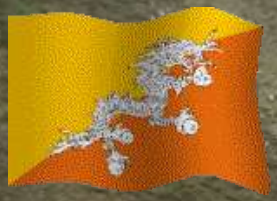


4th Asia-Pacific Climate Change Adaptation Forum 2014

Implication of hydropower for food security in a changing climate,1-3 October 2014

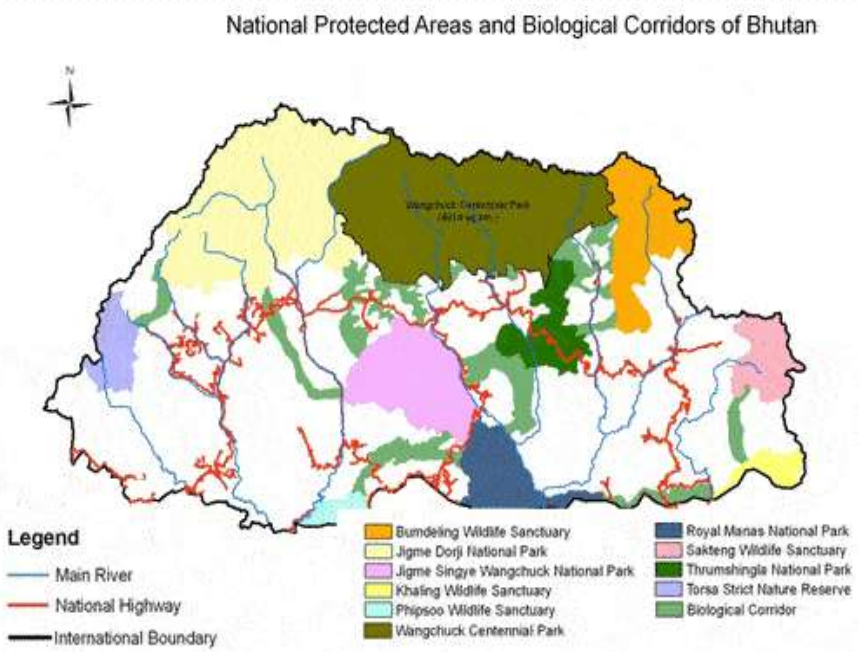
BHUTAN

Overview of Presentation

- Country Background
- Food Security Aspects
- Climate Issues
- Energy in Bhutan
- Hydropower
- Issues and Challenges
- Conclusion

About Bhutan

- Total area: 38,394 Sq. km
- Population: 672,000
- Elevation:100-7000m (170km south to north)
- Forest Coverage: 72.5%
- Protected Areas:>50% of Area
- Industry: Agriculture 69%, Hydropower (20% of GDP)



Food Security Aspects

- 5.9 % of people in Bhutan suffer from food poverty or consume less than 2,124 kilocalories per day (FAO 2014 report)

- Poverty in Bhutan is about 12% in 2013 and food self-sufficiency is an issue due to in-fertile land, steep slopes, seasonal issues and climatic challenges.

- Livestock is an essential part of farming for their products and services including ploughing, and manure.

Food Security Aspects (cont.)

- Major crop grown are – rice, maize, potato, wheat, barley, chilli, apple, oranges, areca nut etc. depending on agro ecological and climate.
- Rice is preferred staple, rice consumption per capita (172 kg)
- Only 50% self sufficient in rice
- Western part of Bhutan is the major rice producer
- Livestock is integral part of farming (draught power, nutrient)

Food Security Aspects (cont.)

- Opportunity for diversity of local dietary habits (food utilization dimension of food security)
- Food Security varies from Dzongkhag and Geogs
- 70% of food shortage is linked to land and low productivity
- Shortage of food is met by cash purchase or barter with livestock products
- Food shortages are seasonal
- Very limited studies on anthropological aspects of food security

Climate Issues

- Changes in climate patterns across Bhutan have been observed in the form of shifting rainfall pattern, new pests and diseases, erratic total rainfall, increase in temperature and fluctuations of river flow (*National News paper 2013 and DHMS 2012*)
- Changes in snow and glacier covers have been found as well (*ICMOD 2014)*
- Most agriculture in Bhutan is dependent on the summer monsoon and manual labour, which are highly sensitive to climate variations.

Climate Issues (cont.)

- Dependency on natural produce from the forests such as ferns, nuts, mushrooms, herbs, and wild fruits are also very high for consumption and income generation.
- Any changes in the climate patterns are likely to cause serious impacts on food security *(CORRB 2012)*

Climate Change in Bhutan

Northern side of Rinchen-zoe La

1984

Photo by Prof. Tsukihara

-*In 1984, no water body*

-*After the formation of Lake, rapid retreat observed*

1999

Photo **by Dr. Naito**

2009

Roughly 500m retreat in 25 years

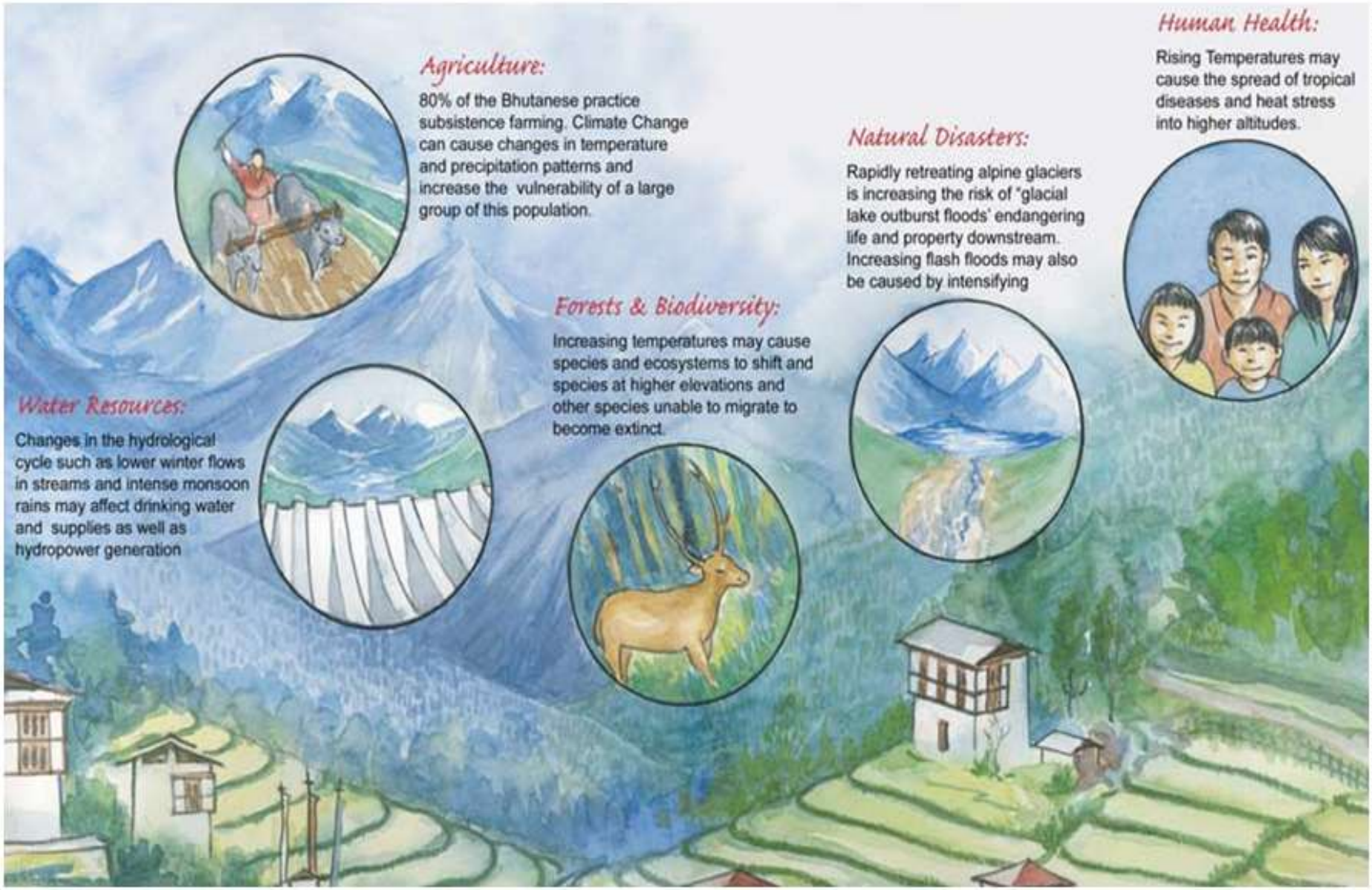
Repeat *photography*

1999

Jichu Dramo Glacier

2010

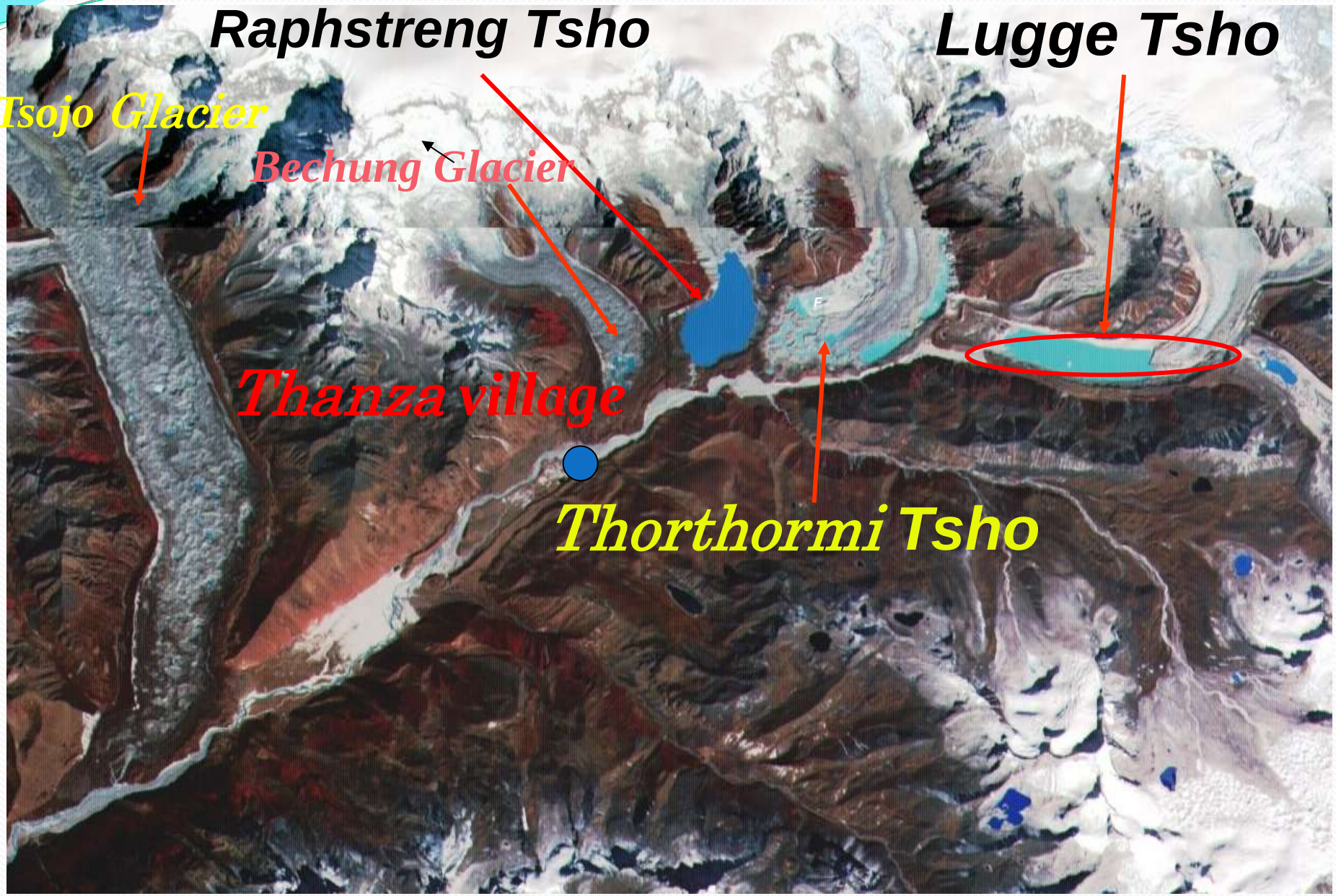
Potential Impacts of Climate Change



Climate Change & GLOF

- Temperature increases due to apparent climate change have changed glacier behavior
- There exist the possibility of excessive melt water bearing down on moraine dams causing GLOFs
- Glacier lakes provide a hazard in many basins of Bhutan

1994 Glacial Lake Outburst Flood



1994 Glacier Lake Outburst Flood

GLOF hazards

- Glacial lake outburst floods
- Damaged infrastructure
- Villages washed away
- Loss of human lives
- Loss of livestock
- Damage to agricultural land
- Damage to cultural heritage sites
- Loss of natural vegetation

Time line for past and probable GLOFs

The Combined GLOF will be 53 million m^3

1957 1960

GLOF emanated from the headwaters of Pho Chhu Sub Basin in these two years. No written records.

1994

2015

Field assessments by the DGM and the Institute of Geology, University of Vienna, have predicted probability of outburst of Thorthormi and Raphstreng Tsho, yet again in the headwaters of Pho Chhu Sub Basin, in the next ten years or so.

Source: Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods in Bhutan, ICIMOD/UNEP, 2001

Impacts of CC: Water resources

- Most of the smaller glaciers may disappear as temperature continues rising
- Glacier melt fed basins during dry season will become seasonal flow
- Seasonal discharge will be more – surface runoff – flashfloods – more casualties
- Lakes formed due to melting glaciers (glacial lakes) possess threats (GLOF)
- Hydrological pattern changes, hydropower generation, floods, drinking water shortage

Impacts of CC: Water resources

- Changes in hydrological cycle
- Intense monsoon – drinking water quality
- 9FYP (2008) - 1,488 MW
- 10FYP (2013) - 3,150 MW
- 10,000MW envisaged by 2020
- 30,000 MW potential ?

Energy in Bhutan

- Fuel wood is main source of primary fuel
- Electricity is 99% Hydropower
- 23,765MW as techno-economically feasible Hydropower potential
- Current;1505MW(5%)
- 10,000MW by 2020
- Low generation and

High demand in winter

Hydropower

- All hydropower projects that had been completed and on-going in Bhutan are run-of-the-river systems with minimal impact on the environment and agriculture.

- Hydropower development helps the economic and bringing in employment opportunities, it also takes away the young farm labours and causing other damages to the agriculture sectors in the form of agriculture land inundation, pollution and relocation.

Hydropower (cont.)

- With only 3% of the area under cultivation, 70% forest cover and many fast flowing rivers, permanent ice, glaciers, and lakes Bhutan's situation is very unique.
- Any area that is taken away from agriculture for hydropower through inundation and construction are definitely going to impact the livelihoods of people.

Hydro power Implementation Status(10,000 MW Initiative)

Sl. #	Name of Project	Capacity (MW)	Implementation Status
1	Punatsangchhu-I	1200	DPR prepared in 2006. Under construction since Nov 2008. To be commissioned by Nov 2018 if RCC dam is adopted else, Nov 2019 if CVC dam.
2	Punatsangchhu-II	1020	DPR prepared in 2009. Under construction since Dec 2010. To be commissioned by Dec 2017.
3	Mangdechhu	720	DPR prepared in 2008. Under construction since Aug 2010. To be commissioned by Sept 2017.
4	Amochhu	540	DPR cleared by CEA in May'13. Final DPR received in May'14. Draft IG Agreement shared with GoI in Sept'12.
5	Sankosh	2,560	DPR submitted in July'12 and yet to be cleared by CEA. Draft IG Agreement shared with GoI in Sept'12.
6	Kuri-Gongri	2,640	Fresh DPR under preparation. Agreement for preparation of new Kuri-Gongri HEP DPR signed in April 2014 with WAPCOS.

B. Joint Venture(JV) Projects

Sl. #	Name of Project	Capacity (MW)	Implementation Status
1	Kholongchhu	600	DPR cleared for implementation by GoI and RGoB. IGA for JV projects signed on April 22, 2014. SHA under finalization between DGPC and SJVNL.
2	Bunakha	180	DPR cleared by CEA and RGoB. Investment approval from GoI awaited.
3	Wangchhu	570	DPR cleared by CEA in Mar'14. Corrected final DPR yet to be submitted. Investment approval from GoI awaited.
4	Chamkharchhu-I	770	DPR yet to be cleared by CEA. Investment approval from GoI awaited.

Impacts of CC: Hydropower

- **Hydropower generations – less in dry seasons (low winter flows)**
  - ***e.g. Power generation in Bhutan in winter drops to 1/6th of that of peak season (summer)***

Issues and Challenges

- No long term data and dependency on models
- Analytical skills are limited
- Rural urban migration
- Subsistence farming
- Climate Change
- Research and technology transfer
- Hydropower is a clean, reliable and economic source of energy in the Himalayas

Issues and challenges (cont.)

- Relocation and resettlement of people by hydropower projects need careful and prior planning.
- Food banks and marketing has been taken over by food Corporation of Bhutan which is proving to be successful.
- Dairy, food and horticulture cooperatives are proving to be more successful than individual private or public institutions for food production, marketing and provision.
- Recommendations and things to do better in reducing negative implications

Conclusion

- Food security in Bhutan is an issue of access to resources and economic opportunities (Inconsistent arises from lack of access to land, water)
- Production meets only rural requirement
- Protection of agricultural land
- Enabling policy and legal framework

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