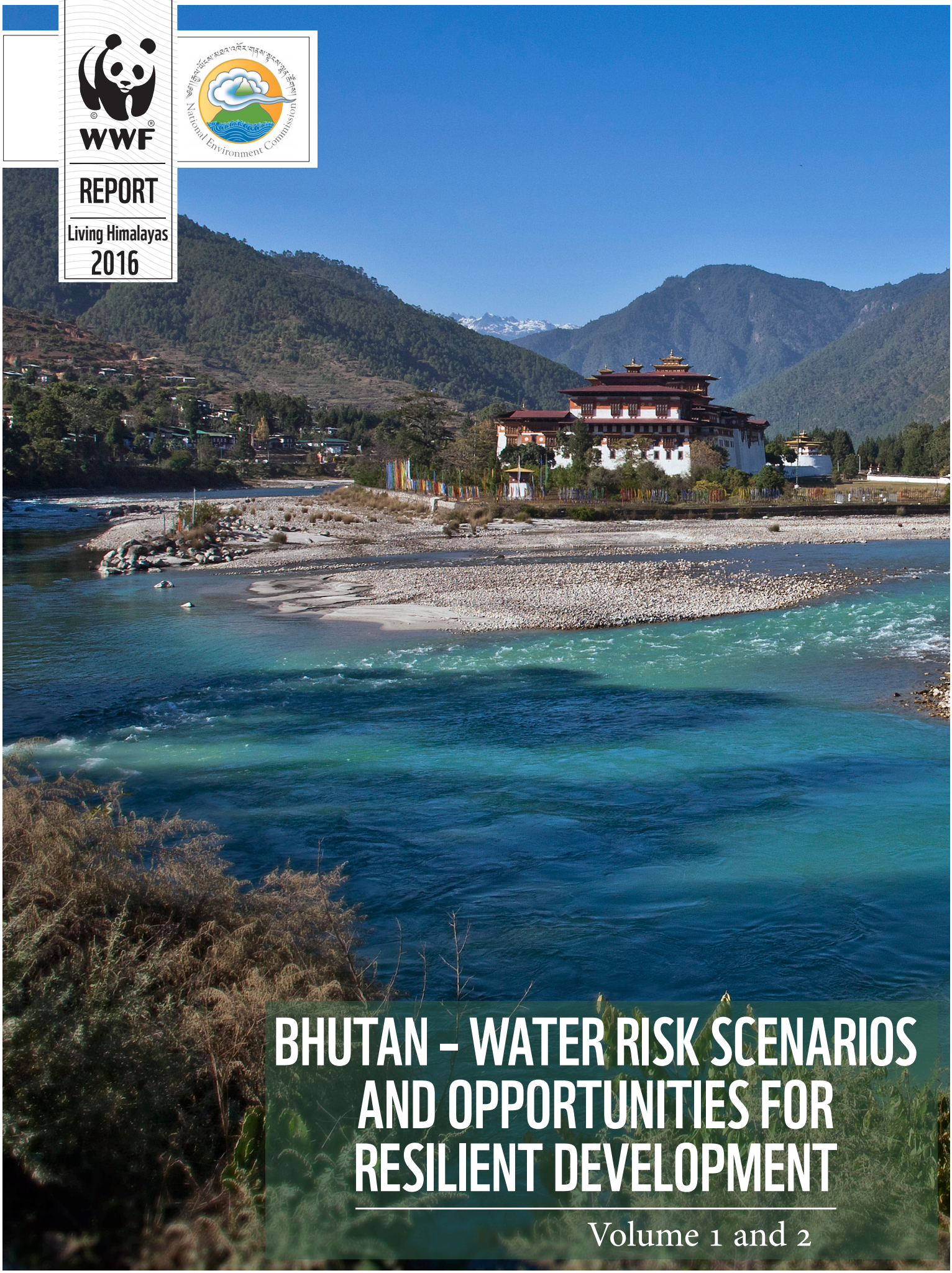
WWF

REPORT

Living Himalayas

2016

National Environment Commission



BHUTAN – WATER RISK SCENARIOS AND OPPORTUNITIES FOR RESILIENT DEVELOPMENT

Volume 1 and 2

Contributors: WWF Living Himalayas Initiative, National Environment Commission, WWF Bhutan, WWF International (Water Sterwardship) and PEGASYS.

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WWF is one of the world's largest and most experienced independent conservation organizations, with over
5 million supporters and a global Network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by: conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

MINISTER

FOREWORD

The Eastern Himalayas is one of the world's most biodiversity-rich regions. This biodiversity along with livelihoods, traditions and ways of life of local communities is underpinned by the ecological health of the two major river systems - the Brahmaputra and the Ganges. The Brahmaputra and the Ganges support lives of millions of people and are critical to the economies of the three countries that share the Living Himalayas region: Bhutan, India and Nepal.

The Kingdom of Bhutan is linked to the Brahmaputra basin which connects the North-Eastern Indian States of West Bengal, Assam, Sikkim and Arunachal Pradesh with over 500 million people. The major rivers of Bhutan all drain into the Brahmaputra basin and form important headwaters for the downstream of Brahmaputra freshwater system. Thus, sustainable use and management of freshwater resources in Bhutan is critical not only for Bhutan's sustainable growth and development but has an important impact on the health of the Brahmaputra basin downstream in the region.

The water risks and scenarios process for Bhutan, initiated by the WWF Living Himalayas Initiative in collaboration with the National Environment Commission, Royal Government of Bhutan, has helped to develop a sound understanding of current and future risks associated with the water dependent sectors such as hydropower, agriculture, tourism, biodiversity including climate change impacts. The study has helped to highlight the social and economic implications of such risks and provide guidance to decision makers on the optimal pathways for better basin management towards building resilient economies.

The 18-month process since November 2014 in Bhutan has brought together all relevant stakeholders linked to water resources in Bhutan. The engagement helped to develop a common understanding on the water risks and opportunities, and chart future scenarios with optimal approaches to improve water resources management and help safeguard the natural capital and livelihoods of local communities.

Bhutan is happy to be part of the first such study on the water risks and scenarios in the region. The knowledge generated will be important for guiding Bhutan on its path towards sustainable growth and development. We would like to thank WWF and all the partners and stakeholders who have been part of the water risks and scenarios process for their valuable contributions. We also look forward to continued support from WWF and partners agencies to implement the recommendations for the sound management of water resources in Bhutan as well as in the Brahmaputra basin that Bhutan is integrally linked to in the Eastern Himalayas.

Yeshey Dorji

Minister, Ministry of Agriculture and Forests
Vice-Chair, National Environment Commission

MESSAGE

Bhutan is endowed with abundant freshwater resources due to the wise and farsighted leadership of our Monarch, combined with people's reverence and respect for nature. It has fueled country's economic growth and biological richness. The Royal Government of Bhutan's vision of development, which is about creation of prosperity that does not come at the expense of societal and ecological well-being, and one that safeguards the wealth of the natural world is consistent with the holistic approach of water resources management that takes into account of economic, social and environmental sustainability for the present and future generations.

However, due to increasing development and population growth, the pressure on the country's rich freshwater resource is growing and water scarcity is being increasingly felt in different parts of the country. The importance and interconnectedness of water resources for economic development and environmental sustainability is something that all stakeholders must take heed of. Different sectors decisions have implications directly or indirectly for the country's water resources. Hence, understanding the key implications of each sectors decision with clear understanding of trade-offs between sectors, and environment and development is imperative.

The National Environment Commission together with the WWF embarked on a 18-month process in June 2014 with stakeholders and partners to provide a sound understanding of current and future ecological risks to Bhutan's water resources.

This report is a product of this process, the first of its kind in Bhutan, which brought together stakeholders to identify and discuss the water risks and plausible scenarios.

It enabled stakeholders and participants to take "water out of the water box" and develop compelling narratives around future scenarios in terms of how Bhutan's economy is exposed to risks through water, which is the most strategic resource in the country. Understanding the role of water in Bhutan's economy along with the associated risks and opportunities is vital for the country's sustainable future.

The National Environment Commission will continue to be at the forefront of efforts to maintain Bhutan's natural resources, including its rivers. The central role of freshwater in the economy makes it imperative that decision makers and policy makers grasp the linkages between robust river systems and take key actions that can help preserve this natural capital.

Chencho Norbu
Secretary
National Environment Commission

MESSAGE FROM WWF BHUTAN

This report, "Bhutan – Water Risk Scenarios and Opportunities for Resilient Development," is a product of an eighteen-month long process designed to engage experts, influencers, decision-makers and key stakeholders in Bhutan on the nature and potential consequences of risks faced by Bhutan's water resources. WWF's Living Himalayas Initiative initiated the process, led by the National Environment Commission (NEC), Royal Government of Bhutan.

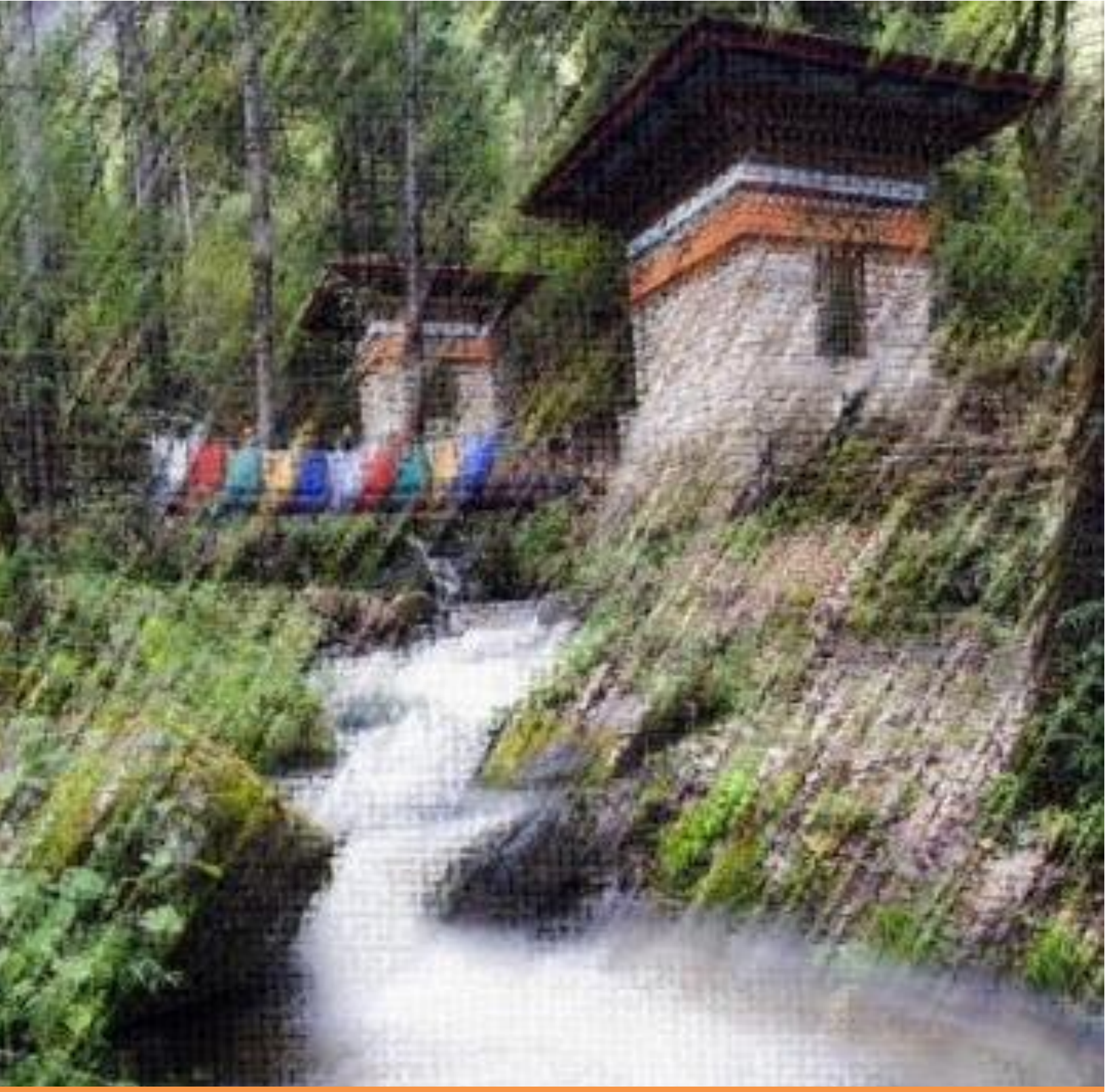
The Volume 1 of the report explores multiple scenarios for how key water-reliant sectors could evolve over the next two decades (through approximately 2035). Each of the scenarios has implications for the country's water resources, and thus the report also examines the implications, underscores the risks and enumerates opportunities to address or manage the risks. The broader context for the scenarios is captured in the report's Volume 2, which highlights the role of freshwater in the country's economy and identifies major threats to heavily water-dependent economic sectors. It also provides a detailed description of the process adopted and the theoretical underpinnings of transformative scenario development.

The process of scenario development adopted provided a platform for in-depth and thoughtful conversations about current and anticipated water-related challenges in Bhutan. It also facilitated cross-sectoral engagement on issues of concern and allowed for potential solutions to emerge and receive endorsement in a collaborative manner.

It is in the spirit of such collaboration that decision makers and key stakeholders – led by the National Environment Commission in partnership with WWF Bhutan – identified and built out three potential scenarios for Bhutan's future. While the scenarios developed represent economic and developmental scenarios (each characterized by a dominant productive sector), these potential futures also represent scenarios for future water use and demand in Bhutan, given that each of the sectors included is heavily water-dependent. This linkage to water also makes the scenarios glimpses into future impacts on Bhutan's water resources, given that the primacy of each economic sector is likely to have a significant and somewhat distinct impact on water resources – in terms of quantity, quality, and spatial distribution.

To minimize the chances of unintended consequences on Bhutan's natural capital – particularly its freshwater systems – there is a need for more holistic, inter-connected economic planning and for actively integrating considerations about Bhutan's water resources into different sectors decision-making processes. WWF Bhutan remains committed to continuing the process of engagement and using the Water Risks and Scenarios process and outcomes for informed decision making.

Dechen Dorji
Country Representative
VWF Bhutan



Executive Summary of This Report

Executive Summary

Bhutan. The very name conjures up visions of verdant fields, lush rolling meadows, sparkling streams, crystal-clear rivers, sylvan mountainsides, and evokes a sense of well-being, serenity, and trust. These are the elements that draw visitors to Bhutan from across the globe, and which have positioned this nation in the minds of people the world over as a model of truly sustainable economic development – to be admired, and emulated.

But could these images of bucolic landscapes coexist with images of Bhutan as an energy powerhouse exporting electricity to South and Southeast Asia? Or with the idea of this country as a major exporter of agricultural commodities and raw materials? With a vision of Bhutan as a prominent and popular tourist attraction, rather than an off-the-beaten-path destination? And could the image of pristine natural beauty be reconciled with the country that is known for its industrial products and manufacturing base?

As our story evolves from the present day into one or more of these distinct futures, it is not only the country's image that may undergo a transformation, it is also our bounty of freshwater resources that will mirror any evolution in the country's economic model.

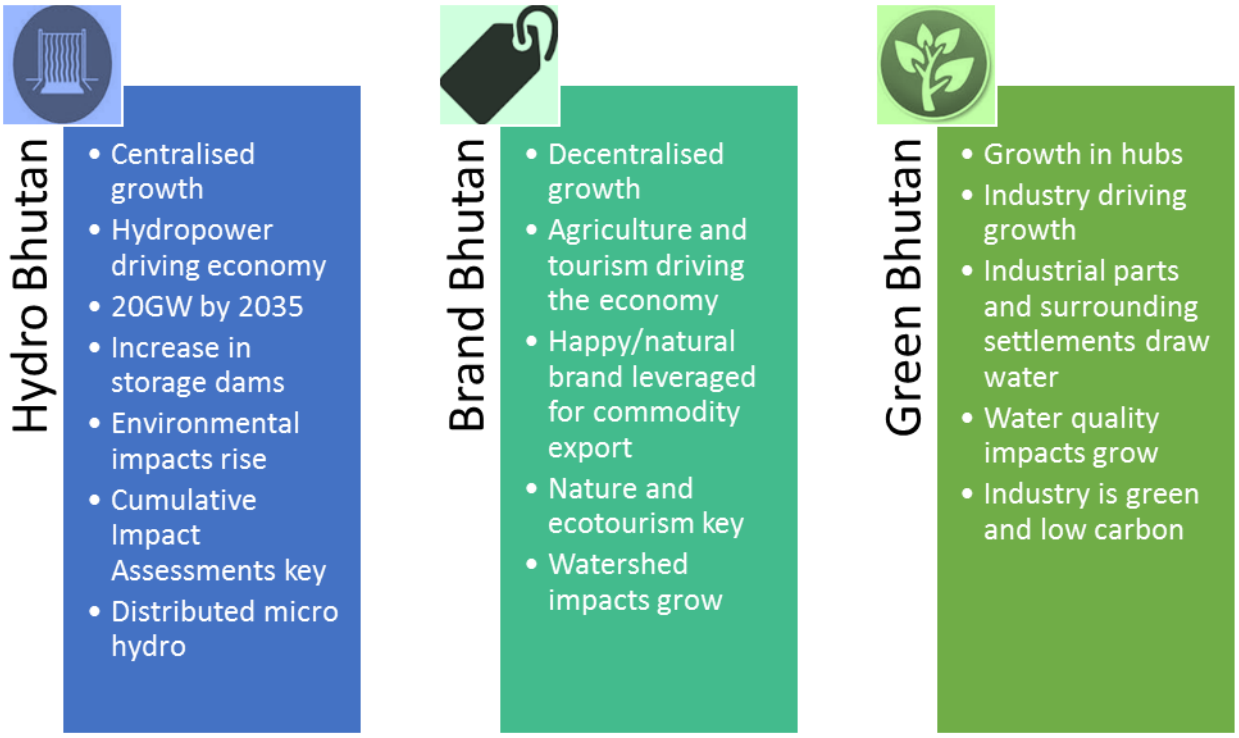
Each of the major economic drivers – agriculture, hydropower, tourism and small-scale industry – are heavily reliant on water. The country is fortunate to have an abundance of water in terms of per-capita availability. However, as Bhutan's major economic sectors are already witnessing, access to adequate and consistent water supply can no longer be taken for granted.

Streams are starting to dry up in some parts of the country. Water shortages are being reported in several towns and population centres. Farming communities are reconsidering their reliance on agriculture in part due to the lack of assurance of adequate water. Bhutan's heavily monsoon-fed river systems already run low in the dry season, but with climate change impacts starting to play a role the rivers could display even more extreme flows in the years ahead, with floods in the monsoon season converting into mere trickles in the dry season. Increasing urbanization and population pressures in cities have also started affecting water quality, with growing concerns about water pollution.

If our freshwater resources are not adequately safeguarded, will the country be able to realize any of the potential futures it may wish to pursue? Will Bhutan's pursuit of any one or all potential futures irrevocably alter the availability and character of the country's freshwater resources, such that it would make any alternate future unattainable?

This report is an attempt to pose, and answer, some of these key questions related to the future of Bhutan's water resources – the natural capital that provides the foundation for all major economic activity. The exploration of these issues is done through scenario development, a useful tool to identify and interrogate plausible future developments that have implications for the country's river basins.

This report examines three potential future scenarios (through the year 2035):



- **Hydro Bhutan**: The country's hydro sector development is initially very centralized and oriented exclusively towards electricity generation. It is a driver of strong GDP growth and revenues, but does not support domestic employment to the extent needed. As hydropower develops and infrastructure expands to service the sector, implications for and trade-offs with tourism and other sectors become increasingly apparent, as do the environmental and social consequences. Bhutan strengthens environmental protections and safeguards. A shift occurs towards more multipurpose projects to support linkages with other sectors, but also towards larger storage projects. Concerns nevertheless grow about rural development and equitable distribution of benefits. Climate change impacts create increased variability and affect performance of the hydropower sector. Disaster risk increases, including from GLOFs and flash floods. Bhutan starts placing extremely high priority on strategic Cumulative Impact Assessments and other integrated planning approaches. It moves towards a model where centralized hydro is complemented by distributed micro hydro, and where hydropower is developed not only for electricity exports but to support economic diversification and growth in domestic economic activities.

- **Brand Bhutan**: Economic opportunities in agriculture and tourism are pursued, relying on rich natural resources and robust ecosystems. The country positions its agricultural commodity (raw material) exports and its tourism as sustainable and eco-friendly, creating a strong brand. With the growth of both these natural capital based sectors as well as the infrastructure required to support them, the country sees increasing impacts on its water resources (such as shortages and competition) and landscapes (such as erosion and watershed degradation). Spatial overlay of these sectors exacerbates water demand in certain areas. This, coupled with the need to

prevent and manage disasters such as landslides results in Bhutan giving high priority to land use planning, siting and more rigorous watershed management.

- **Green Bhutan**: In the Green Economy Bhutan Scenario, affordable energy spurs the development of industrial sectors that leverage Bhutan's natural resources. In particular, these include agro-based processing industries and extractives-based industries. The country realizes early on that in addition to cheap electricity, promoting sustainability and responsible, ethical production makes Bhutan's products more competitive in a niche export market. Thus, the government strongly develops a Green Economy brand, and establishes the necessary high standards and regulations. However, monitoring, implementation, and enforcement do not keep pace with the high standards. This results in lapses that cause water quality deterioration and accidental contamination. Competition for water increases between different sectors. Climate change exacerbates water availability and quality issues, and increases the risk of disasters to Bhutan's industrial hubs. In response, better siting is introduced and better implementation. The private sector also works in partnership with government to strengthen Bhutan's green economy brand.

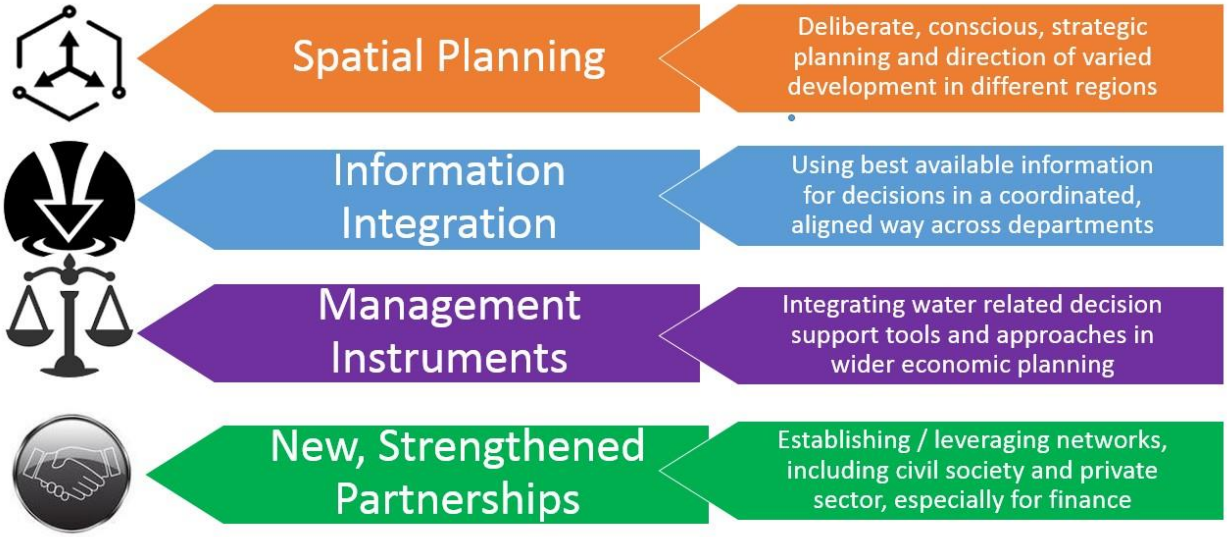
As each scenario is allowed to develop in a "business as usual" manner and take its natural course, it becomes clear that the nation will face some real trade-offs in relation to how different sectors are able to utilize water resources to expand and evolve. The trade-offs largely fall into four major categories:

- Reliability of and access to water supply;
- Downstream water quality;
- Watershed integrity and stability; and
- Natural disaster vulnerability and impact.

Fortunately, there are opportunities – within each scenario and across the three scenarios – to consider interventions, i.e. actions or measures that can support a positive outcome and reduce negative consequences and tradeoffs. The opportunities are likely to present themselves as key pivot points, i.e. moments calling for decisions or processes that result in important determinations:

- Design and implementation of Bhutan's agricultural model;
- Siting and management of Bhutan's industrial nodes;
- Development of Bhutan's linear infrastructure;
- Building of water storage in Bhutan; and
- The model for Bhutan's hydropower development.

Each of these pivot points represents a chance for the country to manage its natural resources – particularly water resources – in a sustainable manner to the benefit of key economic sectors, people, and in keeping with the country's core values and principles. However, for us to be able to decisively and strategically utilize the decision points to influence more favourable outcomes, it needs to be equipped with the right tools. These tools, which the policymakers would be well placed to adopt, strengthen and integrate into existing decision making processes and structures, are as follows:



While some or all of these have previously been discussed in decision-making circles as approaches that would strengthen economic planning and governance as a whole, this report underscores the necessity of adopting these tools from a water resources perspective. By calibrating all of the above tools towards more assiduous water resources management, and then by integrating them into mainstream economic planning, this would allow Bhutan's larger economic planning architecture to give effect to decisions that promote real economic resilience.

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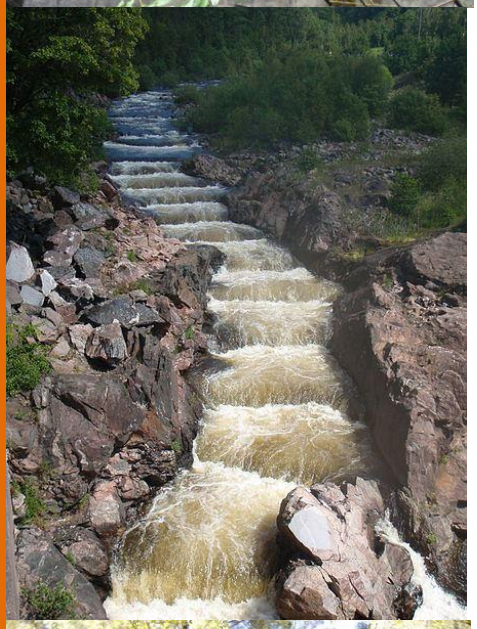
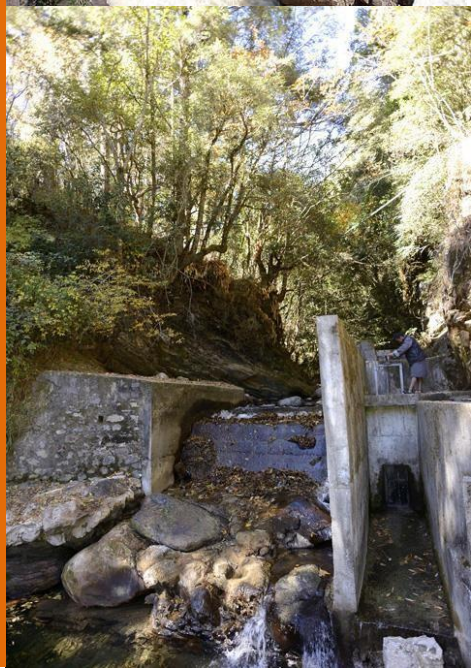
List of Abbreviations

BOIC	–	Bhutan Opportunity and Information Centre
CIA	–	Cumulative Impact Assessment
DGPC	–	Druk Green Power Corporation
GLOF	–	Glacial Lake Outburst Flood
GW	-	Gigawatts
HEP	-	Hydro Electric Project
ICT	-	Information and Communications Technology
IPCC	-	Intergovernmental Panel on Climate Change
MoEA	-	Ministry of Economic Affairs
MW	-	Megawatts
NEC	-	National Environmental Commission
PSMP	-	Power Sector Master Plan
SEA	-	Strategic Environmental Assessment

Chapter One
Hydro Bhutan





Scenario One

Hydro Bhutan

An energy export economy underpinned by the country's vast hydropower potential and rapidly expanding installed capacity, with growth linked to regional power demand

Setting Sail

Sitting on a (Blue) Gold Mine

Bhutan, a small, landlocked country in the Eastern Himalayas, realizes that it is in possession of a powerful economic resource – as much as 30,000 megawatts (or 30 gigawatts) of hydropower potential. Under the Power System Master Plan (PSMP) 2003-2022, Bhutan identifies technologically and economically feasible hydropower potential of approximately 24,000 MW (24 GW) across all of the country's river basins. [i] This potential can be tapped through a roster of 76 projects, 70 of which are slated to be run-of-river projects, while six of the potential projects identified are reservoir schemes. The Sustainable Hydropower Policy of 2008 sets a target of building 10,000 MW (10 GW) of hydropower capacity by 2020 (of which 5,000 MW is earmarked for sale to its power-starved neighbor, India, in accordance with an Indo-Bhutan agreement).[ii]

Riding the Hydropower Wave

By 2014, hydropower development and export comprises a fifth (~ 20%) of the country's whole economy. Taxes and dividends from hydropower companies constitute approximately 40% of national revenue, making this the single biggest source of revenue in Bhutan's economy.[iii] Sales of hydro electricity are also a significant source of foreign exchange, accounting for nearly 45% of all exports by 2014.[iv]

Where Hydropower Goes, Bhutan Goes

Hydropower is central to Bhutan's GDP, and GDP growth becomes heavily dependent on this one single sector. So much so, that the years that are good years for hydropower become the years that the economy sees strong GDP growth, but when hydropower experiences a weak year, GDP also suffers commensurately.

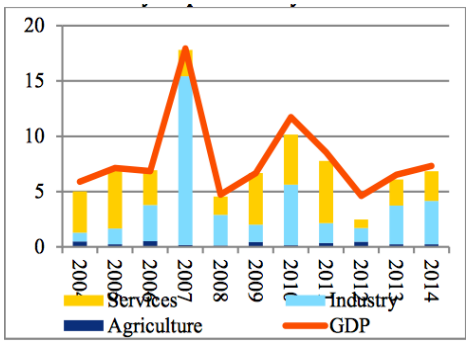


Figure 1 – Bhutan's GDP growth by year, including sectoral contribution each year.

Hydropower is extremely reliant on water levels in the rivers, which is variable depending on good monsoon years. As a result, years with good monsoons and high water levels result in higher electricity sales and greater revenue, while poor monsoons have a depressing impact on revenues and the economy.

The 11th Five Year Plan recognizes that economic prospects are tied almost exclusively to hydropower and suggests that the country move towards economic diversification, but policy shifts to support this diversification do not play out significantly, given how critical hydropower is to the country's future.

Powering Ahead

By 2020, Bhutan accomplishes a large part of its stated goal of building 10 GW of hydroelectric power; it completes construction of and commissions (brings online) about 5 GW of installed capacity, with the remaining 5 GW of projects identified. Power sales to India continue to grow steadily.

Since hydro electricity is the driving force of all projects, the dams are constructed solely with a view to produce power in as efficient a manner as possible. Multipurpose projects – with potential benefits for agriculture / irrigation and even tourism – do not factor in at all in the calculus.

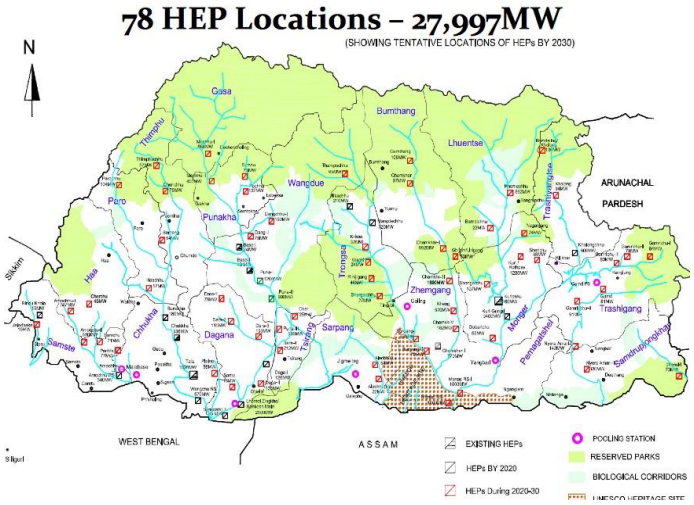


Figure 1 – Locations of existing and proposed hydroelectric projects in Bhutan, per the PSMP.

Bhutan's commitment to sustainability and socio-environmentally responsible development ensures that the overwhelming majority of all projects are run-of river and only a handful are large reservoir schemes. However, the location (siting) of the large reservoir schemes is largely towards the downstream sections of the basins, closer to the lowlands and large population centres. Basin optimization would suggest that some of the storage reservoir projects would be more efficient at slightly higher elevations so that reservoir water could be used to cascade down over a series of small run-of-river dams (also providing some protection against the vagaries of the monsoon and increasing variability in timing and volume of rainfall due to climate change). However, the hydro sector adheres strictly to the PSMP in the initial phase of hydro development in Bhutan. By 2015/2016, there is a move to revise and update it, allowing the possibility of some revision in the plans.

Integration of Ecosystem Considerations

Project selection criteria are broken up into 55% techno-economic factors, and 45% socio-environmental factors. However, data limitations on environmental factors constrain the robustness of Multi Criteria Analysis.

Each individual hydropower project requires an Environmental Impact Assessment (EIA) or a Strategic Environmental Assessment (SEA). These are conducted by the project proponent and evaluated by Druk Green Power Corporation (DGPC)/relevant agencies. EIAs are not always of consistent quality, with different levels of capacity between different project developers. Moreover, Cumulative Impact Assessments (CIA) at the basin level are not conducted as a matter of course.

With increasing attention given to the social and ecological consequences of hydropower development, the government actively explores how to give effect to CIAs, how to determine and set e-flow regulations, and other progressive planning approaches such as Integrated Water Resources Management (IWRM). Initial discussions emerge about potential identification of “wild rivers,” to be free from hydropower development.

Navigating Stormy Waters

Full Steam Ahead

As Bhutan nears completion of the first 5 GW by 2020, it fast tracks construction of another 5 GW to ensure its 10 GW target is met. Thereafter, Bhutan – to maintain its exceptional economic growth and to continue expanding its economy and bring prosperity to its people – actively investigates the design, siting, and project preparatory stages of another 5 GW of hydro electric projects by 2025 to determine what can be brought into a pipeline.

Greater Emphasis on Storage

Between 2020 and 2025, several factors coincide to create a policy shift within the Bhutan hydropower sector towards the building of more storage reservoir projects. On the one hand, such storage is viewed as increasingly critical to protect the hydropower industry against climate variability and change, and to ensure a steady supply of water all year round and especially in the dry season when river flows fall to particularly low levels. Additionally, there is greater interest in multipurpose projects, which typically involve the development of large reservoirs (for fishing, tourism, irrigation and drinking water supply etc.). Furthermore, Bhutan’s primary destination for electricity sales and its largest trade partner, India, rapidly expands its solar energy programme, creating a need for pump storage, which Bhutan is in a position to meet by constructing more storage schemes.

Figure 3 - Tehri dam in India – example of a large multipurpose project in the Himalayan mountains.

International Standards and Best Practices

In recognition of the growing impact hydropower has on Bhutan’s water resources, natural landscapes, as well as its social impacts, the country ensures implementation of a range of international standards and best practices in water resources management. With international development assistance, Bhutan integrates IWRM and basin planning into its approach, and prioritizes basin optimization, implements e-flows requirements, and places even greater emphasis on watershed management. Critically, Bhutan makes it mandatory for Cumulative Impact Assessments to be conducted at the planning stages of all new proposed projects, to examine the basin-wide consequences including the interplay with existing projects and major water users in the area. Within project selection criteria, socio-economic factors start receiving 50% weight.

Concerns About Local Benefits

While hydropower continues to bring in significant revenues that boost Bhutan’s economy, several indices of sustainable economic development do not experience the desired improvement. This is partially because Bhutan’s income continues to be used, in large part, for imports. Expenditure on imports also includes payments for raw materials, equipment, technical components required for hydro projects, as well as payments to non-Bhutanese engineering and construction firms (including foreign contractors and labor).

The hydro sector does not support job growth for the Bhutanese people, as construction labor jobs are not suitable for a relatively well-educated and skilled workforce. While Bhutanese professionals increasingly fill some engineering and project management jobs, these jobs are insufficient to make an impact on overall employment figures in this sector even by 2020. Thus, concerns grow amongst the Bhutanese about the lack of direct employment benefits to Bhutan, particularly in light of youth unemployment.

Concerns About Ecological and Social Impacts

Social discontent also grows over ecological and landscape impacts from hydropower development. Construction equipment and the necessary linear infrastructure to support construction (such as roads) become a source of concern for several communities who witness their environment changing. River flows display a steady decrease. The drying up of mountain streams (sources of drinking water for people and animals) is blamed on hydropower, as a result of the public misperception of diversion of water into main river channels and the alteration of catchment areas. By 2023, watershed functioning is negatively impacted in several regions, causing more vocal public debate about Bhutan's pursuit of hydropower. This public debate is also sparked by the hydropower industry not adequately supporting jobs in rural areas. While revenues from hydropower continue to be reinvested into the country by the government, the redistribution of wealth arising from hydropower still cannot make up for employment challenges for young Bhutanese.

Concerns about altered ecological conditions also emerge within the hydropower sector itself. With growing infrastructure development (especially linear infrastructure including roads and transmission lines) sparked by hydropower expansion, some catchment areas experience deterioration; despite rules requiring that infrastructure be built in the least disruptive manner possible, enforcement of such directives is insufficient, leading to some landscapes at certain road sites or dam sites becoming degraded. This in turn leads to increased erosion and siltation, which – in combination with lower flows in the dry season – take a toll on hydro blades. This increases costs for the industry and shortens the lifespan of some hydro equipment.

Climatic Disruption

The hydropower sector – Bhutan's engine of economic growth – finds itself susceptible to the impacts of climate change. Increasingly, climate change manifests as inter-annual variability in the timing, volume, and spatial distribution of rainfall. While the monsoon strengthens with more incidents of heavy rainfall, there is ever greater variance in total volumes between one year and another, jeopardizing the ability to provide constant flows of electricity to its neighbors. Rainfall increases in the wet season, causing run-of-river dams to deal with frequent heavy overflows, but water levels fall markedly in the dry season. Such impacts are apparent by 2025.

Even as the hydropower sector grapples with how to deal with such increasing variability, disaster strikes an important storage dam in the higher reaches of the *Puna Tsang Chhu* river. In 2025, a Glacial Lake Outburst Flood (GLOF) originating in the Lunana area causes heavy structural damage to a high-elevation facility, and causes loss of capacity at site, with economic impacts.

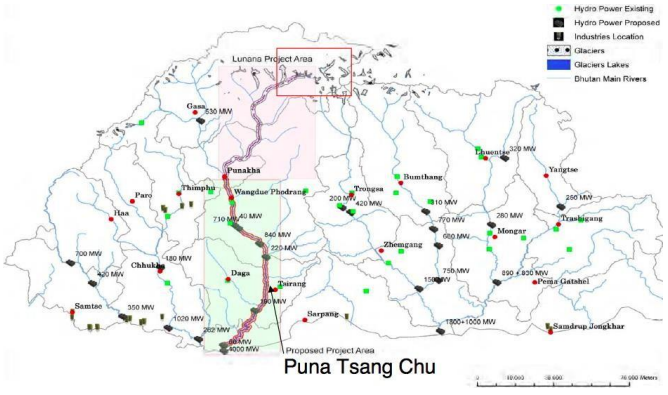


Figure 4 – GLOF risk from the Lunana region and implications for lower reaches of Puna Tsang Chhu.

Encroachment on Opportunities for Other Sectors

Expanding hydropower interferes with the development of tourism in some locations. Hydropower sites, especially the larger multipurpose projects and storage reservoir projects, alter vistas that make some sub-basins less attractive destinations for tourists seeking raw natural landscapes. The projects create an industrial aesthetic in some areas that decreases the draw for ecotourism and nature-based tourism (including fishing tourism). With hydropower as a dominant user of water in several sub-basins, other opportunities (such as agro-processing industrial units) are not adequately explored in such areas, limiting economic diversification.

Shifting Course

Disaster Management

In recognition of the threats posed by climate change, Bhutan invests heavily in disaster risk planning, reduction, and management. Bhutan integrates GLOF and other climate change disaster risk into project evaluation criteria, and mandates that designs of projects be as climate-robust as possible even in the face of some uncertainty about climate scenarios for the region. Keeping disaster management in mind, Bhutan also moves towards a model where it focuses hydropower development on a few specific catchments rather than everywhere, reducing the across-the-board risk of disrupted ecosystems.

Damage Control: Management of Ecological Impacts

Responding to both domestic concerns and international feedback, Bhutan elevates strategic Cumulative Impact Assessments even more by 2025, and prioritizes strategic CIAs that take into account a wider range of climate variability, disaster risk, medium-to-longer term ecological impacts etc. Starting around 2030, Bhutan also increases protections for aquatic biodiversity, creating stricter guidelines for projects on the technologies required to mitigate impacts (for instance, advanced fish ladders with measurable benefits). Based on ecological considerations, Bhutan also designates “No Go” zones for hydropower development.

Regional Markets and Partnerships

Bhutan determines by 2025 or so that it is important to develop partnerships in the hydropower sector that could potentially benefit the country even more than existing arrangements (for instance, sale at peak demand rates, rather than at baseload levels; or a revised Power Purchase Agreement with India reflecting Bhutan’s provision of more storage to support India’s booming solar power sector). Bhutan also seeks to diversify the source of financing and technical input for the development of hydro projects. Thus, it builds and strengthens partnerships around South and South East Asia, and integrates into regional power sharing systems, selling electricity to a broader range of destinations.

Expansion of Distributed Micro-Hydro

By 2025, to redress the highly centralized nature of hydropower and its insufficient benefits to rural communities, Bhutan opts to expand its network of distributed micro hydro projects. These extremely small units produce electricity that can feed into micro-grids at a Geog/block level, and can create opportunities for small rural communities to own power generation infrastructure and supply power to neighboring communities when needed.

Figure 5 – A Micro Hydro Project

Several small distributed micro hydro schemes of 20 MW each add up to another 2-3 GW.

Hydropower as a Support to Other Sectors

By 2030, between the impacts of climate change and the elevated level of domestic concerns about the lack of adequate employment from hydropower, plus an overall desire to avoid economic over-dependence on one sector, Bhutan realizes it needs to start prioritizing economic diversification. While the country decides to continue with the development of hydropower, targeting a full 20 GW by 2035 / 2040, it increasingly emphasizes the harnessing of such power to catalyze growth in other economic sectors such as tourism, value-added agriculture, minerals and metals beneficiation, and services.

In basins where hydropower is developed, Bhutan moves towards a model of building storage upstream, with a series of cascading dams downriver, particularly to create resilience against climate variability and change.

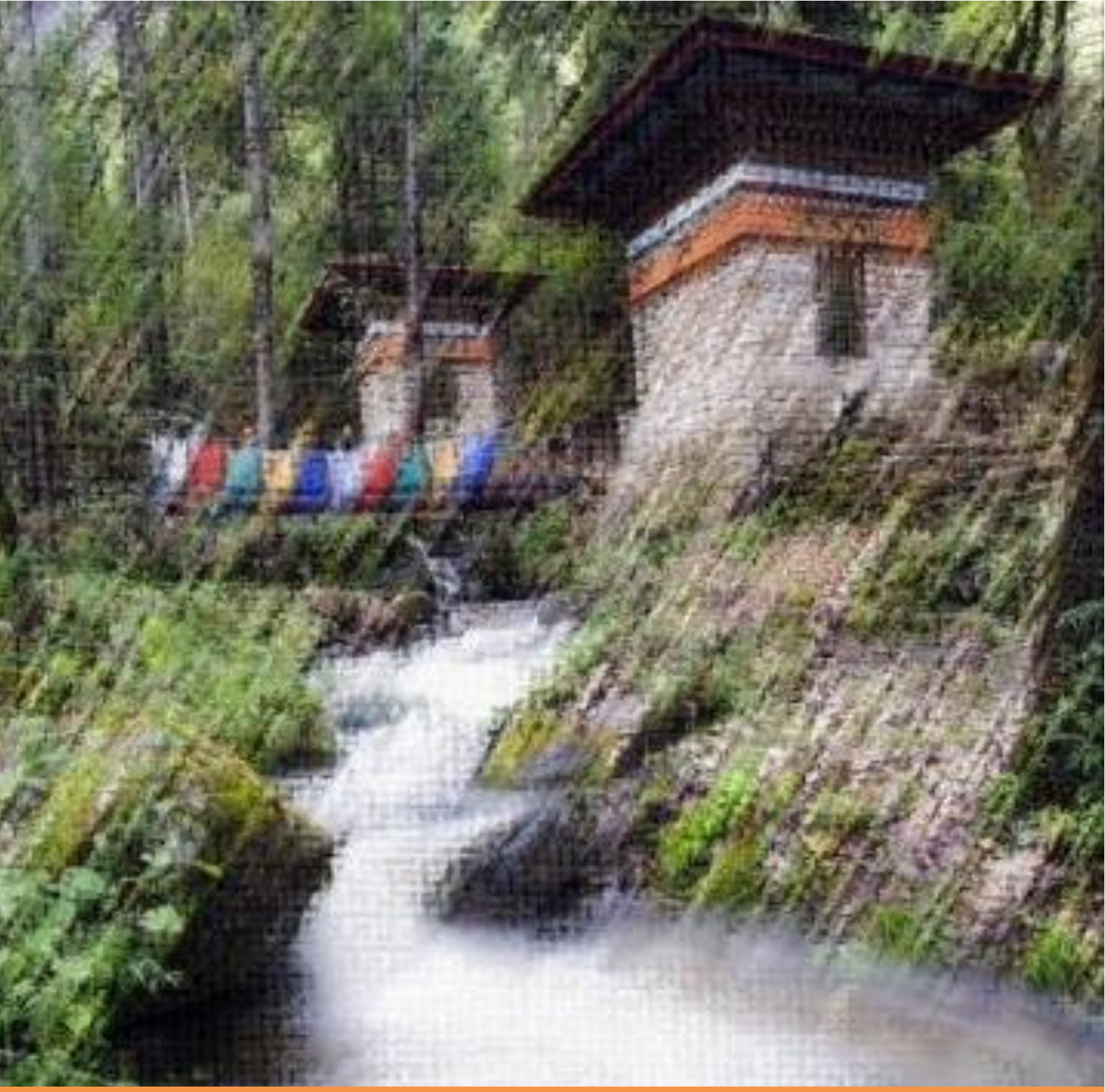
With an adequate supply of electricity for both export and domestic consumption, Bhutan moves towards a future where hydropower is capped at 20 GW, but where the remainder of the 20 GW is developed with deliberation, with strategic intent, and with high levels of social and environmental safeguards.

In the Hydro Bhutan Scenario, Bhutan's hydro sector development is initially very centralized and oriented exclusively towards electricity generation. It is a driver of strong GDP growth and revenues, but does not support domestic employment to the extent needed. As hydropower develops and infrastructure expands to service the sector, implications for and tradeoffs with tourism and other sectors become increasingly apparent, as do the environmental and social consequences. Bhutan strengthens environmental protections and safeguards. A shift occurs towards more multipurpose projects to support linkages with other sectors, but also towards larger storage projects. Concerns nevertheless grow about rural development and equitable distribution of benefits. Climate change impacts create increased variability and affect performance of the hydropower sector. Disaster risk increases, including from GLOFs and flash floods. The country starts placing extremely high priority on strategic Cumulative Impact Assessments and other integrated planning approaches. It moves towards a model where centralized hydro is complemented by distributed micro hydro, and where hydropower is developed not only for electricity exports but to support economic diversification and growth in domestic economic activities.

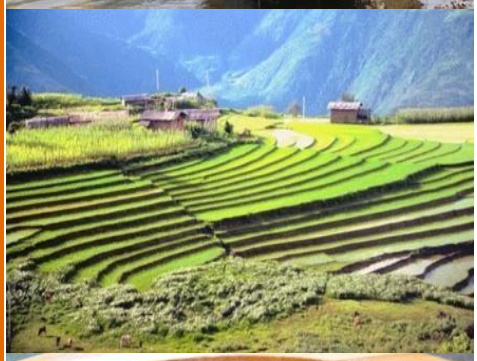
Potential Lessons from:

Sweden

In 2010, Sweden was Europe's largest producer of hydropower, and tenth in the world. Between 2010 and 2012, Sweden undertook significant reforms of its hydro sector to mitigate the negative impacts of river fragmentation and ecological disruption, so it could comply with EU and Swedish environmental standards. By and large, Sweden's river restoration efforts are regarded as successful, leading to improvements both in hydropower production as well as in ecosystem health. While Sweden does offer best practices that could be adopted elsewhere including Bhutan, Bhutan would be better placed to avoid needing such remediation.



Chapter Two
Brand Bhutan



Scenario Two

Brand Bhutan

A natural resources and ecosystems based economy underpinned by decentralized rural development. Characterized by nature tourism, eco-tourism, and agriculture designed to support both food security and raw material exports.

Seeds of Growth

Untapped Potential

Shortages of water and the challenges of back-breaking labor on farms result in a steady decline in the agriculture sector's contribution to GDP and employment. An increasing numbers of people leave their land fallow due to a lack of capacity or interest. Yet, as the nation refines and updates its vision for the future, there is strong affirmation within decision-making circles that its rich natural resource base represents immense opportunity, much of which has not been adequately tapped. Bhutan assesses the economic potential of its natural capital and identifies promising growth opportunities for the tourism and agriculture sectors.

Job Creation and Diversification Imperatives

Bhutan's overall unemployment rate appears to be similar to several other countries (2-3%), but it has become increasingly clear that youth unemployment is a critical problem. Nationwide, male youth (aged 15-24 years) are characterised by 9-10% unemployment and female youth (aged 15-24 years) by 11-12% unemployment. The challenge is even greater in urban areas, where the male and female youth unemployment figures rise to ~20-22% and ~28-30% respectively.[v]

The 11th Five Year Plan (for the period 2013-2018) identifies youth unemployment as a key metric to target, and a goal of bringing this down to ~2.5%.[vi] However, the problem only seems to grow by the time the 12th Five Year Plan comes into effect. Thus the creation of youth employment takes on greater urgency.

Similarly, the 11th Five Year Plan acknowledges that economic over-reliance and dependency on a single driver of economic growth (hydropower) is a key challenge that stands in the way of full achievement of Bhutan's "Vision 2020," a vision for peace, prosperity, and happiness.[vii] Within government planning and policymaking circles, the need for economic diversification is articulated with greater emphasis. Decision makers start pointing to tourism and agriculture as key areas that could be nurtured to create employment, and to promote more

dispersed, decentralized growth that supports greater prosperity across Bhutan as opposed to concentration of wealth and opportunity in cities.

Commitment to Food Security

The royal government states that it is important economically, politically and culturally to achieve self-sufficiency in meeting its own food requirements. Specifically, this translates into a goal of becoming 70% self-sufficient for most food grains, and 100% self-sufficient in growing rice. This drive towards self-reliance is sparked by volatile food prices and concern that high food prices in the region (including in India, Bhutan's primary source of imports) could have negative consequences for the nation's ability to provide adequate food for its people.

Commitment to Natural, Eco-Friendly Agriculture

In keeping with Bhutanese values and the country's deep sustainability ethic, it chooses to pursue a goal of making the agriculture sector as sustainable, natural, healthy and environment-friendly as possible. This includes the desire to make some commodities 100% organic. By tradition, Bhutanese farmers largely practice organic approaches; heavy mechanization and the use of chemical fertilizers, pesticides, and other inorganic supplements is rare. At the same time, there is a realization that in order to improve productivity, a move towards mechanization and advanced farm aids (including fertilizers) may be necessary (which is why Bhutan is not constraining itself to a 100% organic goal for all produce and commodities). Overall, the country is well positioned to maintain its largely eco-friendly farming profile, and between 2015 and 2020 it invests resources in determining how best it can demonstrate compliance with various international and regional standards and certification processes such as fair trade.

Figure 3 - One of many international Fair Trade Labels

Despite the intent of making agriculture more attractive through opportunities for high-value agricultural exports (which target markets that seek natural, eco-friendly, fair trade products), the draw of farming keeps weakening due to difficult farming conditions. One of the continuing challenges to growing high-value agriculture (for niche markets) remains access – difficult terrain makes transportation challenging, creating barriers to entry into markets and constraining the economy of scale for such farming.

Steady and Promising Growth in Tourism

By 2020 Bhutan finds itself increasingly on the travel itineraries of international tourists, who once found it inaccessible but are now drawn in ever greater numbers to the pristine natural landscapes, cultural character, bucolic rural communities, and to the opportunity of experiencing nature in one of its purest forms. Adventure tourism also grows, as does the niche area of eco-tourism. The number of international tourists maintains steady year-on-year growth, as do tourism-related revenues and employment. More opportunities are created in a decentralized manner, across tourism hubs around the country and not merely in Thimphu and Paro.

Recognizing that travelers are willing to pay a premium to travel to Bhutan because of the sense of exclusivity, the desire to experience bucolic rural life, as well as the relatively untrammeled landscapes, the country continues its policy of focusing on high-value tourism. It maintains its Daily Minimum Tariff that effectively excludes budget travelers and backpackers, but softens some of the travel restrictions on foreigners (such as area permits) in order to increase capacity and lengthen visitors' stays around the country. Bhutan encourages visitors to travel widely so that more parts of the country benefit from tourism.

Branching Out (into a Nature-Based Brand)

A Helping Hand

Bhutan introduces a host of incentives and support programmes to provide a boost to agriculture. These include tax breaks, rebates, subsidies, low-interest loans, greater access to credit, and low-cost land. The government ramps up investment in advanced agricultural technologies, to provide farming communities with more equipment, mechanized tools, and technical assistance to make farming less of a hardship.

To address one of the key factors in the abandonment of arable land, the government invests heavily in providing cultivators access to water. Funds are poured into irrigation schemes, with existing schemes repaired and expanded, and new schemes constructed in previously underserved regions. In upland areas where irrigation is not cost-effective, the government expands programmes to assist communities with rainwater harvesting and improved tilling and irrigation approaches. Assistance is also provided in the form of local water storage schemes and expanded terracing tools (machines). Given the challenges of terrain and connectivity, the government differentiates between growing certain regions into commercial agriculture zones, and helping other areas improve productivity to provide adequate livelihoods and sustenance.

Similarly, on the tourism side, the government provides incentives for the development of tourism opportunities in previously under-visited parts of the country. In particular, it creates an enabling environment for low-impact eco-tourism that maintains the integrity of landscapes and involves minimal changes to the region. It encourages the development of the type of eco-tourism that uses local materials for construction and adopts design and architectural elements that blend into the natural landscape. This results in the emergence of more resorts and tourism infrastructure of a dispersed, decentralized nature.

Markets and Infrastructure

To support and sustain growth in the agriculture sector, the government encourages people to return to their land by improving access to markets; for major commercial centres it helps increase access to regional and global export markets, while for small-holders it provides greater assistance in accessing domestic markets. This involves, for instance, more dry port facilities.

Expansion of both agriculture and tourism in a decentralised, spatially dispersed manner also calls for greater infrastructure to support these sectors. Thus there is an increase in road construction, transport facilities, electricity supply, and Information and Communications Technology (ICT) infrastructure.

The government also turns to micro hydro projects to provide power in more remote areas where tourism increases and agriculture expands. Distributed micro hydro is viewed as a means to create more opportunities for far-flung regions, with communities owning and operating the facilities and selling power to micro-grids (for instance, selling to neighboring villages, or even into the national grid if connected).

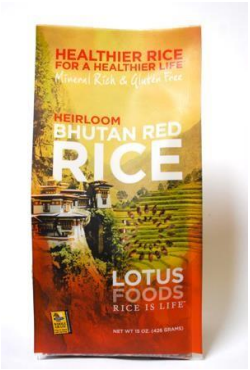


Figure 7 - Bhutan's Famous Red Rice - An Export Product

Branding Bhutan's Agricultural Raw Products

By 2025, after securing food grain self-sufficiency, the country is able to scale up its production of agricultural staples and develop a niche export market for its organic, sustainable, nature-friendly commodities. While there isn't a shift to value-added agro-based processed foods, Bhutan is able to earn significant revenue from raw commodities such as rice, chilies, nuts etc.

Necessary Pruning to Reach for the Sky

Deepening Thirst

By 2025, as both agriculture and tourism expand in a spatially decentralised manner, their growing water use creates competition between each other as well as with other sectors. With more terraced farming in highland areas (geared towards self-sufficiency of staple crops and domestic food security) as well as larger commercial farming hubs (producing export-oriented commodities) supported by increased irrigation facilities, water consumption by the agriculture sector increases.

Simultaneously, with more tourism infrastructure (including hotels, resorts, and guest houses) springing up around the country, and with the sector relying heavily on access to water, the tourism sector's demand for water also shoots up.

Some of this expansion of both agriculture and tourism takes place upstream of certain hydroelectric facilities. With consumptive use by agriculture and tourism drawing a larger share of water in these areas, hydropower projects in these specific regions face greater challenges by 2025, especially in the low flow season when abstractions are highest season.

Pesce Versus Power

One of the niche areas of growth in the tourism sector is sport fishing. As Bhutan becomes a destination for nature-based activities of many varieties, recreational tourists flock to Bhutan to experience wild fishing. The Golden Mahseer is a particularly big draw for anglers, who are willing to pay extremely high fees for fishing permits and licenses. This revenue stream becomes extremely attractive, especially as it also creates employment to support this activity. However, the growth and sustenance of this activity requires that some stretches of rivers remain unimpeded by hydropower projects. This creates competition between hydropower and the tourism industry in some parts of the country.

On Shaky Ground

Expansion of linear infrastructure and construction to support both decentralized agriculture and tourism (roads, telecommunications facilities, tourist accommodation, trading posts and physical markets for goods etc.) results in slow but continuous watershed degradation. Slopes and soil in some areas become destabilized, and development also increases erosion. As climate change causes more rain to fall in heavy episodes, erosion further intensifies between 2020 and 2030.

Figure 8 - An example of a Himalayan landslide

One of the negative impacts of such increase in erosion and decreased slope stability is siltation in rivers. This becomes a growing problem for hydropower facilities by 2030, causing more wear and tear on equipment.

The problem comes into extremely sharp relief in 2032 when heavy rains lead to an extremely massive landslide on a popular tourist route. Several local residents, plus hikers, trekkers, campers and Bhutanese tour guides are killed when a mountainside collapses on them. The landslide also causes heavy damage to property and road links in the region and has an impact on tourist arrivals.

New Shoots of Growth

Water Resource Management at the Forefront

Escalating competition for water between different sectors sparks debate both within the public and within Bhutan's decision making circles. In the period 2030 – 2035 several shifts are made to ensure that water resources are managed carefully and to extend the benefits from such resources as widely as possible.

Given the preemptive water rights of sectors like agriculture and tourism, based on their connection to people's livelihoods, hydropower development takes a backseat. Bhutan decides to build only 10-15 GW of hydropower in total, instead of building out the entire 24 GW of identified potential. There is a shift towards more distributed micro hydro projects that can add up to 2-3 GW instead of continued emphasis on larger projects. The benefit of such projects is that they can provide power to far-flung, rural areas and – if connected to a local micro-grid or even to the national grid – can provide revenue opportunities for the local communities if ownership vests with them and if they can sell excess power to neighboring communities.

Zones where fishing is considered particularly important for tourism are declared off limits to hydropower development.

Agricultural Consolidation

In order to ensure that agriculture receives adequate and assured irrigation, and that agricultural expansion does not lead to widespread, dispersed watershed impacts, a strategy is adopted to consolidate agriculture. Special zones are earmarked for intensive agricultural development, and for the provision of necessary irrigation infrastructure. This also leads to greater focus on crops that have a relatively good water input to revenue generation ratio.

Figure 9 - Irrigation Canal in Bhutan

Lowland agriculture is assured greater access to reliable water supply – despite increasing climate change related variability in rainfall – through the development of new and expanded irrigation schemes. To meet the expanded water needs of both agriculture and tourism (drinking water supply) in upland areas, Bhutan's government invests in a few strategic water storage projects, as well as small-scale initiatives and programmes such as water harvesting. Storage for irrigation takes precedence in certain basins over storage for hydropower.

Watershed Management and Improved Siting

Decision makers give high priority to stabilizing slopes and reducing erosion and siltation. This elevates watershed management to an unprecedented level. Stronger regulations are introduced to better manage siting of tourist facilities, routes of roads, and other man-made structures, taking into account increasing disaster risk as well as catchment area preservation needs.

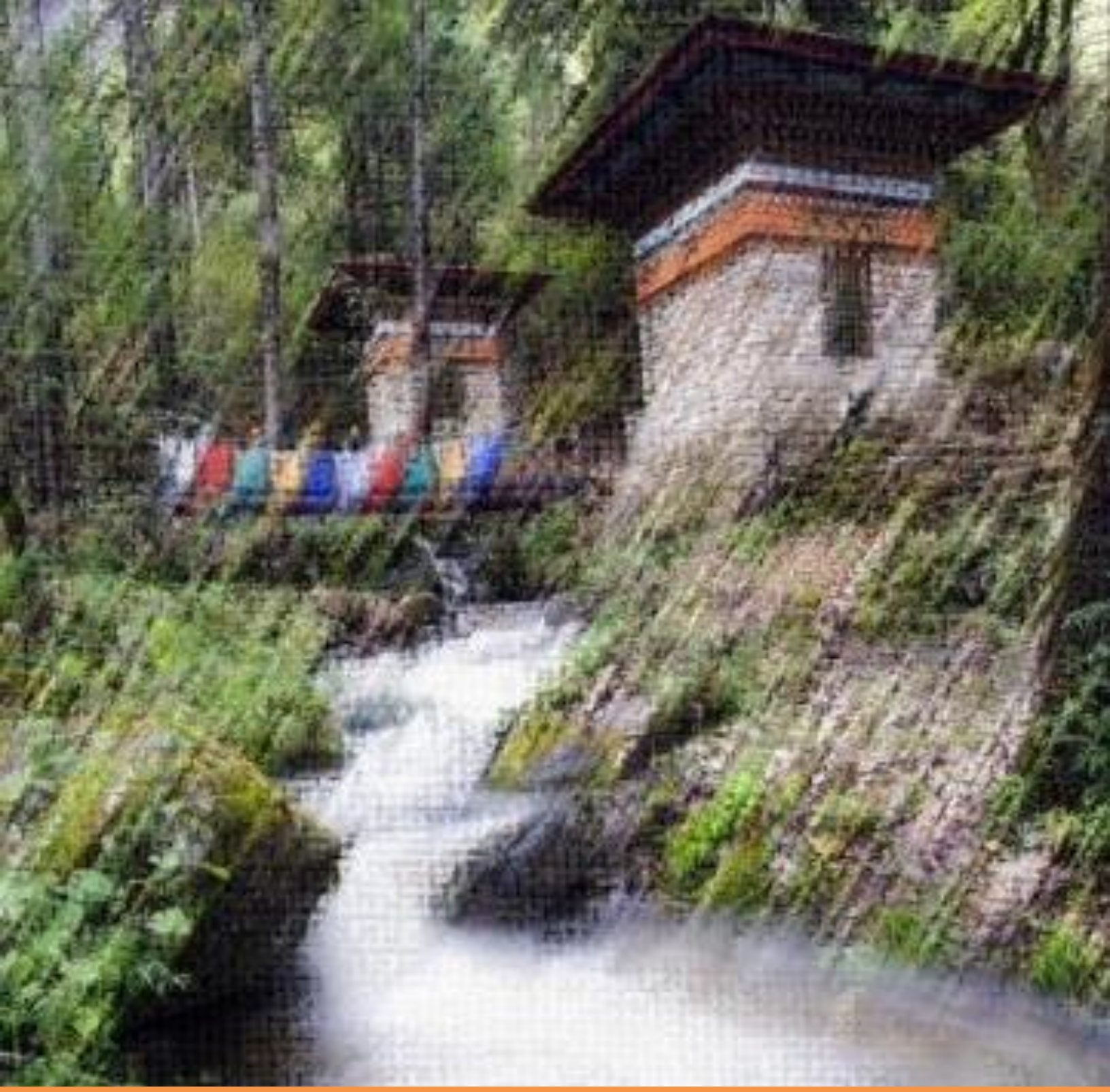
Along with stricter regulations about siting and more holistic planning to take into account the compounding impacts of agriculture, linear infrastructure development, tourism facilities, and other construction, the government invests heavily in improving monitoring and enforcement. This ensures that the standards and best practices reflected in the law translate into implementation.

These measures collectively ensure sustainability of both agriculture and tourism in Bhutan, and the continued strengthening of Bhutan's eco-friendly and environmentally responsible brand.

In the Brand Bhutan Scenario, the country pursues economic opportunities in agriculture and tourism, relying on rich natural resources and robust ecosystems. Bhutan positions its agricultural commodity (raw material) exports and its tourism as sustainable and eco-friendly, creating a strong brand. With the growth of both these natural capital based sectors as well as the infrastructure required to support them, it sees increasing impacts on its water resources (such as shortages and competition) and landscapes (such as erosion and watershed degradation). Spatial overlay of these sectors exacerbates water demand in certain areas. This, coupled with the need to prevent and manage disasters such as landslides results in giving high priority to land use planning, siting, and more rigorous watershed management.

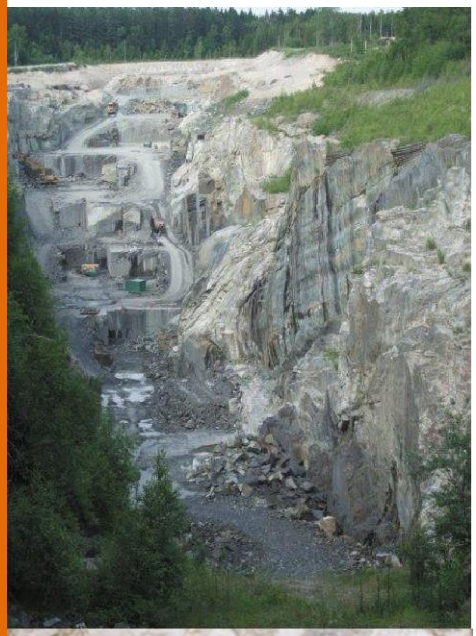
Potential Lessons from: Costa Rica

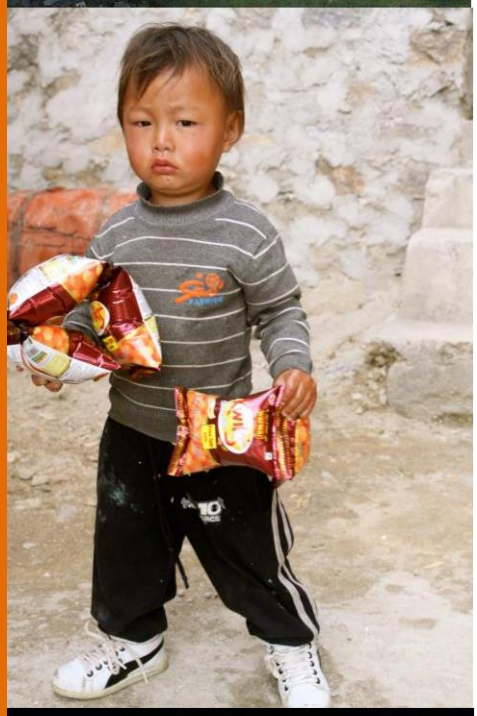
Costa Rica is highly regarded as a model for a sustainable, natural-resource based economy, driven both by nature based and eco-tourism as well as by agriculture. While arable land is limited due to limited land endowment and a commitment to significant forest cover, agriculture contributes 9% of GDP and provides direct employment for 15% of the population. Strikingly, it accounts for 37% of Costa Rica's total exports (including bananas, pineapples, and coffee). Costa Rican exports are increasingly recognized for their fair trade nature and the country's sustainable farming practices, and are able to command a premium. Tourism is Costa Rica's largest foreign exchange earner, and contributes an estimated 12-13% to GDP while accounting for 11-12% of employment. Nearly half (47%) of all tourists engage in eco and nature tourism.

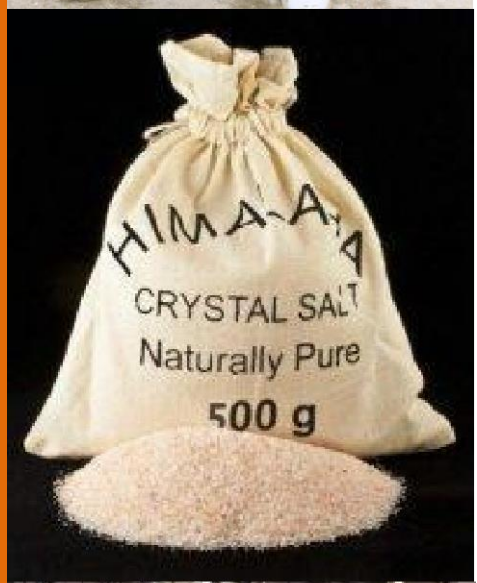


Chapter Three

Green Bhutan







Scenario Three

Green Economy Bhutan

An industrial economy underpinned by the processing of primary products, beneficiation in the extractives sector, and natural resource based industries that target the global economy.

Early Days

Starting Point: The Boon of Cheap Power

The Green Bhutan story starts with the same hydropower development that catalyzed the other two scenarios. After identifying 24,000 MW (24 GW) as being technically and economically feasible to develop, the nation strongly promotes hydropower development. The economy grows on the back of this hydropower expansion, and its revenues steadily increase from hydroelectricity sales to India. Hydropower is mainly centralized and geared towards high volume export production of electricity, with neither distributed micro hydro nor multipurpose projects figuring in early stage plans.

The investments in hydropower enable it to produce electricity at relatively cheap rates. Electricity tariffs are extremely low, for both residential and commercial (including industrial) users. Cheap electricity positions the industrial sector in Bhutan to be competitive in the region and even globally for some products.

Job Creation and Diversification Imperatives

As described in the second scenario, Bhutan struggles with unemployment and underemployment, particularly amongst young persons (aged 15-24). Unemployment is even higher in urban areas because young Bhutanese increasingly leave villages and rural communities to move to cities in search of opportunity, leaving behind family land and rejecting agriculture in favor of other occupations.

Realizing the need to create productive opportunities for youth, the 11th Five Year Plan identifies targets to reduce youth unemployment, but with little success in achieving these.

The 11th five-year plan also articulates the need to move towards greater economic diversification and reduce economic reliance on a single source of growth – hydropower. The need for economic diversification builds up traction in planning and policymaking within Bhutan.
Decision makers start identifying economic activities or sectors that could be built up into significant drivers of growth, and create youth employment.

Embracing Value-Addition

By 2017/2018, the country recognizes the potential of value-addition to primary products. Bhutan has cheap electricity that makes manufacturing and processing competitive in the region. A key benefit of growth in this sector is the reduction of imports of processed goods, and therefore a reduction in the outflow of valuable foreign exchange. Moreover, growth in exports of processed goods is a source of foreign exchange inflow, something Bhutan increasingly needs in order to maintain a healthy Balance of Payments.[viii]

'Kewa' Conundrum

Bhutan exports potatoes ('Kewa') at Nu. 30/Kg. But imports potato chips for ~15-20 Nu/bag (50 grams).

Assessments of Bhutan's mineral wealth[ix] suggest it is well positioned to ramp up beneficiation and processing of metals and minerals, and to grow the extractives sector, particularly in relation to ferro-alloys, cement, limestone, calcium carbide, copper wire, and graphite processing. [x] By 2014, exports of minerals and mineral-based products make up over half of total exports.[xi]

A Fledgling Green Economy

Adopting a Sustainability Brand

By 2020, decision makers in Bhutan recognize the value of positioning Bhutan as a Green Economy, with its products and services carrying a sustainability 'brand.' Thus, an understanding grows that even with the growing agro-processing sector and metals and minerals processing sector, these must reflect a strong environmental ethic. This would help the products to attract a premium in niche markets that value sustainability, fair trade (for instance, the "ethically sourced" market niche).

This shift also catalyzes thinking about adding distributed micro hydro into the mix, so as to have alternatives that have different (and potentially reduced, if well planned and managed) ecological impacts than large hydro. Additionally, the shift prompts thinking about the types of green economy products and services that Bhutan may be positioned to develop domestically and export under its green industrial brand.

Markets Within and Without

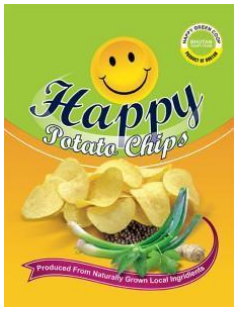


Figure 10 - Happy Chips from Bhutan

Bhutan's transition from a Least Developed Country (LDC) to a Middle Income Country[xii] spurs the rise of its middle class and the growth of disposable income. Consumer preferences change, shifting towards more processed foods and fast moving consumer goods. This internal market for value-added agro products is complemented by the growth of a regional and global niche market for food products from Bhutan. Processed foods from Bhutan (such as chips, beverages, jams, jellies, preserves, relishes etc.) benefit from association with the country's sustainability ethic and its emphasis on fair trade and organic approaches.

By the 2020-2025 period, other industries also grow including high-end value-added wood products, and minerals processing. This growth takes place in industrial nodes in the valleys and lowland areas where there is greater access to water and to energy resources, plus where transportation is relatively easier.

Incentives to Industry

The Government of Bhutan makes green industrial growth a priority in the 12th Five Year Plan (2019-2023), laying out a suite of incentives to support the growth of an industrial sector based on the processing of primary commodities. The Business Opportunity and Information Centre (BOIC)[xiii] expands its role from disbursement of the revolving fund (targeting cottage, small-scale, and non-formal commercial industries) to a wide range of support to processing companies. Financial incentives include instruments like tax breaks, subsidies, low-cost credit, rebates. Business Development assistance includes facilitation of greater market access, support with compliance to regional and global standards etc.

In order to establish and strengthen the brand of Green Bhutan, and to make Bhutan a market leader in sustainable and ethical industry, Bhutan facilitates and supports a range of green compliance and certification for leading industrial actors. By 2025 it incentivizes (and in some cases mandates) compliance with ISO 14000 and ISO 14001 and others such environmental benchmarks.

Infrastructure Development

Industrial growth is accompanied by infrastructure expansion to support this industrial base. The government sets up a number of industrial estates or parks, and over time several green industrial hubs emerge in peri-urban areas around Bhutan. These are served by a growth in linear infrastructure (roads, telecommunication lines) and basic services (water supply, sanitation, and electricity). Intra-country transportation of goods expands significantly, and the government also invests heavily in building up dry-port infrastructure to move the processed goods and materials into regional and global markets.

Bhutan allows industrial estates and parks to emerge in areas that create maximum commercial opportunities, in relation to both raw materials (to reduce transportation costs) and access to markets. In encouraging such industrial zones to develop based on the resource-base, somewhat less importance is placed on siting considerations related to catchment area management and water quality.

Positioning as a Transformational Low Carbon Economy

The country prides itself on being a carbon sink, and continues to put a premium on its association with sustainability. With growth in the industrial sector, Bhutan is aware that industrial activity that is extremely resource-intensive will damage its brand, and thus it commits to expanding industry within the paradigm of 'Bhutan Green Economy.'

Figure 11 - A Bottling Plant in Bhutan

In an increasingly carbon-constrained world, Bhutan leverages its identity as a low carbon economy, giving its industries an additional competitive edge as carbon content and carbon efficiency become increasingly key factors in international trade. As industrialized countries face border adjustments (trade restrictions) and higher production prices due to carbon taxes – which take effect in 2025 as a result of an international climate change agreement - Bhutan's low-carbon intensity (from both hydropower and resource-efficient approaches) makes its industry even more competitive. Even without investing in extremely expensive low-carbon technologies, by virtue of having low-carbon electricity (hydropower), negative net Greenhouse Gas Emissions (due to extensive forest cover), through the investment in low-cost, high-impact energy efficiency technologies (which do not necessarily require a high price tag), and by maintaining responsible sourcing of raw materials, Bhutan's industrial

products are inherently low-carbon, and thus more competitive in a global economy that penalizes carbon intensity or high embodied carbon-based energy in products.

Bhutan showcases its embrace of electric vehicles as an example of its Green Economy,[xiv] encouraging the growth of allied small-scale industries that make accessories and infrastructure components for electric vehicles.

Runaway Impacts

Blue Challenges in a Green Economy

Despite the emphasis on green growth, industrial expansion in Bhutan creates a growing demand for water consumption. Bhutan increasingly grapples with water shortages in all its blocs ("gewogs") and the drying up of streams in highland areas. This continues to spur migration of large numbers of people from rural, upland regions without adequate water to peri-urban areas that become nodal growth points due to the emergence of industry. By 2025 this movement of labor towards industrial zones also creates greater demand for drinking water supply and sanitation facilities. While the Water Act of Bhutan puts both population needs and agricultural requirements above industrial claims on water, the rapid growth of the processing industry leads to significant amounts of water being diverted towards this sector that generates both revenue and employment and also meets changing domestic consumer needs.

At the same time, the agriculture sector, which produces much of the raw material for the processed foods industry, requires more irrigation and expanded water supply. To some degree, agriculture can adapt to inter-seasonal variability in water access, but industry requires stable and reliable supplies. Thus by 2025 there are competing demands on water between these two inter-dependent sectors. Despite the growing emphasis on distributed micro hydro, it becomes apparent that storage needs exist and continue to grow, especially to facilitate water supply in the dry season.

Competition also grows over land, between agriculture (necessary for raw materials for agro processing) and extractives industries (a key source of raw material for minerals and metals processing and beneficiation). Industrial siting also decreases tourism potential of some areas, creating some competition.

Water Quality Deterioration

Figure 12 - Effluents Flowing into a Stream

The implementation of its relatively high green economy standards falls short of the actual standards in many cases. While the rules and regulations on the books are of an international level, over time both monitoring and enforcement are inadequate to address the challenges created by elevated industrial activity. These gaps occur due to both capacity constraints and outdated technology. The regulator mandates technology upgrades, but industry is slow to do upgrades due to their high costs. During the low-flow season, water quality deteriorates further, increasing odor problems.

While there is a slow and steady decrease in water quality over the decade-long growth of the industrial sector, matters come to a head in 2026 when an industrial accident results in a large chemical spill into the Paro river, affecting urban and peri-urban populations and damaging aquatic ecosystems. The spill occurs due to lapses in monitoring and poor implementation of regulations, resulting in insufficient protection to water bodies close to industrial zones.

The chemical spill also impacts industries that rely on water for their operations, such as breweries and beverage manufacturers, causing a shock to overall industrial activity.

News of this water contamination spreads globally because it is considered such an incongruous event for a country like Bhutan, and causes temporary damage to Bhutan's Green Economy brand. While the contamination is quickly cleaned up (including with foreign technical support), the event sparks a more vigorous and sustained debate within Bhutan about protection of natural resources from industrial growth, and this strengthens public discourse about implementation and enforcement of water quality standards.

Climate Chaos and Response

Climate change creates a slow-moving crisis on multiple fronts. Changes in temperature, biodiversity, species range, growing seasons, the emergence of invasive species, and the influence of new pests and parasites start taking a toll on Bhutan's agriculture sector. Over time, Bhutan begins experiencing a fall in yields of certain crops, and suffers failed or damaged harvests due to changes in rainfall timing, spatial distribution, and volume. While some crops benefit and see yield increases, the overall balance of the change is detrimental by 2030. Thus, certain products that built up a regional and global market over a decade of production become commercially unviable due to high raw material prices (spurred by shortages). Partly as a result of Bhutan's emphasis on food grain self-sufficiency and security of foods central to the Bhutanese diet, large portions of R&D funds and internationally funded climate change resilience projects are directed at staple crops. In the process, climate resilient seed development and other agricultural adaptation measures are promoted less in relation to commercial crops. While the government focused on climate resilience of basic grains and staples, the private sector in Bhutan (which emerges as a prominent force in the agro-processing industry) does not commensurately scale up efforts to protect their supply chains from climate variability and change, resulting in a lack of preparedness.

To compound these slow-moving impacts, a large, sudden, and extremely damaging flash flood event in 2028 damages a prominent industrial estate after an episode of unprecedented heavy rainfall. Infrastructure development around the industrial area (including road construction) reduces forest and vegetative cover, and the built up (paved) nature of the industrial park reduces the ground's absorptive capacity. Furthermore, the growth of the value-added high-end wood products industry also contributes to slope degradation upstream of the industrial park. As a consequence, a huge flood results during the rainy season one year, washing away property, costly equipment and machinery, and other infrastructure in the industrial park, and leaving behind severely damaged capital assets. The industrial park had emerged close to the river due to the cost-effectiveness of easy access to water. However, flood risk had not been adequately taken into consideration during the siting process.

Figure 13 - Flash flood near Punakha Dzong in Bhutan

An increasing number of disasters also affect transportation infrastructure that is critical to exporting Bhutan's green industrial products. Over time, disaster management approaches improve, including flood risk reduction and management. This ensures better siting for industrial hubs by 2030, but this also makes certain low-risk locations more attractive to multiple users and land in such areas becomes costly to buy.

Consolidating Green

Positioning Bhutan as a Green Industry Leader

With both chronic and acute water related crises – and pressures on both water quantity and quality – becoming a threat to economic stability and growth, the government re-allocates significant resources to address these challenges. In addition to introducing stringent environmental safeguards (especially water standards for withdrawals, usage, treatment, and recycling etc.), the government prioritizes effective monitoring, reporting, and enforcement. It increases staff capacity in the key agencies (particularly in the water sectors), invests money in periodic and ongoing trainings for staff at all levels (especially field staff in charge of enforcement), and sets up programmes and incentives to make water-related technologies (including effluent treatment and grey-water recycling) more cost-effective for local industry. The government decides to not only meet the highest international standards and safeguards for industrial water quality and efficiency, it positions itself as a leader and demonstrates that it can set an even higher standard.

Critically, the government revamps the entire approach to industrial siting, and pursues more holistic spatial planning. The government adopts a more integrated approach to land use planning, incorporating disaster risk management (siting facilities away from disaster risk areas), catchment management, and careful water resource allocation.

Entry-Point into Tertiary Sustainability Services

Bhutan decides to capitalize on its position as a leader in sustainability and its global green brand. It starts using its green, low-carbon industrial experience as a resource upon which to grow a related tertiary sector, i.e. sustainability services. As countries around the world increasingly turn towards resource-efficiency and seek to pursue sustainable industrial practices (both due to resource depletion as well as rising international standards and trade regimes promoting low-carbon industry), Bhutan draws on its experience in this arena and creates occupations for sustainability advisers, industrial efficiency strategy planners etc. Its sustainability service-providers and consultants are sought after all over the world, particularly in relation to water resources in the industrial context.

Private Sector Stewardship

Figure 14 - Partnerships in Bhutan

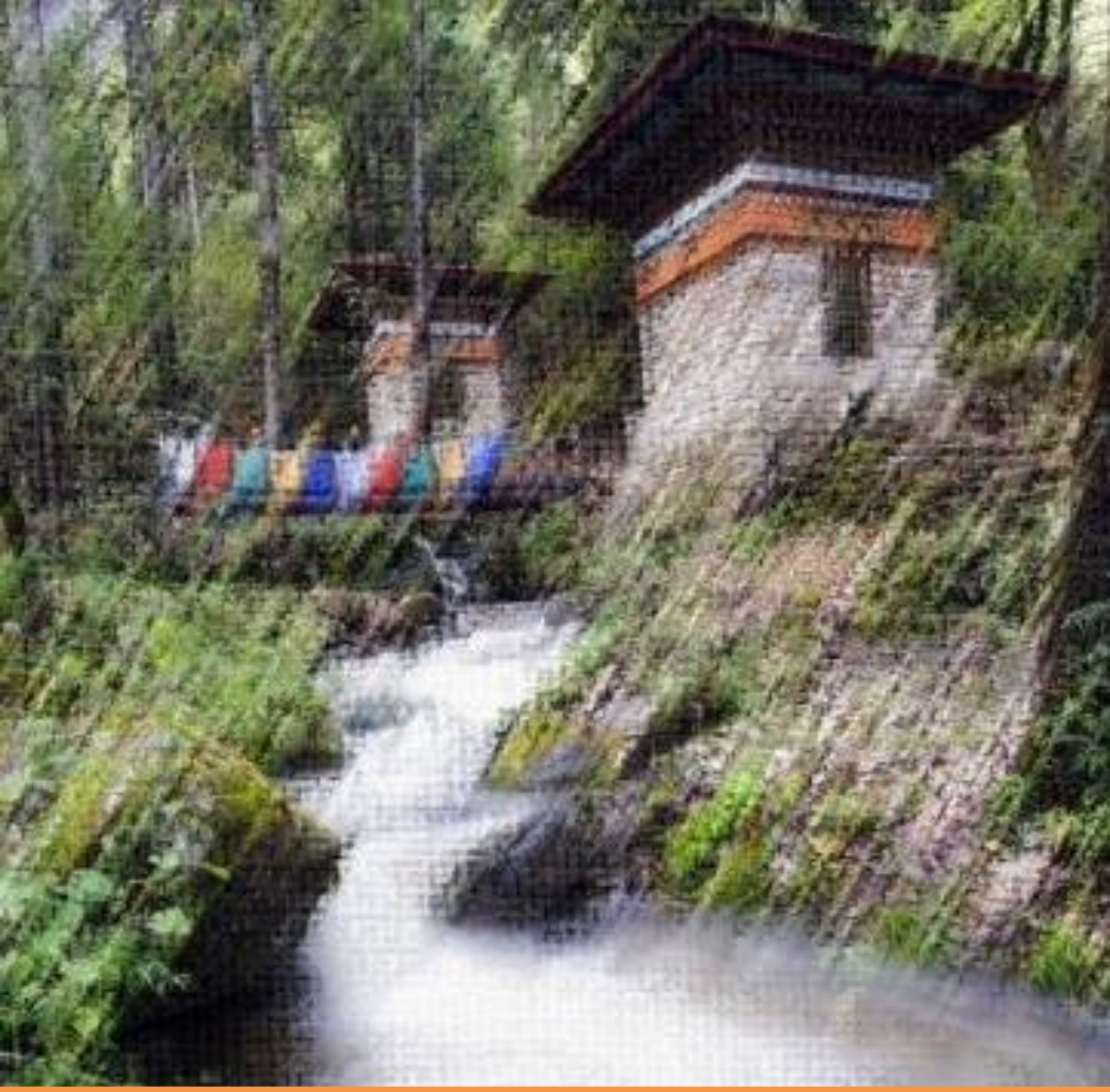
In WWF's parlance, "water stewardship" is about businesses understanding the risks they face from water scarcity and pollution, and taking action to help ensure water is managed sustainably as a shared, public resource.

In Bhutan, as the public sector strengthens the management of water resources, industry simultaneously recognizes that it is integrally connected to Bhutan's water resources. Manufacturing companies start becoming strong champions of natural resource management, given that their operations depend on the health of natural capital and the safety of their assets is also affected by water. Critically, industry recognizes that in order for the country to leverage its brand as a Green Economy in the world market, it must display exemplary leadership in its management of natural resources. Thus the private sector, including industry associations, becomes strongly engaged with stewardship and shared value.

In the Green Economy Bhutan Scenario, affordable energy spurs the development of industrial sectors that leverage Bhutan's natural resources. In particular, these include agro-based processing industries and extractives-based industries. The country realizes early on that in addition to cheap electricity, promoting sustainability and responsible, ethical production makes its products more competitive in a niche export market. Thus, the government strongly develops a Green Economy brand, and establishes the necessary high standards and regulations. However, monitoring, implementation, and enforcement do not keep pace with the high standards. This results in lapses that cause water quality deterioration and accidental contamination. Competition for water increases between different sectors. Climate change exacerbates water availability and quality issues, and increases the risk of disasters to Bhutan's industrial hubs. In response, better siting is introduced and better implementation. The private sector also works in partnership with government to strengthen Bhutan's green economy brand.

Potential Lessons from: Germany

While the scale of Germany's industrial economy and its ambitious energy transformation programme (*energiewende*) are not suitable parallels to Bhutan, Germany nevertheless offers lessons on how to incentivize and support the growth of green industry. It also stands testament to the ultimate profitability and productivity of green industries. Amongst the various measures Germany has taken to catalyze a green industrial economy are: R&D support, low-interest loans, energy and climate funds, quotas, tax breaks, annual energy efficiency improvements, and subsidies. Like Germany, Bhutan is already at an advantageous starting point since its economy is already fairly green and sustainable. With directed investment and enabling policies, Bhutan could emulate some of Germany's green industrial accomplishments.



Chapter Four
Impacts, Tradeoffs and Pivot Points

Water-Resilient Economic Development in Bhutan: Impacts and Tradeoffs

The preceding chapter examined three distinct economic trajectories that Bhutan could take, depending on which of its water-reliant economic sectors becomes the engine of growth, or which of such sectors (or combination of sectors) the country opts to actively prioritize to generate revenue, employment, and to establish an identity for itself in regional and global markets.

As the nation pursues a combination of various economic and development goals, it is likely that it will see the manifestation of each of the three scenarios. Instead of having one monolithic future based on one scenario – to the exclusion of the others – Bhutan will probably see elements of each scenario emerge; different scenario elements will play out at different times in different regions, but will also very likely overlap spatially and temporally.

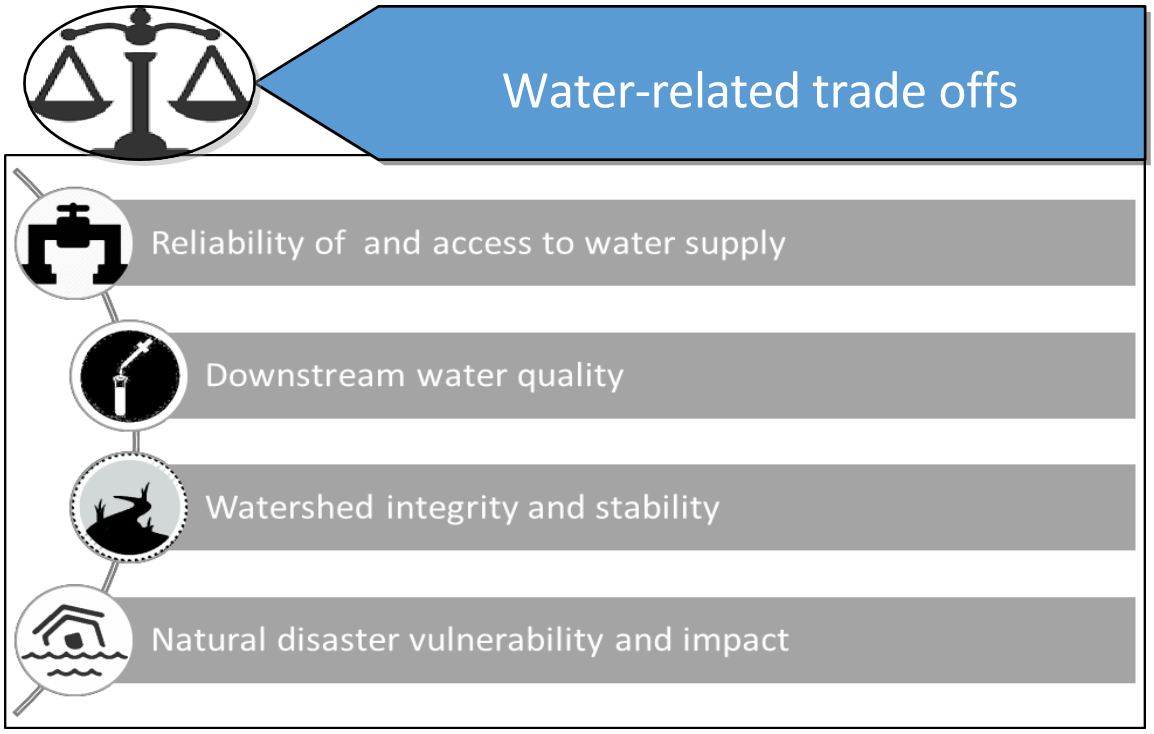
Given the water-dependent nature of the sectors driving the scenarios – hydropower, agriculture, tourism, and natural resources-based industry – it is self-evident that as each sector expands, its claim on country's water resource base will also grow. As such, given the finite nature of water resources, these competing claims will give rise to trade-offs: choices about the extent to which any one sector's water needs may be accorded preeminence over another's.

Major Tradeoffs

A tradeoff is defined as "a balance achieved between two desirable but incompatible features; a compromise."[xv] In other words, tradeoffs are situations where one must choose between or balance two things that cannot be had at the same time.[xvi] Often they are results where one must choose to 'sacrifice' one or more elements that one would want in an 'ideal' situation, but must relinquish in order to have something deemed even more important.

The development of water-reliant economic futures for Bhutan suggests that its future is that of choices – choices that must be made at every stage about the use and allocation of water, as well as the preservation and management of this critical resource that multiple economic sectors depend on. Despite its theoretical abundance of water (for instance, measured by per capita water availability), Bhutan's water resources are not so ample that all streams of economic activity can take this natural capital for granted for their own use at the same points in time, at the same location, without limits. Even greater than the challenge of aggregate volume and availability is the problem of spatial distribution and availability; while some settlements in high elevations may continue having reliable mountain streams, other regions may see their streams dry up. Similarly, some valleys could face greater water scarcity than others. But these areas with constrained water access may very well overlap with areas of high economic activity, creating elevated water stress in some locations. Bhutan may have to consider which regions it will invest in to provide assured water supply, and which regions are less of a priority for water access.

Specifically, Bhutan will have to consider water-related tradeoffs within the following areas:



- **Reliability of and Access to Water Supply**: Bhutan could increasingly face allocation challenges between different water users within the same catchment, and perhaps even at an economy-wide level. The vast majority of the gewogs (blocs) already report that they do not have adequate, perennial, reliable access to the volume of water needed. Low dry season flows in rivers already pose difficulties for different users. This is expected to worsen with climate change. This has significant implications for who uses how much water in the dry season – human settlements (for drinking water), agriculture, tourism, manufacturing industry, or hydropower. Even if allocation is strictly prioritized according to the Water Act, this has implications for the economic sectors and how robust their growth continues to be. Similarly, even with the decision to build water storage to increase year-round reliability of water, there are likely tradeoffs in upland areas between storage for irrigation and storage for hydropower.

- **Downstream Water Quality**: The country should expect to face choices or tradeoffs regarding water quality, especially in downstream areas. As agriculture expands upstream, farm runoff could become a consideration for water quality downstream. Much more significantly, urban growth and/or industrial processing expansion in parts of river catchments would have implications for water quality downriver. Impacts on downstream users and ecosystems could mean water quality challenges for tourism and agriculture, depending on their locations. Siting of facilities and settlements plus enactment and enforcement of water quality regulations are amongst the choices Bhutan must make on water quality.

- **Watershed Integrity and Stability**: As Bhutan's different economic sectors grow, their need for land and land-based support infrastructure will also expand. Certain sectors will find specific locations within the country – and specific river basins and catchment areas – particularly attractive for their needs, while other sectors may also hone in on the same locations for their own needs. As economic activity on the whole increases for each of the water-dependent sectors under consideration, impacts of their activities on watersheds will increase as well. In particular, encroachment from agriculture or commercial forestry is possible if the sectors expand or intensify. This could have serious ramifications on watershed integrity and stability. Given that Bhutan already faces changes in hydrology from climate change, degradation or alteration of watersheds could

- **Natural Disaster Vulnerability and Impact**: The manner and extent to which Bhutan's major water-dependent economic sectors utilize the country's water resources could also mean choices for Bhutan regarding its vulnerability to natural disasters. The Kingdom is located in a seismically active area, and climate change is expected to add additional dimensions of disaster risk in the form of GLOFs, flash floods, and landslides. Decisions Bhutan makes about the growth of each economic sector – including in spatial terms – could have implications for how vulnerable it allows itself to be to major natural disasters and the scale of impacts that could result as a consequence of any disasters. Activities and water use upstream will have implications for downstream disaster risk and vulnerability.

  Recent studies have indicated that the incidence of certain types of natural disasters such as flash floods and landslides have increased in Bhutan in recent years. With climate change, the occurrence and intensity of such disasters is likely to increase, as is the prevalence of GLOFs. Thus, disasters are likely to result in an increasing burden over time. However, depending on the type of economic growth model adopted and the manner in which water resources are managed within such a model, the impact of such disasters could be mitigated to some degree. For instance, if hydropower stations are not built in great numbers in high elevations, this could reduce the exposure of hydro facilities to GLOFs. Similarly, if infrastructure for tourism or hydropower or industry is built in a somewhat measured manner, in less geologically unstable zones, then this could reduce the risk of landslides or flash floods during heavy rains.

  Given the currently limited capacity for disaster management and disaster risk reduction, and the increasing pressures on the disaster management authorities, it is imperative for Bhutan to consider disasters as it weighs different tradeoffs. This is not only because of the immediate costs of disasters in terms of loss of life and property and damage to natural resources / landscapes, but also the long-term costs and consequences of disasters in an economy so heavily dependent on natural resources.

While all of these are relatively common water-related tradeoffs, they take on a specific character in Bhutan's context. This is because of the sheer scope for change from the current baseline to a significantly different state, given Bhutan's currently robust freshwater systems. Today there is a sense that Bhutan has an abundance of water, catchment areas are largely in a healthy state, the quality of Bhutan's water resource is high, and the impacts of natural disasters have not been too severe. Thus it is tempting to assume that if all carries on in the future as it has thus far, significant vulnerabilities are unlikely to arise and that Bhutan can continue pursuing the full range of its development aspirations without any significant constraints from water or any need to alter the approach to managing water, i.e. a "Business as Usual" approach.

However, the scenarios make the case that these challenges are likely to arise – at the very least in some places at specific times in the future as the economy continues to grow. This is possible regardless of which key economic sector expands and becomes a driver of growth.

In light of the major tradeoffs identified above, one critical insight emerges fairly quickly: the management of spatial patterns of development -- and the spatial linkages of development with extreme climate events (such as floods or GLOFs) or difficult climatic impacts (periods of low flows in rivers) -- will be central to the resilience of Bhutan's economy in the future.

Factors That Could Influence the Tradeoffs

The following broader macro-economic and institutional considerations will potentially guide the nature of Bhutan's economic trajectory and thus have implications for its catchments and water resources. In other words, these factors are relevant to how the tradeoffs identified above will manifest and be dealt with.

- **Strengthening and Maintaining the Bhutan Brand**: Bhutan will wish to further establish and maintain its brand in regional and global markets. Whatever may be its specific positioning ("green" / "sustainable" / "eco-friendly" / "ethical" / "responsible" etc.) and the niche market it opts to orient itself towards, decisions Bhutan takes about its brand will have implications on how the country's water resources are allocated and managed. The Brand itself is dependent on water and well-functioning catchment areas.

- **Sources of Finance and Investment**: The sources of finance and investment in each major water-dependent economic sector in Bhutan will possibly play a role in the sector's posture towards water resources. Domestically generated finance, finance from neighboring countries, and development finance from multilateral lenders – each will come with its own prerogatives. External finance introduces different challenges from a domestic finance, which can reflect a domestic driven agenda. The source of finance can have a bearing on decisions such as the type or scale of activity to pursue or the siting of particular facilities, or the commodities to produce for export etc. Thus, as Bhutan potentially diversifies its sources of investment and finance, the implications for its water resources will also see a shift.

- **Level of Institutional Capacity and Coordination**: As Bhutan navigates the transition into full-fledged democratic government, its emerging democratic institutions have the task of managing unprecedented growth in a range of economic sectors. Bhutan has thus far demonstrated exceptional foresight in the need for strong standards and regulations, and its policy frameworks reflect international best practice. However, the capacity to enforce and implement these policies and laws has not kept pace in some departments. Some functions operate in a siloed manner, and coordination has significant scope for improvement. The extent to which decisions are or are not made in a fragmented manner in the future has major implications for water resources in the country.

  In Bhutan today, there isn't a long history of participatory and integrated/aligned natural resource and infrastructure management, and thus mistakes are likely to be made in the early days. New and expanding mandates call for greater number of staff to manage Bhutan's water resources, as well as for more assistance from those who have a body of practice behind them in relevant fields.

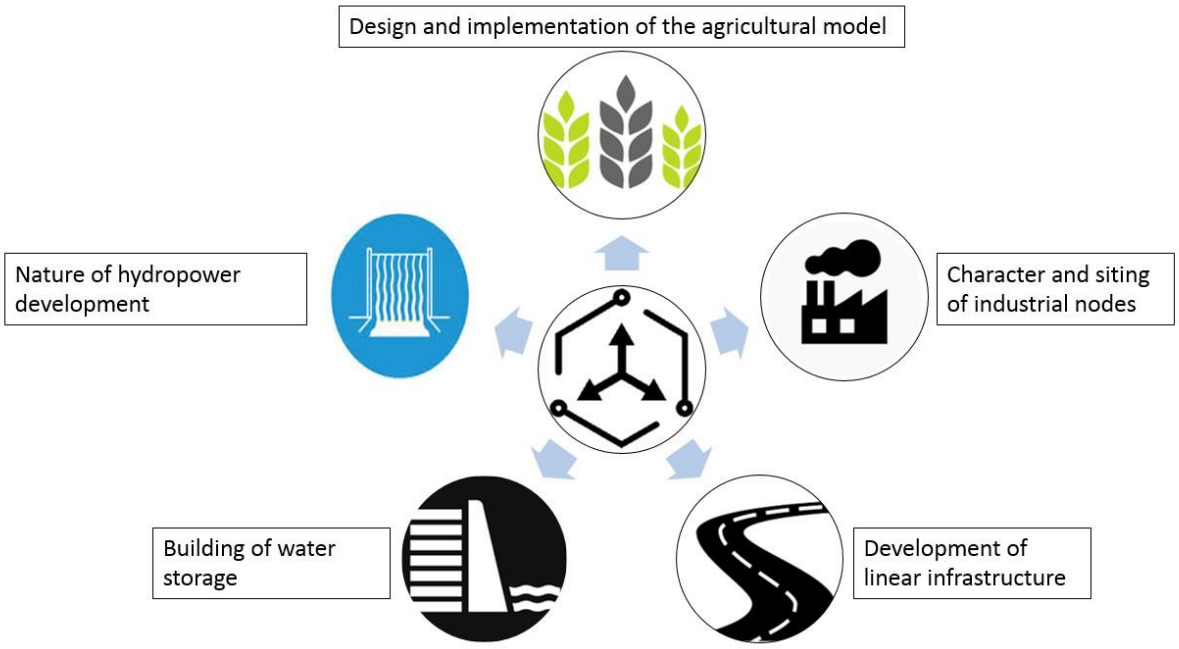
  Bhutan is faced with the challenge of transitioning from a slower growing, predominantly agrarian developing country to a fast growing, middle-income country where growth is driven by hydropower resources and infrastructure development. It needs to balance the sudden expansion of opportunity with the strong ecological ethos of the country.

- **Export Versus Domestic Focus:** Bhutan's economy is currently very export-oriented, with cross-border sales of hydro-electricity bring the primary export (along with a not insignificant level of raw metals and minerals export). While this model has brought notable gains to the country (a rise in overall GDP and income levels, and a marked and rapid reduction in poverty), the country's economic sectors have not yet had an opportunity to flex their muscles in relation to domestic markets. As consumption levels in Bhutan grow (a natural consequence of higher incomes), Bhutan may opt to spur domestic-oriented growth in its major economic sectors. This potential shift also has implications for water use and allocation in the country.

- **Level of Information on Environmental and Social Impacts**: At present, Bhutan collects a range of relevant information regarding the composition and performance of economic sectors, as well as environmental and social indices. It is not adequately clear whether the range of environmental and social data collected is comprehensive, or whether critical gaps exist. It is also not evident that Bhutan is actively able to process, synthesize, analyze, and identify existing or impending trends in the environmental and social information it gathers. As the country's capacity to develop a robust evidence base grows, along with the ability to cull out findings about environmental and social impacts (present and future), this will have a bearing on how the government manages Bhutan's water resources.

Pivot Points: Decisions That Could Determine Bhutan's Water Resilience

The broad factors articulated above have implications for what kind of tradeoffs Bhutan will face regarding its water resources, and how those tradeoffs may be determined. It is valuable to further interrogate the specific types of decisions that it is likely to make about its economic future because these are the points at which – with or without an explicit intent to do so - water resources related choices will be made.



A. Design and Implementation of the Agricultural Model

Bhutan may opt to expand support for smallholder farmers to strengthen food security, or to foster commercial agriculture geared towards exports, or both. The manner in which this is done will have a bearing on water resources. Where this uses irrigation, there will be impacts on downstream water availability during low flow periods, and possible impacts on catchment integrity. Greater irrigation needs would likely also mean a continued demand for cheap energy to enable affordable pumping. Another element of the agricultural model that has significant implications is the choice of crops that Bhutan opts to prioritize and grow in large volumes. Different crop types require different levels of water, and thus if Bhutan makes choices about crop types without taking into consideration their water use, this could lead to particularly high water consumption by the agricultural sector. For instance, Bhutan's commitment to food self-sufficiency in the case of rice implies significant irrigation for rice, which requires highly water-

intensive cultivation. Thus Bhutan's choice of crops should not necessarily be made purely on societal, cultural, or economic grounds, but should also take into account water needs.

B. Character and Siting of Industrial Nodes

Where and how industrial and extractive growth is enabled will create high demands for water supply assurance and will result in water quality impacts. Ensuring that processing and small manufacturing industries in Bhutan are competitive regionally or globally would probably require access to cheap electricity, and efficiency and performance in the industries would require reliable water supply, potentially facilitated through the construction of storage. It will be important to ensure both an adequate level of water quality standards and a commensurate level of implementation and enforcement. Siting of industrial nodes will also have implications for disaster management, both in terms of increasing vulnerability of a region if unwisely sited, and in terms of the threat to the facility itself if sited in a high-risk zone.

C. Development of Linear Infrastructure

Depending on the economic sectors that determine Bhutan's trajectory, a significant expansion of linear infrastructure will occur. Whether it would be an export oriented industrial or agricultural economy, a community-based agriculture economy, or a tourism based economy, road networks and transportation hubs are likely to grow. Transmission lines for power and ICT infrastructure will also play a role in supporting economic growth. Such infrastructure development may both contribute to and be vulnerable to water and climate related disasters (such as flash floods and landslides). Moreover, these are likely to cause catchment deterioration downstream and contribute to watershed instability and erosion.

D. Building of Water Storage

Bhutan will have to grapple with decisions about the purpose and siting of water storage, and pursue greater storage to underpin its development and economic growth. In doing so, it will have to weigh questions of hydropower efficiency, agricultural irrigation, community water supply, urban-industrial supply, and disaster risk. How these decisions on water storage are handled will have impacts on river connectivity and water resource quality (e.g. eflows).

Water storage in Bhutan is clearly a necessity, to meet growing water needs of urban areas, as well as to supply irrigation water for agriculture (which is mostly rain fed at present). These needs are particularly evident in scenarios 2 and 3. In scenario 1, storage is also required, however it is primarily for hydropower, rather than for irrigation. Thus, depending on the type of future Bhutan embarks upon, it will be faced with decisions about building more water storage. The location of such storage and the amount of such storage on each basin implies tradeoffs for other sectors. For instance, more irrigation-oriented storage close to high agricultural productivity areas in certain basins could mean less storage options for hydropower in the higher elevations of the same basin. Similarly, more water storage for urban or industrial water supply to meet human consumption needs (which is more likely in lower elevations, downstream, because most towns are in the valleys) could mean less storage for agriculture or hydropower upstream in the same basins. Since not all types of storage would be possible in all basins, choices will have to be made.

E. Nature of Hydropower Development

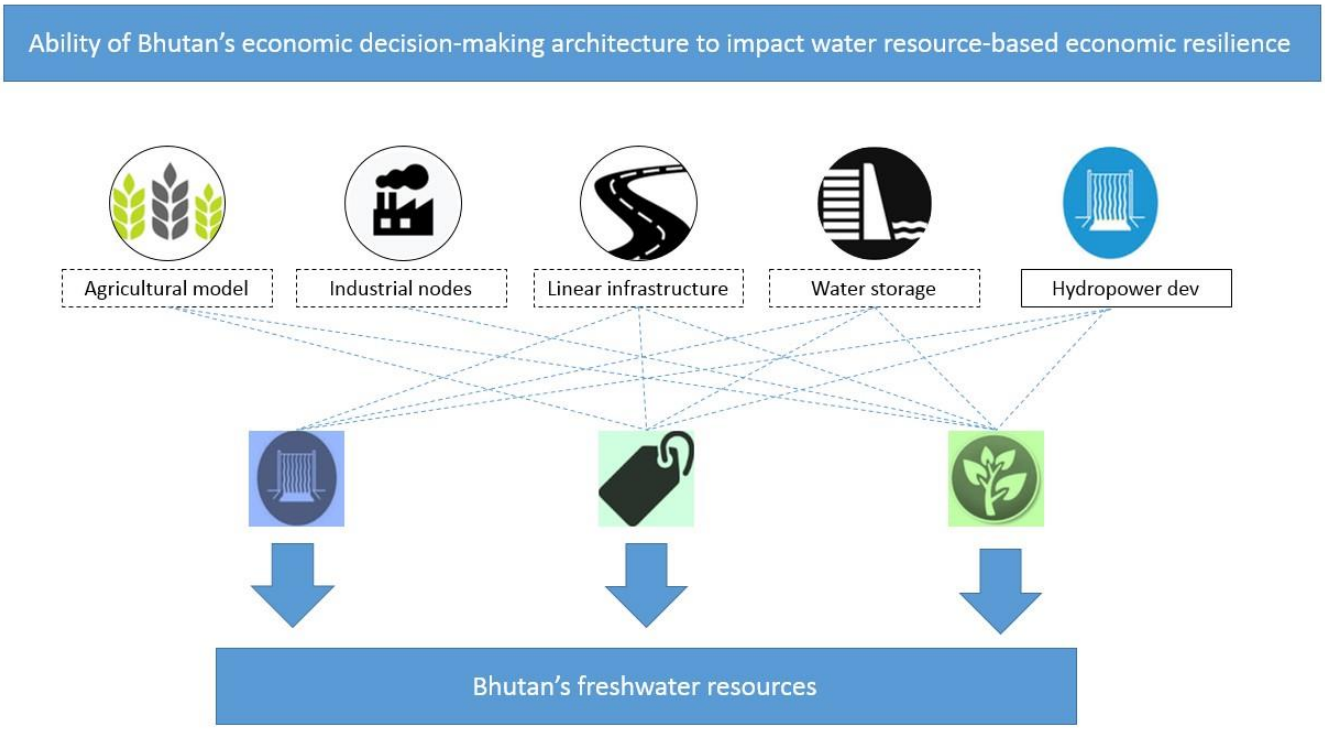
As the hydropower sector evolves and gets re-oriented towards a wider range of opportunities, decisions must be made about dispersed or separate schemes versus single series schemes, storage based hydro or decentralised micro hydro, multipurpose projects versus power generation projects etc. It will also weigh cumulative impacts as it makes decisions. Similarly, it will evaluate whether and how hydropower

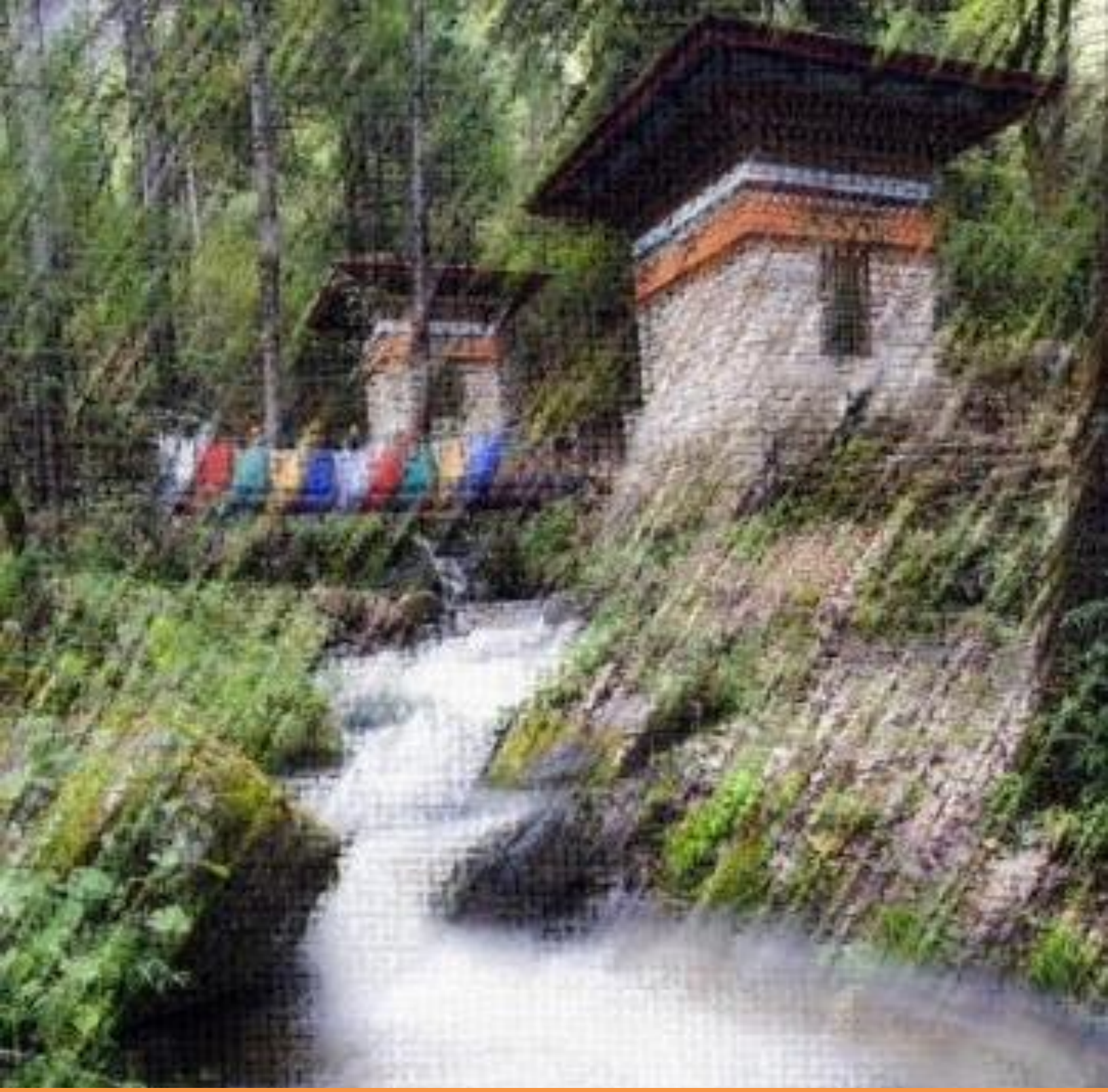
could be domestic oriented as opposed to mainly export oriented. This has implications for ecosystems and people.

The reason export orientation versus domestic use of power can affect the nature of hydropower growth in Bhutan (including the type and size of facility) is because Bhutan's domestic market is small and contained, while the export market is extremely large, with far higher demand and growth. Even with greater industrial demand or demand for power in the agricultural and tourism sectors within Bhutan, the amount of cheap hydropower it would need to meet domestic purposes would be far less than the amount it could generate in pursuance of a large and power-hungry export market. Thus, if the hydropower story is domestic oriented, it may find itself targeting fewer GW of hydropower overall, and may reduce the need for storage (for hydropower) and choose to build on some basins and not others (based on where domestic demand is, rather than where export-oriented transmission grids are), and opt for more small and micro hydro, as opposed to medium sized projects.

One of the most critical decision points regarding hydropower is the decision to conduct Cumulative Impact Assessments. Bhutan has already committed to this, but it needs to be implemented at a basin and sub basin level. The decision, i.e. choice about how much importance to give basin-wide cumulative impact assessments and how central these could be in the decision about hydropower, could have a profound impact on the future of both hydropower development and river basin management. The move towards obtaining more robust and concrete understanding about cumulative impacts of development on the river basin could be a crucial pivot point or decision point that influences future outcomes.

The 5 decision points and their link to the sustainability of Bhutan's water resources are depicted below.





Chapter Five

The Way Forward

Opportunities to Build Resilience

This report is not meant to propose answers to Bhutan's economic development decisions, but rather highlight the opportunities to make the plausible development trajectories more resilient in terms of water resources.

Key opportunities are described below:

Figure 15 - Opportunities to Build Resilience in Bhutan

1. Instituting Coherent Spatial Development Planning

Given that our country is likely to face spatial and temporal water challenges, (i.e. it won't necessarily have as assurance of the level of water demanded or needed in every single location, at all points in time), spatial planning for water resources takes on primary importance. Bhutan already has systematic economic planning architecture, particularly in the form of its Five Year Plans led by the Gross National Happiness Commission (GNHC). While the GNHC plays a central role in providing direction and guidance to sector plans (including annual plans) and integrates the different sectoral plans into a national plan, Bhutan does not yet have a robust system in place to conduct cross-sectoral, integrated, holistic spatial planning.

Thus, Bhutan could consider instituting such a system, which would move beyond traditional land use planning to integrated spatial development planning. The government may consider putting forward a mandate for this approach and constitute a multi-sectoral, inter-departmental task force to bring this into operation. Given the strong economic as well as natural resource character of such spatial planning, the task force could comprise of key sectors such as the Ministry of Economic Affairs (MoEA), the National Environmental Commission (NEC), the GNHC and the National Land Commission. Such an approach may enable tradeoffs between different trajectories and sectors to become more readily visible and thereby, more easy to address. This would contribute to more aligned and coherent decisions.

SPATIAL PLANNING – BRINGING A SPATIAL CHARACTER TO LAND USE AND WATER PLANNING IN BHUTAN

Adoption of a spatial planning approach represents a significant opportunity for Bhutan to manage its water resources – i.e. its critical natural capital that supports economic sectors – in a sustainable way. Spatial planning is a slightly broader concept than traditional land use planning, and it addresses the issue of choices and tradeoffs by prioritizing certain land and water uses in specific areas over others, with a view towards strategic use of natural resources and meeting varying demands in different geographic locations.

Specifically, spatial planning refers to shaping spatial development through the coordination of the spatial impacts of sector policies and decisions.[xvii] Spatial planning considers economic, social and environmental effects of development. It enables the anticipation of long-term change (and the pressures and opportunities that emerge from it) and the articulation of a logical and flexible development path for a more sustainable future.

Spatial planning often results in or takes the form of a strategy identifying critical spatial development issues, and defining clear desired outcomes across functional areas. It allows for the visualisation of spatial goals and key areas of change. It requires a continuous process of plan review and adjustment, as well as mutual learning and information sharing by all entities involved, driven by debates on alternative development models as part of a collaborative political process. Stakeholders actively use the process to achieve their own and mutual goals.[xviii]

To undertake spatial planning, one requires building an understanding of critical spatial development trends and drivers, market demands and needs, and the social, economic and environmental impacts of development. This must be coupled with analysis of options through visioning and strategic choice approaches. It also requires the generation of alternatives and options assisted by methods like strategic environmental assessments (SEAs) or cumulative impact assessments (CIAs). Traditional land use planning tools and approaches are also integrated into spatial planning.[xix]

Spatial planning is an ongoing process, with constant input of data and regular translation of data into visual representations (such as Geographical Information Systems or GIS), and periodic strategic decision-making about development options, including the use of incentives to spur a certain type of development in one region, relative to other types of development or relative to other regions.

Spatial planning can be summed up as involving the following elements:

- Understanding resource capacity and constraints, especially in relation to natural resources.
- Identifying areas of spatial importance, i.e. areas or units to manage sustainably (such as river basins).
- Identifying development objectives for each of those areas, i.e. what are the goals for that region and what is needed to meet those goals.
- Assessing how to match the development goals with resource endowments and with conservation needs.
- Prioritizing the best use of resources that allows for minimal impact while meeting the objectives.

A key feature is that this type of planning takes a zonal approach, recognizing that not all development can take place everywhere, and that not all natural resource users can enjoy the same level of access and use of resources in every location. The zonal approach also allows for anticipation, and conscious influencing of, development patters in various areas.

Given the tradeoffs already identified in Bhutan through the scenarios development process, it is advisable that Bhutan adopt a spatial planning approach to weigh and determine different potential uses and allocations of water in different regions, particularly at the basin and sub-basin level.

2. Coordinating Cross Sectoral Information Management

Spatial planning is heavily constrained or impossible in the absence of adequate and well integrated information. Different departments and sectors in Bhutan collect a wide range of information relevant to their domain area. Data collection already takes place in a regular and systematic manner. However, there is room for growth in bringing the data and information together to share with other departments, synthesize, analyze, look for patterns and trends, and to glean cross-sectoral insights. In order to better understand and investigate the interplay between economic processes or decisions and water resources, it becomes imperative for the necessary information to be more easily viewed together.

Bhutan could consider a more integrated mechanism to bring dispersed streams of data and information together, such as in the form of a clearing house or interactive portal. It could build on the work already done to create the Bhutan Geospatial Portal,[xx] and add several other streams of data and visualizations. This will allow determination of what types of data and evidence are not currently being collected and which still need to be gathered (i.e. identification of research gaps), to enable more strategic and long-term decisions about water resources in Bhutan's economy, and will thereafter allow a more holistic analysis of the two-way linkages between water resources and water-dependent economic sectors. As with spatial planning above, such an approach may enable tradeoffs between different trajectories and sectors to become more readily visible and thereby more easy to address.

3. Adopting Bhutan-Relevant Green Water Management Instruments

A variety of planning approaches and tools exist to support the adoption and growth of specific economic trajectories. If Bhutan wishes to actively influence outcomes, while managing the water resources that both affect and are affected by the outcomes, it must use some of these management instruments strategically, with care and deliberation. Economies in Europe and North America, as well as Asian economies like Singapore, Korea, Japan etc. have used green instruments and approaches around water that are consistent with a sustainable economic trajectory.

In a similar manner, economic planners, policy makers, and other decision makers in Bhutan's government currently have at their disposal a number of decision tools and management instruments that inform economic decisions. Separately, water planners also have a host of tools and management instruments to assist with water resource decision-making. However, there is inadequate cross-pollination between the wider economic planning stream and the water resource planning stream. Given the critical role of water resources in Bhutan's economic trajectory, regardless of which major sector gains prominence, it is advisable that water resources planning and management instruments should be mainstreamed into broader national economic planning.

Thus, even for larger economic decision-making, Bhutan could consider integrating and relying on Cumulative Impact Assessments (CIAs), Integrated Water Resource Management (IWRM) plans, water zonation systems, catchment management plans, e-flows etc. There would be specialized green instruments that would serve each scenario in particular (e.g. hydropower related basin optimization), and some that serve all three (e.g. e-flows or ecosystem valuation).

This would contribute to more appropriate and sustainable decisions.

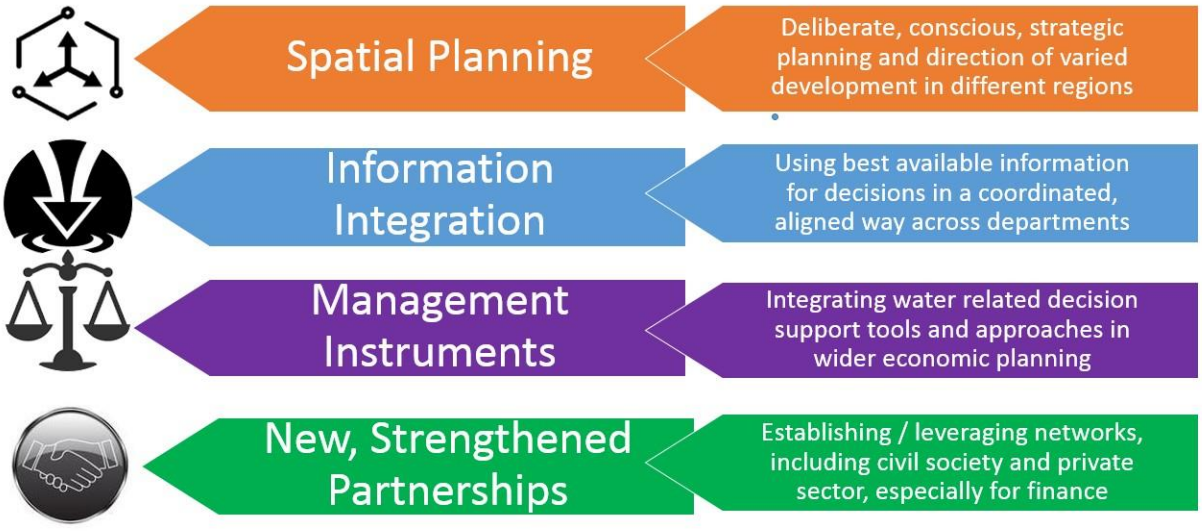
4. Fostering New Institutional Partnerships

As Bhutan enters uncharted territory in terms of its economic growth and the evolution of various sectors, the partnerships it builds and leverages will play an important role informing and assisting decision-making. Thus, forging the most relevant and beneficial partnerships is a key opportunity, not only for wider economic decision-making but also for the management of Bhutan's water resources. This involves relationships both within and outside government. Within government, this calls for stronger institutional (technical and operational) capacity, investment in human capital development, and strengthening cooperative governance processes in and in between various departments.

Outside government, this means bringing in more relevant external expertise to provide input where required, drawing on civil society, academia, international development finance institutions and the private sector. As the private sector matures in Bhutan, this provides scope for more corporate stewardship initiatives by companies and the incorporation of a shared value approach. The government could facilitate this through greater engagement with industry associations and industry thought leaders. This will enable decisions to be made based on a wider range of know-how, and – if partnerships are structured well – will allow decisions to reflect the views and priorities of all the concerned actors with reduced transaction costs.

In particular, Bhutan needs partnerships focused around technology and innovation. To adequately support Bhutan, partnerships have to be primarily driven by the provision of finance, or be geared towards the development of human resources capacity, or to strengthen technical innovation. New and varied partnerships that allow more development finance and finance for the growth of different economic sectors (beyond hydropower) could help diversify the types of interests reflected in the funding Bhutan receives and allow for a broader range of development options.

As with the other opportunities, the types of partnerships and relationships that would need to be built and leveraged would be different for each type of scenario, depending on the economic model Bhutan wishes to prioritize.



Channels for Implementation

Bhutan already has a strong economic planning architecture. Thus, this provides the appropriate channel for the approaches above to be mandated and translated into action.

For instance, the approaches discussed above could be rolled into Bhutan's five-year planning process, starting with the 12th five year plan (2018-2023).

Similarly, the update of Bhutan's Vision 2020, which is likely to be revised to Vision 2030, provides another avenue to integrate these approaches into Bhutan's governance structures. The ongoing revision of the National Environment Strategy and Environmental Assessment Act also provide opportunities to strengthen Cumulative Impact Assessment and spatial planning.

In the case of hydropower specifically, the upcoming revision of the Power Sector Master Plan would allow for an examination of how the recommended approaches can be incorporated into future activity.

The Irrigation Master Plan, the revision of which is also imminent, could also be an appropriate vehicle for applying the necessary approaches in the agricultural sector.

Integration into Bhutan's Basin Planning Processes

Bhutan is already engaging in basin planning, and is in the process of developing basin planning guidelines. Bhutan is also engaging deeply with Integrated Water Resources Management (IWRM), with a heavy emphasis on water security. These ongoing efforts are valuable opportunities to ensure robust, ecologically responsible and strategic basin planning. If the foundation for basin planning has any gaps, these could potentially lead to flawed outcomes in the future. Among the challenges that could emerge are over abstraction, pollution, alien species infestation, catchment alteration, habitat destruction, system fragmentation and connectivity issues due to infrastructure development. Thus it is critical to ensure that Bhutan's approach to basin planning is comprehensive and that it will help safeguard the country's natural capital, which underpins major economic activities.

Planning for the use and allocation of water resources is a complex undertaking. Often, as is the case in Bhutan, planning has to take place in an environment with limited information, constrained institutional capacity, rapid economic and demographic changes and significant infrastructure development. Approaches to river basin management differ from basin to basin, country to country, and region to region, also reflecting differences in priorities between governments or development institutions. However, certain best practices and globally accepted standard approaches have emerged over the years, gaining consensus and demonstrating positive results.

The core feature of strategic basin planning is that it recognizes and is aligned with broader economic development and planning objectives. Reflecting this, WWF's definition of strategic basin planning is "a coherent, multi-disciplinary approach to managing basin water resources and their uses in order to identify and satisfy social, economic and environmental priorities."[xxi]

It must be recognized that strategic basin planning is of a slightly distinct character than technical (and more traditional) basin planning. While technical basin planning is overwhelmingly the domain of hydrologists and engineers, strategic basin planning calls for a significant decision-making role by economic and environmental planners and policy makers who weigh multiple demands, opportunities, risks, tradeoffs, and make informed judgments about the preservation and management of water resources within a broader socio-economic and ecological context.

The objective of strategic basin planning is not merely to meet straightforward quantitative or qualitative objectives, but to choose between a series of possible water management objectives that could best contribute to a range of competing economic, social, and ecological goals. Strategic basin planning also recognizes that meeting such goals necessarily requires that participation of a range of government bodies and stakeholders, widening decision-making beyond just the water resource management officials or the environmental departments.

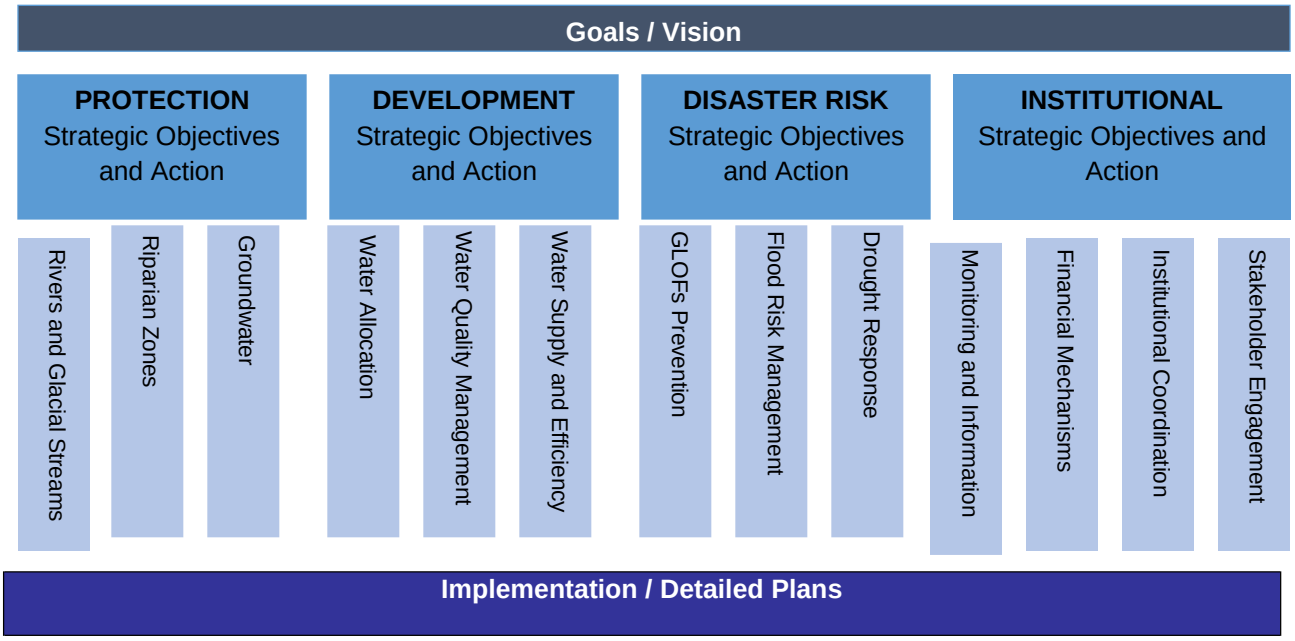
Some key features of strategic basin planning are as follows:

- Trade-offs between alternative economic, social and environmental objectives, and between existing and potential future demands.
- Sophisticated approach to recognizing environmental requirements for water and the importance of aquatic ecosystem functioning in providing goods and services for social and economic development.
- Understanding basin interactions, including a range of hydrological, ecological, social and economic systems and activities at work within a basin.
- Robust scenario-based analysis to addresses uncertainty in future development and climate, by assessing alternative hydro-economic scenarios.
- Prioritization, whether in terms of the needs for economic development, social justice or environmental protection.
- The involvement of multi-disciplinary teams.

Table: Attributes Distinguishing Technical and Strategic Basin Planning[xxii]

	TECHNICAL WATER RESOURCES PLANNING	STRATEGIC BASIN PLANNNING
Extent of basin development	Basins with 'spare' water available for development and not facing significant environmental pressures	Complex or water-stressed basins requiring difficult trade offs between economic, social and ecological objectives
Issues of concern	Responding to identified water resources pressures	Responding to broader basin stress and socio-economic pressures
Purpose of basin planning	Reconciliation of water availability or quality with existing development goals: "water for the economy"	Water planning as an integral part of development planning: "water in the economy"
Objective	Development	Protection and management
Focus of attention	Water focused: water resources infrastructure systems	Society focused: economic, social and environmental systems supported by the river
Environmental requirements	Threshold levels, in particular water quality	Maintenance of ecosystem goods and services
Key skills in the planning process	Water planner led, with a focus on engineering skills	Co-operation between development, water and environment planners
Analysis techniques	"Technical optimisation" • Water resources infrastructure systems analysis • Economic cost-benefit analysis • Water quality assessment • Future water use projections	"Economic and environmental scenarios" • Integrated water resources systems analysis • Social / economic analysis of water • Strategic environmental assessment • Scenario planning

While Bhutan's basin plans should evolve to reflect local priorities and factors, it is recommended that at the very least Bhutan's planners consider the following elements in strategic basin planning:[xxiii]



Strategic basin planning entails numerous elements. At a high level, the following principles or guidelines are recommended for Bhutan to engage with as it prepares basin planning guidelines and rolls out basin plans:

1. Develop a comprehensive understanding of the entire system.
2. Plan and act, even without full knowledge.
3. Prioritise issues for current attention, and adopt a phased and iterative approach to the achievement of long-term goals.
4. Enable adaptation to changing circumstances.
5. Accept that basin planning is an inherently iterative and chaotic process.
6. Develop relevant and consistent thematic plans.
7. Address issues at the appropriate scale by nesting local plans under the basin plan.
8. Engage stakeholders with a view to strengthening institutional relationships.
9. Focus on implementation of the basin plan throughout.
10. Select the planning approach and methods to suit the basin needs.

It should be underscored that in strategic basin planning, the identification of strategic priorities and tradeoffs is central to the process. These priorities are determined by social preferences about the economy, society, and the environment, which planners have to engage with and reflect.

Some examples of strategic basin plans that can offer valuable lessons and insights are:

- The California Water Plan of 2009, developed by the State of California
- The Danube River Basin District Management Plan of 2009, developed by the International Commission for the Protection of the Danube River
- The Water Resources Plan for the Delaware River, 2004, developed by the Delaware River Basin Commission
- The Murray-Darling Basin Plan, 2010, developed by the Murray-Darling Basin Authority
- The Internationally Coordinated Management Plan for the International River Basin District of the

Rhine, 2009, developed by the International Commission for the Protection of the Rhine.

Basin Stewardship

As mentioned above, strategic basin planning calls for the involvement of a large number of stakeholders, representing different sectors, water users, and bringing different views about the management of water for economic and social purposes. In Bhutan, relevant stakeholders whose views and interests would need to be reconciled or aligned – and whose different resources and skill sets can be brought to bear towards more sustainable basin management – include infrastructure developers, local community groups, non-governmental research or advocacy organizations, agricultural exporters and (as they slowly emerge in the future) private companies (such as tourism companies, agro-based industries etc.).

Increasingly, the private sector is also getting engaged in water resource management at the river basin level. WWF is working with companies in 15 priority river basins around the world, developing strategies that involve businesses – working in close collaboration with governments and communities – to manage water risks and foster collective action to maintain the basins. For instance, in Kenya's Lake Naivasha region, companies are working closely with local communities and the local government to manage risks to their supply chain (for large flower export businesses) and working to protect the waters of the lake, which are crucial to the flower farms in the region.

While the government remains the primary steward of Bhutan's natural resources, its ability to more sustainably manage water resources and make decisions about tradeoffs would be greatly enhanced in partnership with other entities such as those mentioned above. This type of collective stewardship is very much in keeping with Bhutan's core values, and can ensure that even competing water needs and uses may be reconciled as harmoniously as possible. The role of the government would be not only to convene these different stakeholder groups and draw them into the decision-making process, but also to create the frameworks and guidelines that would provide direction to a range of stakeholders on what their role could be in relation to basin management. This includes setting baseline or threshold standards for what the different groups are expected to do to preserve and enhance water quality and availability. Several Basin Management Authorities across the world are designed and set up to allow for the participation of different stakeholders, and Bhutan can draw on lessons from successful basin management entities as it evolves its own institutional architecture.

Water Allocation Planning

Allocation planning is a crucial sub-set of strategic basin planning. Decisions of water allocation center around the questions of how much water is available for human use and how can this water be shared amongst competing users. Water allocation in Bhutan must take into account several challenges such as the growth in water abstractions by all sectors, structural changes in the economy, demographic shifts, changing water demand in different regions by different users, degradation of freshwater ecosystems (resulting in the drying up of streams), and climate change.

In the face of these pressures, allocation is the process of optimizing the use of existing supplies through significant economic, social, and environmental analysis and the assessment of trade-offs between competing users. While modern approaches towards allocation have largely veered towards a basin-scale, i.e. basin level allocation, Bhutan could consider other sub-units within the basin (such as Gewogs) once basin-level allocation has been achieved in a strategic manner.

Allocation must prioritize allocation for environmental flows, both during dry periods when water is

contested and during flooding when water would be held back by storage. Thus, assessing environmental flows accurately is an important component of an allocation process.

Strategic water allocation planning at the basin level typically involves the following processes in the stages described below:

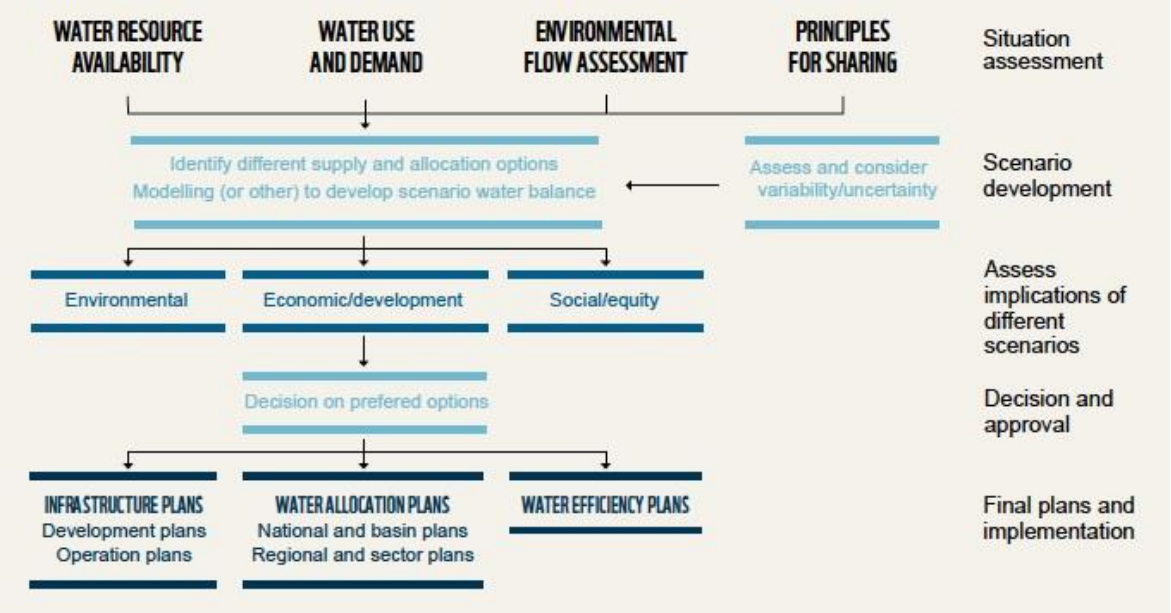


Figure 16: High Level Diagram of a Water Allocation Planning Process[xxiv]

Whither Now?

Specific actions have emerged as "Next Steps" recommended by stakeholders involved in the process. These include the following:

- **Modeling of scenarios:** Decision makers in Bhutan can use the three scenarios as a thought experiment to weigh the consequences of various decisions and policy measures. In order to further strengthen such decision making, modeling the economic and environmental characteristics and potential consequences in each scenario would be a helpful next step.

- **Designing and Implementing Cumulative Impact Assessments**: Bhutan has already taken an affirmative stance on Cumulative Impact Assessments (CIA) at the basin or sub-basin level. The next step is for CIAs to be carried out and implemented. To facilitate this, an Expert Group or advisory body of individuals from relevant sectors could be constituted to provide guidance on how to design and give effect to a CIA, including technical experts and members of Bhutan's civil society. This, in fact, could become the starting point for broader spatial planning efforts.

- **Basin Planning**: Several efforts are already underway to engage in Basin Planning. However, most revolve around traditional water management plans. Bhutan could adopt an approach to Basin Planning that explicitly looks at the nature of water as a catalyst for development and trade

and thus, tailor some of the parameters of Basin Planning accordingly (Refer to the discussion in the prior section about strategic basin planning).

- **Water Security Index Indicators**: The process of identifying and adopting Bhutan's Water Security Indicators for its Water Security Index is underway. It would be useful to explicitly and formally take the decision of incorporating many cross-sectoral indicators that would help better identify tradeoffs and cross-sectoral impacts on water security. The index currently has 12 environmental indicators, 12 economic indicators, 5 urban indicators, 3 rural indicators, and an impressive 25 indicators for resilience of water systems. This process could be enhanced by ensuring that the indicators cover a wide variety of economic sectors, enabling sectoral trade-offs to become more apparent within the Water Security Index framework.

- **Understanding Natural Capital**: Bhutan should incorporate natural capital in economic, social, and of course environmental decision making. Planning processes should therefore be well informed about natural capital. Any future efforts towards natural capital valuation or assessments could integrate the learnings from the Water Risk Narratives and Scenarios process by explicitly or formally tailoring the valuation methodology or protocols to take account of cross-sectoral impacts and tradeoffs. Once the valuation is available, the relevant sectors could work closely to ensure that these valuations are taken into account, especially in relation to water resources, during broader economic or sectoral planning.

- **Spatial Planning Technical Tools:** Stakeholders who engaged in the process noted that the Bhutan would need technical assistance – in terms of both technology and training – to implement integrated spatial planning. To identify, procure and integrate the appropriate spatial planning tools into economic decision-making, it is recommended to constitute a Working Group to investigate and recommend the tools needed for ecosystem based spatial planning.

Platform for Engagement

It is hoped that the Water Risk Narratives and Scenarios process does not come to a close with the publication of this report, but that this report becomes a key initial milestone in an ongoing, long-term process to strengthen the understanding and consideration of water resources in decision-making structures and institutions within Bhutan.

Thus, one of this report's foremost recommendations is that the process should find a platform of engagement that is supported by, but not wholly dependent on, the efforts of WWF. Given that water resources fall within the purview of the National Environment Commission, the NEC could drive the process and provide a forum for continued cross-sectoral, participatory, multi-stakeholder engagement on risks and opportunities related to Bhutan's water resources, and their central role in the evolution of the country's economy.

ANNEX A – List of Stakeholders Involved

National Environment Commission (NEC) and WWF leading, with support from PEGASYS consultancy
Department of Roads, Department of Human Settlement, Department of Engineering Services under the Ministry of Works and Human Settlement
Department of Hydropower and Power Systems, Department of Hydromet Services, Department of Geology and Mines and Department of Cottage and Small Industries under the Ministry of Economic Affairs.
Department of Forests and Park Services, Department of Agriculture, National Biodiversity Center and Policy and Planning Division under the Ministry of Agriculture and Forests
Department of Disaster Management, Ministry of Home and Cultural Affairs
Department of Public Health under the Ministry of Health.
Gross National Happiness Commission
National Land Commission
Druk Green Power Corporation Limited
Tourism Council of Bhutan
Royal Society for Protection of Nature
Bhutan Foundation
Bhutan Trust Fund for Environmental Conservation
The World Bank
United Nations Development Programme
Asian Development Bank and Integrated River Basin Management team leader

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Volume 2: Participatory Scenario Building Process Overview

Preface to this Report

This report, "Participatory Scenario Building Process Overview," is intended as a companion report to Volume 1, i.e. "Bhutan – Water Risk Scenarios and Opportunities for Resilient Development."

Both volumes of the report are products of an eighteen-month long process designed to engage experts, influencers, decision-makers, and key stakeholders in Bhutan on the nature and potential consequences of risks faced by Bhutan's water resources. WWF's Living Himalayas Initiative initiated the process, in partnership with Bhutan's National Environment Commission (NEC). Together, the two volumes capture key insights that emerged or were reaffirmed during the course of the eighteen months.

The broad context for the scenarios (i.e. the substantive foundation for the process) is captured in the present report (Volume 2), which highlights role of freshwater in Bhutan's economy, and identifies major threats to heavily water-dependent economic sectors. This volume also provides a detailed description of the process adopted and the theoretical underpinnings of transformative scenario development. Thus it takes the reader on a journey through scenario development, with a focus on transformative scenario development, and elaborates on the specific stages of the process adopted by the Water Risk Narratives and Scenarios process in Bhutan. Subsequently, it familiarizes the reader with water-dependent sectors in Bhutan's economy, and the threats to and risks faced by the major sectors. An understanding of the same is critical to the crafting of scenarios for Bhutan's heavily water-dependent economy.

The accompanying companion volume (Volume 1) of the report explores the actual scenarios themselves. Thus it describes multiple scenarios for how key water-reliant sectors in Bhutan could evolve over the next two decades (through approximately 2035). Each of the scenarios has implications for Bhutan's water resources, hence Volume 1 also examines the implications, underscores the risks, and enumerates opportunities for Bhutan to address or manage the risks.

While Volume 1 of the report encapsulates some of the critical discussions that took place under the aegis of the Bhutan water risk scenario development process, it is the process itself that is an important product of the effort, making Volume 2 an equally integral component of the report. The process of scenario development adopted provides a platform for in-depth and thoughtful conversations about current and anticipated water-related challenges in Bhutan, facilitates cross-sectoral engagement on issues of concern, and allows for potential solutions to emerge and receive endorsement in an organic, collaborative manner.

Beyond this report, it is anticipated that the dialogue sparked by the scenario development process will continue in one or more forums and will remain a channel for Bhutan's decision makers to consider and prepare for future eventualities that affect not only Bhutan's water resources, but the country's economy and development trajectory.

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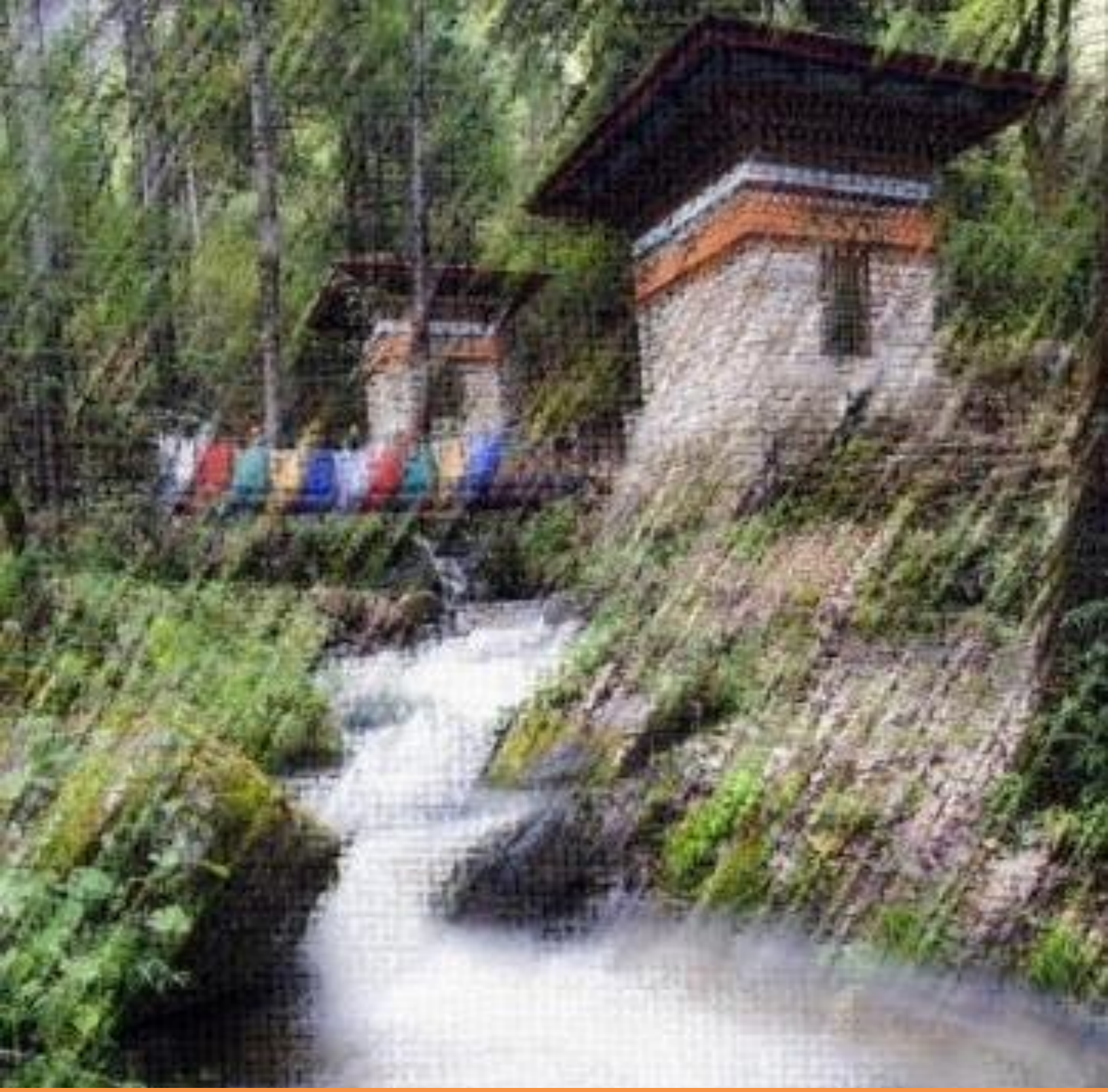
List of Abbreviations

BOIC	–	Bhutan Opportunity and Information Centre
CIA	–	Cumulative Impact Assessment
DGPC	–	Druk Green Power Corporation
GLOF	–	Glacial Lake Outburst Flood
GW	-	Gigawatts
HEP	-	Hydro Electric Project
ICT	-	Information and Communications Technology
IPCC	-	Intergovernmental Panel on Climate Change
MoEA	-	Ministry of Economic Affairs
MW	-	Megawatts
NEC	-	National Environmental Commission
PSMP	-	Power sector Master Plan
SEA	-	Strategic Environmental Assessment



Chapter One

Scenario Development: A Primer

Using Scenario Development and "Storytelling" as Engagement Tools

The WWF Living Himalayas Initiative was interested in adopting a fresh and novel approach towards fostering dialogue in the Eastern Himalayas around the water resources of the Brahmaputra river basin in Bhutan and the tributaries of the Ganges in the mountains of Nepal. Out of this desire emerged the Water Risk Narratives and Scenarios (WRNS) process.

The process aimed to catalyze and strengthen collective conversations about the threats facing the river basins in the Himalayas, the resultant risks to communities in the mountains that rely on the rivers, the implications of such risks for water-dependent sectors of local and regional economies, as well as about what can be done to reduce and better address the threats. The ultimate goal of the effort was to facilitate the emergence of shared ideas about how to manage the water resources of the Brahmaputra and Ganges river basins in the mountains.

Such ideas, forged through a participatory process, can help ensure that the health of these river systems is preserved and that the rivers can continue serving as the foundation of economic activity in the Himalayas.

There is already a wealth of information and continually emerging data and analysis from the Eastern Himalayan region about the hydrology of the Brahmaputra and Ganges rivers as well as the impacts of external forces (such as population-driven rise in water demand, denudation of catchments due to deforestation, alternation of watersheds by linear infrastructure growth etc.). Satellite imagery is available to show changing land use and evolving spatial patterns in the river basins. Even the potential impacts of climate change on the rivers' hydrology are already being projected and modeled, using different climate futures. There is no dearth of reports about how human activity is altering the river basins in question, or about the potential impacts of planned development on river flows. Based on such technical inputs, our understanding of Himalayan river systems grows stronger every day.

However, despite the proliferation of such revealing data and the regular production of such critical analyses – many of which emphasize the need for enhanced, basin-wide management approaches that take a long-term view – holistic, ecosystem-based, forward-looking river basin management has not gained significant traction in the Himalayas. Different parts of different basins are managed with different levels of sophistication, strategic planning, and foresight.

Moreover, water resource management has largely remained the domain of engineers, hydrologists, and water specialists, and has not been adequately mainstreamed into larger economic decision-making and development planning processes, whether as a catalyst or constraint. Even though it is apparent to many policy makers that water resources affect major productive sectors in the economy and that major productive sectors in turn affect water resources, it has been hard to ensure that water resources be considered a central element within economic planning.

In light of this, an innovative approach was felt necessary to bring about different results. To this end, WWF initiated the Water Risk Narratives and Scenarios (WRNS) process in collaboration with National Environmental Commission, and engaged key actors in Bhutan on threats, risks, and management strategies in the Brahmaputra basins by involving them in a scenario-development process about the future of the basins.

Such a process of developing scenarios to depict plausible outcomes in Bhutan's Brahmaputra basin is, in essence, a process of telling stories about a shared future and considering what each story may mean for Bhutan.

Why Use "Stories?"

The use of stories as a vehicle of communication is a universal phenomenon, evidenced throughout history in every civilization across the world.[i] Stories have been used to impart guidance, instil morals, prescribe normative behaviour, and even pass on oral histories. In Bhutan, for instance, there is a wealth of folklore and tales stemming from oral traditions (*kha rgyud*), and popular stories (*dang phu ding phu* folktales or *srung*) with morals including *Meme Haylay Haylay,' and 'The Four Friends.'*

A well-established body of communication science affirms that stories are a powerful tool to bring about change in people's perceptions and even their actions.

Stories have been shown to help rapidly form relationships that allow humans to engage in the kind of large-scale cooperation that is seldom seen in other species. The power of a story is particularly strong in motivating behavioral change when the narrative arc begins with something that evokes concern or tension, then sustains attention, and eventually provides a solution or positive result.[ii]

As the Harvard Business Review notes in relation to the power of storytelling in a business setting, transcendent stories about how things can be improved or bettered are far more powerful than transactional stories that simply contain information to be transferred from one party to another.[iii]

In keeping with this, the Water Risk Narratives and Scenarios (WRNS) process was consciously designed as an opportunity for stakeholders in Bhutan and Nepal to engage in collaborative storytelling. The scenario development process began with stakeholders identifying key threats and risks, and subsequently developing storylines about plausible futures that have distinct outcomes – with elements of "negative" and "positive" outcomes. These scenarios are presented in Chapter Three of this report.

The Use of "Stories" – or Scenarios – in Policymaking

There is growing recognition within policy and advocacy circles (as well as the business community[iv]) that narratives "can more effectively reach a target audience by enhancing their enjoyment, retention, and understanding of complex, information-dense issues" and can "change how politicians think."[v] Even for politicians and public servants themselves, storytelling has started being recognized as an important component of policymaking.[vi] Commenting on why action on climate change has been inadequate thus far, the World Bank has also noted, "Alarming statistics and detailed reports on climate change don't inspire people to act."[vii] In fact, the World Bank's head of climate change, Rachel Kyte, observed, "The tendency with a lot of social movements is to talk to ourselves, so we develop language that we're comfortable with, that speaks to other environmentalists or other engineers but which means absolutely nothing to the lay public. We're very reluctant or reticent to come up with language and idioms that will perhaps not express every little nuance in that one sentence, but which will actually resonate… There's lots of behavioral psychology that some of these words… don't mean anything and they don't speak to the emotional brain."[viii]

The other relevant trend in public policy advocacy is the change in how those seeking policy or regulatory shifts engage with key stakeholders. Just as there has been a move away from the notion of asymmetrical information as the underlying problem, there has also been a move away from asymmetrical participation, i.e. the model of informing or educating stakeholders in a one-directional, top-down manner with findings or reports. As the chief of the American Academy for the Advancement of Science (AAAS) noted, "Simply trying to educate the public about specific science-based issues is not working…We need to move beyond what too often has been seen as a paternalistic stance. We need to engage the public in a more open and honest bidirectional dialogue about science and technology."[ix] The preferred type of dialogue in public policy now is one that allows for mutual satisfaction of both entities, the research enterprise and its public. "Key dimensions of this dialogue are negotiation, compromise, and mutual accommodation. It places a premium on long-term relationship building… public engagement is not about getting the policy you want, it is about getting the public input you need to craft sustainable policies that enjoy public confidence."[x]

The Water Risk Narratives and Scenarios process is based on this more progressive approach. By engaging stakeholders in scenario-development, the project allows for a spectrum of key actors to engage in negotiation, compromise, mutual accommodation, and allows for the creation of public policy through public input.

Scenario development is, in fact, an oft-used approach within policy circles that is akin to storytelling. Scenario development and scenario planning processes have seen significant uptake by leading institutions and organizations. The OECD, for instance, advocates for the use of scenarios by underscoring, "The goal in using scenarios is to reveal the dynamics of change and use these insights to reach sustainable solutions to the challenges at hand. Scenarios help stakeholders break through communication barriers and see how current and alternative development paths might affect the future. The ability to illuminate issues and break impasses makes them extremely effective in opening new horizons, strengthening leadership, and enabling strategic decisions."[xi]

The Harvard Business Review notes that scenario planning has helped leaders prepare for futures that might happen, over and above the futures that they would like to create: "Scenarios provide the right framework for appreciating fundamental long-term choice, which is not the same as next year's annual plan."[xii] A survey by Bain and Company revealed that there has been a sustained increase over the last decade in the use of scenario planning as a management tool, as it helps companies plan for uncertain futures.[xiii]

Scenario Development Explained

Principal Tenets of Scenario Development

Peter Schwartz, a pioneer and leading expert in the field of scenario development, defined scenarios as "Stories that can help us recognize and adapt to changing aspects of our present environment. They form a method for articulating the different pathways that might exist for tomorrow, and finding appropriate movements down each of those possible paths."[xiv] Scenarios are descriptions of what could happen, not what will or should happen.

Some key features of scenarios are as follows:[xv]

- Scenarios are neither forecasts nor projections. They represent plausible futures.
- They are relevant, but at the same time challenging
- They are clear and distinct
- They are memorable, while also being disposable
- They can be supported with quantitative and qualitative evidence

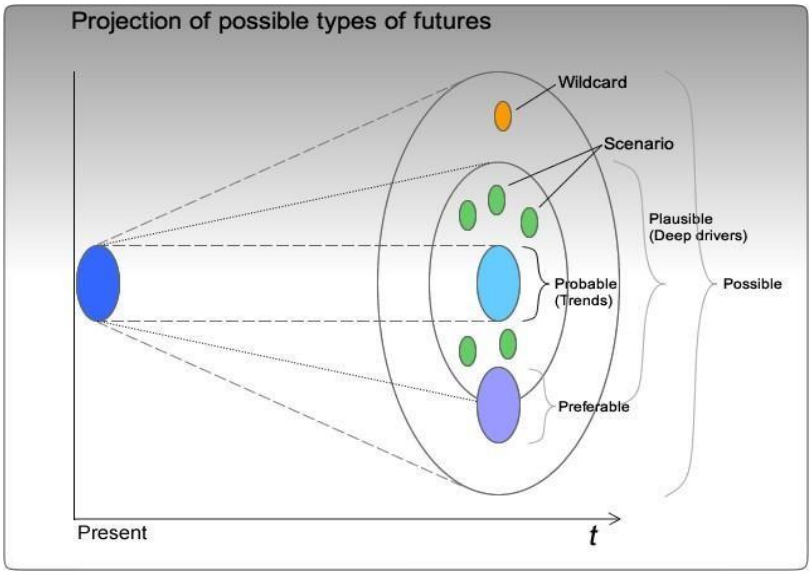


Figure 1 – Scenarios are often located at the outer edge of the "Cone of Plausibility"

Transformative Scenario Development

The Water Risk Narratives and Scenarios process used the Transformative Scenario Development approach, first introduced and developed by Adam Kahane (Chairman of Reos Partners). The key distinction between simple scenario planning and transformative scenario planning is that in the latter, once different stories or scenarios have been identified, participants engage on the question of how to intervene and shape outcomes. Under the traditional approach, once different stories and outcomes emerge, the discussion centers on how to respond to or adapt to each eventuality. With a transformative scenario development process, if one or more of the potential outcomes is deemed undesirable or avoidable, and if no single entity or institution can remedy the situation on their own, then those developing the scenarios have the opportunity to also identify ways to collectively influence different aspects of the system (for instance, the different drivers of the scenarios) so as to avert the most negative consequences.[xvi]

This approach is particularly apt in circumstances where influencing a desired outcome or avoiding an unacceptable outcome is challenging due to a multiplicity of relevant actors and stakeholders. It has been noted that a transformative scenarios process is a "creative and constructive way for diverse stakeholders – even those who don't trust or like one another – to come together to build stories of possible futures together, and in so doing, to unlock stuck and polarized situations."[xvii]

Another reason that transformative scenario development is referred to as "transformative" is because the process itself has the power to change the dynamic between those engaging the system: it transforms

people's understandings, their relationships with one another, their intentions for engaging with the issues at hand, and also allows for change in their actions.

Steps Adopted for Scenario Development

Scenario development is a collaborative process. Inherent to the success of scenario development is the idea that constructing plausible futures requires a diversity of opinion, and a forum where all voices are equal and have the same ability to shape the various storylines. The process is a lengthy one, and is typically not rushed.

Scenario development benefits from evolving through a sequence of stages:

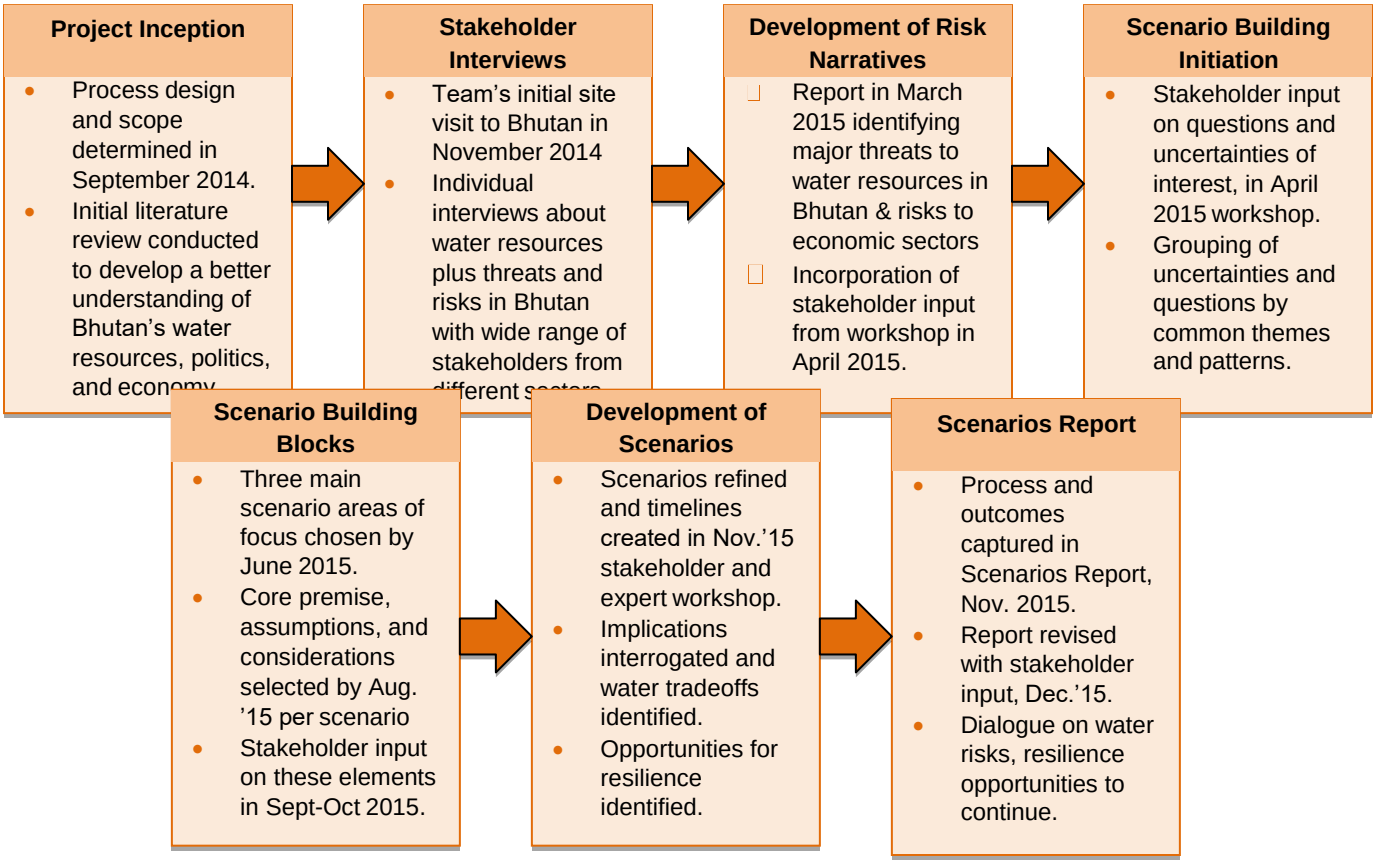
- Convening a team from the whole system, as a means of co-initiating the process together
- Observing what is currently happening
- Constructing stories about what could potentially happen, i.e. scenarios
- Discovering together what can and must be done to influence outcomes
- Acting to transform the system

Through the application of this heavily participatory process, scenarios for water resource-based economic futures have been constructed. These are in the nature of alternative stories about the impact of different development trajectories on Bhutan's water resources, as well as about the role of water resources in supporting or constraining the emergence of different development trajectories. These are not predictions, nor roadmaps, but rather informed speculation about the meandering paths that may take Bhutan to different plausible futures. The strength of scenarios is that they provoke thought about what is possible and help identify options and pitfalls that we may want to choose or avoid. As such they provide a platform for introspection and debate about obstacles that must be overcome and aspirations that may be achieved in creating a vibrant and sustainable future for Bhutan. As such the scenarios describe pathways to 2035, since the twenty year time horizon represents a point when Bhutan would still be a reflection of decisions made and actions taken in the coming decade, but also far off enough that it allows space for truly transformational approaches to take effect and make the Bhutan of 2035 significantly different than the Bhutan of 2015 (just as the Bhutan of 2015 is remarkably distinct from Bhutan in 1995).

A deliberate attempt has been made to avoid more desirable (best-case) or less desirable (worst-case) scenarios. Similarly, possible but highly unlikely outliers ("black swan events") have been omitted to ensure that each scenario demonstrates a specific plausible pathway with its own internal logic and assumptions, as well as distinct decision points that would fundamentally impact on the long-term future. While each scenario attempts to highlight the key pivot points and the implications of decisions, there is no doubt that the actual future could be far worse than the most pessimistic elements of any one of these scenarios, or much better than the most optimistic elements. As such they provide a means of thinking about long-term planning and the translation of policy into action to embrace the vast potential of Bhutan's water resources and avoid catastrophe.

Water Risk Scenario Development in Bhutan – The Process

From August 2014 through December 2015, the Water Risk Narratives and Scenarios process undertook a sequence of activities in Bhutan, described below.



The process initially focused on investigating and synthesizing evidence pertaining to various threats facing the Brahmaputra river basin in Bhutan. Analysis for Bhutan focused on the threats posed by climate change, land use changes such as linear infrastructure development, watershed management, and large-scale hydropower development. Certain economic sectors – namely, agriculture, agro-based industries, tourism, and hydropower -- were identified as highly water-dependent, and thus more vulnerable to the risks arising from threats to the Brahmaputra Basin.

The examination of where the threats lie or will emerge from, and the sectors that will likely bear the consequences of negative impacts to the Brahmaputra Basin, were woven together in the form of risk narratives, i.e. qualitative descriptions what is already happening in the Basin and what could potentially happen. This research was captured in the Bhutan Risk Narratives report (unpublished) shared with all stakeholders in Bhutan, and the said report was revised based on feedback and input from several stakeholders. A summary of findings from this phase is presented in Chapter Two of this report (the entire Bhutan Risk Narratives report, which was intended to be an engagement tool rather than a standalone publication, can be obtained from the WWF Bhutan and National Environment Commission (Water Resources Coordination Division) upon request).

The process then moved into the scenario development phase, which enabled more frequent and deeper engagement with key stakeholders. Their input was critical to ensure that the factors that informed and shaped scenario development were the ones of greatest relevance and interest to actors in Bhutan.

In order to hone in on the thematic focus areas and driving forces of the scenarios, stakeholder input was sought in an April 2015 workshop by posing two queries:

- What questions would you like the scenarios to address regarding the future of Bhutan's development and its use of water resources in a 20 year timeframe?
- What are the key forces or drivers that you think will affect the resilience of Bhutan and its natural or water resources over the next 20 years?

Responses to the questions (see Annex A) helped identify emerging factors of interest that then became central elements in scenario development.

In response, stakeholders identified several questions they wanted to see answered by the scenarios. These represented the result / outcome of the scenarios to come.

- What will Bhutan's economic growth look like based on altered water availability for certain users or sectors?
- What will happen to water use and availability for each of the main users and sectors?
- What will happen to Bhutan's natural resource base and environment, and its sustainability "brand"?

Similarly, stakeholders also identified several key uncertainties that could alter Bhutan's trajectory in terms of the country's use of and approach to water resources. These uncertainties represented the pivot points or moments of potential shifts within the scenarios to be crafted.
In other words, the scenario pathways will depend on how we decide key uncertainties play out:

- Bhutan government's prioritization, i.e. policy shifts on prioritizing hydropower versus tourism versus agriculture
- Geopolitical shifts in regional relations with neighbors
- Impacts of demographic shifts and changing demand on watersheds
- Impacts of infrastructure development on watersheds
- Impacts of climate change and climate related disasters
- Impacts of non-climate disasters

Together, these key questions and uncertainties were subsequently used to shape three distinct scenario frameworks. Specifically, the main questions were examined through the lens of various uncertainties and crosscutting factors. Based on how the different uncertainties played out or manifested, the view through the lens resulted in distinct scenarios.

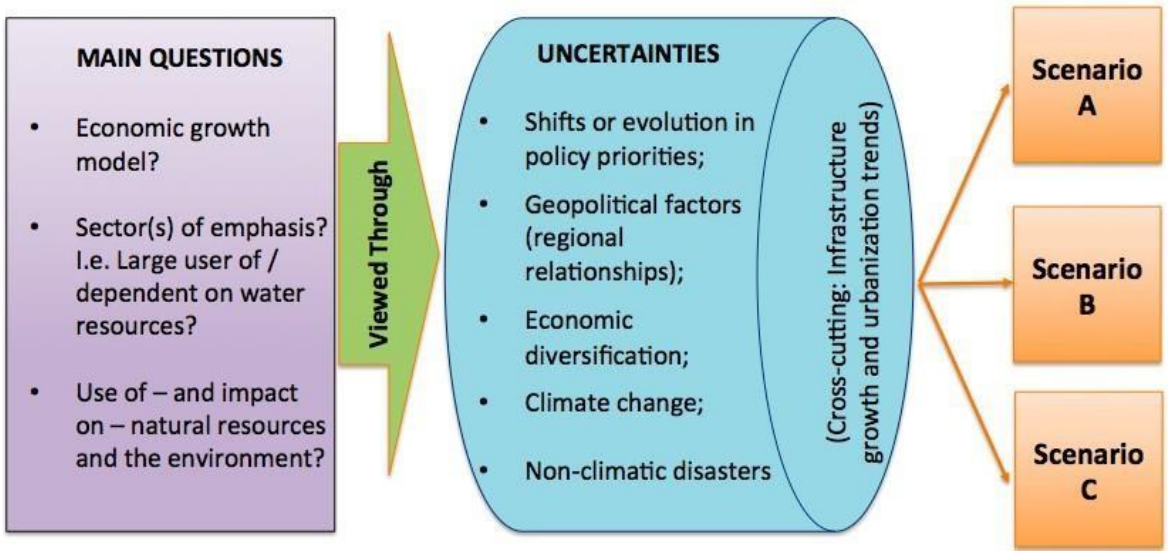


Figure 2 - Constructing Scenario Frameworks from Questions and Uncertainties of Interest

Each scenario framework comprised of some key elements that would define and influence the scenario storylines. These constituent-elements were:

- **The Core Premise**: The fundamental aspects of the scenario, which (once agreed upon by stakeholders) remain static and do not change. These became the "givens" for the scenario, and thus were not contested during the subsequent scenario development process.
- **Assumptions**: Around the core premise a concentric layer of assumptions was added. The assumptions related to, firmed up, and added texture to the core premise. These become the "Rules of the Game," i.e. fixed circumstances that are in the nature of boundary constraints.
- **Considerations**: Questions about aspects of the scenario that do not relate to the core. These pertained to the non-core sectors per scenario that were not the primary focus of the scenario but could still influence outcomes.

All of these elements were discussed and debated by stakeholders in September and October 2015, and revised based on their feedback. It was agreed that once stakeholders were comfortable with these key scenario building blocks, the elements chosen (see Annex B) would stay constant during scenario development.

Finally, a scenario development workshop was convened in November 2015, where stakeholders fleshed out each of the three scenarios with more detail, build out timelines for the evolution of each scenario in three major phases between the present and 2035, and discussed the implications of each scenario for Bhutan's water resources and the country's economic health (which is largely predicated on water resources). Through the discussion, some key insights emerged about approaches to avoid potentially negative ecological and economic consequences. These will be elaborated on in Chapters Four and Five of this report. Prior to that, the report summarizes the risk narratives, and presents the three scenarios.

Chapter Two
Water Risk Narratives for Bhutan

A Moment in Time

The Water Risk Narratives and Scenarios process was initiated at a particularly important juncture in Bhutan. The current period is unlike any in the past, because of a combination of several key factors. One is the transformation underway in the country's governance systems. The country transitioned successfully to a parliamentary democracy in 2008, and is nearing the end of its first decade as a young democracy. Many of our institutions are relatively new and untested, while much of the human capacity within these institutions is also at the early stages of gaining professional growth and experience. However, after nearly eight years of democratic government, Bhutan is finding its feet and starting to build momentum towards strong, stable, and effective democratic governance. It has put in place many of the right pieces of policy and regulation, and is well positioned to deliver on the promise of a representative government that serves the needs of its people.

As it does so, it becomes critical to ensure that the energy and resources of the government are directed towards priorities that are consistent with the country's long-term interests. One of the potential pitfalls of the transition is that the timeframes that leaders consider when weighing decisions tend to shift. While a monarch may take into account the impact of his decisions over his lifetime or the lifetime of his heirs, as well as future legacy, the nature of an electoral cycle sometimes results in political leaders prioritizing short-term gains over long-term gains, with a view to garnering support for the next election. On the other hand, a democratic transition means the institution of processes that allow for public participation and the development of complex capacity required to assess, integrate, and respond to public sentiment, which in itself is often motivated by shorter term interests.

Another reason this is a unique moment in time for Bhutan is that the country is poised at a metaphorical crossroads in its development choices. Bhutan is blessed with an abundance of freshwater, and this natural capital has already become the foundation of its burgeoning economy. Depending on the direction that the country takes over the next five to ten years, it can go the way of countries that build their entire economies on the back of a natural resource and leverage their resources for all they are worth in the short term. Or it can protect and preserve its natural capital, safeguarding it for careful and strategic use in the decades to come, without compromising the ability of future generations to reap the benefits as well. Indications suggest that Bhutan intends to do the latter, but doing so isn't easy; it requires proactive planning and complex juggling of trade-offs and can be done poorly if the right processes and safeguards are not put into place early enough, coupled with the requisite capacity to implement and deliver.

Figure 3 - Bhutan Faces a Range of Choices About Future Development

Bhutan has certainly prioritized sustainability, as is clear from the exemplary decision of the Royal Government of Bhutan to create a constitutional mandate ensuring that a minimum of 60 percent of land cover be maintained as forest for all time. Similarly, 52 percent of the country's land is classified as

protected area – a model for other countries to emulate. The challenge for Bhutan is to ensure that it maintains its leadership position in this space, and to continue to prioritize these targets even in the face of growing development pressures.

Bhutan has gained global attention for its policies on Gross National Happiness and its recent development gains, including bringing vast numbers of its people out of poverty. This track record has in turn attracted a good amount of development aid and grants, and other overseas financial assistance. A number of programs have been initiated or will soon be underway to help Bhutan better manage its natural resources. The preponderance of such efforts in the present also makes this a unique time. If designed and executed right, these programs could set Bhutan on a sustainable and secure path. But if many such programs end up flawed or underutilized, they will unfortunately leave Bhutan poorly equipped and having chosen pathways that may be harder to correct later than it is today to set the optimal path.

It is in this temporal context that the Water Risk Narratives and Scenarios process set about studying Bhutan's major economic sectors, investigating the role of water as natural capital within the sectors, and identifying key threats to water resources. Due to the intimate linkages of water to the sectors in question, these threats in turn, pose risks to the water-reliant sectors that drive the country's growth.

Water-Dependent Sectors of Bhutan's Economy

Agriculture

Bhutan's terrain is highly rocky and mountainous, and thus less than 4% of the total land area is classified as arable land by the FAO.[xviii] According to official government statistics, only 2.93% of total land is agricultural land.[xix]

Despite this, agriculture plays a central role in Bhutanese society and in its economy. The agriculture sector in Bhutan employed 56.3 percent of the country's population, as of 2013,[xx] and contributed 16.8 percent to Bhutan's GDP.[xxi]

The agriculture sector is a heavy user of Bhutan's freshwater resources, relative to other sectors. According to FAO estimates, 94.08% of the water used is in the agricultural sector, while domestic consumption accounts for 5.03% and industrial use 0.89% as of 2011.[xxii]

Figure 4 - Terraced Farming is Common in Bhutan

Agriculture in the country is predominantly rain-fed. Bhutan's Gross National Happiness Commission (GNHC) has identified the lack of irrigation facilities as one of the principal reasons for low productivity in the agricultural sector, combined with fragmented land holding and the lack of mechanization. [xxiii] In 2011, Bhutan's National Irrigation Policy was revised, to widen the irrigation sub-sector's emphasis from solely paddy cultivation (rice) to a broader range of cash crops. The policy noted that nearly 10% of the country's irrigation facilities were not functional, and that on-farm water management technologies and approaches had not been adequately invested in.

Bhutan's Eleventh Five-Year Plan (2013-2018) similarly acknowledges the challenges facing the agriculture sector, and notes that due to an acute shortage of farm labor driven by outbound rural-urban migration, loss of arable land to urbanization, difficult terrain, fragmented land holdings, lack of access to markets and agricultural credit, climate change and natural disasters, post-harvest management issues and the largely subsistence nature of farming, Bhutan is still heavily dependent on the import of food grains.[xxiv]

There is a palpable concern in the five-year plan about food security. It notes that Bhutan is currently "modestly food secure," with 60 percent of cereals and vegetable products being produced domestically. Ninety-five percent of fruit products and nuts consumed are also grown domestically. Nevertheless, to reduce vulnerability to regional and global food price fluctuations, the plan states that one of the key goals for the agriculture sector is to reduce reliance on imports and to increase exports.[xxv] The plan sets several growth targets for the plan-period, to meet the stated objective of "enhancing cereal self-sufficiency," and also mentions goals for vegetable and livestock self-sufficiency.[xxvi] The Food and Nutrition Security Policy of Bhutan, 2012, also echoes these objectives.[xxvii]

In particular, Bhutan aims to be entirely self-sufficient in terms of rice, a staple crop that is essential to the diets of most Bhutanese. Bhutan has experienced significant post-harvest losses of rice paddies in recent years (e.g. from cyclone rains as well as damage by animals), and this resulted in the country having to spend considerable amounts to import rice. Bhutan's trade deficit widened by 24% since 2012, primarily due to rice imports.[xxviii] This has catalyzed a desire to be self-reliant and meet the country's entire rice needs from domestic cultivation.

Another key priority for agriculture in Bhutan is for the country to become the world's first 100 percent organic country, producing food wholly without any reliance on chemical fertilizers or pesticides. This pledge was reflected in the Prime Minister's address at the Rio+20 Summit in 2012, and builds on Bhutan's National Organic Framework, draft National Organic Standard, and a Strategic Action Plan for Organic Development. No specific timeframe has been announced for the achievement of this target, but experts believe it is possible within the decade if the commitment is maintained, given that nearly 70 percent of cultivation in Bhutan is organic already.[xxix]

Hydropower

Nearly all of Bhutan's electricity today (99%) is from hydroelectric power (the remaining 1% is from diesel generators). [xxx] Bhutan estimates that the total hydropower potential in the country is 30,000 MW – more than ten times what exists as installed capacity today.[xxxi] Druk Green Power estimates Bhutan's technically and economically feasible hydropower potential at a slightly lower level, i.e. 23,760 MW.[xxxii]

Figure 5 - Tala Hydroelectric Project, Bhutan

At the start of the eleventh five-year plan in 2014, Bhutan had 1,488 megawatts (MW) of installed hydropower capacity, and expects to have 4,546 MW by the end of 2018, exceeding the interim goal of its "Vision 2020" which targets 3,000 MW for 2017. The overall goal for 2020 is to develop 10,000 MW of hydropower.

The energy sector in Bhutan – comprised almost entirely of hydropower – accounts for 18% of total revenue and 20% of total GDP.[xxxiii] In 2012, the country generated 6,823.7 MU of power and exported 4,924 MU of the total generation.[xxxiv] In the same year, 27% of annual revenues in Bhutan accrued from the sale of hydropower.[xxxv] In 2013, 62% of the power generated was exported.

According to the World Bank, Bhutan's recent GDP growth rate (8% annually in 2011/2012) was driven mainly by the growing hydropower sector.[xxxvi] Both the Bank and the GNHC estimates that Bhutan's annual growth rate during the eleventh plan will likely be close to 12% per annum, on the back of strong hydropower development.[xxxvii]

While rapid growth in the hydropower sector has served to boost the economy, it was one of several contributors to Bhutan's current account deficit and the Rupee shortage crisis, which had a dampening effect on several segments of the economy. Studies indicate that the Rupee shortfall can, in part, be linked to hydropower related inflows (i.e. imports used by the hydropower sector) and an overall rise in purchasing power from the hydro-driven wealth effect. The growth of imports by 132% between 2008/2009 and 2012/2013, eclipsing the growth of exports by 30.5% during the same period, sparked a credit multiplier effect, and led to the current account deficit widening from 1.2% of GDP in 2008/2009 to 27.6% in 2010/2011.[xxxviii]

Bhutan is borrowing heavily to finance its hydropower boom. The eleventh five-year plan notes that during the plan period (2013-2018), public debt is expected to increase by 135% from 110 billion Nu (~US$ 1.7 billion) in 2013 to 259 billion (~US$ 4.1 billion) in 2018. The vast majority of this (80%) is denominated in Indian rupees because it comprises borrowings for hydropower projects. This component is expected to increase by 184% during the plan period, from 73 billion Nu in 2013 (~US$ 1.1 billion) to 206 billion Nu (~US$ 3.2 billion) in 2018.

While public debt in Bhutan is increasing rapidly, and is anticipated to be 121% of GDP at present, Bhutan's debt stock is nevertheless classified as "sustainable" since 80 percent of this debt is for self-liquidating hydropower projects.

Tourism

Despite high potential for growth, the tourism sector presently contributes to less than five percent of Bhutan's GDP. [xxxix] Currently, the tourism sector's importance is mainly in terms of bringing in foreign exchange. In 2013, it constituted 20% of non-hydropower export revenues.[xl]

The tourism sector is expanding at a steady pace. Tourist visits to Bhutan in 2013 rose by over ten percent over the previous year.[xli] In Bhutan, the gross earnings from international leisure tourism in 2012 totaled US$ 62.8 million, up 31.7% from 2011.[xlii]

Figure 6 - Trekking Above Paro Valley

Over 83% of visitors in 2013 identified their type of visit to Bhutan as "holiday," (as opposed to business visits, conferences etc.).[xliii] According to data collected by the Tourism Council of Bhutan, the vast majority of tourists identified "unique culture" and "pristine nature" as their main reasons for visiting the country.[xliv]

A core part of what visitors associate with Bhutan's culture is its prioritization of well-being and societal happiness over material wealth, manifested by Bhutan's embrace of Gross National Happiness (GNH) as opposed to merely GDP. Thus, protection of unique and vulnerable ecosystems is consistent with these cultural connotations.

The other major reason cited by visitors to Bhutan as their motivation is "Pristine nature." Bhutan is rightly viewed as a country that has valued its natural resources and preserved its natural beauty even as it has climbed the development ladder.

Industry

This is a significantly underdeveloped sector in Bhutan. Eighty five percent of Bhutan's industries are small-scale and micro industries, constrained by access to capital, technology, markets, and skilled labor. This makes many of these industries unable to compete, due to high costs and poor quality products.[xlv] Those that are competitive are so in large part due to cheap electricity.

Forests are a source of raw material for some cottage industries. Such activities include resin tapping, beeswax and sticklac collection, and lemon grass distillation. Mushroom cultivation in forested areas has emerged as a common activity.[xlvi]

Bhutan's residents also have an important relationship with the country's forests in terms of their reliance on traditional medicine. The forests, which are sustained by the water resources of the basin, are home to over 300 medicinal plants and herbs.[xlvii] One type of forest product in particular – the cordycep Yarsta Goenbub – has become extremely popular in the Chinese market as a dietary supplement, and this has led to many in Bhutan making a living by foraging for these cordyceps and trading in them. [xlviii] From 2007 through 2011 Bhutan exported over 10,000 kilograms of Yarsta Goenbup and earned over US $4 million Dollars for this trade.[xlix]

Figure 7 - Forests are a Source of Raw Material for Industry

As of 2012, there were more forest based and agro based industries in Bhutan than there were mineral based industries. Recently however, the mining sector has emerged as the largest source of exports after electricity sales. During the period 2005-2011, revenues from mining sector ranged from155 million Nu to 233 million Nu annually.[l] Bhutan has significant deposits of a number of mineral resources, including limestone, coal, graphite, gypsum, slate and dolomite. Most mining activities are limited to relatively small operations, mainly involved in the mining of dolomite, gypsum, limestone, slate, coal, marbles, quartzite and talc. The sector is considered underdeveloped, and Bhutan has thus far not prioritized extractive industries due to social and environmental concerns. Total mineral production has ranged from just 5000 metric tons annually to a million metric tons. However, with mineral exports becoming a key source of foreign revenue, this may change and volumes of mineral extraction and sales are likely to increase.

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Thus, all of Bhutan's major economic sectors are those that rely heavily on the country's rich natural resource base. This natural resource base is, of course, maintained on the basis of the health of Bhutan's ecosystems – in particular the Brahmaputra river basin and its water resources. Hence, any threat to Bhutan's water resources in the Brahmaputra basin is also a threat to the country's economy.

Major Threats to Bhutan's Freshwater Resources

Climate Change

Climate change poses a distinct risk to the river systems in Bhutan, compounding the climate variability the country already deals with. Over the course of the next half-century, warmer temperatures will lead to less snow and more rainfall (including from a strengthened monsoon). This could lead to greater flooding during the rainy or wet season – particularly if catchments are not well managed – but also result in reduced stream-flow in the dry season, with less snow and ice to feed the rivers.

Observed Impacts

Observed climate change trends in Bhutan include temperature rise and an increase in glacial melt. The Tibetan plateau area has already been observed to be experiencing a higher rate of temperature rise than the global average.

An even starker example of how the country is already dealing with climate change impacts is the slow melting of glaciers (measured through areal change, rather than mass balance change – for which there is relatively poor data at present). Studies have shown, in fact, that glaciers in the Eastern Himalayas are melting at a faster rate than in the Western Himalayas.[li]

Projected Impacts

Modeling studies undertaken for the region indicate that in the first half of the century, regardless of which scenario is used, both temperatures and rainfall in Bhutan will increase.

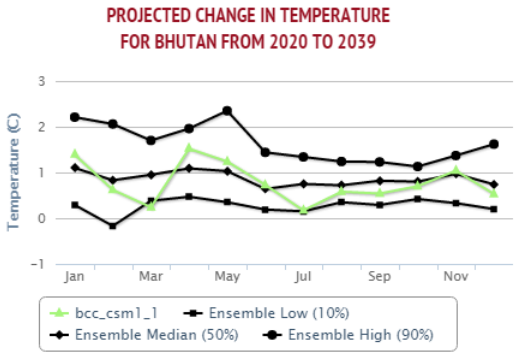

Figure 8 - Projected Temperature Change in Bhutan Based on Various Climate Models

In comparison to the projected global average for temperature rise over the 21st century (1.8-4 degrees C), Bhutan, Nepal, and Himalayan parts of India are likely to experience greater warming. This region is expected to experience warming of 2-4 degrees C in the medium term (2046 – 2065) and 4-6 degrees C in the long-term (2081-2100). The warmest daily maximum temperatures (daily high averages) are projected to increase by 4-7 degrees C, with the highest increases in Asia expected in Bhutan, Nepal, and northern India.[lii]

Studies indicate that climatic changes in the Indian sub-continent will lead to a strengthening of the South West monsoon, which will bring more water to Bhutan during the rainy season at least in the first half of the century. This is significant because the Brahmaputra is heavily dependent on monsoon water for its volume and flows.

Implications for Bhutan's River Systems

Anticipated climate change is likely to have a range of impacts on the Brahmaputra basin in Bhutan:

- ***Increased likelihood of flooding in the wet season:*** Regional climate model studies indicate that there will likely be a significant increase in both peak discharge and flood duration during future pre-monsoon and monsoon seasons. Models suggest that there will be more catastrophic floods in the basin. In the mountains, especially with increased runoff (resulting from deforestation or land use change), greater water volumes could result in more flash floods.

- ***Lower flows in the dry season:*** Climate change is expected to increase the seasonality of river flows; peak flows during the monsoon season may increase by 4.5 – 39.1%, depending on the scenario, while dry season flows may fall by 4.1 – 26.9%. The Brahmaputra River already displays a trend of too much water in the wet season (when monsoon rains and meltwater flows coincide), and too little water in the dry season (compounded by a lack of water storage). Climate change is expected to exacerbate this situation.

- ***Initial increase in glacial melt:*** It is likely that rising temperatures will first create an increase in meltwater from glaciers (early-mid 21st century) and then eventually (late 21st century, 22nd century) glaciers will shrink, reducing glacial discharge. It should be noted however, that for the Brahmaputra – which is heavily reliant on monsoon rains – the impact of such changes is likely to be minimal. In fact, the Brahmaputra will likely see an increase in flows, but with greater variability.[liii]

- ***Growing threat of Glacial Lake Outburst Floods (GLOFS):*** GLOFS in Bhutan are expected to increase with climate change. Meltwater from deglaciation creates lakes, and there has been a marked increase in the formation and size of such lakes, with more expected this century as glaciers continue to retreat. The lakes are typically held back by ice walls, themselves supported by unstable, loose moraine. When the temperature differential between the meltwater and the ice wall causes the ice to soften, these lakes have a tendency to burst suddenly, resulting in a GLOF. Climate change is expected to lead to a rise in such lakes and therefore also such GLOFs.[liv] This is particularly a risk in both Bhutan and Nepal.[lv]

Inadequate Watershed Management

Figure 9 - Mountain Stream in Punakha

Despite having some of the highest per-capita freshwater availability in the world, Bhutan's population has started experiencing water shortages. During the course of the Water Risk Narratives and Scenario process in Bhutan, nearly all stakeholders involved with the effort indicated that streams have been drying up across the country and this has forced relocation of many families away from areas of water insecurity.

In an area of abundant rainfall and ample sources of freshwater, such shortages point both to imbalances between demand and water supply and distribution, as well as to problems in watershed management. Without adequate management, Bhutan will struggle to meet the projected growth in demand for water (gross consumptive demand is estimated to increase from 422 million cubic meters in 2002 to 541 million cubic meters in 2022).[lvi]

Bhutan's growing problem of water shortages in both rural and urban communities has been explicitly acknowledged by its eleventh five-year

plan.[lvii] The plan explains that while at macro level the per capita water availability is high, at local levels access to water is a serious concern with several areas facing water shortages.

As a part of the preparation for the 2002 Water Resource Management Plan, Bhutan carried out a water supply adequacy analysis in 28 urban centers. This revealed that 11 towns faced water shortages and projected that another seven would face water constraints by 2013.[lviii]

The manner in which watersheds are maintained in Bhutan has implications for the ecological robustness of the Brahmaputra, both in Bhutan and downstream. Many Bhutanese have noted that some watersheds are not being maintained optimally and that streams and springs are drying up in certain locations. The cause may be over-abstraction, population pressure, and ecological degradation (including linkages to climate change). Sub-optimal forest management (including poor harvesting practices) also damages soil stability. The rapid growth of linear infrastructure is also a likely contributor to watershed degradation in the region, both during and after construction.

In recognition of the threat, the country is already carrying out efforts to properly manage its watersheds, so as to curb existing water shortages and meet future water demand. If, however, Bhutan is not able to adequately preserve critical watersheds, the country (including major economic sectors) faces several additional risks beyond just water supply challenges. **Some of the risks associated with poor watershed management include:**

- **Landslides**, resulting from loose soil that is not adequately held together by thick vegetative cover. Landslides have, in fact, become more common in Bhutan in recent years. In 2015, five Indian workers were killed in a landslide at the Mangdechu Hydroelectric Power dam site, when a pit collapsed.[lix] Traffic on the Paro-Thimphu highway was disrupted in March 2014 by a large landslide.[lx] Since 2000, there have been at least six large landslide events (triggered variously by rainfall, earthquake tremors, and construction) where there has been loss of life.[lxi] The problem is expected to increase with more intense monsoon rains.[lxii]

- **Sedimentation** in rivers from loose soil, sand, gravel that slides off the eroded slopes and is washed into the rivers by rain. This is, in turn, a risk for hydropower as it creates not only operational challenges and costs but also risks of structural damage if the sediment volume increases dramatically. A recent study of the Punatsangchu basin suggests that river flow and rainfall are not the only factors affecting sediment concentration.[lxiii]

- **Flooding and public safety** more broadly. Eroded slopes with loose soil can lead to increased flood events during heavy rainfall, since there is inadequate absorption of water into the land. Most lives lost in natural disasters in Bhutan are, in fact, in the context of flash floods. Examples include 12 deaths in 2009 after Cyclone Aila.

Linear Infrastructure Development

Bhutan has accelerated road construction across the country in recent years to improve connectivity. In 2008, Bhutan's road length totalled 2,517 kilometers (km). However, by 2013, this had quadrupled to 10,578 kilometers (km). Within this, black-topped (tarred) road length grew from 766 to 2,975 km in the same period, while non black-topped (non tarred) road length grew from 1,751 to 7,602 km. Of the total road length in Bhutan, primary national highways account for 1,860 km and farm roads account for 5,255 km.[lxiv] While Bhutan is now within the top 100 countries in terms of road density (kilometers of road per

square kilometer of land), it is significantly below the OECD levels of road density, and connectivity in the mountains remains a key challenge.[lxv]

Bhutan's eleventh plan notes that the main goal for the plan period is to complete the national highway grid using environmentally friendly technologies. However, in actual practice it is unclear to what extent road construction incorporates environmental safeguards. There is anecdotal evidence of debris from construction obstructing streamflow, and of landslides triggered by loose soil and rocks as a result of partial road construction.

The risks to Bhutan's water resources and river basin integrity from linear infrastructure development are essentially the same as the risks from inadequate catchment management, because linear infrastructure growth can degrade or alter watersheds / catchments. Thus it follows that the risks once more include landslides (see above), sedimentation (see above), and flooding and public safety risks (see above).

Agricultural Intensification

Figure 10 - Rice Farming in Bhutan

As Bhutan sees a growing trend of abandonment of agricultural land and falling employment in the sector, economic planners in Bhutan are prioritizing options to revitalize the sector. While the potential resurgence of agriculture, supported by the government's incentives and enabling infrastructure, will be a source of immense benefit to Bhutan, the shift also creates risks to freshwater resources because of the growth in demand for irrigation. If poorly managed, the change in water use by a transitioning agricultural sector could become a key risk to the water resources in Bhutan's Brahmaputra basin.

Bhutan has set itself a goal of food-grain self-sufficiency and aims to produce enough rice to meet domestic consumption demand. To support this, it has prioritized irrigation intensification and expansion. Partly driven by this imperative, Bhutan aims to provide 100 percent assured irrigation for rice-growing areas (compared to 30 percent assured irrigation today).[lxvi] The eleventh plan allocated a budget of 2.3 billion Nu (approximately US$ 35 million dollars) to the Department of Agriculture, of which 1.6 billion is earmarked for irrigation. Since 2009, 12 new irrigation schemes have been completed, and the eleventh plan identifies 42 new schemes that will be constructed.[lxvii]

The government of Bhutan also aims to develop the agriculture sector through expansion and incentivization of commercial crops, as a means to attract more Bhutanese youth to the agriculture sector. Depending on the level of expansion of commercial farming, this could alter agricultural demand on Bhutan's water resources, including through changes in forest cover, slope stability and erosion.

Some of the risks associated with agricultural intensification include:

- ***Water quality challenges***: with increased commercialization and scale-up of agriculture often comes greater use of chemical fertilizers, pesticides, and other artificial supplements or aids. Both irrigation water and rainfall result in some of this chemical content being washed into streams through runoff and into underground aquifers, contaminating water supplies.

- ***Heightened water demand***: agricultural intensification could create added demand for water in the farming sector, particularly for food crops like rice that receive priority for food-grain self-sufficiency reasons. While increased demand in and of itself is not a threat when water supplies are abundant, in the face of constrained water resources with competing uses, heightened demand and use in one sector such as agriculture could mean lesser water for other sectors. Even within the sector, this could mean more water being consumed by certain crops while others suffer due to water shortages.

- ***Risk to biodiversity***: agricultural expansion or intensification often means the growth of monocultures and the use of fairly homogenous seed varieties. This reduces the natural heterogeneity of ecosystems, leading to loss of biodiversity (which ultimately also increases the threat of crop loss when one particular dominant variety is negatively affected, without other varieties to provide natural resilience).

Hydropower Expansion

If Bhutan's plans to develop 10 GW of hydropower capacity by 2020 (and possible plans down the line to build the remainder of the identified 24 GW) are poorly managed, hydropower growth would constitute a threat to the Brahmaputra river system in Bhutan, and consequently to the key economic sectors that are heavily water and ecosystem-dependent, such as agriculture, forestry, agro-based industries, as well as tourism.

Some of the risks associated with improper or poorly managed hydropower development include:

- ***Reputational risk***: Bhutan's brand identity overseas rests on the notion of the country as a value-driven nation that prioritizes Gross National Happiness (GNH) over Gross Domestic Product. This inherently includes the idea of Bhutan as promoting sustainable development. If rampant hydropower development creates ecological damage and significantly alters the pristine landscapes that Bhutan is well known for (especially amongst tourists), it could well create a perception of Bhutan putting profit above principles and people. In fact, ever since Bhutan signed the 2006 agreement with India and the 2009 protocol, such suggestions have surfaced repeatedly in prominent and influential international news outlets.
- ***Internal political risk***: Poorly managed growth in the hydropower sector could lead to dissatisfaction amongst Bhutanese citizens who experience negative impacts such as noise or debris from construction, or resettlement. Some Bhutanese may view rapid, large-scale hydropower development as inconsistent with national values if it comes at the cost of local ecology, and this may cause support for the government's policies to wane.

Figure 11 - Bhutan's Golden Mahseer

- ***Risks to wildlife, vegetation and aquatic ecology***: Dams alter a river's natural state, and thus affect the aquatic ecosystem, regardless of the type of dam involved. While run-of-river dams alter water flows and disruption through tunnels and diversion pipelines (posing a threat to aquatic fauna such as fish), storage dams can have an even larger ecological footprint, resulting from submergence of land and forests (and the consequent loss of trees and vegetation as well as animal life in those habitats) as well as evaporative

losses from the reservoir surface. Most of Bhutan's proposed dams are run-of-river projects. Nevertheless, they will have an impact as a result of both construction and water diversion. The Punatsangchhu I and II projects, for instance, are to be built in a location that is home to an endangered bird species, the White Bellied Heron, of which there are less than 30 individuals in the wild in Bhutan,[lxviii] comprising 10% of the global population of a species that is listed in IUCN's Red List.[lxix] The Punatsangchhu basin is also home to an endangered fish species, the Golden Mahseer, which breeds upstream of where the proposed dam will release water (potentially impeding migration).[lxx] Reports indicate that an investigation of the impacts of the Sankosh project revealed that its reservoir would submerge 250 species of plants and trees, including 58 species of medicinal plants and four extremely rare species. Additionally, the submergence zone is also home to fourteen species of mammals, 86 species of butterflies, and 21 species of fish.[lxxi] These types of impacts are also a risk to the tourism sector of Bhutan, which is in part based on the country's rich biodiversity.

The hydropower sector in Bhutan is extremely conscious of these risks, and has consistently articulated a commitment to sustainable and environmentally sound projects. Recently, it increased the weightage of environmental and social criteria in hydropower project selection from 30% to 45% of total project selection criteria. By way of explanation, this refers to a Multi Criteria Analysis (MCA) approach that Bhutan adopted in the Power Sector Master Plan for 2003-2022. While the plan considered the merits and demerits of 11 potential hydroelectric projects (i.e. specific project sizes at specific sites), it assessed the project's desirability by scoring the project's characteristics or features against a total allocated score; the total allocated score for technical and economic factors together accounted for 70% in the original PSMP, while social and environmental factors accounted for 30% of the total allocated score (environmental factors alone constituted 15% of the score, and comprised sub-factors such as intrusion into protected areas, loss of primary forest, dewatering impacts downstream, access road erosion, and fish migration). Thus, as individual proposed projects were evaluated, their performance against each indicator was scored. The PSMP eventually selected 6 of the 11 projects that had suitably high scores (including the environmental component). However, even in this list of six Bhutan is moving forward with projects that received relatively low overall and socio-environmental scores, such as the Mangdechu project (52% and 14% respectively).[lxxii] The increase of socio-economic criteria to 45% is, nevertheless, a positive move.

Bhutan does require Environmental Impact Studies for each project. However, at the time of the writing of this report, Bhutan has not yet undertaken any cumulative impact assessments to evaluate the compound effect of the full list of dams on its river systems.[lxxiii]

The most significant challenge is likely to be one of capacity and implementation. Having safeguards and standards on the statute books or instituting policies is an important first step to ensure that hydropower in Bhutan does not expand to the detriment of critical ecosystems. However, to ensure that hydropower growth is strategic, well managed, and truly minimizes the negative impacts, it is essential that there be significant, highly trained, and adequately resources human and technical

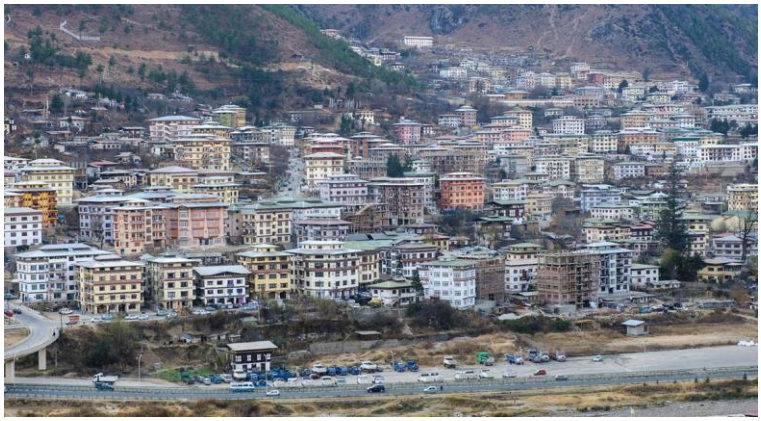

Figure 12 - Thimphu, Bhutan

capacity for enforcement and monitoring.

Urbanization and Industrialization

Water quality is also a critical area for policy makers in Bhutan to prioritize. This is particularly true in Bhutan's urban areas.

Bhutan's urban population has been growing at an average annual rate of more than 7.3%, compared to a national population growth rate of 1.2%. The most rapidly growing urban populations are in Thimphu and Phuntsholing. If the current rural-urban migration rate holds and urban population grows as expected, by 2020 Bhutan will face a situation where 73% of its population will live in urban areas. Even with more conservative estimates, it is extremely likely that urbanization rate will be at least 60% of the population by 2020. This is a vast imbalance with significant implications for water resources.[lxxiv]

The Bhutan government's own urbanization strategy acknowledges that this would put tremendous pressure on water supply, waste water collection and treatment, storm water drainage, and solid waste collection and disposal. [lxxv] Without adequate infrastructure to support waste disposal and sanitation demand, discharges into rivers are likely to increase, negatively affecting water quality. Several reports of such river contamination already exist.[lxxvi]

Closely tied to this is industrialization. While industry represents a minute fraction of Bhutan's GDP, employment, and current water use, it is likely that Bhutan's industrial sector will expand (as is typical when a country moves from a heavily agrarian economy to a secondary and eventually tertiary economy). Indeed, Bhutan's Vision 2020 identified small and cottage industries as a priority sector for the country, and Bhutan affirmed its commitment to growing its industrial base through the 2012 Cottage, Small, and Medium Industry Policy. The policy includes the promotion of industrial estates and Special Economic Zones, suggesting that industry could be encouraged to grow in a nodal manner.[lxxvii]

Primary risks arising from urbanization and industrialization include:

- ***Water quality degradation:*** high rates of urbanization and industrialization create a potential risk of water quality degradation, through more pollution flowing into the rivers. Urban settlements and industrial units sometimes have negligible or inadequate water treatment facilities and thus wastewater flow into rivers can increase water pollution. This subsequently has impacts on aquatic ecology and the ability of downstream users to use water.

- ***Increased water stress in high-demand areas***: in addition to water quality, the quantity of water available for different users, upstream and downstream, is also subject to risk from rapid urbanization and industrialization. As drinking water for human consumption receives primacy amongst water users, the growth of towns, cities, and urban settlements means that water will be prioritized for such areas, creating tradeoffs or potential shortages elsewhere. Similarly, industrial use upstream could have impacts on water availability downstream.

Institutional Capacity Challenges

Figure 13 - Bhutan's Parliament

Since 2007, Bhutan's governance institutions and decision-makers have slowly transitioned into a parliamentary democracy. This has brought with it new demands and pressures on a representative government. While it is clear that there is a measure of strong technocratic knowledge and good theoretical understanding of several issues relating to environmental conservation, river management, climate change etc., implementation experience and exposure to best practices outside Bhutan are still relatively limited.

In Bhutan today, there isn't a long history of participatory and integrated/aligned natural resource and infrastructure management, and thus mistakes are likely to be made in the early days. New and expanding mandates call for greater number of staff to manage Bhutan's water resources, as well as for more assistance from those who have a body of practice behind them in relevant fields.

Over and above insufficient capacity, there is a risk from inadequate coordination within government. Stronger inter-departmental and cross-sectorial communication and coordination are key needs.

The institutional risks associated with the development trajectory Bhutan is on, coupled with limited practical experience, include:

- Flawed implementation of sound policy. Even if the country puts in place well-structured policies and adopts plans or regulations that have proven successful in other countries, it may not achieve the optimal balance of resource development and protection if implementation and enforcement are insufficient.
- Resource mismanagement or even degradation. Well-intentioned but inexperienced officials may not be equipped to manage Bhutan's water resources in a way that establishes adequate safeguards or monitors the actual changes on the ground due to hydropower development and other growing uses.

ANNEX A

Responses from Stakeholder on Key Questions and Uncertainties to Shape Scenarios for Bhutan

Timeframe relevant to the two queries: Next twenty years (approximately until 2035)

KEY QUESTIONS

- How will water availability change in urban and rural areas?
- How will hydropower development affect water availability in the future and vice versa?
- Will the tourism sector's growth be affected by water availability? Will resorts become main users? What is the "carrying capacity" for resorts and hotels (how many can be accommodated)?
- What will China's policy be towards hydropower and water resources in the Eastern Himalayas?
- What level of hydropower development will be "enough" for Bhutan?
- Can Bhutan maintain its brand as a "Shangri La?" Can it preserve its river basins despite pressures of road development, hydropower, and agricultural intensification?
- What will be the role of different sectors (public, private, civil society) in managing Bhutan's water resources?
- How will Bhutan's relations with its neighbours shape its future water resources management?
- Is there another source of economic growth for Bhutan's economy besides hydropower (a Plan B)?
- Which sectors in Bhutan's economy will be most water-intensive?
- What is the impact of significant infrastructure growth in watersheds?
- How will water quality change? Will there be more pollution in river water?

UNCERTAINTIES

- Climate change and variability, and its impacts on the hydrological regime and natural disasters
- Alternate markets for hydropower (besides India)
- Population rise / population levels
- Degree of occurrence and intensity of natural disasters
- Political priorities of future governments of Bhutan
- Ecological and geological stability, including levels of seismic activity
- Impact of slow-growing or slow-moving disasters such as drought

ANNEX B

Core Premise and Main Assumptions for Three Scenarios, as Framed in the Initial Stakeholder Session

Scenario A: Core Premise and Underpinning Assumptions

Core Premise	• Economic growth model is strongly centralised • Economy is export-oriented • Hydropower is a strong factor in overall economic planning that has influence on water resource related decision-making in Bhutan • The Water Act still clearly identifies prioritization for water use • The primary destination for electricity export is India • Geopolitical ties with the South/South-East Asian region are strong
Assumptions (Rules of the Game)	▪ **Installed Generation Capacity**: Bhutan has developed 20 GW of hydropower by 2035 (of the total identified 27 GW potential) ▪ **Storage Capacity:** Bhutan has developed 30 MCM (Million Cubic Meters) of live storage capacity in dam reservoirs. ▪ **Criteria Weightage in Project Selection:** Bhutan gives social and environmental factors 45% weightage (with technical and economic factors being the remaining 55%) for project development and siting. ▪ **Cumulative Impact Assessment:** Bhutan conducts cumulative social and environmental impact assessments at the basin level. ▪ **Plough-back Mechanism is Operational**: 1% of royalty from hydropower sales is invested in catchment management.

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Scenario B: Core Premise and Underpinning Assumptions

Core Premise	• Economic growth model is strongly decentralised • Economy is based on using Bhutan's natural resources to meet domestic needs and create domestic employment in rural areas • Tourism (main foreign exchange earner) and agriculture (to achieve food self sufficiency) are strong factors in overall economic planning and have influence on water resource related decision-making • Both tourism and agriculture have strong elements of sustainability and conservation
Assumptions (Rules of the Game)	▪ **Increase in Annual Visitors and Tourism Revenues:** Bhutan experiences an average year-on-year growth in tourist arrivals by 10-15% and growth in tourist revenues by 10% annually. ▪ **Increase in Employment in Tourism and Agriculture:** Bhutan experiences year-on-year growth in employment in the tourism sector, and maintains a stable rate of employment in agriculture. ▪ **Foodgrain Self Sufficiency:** Bhutan remains committed to foodgrain self-sufficiency, but also continues to pursue and leverage its organic goals. Bhutan leverages its "organic brand" to increase agricultural exports. ▪ **Increase in Tourism Impacts:** Bhutan promotes sustainable tourism but the scale of increase in tourist activity and infrastructure has impacts on waste generation, land use, water consumption and contamination.

Scenario C: Core Premise and Underpinning Assumptions

Core Premise	• Economic growth model is dispersed and decentralised • Economy is driven by growing industrial activity, primarily value-added agro-processing and beneficiation in the extractives industry. • Industrial activity is competitive due to and supported by cheap hydropower. Thus domestic power needs receive primacy before exports. • Electricity is used to serve growing domestic needs, rather than exports • Agro-based and extractive industries are strong factors in overall economic planning and have influence on water resource related decision-making
Assumptions (Rules of the Game)	▪ **Growth in Extractive Industries:** buoyed by cheap electricity, Bhutan starts developing its extractive / mineral industries, particularly for the export of ferro-alloys, cement, calcium carbide, copper wire, graphite processing etc. ▪ **Growth in Domestic Construction Industry:** Bhutan develops domestic construction capacity to reduce reliance on neighbours, and in pursuance of this expands cement manufacturing and limestone quarrying. ▪ **Growth in Agro-Based Industries:** Bhutan increases value-addition in the agricultural sector, with high-end agro-based industries (particularly to leverage its organic brand), including fruit-based beverages, processed foods, artisanal foods. ▪ **Increase in industrial employment:** the expansion of this sector creates greater employment opportunities in Bhutan, particularly for educated youth ▪ **Increase in ecological impacts:** growth in industrial activity increases effluent discharge into rivers, contamination from mining sites, and other ecological impacts

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ANNEX C – List of Stakeholders Involved

Gross National Happiness Commission, Thimphu.
National Environment Commission- Relevant Divisions.
Department of Roads, MoWHS, Thimphu.
Department of Human Settlement, MoWHS, Thimphu.
Department of Engineering Services, MoWHS.
Department of Hydromet Services, MoEA.
Department of Geology and Mines, MoEA.
Department of Hydro-power System, MoEA.
Department of Public Health/Water Supply, MoH.
Department of Forests and Park Services, MoAF – WMD.
Department of Agriculture, MoAF – Agri Specialist and Irrigation Division
Department of Disaster Management, MoHCA.
Department of cottage Industries and Small Industry
Urban development and land-use planning
Water supply and sanitation
National Biodiversity Centre, MoAF
Policy and Planning Division, MoAF
Ministry of Finance
National Land Commission
Centre for Bhutan Studies
Tourism Council of Bhutan
Association of Bhutanese Tour Operators
Druk Green Power Corporation, Thimphu, Bhutan.
Royal Society for Protection of Nature
Bhutan Foundation
Bhutan Trust Fund for Environmental Conservation
World Bank
UNDP
Asian Development Bank and IRBM team leader

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3

We work in three countries: India (North-East), Bhutan & Nepal.

2009

The programme, earlier known as the Living Himalayas Initiative, was established in 2009.

+15M

By 2020, a mosaic of 15 million hectares of East Himalayan Ecosystems (freshwater and terrestrial) is ecologically connected, sustainably resourced and well managed.

500M

About 500 million people live in the Ganga and Brahmaputa basins, which are the geographic focus of the Living Himalayas Initiative.

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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