked Simulation Optimization Approach***, WARM, 2014

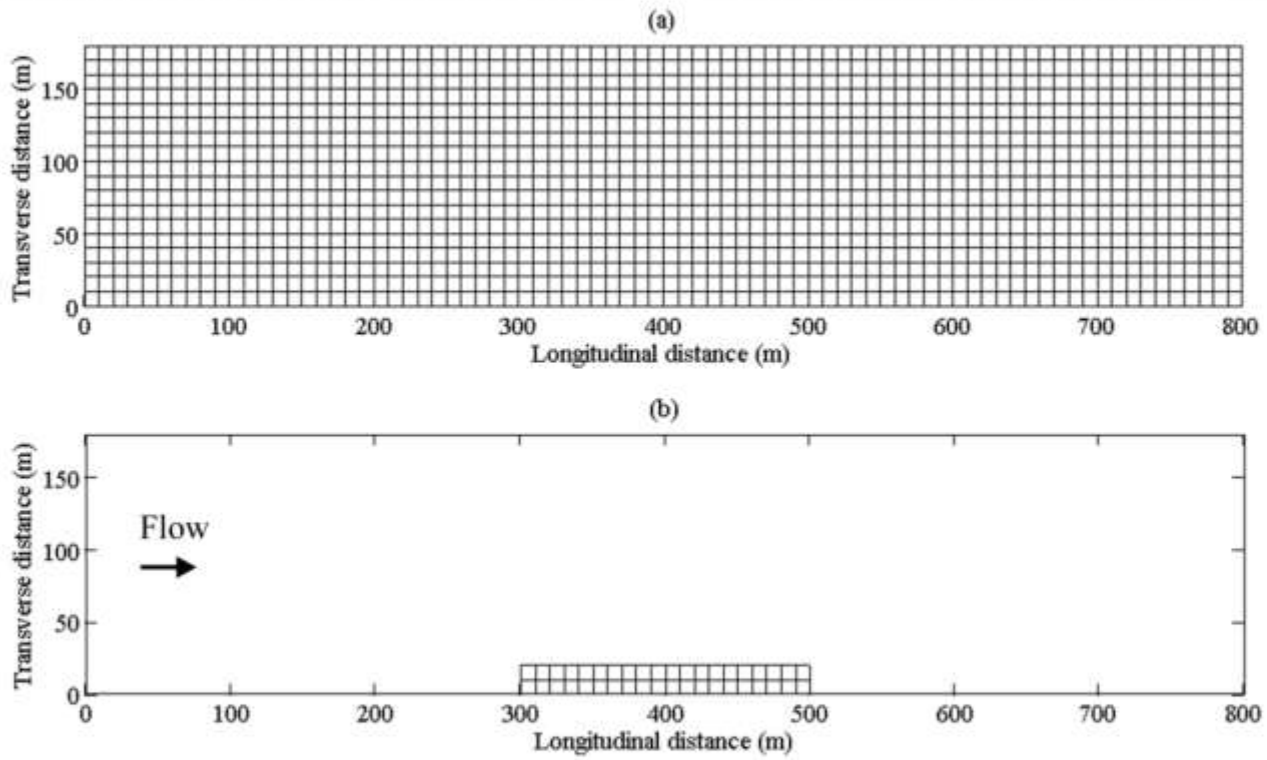
Kalita H.M., Bhattacharjya R.K and Sarma, A,K. **Linked simulation optimization model for evaluation of optimal bank protection measures** (Under review)

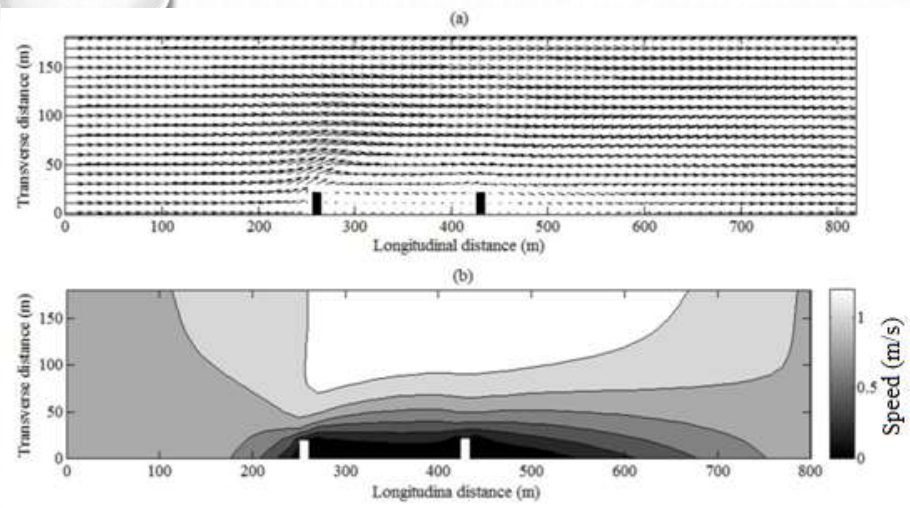
BRAHMA: BRAIDED RIVER AID: HYDRODYNAMIC AND MORPHOLOGICAN ANALYZER



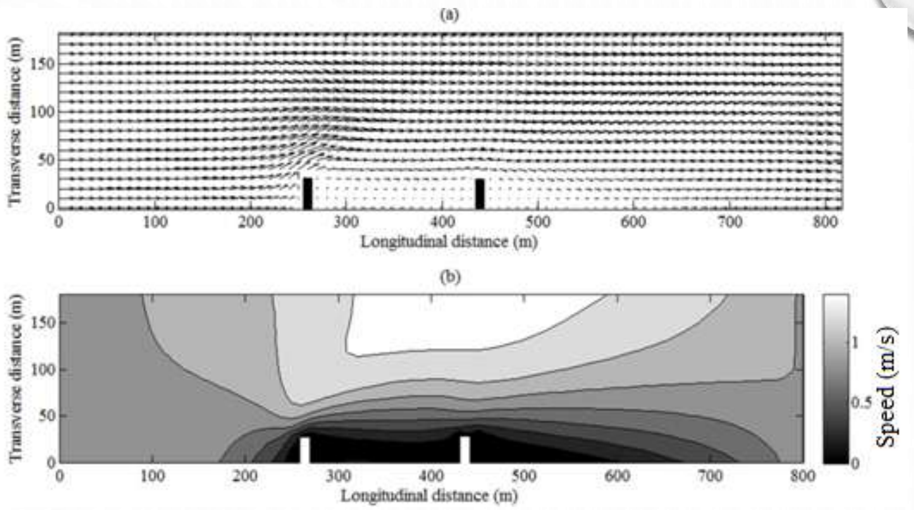
Application of the model

Hypothetical straight channel

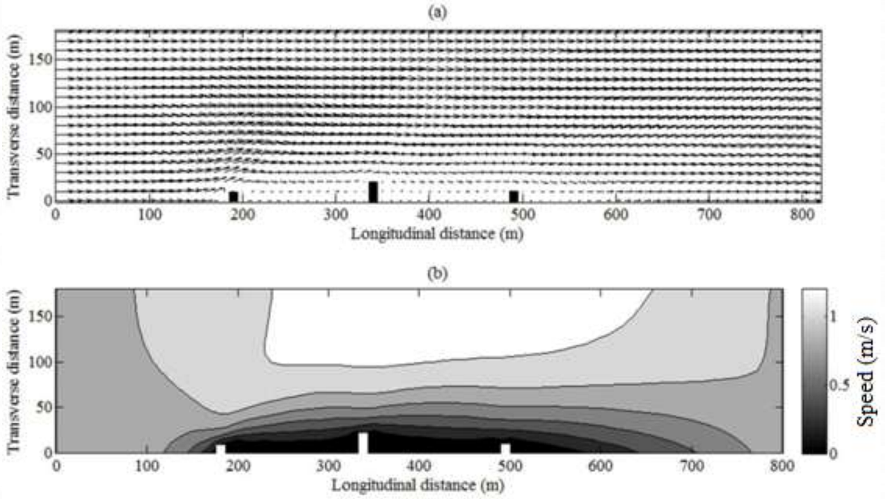




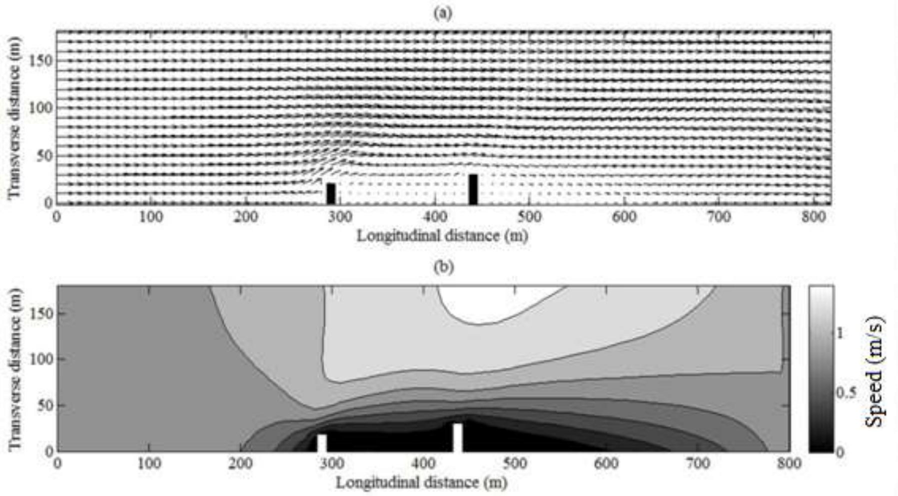
Formulation I, target speed 0.3 m/s



Formulation I, target speed 0.2 m/s

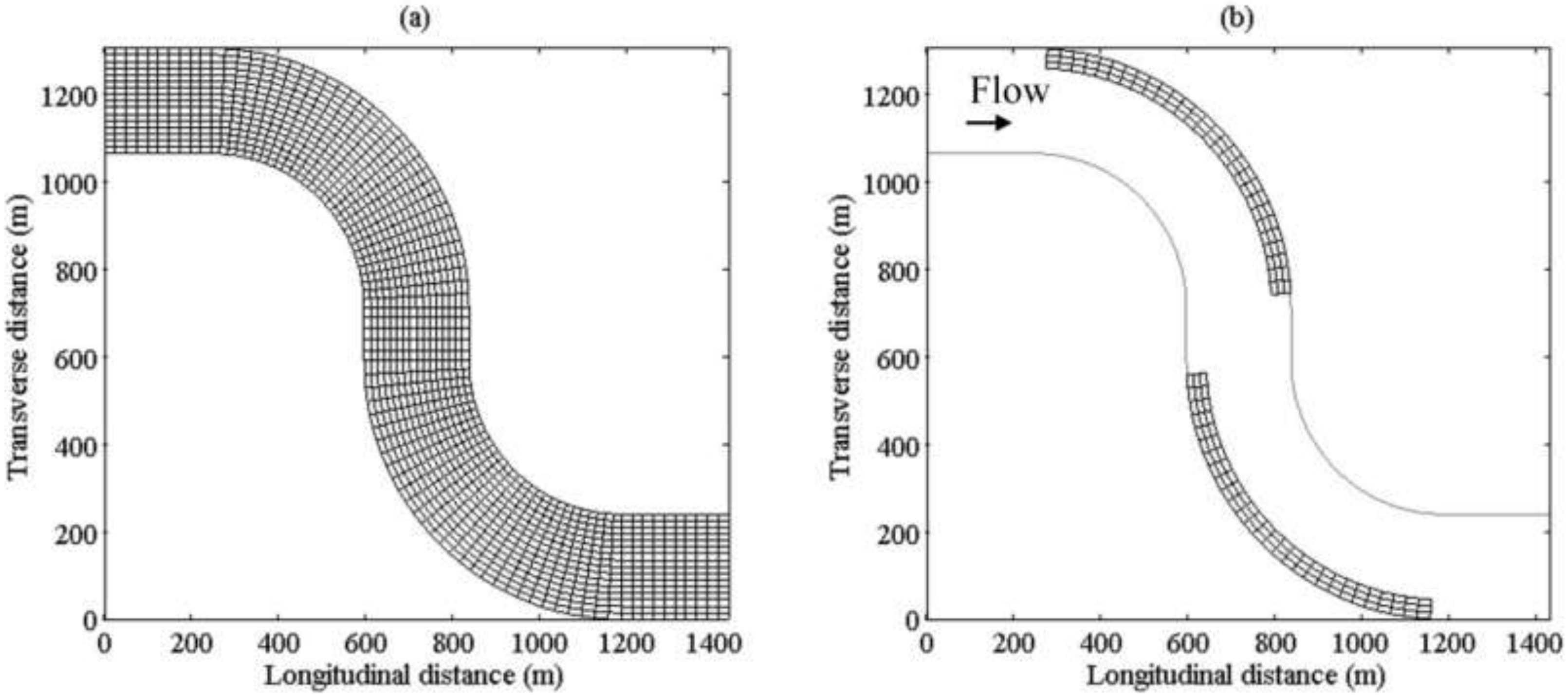


Formulation II, target speed 0.3 m/s

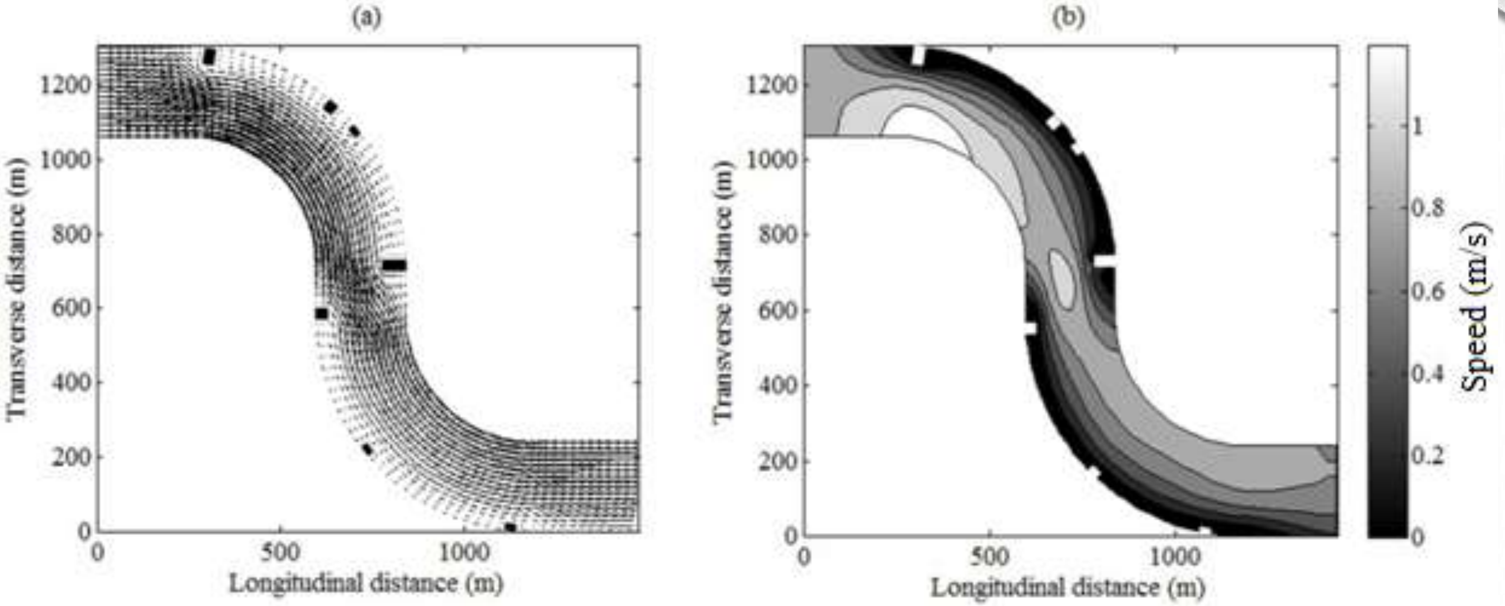


Formulation II, target speed 0.2 m/s

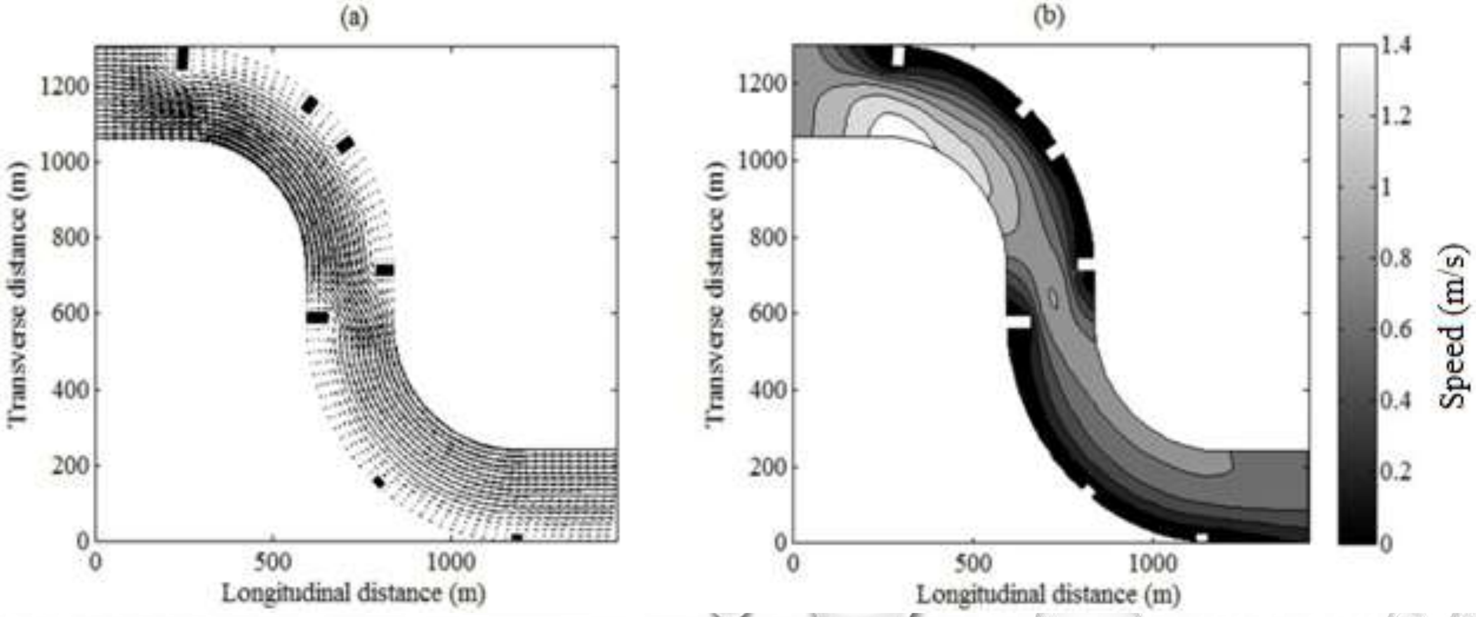
Hypothetical meandering channel



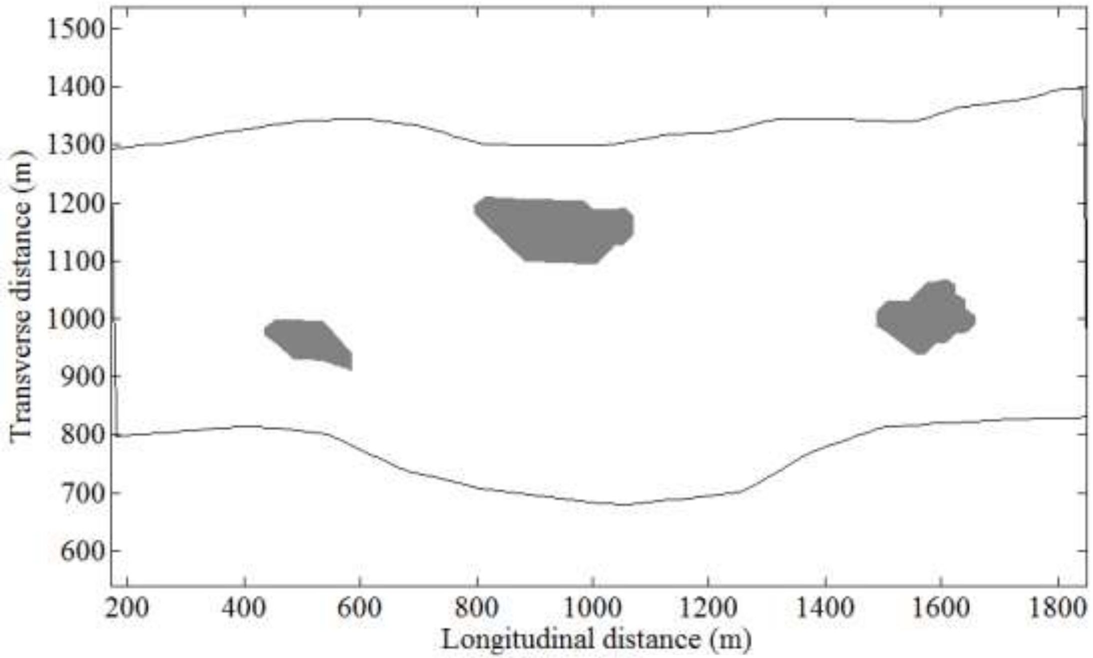
Ω = 0.3 m/s

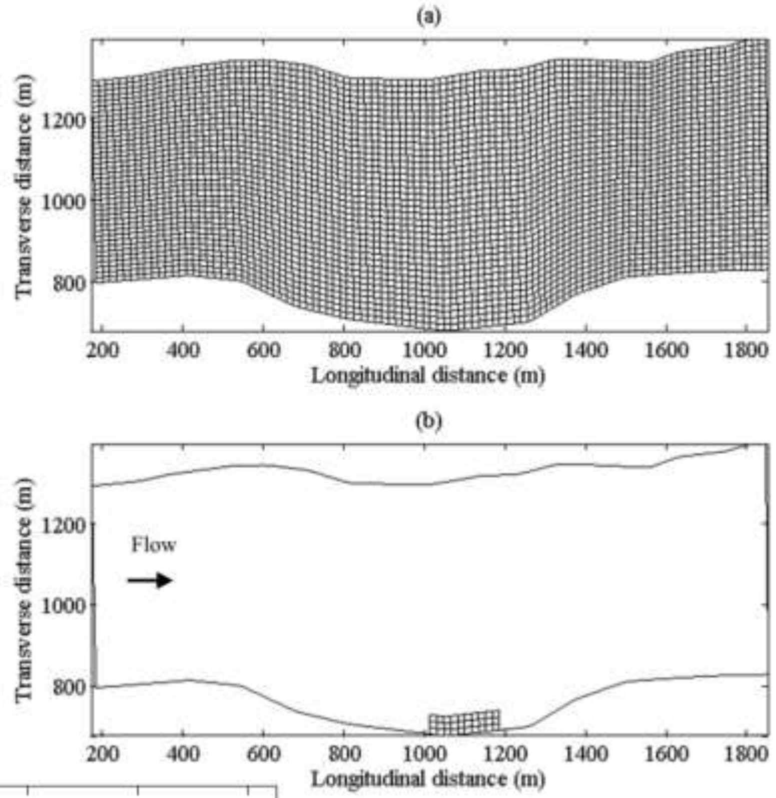


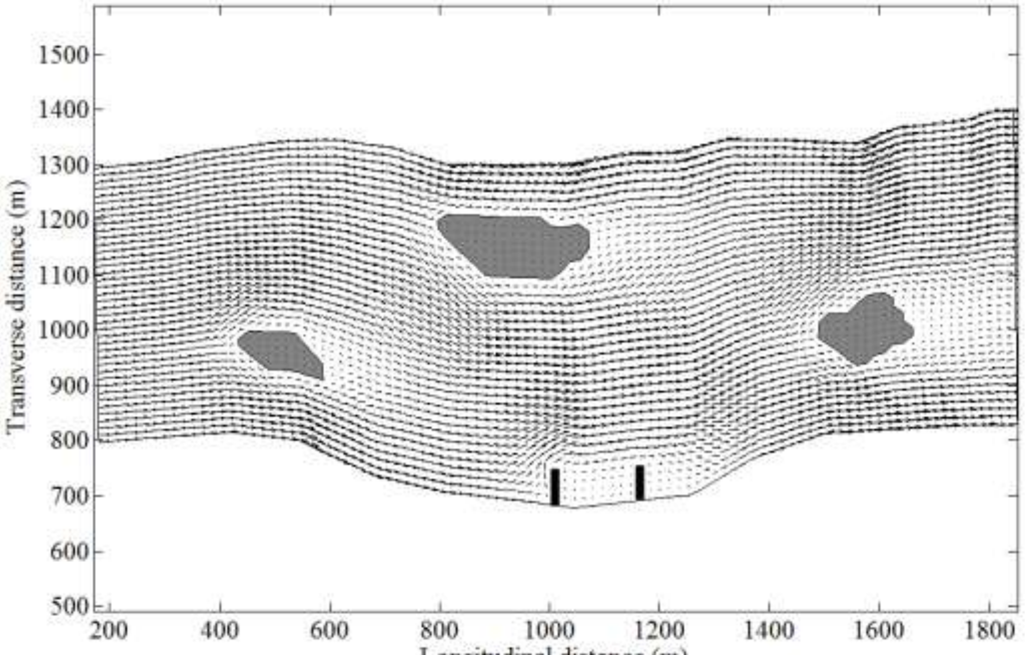
Ω = 0.2 m/s



Hypothetical braided channel



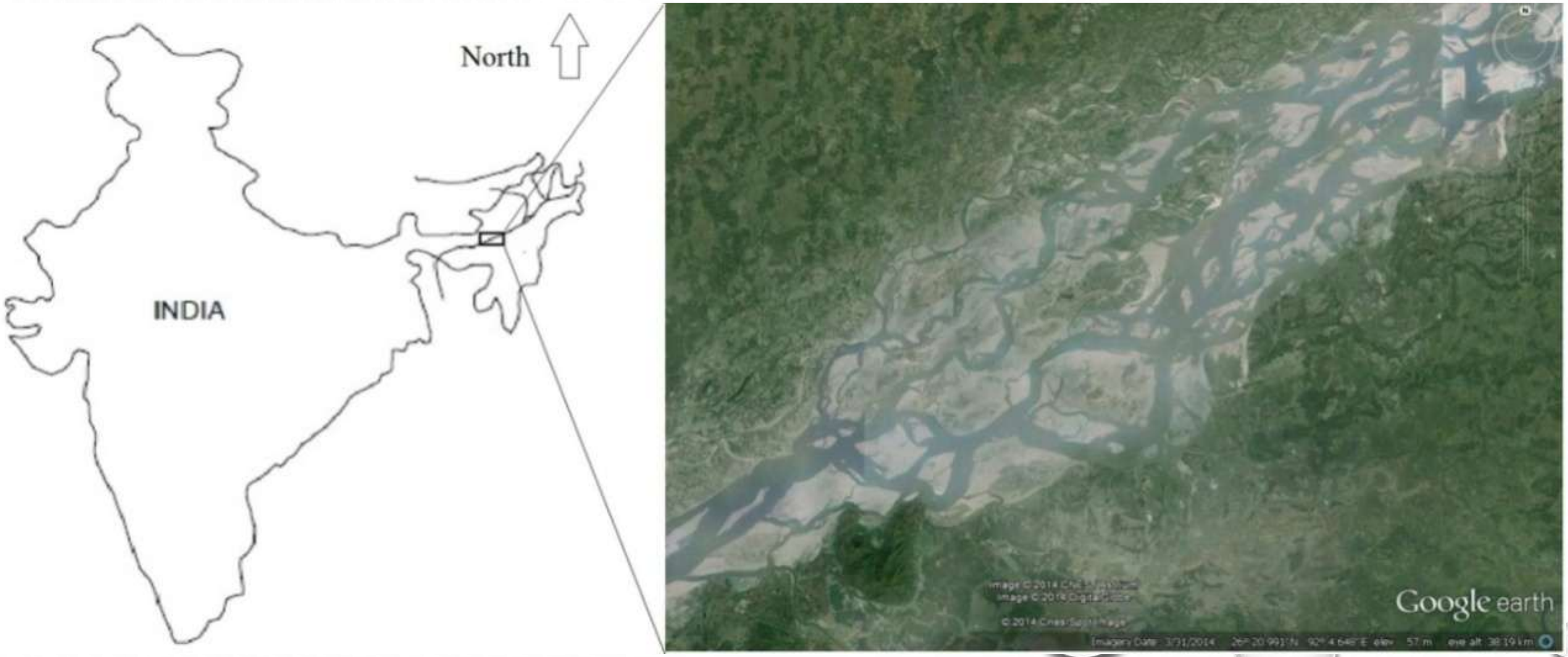




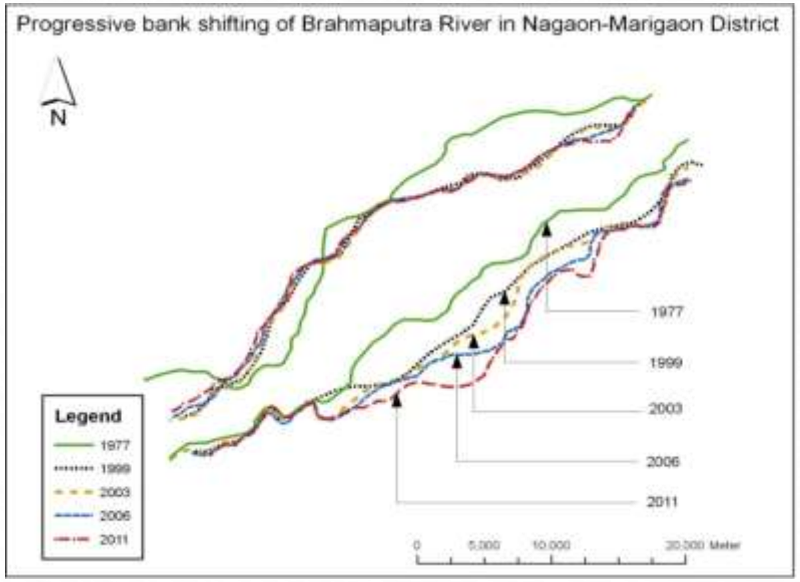
Model application Brahmaputra River

Study area

The study area is located on Nagaon and Marigaon district in Assam, where the erosion affected areas located on south bank of Brahmaputra extend from the hillock of Burha Mayang at Lat 26^0 16’ 30”N & Long 92^0 01' 00”E upto the Lat 26^0 24’ 16”N & Long 92^0 13' 00”E towards upstream.

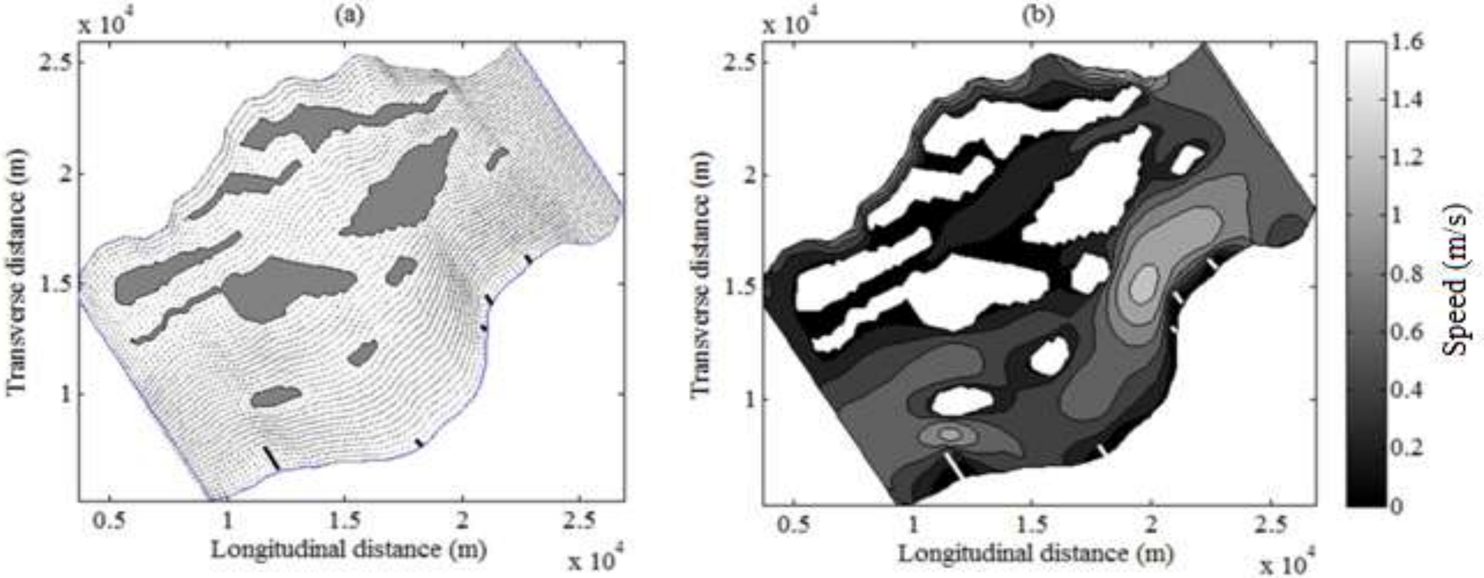


Bank on the verge of erosion

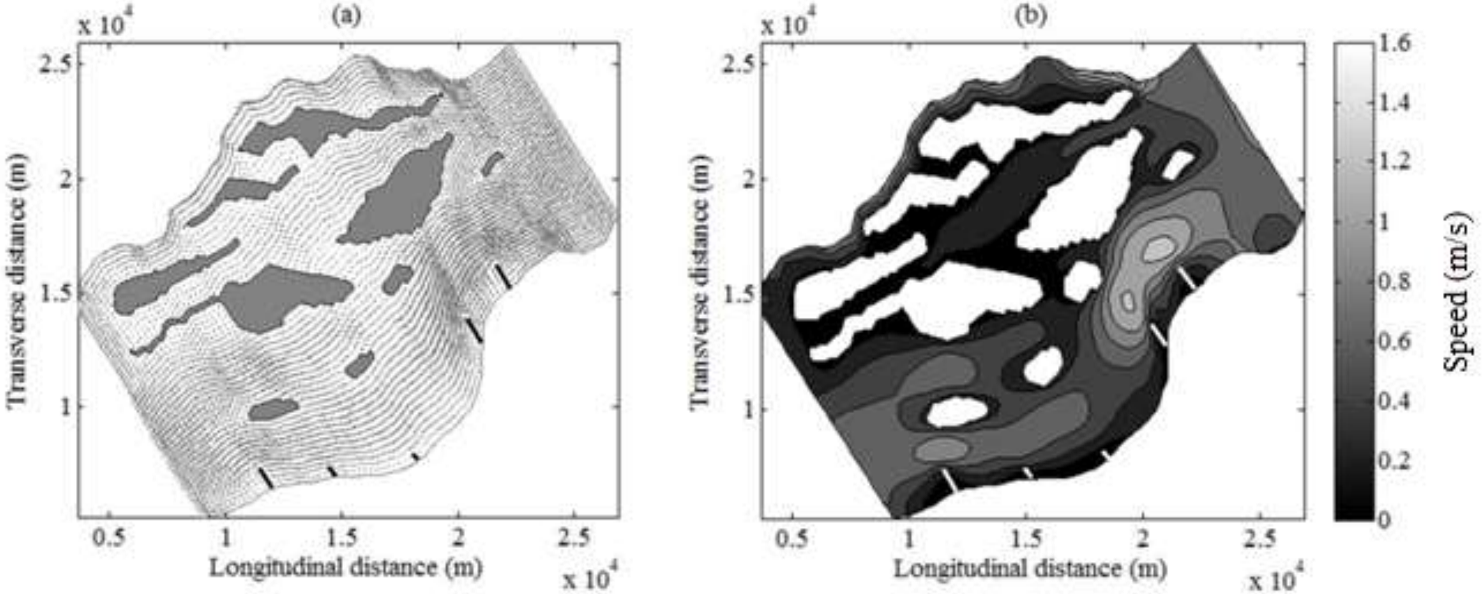


Author discussing with local people

Ω = 0.6 m/s

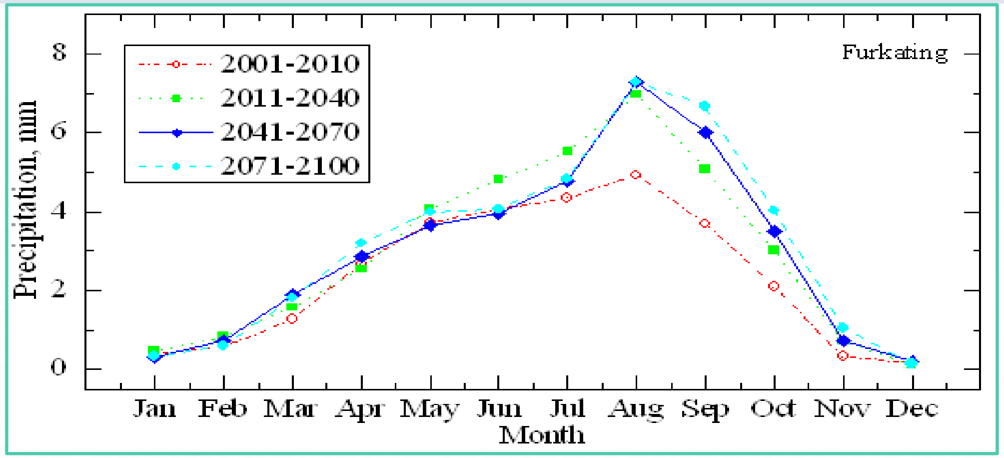

(a)
(b)
x 10^4
Transverse distance (m)
Longitudinal distance (m)
x 10^4
Speed (m/s)

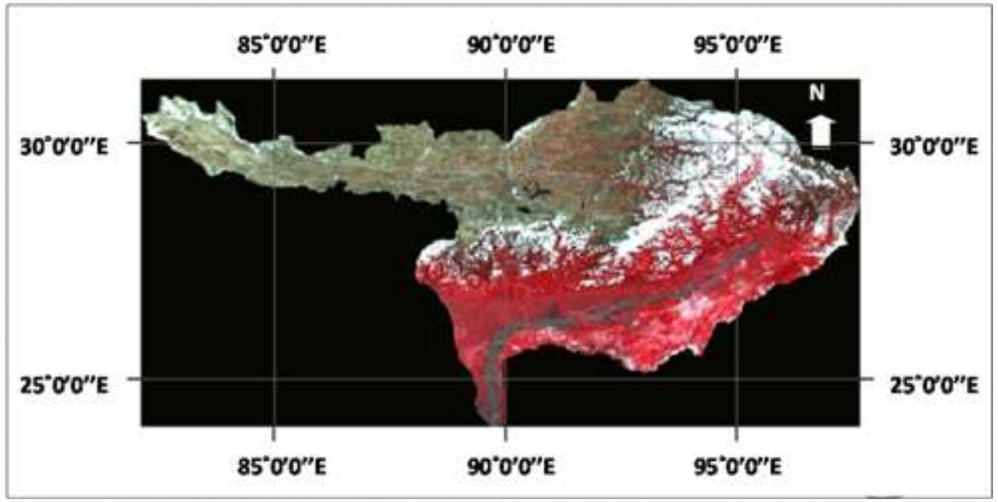
Ω = 0.5 m/s

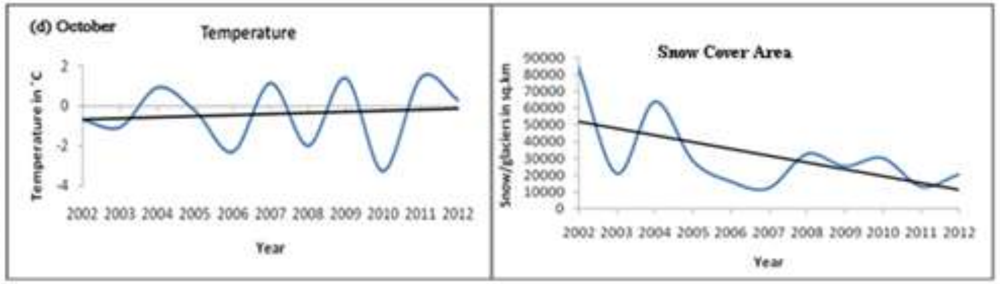

(a)
(b)
x 10^4
Transverse distance (m)
Longitudinal distance (m)
x 10^4
Speed (m/s)

Impact of climate change

- ✓ Climate change may have significant impact on flow of river Brahmaputra
- ✓ Monsoon flow of the river may increase by twenty percent in future
- ✓ Lean period flow may decrease by fifteen to twenty percent
- ✓ Number of dry day may increase in future
- ✓ Temperature increase by 0.5   to 1.0 degree
- ✓ Shifting of Monsoon
- ✓ Reduction in Himalayan glacier/snow cover







CONCLUSIONS

- A BASIN LEVEL PLANNING IS NECESSARY FOR A LONG TERM SUSTAINABLE SOLUTION OF FLOOD AND EROSION PROBLEM OF ASSAM.
- HOLISTIC APPROACH HAS TO BE ADOPTED CONSIDERING ANTHROPOGENIC DEVELOPMENT AT THE UPSTREAM AND CLIMATE CHANGE
- STUDY TO ASSESS THE POSSIBLE IMPACTS OF THE UPSTREAM PROJECTS ON THE INDIAN SIDE OF RIVER BRAHMAPUTRA
- SHARING HYDROLOGICAL DATA OF RIVER BRAHMAPUTRA BETWEEN THE STAKEHOLDERS
- WATER SHARING TREATY AMONG THE STAKEHOLDERS FOR SUSTAINABLE USE OF THE WATER RESOURCES OF THE RIVER

THANKS