

**Ministry of Agriculture and Forests  
Royal Government of Bhutan**



**LOW EMISSION DEVELOPMENT STRATEGY  
FOR FOOD SECURITY**

**JUNE 2021**

# **LOW EMISSION DEVELOPMENT STRATEGY FOR FOOD SECURITY 2021**

**Ministry of Agriculture and Forests  
Royal Government of Bhutan**

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## **Disclaimer**

The strategy documents, data and information underpinning this Low Emission Development Strategy correspond to the most recent data available in January 2021. Developments due to the continuing and dynamically evolving situation caused by the COVID-19 pandemic might not be reflected in the data used.

## FOREWORD

Agriculture, livestock and forestry continue to remain mainstays of the Bhutanese economy. The agriculture sector continues to provide employment to over 50% of Bhutan's population and contributes over 15% to Bhutan's GDP (2020, NSB). And forests which cover 71% of Bhutan's total land area provide critical ecosystem services and remain central to the wellbeing of our farming community.

So far, emissions from the agriculture sector, categorised as survival emissions, have constituted a significant portion of Bhutan's total emissions. It is becoming increasingly evident that Bhutan needs to increase our food production and significantly reduce our dependence on imports. This untenable situation of heavy import dependence has been brought into sharp relief as the COVID-19 crises continues to unfold. As such, while we pursue growth strategies within the agriculture sector, there is a possibility that GHG emissions from the sector may increase.

It is therefore timely that a Low Emissions Development Strategy (LEDS) for the Agriculture and Livestock Sector has been developed with clear implementation strategies. The Ministry welcomes the opportunity for the Agriculture and Livestock Sector to proactively reduce GHG emissions while ensuring growth, resilience and employment creation. The Ministry assures its full support in implementing the strategies outlined and will ensure mainstreaming of the LEDS within the overall development plans and strategies of the Ministry.

The Ministry also seeks the support of development partners to collaboratively raise finances and provide technical support for the implementation of the LEDS.

Given the importance of the agriculture and livestock sector for Bhutan, I thank all those engaged, in particular our development partners and donors, who have contributed to the formulation of the LEDS.

I am particularly pleased as this LEDS recommits and demonstrates Bhutan's commitment to remain carbon neutral and do all that Bhutan can to avert a climate crisis. We continue to champion for a world which is carbon neutral, safe and resilient.

Tashi Delek.



## ACKNOWLEDGEMENTS

A series of stakeholder consultations has been conducted during the elaboration of this LEDS engaging both public and private sector actors, as well as development partners and other key stakeholders. We thank all of them for their inputs and time.

In particular, we are grateful for the extensive contributions provided by the Core and Expert Group Committee members (See Annex D) from the Ministry of Agriculture and Forests who provided the context and content for this report.

We would like to express our appreciation to the team of consultants. Perspectives Climate Group (International experts) and Mr. Ganesh Dahal Chettri, National Expert who were engaged in preparing the strategy document. We thank Dr. Ngawang Norbu for the editing, and UNDP Bhutan team for the technical and financial support.

The preparation of the Low Emission Development Strategy (LEDS) for Food Security in Bhutan (Agriculture and Livestock sector) has been made possible with support through the UNDP Climate Promise program and allied donors.

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## ABBREVIATIONS

|       |                                                           |
|-------|-----------------------------------------------------------|
| 12FYP | The 12th Five Year Plan 2018-2023                         |
| ADB   | Asian Development Bank                                    |
| AED   | Agriculture Engineering Division                          |
| AFOLU | Agriculture, Forestry and Other Land Use                  |
| AMC   | Agriculture Machinery Centre                              |
| APD   | Agriculture Production Division                           |
| ARED  | Agriculture Research and Extension Division               |
| BAFRA | Bhutan Agriculture and Food Regulatory Authority          |
| BES   | Bhutan Ecological Society                                 |
| BDBL  | Bhutan Development Bank Limited                           |
| CSM   | Climate Smart Agriculture                                 |
| CDPB  | Comprehensive Development Plan for Bhutan                 |
| DoL   | Department of Livestock                                   |
| DRE   | Department of Renewable Energy                            |
| ECP   | Economic Contingency Plan                                 |
| EDP   | The Economic Development Policy                           |
| ETS   | Emission Trading Schemes                                  |
| FMCL  | Farm Machinery Corporation Limited                        |
| FCB   | Food Corporation of Bhutan                                |
| FCPF  | Forest Carbon Partnership Facility                        |
| FSAP  | Food Security and Agriculture Productivity                |
| GCF   | Green Climate Fund                                        |
| GDP   | Gross Domestic Product                                    |
| GEF   | Global Environment Facility                               |
| GHG   | Greenhouse Gas                                            |
| GNHC  | Gross National Happiness Commission                       |
| GNH   | Gross National Happiness                                  |
| ICT   | Information and Communication Technology                  |
| IFAD  | International Fund for Agricultural Development           |
| INDC  | Intended Nationally Determined Contribution               |
| IFOAM | International Federation of Organic Agriculture Movements |
| IKI   | Germany's International Climate Initiative                |
| ITMO  | Internationally Transferred Mitigation Outcomes           |
| IPCC  | Intergovernmental Panel on Climate Change                 |
| JCM   | Joint Crediting Mechanism                                 |
| LDCF  | Least Developed Countries Fund                            |
| LEDs  | Low Emission Development Strategy                         |
| MHV   | The Mountain Hazelnut Venture                             |
| MoAF  | Ministry of Agriculture and Forest                        |

|        |                                                              |
|--------|--------------------------------------------------------------|
| MoEA   | Ministry of Economic Affairs                                 |
| MoF    | Ministry of Finance                                          |
| MoFA   | Ministry of Foreign Affairs                                  |
| NAMA   | Nationally appropriate mitigation actions                    |
| NAP    | National Adaptation Plan                                     |
| NC2    | Second National Communication                                |
| NC3    | Third National Communication                                 |
| NCWC   | National Commission for Women and Children                   |
| NDC    | National Determined Contribution                             |
| NEC    | National Environment Commission                              |
| NEPA   | The National Environment Protection Act                      |
| NGO    | Non-Governmental Organization                                |
| NKRA   | National Key Result Areas                                    |
| NOF    | National Organic Framework                                   |
| NPHC   | National Post Harvest Center                                 |
| ODA    | Official Development Assistance                              |
| REDD+  | Reducing Emissions from Deforestation and Forest Degradation |
| RGoB   | Royal Government of Bhutan                                   |
| RNR    | Renewable Natural Resource                                   |
| SDG    | Sustainable Development Goals                                |
| SNV    | Netherlands Development Organization                         |
| SOC    | Soil Organic Carbon                                          |
| TCAF   | Transformative Carbon Asset Facility                         |
| TMR    | Total Mixed Ration                                           |
| UNDP   | United Nations Development Programme                         |
| UNFCCC | United Nations Framework Convention on Climate Change        |
| WB     | World Bank                                                   |



## EXECUTIVE SUMMARY

GHG emissions from the agriculture and livestock sector have historically been a significant contributor to Bhutan's total national greenhouse gas (GHG) emissions. The GHG inventory of the Third National Communication (TNC) of Bhutan to the UNFCCC indicates that in 2015 the Agriculture, Forestry and Other Land Use (AFOLU) sector accounted for 57.2% (2,183.25 ktCO<sub>2</sub>e) of the national emissions. Within the AFOLU sector, the agriculture sector (including livestock related emissions) emitted 14.5% (552.9 ktCO<sub>2</sub>e) of total national emissions.

Agriculture and livestock remain essential components of the Renewable Natural Resource (RNR) sector and underpin the sustainability of Bhutan's food systems. Despite a high focus on domestic food production, Bhutan continues to heavily rely on imports. This dependence on imports has been brought into sharp focus during the on-going COVID pandemic. Therefore, there is renewed focus and attention to enhance food production, and improve efficiencies across storage, distribution, and consumption chains. It is therefore inevitable that agriculture and livestock related GHG emissions will rise if concrete strategies are not envisioned and planned for implementation to decouple growth in food production with GHG emissions.

Recognizing the need to enhance food production while considering Bhutan's commitment to remain carbon neutral 'for all times', the LEDS for Food Security is a key strategic long-term planning document. The strategy introduces actions to mitigate GHG emissions from the agriculture and livestock sectors, while simultaneously aiming to enhance food security, facilitate post COVID-19 economic recovery, and further the pursuit of Gross National Happiness (GNH) goals and targets.

The LEDS covers the short (2025), medium (2030), and long term (2050) time frames against which two mitigation scenarios were developed: i) a focused mitigation scenario which covers prioritized mitigation activities; and ii) a high ambition mitigation scenario in which all the mitigation activities identified can be achieved. To determine the mitigation potential of the identified mitigation activities, a four-step methodological approach was followed based on the revision and analysis of high-level policy targets and taking into consideration the sectoral boundaries of concerned sectors: i) identification of relevant mitigation activities; ii) prioritization of mitigation options following validated criteria; iii) estimation of baseline emissions and mitigation potential; and iv) identification of co-benefits, barriers and action plan. Throughout the process, in-depth consultations and meetings with relevant stakeholders were undertaken.

Six mitigation actions were identified and split into two priority groups. The mitigation proposals include interventions aimed at reducing emissions, and those focusing on increasing carbon sequestration. The mitigation actions include switching from synthetic to organic fertilizers, improving agricultural practices, increasing biomass through increased perennial crop production, producing domestic biogas, reducing continuous rice flooding, and improving dairy cattle production.

The cumulative total mitigation potential (High Ambition Scenario) of the LEDS for Food Security for short, medium- and long-term scenario are, 266.28 ktCO<sub>2</sub>e for 2025, 710.09 ktCO<sub>2</sub>e for 2030, and 3,563.19 ktCO<sub>2</sub>e for 2050.

The mitigation options included in the LEDS need to be further developed and detailed out in the form of concrete mitigation plans and a financing strategy. Furthermore, capacities on GHG related programs at all levels (including policy, farmers, research, and extension services) need to be increased, and research and information gaps addressed.

Since the assessment of mitigation options for these two sectors is a recent process undertaken by the RGoB, the list of mitigation actions highlighted in this document is not exhaustive. Additional actions may be elaborated with further assessments.

Table 1: Overview of assessed measures (2021-2050)

| Measure                                                              | Description                                                                                                                                                                                                                                           | Cumulative emission reductions until 2025 (kt CO <sub>2</sub> e) | Cumulative emission reductions until 2030 (kt CO <sub>2</sub> e) | Cumulative emission reductions until 2050 (kt CO <sub>2</sub> e) | Abatement costs USD/ t CO <sub>2</sub> e |
|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------------------------------|------------------------------------------|
| <b>Switch from synthetic to organic fertilizers</b>                  | The mitigation action considers a linear increase of the reduction rate of fertilizer use of 5% each year of the volume of fertilizers used in the baseline scenario.                                                                                 | 1.60                                                             | 6.94                                                             | 57.30                                                            | 12                                       |
| <b>Improved agricultural practices</b>                               | Conversion of 44,914 ha of land to organic management agriculture, which consists of maintaining reduced tillage and improving fertilization level.                                                                                                   | 36.96                                                            | 133.90                                                           | 953.23                                                           | 327                                      |
| <b>Increased biomass through increased perennial crop production</b> | 28,962 hectares of fallow and shrub land are turned into perennial crop production between 2020 and 2050.                                                                                                                                             | 169.97                                                           | 442.505                                                          | 1,978.23                                                         | - 577                                    |
| <b>Domestic biogas production</b>                                    | Implementation of 16,792 new biogas facilities (4, 6, 8 and 10m <sup>3</sup> ) by 2050.                                                                                                                                                               | 52.39                                                            | 107.05                                                           | 409.03                                                           | 14                                       |
| <b>Reduction of continuous rice flooding</b>                         | The mitigation action considers a linear decrease of continuously flooded rice fields of 200 ha per year (from 2021 until 2030) into Intermittently flooded single aeration (100 ha/year) and intermittently flooded multiple aeration (100 ha/year). | 0.08                                                             | 0.29                                                             | 1.34                                                             | 0                                        |
| <b>Increased cattle productivity through improved feeding</b>        | Increase the number of cattle heads under TMR feeding from 0 in 2020 to 25,000 in 2050.                                                                                                                                                               | 5.29                                                             | 19.40                                                            | 164.05                                                           | - 40.71                                  |
| <b>Total</b>                                                         |                                                                                                                                                                                                                                                       | <b>266.28</b>                                                    | <b>710.090</b>                                                   | <b>3563.19</b>                                                   |                                          |

# 1. INTRODUCTION

## 1.1 Objectives of the LEDS

Bhutan committed to remain carbon neutral ‘for all times’ in 2009 at the 15<sup>th</sup> Conference of Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) at Copenhagen. In 2015, this commitment was reiterated and communicated to the UNFCCC in line with the requirements of the Paris Agreement, as part of Bhutan’s Intended Nationally Determined Contribution (INDC) which was ratified as Bhutan’s NDC in 2017. With national emissions on the rise with economic growth (NEC 2020), the goal to remain carbon neutral will require concerted low-emission development strategies across sectors. The GHG Inventory of the Third National Communication (TNC) indicates that the Agriculture, Forestry and Other Land Use (AFOLU) sector is the highest contributor to national emissions with 2,183.25 ktCO<sub>2</sub>e in 2015 (57.2% of national emissions). Within the AFOLU sector, the agriculture sector (agriculture and livestock) emitted 552.9 ktCO<sub>2</sub>e in 2015, accounting for 14.5% of total national emissions. Of this, 63% are livestock related emissions from enteric fermentation; 18.6% are direct and 1.2% indirect N<sub>2</sub>O emissions from soils; 9.6% from rice cultivation; 7.4% from manure management; and 0.2% from urea application (NEC 2020). The agriculture and livestock sectors and their connection to land use are therefore key to the achievement of future national plans in terms of remaining carbon neutral and achieving food security. Economic growth within the agriculture and livestock sector needs to be pursued within a framework of low-carbon emissions while also ensuring alignment with post COVID-19 pandemic recovery plans.

This report presents the LEDS for Food Security which strives to balance the need for food security, post COVID-19 economic recovery and development, and Gross National Happiness (GNH) with Bhutan’s net climate goals. The LEDS for Food Security will inform the contribution of agriculture and livestock sector to the second NDC of Bhutan to the UNFCCC.

## 1.2 Sectoral context for agriculture and livestock

Agriculture and livestock production are key components of the Renewable Natural Resources (RNR) sector. In 2019, crop sector accounted for 10.64% of GDP while the livestock sector contributed 4.3% (MoAF 2021). Given the importance of agriculture and livestock sector in Bhutan, significant attention needs to be paid to the possible impact in terms of GHG emissions from increased domestic production. While emissions from these sectors are survival emissions, there are opportunities

for further reduction with additional investments, capacity building and technology transfer to safeguard basic livelihood.

Agriculture is practiced mostly on small farms of less than 0.9 hectare for subsistence and semi-subsistence purposes. The following crops are the most dominant crops cultivated in Bhutan: Cereals (rice, maize, wheat, buckwheat, barley, millets); fruits and nuts (citrus, apples, walnuts, areca nuts); vegetables (chillies, brassicas); potatoes; cardamom and ginger (DoA 2019). Citrus, apple, potato, cardamom and ginger are the most significant export crops (DoA 2019).

Livestock and livestock products are a significant source of income for households as well as an important source of protein for many families (RGoB n.d.). At least 67% of Bhutan's households have livestock holdings, rearing some cattle, poultry, pigs, horses, goats, sheep and yaks (MoAF 2019). Bhutan produces eggs, dairy products, and meat, although the production of meat is much lower due to cultural and religious sentiments (MoAF 2021).

Despite sustained emphasis on domestic food production, Bhutan heavily relies on imports. By 2017, the import volume and value of the key imported commodities (rice, maize, vegetables, cooking oils, potatoes, fruits, nuts and citrus) increased from 70,867 t worth Nu 1,754 million in 2013 to 120,246 t worth Nu 3,578 million in 2017 (DoA 2019). Cereal imports also increased considerably from 54,031 t to 90,021 t between 2013 to 2017 (DoA 2019). Livestock produce imports have witnessed similar trends. In 2018, Bhutan imported livestock products worth BTN 1.94 billion (out of a total value of BTN 6.13 billion for agricultural imports) (BTS 2018).

Due to this high dependence on imports which threaten national food security, the RGoB has been promoting several policies and establishing several development goals aiming at reversing the situation. To promote transformational change within the sector, the RNR Strategy 2040 proposes eleven strategies to achieve the vision of "Sustainable Natural Resources and Self-reliant Food Systems Contributing to Inclusive Socio-economic Well-being of Bhutanese": (i) enhance production and quality of RNR commodities; (ii) enhance contribution of RNR sector to national economy; (iii) accelerate agri-business development and expansion; (iv) develop enabling policies for RNR sector; (v) strengthen research, innovation and dissemination; (vi) institute efficient RNR service delivery; (vii) enhance production efficiency of RNR commodities; (viii) promote research and innovation; (ix) diversify sustainable financing for RNR sector development; (x) mainstream sustainable management (conservation and utilization) of natural resources; and (xi) enhance and promote resilience to climate change impacts (MoAF 2021).

The 12th Five Year Plan (12FYP) 2018-2023 pursues the following objectives for the agricultural sector: (i) enhance the internal production of key crops such as rice, maize, and citrus; (ii) enhance the irrigation system within the country; and (ii) promote land development and farm mechanization (DoA 2019). As outlined in RNR Strategy 2040, Bhutan aims to pursue self-sufficiency by producing most of its staple foods and only resort to importing those produce which cannot be grown internally (RGoB 2020). The 12FYP also aims to achieve livestock product self-sufficiency by: (i) promoting livestock farming; (ii) enhancing delivery of livestock services; (iii) creating relevant technology; (iv) encouraging youth and public sector investment in livestock enterprises; and (v) promoting the sustainable management and utilization of natural resources (DoL 2019).

### 1.3 Relevant institutions, policies, and programmes

This section summarises the roles and responsibilities of relevant institutions and highlights key legislation and policies that bear on climate related initiatives within the agriculture and livestock sector in Bhutan.

Table 2 Institutions with relevance for the LEDS for Food Security and respective responsibilities

| Relevant Institution                              | Responsibilities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Gross National Happiness Commission (GNHC)</b> | GNHC is charged with promoting coherence and collaboration during formulation and implementation of all government policies and plans, irrespective of their origin, including reaching out to stakeholders. This is to ensure that GNH and other cross-cutting themes is mainstreamed into the planning, policy making and implementation process. It is also responsible for mobilizing public international and bilateral climate finance.                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>National Environment Commission (NEC)</b>      | The NEC is a high level multi-sectoral body, with representatives from various Ministries, Non-Governmental Organizations (NGOs), and the private sector. It is responsible for coordinating all matters relating to the protection, conservation and improvement of the natural environment. One of the core functions of the NEC is to ensure that socio-economic development activities are planned and executed with minimum adverse impact to the environment and human health. Moreover, the NEC is the UNFCCC focal point and the lead authority to coordinate and facilitate the implementation of bilateral and multilateral environmental agreements, conventions, treaties, and declarations. It also has the Secretariat role of the National Climate Change Committee and Chair of the Climate Change Coordination Committee (C4). |

|                                                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|--------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Ministry of Agriculture and Forest (MoAF)</b> | <p>The MoAF aims to ensure sustainable socio-economic well-being through adequate access to food and natural resources. The overall policy objectives include the conservation and promotion of sustainable utilization of forest and water resources, the sustainable use of arable agriculture and pastureland resources and the enhancement of food security within the country. More specific mandates include: support on agricultural land management, drafting of agricultural regulations, providing general guidance on extension services, facilitating the achievement of agricultural production targets, management of genetic resources, development of livestock programmes including improvement of breeds and feed resources, development of guidelines for watershed management, promoting the conservation of wildlife and managing habitat, supporting non-wood forest products management, undertaking agriculture-relevant research, and disseminating information to grassroot level.</p> <p>The most relevant Departments for the development and implementation of the LEDS for Food Security are the Department of Agriculture and the Department of Livestock. The Department of Agriculture (DoA) comprise of three divisions: Agriculture Research and Extension Division (ARED), Agriculture Production Division (APD) and Agriculture Engineering Division (AED). The Department of Livestock (DoL) has three Divisions: The Livestock Production Division (LPD), the Livestock Research &amp; Extension Division (LRED), and the Animal Health Division (AHD). Several national agencies/institutions relevant for the LEDS for Food Security are active under the DoA and DoL. These include the Center for Organic Agriculture, National Soil Services Centre, National Post Harvest Centre, Agriculture Research and Development Centres, Agriculture Machinery Centre, National Organic Flagship Programme, National Plant Protection Centre, National Seed Centre, Farm Machinery Corporation Ltd., Bhutan Livestock Development Corporation Ltd., National Research and Development Centre for Animal Nutrition, Livestock Biogas program, National Dairy Research and Development Centre and the Regional Livestock Development Centres (RLDC) .</p> |
| <b>Ministry of Economic Affairs (MoEA)</b>       | <p>The Ministry has the mandate to set the economic development agenda of the country, and promoting a “green and self-reliant economy”.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Ministry of Foreign Affairs (MoFA)</b>        | <p>The Ministry represents Bhutan in all international negotiations including the ones held under the UNFCCC.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <b>Ministry of Finance (MoF)</b>                 | <p>The Ministry is mandated to formulate and implement a dynamic fiscal policy and sound financial management through maximization of resource generation, efficient allocation, prudent expenditure and debt management, and proper accountability of public resources.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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|-----------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>National, Regional, Dzongkhags, Gewog Extension Services</b> | <p>Institutional arrangements regarding extension services encompasses the national, regional, Dzongkhags and Gewog level. The regional level focuses on the technical capacity building of Dzongkhags and Gewog extension officers, as well as on carrying out the activities that fall beyond the technical capacity of dzongkhags. The DoA and DOL work through Extension Officers at the Dzongkhags and Gewog level to help farmers develop and improve their livelihood. Extension officers work closely with farming communities and other clients providing advisory, technology transfer, facilitation, and administrative services such as linking farmers to domestic and export markets, promoting environmentally sustainable production techniques, adapting to climate change and mobilization of farmers' group. Extension officers can support in the implementation of mitigation measures such as providing technical assistance on increasing rice yield per hectare or milk production through TMR feeding and breed improvements.</p> |
| <b>Private Sector</b>                                           | <p>The presence of private companies within the agricultural commodity production market is limited. A stronger presence of these actors is found in the import and export of agricultural products and contract farming. The private sector has an increasing role in value addition and product development such as value addition in the following products: fresh wild-collected mushrooms, retail honey, crated fruit (mandarins and kiwi fruit), processed hazelnuts, walnuts, black pepper, Sichuan pepper, retail-packaged cardamom, and processed ginger products.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Cooperatives/ Farmer Groups</b>                              | <p>Based on the Cooperatives (Amendment) Act of Bhutan 2009 and with support of the MoAF, several farmers groups and Cooperatives involved in vegetable production, dairy processing, poultry cooperatives, bee keeping, fruit marketing, cereal crop processing and seed production have been created at the grassroots level.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

The following overarching policy documents have been noted and considered for the LEDS for Food Security:

- The Constitution of the Kingdom of Bhutan 2008
- The National Environment Protection Act (NEPA) 2007
- The Economic Development Policy (EDP) 2016
- The Comprehensive Development Plan for Bhutan 2030
- Twelfth Five Year Plan 2018-2023
- Carbon Neutral Declaration 2009
- Nationally Determined Contribution (NDC) 2015
- Climate Change Policy of the Kingdom of Bhutan 2020
- The Third National Communication (TNC) of Bhutan 2021
- RNR Sector 12 Five Year Plan (2018-2023)

- National Environment Strategy 2020
- National Gender Equality Policy 2020
- RNR Strategy 2040
- National Organic Flagship Programme 2018
- National Food & Nutrition Security Policy 2014
- Agriculture Extension Strategy 2019-2028
- National Biogas Implementation Strategy 2020

The LEDS for Food Security additionally considers all relevant strategic sectoral policy documents as presented in Annex A: Documents reviewed for the 2020 LEDS.

## 2. METHODOLOGY

The initial objective was to adopt a two-pronged approach, distinguishing between short (till 2025) and medium (till 2030) term mitigation activities on the one hand and long-term mitigation activities (till 2050) on the other hand. Because the assessment of mitigation options in the agriculture and livestock sector is a recently formalized process, there is currently no specific list of identified mitigation actions in the sector. Therefore, the methodological approach considered here is based on the analysis of high-level policy target to determine the mitigation potential of identified mitigation activities (instead of calculating the mitigation potential of specific projects) (See Figure 1).

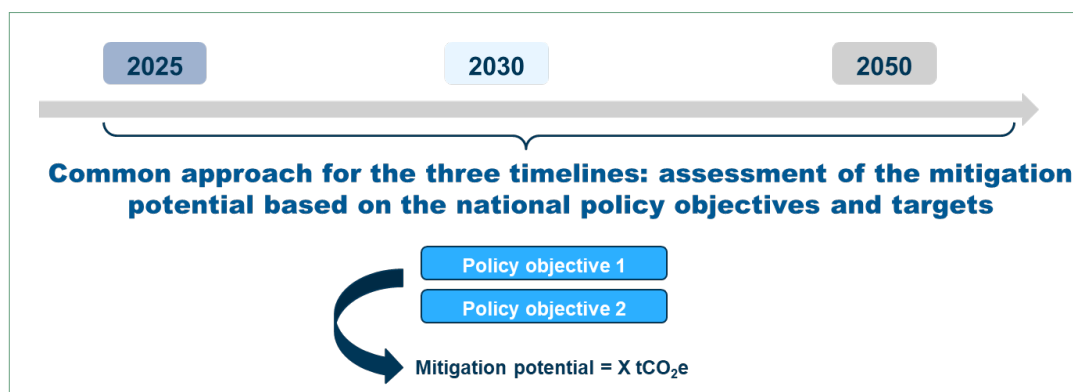


Figure 1: Methodological approach for assessing the mitigation approach

### 2.1 Fundamental methodological questions

- **Boundaries of the agriculture and livestock sectors**

In order to ensure the alignment of LEDS for Food Security with the categorization and methodologies developed under the United Nations Framework Convention on Climate Change (UNFCCC), the work focused on the emissions and sequestration from sources and sinks identified for the agriculture and livestock sectors by the Intergovernmental Panel on Climate Change (IPCC). The 2019 Refinement to the 2006 IPCC Guidelines on National Greenhouse Gas (GHG) Inventories (Calvo Buendia et al. 2019) proposes a categorization of sectors and their related emission sources which includes for agriculture and livestock the following sources of GHG emissions (see the table in Annex 1 that describe emission sources in more details):

- 3A1. Enteric emissions
- 3A2. Manure management
- 3C1. Biomass burning
- 3C2. Liming
- 3C3. Urea application
- 3C4. Direct N<sub>2</sub>O Emissions from managed soils
- 3C5. Indirect N<sub>2</sub>O Emissions from managed soils
- 3C6. Indirect N<sub>2</sub>O Emissions from manure management
- 3C7. Rice cultivation

In addition to GHG emissions arising from the specific farm practices mentioned above, agriculture and livestock sectors practices can have an impact on three carbon pools considered by IPCC guidelines: living biomass (above and below ground), dead organic matter and soil organic carbon. The IPCC guidelines for inventories identify six land uses: Forest land, Cropland, Grassland, Wetlands, Settlements, Other lands (bare soil, rock, ice, etc.). The LEDS for Food Security assessed the impact of agriculture and livestock practices on carbon pools of cropland and grassland.

- **Criteria for prioritization of mitigation activities**

The following criteria were validated for the prioritization of mitigation actions:

- Activities need are included within sectoral boundaries described above.
- Activities need to represent material contribution to mitigation (at least 5% of sectoral emissions except if they have a “catalytic effect” and sustainable development co-benefits).
- Abatement costs
- Sustainable development and GNH co-benefits.

- **Key years for analysis and mitigation scenarios**

The LEDS covers the short (2025), medium (2030) and long term (2050) time frames and two mitigation scenarios are developed:

- **Focused mitigation scenario:** scenario which covers prioritized mitigation activities, taking into account the national interest to develop funding proposals for: (a) carbon markets under Article 6 of the Paris

Agreement (revenues from sale of emission credits); and (b) multilateral/ bilateral public climate finance.

- **High ambition mitigation scenario:** scenario in which all the mitigation activities identified can be achieved.

## 2.2 Methodological approach for assessing the LEDS for Food Security mitigation potential

The approach to estimating the mitigation potential for activities in the short- and medium-term followed four steps:

- Identification of relevant mitigation activities
- Prioritisation of mitigation options, according to prioritisation criteria
- Estimation of baseline emissions and mitigation potential
- Identification of co-benefits, barriers, and action plan

### ▪ Identification of mitigation activities

In the first step, the different documents shared by the national stakeholders were reviewed to assess potential mitigation actions. The documents reviewed are listed in Annex A. This desk-review was completed and validated through consultations undertaken by the national consultant with a broad range of stakeholders from relevant institutions.

### ▪ Prioritisation of mitigation activities

In the second step, activities were prioritised according to the criteria listed in the above section.

Based on the prioritisation exercise, two scenarios were developed:

- scenario covers prioritised mitigation activities, considering the national interest to develop funding proposals for carbon markets under Article 6 of the Paris Agreement (revenues from sale of emission credits) and multilateral/bilateral public climate finance (focused mitigation scenario);
- scenario includes all activities (high ambition scenario).

## ▪ **Estimation of baseline emissions and mitigation potential**

An excel-based tool was developed consisting of two sheets for each of the mitigation actions selected:

- **Parameter's sheet** which includes all the different parameters and assumptions used for the calculations;
- **Projection sheet** which presents the results of the baseline and LEDS for Food Security scenarios.

Given the specificity and uncertainties around the mitigations considered under the LEDS, it is important to note that the baseline developed is not sectoral, but always mitigation activity specific.

### 3. IDENTIFICATION AND PRIORITIZATION OF MITIGATION ACTIONS

Based on the desk-review and national stakeholders consultation process (individual meetings with the national consultants and two dedicated workshops), the following mitigation actions were identified:

- Mitigation actions that reduce emissions:
  - Reduction of continuous rice flooding
  - Switch from synthetic to organic fertilizers
  - Domestic biogas production
  - Increased cattle productivity through improved feeding
- Mitigation actions that increase carbon sequestration:
  - Improved agricultural practices
  - Increased biomass through increased perennial crop production

As described above, the following criteria were identified for prioritization of mitigation actions:

- Activities need are included within sectoral boundaries described above
- Activities need to represent material contribution to mitigation (at least 5% of sectoral emissions except if they have a “catalytic effect” and sustainable development co-benefits)
- Abatement costs
- Sustainable development and GNH co-benefits

Table 3 presents the analysis of sustainable development and GNH co-benefits of the selected mitigation options.

Table 3: Analysis of sustainable development and GNH co-benefits on the selected mitigation actions

| Criterion                                        | GNH indicator (NKRA/KPI) <sup>1</sup>                                                                                                                                                                                                                        | Related SDGs                                                                           |
|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| <b>Improved productivity</b>                     | NKRA 2: Economic Diversity and Productive Capacity Enhanced<br>Total Labour Productivity Level<br>Contribution of Productive Sectors to GDP<br>NKRA 8: Water, Food and Nutrition Security Ensured:<br>Agriculture Land under Cultivation<br>Food Sufficiency | SDG 2: Zero Hunger<br>SDG 8: Economic Growth<br>SDG 13: Climate Action                 |
| <b>Increased water availability</b>              | NKRA 8: Water, Food and Nutrition Security Ensured<br>Food Sufficiency<br>Water security Index                                                                                                                                                               | SDG 13: Climate Action<br>SDG 15: Life on land                                         |
| <b>Improved soil quality</b>                     | NKRA 8: Water, Food and Nutrition Security Ensured<br>Food Sufficiency<br>NKRA 5: Healthy Ecosystem Services Maintained<br>Degraded land                                                                                                                     | SDG 13: Climate Action<br>SDG 15: Life on land                                         |
| <b>Increased energy availability</b>             | NKRA 3: Poverty Eradicated & Inequality Reduced<br>National Poverty rate<br>Subsistence Poverty Rate<br>Inequality of Subjective Wellbeing                                                                                                                   | SDG 7: Affordable and clean energy<br>SDG 8: Economic Growth<br>SDG 13: Climate Action |
| <b>Reduced pressure on natural resources</b>     | NKRA 5: Healthy Ecosystem Services Maintained<br>Degraded land                                                                                                                                                                                               | SDG 13: Climate Action<br>SDG 15: Life on land                                         |
| <b>Increased competition for food production</b> | NKRA 2: Economic Diversity and Productive Capacity Enhanced<br>Total Labour Productivity Level<br>Contribution of Productive Sectors to GDP<br>NKRA 8: Water, Food and Nutrition Security Ensured:<br>Agriculture Land under Cultivation<br>Food Sufficiency | SDG 2: Zero Hunger<br>SDG 8: Economic Growth<br>SDG 13: Climate Action                 |
| <b>Increased ground cover</b>                    | NKRA 5: Healthy Ecosystem Services Maintained<br>Land Degradation                                                                                                                                                                                            | SDG 13: Climate Action<br>SDG 15: Life on land                                         |

<sup>1</sup> NKRA 6 Carbon Neutral, Climate and Disaster Resilient Development Enhanced applies for the different criteria.

For each selected mitigation action, the following aspects were assessed:

- inclusion within the sectoral boundaries
- estimation of mitigation potential
- estimation of abatement costs
- identification of co-benefits

The Table in Annex B presents the assessment of the results of the assessment of those prioritization criteria.

The final decision on the prioritization of mitigation actions is as follows:

Table 4 Prioritization of mitigation actions

| Priority 1 Mitigation Actions                                                                                                                                                                                                                                                     | Priority 2 Mitigation Actions                                                                                                                                                       |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>▪ Switch from synthetic to organic fertilizers</li> <li>▪ Improved agricultural practices</li> <li>▪ Increased biomass through increased perennial crop production</li> <li>▪ Small and medium scale domestic biogas production</li> </ul> | <ul style="list-style-type: none"> <li>▪ Reduction of continuous rice flooding</li> <li>▪ Improved dairy cattle production through breed improvement and feed management</li> </ul> |

## 4. BASELINE & LEDS SCENARIOS AND MITIGATION POTENTIAL ASSOCIATED TO THE SELECTED MITIGATION ACTIONS

In 2015, the total GHG emissions of Bhutan amounted to 3.81 million tCO<sub>2</sub>e (NEC 2020), while net sequestration after accounting for the forest sink reached 5.57 million tCO<sub>2</sub>e. See Figure 2.

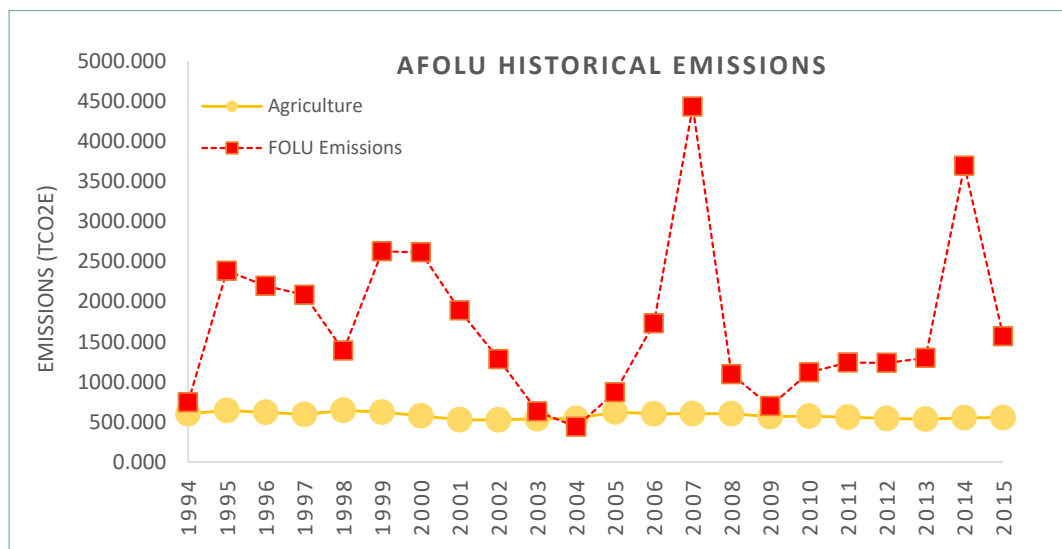


Figure 2: Historical GHG emissions from AFOLU and agriculture only sectors (excluding sink capacity) of Bhutan (after NEC 2020)

As mentioned previously, given the uncertainty on the methodology used for assessing historical agriculture GHG emissions and given the lack of concrete mitigation actions for the agriculture and livestock sectors, we defined baselines that are activity-specific do not cover the whole sector.

### 4.1 Switch from synthetic to organic fertilizers

The National Organic Framework (NOF) is the cornerstone national policy as it sets the target for the conversion of current farming systems to sustainable, natural, and organic management systems.

The International Federation of Organic Agriculture Movements (IFOAM) standards used in Bhutan target several objectives including: “assuring long-term, biologically-based soil fertility and avoiding/minimizing synthetic inputs at all stages of the organic product chain”.

Two mitigation actions considered under the LEDS for Food Security are aligned with the NOF targets, namely the switch from synthetic to organic fertilizers (focused on N<sub>2</sub>O emissions) and improved agricultural practices (considering tillage and fertilization practices on improved soil organic carbon sequestration).

With regards to the first action, urea is the main nitrogen synthetic fertilizer imported in Bhutan. Figure 3 illustrates imports from 2014 to 2018. One of the objectives of the National Organic Flagship Program is to reduce the use of imported synthetic fertilizers and replace them by organic fertilizers that will help to improve soil fertility.

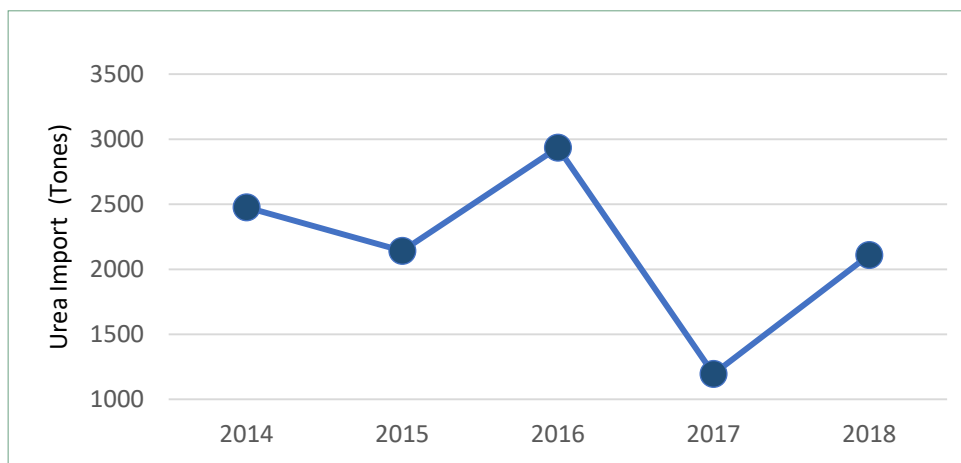


Figure 3: Imports of urea between 2014 and 2018 (after RNR Statistics 2018)

This mitigation action focuses on the shift from synthetic to organic fertilizers assuming no change in the nitrogen dose. When identifying more concrete mitigation actions, it will be relevant to understand if the baseline synthetic N dose applied is adequate or whether there is a potential to adapt (and reduce) the dose to the plants' requirements. Precision fertilization can reduce N<sub>2</sub>O emissions by decreasing the amount of N applied to the soil.

Under the baseline scenario, we assume that synthetic fertilizers consumption would have increased by 5% annually. The mitigation action considers a linear increase of the reduction rate of fertilizer use of 5% each year of the volume of fertilizers used in the baseline scenario (assuming that sufficient organic fertilizers are available) until 2030. From 2031 onwards, the reduction rate remains stable (50%).

Figure 4 presents emissions of the baseline and of the LEDS for Food Security Scenarios.

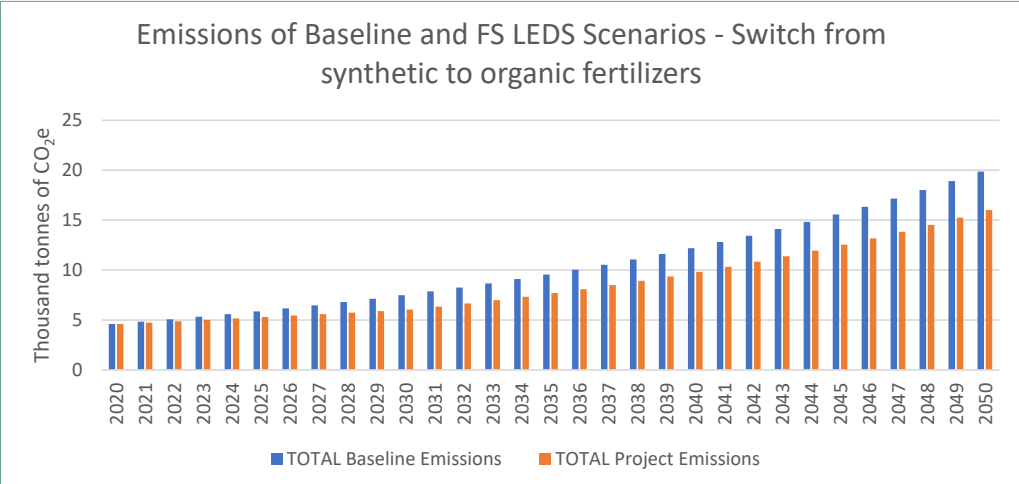


Figure 4: Emissions of Baseline and FS LEDS Scenarios – Switch from Synthetic to Organic Fertilizers

Figure 5 presents the emissions reduction potential of the action undertaken under the LEDS for Food Security.

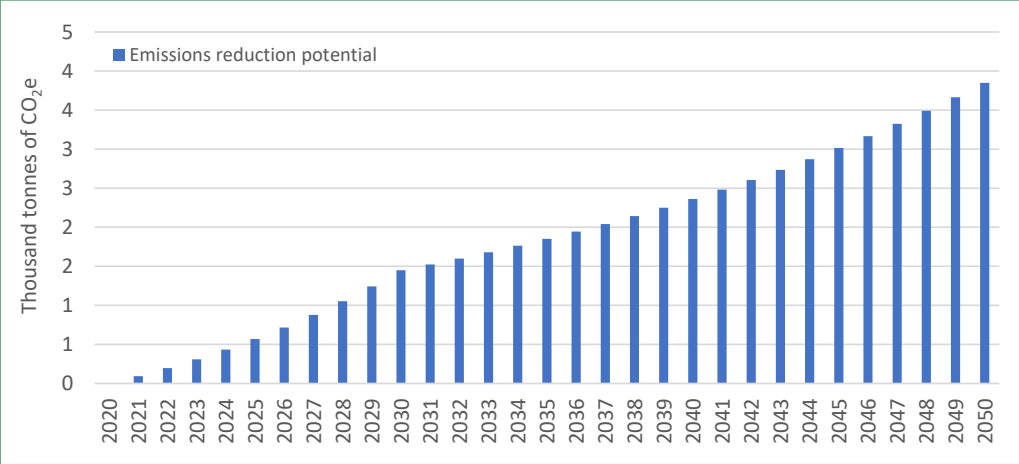


Figure 5: Emissions reduction potential – Switch from synthetic to organic fertilizers

The graphs above show that emissions from the baseline increase steadily because of the increase of synthetic fertilizers use by 5% annually. The progressive shift from synthetic to organic fertilizers in the LEDS for Food Security scenario results in potential mitigation, as one unit of organic fertilizer emits less GHG than one unit of synthetic fertilizer.

|                                                                                                                                                                                                                                                                     |                                                       |                                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|
| <b>Name of the Measure: Switch from Synthetic to Organic Fertilizers</b>                                                                                                                                                                                            |                                                       |                                                        |
| <b>Scenario: Focused Mitigation</b>                                                                                                                                                                                                                                 |                                                       |                                                        |
| <b>Activities Planned:</b><br><b>The mitigation action considers a linear increase of the reduction rate of fertilizer use of 5% each year of the volume of fertilizers used in the baseline scenario till 2030 and stabilizes at 50 % reduction rate till 2050</b> |                                                       |                                                        |
| Mitigation potential 2025<br>1.60 ktCO <sub>2</sub> e                                                                                                                                                                                                               | Mitigation potential 2030<br>6.94 ktCO <sub>2</sub> e | Mitigation potential 2050<br>57.30 ktCO <sub>2</sub> e |
| <b>Abatement Costs: 12 USD / tCO<sub>2</sub>e</b>                                                                                                                                                                                                                   |                                                       |                                                        |
| Co-Benefits: Improved soil quality, better nutrition, and improved health benefits                                                                                                                                                                                  |                                                       |                                                        |

## 4.2 Improved agricultural practices

As mentioned in the previous section, the NOF is the cornerstone national policy which sets the target for the conversion of current farming systems to sustainable, natural, and organic farming systems. The NOF targets an improvement of agricultural practices like conservation agriculture (tillage management), precision farming, protected agriculture (inside greenhouses), water management as well as improved and efficient nutrient management. The objective is to implement practices that are aligned with Bhutan's standard for Good Agricultural Practices (GAP) but also the principles of Climate Smart Agriculture and Agroecology.

For certified organic production, Bhutan uses the IFOAM standards which target several objectives including: "assuring long-term, biologically-based soil fertility and avoiding/minimizing synthetic inputs at all stages of the organic product chain".

This mitigation action focuses on improved and sustainable agricultural practices among those listed above that can increase Soil Organic Carbon (SOC) stocks. According to IPCC guidelines, the level of fertilization (described as level of inputs in the guidelines) as well as the level of tillage are the main factors influencing SOC. We will thus consider tillage practices and fertilization practices (level of fertilization applied).

According to the expert group, the shift to improved agricultural practices will target an additional area of 44,914 ha from 2021 to 2050. A linear increase of this area is considered.

Following IPCC guidelines, for three farming types, we define two parameters as below:

- Low Inputs agriculture which characterizes traditional farming with limited intervention
  - Low tillage
  - Low fertilization
- Conventional agriculture
  - High tillage
  - Medium fertilization
- Organic management agriculture
  - Low tillage
  - High fertilization

In the baseline scenario, we assume a shift from the base year to 2050 as follows:

- Base year 2020: mix of two farming systems: low inputs agriculture represents 80% of the targeted area and conventional agriculture represents 20% of the targeted area;
- 2050: we assume a reversal of the trend: low inputs agriculture represents 20% of targeted areas whereas conventional agriculture represents 80% of targeted areas.

In the LEDS for Food Security scenario, we assume a shift from the base year to 2050 as follows:

- Base year 2020: similar situation as for the baseline scenario (see the description above);
- 2050: we assume that 50% of the targeted area is under organic management agriculture (22,457 ha).

Table 5 describes the situation in the baseline scenario and in the LEDS for Food Security scenario.

Table 5. Situation in the baseline scenario and in the LEDS for Food Security

| Scenario/ Period                                                | 2020                                                                  | 2050                                                                   |
|-----------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------------------------------------------|
| Baseline/ BAU                                                   | LIA: 80%<br>CA: 20%                                                   | CA: 80%<br>LIA: 20%                                                    |
| LEDS                                                            | LIA: 80%<br>CA: 20%                                                   | OMA: 50%<br>LIA/CA: 50%                                                |
| Low Input Agriculture (LIA)<br>Low Tillage<br>Low Fertilization | Conventional Agriculture (CA)<br>High Tillage<br>Medium Fertilization | Organic Management<br>Agriculture<br>Low Tillage<br>High Fertilization |

Figure 6 presents carbon sequestration of the baseline and of the LEDS for Food Security Scenarios.

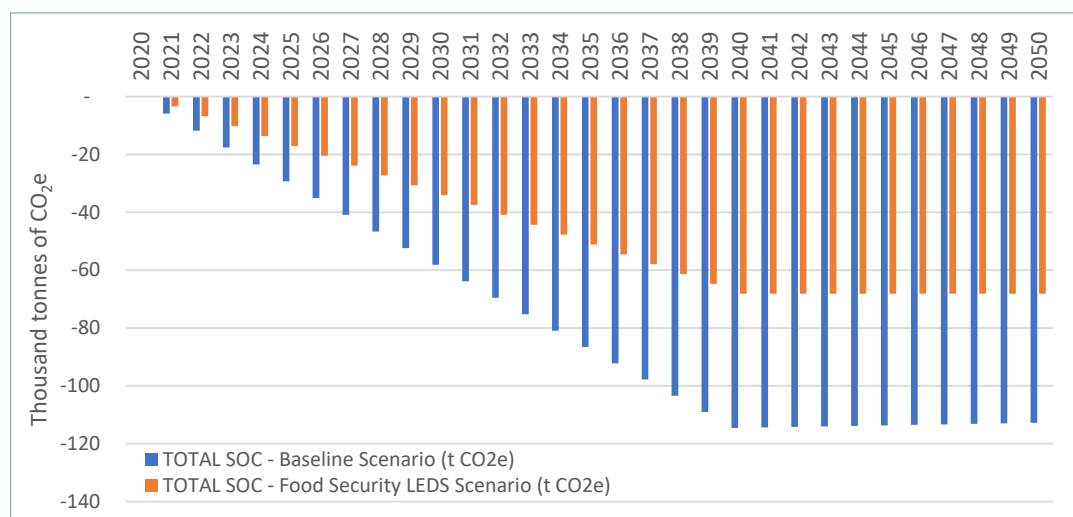


Figure 6: Carbon sequestration of baseline and FS LEDS Scenarios – Improved agricultural practices

Figure 7 presents the increase in carbon sequestration potential of the action undertaken under the LEDS Food Security and shows that during the first 20 years, the mitigation potential of this action increases linearly with the linear increase of areas under improved agriculture practices, which corresponds to organic management agriculture. For each hectare, 20 years are considered as the period needed for reaching the new SOC content equilibrium as suggested in the IPCC guidelines.

This means that one hectare planted in 2020 will yield a mitigation benefit for 20 years until 2040. Therefore after 2040 the mitigation potential decreases slowly compared with the maximum reached in 2040 because of the decrease in total area.

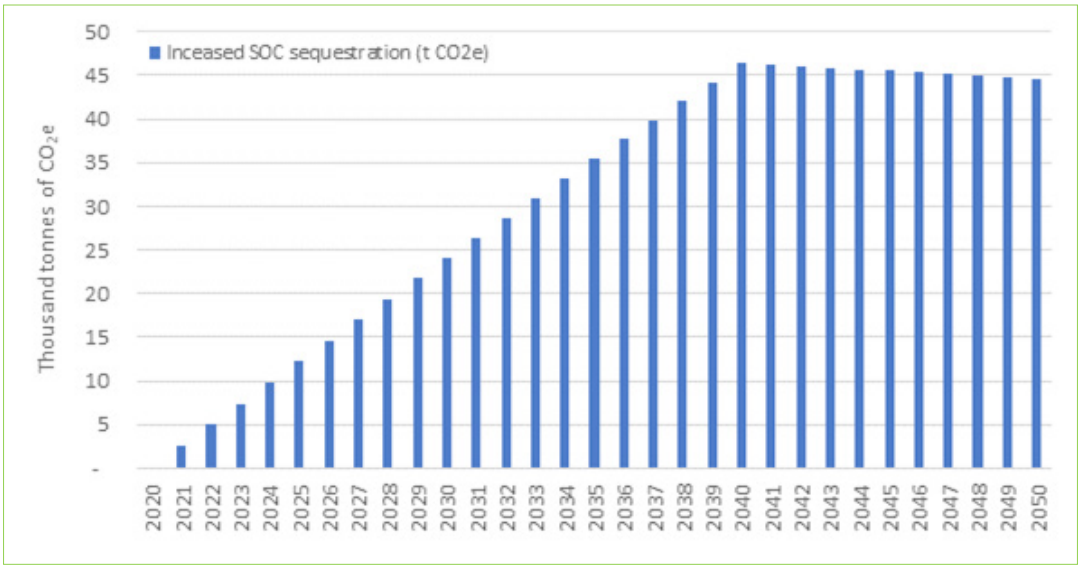


Figure 7: Improved carbon sequestration – Improved agricultural practices

|                                                                                                                                                                         |                                           |                                           |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|-------------------------------------------|
| Name of the Measure: Improved Agricultural Practices                                                                                                                    |                                           |                                           |
| Scenario: Focused Mitigation                                                                                                                                            |                                           |                                           |
| Activities Planned:<br>Conversion of 44,914 ha of land to organic management agriculture, which includes maintaining reduced tillage and improving fertilization level. |                                           |                                           |
| Mitigation potential 2025<br>36.96 ktCO2e                                                                                                                               | Mitigation potential 2030<br>133.90ktCO2e | Mitigation potential 2050<br>953.23ktCO2e |
| Abatement Costs:<br>327 USD / tCO2e                                                                                                                                     |                                           |                                           |
| Co-Benefits: Improved soil quality and water retention                                                                                                                  |                                           |                                           |

### 4.3 Increased biomass through increased perennial crop production and fodder trees plantation

This mitigation actions targets the increase of area under perennial crop production thereby increasing areal extent of carbon stored in biomass.

| Crops                          | Baseline area under perennial crop | Overall Estimated Future Area (ha) |               |               | Estimated Additional Area compared to Previous Period (ha) |              |               |
|--------------------------------|------------------------------------|------------------------------------|---------------|---------------|------------------------------------------------------------|--------------|---------------|
|                                | 2018                               | 2025                               | 2030          | 2050          | 2025                                                       | 2030         | 2050          |
| Hazelnuts                      | 5,455                              | 7,682                              | 8,091         | 8,091         | 2,227                                                      | 409          | 0             |
| Apples                         | 1,068                              | 1,196                              | 1,154         | 985           | 128                                                        | --           | --            |
| Citrus                         | 6,640                              | 8,500                              | 10,525        | 16,622        | 1,860                                                      | 2,025        | 6,097         |
| Temperate Fruits (others)      | 888                                | 899                                | 948           | 1,045         | 11                                                         | 49           | 97            |
| Areca nut                      | 2,796                              | 3,031                              | 3,627         | 6,009         | 235                                                        | 596          | 2,382         |
| Cardamom                       | 8,658                              | 10,658                             | 12,658        | 15,658        | 2,000                                                      | 2,000        | 3,000         |
| Sub-tropical Fruits (others)   | 1,602                              | 2,849                              | 2,993         | 4,570         | 1,247                                                      | 144          | 1,577         |
| Agro-forestry                  | 0                                  | 1,300                              | 1,500         | 3,000         | 1,300                                                      | 200          | 1,500         |
| Fodder Trees                   | 810                                | 1,220                              | 1,626         | 2,033         | 410                                                        | 406          | 407           |
| Improved Pasture and Rangeland | 5,000                              | 10377                              | 10895         | 11439         | 1730                                                       | 518          | 544           |
| <b>Total</b>                   | <b>32,917</b>                      | <b>47,712</b>                      | <b>54,017</b> | <b>69,452</b> | <b>11,148</b>                                              | <b>6,347</b> | <b>15,604</b> |
| <b>TOTAL New Area (ha)</b>     |                                    |                                    |               |               | <b>33,099</b>                                              |              |               |

provided by the expert group indicates the increase in area for the different perennial crops.

Table 6: Area evolution for different perennial crops

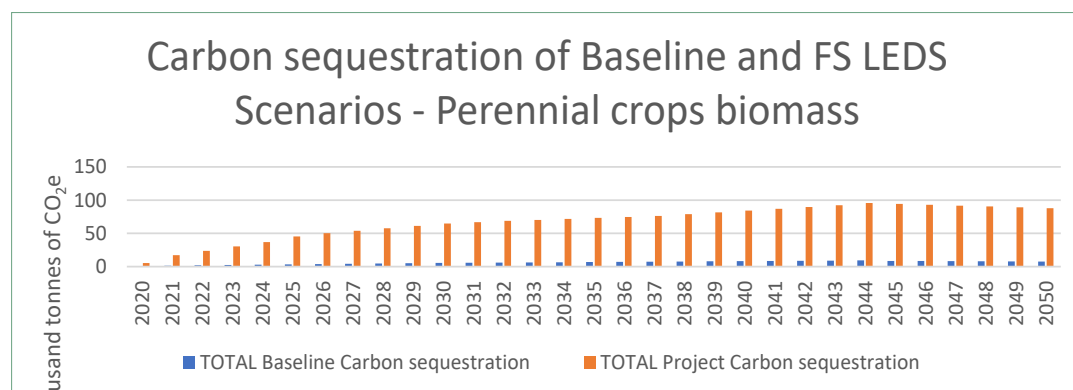
| Crops     | Baseline area under perennial crop | Overall Estimated Future Area (ha) |       |       | Estimated Additional Area compared to Previous Period (ha) |      |      |
|-----------|------------------------------------|------------------------------------|-------|-------|------------------------------------------------------------|------|------|
|           | 2018                               | 2025                               | 2030  | 2050  | 2025                                                       | 2030 | 2050 |
| Hazelnuts | 5,455                              | 7,682                              | 8,091 | 8,091 | 2,227                                                      | 409  | 0    |
| Apples    | 1,068                              | 1,196                              | 1,154 | 985   | 128                                                        | --   | --   |

|                                |               |               |               |               |               |               |               |
|--------------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| Citrus                         | 6,640         | 8,500         | 10,525        | 16,622        | 1,860         | 2,025         | 6,097         |
| Temperate Fruits (others)      | 888           | 899           | 948           | 1,045         | 11            | 49            | 97            |
| Areca nut                      | 2,796         | 3,031         | 3,627         | 6,009         | 235           | 596           | 2,382         |
| Cardamom                       | 8,658         | 10,658        | 12,658        | 15,658        | 2,000         | 2,000         | 3,000         |
| Sub-tropical Fruits (others)   | 1,602         | 2,849         | 2,993         | 4,570         | 1,247         | 144           | 1,577         |
| Agro-forestry                  | 0             | 1,300         | 1,500         | 3,000         | 1,300         | 200           | 1,500         |
| Fodder Trees                   | 810           | 1,220         | 1,626         | 2,033         | 410           | 406           | 407           |
| Improved Pasture and Rangeland | 5,000         | 10377         | 10895         | 11439         | 1730          | 518           | 544           |
| <b>Total</b>                   | <b>32,917</b> | <b>47,712</b> | <b>54,017</b> | <b>69,452</b> | <b>11,148</b> | <b>6,347</b>  | <b>15,604</b> |
| <b>TOTAL New Area (ha)</b>     |               |               |               |               |               | <b>33,099</b> |               |

The total new area that will be planted under perennial crop production between 2018 and 2050 (from 2019 onwards) reaches 33,099 ha. The area planted in 2019 (1345 ha) is not considered part of the LEDS for Food Security, therefore the total area considered under the LEDS accrues to 31,754 ha.

This area is larger than the current available fallow land (approx. 23,000ha) and to increase coverage, plantation on degraded shrubland and dry land can be taken up.

Figure 8 presents carbon sequestration of the baseline and of the LEDS for Food Security Scenarios.



**Figure 8: Carbon sequestration of baseline and FS LEDS Scenarios – Perennial crops biomass**

Figure 9 presents the increase in carbon sequestration potential of the action undertaken under (new areas brought under perennial crop production from 2020 onwards) the LEDS for Food Security.

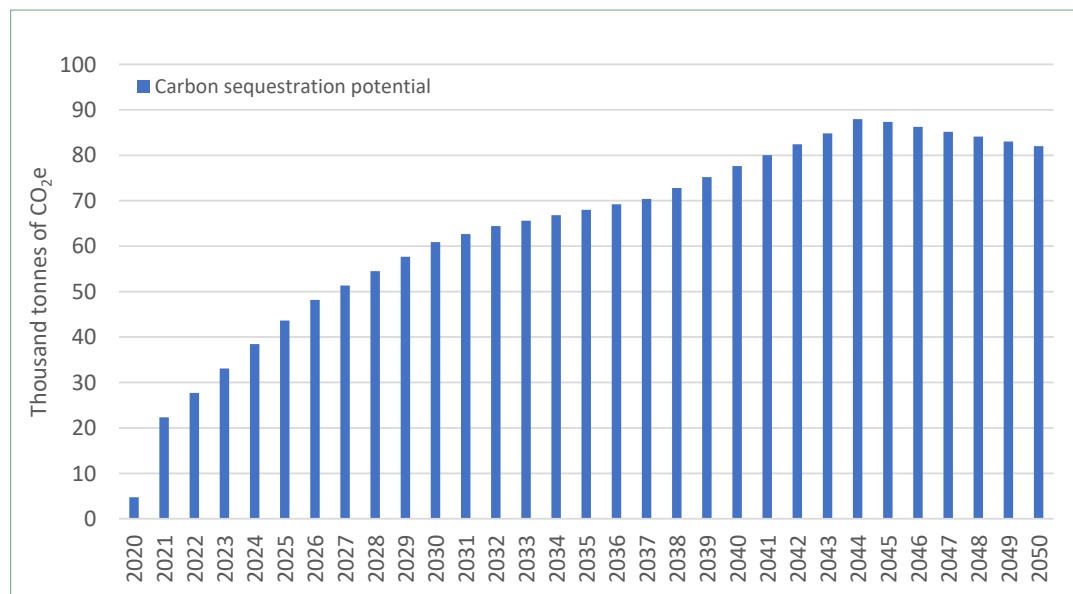


Figure 9: Carbon sequestration potential – Perennial crops biomass

Figure 9 above show the increase in carbon sequestration over the years with the increase of planted area. The mitigation potential increases until 2044, which corresponds to the 25 years lifetime of the major part of the perennial crops considered under the analysis (except cardamom).

|                                                                                                                                         |                                                         |                                                          |
|-----------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|
| <b>Name of the Measure: Increased Biomass through Increased Perennial Crop Production and Fodder Trees Plantation</b>                   |                                                         |                                                          |
| <b>Scenario: Focused Mitigation</b>                                                                                                     |                                                         |                                                          |
| <b>Activities Planned:</b><br><b>33,099.00 hectares of fallow land are turned into perennial crop production between 2020 and 2050.</b> |                                                         |                                                          |
| Mitigation potential 2025<br>169.97 ktCO <sub>2</sub> e                                                                                 | Mitigation potential 2030<br>442.51 ktCO <sub>2</sub> e | Mitigation potential 2050<br>1978.23 ktCO <sub>2</sub> e |
| <b>Abatement Costs: - 577 USD / tCO<sub>2</sub>e</b>                                                                                    |                                                         |                                                          |
| <b>Co-Benefits:</b> Increased food production and nutrition security, ground cover, income and employment generation                    |                                                         |                                                          |

## 4.4 Small and medium scale domestic biogas production

The development of small and medium scale biogas facilities in Bhutan started in 2011 through the Bhutan Biogas Project (BPP) as a joint programme of the Asian Development Bank (ADB), Department of Renewable Energy (DRE), Department of Livestock (DoL), Netherlands Development Organization (SNV) and Bhutan Development Bank Limited (BDBL). Currently, a total of 6983 biogas plants are operational across the country. Small scale biogas plants are defined as those plants with capacity of 4-10m<sup>3</sup>, while medium scale are those with 11-100m<sup>3</sup>. The MoAF will focus on small and medium scale biogas plants based on animal wastes while the industrial production of biogas from other sources may be pursued by the Department of Renewable Energy. Future objectives are to further increase small and medium scale domestic facilities for biogas production. Where feasible, potential for harnessing biogas from piggery and poultry will be explored, that would require facilities smaller than 4m<sup>3</sup>. The biogas produced is used for cooking, replacing the baseline practices of using liquid petroleum gas (LPG). Bio-slurry produced from biogas production will partially meet the demand for organic fertilizers.

The biogas generation potential considered to replace LPG was derived from IRENA (2016), assuming fixed dome plants and the same penetration rate by size as currently observed. We assumed no electricity or fossil fuel consumption for operation of the biogas plants (i.e., no project emissions from these sources), however, leakage of 10% of biogas on a mass basis was considered as per default value from CDM Tool 14 (UNFCCC 2017). For simplification, it was assumed that a biogas plant installed can be operated with appropriate maintenance until the end of the period under consideration. Further guidance on energy content and emission factor for LPG is taken from IPCC 2006 Guidelines and Good Practice Guidance.

Figure 10 presents emissions of the baseline and LEDS for Food Security scenarios.

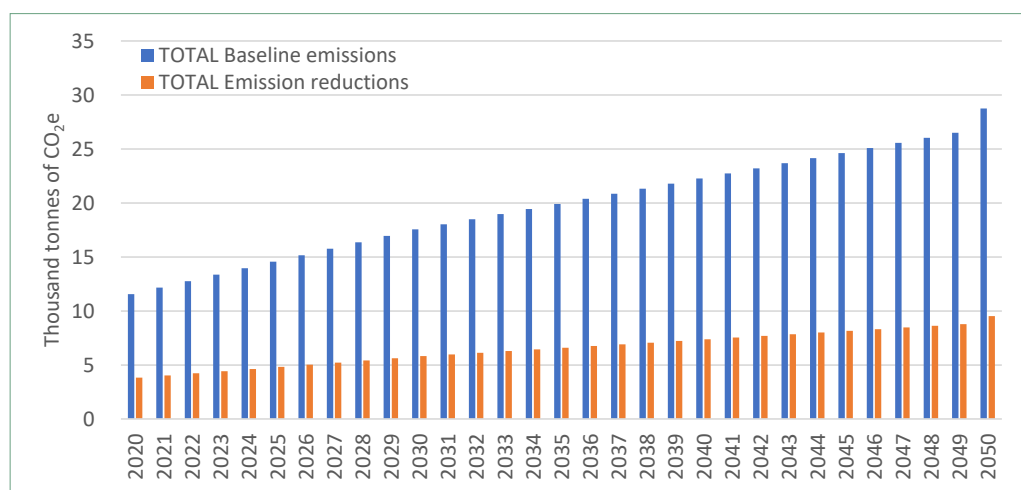


Figure 10: Emissions of Baseline and FS LEDS Scenarios – Small and medium scale domestic Biogas production

Figure 11 presents the emissions reduction potential of the action undertaken under the LEDS for Food Security.

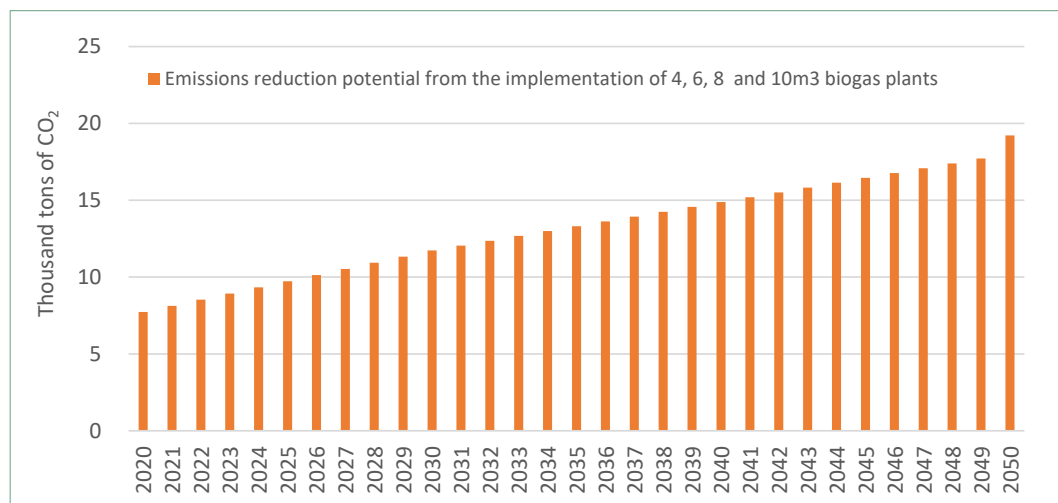


Figure 11: Emissions reduction potential – Small scale domestic biogas production

The graphs above show that emission reductions from biogas production installed from 2020 onwards are growing linearly until approx. 19.217 ktCO<sub>2</sub>e in 2050. Project emissions are related to the 10% leakage associated with the operation of biogas plants.

|                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                          |                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|
| <b>Name of the Measure: Small and Medium Scale Domestic Biogas Production</b>                                                                                                                                                                                                                                                                                                                                                  |                                                          |                                                          |
| <b>Scenario: Focused Mitigation</b>                                                                                                                                                                                                                                                                                                                                                                                            |                                                          |                                                          |
| <b>Activities Planned:</b><br><b>Implementation of 16,792 new biogas facilities by 2050.</b><br><b>Penetration rate was forecasted to be same among the different capacities of biogas digesters compared to the initial situation:</b> <ul style="list-style-type: none"> <li>- 4 m3: 54.8%</li> <li>- 6 m3: 44.9%</li> <li>- 8 m3: 0.2%</li> <li>- 10 m3: 0.0 %</li> <li>- 50 m3: 0.01 %</li> <li>- 75 m3: 0.04 %</li> </ul> |                                                          |                                                          |
| Mitigation potential 2025<br>52.92 ktCO <sub>2</sub> e                                                                                                                                                                                                                                                                                                                                                                         | Mitigation potential 2030<br>107.054 ktCO <sub>2</sub> e | Mitigation potential 2050<br>409.031 ktCO <sub>2</sub> e |

**Abatement Costs: 14 USD / tCO<sub>2</sub>e**

Co-Benefits and Synergies: Increased energy production. Improved indoor air quality. Improved health conditions (including sanitary aspects related to manure treatment). Reduction in energy use and firewood; time benefits; reduction in drudgery particularly for women; Composting and reduction of use of synthetic chemicals. Bio-slurry as by-product is valuable fertilizer for vegetable production benefiting women and children, employment generation, import substitution on LPG.

## 4.5 Reduction of continuous rice flooding

Rice is the main cereal crop of Bhutan and plays a key role for in the food security strategy of the country (MoAF 2018). However, according to the 12FYP (DoA 2019), the average rice self-sufficiency in 2015-2017 was only 46.7%. The increase in rice self-sufficiency is one of the main policy targets for the agriculture sector in Bhutan. Given the high pressure on land due to urbanization, rice fields are expected to decrease in the coming years (Draft, IFPRI 2020). Therefore, maximizing productivity will be crucial for increasing rice self-sufficiency.

The need for mitigation related to rice production is mentioned in several policy documents. Emissions related to rice production are related to water management for paddy fields irrigation. Methane emissions are particularly important in flooded fields where organic material decomposes under anaerobic conditions. In 2018, 14,840 ha were under rice cultivation with the following water management options:

- Irrigated – Continuously flooded [15%]
- Irrigated – Intermittently flooded single aeration [14%]
- Irrigated – Intermittently flooded multiple aeration [21%]
- Rainfed – Regular rainfed [25%]
- Rainfed – Drought prone [25%]

The overall area under continuous flooding in the base year (2020) is relatively low (2226 ha), therefore the possibility to shift methane emissions from rice irrigation are relatively small.

The mitigation action considers a linear decrease of continuously flooded rice fields of 200 ha per year into intermittently flooded single aeration (100 ha/year) and intermittently flooded multiple aeration (100 ha/year).

The productivity level of continuous flooded rice fields is similar to the productivity of fields under intermittent flooding management (6.0 t/ha).

Additionally, the effect of fertilization has not been considered in this high-level analysis. A shift from synthetic to organic fertilizers will not lead to increased methane emission since organic inputs will comprise use of processed organic fertilizers involving improved application methods. Reduction of continuous flooding (alternate wetting and drying) will reduce anaerobic conditions thereby, controlling methane emissions to some extent.

Figure 12 presents emissions of the baseline and of the LEDS for Food Security Scenarios.

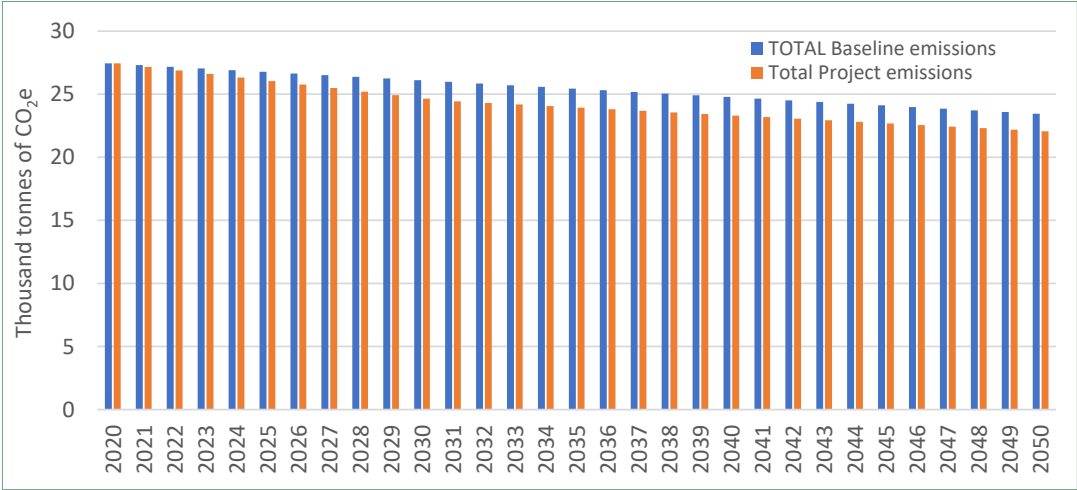


Figure 12: Emissions of baseline and FS LEDS Scenarios – Reduction of continuous rice flooding

Figure 13 presents the emissions reduction potential of the action undertaken under the LEDS for Food Security.

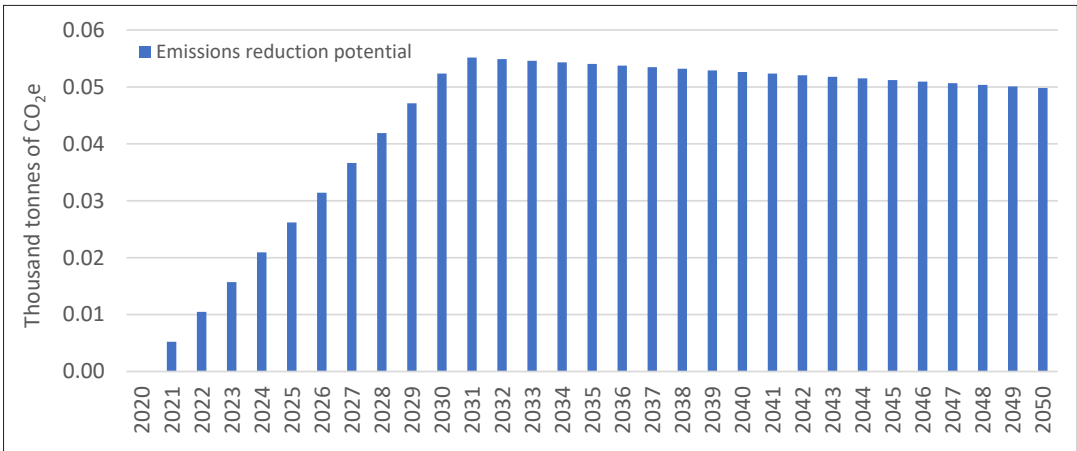


Figure 13: Emission reduction potential - Reduction of continuous rice flooding

The graphs above show that the mitigation potential increases from 2020 until 2031 during the shift of continuous rice flooding irrigation management to intermittent flooding. After 2031, all the existing fields under continuous rice flooding have been converted to intermittent flooding. Therefore, there is no additional increase in the mitigation potential. The slight decrease in the mitigation potential after 2031 is related to the decrease of rice cultivated area.

|                                                                                                                                                                                                                                                                                            |                                                       |                                                       |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------|
| <b>Name of the Measure: Reduction of Continuous Rice Flooding</b>                                                                                                                                                                                                                          |                                                       |                                                       |
| <b>Scenario: High Ambition Mitigation</b>                                                                                                                                                                                                                                                  |                                                       |                                                       |
| <b>Activities Planned:</b><br><b>The mitigation action considers a linear decrease of continuously flooded rice fields of 200 ha per year (from 2021 until 2030) into Intermittently flooded single aeration (100 ha/year) and Intermittently flooded multiple aeration (100 ha/year).</b> |                                                       |                                                       |
| Mitigation potential 2025<br>0.08 ktCO <sub>2</sub> e                                                                                                                                                                                                                                      | Mitigation potential 2030<br>0.29 ktCO <sub>2</sub> e | Mitigation potential 2050<br>1.34 ktCO <sub>2</sub> e |
| <b>Abatement Costs: 0USD / tCO<sub>2</sub>e</b>                                                                                                                                                                                                                                            |                                                       |                                                       |
| Co-Benefits: Increased water availability, labour saving and reduced cost of production                                                                                                                                                                                                    |                                                       |                                                       |

## 4.6 Increased cattle productivity through breed improvement and feeding management

Livestock forms an integral part of agricultural system in Bhutan. About 90% of the farming households keep one form of livestock or the other. The cattle population currently stands at 302,589 heads, of which 40% are improved cattle breeds (DOL 2019). The DoL will intensify crossbreeding activities to replace the majority of the low yielding cattle with high yielding crossbreds. The TNC identifies that enteric emissions represent 63% of the emissions identified under the agriculture sector (552.9 ktCO<sub>2</sub>e). Thus, targeting those emissions present a significant opportunity for reducing the overall contribution of the sector to national emissions.

Currently there are no clear mitigation action identified in the national public policies for reducing those emissions. During the consultation process, national stakeholders identified breed improvement and feeding management through interventions such as the development of Total Mixed Ration (TMR) feeding as relevant option for enhancing productivity of dairy cattle. The possible mitigation action from livestock and their potential co-benefits are mentioned below.

| Interventions                       | Co-benefits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Breed improvement</b>            | <ul style="list-style-type: none"> <li>• Higher productivity (reduction in number of low yielding animals)</li> <li>• Higher income</li> <li>• Lower GHG per unit product</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Improved pasture development</b> | <ul style="list-style-type: none"> <li>• Better nutrition</li> <li>• Efficient fermentation/digestion</li> <li>• Lower enteric GHG per unit product</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>TMR</b>                          | <ul style="list-style-type: none"> <li>• Better nutrition</li> <li>• Higher yield per animal</li> <li>• Lower enteric GHG per unit product</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <b>Stall feeding</b>                | <ul style="list-style-type: none"> <li>• Higher yield per unit area</li> <li>• Facilitate manure management</li> <li>• Reduced grazing pressure on forest</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Biogas</b>                       | <ul style="list-style-type: none"> <li>• Reduced GHG emission</li> <li>• Increased green energy production</li> <li>• Improved indoor air quality</li> <li>• Improved health conditions (including sanitary aspects related to manure treatment)</li> <li>• Reduction in energy use and firewood; time benefits; reduction in drudgery particularly for women;</li> <li>• Composting and reduction of use of synthetic chemicals.</li> <li>• Bio-slurry as by-product is valuable fertilizer for vegetable production benefiting women and children, employment generation</li> <li>• Import substitution on LPG</li> </ul> |

Given the minimal awareness and adoption of TMR currently, the direct impact of TMR on enteric emissions cannot be determined. For this reason, this mitigation action considers the complementarity of breed improvement and the impact of TMR on productivity. We consider here that the use of TMR with improved cattle will improve productivity, therefore the total cattle heads are projected to reduce in the LEDS for Food Security scenario compared to the baseline scenario. The reduced number of cattle heads will induce reduced enteric emissions compared to the baseline situation without negative impact on the production and income.

The current objective is to reach a total number of improved milking cattle under TMR feeding of 25,000 by 2050. A linear increase is assumed. National stakeholders indicated that TMR feeding should increase dairy cattle productivity from 5 to 7 litres of milk per day.

Figure 14 presents emissions of the baseline and of the LEDS for Food Security Scenarios.

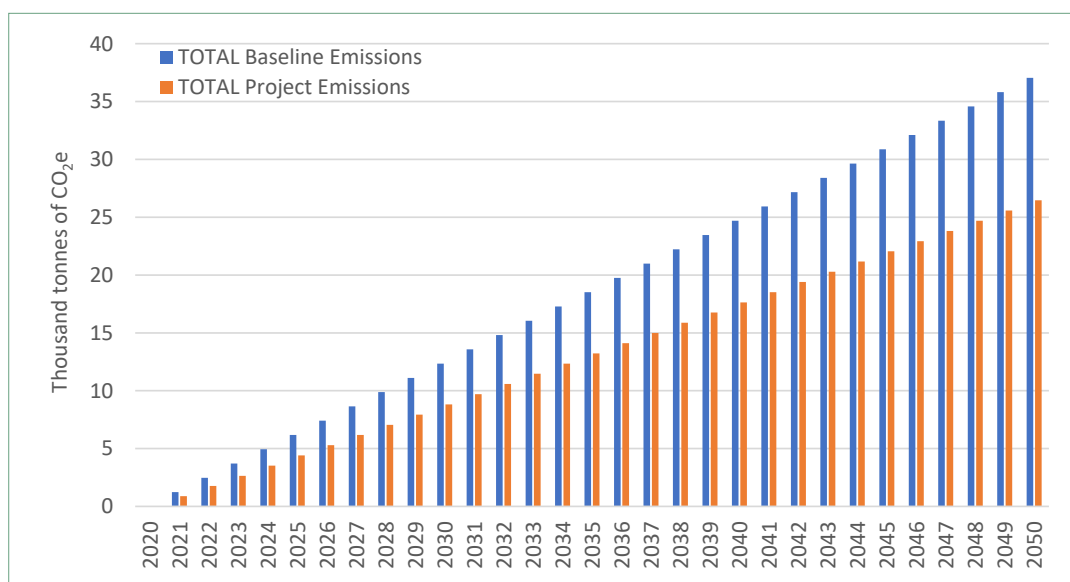


Figure 14: Emissions of baseline and FS LEDS Scenarios – Improved cattle productivity through feeding

Figure 15 presents the emissions reduction potential of the action undertaken under the LEDS for Food Security.

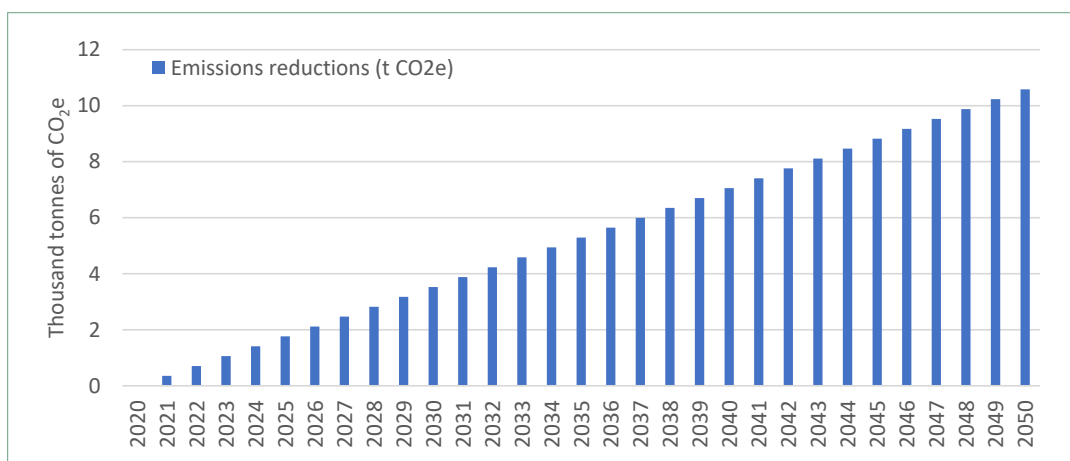


Figure 15: Emissions reduction potential – Improved cattle productivity through feeding and breed improvement

Figure 15 above show that emission reductions increase linearly from 2020 to 2050, along with a linear increase of the number of cattle heads fed with TMR. The same level of milk production is assumed in baseline and LEDS for Food Security scenario. Under TMR feeding, less cattle heads are required to produce the target production,

compared to the baseline scenario under normal feeding conditions. Therefore, the reduced number of cattle heads under the LEDS scenario (TMR feeding) reduces overall dairy cattle emissions.

|                                                                                                                                                                                                                                                                                                                                 |                                                        |                                                         |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|---------------------------------------------------------|
| <b>Name of the Measure: Increased Cattle Productivity through Breed Improvement and Feeding Management</b>                                                                                                                                                                                                                      |                                                        |                                                         |
| <b>Scenario: High Ambition Mitigation</b>                                                                                                                                                                                                                                                                                       |                                                        |                                                         |
| <b>Activities planned:</b><br><b>Increase the number of milking cattle of improved breeds under TMR feeding from 0 (2020) to 25,000 in 2050.</b>                                                                                                                                                                                |                                                        |                                                         |
| Mitigation potential 2025<br>5.29 ktCO <sub>2</sub> e                                                                                                                                                                                                                                                                           | Mitigation potential 2030<br>19.40 ktCO <sub>2</sub> e | Mitigation potential 2050<br>164.05 ktCO <sub>2</sub> e |
| <b>Abatement Costs: -40,71 USD / tCO<sub>2</sub>e</b>                                                                                                                                                                                                                                                                           |                                                        |                                                         |
| Co-Benefits and Synergies: Reduced pressure on grassland, enhanced productivity per animal, increased biogas inputs through manure management under stall-feeding conditions, reduced human-wildlife conflict, watershed protection, reduced disease incidences and better reproductive and breeding performance, labour saved. |                                                        |                                                         |
| <b>Negative Impact: Increased production of animal feed might lead to increased competition with food production.</b>                                                                                                                                                                                                           |                                                        |                                                         |

## 4.7 Overall mitigation potential of the LEDS for Food Security

Table 7 presents the different cumulative mitigation potentials for the two scenarios considered:

Table 7: Cumulative mitigation potentials for the two scenarios

|                                                                                    | 2025    | 2030    | 2050      |
|------------------------------------------------------------------------------------|---------|---------|-----------|
| <b>Cumulative mitigation potential – FOCUSED Scenario (tCO<sub>2</sub>e)</b>       | 184,719 | 551,506 | 2,924,291 |
| <b>Cumulative mitigation potential – HIGH AMBITION Scenario (tCO<sub>2</sub>e)</b> | 242,475 | 678,252 | 3,498,712 |

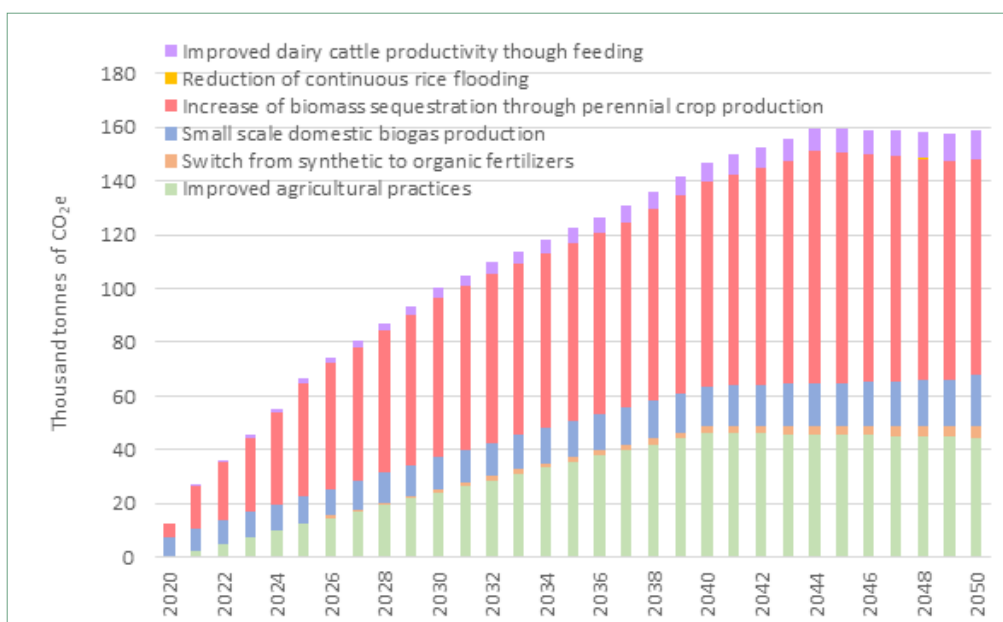


Figure 16. Mitigation potential of 6 selected mitigation actions under the High Ambition Scenario

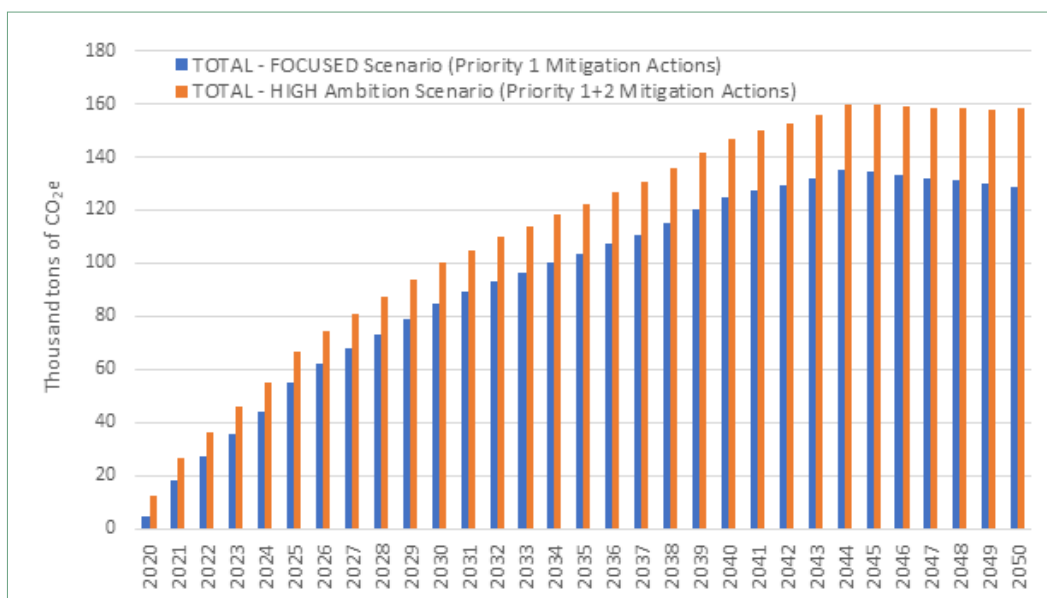


Figure 17. Total mitigation potential under two scenarios

Figure 16 presents the mitigation potential of 6 selected mitigation actions under the High Ambition Scenario and Figure 17 presents the total mitigation potential under two scenarios.

## 5. SYNERGIES

### 5.1 Synergies of the LEDS for Food Security with mitigation in other sectors

Mitigation actions identified for the LEDS for Food Security are aligned with the aim of promoting Climate Smart Agriculture (CSA), one of Bhutan's strategies for Reducing Emissions from Deforestation and Forest Degradation (REDD+) in developing countries, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries (RGoB 2020c). As it is stressed in Bhutan's REDD+ strategy, the implementation of CSA aims to reduce the pressure on forests. Bhutan's Proposed National Forest Reference Emission Level and National Forest Reference Level submitted in 2020 to the UNFCCC stresses that expansion of agriculture areas might exert pressure on forest land (RGoB 2020a). It is projected that about 3,890 ha between 2015 and 2020, and up to 11,670 ha by 2030 would be lost due to conversion of forest land to agriculture (RGoB 2020a). In addition, the REDD+ strategy includes livestock grazing as one of the main causes of forest degradation (RGoB 2020c). Therefore, Bhutan's REDD+ strategy calls for improving agricultural efficiency and diversification through CSA that include activities such as the promotion of high yielding livestock, crop diversification, agroforestry, intercropping, greenhouse farming, advanced irrigation systems, soil conservation and organic farming (RGoB 2020c). The REDD+ strategy is aligned with the mitigation actions considered under the LEDS for Food Security which aim to reduce pressure on natural resources by increasing productivity.

The emission reductions interventions identified in the LEDS, particularly the improvement of dairy cattle productivity through breed improvement and feeding management interventions such as TMR can reduce cattle heads compared to the baseline scenario, and hence, reduce pressure on grassland areas and grazing within the forest and allow for adequate natural forest regeneration. Also, the TMR/pasture mix composition is envisaged to have positive influence on the reduction of overall pressure on forest. A 100% TMR composition will have the most positive impact on reducing forest pressure. Scientific research advocates towards more balanced diet that includes TMR and improved pasture to avoid an overall increase in GHG emissions. Improved cattle breeds, which is an ongoing process in the country and improved pasture in tandem with stall feeding and biogas plants will have a multiplier effect in carbon sequestration, emission avoidance, and reduced pressure on forest and biodiversity. Additionally, small, and medium scale domestic biogas production enables slurry composting which is a resource that can be used for permaculture, commercial farms, and amenity landscaping. While other agriculture-

related mitigation activities have been identified, as per IPCC Guidelines, their mitigation potential are to be analysed under other sectors (i.e., energy).

Farm mechanization has been a key policy of the RGoB since 1983, when the Agriculture Machinery Centre (AMC) was established (Gurung et al. 2017). This goal has been reaffirmed through several policies such as the Five-year Plans. These farm mechanization policies have focused mainly on the supplying of machinery and labour-saving tools and capacity building processes in operation of machinery, maintenance, and management (DoA 2019). The supply of machinery has been mainly in land preparation, transplanting, harvesting and post-harvest processing of mainly rice, maize and potato (Gurung et al. 2017). Currently, machinery supply is carried out not only by the AMC but also by the Farm Machinery Corporation Limited (FMCL) and in the latest years by private firms (Gurung et al. 2017). By 2017, more than 3000 units of 12 hp power tillers were supplied by the private sector besides many other machineries, with its participation in the market expected to increase in the coming years (Gurung et al. 2017).

Farm mechanization aims to alleviate farm labour shortages and the drudgery associated with it while also improving productivity and reducing the pressure on the forest resources. However, farm mechanization can also increase energy emissions related to farming. In this sense, the role of the AMC is key to identify environmentally friendly farm mechanization technology. Research and development of sustainable farm mechanization might include the identification of state-of-the-art machinery with efficient use of energy, proper size of tractors, use of low horsepower tractors, reduction in the use of fossil fuels, use of renewable energy or biofuels, and allow for alternatives to motorized mechanization systems. According to officials, electric-operated machineries may gradually replace fuel operated machineries. Emissions and mitigation potential from farm mechanization have been included under the energy sector given that they are related to fuel use. However, during the implementation phase in the mitigation process, the agriculture sector as the concerned stakeholder, may take the lead role. It is important that agriculture sector coordinate with the energy sector to identify synergies of mitigation measures such as large-scale biogas plants which can enable to enhance not only the performance of the LEDS for Food Security Bhutan, but also the overall national GHG mitigation potential.

Given the topography, sustainable land management in Bhutan employing terracing, hedge rows plantations, and other measures, will not only help reduce soil erosion, but also help bring under production limited land resources. Reduction of soil erosion can positively impact soil carbon sequestration. However, given the uncertainty on

the quantification of such processes that are highly diverse and subject to slope and soil characteristics, the mitigation potential associated with measures preventing erosion is not quantified in the LEDS for Food Security. Enhanced soil microbial health through improved irrigation systems also offers opportunities both in terms of raising productivity and in enabling soil carbon sequestration process.

Transformation and commercialization of agricultural products can also impact emissions of the energy and transport sectors. In the past years, improvements in Bhutan's infrastructure, as well as internal migration processes have created more complex rural-urban interactions and has created a higher demand for cereals, vegetables, and dairy products (Dhendup 2018). Moreover, exports to neighbouring countries (India and Bangladesh) have increased in the past years. Additionally, the agriculture sector in coordination with other stakeholders in the processing and supply chain sector should investigate designing and putting in place appropriate intervention measures to reduce post-harvest and storage related emissions. Synergies will need to be built into interventions pertaining to urban food waste management.

The participation and capacity building of food processing, regulatory, and certification agencies, on the mitigation actions taken in the agriculture and livestock sector will be important. Mitigation actions should be aligned with other policies and actions in the agriculture and livestock sector.

## 5.2 Synergies of the LEDS for Food Security with other national policies

Besides the synergies with other GHG sectors, it is important to align the LEDS with other national strategies and plans. This LEDS has been designed based on the review of key Bhutanese policies and programmes (Annex A). The draft RNR Strategy for 2040 is one of the key documents that was used to develop the LEDS. In the following paragraphs relevant synergies with the following policy instruments and programmes will be assessed:

- the Post-COVID-19 Economic Contingency Plan (Part I)
- the National Adaptation Plan (NAP) process.

In addition, synergies with relevant cross-cutting issues such as gender and biodiversity conservation will also be stressed.

As a response to the economic repercussions of the COVID-19 pandemic, the government presented an Economic Contingency Plan (ECP) (RGoB 2020b) to mitigate and address the impacts on the sectors most affected by the pandemic:

tourism and allied sectors, construction, and agricultural sector. The ECP of the agricultural sector on food self-sufficiency and nutrition security aims to boost agriculture and livestock production, bring back potential fallow lands under cultivation, provide alternative employment for displaced people, and improve and enhance market access. The LEDS for Food Security is aligned with the targets of increasing food production and increasing the use of fallow lands.

Due to the geography of the country, small agricultural landholders are highly vulnerable to the effects of climate change. Their cultivated land is prone to landslides and erosion. About 61% of dry arable land is rain-fed with no adequate irrigation facilities and remain highly vulnerable to irregular rainfall patterns. Extreme events such as flash floods, windstorms, pests, and diseases outbreaks continue to take a toll on crop yield (NEC 2020). Limited resources and precarious socio-economics status of farmers in rural areas mean lower adaptive capacity to the impacts of climate (NEC 2020). To cope with these challenges, the vulnerability assessment undertaken in the context of the TNC identified several adaptation priorities and measures to ensure food security such as: improving irrigation including storage and pumping systems promoting sustainable land management techniques; adopting new crops; as well as development and use of crop varieties and animal breeds resilient to climate change. In this sense, it is important to undertake further studies to identify areas where, for example, rice production and perennial crops are expected to expand, and to identify their possible vulnerability to climate change impacts. Currently, Bhutan is in the process of developing a NAP, which will complement the vulnerability assessment, and an appraisal and prioritisation of adaptation options undertaken for the TNC. The finalisation of the initial NAP document is foreseen for 2023 and it is important that it explores synergies with mitigation activities proposed in this document.

In 2020, a study on gender and climate change with a focus on agriculture, energy and waste was undertaken by the National Commission for Women and Children (NCWC) in partnership with the NEC and the United Nations Development Programme (UNDP). The study aimed to support Bhutan's policy effort to be gender-responsive while pursuing its carbon-neutral and sustainable development vision (NCWC 2020), and in keeping with the National Gender Equality Policy and the National Plan of Action for Gender Equality (2019-2023), the NKRA 6 "climate" and NKRA10 "gender equality" of the 12FYP and the GNH Index. Recommendations pertaining to the agriculture sector included: (i) designing mitigation and adaptation programs to meet the needs and priorities of rural women and men; (ii) facilitating and ensuring rural women's access to sustainable technologies; (iii) promoting awareness of female and male farmers on climate smart and resilient agriculture; (iv) and facilitating equal participation in access to benefits.

Table 8: Linkages of selected mitigation actions with gender dimensions of the NCWC 2020 report and specific gender considerations

| Mitigation Action                                                               | General Link with Gender Dimensions of the NCWC 2020 Report                                                                                                         | Specific Gender Considerations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. <b>Switch from synthetic to organic fertilizers</b>                          | Job opportunities for rural women that can contribute to their empowerment, leadership building and better livelihood and life quality                              | If the development of organic farming is accompanied by education, increase of agricultural knowledge and marketing capacity, organic farming can contribute to the empowerment of women (Deb Nath and Athinuwat 2020)                                                                                                                                                                                                                                                                                                                                                      |
| 2. <b>Improved agricultural practices</b>                                       | Enhance rural womens' access and control over productive resources of good quality                                                                                  | If the improvement of N balance is targeted, the literature indicates that a more balanced use of N can secure equity in intra-household decision-making, as long as policies implemented have a gender approach component (Rozel et al. 2017)                                                                                                                                                                                                                                                                                                                              |
| 3. <b>Increased biomass through increased perennial crop production</b>         | Promote access of rural women to sustainable technologies thereby reducing drudgery                                                                                 | Increasing biomass through hazelnut and other nut/fruit plantations can easily create job opportunities for women, because harvesting such crops does not require heavy manual labour, offering an ideal source of income                                                                                                                                                                                                                                                                                                                                                   |
| 4. <b>Small and medium scale domestic biogas production</b>                     | Promote women's participation in supply and access to renewable energy technologies                                                                                 | Access to biogas can reduce time in household activities such as cooking and cleaning time, allowing women to use the extra time in other activities such as harvesting and kitchen gardening. It also reduces the time exposed to smoke, thereby lessening potential health problems in women.                                                                                                                                                                                                                                                                             |
| 5. <b>Reduction of continuous rice flooding</b>                                 | Promote awareness and ensure womens' access to organic agriculture and CSA                                                                                          | Rice irrigation seems to be a task shared equally by women and men in Bhutan and represents 9 days of work per acre (Dorji et al. 1990). Shift to intermittent flooding may require a slight increase of irrigation work which will affect both men and women. The increase in labour intensity may increase the burden of women's tasks, therefore adequate measures should be implemented to ensure a balanced repartition of the task.                                                                                                                                   |
| 6. <b>Improved dairy cattle production through feeding and breed management</b> | Job opportunities for rural women that can contribute to their empowerment and leadership-building<br><br>Promote access of rural women to sustainable technologies | Men and women in Bhutan have almost equal responsibilities in rearing of livestock (RGoB 2001). However, in some households in Thimphu and Haa, women are mainly the ones responsible for activities such as fodder collection and livestock care (RGoB 2001). Availability of readymade TMR locally will potentially reduce women's workload. Also, by increasing the productivity, TMR enables to reduce the number of cattle heads and therefore decrease the time required for cattle care. More precise impact assessment of TMR on women labour should be undertaken. |

When properly implemented, mitigation actions under LEDS for Food Security can contribute to reach gender equality and women and girls empowerment goals, by addressing women unemployment rate and gender payment gaps. Most of the emission reduction strategies proposed (modification of rice irrigation techniques, increasement of organic fertilizers,) imply more workforce than the baseline scenario activities. Taking into consideration that half of the farmers are female, and that feminisation of agriculture is taking place due to male out-migration (NCWC 2020), rural women are strong candidates to supply the job demand that the mitigation actions will trigger. However, for this to be achieved, it is necessary to strongly engage girls into agriculture-related education as well as to design a capacity-building plan for rural women to properly participate in the new job opportunities. Trainings should not only be technology-oriented, but also focus on enhancing their soft skills, such as their communication and leadership abilities to make informed farming decisions. Moreover, CSA job opportunities not only allow accessing the job market, but additionally allow women to enjoy a better-quality life.

The interventions proposed under livestock LEDS complement both land management and forest protection while providing more carbon sinks and emission avoidance. Establishment of improved pastures along with breed improvement as well as development of fodder trees plantation areas (included in the mitigation actions) will have slope stabilization, prevent soil nutrient run-off and reduce grazing pressure on forest resources. The bio-slurry generated through biogas plants is laden with rich nutrient that contribute to agriculture, for production of organic fertilizer or direct application to crops.

Bhutan is a party to the Convention on Biological Diversity and by 2017 it had adopted 15 national policies and 16 national legislations related to biodiversity and climate change aspects (BIOFIN 2016/2017). On one side, the LEDS for Food Security should be aligned with these laws and policies to avoid negative impact on the biodiversity. For example, biodiversity can be safeguarded by increasing the area of perennial crops through shade-grown systems instead of sun-grown monocultures.

On the other side, mitigation actions proposed can contribute to protect biodiversity within the country. Land use conversion, over grazing, unsustainable agricultural practices, human wildlife conflicts are direct threats to biodiversity in Bhutan (BIOFIN 2016/2017). Most of the emission reductions and carbon sequestration strategies provided in the LEDS can address these drivers.

TMR feeding can reduce the exposure of livestock to wildlife depredation. When implementing the LEDS, a strong coordination with the Department of Forests and

Park Services (DoFPS) and the National Biodiversity Centre (NBC) is encouraged to verify that strategies being implemented do not have a negative impact on biodiversity.

Additionally, the LEDS for Food Security is part of a nation-wide assessment of mitigation actions. For certain sectors like waste treatment boundaries were defined between the different LEDS to avoid double counting of activities. The LEDS for Food Security includes for instance small and medium scale biogas production facilities from animal manure. Other actions included in the waste management policy like urban composting are tackled in the corresponding LEDS (Human Settlements LEDS in the case of urban composting).

## 6. IMPLEMENTATION PLAN AND STRATEGY

The objective of this section is to provide recommendations on how to develop concrete proposals for roll-out and financing of short- and medium-term measures, taking into consideration the implementation timeline for planned measures, as well as the barriers to implementation described in section 4. For this, three components are considered:

- Governance and policy, i.e., questions that relate to the concrete implementation of policy measures and programmes to support the mitigation actions identified, as well as the definition of institutional responsibilities.
- Addressing technology and capacity barriers.
- Opportunities for mobilising finance, considering international climate finance, the potential of attracting revenues from international market mechanisms and the cooperation with development partners.

Table 9 outlines the institutions responsible for implementation of the priority mitigation actions.

Table 9: Implementing institutions for the various mitigation actions

| No | Priority Action                                                                                                                                                                   | Targets      |               |                           | Lead        | Collaborator                                                                          |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------|---------------------------|-------------|---------------------------------------------------------------------------------------|
|    |                                                                                                                                                                                   | Short (2025) | Medium (2030) | Long term (2050)          |             |                                                                                       |
| 1  | Switch from synthetic to organic fertilizers: reduction in synthetic fertilizer usage to                                                                                          | 25%          | 50%           | 50% (retain same as 2030) | DoA         | NCOA, NSSC, ARDCs, NSC, Private Sector, LG, NEC, DoFPS, DoL                           |
| 2  | Improved agriculture practices: area of land converted to organic agriculture management                                                                                          | 13046 ha     | 20531 ha      | 50474 ha                  | DoA         | ARDCs, AMC, FMCL, NPPC, NSSC, Private Sector, LG                                      |
| 3  | Increased biomass through increased perennial crop production. Additional area of fallow and shrub land brought under perennial crop production including fodder tree plantations | 11148 ha     | 6347 ha       | 15604 ha                  | DoA/<br>DoL | ARDCs, NSC, Private Sector, LG, DoFPS<br>Dzongkhags, RLDC, GNHC, NEC, Farmers, NRDCAN |

|   |                                                                                                               |          |          |           |     |                                                                                     |
|---|---------------------------------------------------------------------------------------------------------------|----------|----------|-----------|-----|-------------------------------------------------------------------------------------|
| 4 | Reduction of continuous rice flooding<br>Decrease in area under continuously flooded rice fields to           | 1172 ha  | 118 ha   | 0 ha      | DoA | ARDCs, LG                                                                           |
| 5 | Small and medium Scale domestic biogas production                                                             | 3783 Nos | 6335 Nos | 16792 Nos | DoL | Dzongkhags<br>RLDCs<br>DRE<br>DOA<br>NECS<br>GNHC<br>Farmers<br>Private Enterprises |
| 6 | Increased cattle productivity and reduced population through breed improvement (local: improved) <sup>2</sup> | 55:45    | 50:50    | 45:55     | DOL | NDRDC<br>RLDC<br>Dzongkhag<br>GNHC<br>NECS<br>BLDCL                                 |
| 7 | Increased number of improved breed cattle accessing TMR                                                       | 4167     | 8333     | 25000     | DoL | NRDCAN<br>Dzongkhags<br>RLDC<br>DoFPS<br>GNHC<br>NECS<br>Farmers                    |

## 6.1 Developing governance structures and policy measures to support the implementation of identified activities

This LEDS for Food Security is a first step for MoAF towards the development of a sound mitigation strategy in the agriculture and livestock sector. The MoAF will ensure integration of mitigation actions outlined in the LEDS within the sector's plans, policies, and programs. It is understood that further work must be undertaken to be able to refine mitigation options, prioritize them, and develop a more detailed mitigation plan. For this to be achieved, the MoAF needs to undertake certain activities which includes the building of internal capacities and addressing information and data needs that currently exist.

<sup>2</sup> Not captured in the analysis but important to be considered for the mitigation action on the 'breed improvement and feeding management'.

Strengthening data collection processes is key to help better understand current context and thereby avoid uncertainties when developing a forward-looking approach. Data gaps refer to uncertainty on calculating current areas under cultivation (i.e., data gaps observed during estimation of rice cultivated areas), but also the identification of proper combination of TMR concentrate and pasture vis-à-vis breed improvement that is needed to reduce emissions in the sector.

Strengthening internal capacities on mitigation-related aspects will contribute to enhance the understanding of key data and assumptions for defining the future strategy. This recommendation applies for actions related to the agriculture and livestock sector with energy-related emissions; for instance, there is currently no information on the fuel use for farm machineries.

The taskforce set up for the LEDS preparation is one of the successful outcomes of the preparation of the Food Security strategy. It has been materialized by the setup of small working groups of experts targeting specific technical issues. It is therefore recommended to pursue the engagement of the sectorial experts and the technical discussions started under the LEDS, with a specific plan of action for the Task Force.

It is important to ensure that the work undertaken for the LEDS for Food Security is aligned with the national mitigation effort. The contribution of the LEDS for Food Security could be coordinated through an institutional working group which could gather the following institutions: MoAF, NEC, GNHC, MoEA, and the Ministry of Finance, as well as representatives from Dzongkhags and other relevant agencies.

The main role of the institutional working group should be to: (i) approve the mitigation efforts under the LEDS for Food Security; (ii) provide detailed guidance on mitigation activities, (iii) ensure implementation of the priority mitigation actions in close coordination with the LGs and other relevant stakeholders; (iv) ensure the alignment of the LEDS for Food Security with the other sectors; and (v) explore mobilization of resources in coordination with the GNHC. To achieve these goals, it is important for the institutional working group to have an official status, and discussions and alignment need to be maintained and carried out by high-level officials.

In the long run, it is important to involve civil society organizations through special awareness raising and behavioural programmes. This is an activity that would mainly need to be conducted at the Dzongkhags where technical assistance is provided to farmers (e.g., reinforcing farmers' capacity building on sustainable rice irrigation management systems like alternate wetting and drying). These

activities, besides mainstreaming LEDS to the most local level, can also help to gather inputs to improve the strategy through a bottoms-up approach. In addition, with guidance from the institutional working group, local governments shall work towards improving their data collection systems to ensure monitoring and reporting of emission reductions. Capacity building of Dzongkhag experts on data collection, processing and visualization systems should be prioritized to ensure and facilitate the access to good quality data.

## 6.2 Addressing technology barriers

Further work needs to be carried out by the MoAF regarding the identification of technologies that could be useful for the mitigation of emissions in the Agriculture and Livestock sector. As mentioned in the previous section, the strengthening of capacities of MoAF officials including those at the local level will be a key first step towards the prioritization of mitigation actions and the consecutive identification of relevant technologies.

Concurrently, it is important to bear in mind that the Agriculture and Livestock Sector has the overarching goal to increase its production. Thus, it is important to identify technologies that can ease the process of reaching the goal, but without producing any additional harm to the environment, and being sensitive to gender needs. Moreover, it is relevant to stress that the proper technology does not only refer to use of state-of-the-art technology, but also can imply relying on traditional or ancient technology.

Addressing institutional governance needs and technology gaps are crucial to enable the shift from a policy level Food Security to a more concrete strategy. The following steps should be followed:

- Define clear activity boundaries and mitigation potential attributable to specific activities;
- Selection of activities which enable catalytic changes (transformational activities);
- Define clear implementation responsibilities for activities;
- Continue identifying and addressing data gaps to develop monitoring approaches, as part of the development of an information and communication technology (ICT) enabled data collection and management system;
- Identify and promote co-benefits of identified activities; and
- Enhance national, regional and international institutional linkages

## 6.3 Mobilizing international climate finance and revenues from international carbon market mechanisms

Several sources of international financing for activities on low emission agriculture and livestock in low-income countries exist in the form of bilateral and multilateral institutions such as government aid agencies, development banks and international funds, foundations, private sector (Basak 2015) and market-based mechanisms.

The GNHC, which is charged with promoting coherence and collaboration during formulation and implementation of all government policies is also responsible for mobilising public international and bilateral climate finance. Therefore, this institution will play a key role in the definition of the strategy for financing the LEDS for Food Security. Additionally, a concerted effort to mobilize resources may be undertaken wherein, the MoAF as the lead technical agency could also identify potential financing windows as provided in Table 10 and initiate mobilization through existing resource mobilization systems and processes.

### ● **Bilateral and Multilateral Sources of Climate Finance**

Despite COVID-19-induced economic disruptions, Bhutan's plan to graduate from the group of LDCs in 2023 is still in place (SAM 2020). Although official development assistance (ODA) is expected to decrease, development financing should not be significantly affected because LDC status is not a critical factor when deciding about aid allocation (UNESCAP 2020)<sup>3</sup>. Therefore, Bhutan is still a strong candidate to access international climate finance through avenues such as the Green Climate Fund (GCF) or the NAMA facility for mitigation actions. Other funding sources like the Global Environment Facility (GEF) and Adaptation Fund are relevant sources of finance for the country. Also, bilateral climate finance sources such as Germany's International Climate Initiative (IKI) which aims at financing climate protection and biodiversity projects to implement countries' NDCs could also be considered as an important source of funding. Other countries such as Austria and Norway have similar programmes which may provide more easily accessible ex-ante finance.

In addition, as it has been mentioned before, strong synergies with strategies included in the Bhutan' REDD+ Strategy exist. Hence, when implementing mitigation activities included in the LEDS for Food Security, REDD+ goals can be achieved and vice versa. In this sense, funds that will be channelled to implement (CSA) activities of the REDD+ Strategy can be harnessed to implement some of the activities cover

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<sup>3</sup> Nevertheless, in light of its graduation, the Bhutanese government strives to establish a clearer focus of its policies on priority sectors and seeks to explore alternative sources of financing and investments by development partners as well as private investments.

by the LEDS. REDD+ related multilateral funds include, among others, the GCF, which is implementing a five-year pilot funding for REDD+ results-based payments; the Forest Carbon Partnership Facility (FCPF) and the Bio Carbon Fund, two World Bank initiatives dedicated to results-based finance through the purchase of verified emissions reductions; and the UN-REDD Programme whose focus is to support the design and implementation of national REDD+ programmes. In addition, the German REDD Early Movers Program, and Norway's International Climate and Forest Initiative are two significant bilateral programmes that exist to fund REDD+ results-based payments (Greiner et al. 2019). Ecuador is an example of a country who will use the REDD+ results-based payments to invest in activities related to transitioning to sustainable agricultural production systems (GCF n.d.).

Bhutan has so far successfully received support for climate smart production from the following international donors: GCF, GEF, GEF-Least Developed Countries Fund (LDCF), Food Security and Agriculture Productivity (FSAPP) project supported by World Bank and the International Fund for Agricultural Development (IFAD).

#### ● **Market-based mechanisms**

In addition, Bhutan may seek opportunities through the development of carbon market pilots under Article 6 of the Paris Agreement. Several of Bhutan's key development partners are engaged in Article 6 pilot programmes. Relevant initiatives related to the agriculture and livestock sector include:

- Japan, one of Bhutan's main bilateral cooperation partners established the Joint Crediting Mechanism (JCM) in 2010 to promote market-based cooperation on mitigation activities in multiple sectors with developing countries. The main goal of the JCM is to allow cooperation between Japan and developing countries that can deliver mitigation results to be accounted for toward the NDC achievement of both Japan and host countries. All sectors and technologies are available, although most of the pilot implemented have focused on energy and waste-related technologies (Greiner et al. 2019).
- Switzerland's KliK foundation, another key partner of Bhutan, aims to purchase certificates from international mitigation activities. The foundation currently funds domestic projects that generate offset credits based on a Swiss Carbon Standard. For example, in 2022, it will start financing a Sustainable Manure Treatment Program in Mexico. However, before ITMOs can be purchased by KliK, a bilateral agreement will need to be signed between the Swiss Government and the respective host country. Such agreements have already been sealed between Switzerland and Peru, and

Ghana. All sectors and technologies, with the exclusion of biological carbon sequestration, nuclear energy and fossil fuels are eligible (Greiner et al. 2020).

- The Transformative Carbon Asset Facility (TCAF) of the World Bank (WB) is a trust fund of the WB piloting innovative CO2 crediting and quantification mechanisms. It aims to pilot approaches to increase developing countries' NDC ambition mostly by allowing them to generate and sell carbon credits from enhanced climate action. Any sector and technology linked to the mitigation goals of the host country's NDC (excluding forestry and fossil fuel-related activities) is eligible (Greiner et al. 2020).
- The Article 6 Support Facility of the Asian Development Bank (ADB), although currently in its early stage of implementation with an envelope of 4 million USD provided by Sweden and Germany, aims to provide capacity building, technical and policy support to develop and pilot Article 6 activities in all adaptation-related sectors and technologies (Greiner et al. 2019).
- **Current initiatives with potential to be upscaled under climate finance or carbon markets**
  - In 2011, with the support of the ADB, Bhutan initiated bio-gas digesters. Until 2020, 6983 small and medium scale bio-gas plants were promoted. In the past years, the biogas project has also received support from Bhutan for Life (BFL) and the EU Rural Development and Climate Change Response Program (RDCCRP) (RGoB n.d). Given the previous successful funds-leverage experiences for its implementation, small-scale domestic biogas production can end up being a highly relevant strategy to minimize GHG in the agricultural sector. Moreover, upscaling the use of biogas with a proper gender approach, can significantly improve the lives of rural women, by contributing to the reduction of indoor air pollution, drudgery, and harmful impacts on women's health (NCWC 2020).
  - Citrus and other fruits plantations have potentials to be upscaled both under current and future climate scenarios. Given their lifespan of more than 25 years, these crops present immense scope for carbon sequestration and opportunities for higher economic returns.
  - Mountain Hazelnut Venture Private Limited operates in Bhutan under a contract farming system. Significant progress both in terms of area coverage (14,460 acres) and employment opportunities (around 800 employees) have been made and it is expected to have a positive impact on farmers income. The company operates by providing young hazelnut trees and technical

assistance to smallholder farmers, and once the trees mature, the company purchases the harvested hazelnuts. Contract farming is internationally discussed and has advantages as well as disadvantages. On one side it facilitates the integration of small farmers into commercial agriculture contributing to alleviate poverty (Minot and Sawyer 2016). On the other side, control and flexibility in deciding production mixes can be lost, as well as the possibility to benefit from newly opening market opportunities (Tiruwha 2012). Despite the controversy regarding contract farming, International agricultural trends suggest that it will continue to increase in developing countries (Minot and Sawyer 2016). Over the years, contract farming has caught the attention of the private sector. In this sense, Bhutan can harness the private sector interest through contract farming to achieve its agricultural targets. However, to minimize potential social negative consequences, it is highly recommended for the MoAF to ensure farmers are not exploited by private sector entities, State Owned Enterprises (SOE) and FDIs.

- Current climate smart agriculture initiatives through the ongoing projects such as Food Security Agriculture Productivity Project (FSAPP), Commercial Agriculture Resilient Livelihood Enhancement Project (CARLEP) and RDCRRP have driven farming communities to increase productions of perennial crops and has further potentials to be upscaled.
- The Bhutan Ecological Society (BES) has recently launched their million-tree project with the aim to cultivate high value trees in at least 10%, about 5460 acres of the fallow land. Planting an average of about 200 to 300 trees per acre, BES aims to nurture over a million high value tree crops across Bhutan. This will generate annual and long-term incomes for rural farmers and serve as community carbon banks. Ecologically fecund landscapes will also significantly add to biodiversity and help buffer the impacts of climate change.

The table below summarizes the financial architecture potentially suitable for LEDS for Food Security:

Table 10. Potential financing windows for LEDS for Food Security

| Financing Mechanism                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Channel               | Revenue raising |
|------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------|
| <b>Multilateral finance</b>              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                       |                 |
| <b>Global Environment Facility (GEF)</b> | <ul style="list-style-type: none"> <li>The GEF has been the main provider of green finance for addressing biodiversity and climate change in Bhutan.</li> <li>The total amount raised by Bhutan through the GEF to date equals \$154 million (leveraging co-financing equivalent to \$160 Million)</li> <li>The amount allocated to Bhutan during the GEF-6 equaled \$6.1 million and GEF 7 is around \$ 6 million</li> <li>Areas of relevance: Biodiversity, CC adaptation, CC mitigation</li> </ul>                                                                                                         | <ul style="list-style-type: none"> <li>LEDS could prioritize accessing the STAR-allocated funding to be made available through the GEF-8 replenishment, currently under negotiation. Bhutan's track record in accessing GEF funding and the large size and broad scope of available funding makes it likely for the RGoB to cover a large share of its funding gap through the GEF.</li> <li>Partnerships with existing implementing agencies in Bhutan through which to access GEF funding, including UNDP, UNEP, the World Bank, World Wildlife Fund, can be explored to prepare a pipeline of GEF funding proposals in line with Bhutan's "integrated approach".</li> </ul> | Multilateral (UNFCCC) | Grants          |
|                                          | <ul style="list-style-type: none"> <li>Supports developing and implementing national adaptation programs of action (NAPA), but can cover some elements of mitigation through innovation</li> <li>Mostly through smaller-scale projects (Ceiling for Medium-sized Projects up to \$ 2 million).</li> <li>"Equitable allocation": Resources are divided evenly among LDCs, cap rises with new deposits.</li> <li>Total amount raised by Bhutan to date: \$25.6 million (leveraging co-financing equivalent to \$163 million)</li> <li>Areas of relevance: Biodiversity, CC adaptation, CC mitigation</li> </ul> | <ul style="list-style-type: none"> <li>Bhutan is eligible for funding the implementation of its NAPA under the LDCF.</li> <li>Available future funding to Bhutan depends on the gap between the current GEF-LDCF country ceiling and the total funding raised in the past by Bhutan.</li> <li>Considering the strong potential for co-financing, even small amounts of funding from the GEF-LDCF should be pursued before Bhutan's likely graduation from LDC status.</li> <li>A \$10 million project is under preparation.</li> </ul>                                                                                                                                         | Multilateral (UNFCCC) | Grants          |

| Financing Mechanism                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Channel               | Revenue raising |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------|
| <b>GEF - NAGOYA PROTOCOL IMPLEMENTATION FUND (NPIF)</b> | <ul style="list-style-type: none"> <li>Multi-donor trust fund to promote the early entry into force and effective implementation of the Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization.</li> <li>The fund encourages engagement with private sector entities interested in exploring the economic potential of genetic resources and facilitate the transfer of appropriate technologies.</li> <li>Extended until 2023.</li> <li>Estimated total fund size: \$14.85 million</li> </ul>                | <ul style="list-style-type: none"> <li>Bhutan accessed the NPIF of circa \$ 1 million (co-financing: \$3 million). While the current extension of the Fund is mostly to allow for the completion of existing projects, the new Global Biodiversity Framework may discuss similar funding windows.</li> <li>Bhutan has already ratified the Nagoya Protocol, approved the ABS Policy, and now in the process of endorsing the Biodiversity Bill which provides fertile grounds for accessing funds similar to NPIF in the future.</li> </ul>                                                                                                                                                         | Multilateral (UNFCCC) | Grants          |
| <b>GEF – Special Climate Change Fund (SCCF)</b>         | <ul style="list-style-type: none"> <li>The SCCF complements the Least Developed Countries Fund (LDCF).</li> <li>While it covers the incremental costs of interventions to address climate change adaptation, accessing the funds have mitigation benefits for agriculture and land development</li> <li>Areas of relevance: key sectors for adaptation (biodiversity, water resource management, land management, agriculture, health, infrastructure development), and climate-resilient technology transfer for both mitigation and adaptation.</li> </ul>                        | <ul style="list-style-type: none"> <li>Unlike the LDCF, the SCCF is open to all vulnerable developing countries.</li> <li>Bhutan participated in a global project on Piloting Climate Change Adaptation to Protect Human Health</li> <li>The process is similar to GEF-LDCF, which presents several opportunities for Bhutan to access up to \$2 million medium-sized projects or full-sized of over \$2 million, the latter requiring a longer and more comprehensive review process.</li> </ul>                                                                                                                                                                                                   | Multilateral (UNFCCC) | Grants          |
| <b>Green Climate Fund (GCF)</b>                         | <ul style="list-style-type: none"> <li>The GCF is expected to become the primary channel through which international public climate finance will flow over time.</li> <li>Areas of relevance: funding the paradigm shift toward climate-resilient and low-carbon development in developing countries.</li> <li>Committed 50% allocation of finance to CC adaptation and CC mitigation.</li> <li>Countries can access the GCF both through MDBs and UN agencies, as well as directly through accredited National, Regional, and Sub-National Implementing Entities (NIE).</li> </ul> | <ul style="list-style-type: none"> <li>Considering the growing strategic importance of GCF financing and the large size of projects, building domestic capacity preparing a pipeline of GCF projects should be given high priority.</li> <li>The recent accreditation of the BTFEC as an NAI for the AF should facilitate its accreditation as an NIE to GCF enabling direct access to GCF funding.</li> <li>Example: The GCF contributed \$26.6 million to the \$43 million “Bhutan for Life” project and another \$ 25.5 million for Climate-Smart Agriculture.</li> <li>The entire LEDS can be submitted as a big-ticket GCF project focusing on mitigation with adaptation benefits.</li> </ul> | Multilateral (UNFCCC) | Grants          |

| Financing Mechanism               | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                             | Channel               | Revenue raising |
|-----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|-----------------|
| <b>NAMA Facility</b>              | <ul style="list-style-type: none"> <li>NAMA funding comes from the NAMA Facility and a variety of other sources, mostly bilateral. The NAMA Facility is jointly established by Germany and UK, with contributions from Germany's IKI and UK's ICF. The Facility finances the implementation of the ambitious country-led NAMAs. It provides results-based finance as well as non-results-based support to AFOLU mitigation.</li> <li>Up to approximately EUR 523 million (Calls 1-7). Call 7 and an Ambition Initiative of the NAMA Facility is now closed.</li> </ul>                   | <p>NAMA Facility works with a similar approach as the GCF:</p> <ul style="list-style-type: none"> <li>Demonstrates a framework for providing tailor-made climate finance for developing countries in the field of mitigation</li> <li>Conducts competitive calls for ambitious and transformative NAMAs</li> <li>Integrates financial and technical instruments</li> <li>Closely aligns with national strategies and plans</li> <li>Access NAMA Call 8</li> </ul> | Multilateral (UNFCCC) |                 |
| <b>GEF – Small grants program</b> | <ul style="list-style-type: none"> <li>Implemented by the UNDP. It provides financial and technical support to communities and CSOs to meet the overall objective of “global environmental benefits secured through community-based initiatives and actions”.</li> <li>Building capacity of Bhutan’s maturing and growing CSO sector to benefit from the GEF small grants program can support biodiversity conservation and climate action in niche areas and difficult-to-access locations, where CSO may have a competitive advantage for delivering results over the RGoB.</li> </ul> | <ul style="list-style-type: none"> <li>In Bhutan, GEF-SGP supports over fifty small projects that make a difference to the people of rural Bhutan.</li> <li>Enourage local CSOs to access funding of upto \$ 50,000</li> </ul>                                                                                                                                                                                                                                    | Multilateral (UNFCCC) | Grants          |

| Financing Mechanism                                     | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                     | Channel      | Revenue raising         |
|---------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------------------|
| Climate Investment Funds (CIF)                          | <ul style="list-style-type: none"> <li>The CIFs include four key programs that help developing countries pilot low-emissions and climate-resilient development.</li> <li>Established in 2008 the CIFs are administered by the World Bank, but operate in partnership with regional development banks.</li> <li>The CIF introduced the programmatic approach to development planning and financing. This approach divides development planning into two phases: programming and implementation. The programming phase is used to develop an investment plan that targets investments that are in line with and reinforce, national development priorities.</li> <li>The investment plan is developed through constructive consultations between the country government, multilateral development banks and key stakeholders, including civil society, indigenous peoples and the private sector. Such an inclusive approach helps to mainstream an understanding of climate change in society. Following the programming phase upon approval and endorsement of the investment plan, work shifts toward implementation and making the projects a reality.</li> <li>Total amount of financing pledged to the CIF as per 2015: \$8.1 billion.</li> </ul> | <ul style="list-style-type: none"> <li>Bhutan is currently in process of developing its CIF investment plan.</li> <li>Considering this investment plan will guide the strategic use of future available CIF funding towards Bhutan's climate targets it is important to ensure LEDS analysis and the climate targets within the 12th FYP inform the current programming phase.</li> </ul> | Multilateral | Grants and co-financing |
| Adaptation for Smallholder Agriculture Programme (ASAP) | <ul style="list-style-type: none"> <li>International Fund for Agriculture and Development (IFAD) administers the Adaptation for Smallholder Agriculture Programme (ASAP) that supports smallholder farmers in scaling up climate change adaptation in rural development programmes. The largest global financing source dedicated to supporting the adaptation of poor smallholder farmers to climate change.</li> <li>Total fund size +\$300 million. Financed by IFAD and the governments of Belgium, Canada, Finland, France, the Republic of Korea, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom and the Region of Flanders.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <ul style="list-style-type: none"> <li>Bhutan could explore access to ASAP to support its large rural smallholder farmers access the information, tools and technologies that can help build their resilience to climate change.</li> </ul>                                                                                                                                               | Multilateral | Grants                  |

| Financing Mechanism                        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Channel      | Revenue raising |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-----------------|
| Asian Development Bank                     | <ul style="list-style-type: none"> <li>ADB's country operations business plan (COBP) for 2022–2024 under preparation includes farm roads and irrigation of up to \$300 million.</li> <li>The Article 6 Support Facility of the Asian Development Bank (ADB), although currently in its early stage of implementation with an envelope of 4 million USD provided by Sweden and Germany, aims to provide capacity building, technical and policy support to develop and pilot Article 6 activities in all adaptation-related sectors and technologies (Greiner et al. 2019).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>The new COBP drawn up between the ADB and RGoB for 2022-2024 will be an opportunity for some LEDS activities to be incorporated if the current themes of agriculture growth and water resources management are continued.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Multilateral | Grants          |
|                                            | <ul style="list-style-type: none"> <li>The overall objective of the GCCA+ is to build a new alliance on climate change between the EU and the developing countries that are most affected and that have the least capacity to deal with climate change.</li> <li>The GCCA+ works with its partners to pool resources, expertise and knowledge. GCCA+ partners include national and local governments, regional organisations, non-governmental organisations, academic and scientific institutions, plus local representations of international organisations, multilateral and bilateral development agencies.</li> <li>The 2014-2020 programming process for EC external cooperation also offers opportunities for dialogue and action. Indeed, some 20 percent of new funding made available from the EU budget (including external cooperation programmes) must contribute to the transition towards a low-carbon, climate-resilient society.</li> <li>Priority areas of focus: supporting adaptation and mitigation efforts in LDCs and SIDS.</li> </ul> | <ul style="list-style-type: none"> <li>Bhutan could explore receiving either technical or financial support from the GCCA+ or engage in policy dialogue with the European Union, before it graduates from LDC status:</li> <li>To receive funds, Bhutan must participate in a needs assessment to understand its vulnerability to climate change, including risks relating to floods, droughts, storms and glacier melting. This assessment also considers the proportion of Bhutan's population deemed at risk from the effects of climate change, the agricultural sector and estimates of Bhutan's adaptive capacity. Finally, eligible countries are assessed on how engaged they are in the dialogue on climate change. Governments must express an interest in receiving support from the GCCA+.</li> <li>Potential climate activities that could be supported by the GCCA+ include REDD projects that are building reporting systems and national capacity to monitor deforestation; strengthening institutions and developing national strategies to combat deforestation; supporting innovative performance-based mechanisms to provide positive incentives for REDD.</li> </ul> |              |                 |
| EU - Global Climate Change Alliance (GCCA) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Multilateral |                 |

| Financing Mechanism                                      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Channel                    | Revenue raising                                               |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------------------------------------------------------|
| German Development Bank-International Climate Initiative | <ul style="list-style-type: none"> <li>Since 2008, the German International Climate Initiative (ICI) provides financial support to international projects supporting climate change mitigation, adaptation and biodiversity projects with climate relevance.</li> <li>It supports projects carried out in partner countries by federal implementing agencies, NGOs, business enterprises, universities and research institutes, and by international and multinational organisations and institutions, e.g. development banks and United Nations bodies and programmes.</li> <li>Estimated annually available funding: \$318 million (2014)</li> </ul>                                      | <ul style="list-style-type: none"> <li>It could therefore leverage its expertise in attracting transnational ICI funding for harnessing additional ICI funding through bilateral projects.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Bilateral/<br>multilateral | Grants                                                        |
|                                                          | <ul style="list-style-type: none"> <li>The UK's International Climate Fund has a current capitalization of USD 5.95 billion and has channeled a substantial share of ICF money through dedicated multilateral funds, including the CIFs and the GCF.</li> <li>Engaging with the private sector is a key part of the ICF strategy to help increase private finance to tackle climate change.</li> </ul>                                                                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Currently, Bhutan doesn't feature on the list of ICF priority countries.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                            |                                                               |
| Global Climate Partnership Fund (GCPF)                   | <ul style="list-style-type: none"> <li>As an innovative public-private partnership, GCPF uses public funding to leverage private capital to mitigate climate change and drive sustainable growth in developing and emerging markets</li> <li>GCPF mainly invests through local financial institutions, but also directly.</li> <li>Germany, the UK and Denmark also support the GCPF, managed by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMUB) and KfW, which focuses on renewable energy and energy efficiency through a public-private partnership.</li> <li>Estimated fund size: USD 451 m invested in partner institutions.</li> </ul> | <ul style="list-style-type: none"> <li>Bhutanese local financial institutions with the ambition to develop a green lending portfolio and complying with the GCPF social and environmental standards could apply for GCPF funding for energy efficiency projects (that reduce projected greenhouse gas emissions by at least 20%) and renewable energy generation projects of small and medium-sized businesses and private households.</li> <li>Total facilities usually amounting to USD 10 million – USD 30 million, with flexible funding schedules.</li> <li>The GCPF may also provide direct funding primarily in the form of senior debt to small scale projects (typically 15 MW) that are in a late development stage or fully authorized. (Typical deal size of between \$5 million and \$15 million)</li> </ul> | Public-private             | Senior or subordinated debt<br><br>Mid to long-term financing |

| Financing Mechanism                            | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Market-based mechanisms and Innovative Finance                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Accessing the funding | Channel | Revenue raising |
|------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|---------|-----------------|
| <b>Payment of Environmental Services (PES)</b> | <ul style="list-style-type: none"> <li>PES is a system of incentives/payments made to farmers or landowners in exchange for sustainably managing their natural resources<sup>1</sup>.</li> <li>Recent evaluation has valued Bhutan's total ecosystem services to be worth \$15.5 billion per year<sup>2</sup>.</li> </ul>                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>The Watershed Management Division and Bhutan's Department of Forests and Park Services (DoFPS) are developing approaches and policies for PES around the country related to protection of drinking water source areas, hydropower water supply and scenic beauty services</li> <li>So far, only the PES for the provision of freshwater has been implemented on the ground. There is a need for assessments that can guide the channeling of funds from the hydropower sector to the upstream priority areas including the communities that take care of the water source areas and watersheds.</li> </ul> |                       | Private |                 |
| <b>Joint Crediting Mechanism (JCM)</b>         | <ul style="list-style-type: none"> <li>Japan, one of Bhutan's main bilateral cooperation partners established the Joint Crediting Mechanism (JCM) in 2010 to promote market-based cooperation on mitigation activities in multiple sectors with developing countries. The main goal of the JCM is to allow cooperation between Japan and developing countries that can deliver mitigation results to be accounted for toward the NDC achievement of both Japan and host countries.</li> </ul>                                                                                                                                                        | <ul style="list-style-type: none"> <li>All sectors and technologies are available, although most of the pilot implementations have focused on energy and waste-related technologies (Greiner et al. 2019).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                             |                       |         |                 |
| <b>Switzerland's KLIK foundation</b>           | <ul style="list-style-type: none"> <li>Switzerland's KLIK foundation, another key partner of Bhutan, aims to purchase certificates from international mitigation activities. The foundation currently funds domestic projects that generate offset credits based on a Swiss Carbon Standard. For example, in 2022, it will start financing a Sustainable Manure Treatment Program in Mexico. However, before ITMOs can be purchased by KLIK, a bilateral agreement will need to be signed between the Swiss Government and the respective host country. Such agreements have already been sealed between Switzerland and Peru, and Ghana.</li> </ul> | <ul style="list-style-type: none"> <li>All sectors and technologies, with the exclusion of biological carbon sequestration, nuclear energy and fossil fuels are eligible (Greiner et al. 2020).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                        |                       |         |                 |

| Financing Mechanism                                                    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Channel | Revenue raising |
|------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------|
| The Transformative Carbon Asset Facility (TCAF) of the World Bank (WB) | <ul style="list-style-type: none"> <li>The Transformative Carbon Asset Facility (TCAF) of the World Bank (WB) is a trust fund of the WB piloting innovative CO2 crediting and quantification mechanisms. It aims to pilot approaches to increase developing countries' NDC ambition mostly by allowing them to generate and sell carbon credits from enhanced climate action.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <ul style="list-style-type: none"> <li>Any sector and technology linked to the mitigation goals of the host country's NDC (excluding forestry and fossil fuel-related activities) is eligible (Greiner et al. 2020).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |         |                 |
| Developing markets for green products                                  | <ul style="list-style-type: none"> <li>Green products include goods and services that are based on sustainable use of biodiversity and ecosystems (e.g. <b>eco-tourism</b>, <b>medicinal herbs</b> and <b>biotrade</b>), goods which have been produced with fewer impacts on biodiversity because of more efficient or lower impact production methods (e.g. timber procured from reduced impact logging), and goods whose consumption will have a reduced environmental impact because of decreased pollution load (e.g. biodegradable detergent)<sup>3</sup>.</li> <li>Creating and developing private markets for new, green products involves public support (e.g. by reducing risks of private entry), particularly in LDCs where the perception of high financial risks and low returns deter private investments. Providing catalytic first-loss capital may lower some of the financial risks (as in the case of junior equity or subordinated debt). Less risk crowds in other investors, thus catalyzing additional resources for conservation. In so doing, they lay the groundwork for sustainable investment flows into new markets. And they help improve the terms at which project developers can access capital.</li> <li>Green commodity markets have witnessed sustained growth over the past few years. The global market for organic products in 2010 was estimated at around USD 59 billion, more than double the market size in 2003<sup>4</sup>, and the global area under the two largest forest certification schemes (FSC and PEFC) increased from just over 324 million hectares at the end of 2008<sup>5</sup> to over 414 million hectares (about 35% of global forests designated for production<sup>3</sup>) by November 2011.</li> </ul> | <ul style="list-style-type: none"> <li>Previous analysis has identified several marketable niche products and services with the potential to attract private funding to support Bhutan's biodiversity conservation. Strengthening the 'Brand Bhutan' can support the creation of these high value, niche export products, such as medicinal herbs, or services, such as ecotourism: <ul style="list-style-type: none"> <li>Diversifying Bhutan's tourism by supporting ecotourism ventures can provide a platform for private sector-led sustainable conservation of Bhutan's natural richness, in addition to job creation and sustaining livelihoods in remote areas.</li> <li>Certification schemes, such as FSC and PEFC for forests or The Rainforest Alliance for sustainable agriculture, may support developing high value-added, low-impact niche products for exports while supporting rural livelihood and resilience.</li> </ul> </li> </ul> | Private |                 |

| Financing Mechanism                          | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Channel | Revenue raising |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|-----------------|
| <b>Public-private partnerships (PPP)</b>     | <ul style="list-style-type: none"> <li>Incentive-based conservation arrangements can increase private funding towards environmental conservation objectives. Examples include PPP models for the management of natural parks, administration contracts, service concession, co-management, and private reserves.</li> </ul>                                                                                                                                                                                                                                                                                                                                                            | <ul style="list-style-type: none"> <li>The RGoB could leverage or mobilize private finance to manage specific areas of its 5-million-acre network of protected areas in partnership with local communities. This requires identifying those areas that offer the potential for developing commercially viable economic activities, such as ecotourism, that can cover the management costs. This would free up public resources that can be destined to preserving areas that don't lend themselves to incentive-based conservation arrangements.</li> </ul> | Private |                 |
| <b>Corporate Social Responsibility (CSR)</b> | <ul style="list-style-type: none"> <li>CSR activity and reporting presents one significant entry point to engage with the private sector on biodiversity investments. For example, by making CSR a legal requirement and facilitate the channeling of CSR finance to dedicated funds.</li> <li>According to PwC research (2015) the private sector deems its impact on meeting the SDGs is largest in providing decent work and economic opportunities, followed by supporting climate action.</li> </ul>                                                                                                                                                                              | <ul style="list-style-type: none"> <li>The Bhutan Chamber of Commerce and Industry can be useful platform to engage the national process with the relevant national private sector companies.</li> <li>Bhutan's large state-linked enterprises and government holdings, such as Druk Holding Incorporated, could pave the way in contributing through their CRS to biodiversity conservation and climate action through investments towards reducing their carbon footprint or developing low-carbon technologies and economic activities.</li> </ul>        | Private |                 |
| <b>Green lending</b>                         | <ul style="list-style-type: none"> <li>Green lending is lending dependent on environmental criteria for the planned use of the funds. It involves local banks providing loans for energy efficiency and renewable energy projects.</li> <li>A lack of awareness and know-how from financial intermediaries is the greatest challenge to the growth of green lending. Therefore, to drive green loans, technical support for domestic banks is vital.</li> <li>The manufacturing sector has traditionally been driving green lending in the form of energy efficiency financing. However, opportunities are arising also in agriculture, the service sector and real estate.</li> </ul> | <ul style="list-style-type: none"> <li>Specific opportunities in Bhutan that could lend themselves to be financed through green lending are the expansion of electric or hybrid car parks.</li> <li>The agricultural sector –local farmers and livestock owners could rely on green lending to invest in the modernization of their irrigation systems and energy provision to save costs.</li> </ul>                                                                                                                                                        | Private |                 |

| Financing Mechanism | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Accessing the funding                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Channel       | Revenue raising |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|-----------------|
| <b>Green Bonds</b>  | <ul style="list-style-type: none"> <li>Green bonds are bonds whose proceeds are invested exclusively in projects that generate climate and/or other environmental benefits.</li> <li>They are usually best suited to large-scale projects such as low carbon transportation, sustainable water management, and renewable energy, which generate cash flows over a long investment horizon.</li> <li>The Climate Bonds Initiative believes the labeled green bond market can reach \$300bn of issuance by 2018, whereas the value of the broader green bond market has grown to over \$694 billion.</li> <li>In 2016 the IFC issued first-of-its-kind "forest bonds", which coupons will support forest conservation in Kenya and offer an option to deliver REDD credits to bondholders. More info <a href="#">here</a>.</li> </ul> | <ul style="list-style-type: none"> <li>Bhutan's limited financial depth and illiquid financial markets would require issuing potential green bonds in foreign markets, including via the intermediation of international and regional development banks. Considering the relative complexity and Bhutan's high debt levels issuing green bonds may not be an option for the immediate future. Nevertheless, this could be a financing solution to further develop Bhutan's hydropower sector.</li> <li>Bhutan could consider replicating the IFC's innovative 'forest bond' model to reduce its deforestation pressure in support of its REDD++ objectives.</li> <li>Additionally, green bonds could be an option for increasing financing options of the Thromdes through the municipal bond market to finance climate-friendly infrastructure in the water, waste and transport services. The increased spending decentralization foreseen in the 12th FYP may provide the momentum to assess the technical, political and economic feasibility of municipal green bonds.</li> </ul> | Public – debt |                 |
|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |               |                 |

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## ANNEXES

### Annex A: Documents reviewed for the 2020 LEDS

| No             | Document                                                                                             | Year | Agency     |
|----------------|------------------------------------------------------------------------------------------------------|------|------------|
| 1              | 12 Five Year Plan_ Volume I (2018-2023) Main Document                                                | 2019 | GNHC       |
| 1 <sup>a</sup> | 12 Five Year Plan_ Volume II (2018-2023) Central Plans                                               | 2019 | GNHC       |
| 2              | Strategic Program for Climate Resilience (SPCR)_ Working Draft                                       | 2017 | GNHC       |
| 3              | Third National Communication from Bhutan to the UNFCCC                                               | 2020 | NEC        |
| 4              | Environmental Standards                                                                              | 2020 | NEC        |
| 5              | Climate Change Policy of the Kingdom of Bhutan                                                       | 2020 | NEC        |
| 6              | National Environment Strategy 2020                                                                   | 2019 | NEC        |
| 7              | Bhutan's INDC to Paris Agreement_RTM                                                                 | 2017 | NECS       |
| 8              | Comprehensive Development Plan for Bhutan 2030_ Volume III                                           | 2019 | MoWHS      |
| 8a             | Comprehensive Development Plan for Bhutan 2030_ Volume I Summary                                     | 2019 | MoWHS      |
| 8b             | Comprehensive Development Plan for Bhutan 2030_ Volume II Existing Conditions and Development Issues | 2019 | MoWHS      |
| 8c             | Comprehensive Development Plan for Bhutan 2030_ Volume IV Appendix                                   | 2019 | MoWHS      |
| 8d             | Comprehensive Development Plan for Bhutan 2030_ Volume V GIS Atlas                                   | 2019 | MoWHS      |
| 9              | Climate SMART HS Planning and Development in SJ Thromde                                              | 2019 | DHS, MoWHS |
| 10             | Spatial Planning Standards                                                                           | 2017 | DHS, MoWHS |
| 11             | Gender and Climate Change in Bhutan                                                                  | 2020 | NCWC       |
| 12             | National Gender Equality Policy                                                                      | 2020 | NCWC       |
| 13             | National Land Use Zoning Implementation Guidelines                                                   | 2018 | NLCS       |
| 14             | 12th Five Year Plan (2018-2023) RNR Sector                                                           | 2019 | MoAF       |
| 15             | 12th Five Year Plan (2018-2023) Department of Agriculture                                            | 2019 | DoA        |
| 16             | 12th Five Year Plan (2018-2023) Department of Livestock                                              | 2019 | DoL        |
| 17             | RNR Strategy 2040 (zero draft)                                                                       | 2020 | MoAF       |
| 18             | National Irrigation Master Plan                                                                      | 2016 | DoA-ADB    |
| 19             | Review of the Impact of National irrigation policy 2017                                              | 2017 | D0A        |

|    |                                                                                                  |           |                   |
|----|--------------------------------------------------------------------------------------------------|-----------|-------------------|
| 20 | Chapter on Assessment of Climate Change and Its Impact on Agriculture                            | 2018      | DoA               |
| 21 | Strategic Agriculture sector review 2018 The World Bank                                          | 2018      | The World Bank    |
| 22 | National Organic Flagship programme Strategy                                                     | 2018      | DoA               |
| 23 | Farm Mechanization Review                                                                        | 2005      | DoA               |
| 24 | Annual Agriculture Statistics                                                                    | 2004-2020 |                   |
| 25 | Bhutan Poverty Assessment Report BLSS                                                            | 2017      | NSB               |
| 26 | Bhutan Climate Summit - Food Security paper                                                      | 2011      | MoAF              |
| 27 | Bhutan Strategic Review                                                                          | 2018      | The World Bank    |
| 28 | Economic Development Policy                                                                      | 2016      | MoF               |
| 29 | Food & Nutrition Security Policy                                                                 | 2014      | MoAF              |
| 30 | Bhutan Climate Change Report                                                                     | 2019      | GNHC              |
| 31 | Land Degradation in Eastern Bhutan                                                               | 2004      | DoA-NSSC          |
| 32 | Review of Bhutan Agricultural Marketing                                                          | 2018      | FAO-MoAF          |
| 33 | Sustainable Land Management Overview                                                             | 2013      | DoA NSSC          |
| 34 | Soil Carbon Stocks Bhutan                                                                        | 2017      | DoA NSSC          |
| 35 | Soil Fertility and Nutrient Management Rice system                                               | 2009      | DoA               |
| 36 | Estimation of National Dietary Energy Consumption Status and Self-Sufficiency Ratio              | 2015      | MoAF- DoA-DoL     |
|    | Food Self Sufficiency ratio-dietary energy - summary                                             | 2015      | DoA               |
| 37 | Agriculture Research Strategy 2018 -2028                                                         | 2019      | DoA               |
| 38 | Bhutan RNR Statistics 2018                                                                       | 2018      | MoAF              |
| 39 | Livestock Statistics                                                                             | 2019      | DoL-MoAF          |
| 40 | Excel Food Crops Data Trends                                                                     | n/d       | n/d               |
| 41 | Excel Horti Fruit Crops Data Trends                                                              | n/d       | n/d               |
| 42 | PPT: Farm Mechanization Strategy                                                                 | n/d       | AMC/DoA           |
| 43 | PPT: Agriculture Machinery Centre- Enhancing farm mechanization programme in the country         | n/d       | AMC               |
| 44 | Annual Report 2018-2019                                                                          | 2019      | AMC/MoAF          |
| 45 | Budget Projection (2019-2023) Farm Machinery Corporation Limited                                 | 2019      | FMCL              |
| 46 | Annual Report 2019 Farm Machinery Corporation Limited                                            | 2019      | FMCL              |
| 47 | Assessment of Soil Fertility Status Using Soil Nutrient Index in Three Landuse Systems in Bhutan | 2020      | Chhtri, S. et al. |
| 48 | National Strategy and Action Plan for Low Carbon Development, 2012                               | 2012      | NEC               |

|    |                                                                                                                                  |      |                                               |
|----|----------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------|
| 49 | Study on Poverty-Sustainable Land Management Linkages in Bhutan                                                                  | 2009 | UNDP                                          |
| 50 | Sustainable Land Management Project                                                                                              | 2011 | NSSC/GEF/WB                                   |
| 51 | Participatory Approaches in Sustainable Land Management. Planning Implementation and Monitoring as Continuous Learning Processes | 2011 | NSSC/GEF/WB                                   |
| 52 | Annual Report 2019-2020 Department of Livestock                                                                                  | 2019 | DoL/MoAF                                      |
| 53 | Bhutan Livestock Development Corporation Ltd. Stimulus Plan. Standard Operating Procedure 2020-2021                              | 2020 | Bhutan Livestock Development Corporation Ltd. |
| 54 | Draft Report- Towards preparing Bhutan's 2nd NDC                                                                                 | 2020 |                                               |
| 55 | Organic Agriculture Development Strategies: Roadmap for 12th Five Year Plan and Beyond                                           | 2018 | MoAF                                          |
| 56 | Master Plan for Organic Sector Development                                                                                       | 2012 | NOP/MoAF                                      |
| 57 | National Framework for Organic Farming in Bhutan                                                                                 | 2006 | DoA/MoAF                                      |
| 58 | Brief Overall Report on Mountain Hazelnut                                                                                        | 2018 | Mountain Hazelnut Venture Private Limited     |
| 59 | Bhutan- Irrigation in Southern and Eastern Asia in figures                                                                       | 2011 | Aquastat                                      |
| 60 | National Integrated Water Resources management Plan 2016                                                                         | 2016 | NEC                                           |
| 61 | A Technical Note: Soil Conservation Improves Carbon Stocks, Soil Fertility and Agricultural Productivity                         | 2018 | UWICER                                        |
| 62 | Sharing Irrigation Water in Bhutan: Companion Modeling for Conflict Resolution and Promoting Collective Management               | 2010 | Raj Gurung, Tayan et al.                      |
| 63 | Updated list of irrigation schemes implemented as of June 2020                                                                   | 2020 | AED, DoA, LG                                  |
| 64 | Bhutan Organic Standard BOS 01:2020                                                                                              | 2020 | NOP/MoAF                                      |
| 65 | The IFOAM Norms for Organic Production and Processing                                                                            | 2012 | IFOAM                                         |
| 66 | The IFOAM Norms for Organic Production and Processing Version 2014                                                               | 2014 | IFOAM                                         |

## Annex B: Assessment of the prioritization criteria (updated with final results)

| Mitigation action                                             | Sectoral boundaries | Materiality ktCO <sub>2</sub> e – Mitigation potential until 2050 | Abatement Cost – USD/tCO <sub>2</sub> e | SD co-benefits                                                                                                                                                                                                        |
|---------------------------------------------------------------|---------------------|-------------------------------------------------------------------|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reduction of continuous rice flooding                         | ↑                   | 1.34<br>↓                                                         | 0<br>↑                                  | + water availability, labour saving and – cost of production<br>↑                                                                                                                                                     |
| Switch from synthetic to organic fertilizers                  | ↑                   | 57.30<br>↓                                                        | - 79<br>↑                               | + soil quality<br>↑                                                                                                                                                                                                   |
| Domestic biogas production                                    | ↑                   | 768.66<br>↑                                                       | + 14<br>↓                               | + energy, + indoor air quality and health conditions. Time benefit and reduction in drudgery, by-product production, + employment and LPG import substitution<br>↑                                                    |
| Increased cattle productivity through improved feeding        | ↑                   | 164.05<br>↑                                                       | - 45<br>↑                               | - Pressure grassland, +productivity + biogas production (stall-feeding), - human-wildlife conflict, + watershed protection, reduced diseased incidence, labour saved. Increased competition with food production<br>↑ |
| Improved agricultural practices                               | ↑                   | 953.23<br>↑                                                       | 367<br>↓                                | + soil quality and water retention<br>↑                                                                                                                                                                               |
| Increased biomass through increased perennial crop production | ↑                   | 1,512.11<br>↑                                                     | - 832<br>↑                              | + food production & nutrition security, + ground cover, + income and employment<br>↑                                                                                                                                  |

## Sectoral boundaries



Action within the sectoral boundaries

## Materiality



Overall mitigation potential (until 2050) > 500 ktCO<sub>2</sub>e



Overall mitigation potential (until 2050) between 100 and 500 ktCO<sub>2</sub>e



Overall mitigation potential (until 2050) < 100 ktCO<sub>2</sub>e

## Abatement costs



Negative abatement cost



Abatement cost = 0



Positive abatement cost

## SD Co-benefits



Only positive co-benefits



At least one negative side effect



Only negative side effects

## Annex C: Implementation timeline

|                                | 2021                                                                                                                                                                                                     | 2022 | 2023                                                            | 2024 | 2025                                                       | 2026 | 2027 | 2028 | 2029 | 2030                                                       |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|-----------------------------------------------------------------|------|------------------------------------------------------------|------|------|------|------|------------------------------------------------------------|
| <b>Governance and Policies</b> | Consolidate the governance for mitigation actions in the agriculture and livestock sectors: task force of experts and institutional working group on Climate Change action for agriculture and livestock |      |                                                                 |      |                                                            |      |      |      |      |                                                            |
|                                | Develop guidance on mitigation actions in the agriculture and livestock sector                                                                                                                           |      |                                                                 |      | Every five years: new prioritization of mitigation options |      |      |      |      | Every five years: new prioritization of mitigation options |
|                                | Identification of data gaps                                                                                                                                                                              |      | Improve data collection, in particular on, data gaps identified |      |                                                            |      |      |      |      |                                                            |
|                                | Involve civil society and local level                                                                                                                                                                    |      |                                                                 |      |                                                            |      |      |      |      |                                                            |
| <b>Technology</b>              | Further refine relevant mitigation technologies                                                                                                                                                          |      |                                                                 |      |                                                            |      |      |      |      |                                                            |
| <b>Finance</b>                 | Prioritization of sources of international and bilateral climate finance                                                                                                                                 |      |                                                                 |      |                                                            |      |      |      |      |                                                            |

## Annex D: Core and Expert Group Members from the MoAF

| No                                                            | Name                | Designation                                         | Agency              |
|---------------------------------------------------------------|---------------------|-----------------------------------------------------|---------------------|
| <b>Core group</b>                                             |                     |                                                     |                     |
| 1                                                             | Mr. Jigme Wangdi    | Specialist                                          | DOL                 |
| 2                                                             | Dr. Kuenga Namgay   | Specialist                                          | DoL                 |
| 3                                                             | Mr. Tashi Dhendup   | Dy. Chief Livestock Production Officer, LPD         | DoL                 |
| 4                                                             | Mr. Jigme Tenzin    | Principal Agriculture Officer                       | APD, DoA            |
| 5                                                             | Ms. Kesang Tshomo   | Specialist, National Organic Flagship Programme     | NOFP, DoA           |
| 6                                                             | Mr. Lakey           | Principal Agriculture Officer                       | ARED, DOA           |
| 7                                                             | Ms. Tashi Yangzom   | Dy. Chief Planning Officer                          | PPD                 |
| 8                                                             | Mr. Karma Tshering  | Chief Planning Officer                              | PPD                 |
| <b>Focal experts/ officials who contributed to the report</b> |                     |                                                     |                     |
| 1                                                             | Mr. Suraj Chettri   | Principal Soil Fertility & Plant Nutrition Officer  | NSSC, DoA           |
| 2                                                             | Mr. Mahesh Ghimirey | Rice Specialist                                     | ARDC, Bajo          |
| 3                                                             | Mr. Kailash Pradhan | Specialist                                          | NCOA, Yusipang      |
| 4                                                             | Dr. Yadunath Bajgai | Potato Specialist                                   | NCOA, Yusipang      |
| 5                                                             | Mr. Sangay Dhendup  | Dy. Chief Agriculture officer (Fruits & Nuts focal) | APD, DOA            |
| 6                                                             | Ms. Choney Zangmo   | Sr. Agriculture Officer (Rice Focal)                | APD, DOA            |
| 7                                                             | Mr. Dorji Gyaltsen  | Project Director                                    | Biogas Program, DOL |
| 8                                                             | Mr. Sonam Phuntsho  | Sr. Program Officer (Biogas Program)                | Biogas Program, DOL |
| 9                                                             | Dr. Narapati Dahal  | Specialist                                          | AHND, DOL           |
| 10                                                            | Mr. Jambay Gyaltsen | Specialist                                          | NRDCAN, DOL         |
| 11                                                            | Dr. NB Tamang       | Specialist                                          | NDRDC, DOL          |
| 12                                                            | Mr. Jigme Wangchuk  | CEO                                                 | BLDCL               |
| 13                                                            | Mr. Karma Thinley   | CEO                                                 | FMCL                |



Federal Ministry for the  
Environment, Nature Conservation  
Building and Nuclear Safety



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