



Climate Resilient Infrastructure Guideline under
BRECSA Project Financing
Project Management Unit, ARDC Samtenling

June,2024



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Ministry of Agriculture and Livestock

Building Resilient Commercial Smallholder Agriculture Project

Samtenling: Sarpang



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ACRONYMS

ARP	Agriculture Resilience Plan
CLEAR	Consolidated Livelihood Exercise for Analyzing Resilience
GLOF	Glacial Lake Outburst Flood
GAfSP	Global Agriculture and Food Security Program
HVAC	Heating, Ventilation, and Air Conditioning
IFAD	International Fund for Agricultural Development
RNR	Renewable Natural Resources
WFP	World Food Programme
ALD	Agriculture Land Development



1. Background

Bhutan is a land-locked country and is highly prone to vagaries of climate induced hazards that affect agricultural production and subsequent livelihood of the people. Studies have shown that agriculture, transportation and infrastructure, among others, fall under increasing risks of climate extremes. More so, the empirical evidence suggest that farming communities are highly vulnerable to the ensuing impacts of climate change.

In view of this increasing risks, Royal Government of Bhutan through various line agencies have accorded highest priority toward mitigating the risks and enhancing the adaptive capacity of the rural communities. Over the years, MoAL has implemented various plans, projects and programs in various parts of the country to overcome the challenges posed by the climate extremes. One among such projects, is a fully blended, seven-year project titled “Building Resilient Commercial Smallholder Agriculture (BRECSA)” in central and south-central region of Sarpang, Trongsa, Tsirang and Zhemgang Dzongkhags. The project is funded by Global Agriculture and Food Security Program with a grant financing of USD 13 million. IFAD is co-financing the project with USD 8.935 million as a fully blended project. IFAD is the overall Supervising Entity for Investment and the Lead Implementing Partner Agency, while WFP is the Supervising Entity for Technical Assistance and Implementation Support.

The goal of BRECSA is to catalyze a 30% increase in resilient commercial agricultural production and improve food and nutrition security in the 4 target Dzongkhags by 2030. The development objective is to transform smallholder agriculture into inclusive and resilient agri-food systems that are increasingly profitable and food and nutrition-secure. BRECSA will target subsistence, semi-commercial, and commercial farmer households. The total direct beneficiaries of BRECSA interventions are 12,074 farmer households (47088 beneficiaries), out of which 60% will be women and 30% youth.

2. Introduction

Climate resilience in infrastructure development is of paramount importance in the face of escalating climate change impacts. Infrastructure, ranging from transportation networks to energy systems and buildings, forms the backbone of modern societies, supporting economic activity, social well-being, and quality of life. However, as climate change intensifies, infrastructure assets are increasingly vulnerable to a wide range of climate-related hazards, including extreme weather events, floods, and temperature fluctuations.

Overall, climate change poses significant challenges for infrastructure planning, design, construction, operation, and maintenance. Addressing these challenges requires adopting climate-resilient approaches, integrating adaptation and mitigation measures into infrastructure development, and fostering collaboration among stakeholders to build a more sustainable and resilient infrastructure system.



With a fragile mountainous ecosystem and high reliance on climate-sensitive sectors such as hydropower and agriculture, Bhutan’s economy is particularly vulnerable to the adverse impacts of climate change. Moreover, the country is also exposed to hazards such as flash floods, including Glacial Lake Outburst Floods (GLOFs), forest fires, storms, and landslides. The impact of flooding on human health and livelihoods is expected to grow and could amount to 4% of GDP by the 2030s (ADB).

Farming in Bhutan is mostly rain-fed or dependent on rain-charged spring waters and streams. A more erratic rainfall pattern in the dry season has directly impacted both the availability and amount of irrigation water. Smallholders are facing seasonal water shortages and the drying out of water sources poses a further threat to agriculture and livestock. Other impacts of climate change include extreme conditions such as long spells of dry season, hefty monsoon rains, extreme hailstorm events, and outbreaks of pest and disease incidences. The shift of agro-ecological zones attitudinally however provides new opportunities. Most villages across Bhutan are highly vulnerable to climate impacts and have low adaptive capacity attributed to their limited resource base and precarious socio-economic status.

3. Rationale and Project Targeting

BRECSA directly addresses systemic barriers in the agriculture sector, post-COVID-19 challenges and priorities identified in Bhutan’s Renewable Natural Resources (RNR) Strategy 2030, the Food Self-sufficiency Policy, RNR Marketing Policy 2018, RNR Marketing Strategy 2021, the Food Systems Summit Pathways recommendations, Transformation of Agriculture through Crop Prioritization 2022 (A strategy document for 2022-2027) and Bhutan’s COVID-19 Economic Recovery Plan. BRECSA addresses the following common IFAD, WFP and GAFSP cross-cutting priorities: (i) gender and empowerment of women and girls (SDG5); (ii) climate resilience (SDG13); (iii) improved nutritional outcomes by achieving national food and nutrition security (SDG2); (iv) alleviating poverty (SDG1); (v) Create Decent Work and Economic Growth (8); and (vi) Reduce Inequality (SDG10). BRECSA also prioritizes youth engagement and vulnerable populations, such as households with differently-abled persons and women-headed 7 households. Sixty percent of BRECSA beneficiaries are women, including a minimum of five percent of women-headed households and thirty percent are youth. Six hundred differently-abled women, men, and youth, constituting 25 percent of the population of differently-abled persons in the target Dzongkhags will benefit from BRECSA interventions. Moreover, IFAD’s Empowerment Indicator will be included in the baseline survey to measure Intrinsic agency, Instrumental agency, and Collective agency to identify development obstacles and ensure empowerment and inclusion of women in the agricultural sector.



4. Purpose and Scope

- Mitigate the impacts of climate change by reducing vulnerability to extreme weather events water-level rise, and other climate-related hazards.
- Ensure the longevity and functionality of infrastructure systems despite changing climate conditions.
- Enhance the resilience of communities, economies, and ecosystems by providing reliable and sustainable infrastructure services.
- Minimize the costs associated with repairing and rebuilding infrastructure damaged by climate-related disasters.
- Promote sustainable development by integrating climate resilience into infrastructure planning, design, construction, and maintenance processes.
- Safeguard lives, livelihoods, and property by strengthening infrastructure resilience against the adverse effects of climate change.

5. Principles for Resilient Infrastructure-Governance and Theory of Change

5.1 Key Principles of Resilient Infrastructure in Agriculture and Livestock

1. **Water Management:** Investing in efficient irrigation systems, rainwater harvesting, and water conservation practices helps to ensure adequate water supply for agriculture and livestock, even during dry periods. Bhutan's mountainous terrain presents unique challenges for water management, but innovative solutions can be implemented.
2. **Climate-Smart Agriculture:** Adopting climate-smart agriculture practices helps to adapt to climate change and mitigate its impacts on agriculture. This might include using drought-tolerant crop varieties, improving soil health, and promoting agroforestry.
3. **Infrastructure Resilience:** Building resilient infrastructure, such as flood-resistant barns, storage facilities, and transportation networks, helps to protect agricultural assets and ensure uninterrupted supply chains. Bhutan's infrastructure needs to be designed to withstand extreme weather events and climate change impacts.



5.2 National Impact of Resilient Infrastructure in Agriculture and Livestock

- **Enhanced Food Security:** Resilient infrastructure in agriculture and livestock helps to ensure a stable food supply for Bhutan's population, reducing food insecurity and malnutrition.
- **Reduced Poverty:** A resilient agricultural sector can help to reduce poverty by providing income opportunities for rural communities.
- **Improved Rural Livelihoods:** Resilient infrastructure supports sustainable livelihoods for farmers and livestock herders, enabling them to adapt to changing conditions and improve their living standards.
- **Environmental Sustainability:** Resilient agricultural practices can help to protect the environment by conserving natural resources, reducing soil erosion, and mitigating climate change.
- **National Security:** A resilient agricultural sector contributes to national security by ensuring food self-sufficiency and reducing dependence on imports.

6. Importance of Building Resilience into Infrastructure Development

The importance of building resilience into infrastructure development is paramount for several reasons:

1. **Risk Reduction:** Resilient infrastructure can withstand and recover from natural disasters, extreme weather events, and other hazards, reducing the risk of damage, disruption, and loss of life.
2. **Long-Term Sustainability:** By incorporating resilience measures into infrastructure projects, they become more durable and adaptable over time, contributing to long-term sustainability and minimizing the need for costly repairs or replacements.
3. **Protection of Investments:** Resilient infrastructure protects investments in critical assets, such as transportation networks, water systems, and energy grids, ensuring their continued functionality and economic viability.
4. **Community Well-being:** Resilient infrastructure enhances community well-being by providing reliable access to essential services, such as clean water, good irrigation system, and transportation even in the face of environmental challenges.



5. Climate Change Adaptation: Building resilience into infrastructure development helps communities adapt to the impacts of climate change, such as sea-level rise, increased temperatures, and more frequent and intense extreme weather events.
6. Enhanced Socioeconomic Development: Resilient infrastructure supports socioeconomic development by fostering economic growth, creating employment opportunities, and attracting investment, while also reducing the social and economic costs of disasters.

Overall, integrating resilience into infrastructure development is essential for ensuring the safety, sustainability, and prosperity of communities now and in the future. It allows for better preparedness, response, and recovery from various threats, ultimately contributing to a more resilient and prosperous society.

For any infrastructure construction project, 10% of the initial cost estimate should be allocated as a provision for climate resilience measures.

7. Infrastructure development under BRECSA Project:

Climate change could have significant implications for infrastructure. As infrastructure assets have long operational lifetimes they are sensitive not only to the existing climate at the time of their construction, but also to climate variations over the decades of their use. For example, a substantial proportion of infrastructure built in the next five years, will still be in use long after 2030. To increase the resilience of both new and existing infrastructure, we must be prepared to plan ahead and manage the impacts of climate change. This is an important part of the transition to a green economy.

New infrastructure can be climate resilient by ensuring that an asset is located, designed, built and operated with the current and future climate in mind.

Existing infrastructure can be climate resilient by ensuring that maintenance regimes incorporate resilience to the impacts of climate change over an asset's lifetime.

To support the Agriculture and Livestock production activities, the project will invest in good infrastructure, which will be climate-proofed. The infrastructures include:

7.1 Climate-resilient Irrigation Infrastructure Development

Climate-resilient features in irrigation systems are essential for adapting to the increasing variability in water availability due to climate change. These features help ensure sustainable water use and crop productivity despite changing weather patterns.

Key climate-resilient features in irrigation includes;



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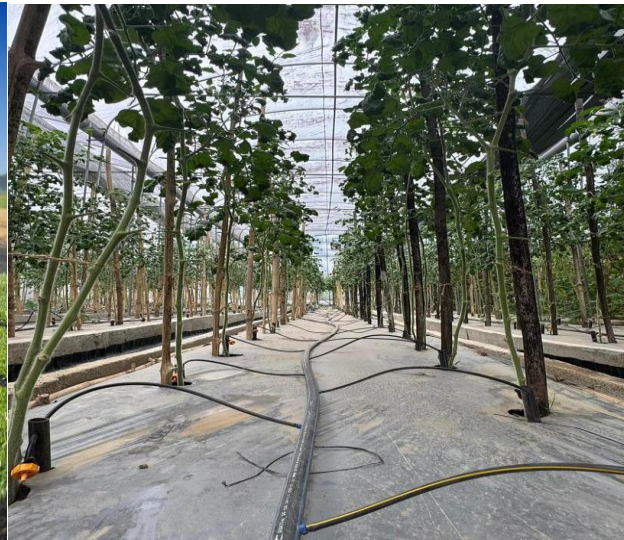


7.1.1 Efficient Water Management Technologies

Drip and Micro-Sprinkler Irrigation: These systems deliver water directly to the plant roots, reducing water wastage through evaporation or runoff and ensuring efficient use.



a. *Sprinkler Irrigation*



b. *Drip Irrigation*

7.1.2 Water Harvesting and Storage

- **On-farm Water Storage:** Constructing ponds or reservoirs allows farmers to capture rainwater or excess irrigation runoff for future use, increasing water security during dry spells.



c. *Simple collection chamber*



7.1.3 Soil Moisture Conservation

- **Mulching:** Applying organic or synthetic mulch can reduce soil evaporation, conserve soil moisture, and improve the efficiency of water use in irrigation.

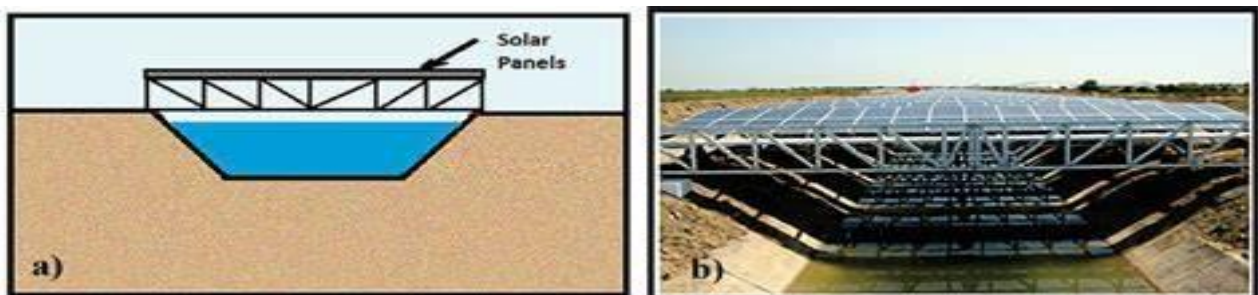


d. Mulching

7.1.4 Improved Canal Systems

Covered Canals

Shaded or Roofed Canals – Installing covers, shaded, or roofing over the canals helps reduce direct exposure to sunlight, thus lowering evaporation. In some cases, photovoltaic (solar) panels can be used to cover the canals serving the dual purpose of reducing the water loss and generating energy.



e. Lined canal with photovoltaic panels

The provision of irrigation (new/ rehabilitation schemes) was identified by the RGoB and communities as the highest priority. Currently, many irrigation systems in Bhutan are in poor condition and require rehabilitation. Leaky canals, frequent damage by landslides, sedimentation in the upper reaches of the canal, lowering of the river bed, insufficient water



at the source, inappropriate structures, and increasing competition over the use of water are some of the common problems these irrigation systems face.

The detailed irrigation schemes the project will fund are as below:

New Irrigation

No. of Irrigation Schemes	No. of Household(Beneficiaries)	Area (acres)
4	1376	2432

Rehabilitation

No. of Irrigation Schemes	No. of household beneficiaries	Area(areas)
16	1000	1200

Development of 4 new irrigation schemes (The final selection of schemes/sites will be determined based on the CLEAR and ARPs.

For each irrigation infrastructure project, climate change impacts and the measures to mitigate them are to be recognized in a process of infrastructure planning, design, and implementation. This process is also referred to as “mainstreaming” climate change.

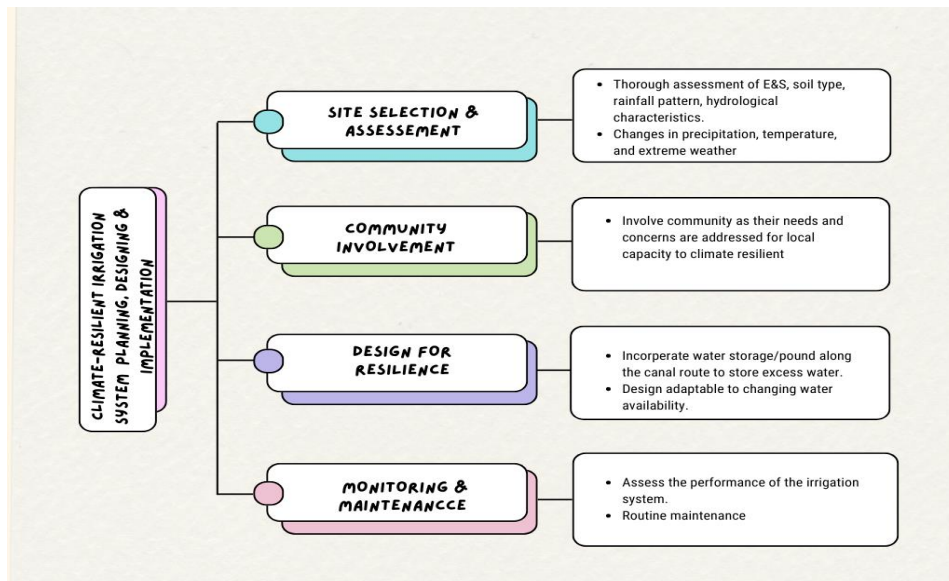


Fig. 2 Mainstreaming climate-resilient irrigation system



As a result of the project, the springs or surface water sources are expected to become more reliable, with water yield either remaining stable or increasing. Thus, the project's outcome will be that the target communities will have more reliable water supplies during the dry season.

7.2 Post-Harvest and Marketing Infrastructure

Building climate-resilient marketing infrastructures involves designing systems that can adapt to and mitigate the impacts of climate change. Here are some strategies:

1. Water Management: Implement water-saving technologies and sustainable water management practices to minimize water use in marketing activities, such as cleaning, packaging, and processing.

The rainwater harvesting would be one critical component for climate-resilient infrastructure. Incorporating rainwater harvesting into climate-resilient infrastructure can greatly enhance a community's ability to adapt to and mitigate the effects of climate change, ensuring more sustainable and secure water management in the face of growing environmental challenges.

2. Resilient Infrastructure: Build and maintain resilient marketing infrastructure, such as warehouses, distribution centers, and retail outlets, to withstand extreme weather events and other climate-related hazards.

- Design retail spaces with climate resilience incorporating natural ventilation, green roofs, and flood-resistant construction materials to minimize risks from extreme weather events like heatwaves, storms, and floods.

3. Energy Efficiency: Invest in energy-efficient technologies for marketing infrastructure, such as LED lighting, smart heating, ventilation, air conditioning (HVAC) systems, and renewable energy sources like solar panels, to reduce carbon emissions and operational costs.

4. Community Engagement: Engage with local communities and stakeholders to understand their climate-related vulnerabilities and concerns, and incorporate their perspectives into marketing initiatives and strategies.

Details of Milk Processing Unit (MPU) infrastructures are to be followed as per Guidelines for establishment of Dairy Infrastructure (2021-2022), but climate-resilient measures should be incorporated.

7.3 Fencing

In agriculture, climate-resilient chain link fencing is crucial in protecting crops, livestock, and



property from various environmental hazards. Creating a climate-resilient chain link fencing system involves selecting durable materials and designing the fence to withstand various weather conditions. Here are the key strategies:

- i. Proper Installation: Ensure the fence is installed securely and according to manufacturer guidelines. Use sturdy posts set in concrete footings to provide stability, especially in areas prone to high winds or erosion.
- ii. Consider Wind Resistance: In windy areas, install wind-resistant features such as tension wire at the top and bottom of the fence and vertical slats or windscreens to reduce wind load and minimize the risk of damage.
- iii. Erosion Protection: If the area is prone to erosion, install the fence at an appropriate height above the ground and incorporate drainage systems to prevent water buildup and minimize corrosion.
- iv. Regular Maintenance: Perform routine inspections and maintenance to identify and address any signs of damage, such as rust, corrosion, or loose components. Clean the fence periodically to remove debris and vegetation that can trap moisture and accelerate deterioration.
- v. Vegetation Management: Keep vegetation trimmed and away from the fence to prevent it from causing damage or impeding drainage. Consider using weed barriers or landscaping materials to minimize vegetation growth near the fence line.
- vi. Climate-Informed Design: Consider local climate conditions, including temperature fluctuations, precipitation levels, and exposure to sunlight, when designing the fence to ensure it can withstand seasonal variations and long-term climate impacts.

The BRECSA Project will fund appropriate fencing (vegetative, electric, chain-link) for the farms demonstrating high potential for agriculture commercialization. The project will fund 160 km of electric and hybrid fencing and will pilot 32 km of chain link fencing for scaling up based on the results. The project will sensitize and proactively encourage farmers to employ vegetative fencing such as Sichuan pepper (*Zanthoxylum* spp), a sturdy thorny bush that deters certain wildlife species.

7.4 Land Development

Land Development is the sustainable development of arable land, through change in landform, for enhanced agriculture production and continuous agro-ecosystem services. Based on this definition, eight different ALD technologies have been identified viz: i) bench terracing, ii) consolidation of existing small terraces, iii) orchard terracing, iv) removal of surface stones from agriculture fields, v) contour stone bunds, vi) orchard basin, vii) alley cropping, and viii) check dam. All these ALD technologies have been tried and proven to be effective in mitigating soil erosion, increasing soil fertility, easing workability, promoting farm mechanization, and/or enhancing agriculture production thereby helping to increase rural livelihoods, enhance resilience against climate change, conserve biodiversity, and ensure sustainable



agro-ecosystem services.

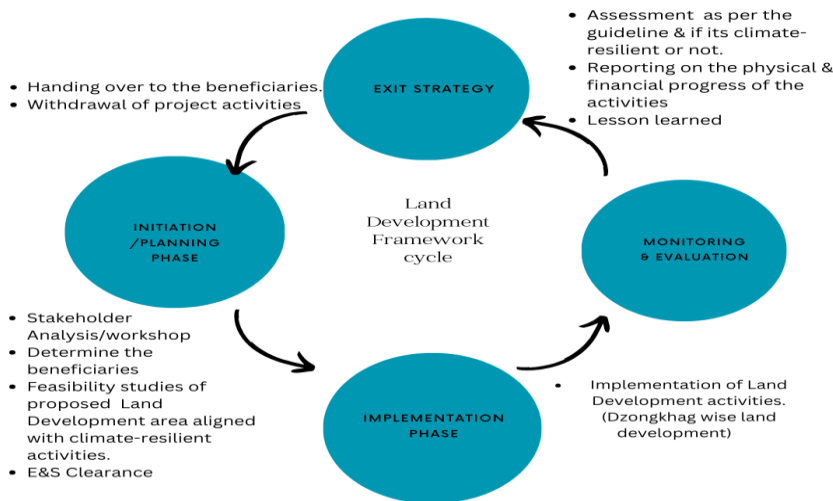


Fig. 1 Land Development Framework

The forms for Land Development activities i.e. Application form, Agreement form, Feasibility Assessment form, and Data Collection form will be available on the Project Website.

The cost-sharing modalities will be as per the Agriculture Land Development Guideline(ALDG)-2017.

8. Implementation Modalities.

The implementation of the Infrastructure development work shall be done with beneficiaries' labor contributions and input from the project with technical supervision from the PMU

9. Monitoring and Evaluation

The PMU with support from PIU Dzongkhags and Gewogs shall carry out regular monitoring and evaluation, and submit regular reports of the Project with recommendations for any intervention, if required for onward submission to IFAD.



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