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CGIAR

Fostering adoption of model-driven WEF solutions through IWRM approaches in Western Nepal

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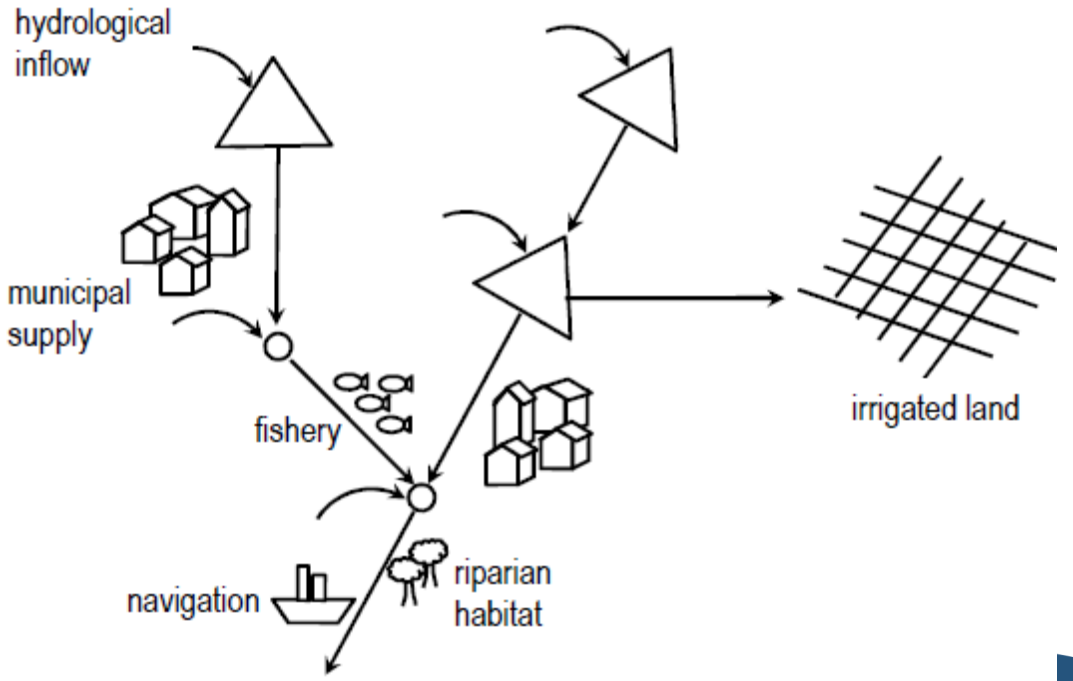
Innovative water solutions for sustainable development

Food · Climate · Growth

Achieving Multiple Objectives- WEF Nexus

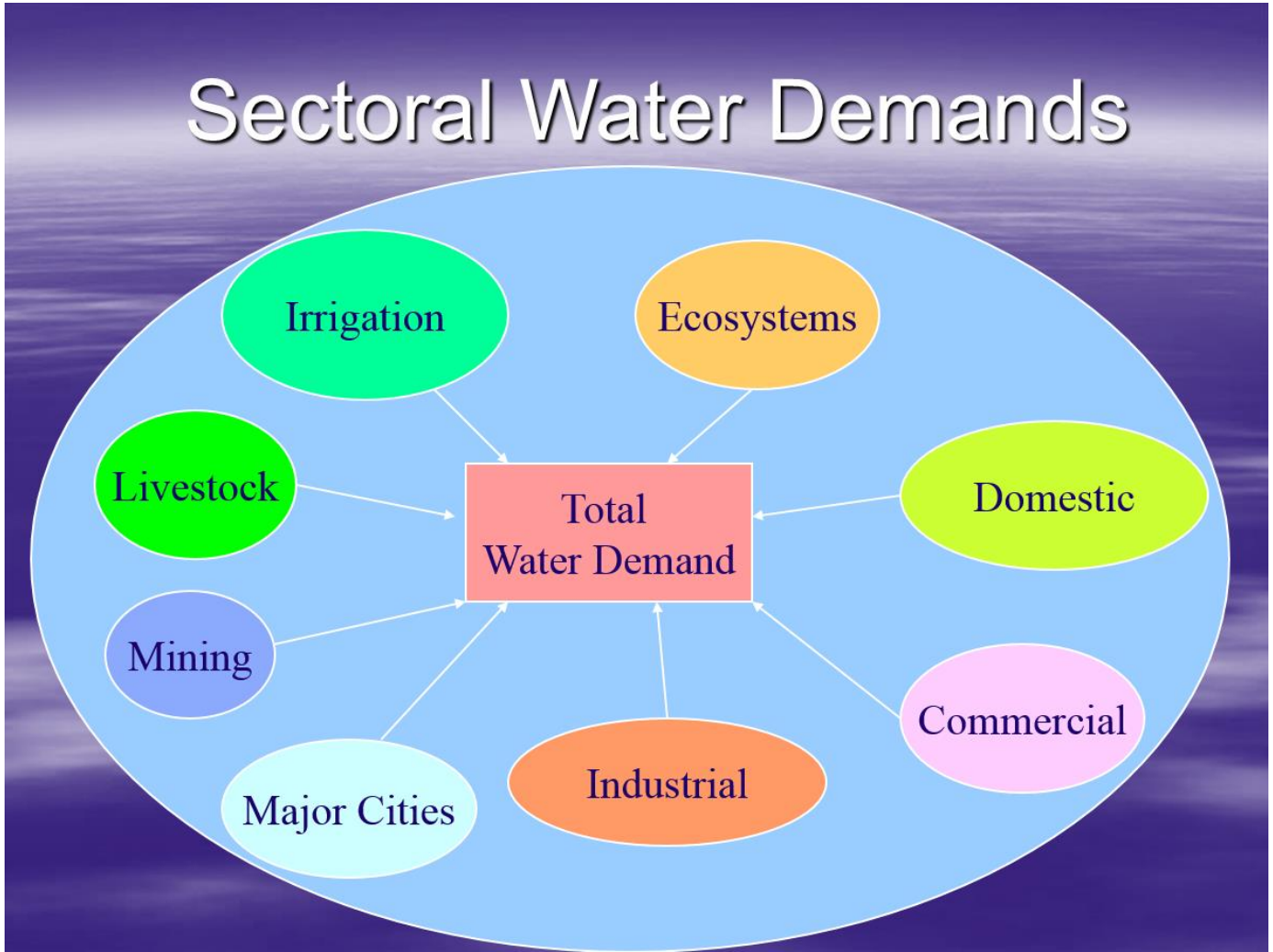
- Water resources planning should ideally meet demands and achieve various societal objectives (‘**balanced**’) under a wide range of plausible futures (‘**robust**’)

- **Main Challenge:**
  - A shared vision to develop a basin/country that is robust and balanced



Adapted from: Harou, 2014

Achieving Multiple Objectives- WEF Nexus



Nepal: The Water Context

Water resources (WR) remain under-developed

- < 7% of available WR are managed for socio-economic purposes (WECS, 2005)
- 2.5 % of economically feasible hydropower potential (42000 MW) harnessed (NEA, 2018)
- 30% of arable land is irrigated (CBS, 2012)
- 22% of groundwater utilized in Terai (Shrestha et al., 2018)
- Crop productivity is significantly lower than rest of South Asia (Bartett et al., 2010)
- Integrated planning is not done (Suhardiman et al., 2018)

If water resources is properly harnessed, it would be the ticket out of poverty through economic growth in the hydropower and ag. sectors

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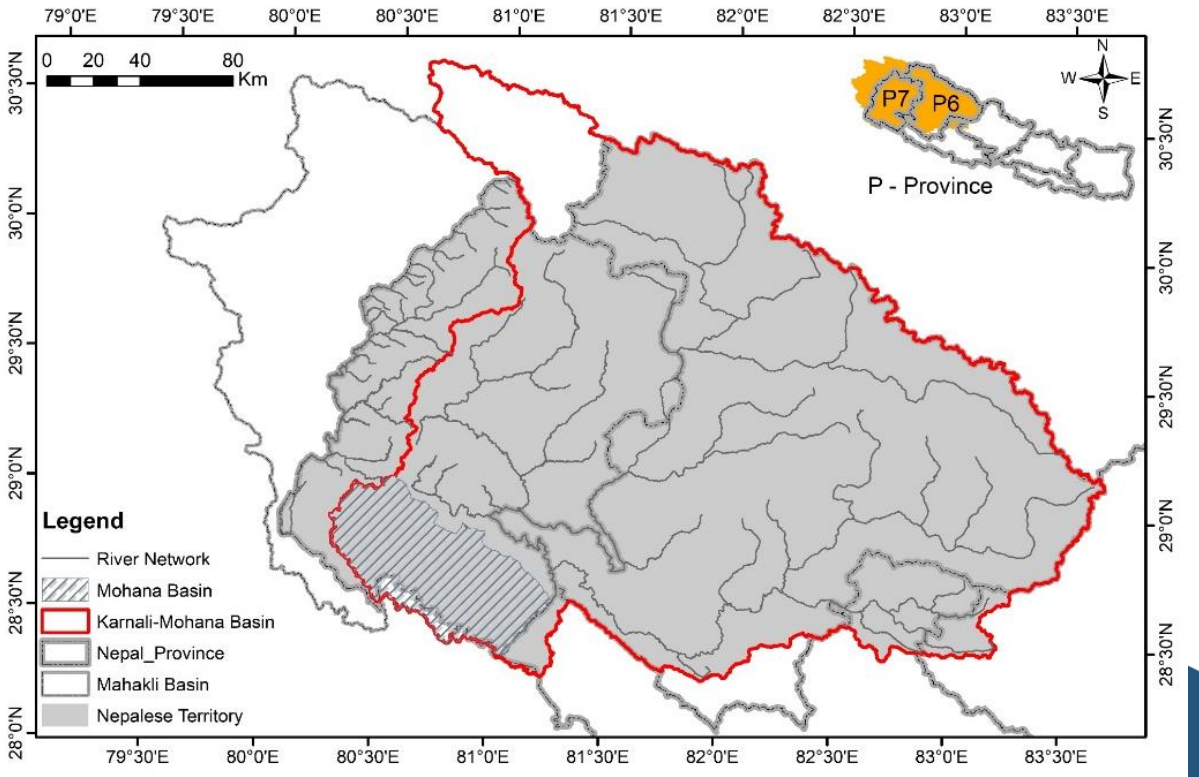
What Tools are Developed?

- 2-Hydrological Models (SWAT) developed
  - Karnali-Mohana
  - Mahakali
- Climate futures matrices developed based on projections from 19 RCMs
- Hydro-economic model for the Basin

Goal: Promote sustainable WRD in Western Nepal through **balancing future vision, economic growth, social justice and healthy & resilient ecosystems**



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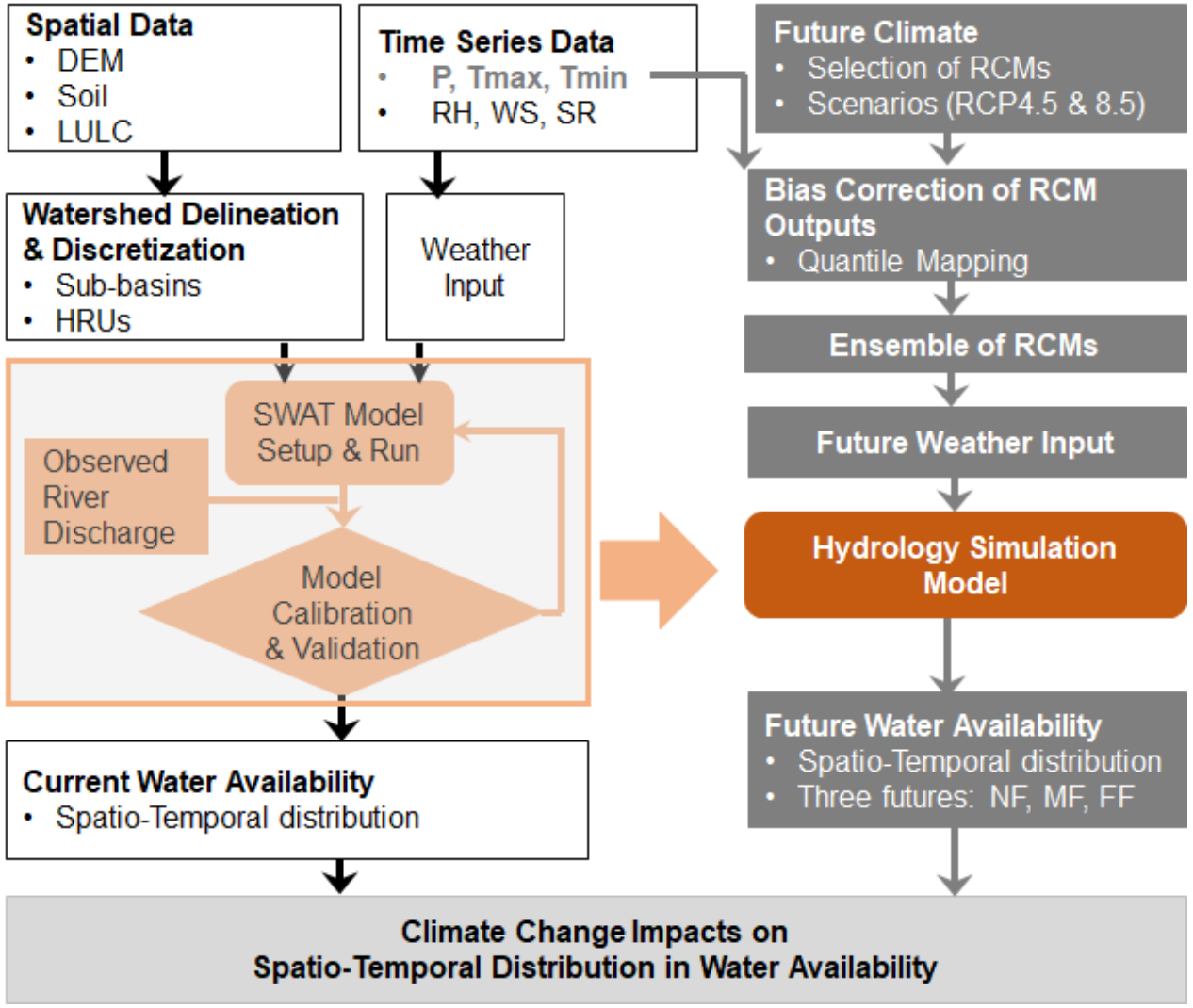
Approach: Integration of Bio-physical and Socio-economic Aspects

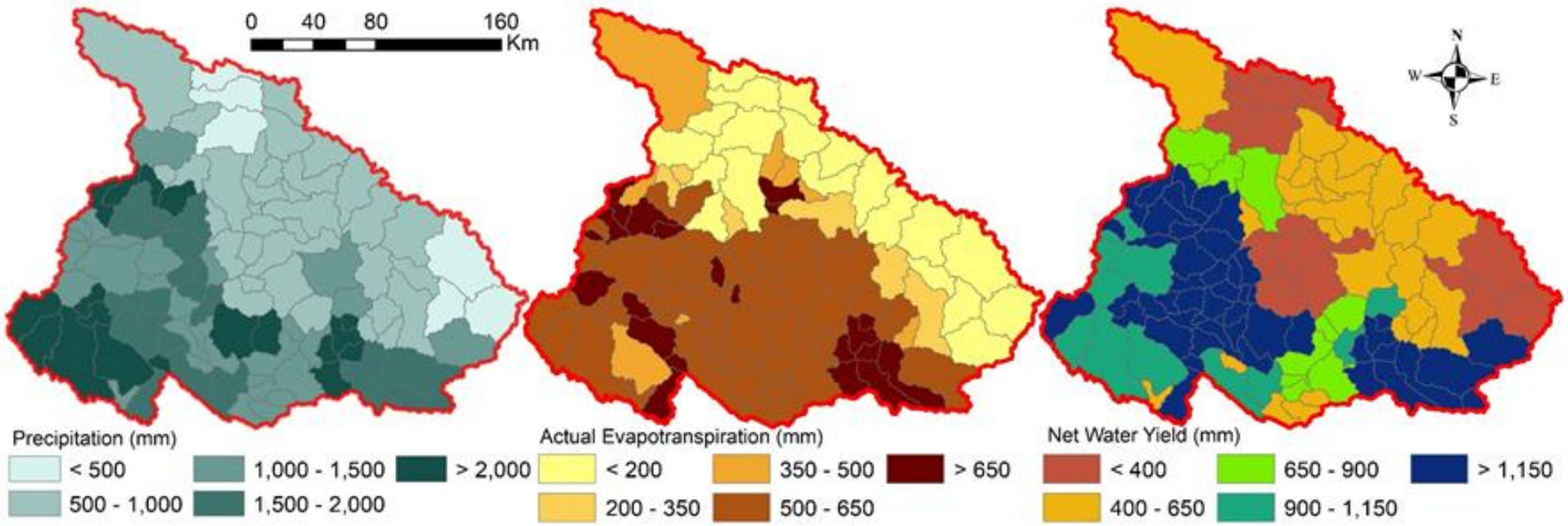
Hydro-climate Modeling and Analysis

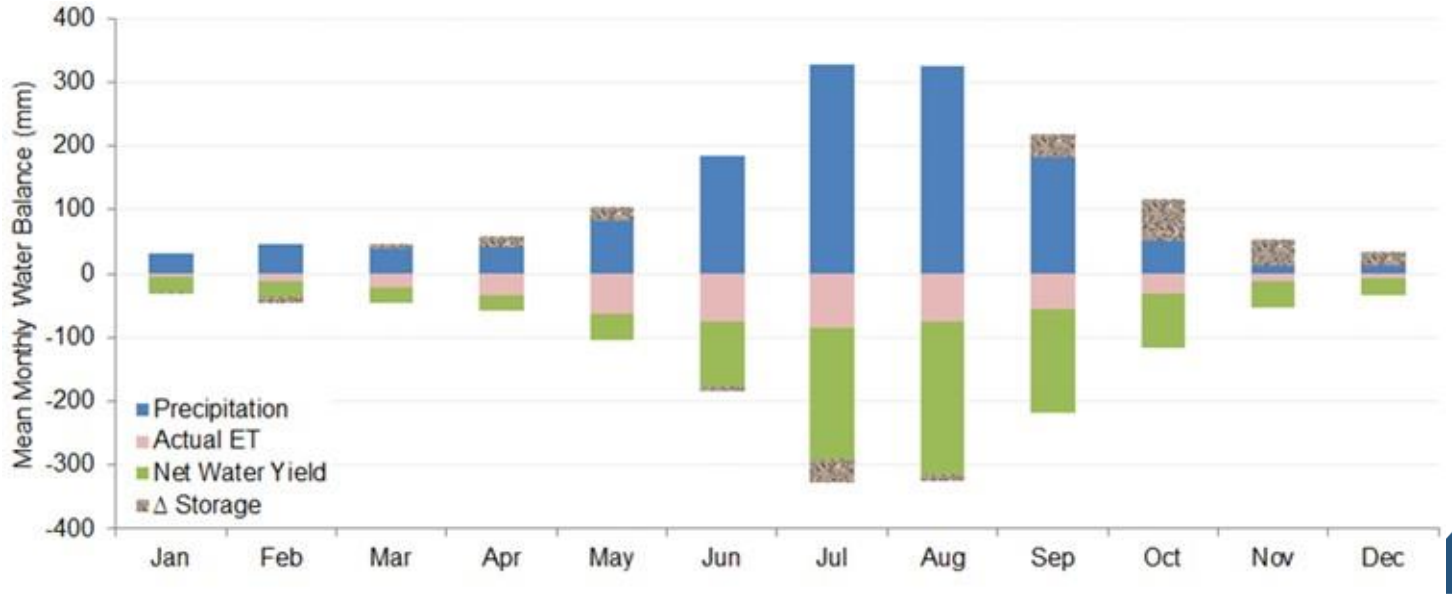


Stakeholder Engagement

- 255 Stakeholders engaged over 6 events
- 4730 Surveyed
- 121 Interviewed

Results: Current Water Availability





- **P =1,332 mm**
- **Q =1,004 mm**
- **AET =474 mm**

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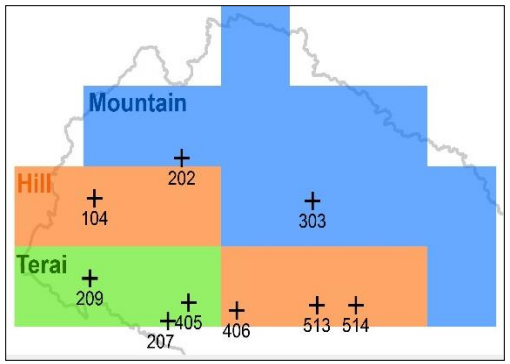
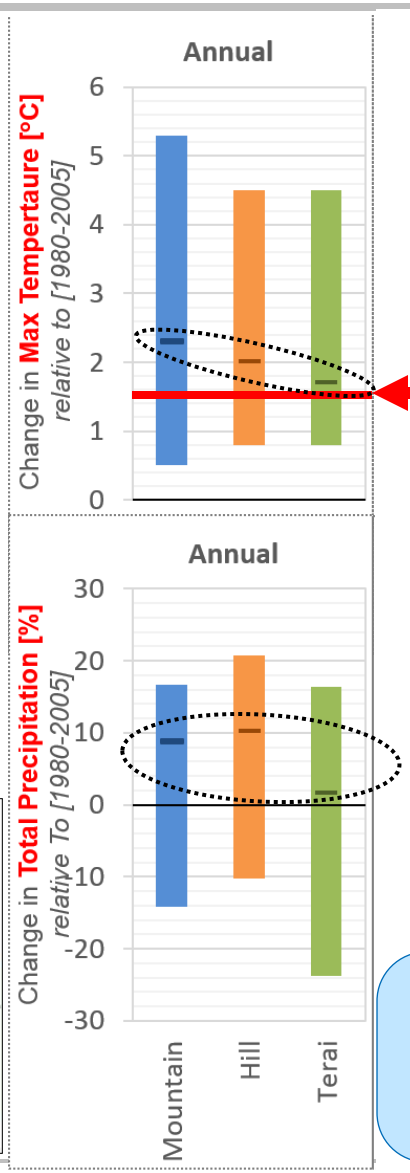
Projected Future Climate for Western Nepal

Range of projections
- 10 climate scenarios
  - (5 RCP 4.5 & 5 RCP 8.5)
- 19 RCM outputs
- 9 stations
- Three future time frames

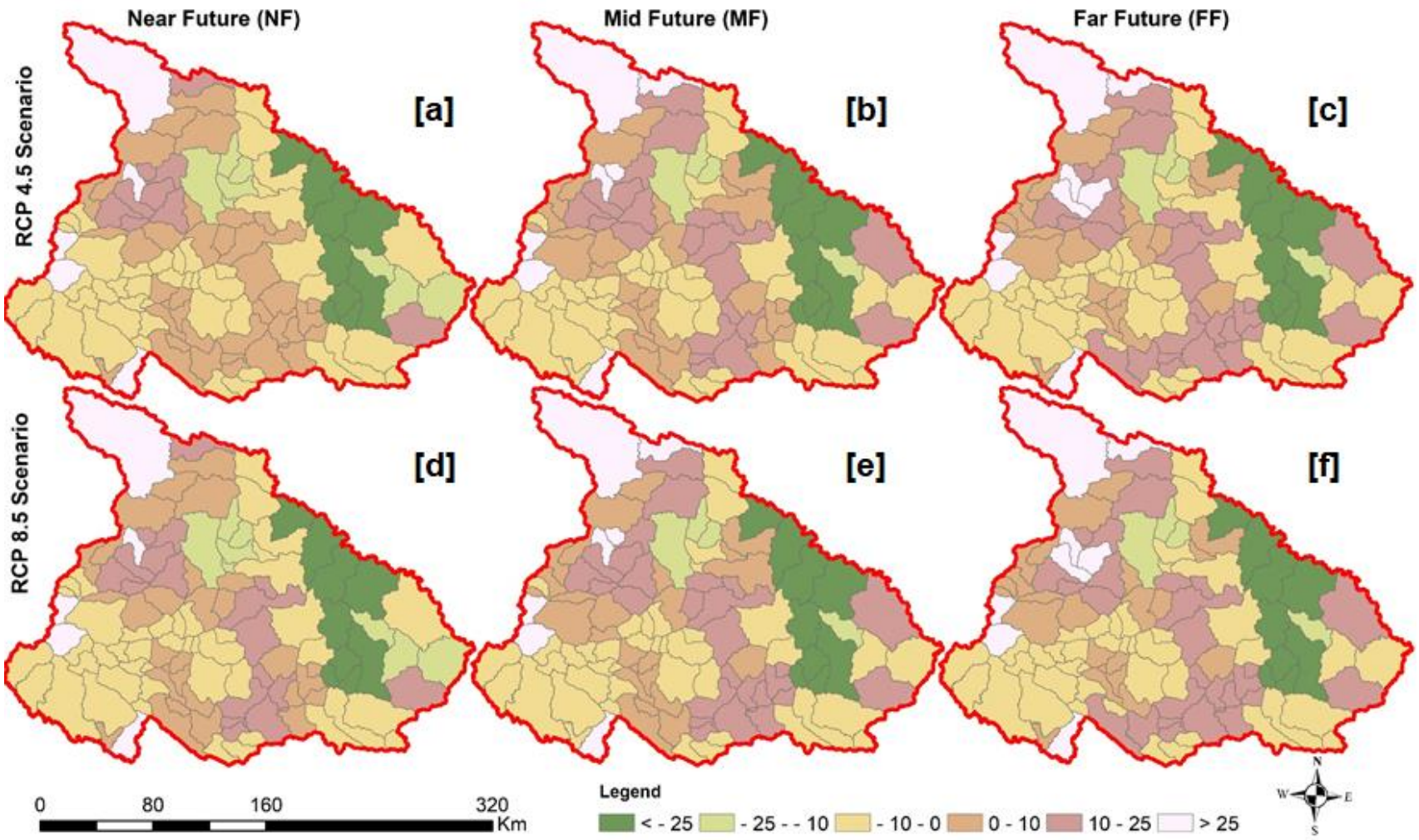




Global Target 1.5°C (Paris Agreement 2015)

Higher temperatures, prolonged monsoon and sporadic rain events even in drier months are projected

Projected Future Climate for Western Nepal



- **Figure**: Change (%) in average **annual precipitation** w.r.t. reference period

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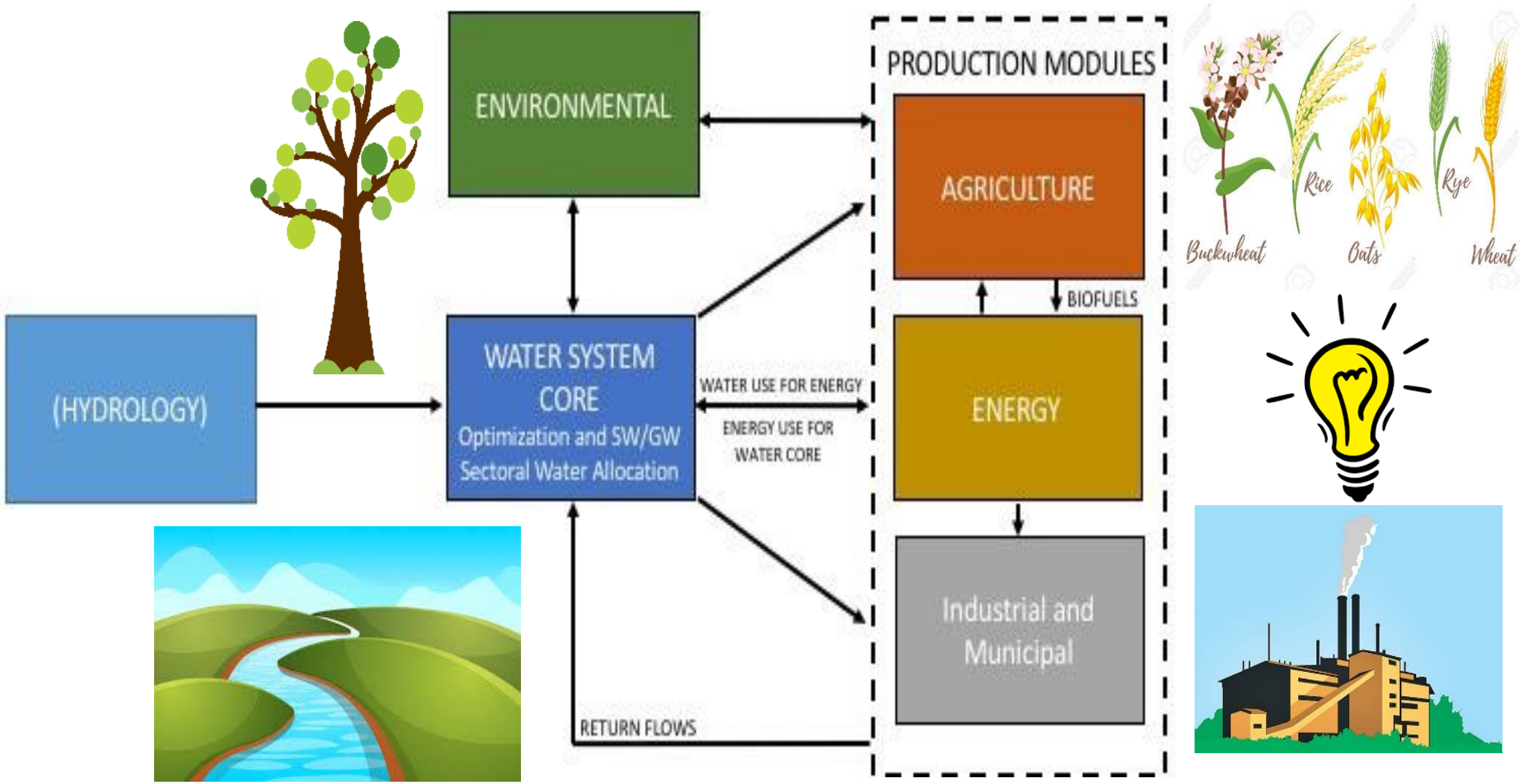
Hydro-economic Model Structure



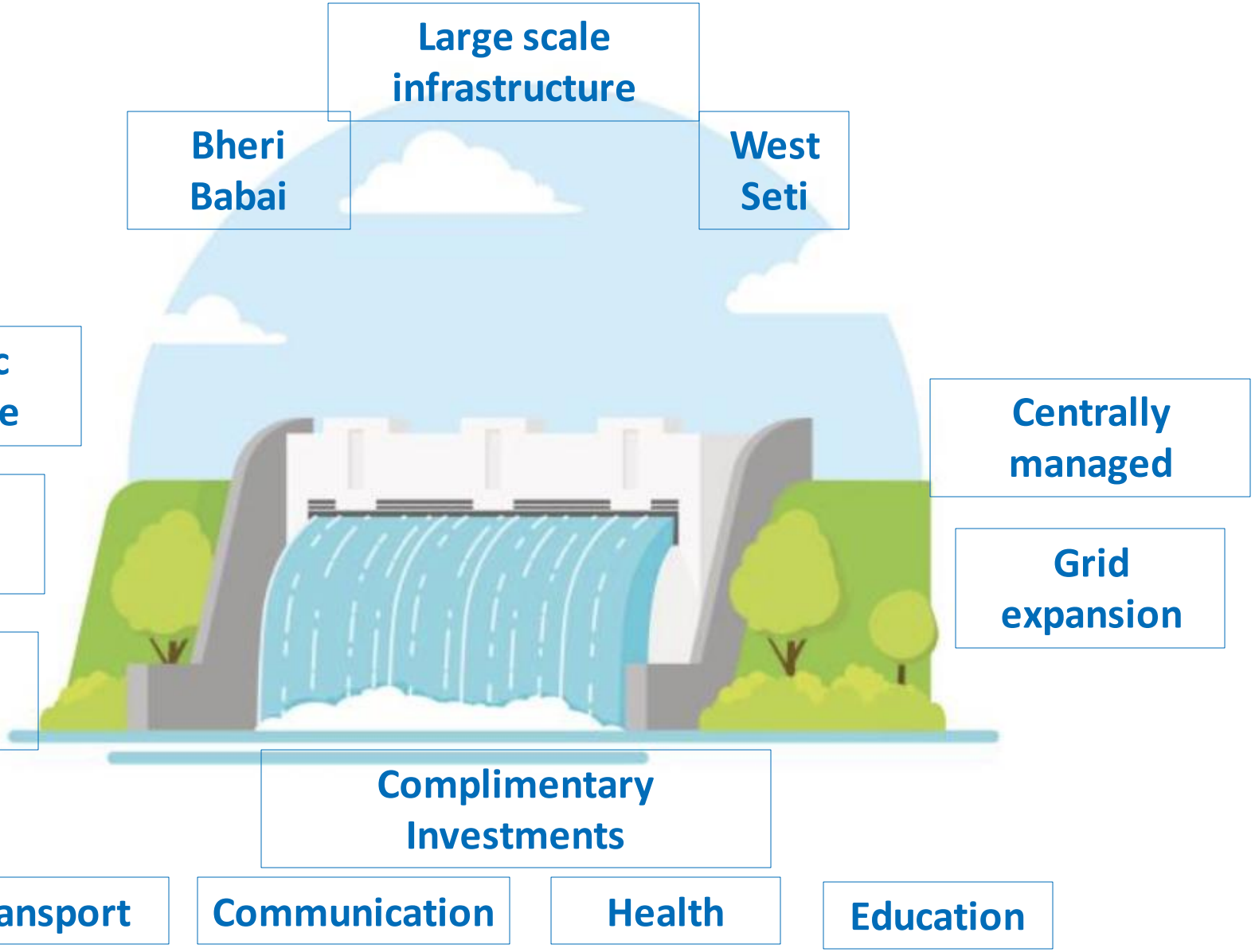
Development Pathways based on stakeholder engagement

1. Large Infrastructure Development

2. Locally Managed Development

3. Preserving Ecosystem Integrity

Development scenarios: 1. State-led development



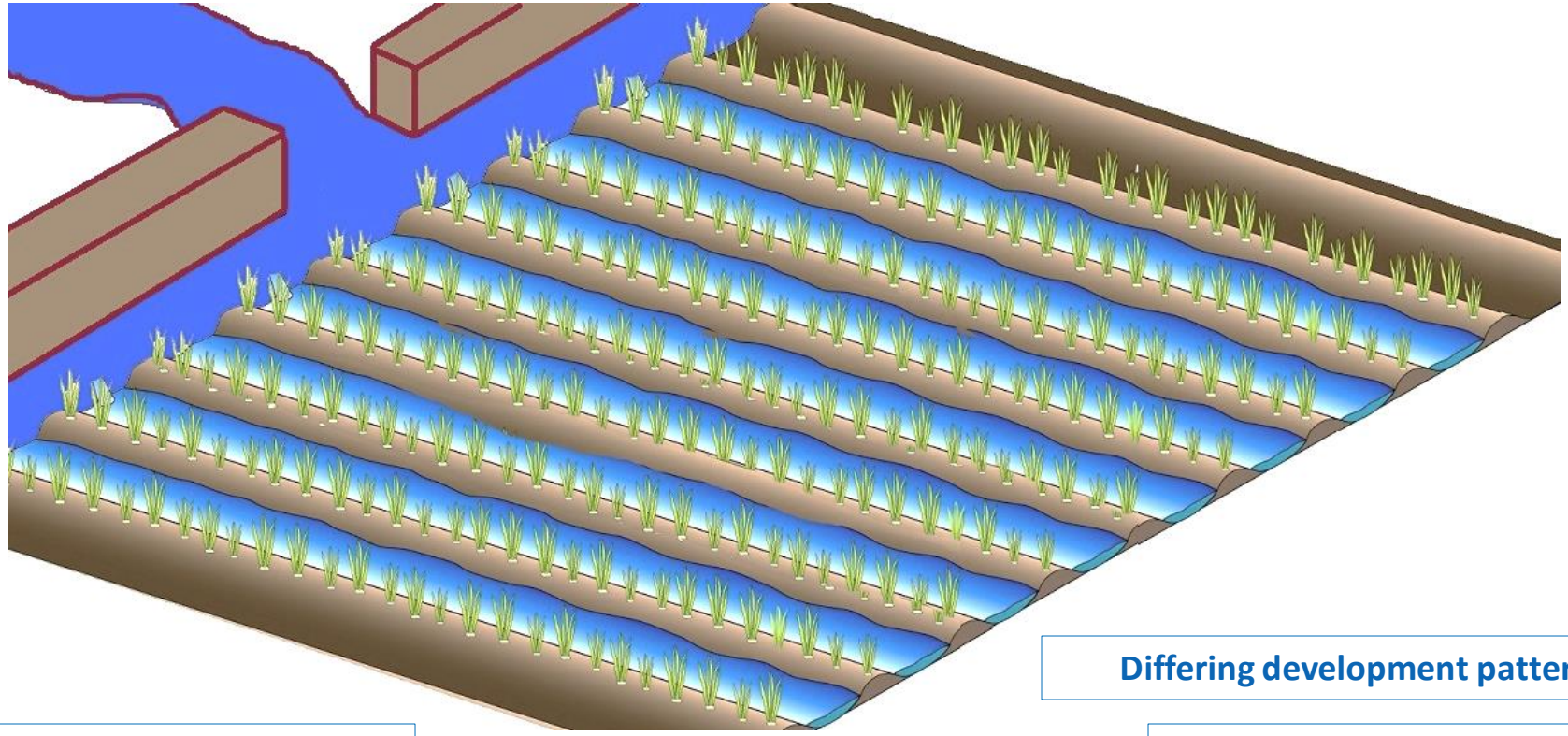
Development scenarios: 2. Locally-managed development

Community managed hydropower

Small scale infrastructure

Farmer managed irrigation

Municipal water supply



Differing development patterns

WUMP process

Localized costs and benefits

3. Development Scenarios: 3. Preserving Ecosystem Integrity

Environment focused

Central policies

Local enforcement

Eco-tourism

Species preservation

Maintain natural flows

Leveraging natural assets to meet energy and food production

WEF Nexus Opportunities and Trade-Offs

Hydropower and irrigation

- Storage hydropower for vs. water for agricultural production
- **Findings:** Very little tradeoff in Nepal (Storage elevates year-round irrigation water availability)

Energy Generation

- Large-scale/storage plants for export vs. small plants for domestic demand and rural electrification
- **Findings:** Storage generates much more power and revenue

Institutional

- Energy for domestic demands or export; transboundary water flows **Findings:** Tradeoff in local vs. export consumption of energy; some tradeoff from Terai irrigation vs. flow into India

Environmental

- Impacts of environmental flow constraints
- Findings: More stringent E-flows reduces ag. and energy production

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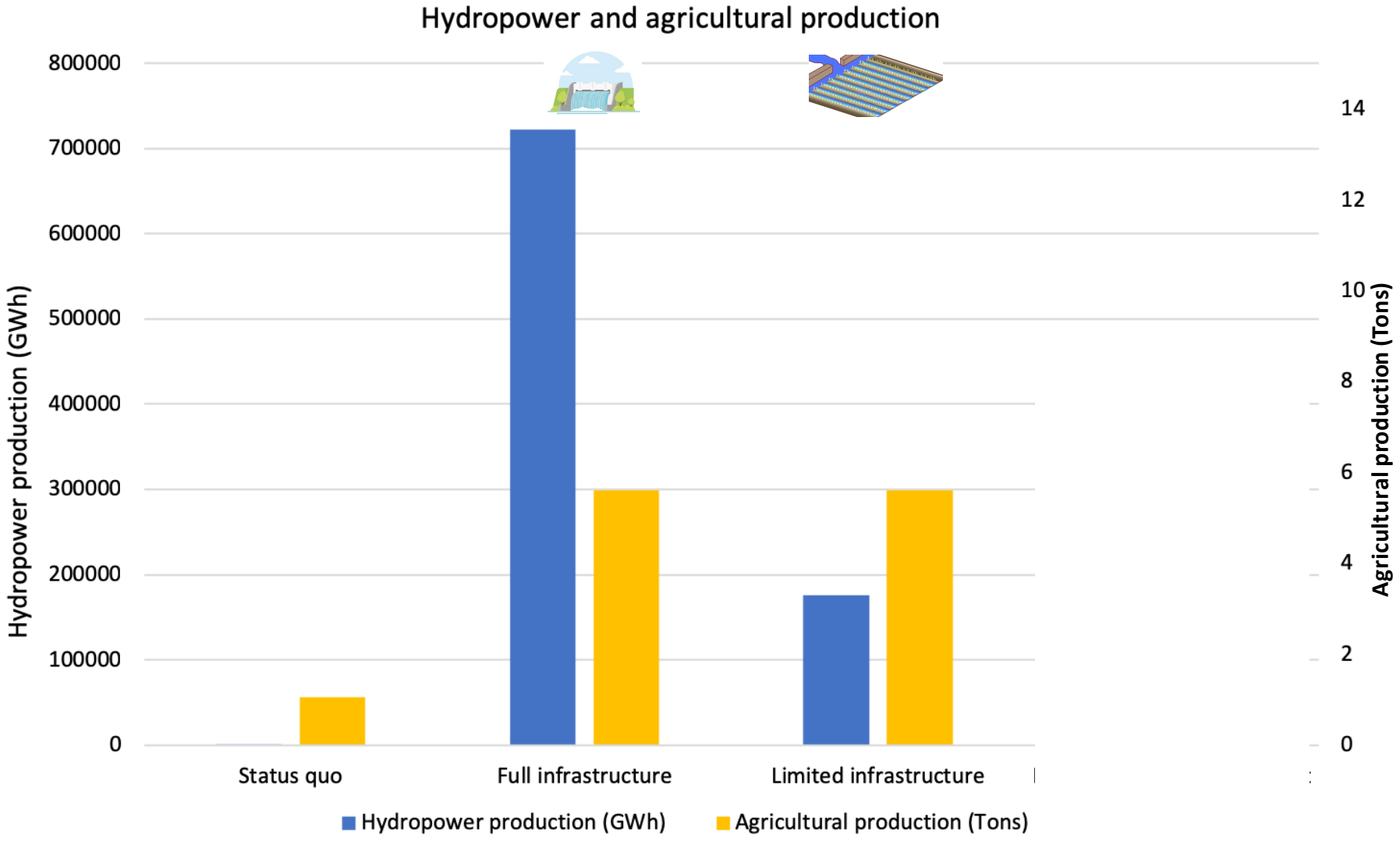
Balancing Demands



Impact and Uptake

- The hydrological models were taken up to develop Nepal's **National Irrigation Master Plan by the Department of Irrigation under the Ministry of Water Resources (**Supported by ADB)

- The E-flows Assessment will also be incorporated into the Irrigation Master Plan

- All project generated data, tools, models and publications are available through the IWMI water data portal as well as the DJB project website:
  - http://waterdata.iwmi.org/
  - http://djb.iwmi.org/

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Take Away Messages

- Hydrological models such as SWAT are very useful in quantifying spatial and temporal water availability and distribution as well as the impact of climate change.

- They can also be coupled with hydro-economic models to evaluate the impacts of various water use scenarios and development pathways TO VISUALIZE WEF SYNERGIES and TRADE0FFS

- Accompanying modeling activities with stakeholder engagement PROCESSES SUPPORTS ownership and PROMOTES uptake and impact

Selected Peer-reviewed Journal Articles

https://djb.iwmi.org/outputs/

- Dhaubanjar S., Pandey V.P., Bharati L (2019). Climate Futures for Western Nepal based on Regional Climate Models in the CORDEX-SA. International Journal of Climatology. https://doi.org/10.1002/joc.6327
- Pakhtigian E.L., Jeuland M. (2019). Valuing the environmental costs of local development: Evidence from households in Western Nepal. Ecological Economics, 158: 158-167. (https://www.sciencedirect.com/science/article/pii/S092180091830808 5?via%3Dihub)
- Pakhtigian E.L., Jeuland M., Dhaubnjar S., Pandey V.P. (2019). Balancing intersectoral demand in basin-scale planning: The case of Nepal's western river basins. Water Resources Economics. In Press. https://doi.org/10.1016/j.wre.2019.100152
- Pakhtigian E.L., Jeuland M., Bharati L., Pandey V.P. (2019). The Role of Hydropower in Visions for Water Resources Development for the Rivers of Western Nepal. International Journal of Water Resources Development. https://doi.org/10.1080/07900627.2019.1600474
- Pandey V.P., Sharma A., Dhaubanjar S., Bharati L., Joshi, I.R. (2019). Climate shocks and responses to Karnali-Mahakali basins in Western Nepal. *Climate*, *7*, 92. https://www.mdpi.com/2225-1154/7/7/92
- Pandey V.P., Dhaubanjar S., Bharati L., Thapa B.R. (2019). Hydrologic response of Chamelia Watershed in Mahakali Basin to climate change. Science of the Total Environment, 650 (Part 1): 365-383. (https://www.sciencedirect.com/science/article/pii/S0048969718334892).
- Bharati L., Bhattarai U., Khadka A., Gurung P., Neumann L. E., Penton D. J., Dhaubanjar S. & Nepal S. (2019). From the mountains to the plains: impact of climate change on water resources in the Koshi River Basin. IWMI Working Paper. 187, 49 https://www.iwmi.cgiar.org/publications/iwmi-working-papers/iwmi-working-paper-187/

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Thank You

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