Policy Handbook

STRATEGIES FOR A CLIMATE RESILIENT ECONOMY IN MONGOLIA

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June 2025

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TABLE OF CONTENTS

1 INTRODUCTION

This handbook has been prepared under the Climate Resilient Economic Development (CRED) and Policy dialogue and knowledge management on climate protection strategies (DIAPOL-CE) project implemented by GIZ, which aim to fill a gap present in many countries: the lack of model-based assessments which can demonstrate how climate change affects economic growth, public finances, and sector performance. By translating climate risks into concrete economic data, policymakers can make better informed decisions and develop adaptation strategies that are grounded in evidence. This approach leads to more climate-resilient policies and enables effective resource allocation.

Within this context, the E3.mn model (economy, energy, emissions) - an analytical tool that integrates economic, energy, and environmental data - plays a key role. Although it is applied to medium- and long-term scenario analysis, the model can also help guide near-term decisions, such as budget allocations and the roll-out of initial public investment programs in the context of strategic long-term visions. Through the step-by-step guidance provided in this handbook, users will learn how to identify, model, and refine adaptation measures so that they yield tangible benefits - ranging from reduced climate vulnerabilities to sustainable economic development.

This handbook is aimed at policymakers, adaptation specialists, and others who contribute to climate and development planning in Mongolia. Public officials can use it to align resilience measures with national strategies and inform fiscal or regulatory decisions, ensuring that climate actions are backed by robust data. Adaptation practitioners - especially those working on National Adaptation Plans (NAPs) or sector-level initiatives - can follow these guidelines to select policy scenarios, evaluate their potential outcomes, and present model findings to decision-makers. By offering step-by-step instructions for scenario development, data analysis, and interpretation of results, this handbook equips stakeholders to incorporate climate-focused actions into broader development programs. It provides a practical resource to design and implement adaptation strategies grounded in robust evidence, tailored to policy needs.

2 POLICY ENTRY POINTS FOR EVIDENCE-BASED ADAPTATION PLANNING

2.1 Role of climate adaptation in the country's development goals and strategic documents

Climate adaptation is central to achieving sustainable economic development and addressing climate risks. Strategic documents such as NAPs and Nationally Determined Contributions (NDCs) outline key priorities for integrating climate adaptation measures. In Mongolia, climate adaptation is being embedded within sectoral strategies and broader development frameworks, which emphasise the importance of resilience in economic planning. The recent approval of Mongolia's NAP marks a significant milestone in the country's efforts to integrate adaptation measures across eight key sectors until 2030.[1] This development underscores Mongolia's commitment to aligning national goals with international climate commitments, fostering policy coherence, and increasing opportunities for accessing climate financing. Key stakeholders like the Ministry of Economy and Development (MED) and Ministry of Environment and Climate Change (MECC) drive these efforts, ensuring the integration of sector-specific adaptation measures into the country's development goals.

2.2 Entry points for policy integration explored in the context of the CRED project

The GIZ projects, CRED and DIAPOL-CE, identify several key entry points for integrating climate economic modelling results into the economic development policy cycle in Mongolia.2 Policy entry points refer to the opportunities or stages within planning and decision-making processes where adaptation measures can be incorporated to most effectively influence policy outcomes. These points may include strategic frameworks, sectoral policies, or fiscal planning mechanisms that provide a foundation to incorporate measures into broader goals.

In the context of Mongolia, one such entry point is the development of strategic plans and frameworks. By leveraging the results of climate economic modelling, sectoral adaptation strategies can be aligned with NAP and NDC priorities. For instance, the Ministry of Finance (MoF) and MECC can collaborate on identifying actionable measures for sectors like agriculture and water management, which are highly vulnerable to climate impacts.

Another significant entry point lies in budget formulation and approval processes. Incorporating climate adaptation into national and sectoral budgetary frameworks allows for the justification of climate-resilient allocations, such as investments in drought-resistant agricultural practices. During budget statements, the MoF can underscore climate-resilient economic development as a critical priority.

Resource mobilisation and allocation also offer substantial potential for policy integration. Ensuring that adaptation finance is protected and aligns with policy objectives, even in the face of fiscal constraints, is crucial. Climate tagging systems could be employed to monitor adaptation-related expenditures, while public procurement frameworks may incorporate climate resilience criteria to guide sustainable investments. These efforts are bolstered by sectoral dialogues involving key stakeholders, such as the

[1] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change. Ulaanbaatar, Mongolia: Government of Mongolia. Retrieved from https://unfccc.int/sites/default/files/resource/MONGOLIA%20FOURTH%20NC%202024.pdf

[2] International Institute for Sustainable Development. (2021). Using Climate Economic Modelling for Sustainable Economic Development: A Practitioner's Guide. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2021-en-climate-economic-modelling-practitioners-guide.pdf

Ministry of Food, Agriculture and Light Industry (MOFALI) and the Bank of Mongolia (BOM). Collaborative efforts ensure that adaptation scenarios are accurately represented and that data gaps are addressed. Recent meetings with stakeholders, including National Emergency Management Agency (NEMA) MOFALI, and BOM, have highlighted critical areas such as pasture and livestock resilience, water management, forestry, resilient agriculture and crops. Policy scenarios discussed with MED and other stakeholders seek to incorporate these considerations into macroeconomic and sectoral planning processes, thereby promoting climate resilience within the broader context of national development objectives.

2.3 Key challenges

Despite significant progress, several challenges hinder the integration of climate adaptation into economic policy in Mongolia.

› Data limitations pose a major obstacle, as comprehensive and high-quality climate and economic data, particularly at the subnational level, are often unavailable. This lack of data restricts the ability to conduct detailed vulnerability and risk assessments, thereby impeding evidence-based decision-making. Institutional capacity gaps further exacerbate these challenges, with many institutions lacking the technical expertise required to interpret and apply climate economic modelling results. This issue is especially pronounced in rural areas, where resources for training and capacity building are scarce.

› Fragmented coordination mechanisms present another hurdle, as effective adaptation planning requires cross-sectoral and inter-ministerial collaboration. Insufficient frameworks for coordination and unclear mandates often limit the effectiveness of these efforts.

› Financial constraints also impede progress. While international climate finance provides certain support, domestic funding for adaptation remains limited, hindering the implementation of large-scale adaptation projects. In particular, private sector engagement is often low due to a lack of risk-sharing mechanisms such as blended finance instruments, insufficient regulatory incentives, and limited awareness of bankable adaptation opportunities.

› Limited stakeholder engagement reduces the effectiveness of adaptation initiatives. Non-government actors, including the private sector and civil society, are often not systematically involved in the design and implementation of adaptation measures, which weakens ownership and limits the mobilisation of additional resources and expertise.

Addressing these challenges requires a robust enabling environment that supports leadership, data sharing, capacity building, and multi-stakeholder engagement. By overcoming these barriers, Mongolia can fully leverage the potential of climate economic modelling to inform and guide its adaptation planning and economic development efforts.

SUMMARY

Integrating climate adaptation into economic development is vital for building resilience and achieving sustainability. Strategic frameworks like NAPs and NDCs enable alignment with global climate goals, while entry points such as planning, budgeting, and resource mobilisation embed adaptation into vulnerable sectors. Key challenges – data gaps, institutional capacity, coordination, funding, and stakeholder engagement – need be addressed. By fostering collaboration, evidence-based decisions, and inclusive participation, countries can strengthen adaptation integration and ensure sustainable development.

3 THE PROCESS OF USING THE E3 MODEL

This section provides an overview of the application of the E3 model for developing and refining adaptation policy scenarios. It draws on key insights from the Handbook on macroeconomic modelling for resilience and offers guidance on how national stakeholders can use the model effectively in their specific contexts.3

The model helps to quantify the economic effects of adaptation measures by offering a consistent framework to develop data-driven policy recommendations. It includes a structured, seven-step process, from project setup and preparation to independent application with subsequent monitoring and evaluation, ensuring the thorough integration of adaptation considerations into macroeconomic policies: [Figure 1]

The use of E3 templates for developing countries ensures the model's adaptability and transferability across various contexts. By integrating economic, energy, emissions data, the E3 model serves a robust tool for scenario analysis, guiding evidence-based adaptation planning and decision making. [4] More detailed overview is provided in the following sections.

3.1 Model overview

The E3 model is designed to capture the interlinkages between economic activity, energy use, and environmental impacts. While its core components include energy, emissions, and macroeconomic interactions, the model is particularly well suited for adaptation analysis.

Figure 1. Macroeconomic modelling in the adaptation policy cycle

Source: Adopted from GIZ (2021); Climate-ADAPT (n.d.)[5]

It enables the quantitative evaluation of sector-specific adaptation measures by assessing their costs, macroeconomic implications, and co-benefits - such as employment effects or avoided losses.

- Its input-output (IO) foundation enables it to analyse several economic sectors and their interdependencies while accounting for domestic and foreign drivers of economic growth. By integrating both demand and supply dynamics alongside pricing mechanisms, the model effectively evaluates macroeconomic trends and provides insights into sectoral interactions and policy outcomes. The model supports detailed

[3] GIZ. (2023). Handbook on Macroeconomic Modelling for Climate Resilience: A manual for designing technical assistance on macroeconomic modelling supporting climate resilient development. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2023-en-handbook-macromodelling-resilience.pdf

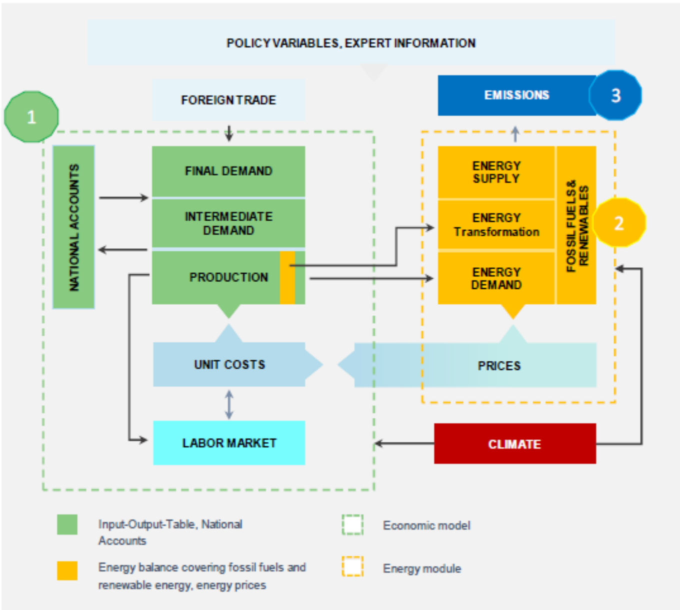
[4] GIZ. (2023). Handbook on Macroeconomic Modelling for Climate Resilience: A manual for designing technical assistance on macroeconomic modelling supporting climate resilient development. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH. Retrieved from https://www.giz.de/en/downloads/giz2023-en-handbook-macromodelling-resilience.pdf; ibid, GIZ. (2021). Macroeconomic models for climate resilience: An economic tool for adaptation and development planning. Retrieved from https://www.giz.de/en/downloads/giz2021-en-cred-macroeconomic-models-for-climate-resilience.pdf

[5] GIZ. (2021). Macroeconomic models for climate resilience: An economic tool for adaptation and development planning. Retrieved from https://www.giz.de/en/downloads/giz2021-en-cred-macroeconomic-models-for-climate-resilience.pdf; European Environment Agency. (n.d.). The Adaptation Support Tool - Getting started. Climate-ADAPT. https://climate-adapt.eea.europa.eu/en/knowledge/tools/adaptation-support-tool

assessments of policy scenarios, enabling the comparison of adaptation measures across sectors based on their economic relevance and feasibility.

- The energy module provides a detailed examination of energy sector dynamics, encompassing demand, supply, and transformation processes across fossil fuels and renewables, as outlined in energy balances. This granularity enables precise assessments of fossil fuel combustion and its related CO2 emissions, which are further analysed in the emissions module.
- These emissions are represented in physical units, allowing the model to illustrate the impact of renewable energy deployment and energy efficiency improvements on CO2 savings. Notably, the emissions component of the E3 model does not include feedback effects on other model variables, ensuring a clearer distinction between direct and indirect impacts.

Figure 2. E3 model overview



Source: Adopted from GIZ (2021)[6]; GWS (n.d.)

The E3 model is particularly useful for scenario analysis, simulating the macroeconomic effects of various climate change scenarios and adaptation measures. This "what-if" approach addresses questions such as "What are the macroeconomic impacts of specific climate hazards?" or "How do sector-specific adaptation measures influence economic outcomes?" Scenarios are constructed using quantified assumptions assigned to model variables, which trigger chain reactions across the economy. The model outputs reveal not only direct effects but also indirect and induced consequences, offering a comprehensive perspective on macroeconomic outcomes.

- The analysis begins with climate change scenarios that define potential extreme weather events (EWEs), their economic impacts and associated damages, such as destroyed assets, production losses, and reduced labour productivity or infrastructure reconstruction costs. These scenarios draw on the Shared Socioeconomic Pathways (SSPs) developed by the IPCC to

[6] GIZ. (2021). Macroeconomic models for climate resilience: An economic tool for adaptation and development planning. Retrieved from https://www.giz.de/en/downloads/giz2021-en-cred-macroeconomic-models-for-climate-resilience.pdf; https://www.gws-os.com/de/energie-klima/modelle/detail/panta-rhei

represent different climate futures and vulnerability levels.

- These scenarios are benchmarked against a reference case that assumes climate change impacts without any intervention or adaptation measures.
- Adaptation scenarios are then developed to incorporate measures that minimise or prevent these impacts.

3.2 E3.mn specifications

The E3.mn model is a macro-econometric input-output model specifically tailored to Mongolia[7]. It reflects the structure of the national economy and its linkages with the energy system and emissions, enabling consistent simulation of adaptation policy effects across sectors. The model is built on a country-specific, annually resolved dataset, covering macroeconomic, energy, and emissions data from 1990 (for energy and emissions) and from 2008 (for economic indicators), drawn from the National Statistics Office, UN databases, IEA, World Bank, ADB, and ERC.

The economic core of the model is grounded in Mongolia's input-output table and national accounts, supplemented by employment, wage, and population data. Sectoral outputs and macroeconomic indicators - such as GDP, investment, and consumption - are modelled through econometric relationships, with key exogenous drivers including world market prices and demographic trends. The model follows a post-Keynesian demand-driven approach, where economic activity is shaped by expenditure decisions rather than equilibrium price adjustments. Supply-demand imbalances are corrected via demand shifts rather than price flexibility.

Mongolia's economy is strongly resource-based and climate-sensitive, with prominent sectors such as mining, agriculture, and livestock husbandry. These are explicitly represented in the model. For instance:

- Comparing the results of climate change and adaptation scenarios highlights the economy-wide and sector-specific effects of preventive actions, including changes in GDP, employment, and emissions.

By linking adaptation measures to macroeconomic indicators, the E3 model enables policymakers to evaluate costs, benefits, and trade-offs, supporting evidence-based decision-making for sustainable adaptation planning.

- Mining plays a central role in GDP and exports, but its energy-intensive nature and reliance on infrastructure make it vulnerable to flooding and energy supply disruptions.
- Agriculture and livestock, employing more than a quarter of the population, are highly exposed to extreme weather events such as dzuds and droughts, which lead to livestock mortality and pasture degradation.
- Construction and services are important in climate-resilient infrastructure development and are responsive to public investment scenarios in adaptation planning.

These sectoral linkages are captured through the model's input-output framework, which quantifies how demand in one sector stimulates production and employment in others via Leontief multipliers. For example, investments in climate-resilient irrigation systems will generate immediate output in construction, upstream demand for manufactured goods, and downstream employment and income gains.

The energy module builds on Mongolia's energy balances, capturing the dominant role of coal in electricity and heat generation. It models energy demand by sector and source, supply from domestic and imported fuels, and transformation processes including efficiency losses. Energy prices are linked to international projections and recent domestic cost trends, influencing sectoral consumption patterns. The emissions module estimates CO_2, CH_4, and N_2O

[7] GIZ (2025). Economy-wide impacts of climate change and adaptation in Mongolia: Assessing the macroeconomic impacts with the E3.mn model. https://www.giz.de/de/downloads/giz2025-en-climate-economy-modelling-adaptation-report.pdf; GIZ (2025b). E3.mn model handbook: Assessing the macroeconomic impacts of climate change and adaptation in Mongolia with the E3.mn model

from fuel combustion using UNFCCC emission factors but excludes feedback effects on economic variables - ensuring clarity in the analysis of adaptation scenarios.

The E3.mn model is designed for scenario-based policy analysis. By adjusting climate hazard probabilities or introducing sector-specific adaptation measures, the model can quantify both direct and economy-wide effects, including on GDP, employment, final energy demand, and GHG emissions. These features make it highly suitable for evaluating Mongolia's NAP, NDCs, and sectoral strategies. It enables tailored scenario analysis, addressing questions such as: "What are the macroeconomic consequences of reduced livestock productivity due to dzuds?" or "How does investment in resilient infrastructure affect employment and emissions outcomes?"

In summary, the E3.mn model is well-adapted to Mongolia's structural realities, climate vulnerabilities, and development objectives. It provides a data-driven foundation for assessing macroeconomic and sectoral trade-offs in climate adaptation planning.

3.3 Process of using the E3 model in Mongolia

The application of the E3.mn model in Mongolia has been embedded in a collaborative process involving national authorities and international experts. The goal was to strengthen Mongolia's institutional capacity to conduct macroeconomic assessments of climate change and adaptation policies.

The MED, BOM, and MECC (previously, the Ministry of Environment and Tourism) as the main political partners, ensuring policy alignment with Mongolia's NAP, NDCs, and green development objectives. The NEMA and the National Agency for Meteorology and Environmental Monitoring (NAMEM) supported the integration of climate hazard data and sector-specific vulnerability assessments into the modelling framework.

The technical implementation and model transfer were led by GWS (Gesellschaft für wirtschaftliche Strukturforschung), the institution behind the DIOM-X framework used to develop the Excel-based E3.mn model. The process included data harmonisation, model customisation for Mongolia's economic and sectoral structure, and iterative validation in coordination with national experts.

The BOM received targeted training to support the use of the model for economic planning and scenario analysis. Additional training activities targeted a broader group of technical staff from ministries and research institutions to ensure the sustainability of model use beyond the project period.

All national partners received hands-on support and access to the model, user documentation, and training materials. These included custom-built Excel templates, guidance on integrating macroeconomic, energy, and emissions data, and tutorial videos on operating and maintaining the model. The E3.mn model is expected to become an operational tool for scenario analysis in Mongolia, enabling stakeholders to assess the economy-wide implications of climate risks and adaptation responses, and to inform strategic planning through evidence-based projections. [8]

[8] GIZ (2025). Economy-wide impacts of climate change and adaptation in Mongolia: Assessing the macroeconomic impacts with the E3.mn model. https://www.giz.de/de/downloads/giz2025-en-climate-economy-modelling-adaptation-report.pdf; GIZ (2025b). E3.mn model handbook: Assessing the macroeconomic impacts of climate change and adaptation in Mongolia with the E3.mn model

4 DEFINING AND FORMULATING ADAPTATION POLICY SCENARIOS

The formulation of adaptation policy scenarios serves as a crucial step in translating climate objectives into practical, data-informed measures. The identification of 4 viable scenarios involved close collaboration with a national adaptation expert group consisting of involved stakeholders, including the MED, MECC, MOFALI, BOM and other national institutions. Their engagement ensures that the chosen scenarios draw upon existing sectoral strategies, reflect the actual needs of local stakeholders, and account for data availability and technical constraints. This collective input also helps clarify how each measure can be incorporated into the macroeconomic model and informs discussions on required datasets and baseline information.

4.1 Selection criteria for qualitative adaptation policy scenarios

A clear and systematic framework for selecting adaptation policy scenarios is essential to ensure they are relevant, feasible, and impactful.9 Four key criteria guide this process:

1. Alignment with national priorities ensures that scenarios address the critical challenges identified in the NAP and are reconfirmed with key stakeholders. This alignment guarantees that the proposed measures support broader national strategies and development goals.

2. Addressing climate impacts evaluates the extent to which a scenario targets critical vulnerabilities, such as land degradation, water scarcity, and other climate-related risks. Adaptation measures are tailored to mitigate these threats effectively, while also considering co-benefits such as improved public health or enhanced social equity.

3. Economic relevance and data availability assesses the potential for scenarios to deliver quantifiable economic benefits, such as increased productivity or cost savings, while ensuring that the necessary data and technical expertise are accessible to support implementation.

4. Integration into modelling tools focuses on ensuring that scenarios are designed to work seamlessly with macroeconomic models. This compatibility enables the quantification of costs, benefits, and long-term impacts, providing robust evidence to inform policy decisions.

In addition to these criteria, three principles - feasibility, impact, and cost-effectiveness - guide the framework.

› *Feasibility* examines the practical capacity for implementation, including regulatory, institutional, and financial conditions.

› *Impact* captures how effectively the proposed measures address climate risks and their potential to deliver co-benefits.

› *Cost-effectiveness* evaluates whether the anticipated benefits of an adaptation measure outweigh its financial and administrative costs.

Scenario selection must also reflect local priorities. For instance, in contexts where agriculture and water resource management are high-priority sectors, adaptation measures related to drought-resistant crops, irrigation infrastructure, or watershed protection should receive special attention. By incorporating these considerations into a stakeholder-driven consultation process, decision-makers can ensure that selected scenarios balance ambition with achievability.

[9] European Environment Agency. (2016). Assessing and selecting adaptation options. Climate-ADAPT. Retrieved from https://climate-adapt.eea.europa.eu/en/knowledge/tools/urban-ast/step-4-0

This approach not only strengthens the relevance of the macroeconomic modelling and analyses but also fosters national ownership of the adaptation strategy, ensuring that the selected scenarios align with both local needs and long-term development objectives.

4.2 Formulating a sound adaptation policy scenario

Once promising measures are identified, the next step involves assembling each scenario into a coherent set of measures that aligns with defined policy objectives. At the heart of this process is the need to clearly articulate baseline conditions - including current levels of sectoral productivity, infrastructure, and climate vulnerability - against which the effectiveness of new measures can be gauged. The baseline also incorporates existing policies and sectoral targets, ensuring that proposed interventions do not duplicate efforts or conflict with ongoing initiatives.

Within each scenario, it is important to specify policy levels, which may include the scale of interventions (regional or nationwide), the timeline for implementation (immediate, mid-term, or long-term), and any budgetary or legislative adjustments required. When designing such policy levels, stakeholder feedback is invaluable: consultations with the National Adaptation expert group, sector ministries, and local policy advice institutions help validate assumptions about costs, benefits, and technical feasibility. These consultations also clarify data availability - especially relevant to cost-benefit analyses or macroeconomic modelling - and spotlight any gaps that must be addressed before finalising scenarios.

This collective process ensures that adaptation policy scenarios are grounded in practical realities while remaining aligned with broader development goals. Once formulated and validated, the scenarios can be fed into the macroeconomic model to capture economy-wide effects, thereby informing revisions to national adaptation strategies and guiding more targeted, effective interventions across key sectors.

4.3 Relationship between cost-benefit analyses and the E3 model

The cost-benefit analysis (CBA) and the E3.mn model serve complementary functions in assessing climate adaptation measures. While the CBA focuses on the direct financial and economic implications of individual measures - such as infrastructure upgrades, livestock protection systems, or energy efficiency interventions - the E3.mn model assesses their broader macroeconomic effects, including indirect and induced impacts across sectors and time.

In Mongolia, the two approaches were used in combination where possible[10]. Cost estimates from national documents - particularly the NDC Action Plan, NAP drafts, and sectoral strategies - served as valuable input for scenario building. These documents provided quantified assumptions for selected measures, including unit costs, investment needs, and expected benefits, such as reduced livestock mortality or avoided crop losses.

These values were used to inform the structure of adaptation policy scenarios and to quantify model parameters such as public investment levels or productivity gains. The E3.mn model then translated these into economy-wide impacts, allowing policymakers to examine not only the sector-specific outcomes but also the resulting shifts in GDP, employment, energy use, and emissions.

Where such national estimates were not available, literature-based proxies and open-source benchmarks were applied, and validated through expert consultations. This ensured consistency and contextual relevance while maintaining transparency around assumptions. In some cases, benefit estimates were conservatively defined to avoid overstatement in the absence of robust data.

This combined approach allowed the model to reflect both the financial dimension of adaptation and its systemic economic implications, even when full, standalone CBAs were not available for all measures.

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[10] GIZ (2025). *Economy-wide impacts of climate change and adaptation in Mongolia: Assessing the macroeconomic impacts with the E3.mn model.* https://www.giz.de/de/downloads/giz2025-en-climate-economy-modelling-adaptation-report.pdf; GIZ (2025b). E3.mn model handbook: Assessing the macroeconomic impacts of climate change and adaptation in Mongolia with the E3.mn model

4.4 Potential limitations and response strategies

The formulation of adaptation scenarios and their integration into the E3.mn model faced several data-related and institutional limitations in Mongolia. While useful cost estimates were available from the NAP and NDC Action Plan, full CBAs were not available for all measures. In many cases, benefit quantification remained partial or qualitative.

To address this, the modelling team:

- Used literature-based benchmarks and open-source data for missing cost or benefit estimates;
- Validated assumptions through expert consultations;
- Applied conservative values or sensitivity ranges to reflect uncertainty.

Another challenge was the lack of quantified adaptation targets, particularly in sectors like health or regional-level infrastructure, which limited the ability to model specific outcomes. Inconsistencies in national datasets and gaps in long-term projections also required harmonisation and cautious extrapolation.

Recommended mitigation strategies include:

- Developing sector-specific CBAs as part of national adaptation planning;
- Clarifying quantitative adaptation targets for priority sectors;
- Strengthening cross-agency data coordination and institutional capacity for ongoing model use.

Despite these limitations, the combined use of national data, expert input, and transparent assumptions allowed the model to generate meaningful insights and support scenario-based decision-making.

5 DEVELOPED POLICY RECOMMENDATIONS AND RESULTS

In response to Mongolia's increasing vulnerability to climate change, four key adaptation scenarios were developed to reflect the country's most urgent environmental and socio-economic challenges. These scenarios - resilient agriculture and crops, livestock and pastures, water management, and forestry - were selected based on their alignment with national adaptation priorities, modelling feasibility, and potential for transformative impact. Each scenario presents a targeted policy recommendation, supported by a CBA where data allowed, and is complemented by macroeconomic modelling, financing schemes, and implementation guidance. Together, they offer a strategic blueprint for enhancing climate resilience across Mongolia's economy.

5.1 Resilient agriculture and crops

Scenario description

Mongolia's agricultural sector is facing critical challenges due to the intensifying impacts of climate change. The impacts include extreme weather events, such as dzuds, desertification, water scarcity, and the degradation of pasturelands and cultivated lands. By 2022, 4.7 million hectares of pastureland and 81.5 thousand hectares of cultivated area were classified as degraded, threatening food security, rural livelihoods, and environmental sustainability.[11] The increasing variability in precipitation patterns and rising temperatures are worsening the already fragile agricultural ecosystem, which relies heavily on water-intensive practices. Agriculture accounts for approximately 30% of water consumption[12], yet inefficient irrigation practices may lead to substantial losses.

The urgency to address these issues is heightened by the broader implications for Mongolia's economy and rural communities. Climate projections indicate that without intervention, agricultural productivity will decline further, exacerbating poverty and accelerating migration from rural to urban areas. This policy recommendation aligns with Mongolia's NAP (Measure 13.1) and NDC Action Plan (Measure 3.2.1), which emphasise reducing water use and irrigation costs while enhancing climate resilience in agriculture.[13] It also supports the goals outlined in Mongolia's Vision 2050, which prioritises green and sustainable development pathways.[14]

The main objective of this policy recommendation is to enhance the resilience of Mongolia's agricultural systems through innovative and efficient water management solutions. Current irrigation practices are highly inefficient, with significant water loss due to evaporation and runoff, exacerbating the effects of water scarcity.[15] At the same time, traditional farming methods leave crops vulnerable to fluctuating temperatures, pest infestations, and nutrient depletion. The adoption of targeted technologies - namely, drip irrigation systems and eco-synthetic film covering - represents a practical and effective approach to addressing these challenges. By tackling these issues, the policy also contributes to broader goals of food security, sustainable livelihoods, and environmental conservation.

[11] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change. Ulaanbaatar, Mongolia: Government of Mongolia. Retrieved from https://unfccc.int/sites/default/files/resource/MONGOLIA%20FOURTH%20NC%202024.pdf

[12] World Bank. (2024). Mongolia Country Climate and Development Report: Overview. Washington, D.C.: World Bank Group. Retrieved from https://documents.worldbank.org/curated/en/099530006012264185/P17426201d1e7c09f0bf560a80824f5422atation

[13] Government of Mongolia. (2024). *National Adaptation Plan to Climate Change 2024-2030*; Government of Mongolia. (2021). Nationally Determined Contribution (NDC) Action Plan 2021-2025. https://www4.unfccc.int/sites/submissions/INDC/Published%20Documents/Mongolia/1/150924_INDCs%20of%20Mongolia.pdf

[14] Government of Mongolia. (2020). Vision 2050: Long-term development policy of Mongolia. https://vision2050.gov.mn/eng/

[15] World Bank. (2024). *Mongolia Country Climate and Development Report: Overview*. Washington, D.C.: World Bank Group. Retrieved from https://documents.worldbank.org/curated/en/099530006012264185/P17426201d1e7c09f0bf560a80824f5422atation

Due to data limitations, it was not possible to integrate all identified measures into the modelling. Nevertheless, the broader context includes a wide range of potential adaptation measures to enhance climate resilience in agriculture:

- Introduce crops and varieties resistant to drought, diseases, and pests and improve seed supply of these varieties
- Expand the number and coverage of research institutes working on regional varieties of seeds and crops resistant to local conditions
- Increase the amount of self-prepared fodder at the level of herder households by planting fodder plants in winter-spring shelters
- Introduction of drip irrigation and eco-synthetic film covering technology in the production of potatoes, vegetables, and fruits
- Implement a project to introduce smart technology in the management of plant protection, moisture, heat, and fertiliser supply in agricultural production
- Introduce the reduced and zero-tillage technologies in mechanical compaction cereal, fodder, annual plant crops soil to protect soil fertility and reduce moisture loss
- Introduce the multi-rotation cropping system that is friendly to soil fertility and economically efficient, reduce the percentage of solid fallow, and increase the number of legumes and other food and fodder crops
- Straw mulching of grain, fodder, and technical plant areas
- Make use of extended vegetation phases by introducing suitable crops

The proposed policy is based on the implementation of two specific measures: drip irrigation systems and eco-synthetic film covering technology. These actions are designed to improve water-use efficiency, protect soil health, and boost crop yields in the context of Mongolia's harsh climatic conditions.

Drip irrigation is a targeted water delivery system that provides water directly to the root zone of crops through a network of pipes, tubes, and emitters. This technology significantly reduces water wastage by minimising evaporation and runoff, making it highly suitable for Mongolia's water-scarce regions. Compared to traditional flood irrigation methods, drip irrigation ensures uniform water distribution, optimising the use of available water resources while enhancing crop growth and quality.[16]

Eco-synthetic film covering involves the use of biodegradable or recyclable synthetic films to create a controlled microenvironment for crop cultivation. These films act as a protective barrier, reducing soil moisture loss, stabilising soil temperatures, and shielding crops from extreme weather events, pests, and diseases. This technology is particularly beneficial for crops like potatoes, vegetables, and fruits, which are sensitive to temperature fluctuations and water stress.[17]

Assumptions

The scenario assumptions are based on a CBA conducted under Mongolia's NDC Action Plan. The measure foresees the introduction of drip and permeable irrigation systems across an additional 290,000 hectares between 2026 and 2030 (see Table 1). Total investment needs are estimated at 235 billion MNT, with annual operation and maintenance costs projected at 98 billion MNT after implementation. Investment costs are assumed to be covered by international donors. Upon full implementation, annual agricultural output is expected to increase by approximately 502 million USD.

[16] Ministry of Environment and Tourism (currently Ministry of Climate and Environment), United Nations Environment Programme (UNEP), & NDC Action. (2024). Adaptation policy assessment report: Agriculture sector - arable farming.

[17] Salama, K., & Geyer, M. (2023). Plastic mulch films in agriculture: Their use, environmental problems, recycling and alternatives. *Environments*, *10*(10), 179. https://publications.zalf.de/publications/0ECF1F8C-4C1B-425D-A584-3DFC544B99EC-1.pdf

Table 1. Assumptions on costs and benefits for the introduction of drip irrigation systems and eco-synthetic film coverage

COMPONENT	2026	2027	2028	2029	2030
CUMULATION OF ADDITIONAL IRRIGATED AREA (1 000 HECTARES)	58	116	174	232	290
INVESTMENT IN DRIP IRRIGATION, ECO-SYNTHETIC FILM COVERAGE ETC. (MN. MNT PER 100 HECTARE)	81	81	81	81	81
OPERATION AND MAINTENANCE COSTS P.A. (BN. MNT)	20	39	59	79	98
INCREASED AGRICULTURAL PRODUCTION P.A. (BN. MNT)	100	201	301	402	502

Source: Based on GIZ (2025) 18 - CBA conducted for the Green Climate Fund (GCF) funded UNEP/MET implemented project "Building Capacity to Advance National Adaptation Plan Process in Mongolia", see also NCC (2021)

Modelling outcomes and macroeconomic results[19]

The modelling results for the resilient agriculture adaptation measure - focused on the introduction and scaling-up of drip irrigation systems - demonstrate its potential to stimulate Mongolia's economy while enhancing climate resilience. The measure was assessed under a high-emissions climate scenario [20](used for the CBA), comparing outcomes against a baseline that does not address adaptation concerns. The results highlight how targeted investment in climate-resilient practices in agriculture can generate broad-based economic, employment, and environmental impacts, both during implementation and beyond.

Economic growth and GDP impact

The deployment of drip irrigation systems leads to a real GDP increase of up to 0.6%, equivalent to approximately 270 billion MNT over the period. This growth is driven by both infrastructure investment and increasing agricultural productivity.

- Short-term growth (during implementation): Economic growth is supported by investments in irrigation infrastructure and steadily rising agricultural yields, contributing up to +0.6% p.a.
- Post-implementation (from 2030 onward): Once the irrigation systems are fully operational, continued benefits include export opportunities (up to +0.4% p.a.) and reduced agricultural imports.
- Ongoing effects: Operation and maintenance activities sustain positive impacts on GDP beyond the implementation period.

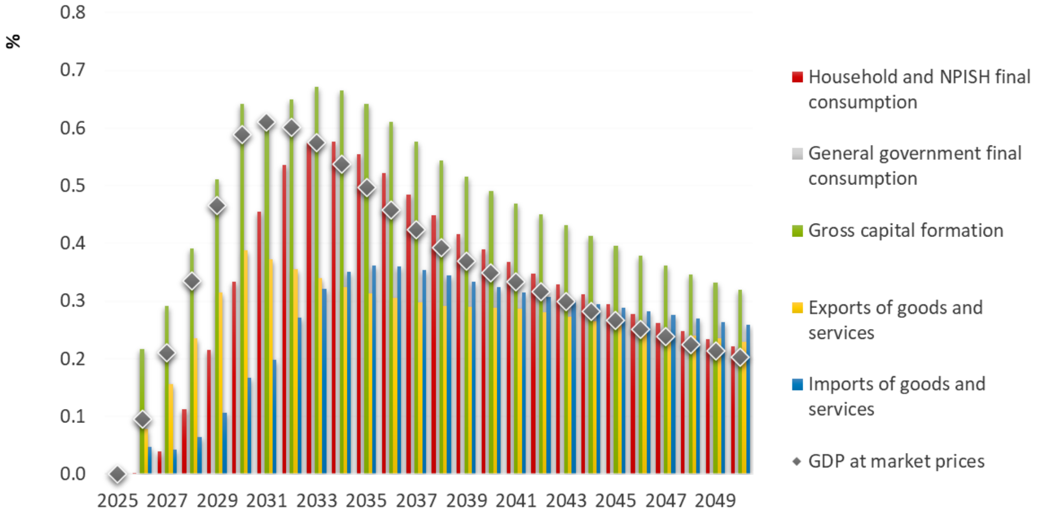
Imports increase by 0.36% p.a., mainly due to the demand for imported irrigation systems, machinery, and land management equipment. Household consumption rises due to job creation and income growth, with a corresponding increase of up to 0.6% p.a.

[18] GIZ (2025). Economy-wide impacts of climate change and adaptation in Mongolia: Assessing the macroeconomic impacts with the E3.mn model. https://www.giz.de/de/downloads/giz2025-en-climate-economy-modelling-adaptation-report.pdf

[19] GIZ (2025). Economy-wide impacts of climate change and adaptation in Mongolia: Assessing the macroeconomic impacts with the E3.mn model. https://www.giz.de/de/downloads/giz2025-en-climate-economy-modelling-adaptation-report.pdf

[20] The high-end emissions scenario (RCP8.5) reflects an extreme but plausible climate pathway, leading to an estimated global average temperature rise of approximately 5–6°C by 2100 compared to pre-industrial levels. It is often referred to as a 'business-as-usual' scenario, assuming limited action to reduce greenhouse gas emissions. World Bank. (2025). Climate Knowledge Portal: Overview. Retrieved from https://climateknowledgeportal.worldbank.org/overview

Figure 3. Macroeconomic effects, 2025-2050, in percent



Source: GWS illustration based on E3.mn results

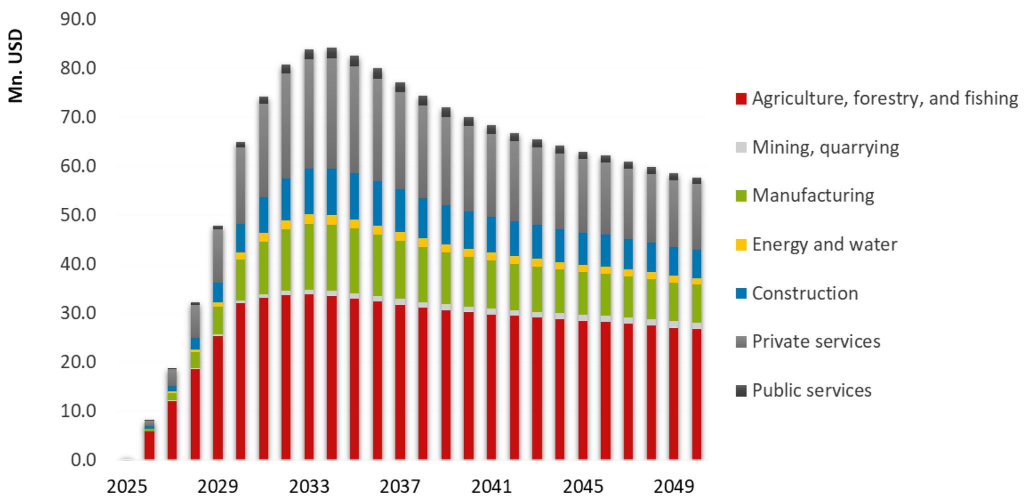
Sectoral economic output

The largest initial gains are in sectors directly involved in irrigation system deployment and agriculture. Estimated sectoral impacts include:

- Agriculture: Output increases by up to 1.7%, or 32 million USD
- Manufacturing: Up to 0.45% p.a., or 13.5 million USD
- Construction: Up to 0.4% p.a., or 10 million USD
- Private services (e.g., trade and transport): Benefit indirectly through value chain effects and higher consumer demand

Overall, total real output increases by 0.3%, equivalent to approximately 84 million USD. These effects gradually decrease over time but remain positive relative to a non-adaptation scenario.

Figure 4. Effects on gross production by economic sectors in constant prices, 2025-2050, in Mn. USD



Source: GWS illustration based on E3.mn results

Employment effects

Labour market impacts closely follow output trends, with up to 7,000 new jobs created, or +0.5% p.a.:

- Agriculture: Up to 4,000 jobs, or +1.7% p.a.
- Private services: Up to 1,400 jobs, or +0.3% p.a.
- Construction: Up to 400 jobs, or +0.4% p.a.
- Manufacturing: Up to 600 jobs, or +0.4% p.a.

Total employment increases by up to 7,000 jobs, or +0.5% p.a.

Energy demand and GHG emissions

Without further energy efficiency measures, higher economic activity leads to a rise in final energy demand by up to 0.26%, or 1,400 TJ. The sectoral breakdown is as follows:

- Other consumption n.e.c. (mainly agriculture and unspecified services): +1,100 TJ, or 0.3% p.a.
- Service sectors: +140 TJ, or 0.3% p.a.
- Manufacturing & Transport: Each approx. +70 TJ, or 0.1% p.a.
- Agriculture: Smaller absolute increase (+8 TJ p.a.) but the largest relative growth (+1.3% p.a.)

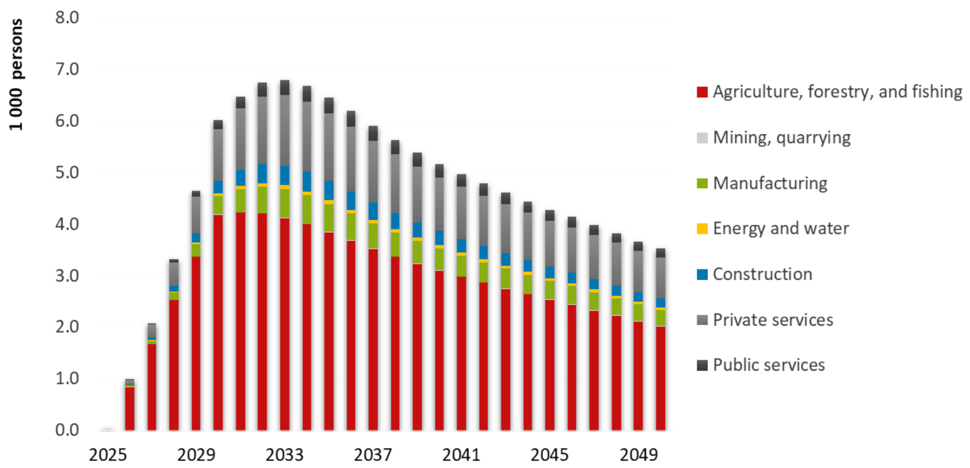
This translates into additional GHG emissions of up to 58 Gg CO_2e, mainly from:

- Energy industries: +30 Gg CO_2e, or +0.16% p.a.
- Transport: +21 Gg CO_2e, or +0.26% p.a.

These increases are primarily tied to coal and oil use in energy and transport sectors.

The modelling results confirm that scaling up drip irrigation in Mongolia offers a high-impact climate adaptation measure with strong economic co-benefits. It supports GDP growth, sectoral output, and employment, particularly in agriculture and services. However, the benefits come with increased energy demand and GHG emissions, underscoring the need to complement adaptation measures with energy efficiency and fuel-switching policies.

Figure 5. Effects on employment by economic activities, 2025-2050, 1,000 persons / new jobs



Source: GWS illustration based on E3.mn results

Financing[21]

To support the adoption of drip irrigation and climate-smart agricultural practices, the project proposes a blended financing mechanism that combines grants, concessional loans, and guarantees. This approach is designed to address financial barriers for smallholder farmers and cooperatives, while ensuring long-term financial sustainability and scalability.

Objectives and rationale

The financial structure aims to:

- Lower entry barriers for farmers through initial grant funding
- Encourage performance via results-based incentives
- Ensure sustainability through concessional loans and a revolving financing model
- Enable institutional ownership by gradually shifting responsibility to a national entity.

This scheme addresses both the capacity gaps and investment constraints that hinder smallholders from transitioning to climate-resilient practices.

Structure of the blended financing mechanism

The financing model is composed of three main components:

- Grants are used to support knowledge transfer, technical training, and initial piloting of drip irrigation
- Results-based grants reward verified implementation and effectiveness of irrigation systems
- Concessional loans, with favourable terms, form the backbone of long-term financing

COMPONENT	PURPOSE	SHARE
SEED GRANT (10%)	Capacity building, training, and early business development	10%
RESULTS-BASED GRANTS	Incentives for successful adoption and maintenance of irrigation	30% → ¯ 20%
CONCESSIONAL LOANS	Primary financing for infrastructure investments	60% → ↑ 80%

Over time, the share of loans will increase to 80%, while the share of grants will reduce to 20%, strengthening the mechanism's sustainability.

Financial flows and institutional roles

The financial flow is designed to ensure accountability, effective disbursement, and alignment with national systems:

1. International climate finance provides seed funding (grants and concessional loans), channelled through the Government of Mongolia.

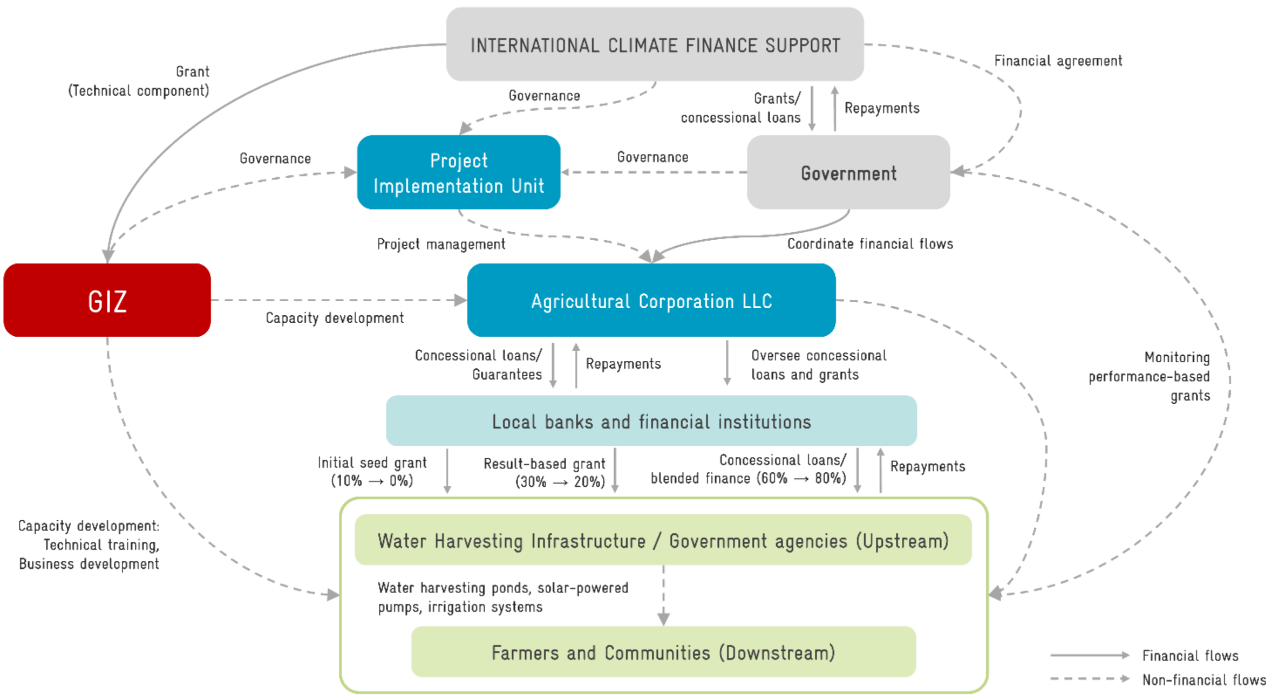
2. The Agricultural Corporation LLC serves as the central financial coordinator, responsible for:
    - Managing concessional loan and grant portfolios
    - Overseeing disbursements via local banks and financial institutions
    - Monitoring repayment flows and recycling funds for reinvestment
    - Ensuring alignment with national agricultural and climate adaptation priorities.

3. Local financial institutions disburse funds directly to beneficiaries, including smallholder farmers, cooperatives, and women-led agribusinesses.

4. A Project Implementation Unit (PIU), supported by GIZ, provides technical assistance, capacity building, and governance oversight.

[21] Adopted and based on GIZ (2025). Financing Options for Sectoral Adaption Programmes in Mongolia [Ferreira, M.] GIZ, Berlin.

Figure 6. Financial flows and institutional roles



Source: Greenwerk illustration - GIZ (2025). Financing Options for Sectoral Adaption Programmes in Mongolia [Ferreira, M.] GIZ, Berlin.

Revolving fund and long-term sustainability

The model is based on a revolving financing mechanism, in which loan repayments are returned to the Agricultural Corporation LLC and used to finance future investments. This allows the project to:

- Sustain financing beyond the initial donor support period
- Scale up to other agricultural sectors or regions
- Reduce dependency on external grants over time

By the end of the project cycle, the revolving fund is expected to operate independently, institutionalised within the Agricultural Corporation LLC and supported by government frameworks.

Alignment with national strategies and complementary initiatives

The proposed financing mechanism:

- Aligns with Mongolia's national climate adaptation and agricultural development priorities;
- Builds on existing initiatives, such as:
  - The Vegetable Production and Irrigated Agriculture Project;
  - The MNT 500 billion soft loan programme for agribusiness, including MNT 100 billion for agricultural production;
  - The Agricultural Value Chain Financing Project, which enhances access to finance and technology adoption.

By focusing specifically on drip irrigation, the project targets a proven, high-impact technology for improving water efficiency and agricultural resilience, while leveraging and complementing existing public and private financing tools.

Steps for implementation

To implement the proposed measures – drip irrigation systems and eco-synthetic film covering technology – policymakers must adopt a structured and phased approach. While Mongolia's strategic frameworks, such as the NAP and key agricultural and environmental laws, provide a strong foundation, there is a critical need to strengthen bylaws, operational guidelines, and institutional mechanisms to translate these provisions into actionable and effective measures.

1. *Strengthening institutional leadership and coordination*

The MOFALI is well-placed to lead the implementation process by overseeing resource allocation, identifying high-priority regions for pilot projects, and ensuring alignment with national climate adaptation strategies. Collaboration with the MED and MECC would further support integration across sectors and enhance coherence with broader environmental goals. At the local level, governors of aimags, sums[22], capitals, and districts should play an important role in adapting implementation to regional needs and realities. Local governments should be empowered to facilitate engagement with farmers and communities while ensuring effective monitoring of progress. Institutional capacity-building for both central and local authorities will be essential to address gaps in operational resources and expertise.

2. *Strengthening bylaws and operational provisions*

While strategic-level frameworks, such as the NAP and existing laws (e.g., Law on Agriculture, Law on Soil Protection and Prevention of Desertification), provide strategic goals and guidance, their operationalisation often lacks clarity and specificity. Policymakers should focus on:

- Amendments and updates to bylaws are needed to define how strategic provisions will be applied in practice, particularly for emerging technologies like drip irrigation and eco-synthetic film. For example, bylaws could specify standards for irrigation systems, define subsidy mechanisms, or outline procedures for technology certification.
- Streamlining bureaucratic processes for accessing subsidies, loans, or grants will make the technologies more accessible, particularly for smallholder farmers.
- Clearer enforcement guidelines are needed to ensure compliance with standards related to irrigation, soil protection, and sustainable farming practices.

3. *Enhancing research and tailoring technologies*

Research institutions (e.g. the Institute of Plant and Agricultural Sciences (IPAS), the Mongolian University of Life Sciences (MULS), and the Water Research Center) should be engaged into adaptation of these technologies to Mongolia's environmental and agricultural conditions. These institutions can conduct field trials to assess the effectiveness of drip irrigation systems and eco-synthetic film covering, collect performance data, and recommend improvements for scaling.

The Climate Change Research and Cooperation Center and the Institute of Geography and Geoecology at the Mongolian Academy of Sciences can assist with aligning technological adaptation with regional climatic variability and broader climate resilience goals.

Policymakers should ensure adequate funding and technical support for research initiatives to strengthen their capacity. Collaboration with international organisations can provide access to global expertise and resources, helping Mongolia adopt best practices and tailor them to its local context. Strengthened research capacity will also enable better integration of data-driven insights into policymaking.

4. *Phased implementation and pilot testing*

A phased approach is recommended to build confidence and reduce risks:

Pilot projects (1-2 years) focusing on high-priority regions with acute water scarcity and high-value crops that generate more income per hectare compared to staple crops. For example, potatoes, vegetables, nuts, and fruits. Pilot projects will test the feasibility of the technologies, identify challenges, their potential solutions as well as demonstrate benefits to farmers and stakeholders.

Evaluation and adjustment (3-4 years) assessing results and addressing challenges through adjustments to technology deployment, training programs, and financing mechanisms.

[22] Mongolia's administrative structure is divided into aimags (provinces), which are the primary regional units, and sums (districts), which are sub-units within aimags.

Nationwide scaling (5 years+) of the technologies focusing on equitable access for smallholder farmers and addressing disparities in regional implementation capacity.

5. *Monitoring and evaluation*

Robust M&E systems are essential to track progress, improve transparency, and ensure accountability. The framework should measure both environmental outcomes and socio-economic benefits, while remaining adaptive to evolving conditions. To improve planning and clarify ambition, indicative targets may be included – such as, for example, reaching up to 20% of vegetable production with drip irrigation or covering a defined share of cultivated land with eco-synthetic film by 2030. These are not binding commitments but serve as planning benchmarks to guide implementation and prioritise resources. Such targets can also assist in introducing incentive-based policy instruments, by providing clear criteria against which financial support, grants, or technical assistance can be linked.

Key performance indicators (KPIs) may include:

- Estimated volume of water saved (litres per hectare or per crop)
- Share of irrigated land using drip or eco-synthetic film technologies (as a % of total cultivated area)
- Adoption rates by smallholder farmers, disaggregated by gender or region
- Average crop yield increase (e.g., potatoes, vegetables, fruits) in pilot vs. baseline areas
- Cost savings per hectare for water and input use
- Number of farmers trained or receiving financial support

Annual and mid-term evaluations should assess these KPIs to identify implementation bottlenecks, determine cost-effectiveness, and revise strategies accordingly. Research institutions, in collaboration with local authorities, should lead data collection and contribute to refining the indicators based on field-level experience. Transparency and inclusivity in the M&E process will build trust among stakeholders and strengthen the credibility of the measures.

5.2 Livestock and pastures

Scenario description

Mongolia's rangelands play a critical role in supporting livelihoods, contributing to the economy, and maintaining ecological balance. Approximately 96% of Mongolia's agricultural land is classified as rangeland, serving as grazing grounds for livestock while also providing habitats for native vegetation, wildlife, and critically endangered species.[23] However, the country's rangelands are deteriorating at an alarming rate due to overgrazing, unsustainable livestock management, and climate change. The total area of rangelands decreased by 11.25%, from 123.6 million hectares in 1987 to 109.6 million hectares in 2020, with 70-88% of the remaining rangelands showing signs of degradation.[24]

The rapid expansion of Mongolia's livestock population is a key driver of rangeland degradation. Between 1987 and 2022, livestock numbers grew from 22.7 million to 71.1 million, far exceeding the carrying capacity of pastures in most regions.[25] The number fell to 57.6 million animals in 2024 due to adverse weather conditions and shrinking pasturelands.[26] Overgrazing is further exacerbated by the dominance of goats, whose grazing habits cause greater damage to rangelands by consuming not only grass leaves but also grass roots. By 2024, goats accounted for 40% of

[23] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change. Ulaanbaatar, Mongolia: Government of Mongolia. Retrieved from https://unfccc.int/sites/default/files/resource/MONGOLIA%20FOURTH%20NC%202024.pdf

[24] World Bank. 2024. Investing in Nature as a Climate and Development Opportunity for Mongolia. Washington DC: World Bank

[25] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change.

[26] DairyNews Today. (2024). Mongolia's livestock numbers drop by 7 million in 2024. DairyNews Today. https://dairynews.today/global/news/mongolia-s-livestock-numbers-drop-by-7-million-in-2024.html

Mongolia's total livestock population, driven largely by the high global demand for cashmere.[27]

Climate change has intensified the challenges facing the pastoral sector, with rising temperatures, reduced precipitation, and extreme weather events such as dzuds (harsh winters) leading to increased livestock mortality and reduced forage availability as was seen in 2024. Soil degradation, including a decline in soil organic carbon by an estimated 18-28% by mid-century, is further reducing the productivity of rangelands. These cascading effects threaten the resilience of herders, who make up 24.9% of Mongolia's workforce and rely heavily on livestock production, which constitutes 82.5% of agricultural output. [28]

The policy frameworks outlined in Law on Livestock and Animal Health (2017), Mongolia's NAP (Measure 11.4) 29, NDC Action Plan (Measure 3.1.1) the Law on Reducing the Negative Effects of Climate Change Caused by Traditional Livestock Agriculture (2024), Decision of the Government of Mongolia on Launching "New Cooperative Movement" (2024), as well as Law on Indexed Livestock Insurance Act (2024) emphasise the need for sustainable pasture and livestock management. However, despite these policy frameworks, challenges persist. Open access to rangelands has led to unregulated grazing, increasing pressure on fragile ecosystems and accelerating pasture degradation. Current management systems lack mechanisms to address overstocking, leading to declining productivity and greater climate vulnerability among herders.

This policy recommendation seeks to align national goals with actionable measures to restore rangelands, improve livestock productivity, and enhance the resilience of Mongolia's rural communities. Due to data limitations, it was not possible to integrate all identified measures into the modelling. Nevertheless, the broader context includes a wide range of potential measures:

- Focus primarily on increasing the quality and yield of existing livestock to try to maintain or decrease numbers of livestock
- Implement erosion control techniques, such as planting cover crops, building terraces, and using windbreaks
- Adjust the number of livestock to sustainable levels and track their migration patterns
- Combat desertification through reforestation, soil management practices, and sustainable land management
- Establish protected areas for critical grassland ecosystems and implement rotational grazing practices
- Demarcate winter-spring pastures for herders and community-based groups
- Implement long-term land use management systems through contracts
- Link incentives and support mechanisms with sustainability assessments of livestock sector producers and facilities, e.g., establishing procedures to assess ecological, economic, and social indicators every two years

The main objective of this policy recommendation is to mitigate rangeland degradation, reduce the vulnerability of herders to climate change impacts, and improve the productivity and sustainability of the livestock sector. To achieve this, the proposed measures focus on:

- Improving water resources and fodder production by building irrigation points and engineered wells.

Assumptions

In line with the NDC Action Plan, the scenario assumes the construction of 800 new herding points over a five-year period, with 160 units added annually. Each herding point includes essential infrastructure such as engineered wells, stables, fences, open yards, and residential housing for herders.

[27] National Statistics Office of Mongolia. (2025). NUMBER OF LIVESTOCK, by type, by region, bag, soum, aimags and the Capital. https://www.1212.mn/en/statistic/statcate/573054/table-view/DT_NSO_1001_021V1

[28] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change.

[29] Government of Mongolia. (2024). National Adaptation Plan to Climate Change 2024-2030

Based on the cost-benefit analysis (Table 2), the total investment amounts to 261 billion MNT, which, as outlined in the NDC Action Plan, is to be fully financed by the government. It is further assumed that public expenditures for administration will be gradually reduced over the next decade to support budget reallocation. Annual operation and maintenance costs for the newly constructed herding points are estimated at 29 billion MNT, while the expected annual benefits from increased livestock production reach approximately 169 billion MNT.

Table 2. Assumptions on costs and benefits for the construction of herding points

COMPONENT	2026	2027	2028	2029	2030
CUMULATED NUMBER OF ADDITIONAL HERDING POINTS	160	320	480	640	800
INVESTMENT IN HERDING POINTS (MN. MNT PER HERDING POINT)	326	326	326	326	326
OPERATION AND MAINTENANCE COSTS P.A. (BN. MNT)	6	11	17	23	29
INCREASED AGRICULTURAL PRODUCTION P.A. (BN. MNT)	34	68	101	135	169

Source: Based on GIZ (2025) - based on CBA conducted for the GCF funded UNEP/MET implemented project "Building Capacity to Advance National Adaptation Plan Process in Mongolia", see also NCC (2021)

Modelling outcomes and macroeconomic results

The modelling results for the herding infrastructure adaptation measure - centred on the construction of 800 new herding points - illustrate its positive contribution to Mongolia's economy and rural resilience. The measure was analysed under a high-emissions climate scenario (used for the CBA), comparing outcomes with a baseline. The results show that targeted public investment in rural infrastructure can deliver significant economic, employment, and environmental benefits, particularly in the livestock sector.

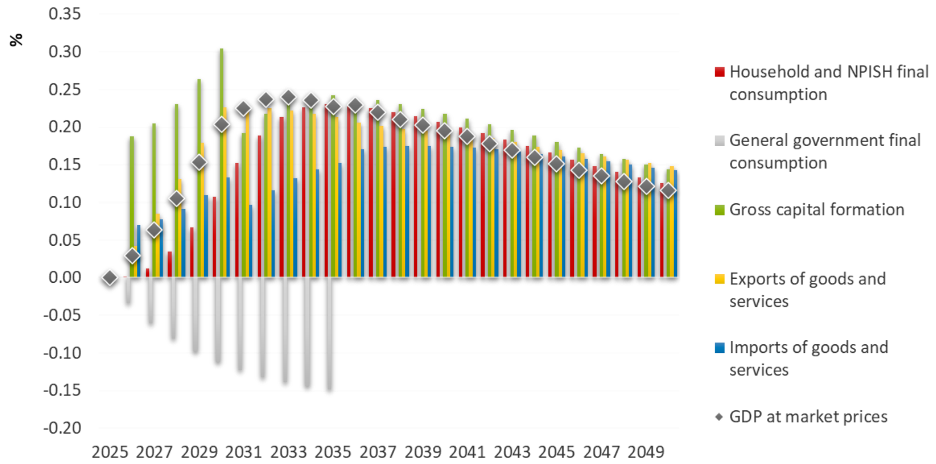
Economic growth and GDP impact

The construction of herding points contributes to real GDP growth of up to 0.24% per year, equivalent to approximately 120 billion MNT (see Figure 7)

. This growth is primarily driven by public investment during the implementation phase (until 2030), which contributes up to 0.3% p.a. After the investment phase, GDP continues to benefit from increased economic activity, albeit at a slower rate.

- Trade impacts. Livestock exports rise, while agricultural imports decline. Total exports increase by up to 0.23% p.a., and imports by 0.13% p.a., resulting in a positive trade balance.
- Public consumption. To finance the adaptation measure, government spending on public administration is reduced over ten years. As a result, public consumption declines by up to 0.15% compared to the baseline.
- Private consumption. Job creation and higher incomes raise household consumption, which increases by up to 0.23% p.a., stimulating both domestic production and imports.

Figure 7. Macroeconomic effects, 2025-2050, in percent



Source: GWS illustration based on E3.mn results

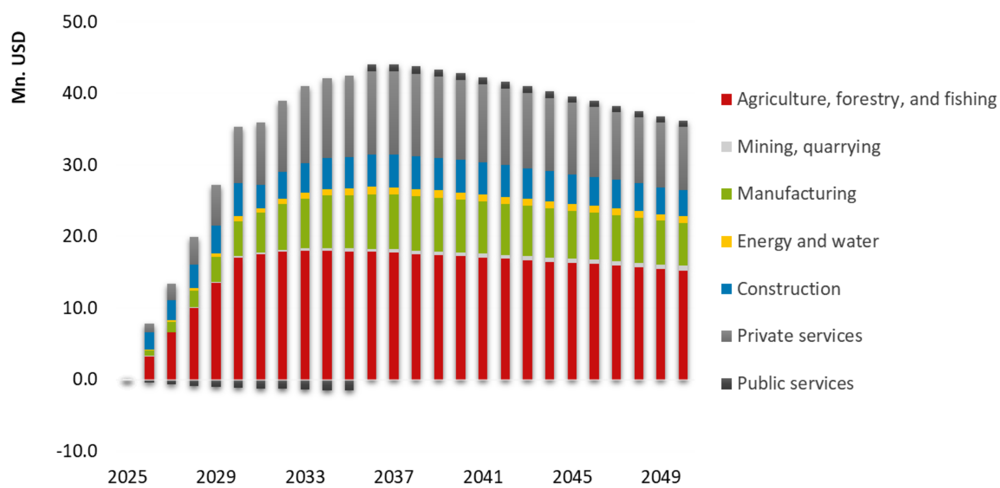
Sectoral economic output

The strongest output gains occur in agriculture, which sees an increase of up to 0.9%, or approximately 17 million USD annually. This is followed by manufacturing and construction, which benefit indirectly from investment in infrastructure (e.g. machinery, equipment, and building materials). However, their expansion remains moderate at around 5 million USD (0.2% p.a. each), due to limited domestic production capacity and short implementation duration.

- Public services experience a temporary slowdown in output during the first decade, driven by reduced spending on administration, before stabilising and recovering.
- Private services show consistent positive effects, supported by income-induced demand and downstream economic activity, growing by up to 12 million USD, or 0.14% p.a.

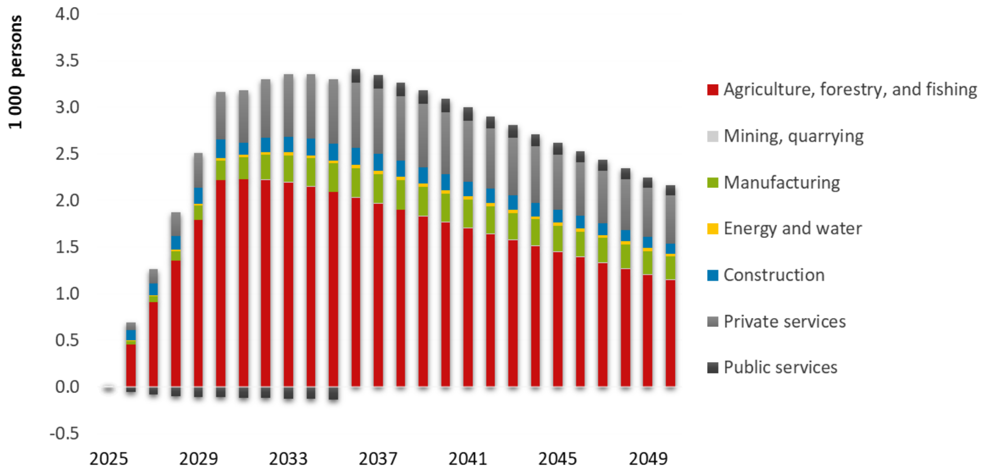
In total, real output increases by up to 45 million USD, or 0.14% annually. After 2030, the positive effects diminish but remain above the baseline, reflecting the long-term benefits of the measure.

Figure 8. Effects on gross production by economic sectors in constant prices, 2025-2050, in Mn. USD



Source: GWS illustration based on E3.mn results

Figure 9. Effects on employment by economic activities, 2025-2050, in 1 000 persons / new jobs



Source: GWS illustration based on E3.mn results

Employment effects

Employment trends closely follow output dynamics. The sectors with the strongest job growth are those directly impacted by the measure:

- Agriculture sees the largest increase, with up to 2,200 new jobs, or 0.9% p.a.
- Private services create an additional 700 jobs, or 0.14% p.a.

Overall, total employment increases by up to 3,400 persons, or 0.25% annually.

Energy demand and GHG emissions

The expansion of economic activity leads to a moderate rise in final energy demand, increasing by up to 0.1%, or 700 TJ.

- The largest increase is recorded under "Other consumption n.e.c.", largely representing agriculture and unspecified services (+560 TJ, or 0.15% p.a.)
- Public and private services follow, with an increase of 70 TJ, or 0.12% p.a.

In line with energy use, GHG emissions also rise, particularly in energy-intensive sectors:

- Energy industries: +15 Gg CO_2e (+0.1% p.a.) due to higher electricity and heat demand
- Transport: +11 Gg CO_2e (+0.12% p.a.)
- Public and private services: +3 Gg CO_2e (+0.13% p.a.)

In total, GHG emissions increase by almost 30 Gg CO_2e, or 0.1% per year.

Financing

To support sustainable livestock management and rangeland restoration, a blended financing approach is proposed for the development of herding infrastructure and improved pasture use systems. The financing model combines public investment, performance-based grants, and concessional instruments, aiming to reduce entry barriers for herder households while ensuring long-term financial sustainability and institutional ownership.

Objectives and rationale

This approach addresses the full cost of adaptation by responding to both investment and capacity gaps in Mongolia's livestock sector. It is designed to:

- Enable access to infrastructure for herders and cooperatives
- Incentivise sustainable livestock and pasture practices
- Build institutional capacity and financial resilience
- Align financial flows with national adaptation and rural development goals

COMPONENT	INDICATIVE ROLE
PUBLIC INVESTMENT / DONOR GRANTS	Finance the initial construction of herding points (e.g. wells, shelters, fencing)
RESULTS-BASED GRANTS	Reward compliance with sustainable land use, pasture management, and herd planning
CONCESSIONAL LOANS / LEASING	Support upgrades, O&M, and equipment investments by herders or cooperatives
GUARANTEES / RISK-SHARING INSTRUMENTS	Mobilise private actors in infrastructure delivery and service provision

Blended financing structure and financial flows

The proposed mechanism builds on a combination of public and concessional resources and encourages a transition to performance-based and revolving financing over time: [see Table above]

Financial flows would be channelled through a national-level intermediary - such as the Agricultural Corporation LLC - which would manage funding distribution, monitor outcomes, and ensure alignment with national policy objectives. Local financial institutions, cooperatives, and community-based groups would facilitate loan and grant disbursement. A Project Implementation Unit (PIU) supported by development partners would oversee capacity development, performance verification, and governance. Where possible, the financing scheme can be linked with indexed livestock insurance and pastureland use contracts, reinforcing both risk management and accountability.

The financing model should be designed to evolve into a revolving mechanism, using loan repayments and retained earnings to fund future investments. Over time, the share of grants would be reduced, while concessional and cooperative-based financing would become more prominent. This enables:

- Scalability across other regions or livestock value chains
- Reduced reliance on external funding
- A stronger link between access to finance and environmental stewardship

Institutionalisation within a national financing framework ensures continuity beyond the project period and enhances integration with broader rural development goals.

The proposed approach supports the implementation of Mongolia's key legal and policy frameworks, including:

- The NAP and NDC Action Plan (Measures 3.1.1 and 11.4)
- The Law on Livestock and Animal Health (2017)
- The Law on Reducing the Negative Effects of Climate Change Caused by Traditional Livestock Agriculture (2024)
- The Government's Decision on Launching the New Cooperative Movement (2024)
- The Indexed Livestock Insurance Act (2024)

It also complements national financing efforts such as the MNT 500 billion soft loan programme for agribusiness, offering a pathway to embed climate-resilient livestock practices into Mongolia's broader agricultural credit ecosystem.

By linking finance to sustainability criteria and herder-led governance structures, this measure helps foster a more resilient livestock sector that contributes to national food security, ecosystem restoration, and equitable rural development.

Implementation steps

To operationalise the proposed measures - regulating livestock numbers and improving water infrastructure - policymakers need to adopt a structured and phased approach.

1. *Institutional coordination*

A coordinated institutional framework is critical for effective implementation. MOFALI should lead implementation efforts, supported by the MED, MECC and local authorities. MOFALI should oversee resource allocation, grazing quota enforcement, and the development of water infrastructure, while local governments (governors of provinces, sums, capitals, and districts) can facilitate engagement with herders and community-based initiatives as well as support the integration of Pasture User Groups[30] into the pasture governance. Integrating PUGs into policy implementation process would strengthen local ownership, improve compliance with grazing quotas and facilitate community-based management practices.

Research institutions such as the Mongolian University of Life Sciences and the Climate Change Research and Cooperation Center should assess regional carrying capacities, monitor pasture degradation, and study the ecological impacts of livestock migration. Their findings can inform grazing quotas, fodder production strategies, and water resource development plans.

Given the scale of the challenge, a phased implementation approach is necessary.

Pilot phase (1-2 years) to be implemented in regions with the highest levels of rangeland degradation, focusing on grazing quotas and water infrastructure.

Evaluation and adjustment phase (3-4 years) of the pilot outcomes, refining of the policies, and expansion of the measures to additional regions.

Scaling phase (5+ years) through roll-out of measures nationwide, ensuring equitable access for smallholder herders and addressing regional disparities.

2. *Strengthening legislative frameworks*

To reinforce implementation, existing laws, such as the Law on Livestock and Animal Health, should be supplemented with bylaws that:

- Define sustainable livestock quotas by region
- Establish standards for engineered wells and fodder production
- Streamline access to subsidies and financial mechanisms for herders.

3. *Data collection and analysis*

Research institutions, including the Mongolian University of Life Sciences and the Climate Change Research and Cooperation Center, should lead data collection and collaborate with local governments for monitoring and evaluation purposes. Findings should be reviewed annually, and reports shared with stakeholders to promote transparency and accountability.

4. *Monitoring and evaluation*

A well-structured M&E framework is essential to track the ecological, social, and economic outcomes of pasture restoration and improved livestock management. While fixed quotas may not be feasible due to regional variation, indicative planning targets - such as limiting goat share in total livestock to below certain percentage in overgrazed areas or allocating winter-spring pasture demarcation to cover at least XY % of highly degraded zones by 2030 - can help guide action and resource prioritisation.

Suggested KPIs include:

Ecological indicators will provide insight into the restoration of rangeland health and ecosystem resilience:

- Share of pastureland under community-based rotational grazing or contractual use (% of total)
- Area of rangeland showing signs of recovery (vegetation cover or NDVI-based metrics)

Livestock-related indicators will measure the direct impact of the interventions on the sector:

- Livestock productivity (e.g., average weight gain, milk yield) per species
- Goat share in total livestock population and change over time

[30] Collective organisations of herders managing shared pastureland under customary law. Since the establishment of the National Federation of Pasture User Groups of Herders (NFPUG) in 2015, it represented over 81,000 individual herders and 1,445 PUGs as of 2019 (Mongolian National Federation of Pasture User Groups, n.a.). http://en.greenmongolia.mn/

Socio-economic indicators will demonstrate whether the interventions are successfully addressing the needs of herder communities and contributing to their long-term resilience:

- Number of engineered wells and herding points constructed and operational
- Herder household income stability and access to fodder/water sources
- Adoption rate of grazing quotas or carrying capacity plans by region

Mid-term reviews every 2-3 years to assess herd structure, pasture health, and socio-economic impacts. Feedback loops for adjusting grazing quotas and refining regional carrying capacity estimates.

5.3 Water management

Scenario description

Mongolia's water resources are predominantly derived from precipitation, glacier melt, and a limited groundwater supply, making the country acutely vulnerable to fluctuations in climate patterns. Total annual water reserves are estimated to be at roughly 564.8 km³, with 88.5% (500.0 km³) held in lakes and 6.1% (19.4 km³) in glaciers. Despite these ostensibly large figures, the country's hydrological balance has come under increasing strain in recent decades. Notable is the prolonged low-flow period from 1996 to 2017, during which the total river flow in some years dipped below 17 km³, a marked decline from a historical high of 78.4 km³ recorded in 1993. Observational data further indicate that Mongolian rivers have reduced their overall flow norm by about 10% - from 34.6 km³ to 30.6 km³ - due to persistent drought episodes, especially during the late 1990s and early 2000s.[31]

These fluctuations have direct consequences for the surface waters and critical downstream ecosystems that support Mongolia's population, agriculture, and industry. The drying of lakes is especially pronounced, with remote-sensing analyses suggesting that the total lake area decreased by 7.4% between 1945 and 2020, and hundreds of lakes have been reported dry in recent years.[32] Glacial retreat is similarly alarming: the area of Mongolian glaciers has decreased by approximately 37% over the last seven decades, with some glaciers - such as those in the Turgen massif - observed to have retreated by up to several hundred meters.[33]

The socioeconomic dimension of this challenge is evident in water-dependent sectors such as agriculture and herding, which form the backbone of rural livelihoods. Frequent droughts, alongside heightened grazing pressures, exacerbate rangeland degradation, resulting in shrinking forage areas for livestock. Climate extremes, including dzuds (harsh winters) and flash floods, further underline the pressing need for improved water infrastructure and robust mitigation strategies. In urban centers, population growth is driving increased demand for drinking water and sanitation services, while industrial activities, notably mining, require large quantities of water for operations.

Legislatively, Mongolia has sought to tackle these issues through the Water Law (2012), which mandates basin-level protection, sustainable use, and the restoration of water resources. The Integrated State Water Resources Management Plan (2013) strengthens these mandates by detailing measures for sanitary zones, expanded water supply and sewage networks, and advanced treatment technologies. Additionally, Mongolia's NAP identifies water management as a priority (Measures 6.9 and 6.7) as well as NDC Action Plan (measure 3.3.4), recognising the importance of water security for climate resilience, agricultural productivity, and sustainable development. These efforts also complement the country's commitments to the Sustainable Development Goals, particularly SDG 6 on Clean Water and Sanitation.

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[31] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change.

[32] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change.

[33] Asian Development Bank. (2020). *Overview of Mongolia's water resources system and management: A country water security assessment*. https://www.adb.org/sites/default/files/institutional-document/618776/mongolia-country-water-security-assessment_0.pdf; Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change. Ulaanbaatar, Mongolia: Government of Mongolia. Retrieved from https://unfccc.int/sites/default/files/resource/MONGOLIA%20FOURTH%20NC%202024.pdf

However, persistent capacity gaps - both technical and administrative - continue to impede effective water management. Fragmentation of responsibilities across multiple agencies and varying governance levels creates overlapping mandates and inconsistent enforcement. Data sharing among ministries and local authorities remains limited, constraining the potential for adaptive, evidence-based policymaking.

To address these challenges and implement Mongolia's water-related adaptation targets, the following measures are possible. Due to data limitations, it was not possible to integrate all identified measures into the modelling. Nevertheless, the broader context includes a wide range of potential measures that should inform future planning and policy development:

- Build reservoirs, marshes, and ponds from snow and rain flood water.
- Increase water supply and use it for irrigation of fodder crops, potatoes, and vegetables.
- Update Integrated Water Resource Management Plans (IWRMP) (e.g., Tuul River) to strengthen the integrated management of water resources in river catchment areas, focusing on climate-sensitive and ecosystem parameters.
- Build ponds in cool and humid regions for hay and crop irrigation, and fish and aquatic breeding, and create water supply through canals and pipes for wildlife and livestock in arid and semi-arid climates.
- Creating incentives and mechanisms to support the irrigation of pasture, fruits and vegetables cultivated for household use and fish breeding through water delivery to the drying lakes of flood plain areas.
- Assign flood zones, plan, and build retention basins, and other flood protection infrastructure (absorption by volcano rocks).

In response to the documented threats to Mongolia's water resources, policy interventions should focus on both infrastructure-based and ecosystem-based solutions, backed by robust institutional coordination and scientific research. First, there is an urgent need to develop and upgrade water retention and distribution infrastructure, particularly in areas prone to increased flooding or chronic scarcity. Measures such as building reservoirs, marshes, and ponds in cooler, more humid regions can capture seasonal floodwater from snowmelt and rain. In more arid zones, retention basins and other flood protection infrastructure (including the use of volcanic rock for enhanced absorption) will mitigate asset damage and increase availability for both livestock and wildlife. This is consistent with the Integrated State Water Resources Management Plan's call for multi-purpose water storage facilities and the NAP's emphasis on constructing ponds and canals (NAP Action 4.3.4).

Second, implementing an integrated management approach will ensure that decisions about surface and groundwater use are made in a coordinated fashion. Strengthened mandates for River Basin Organisations - under the supervision of the National Water Committee and the Ministry of Environment and Climate Change - should be accompanied by regular hydrological assessments. These should use updated norms for river flow, which have shifted downward from 34.6 km^3 to 30.6 km^3 annually due to persistent low-flow periods in the 1990s and early 2000s.[34]

Third, ecosystem restoration and protection should be expanded. This involves safeguarding riparian zones through reforestation or wetland rehabilitation, which can help stabilise water tables, filter pollutants, and maintain biodiversity. Reinforcing sanitary protection zones and ensuring compliance with existing Water Law provisions will protect upstream ecosystems critical to sustaining river flow.

Assumptions

According to the NDC Action Plan, twelve water reservoirs are planned to be built within a four-year period, with investment costs and benefits based on data from the NCC (2021). The CBA outcomes are used as inputs for the E3.mn model to assess broader economic impacts.

Each reservoir is estimated to cost 4 billion MNT to construct (see Table 3). Additional expenditures are required to make the stored water usable for agriculture, including investments in irrigation

[34] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change.

infrastructure and machinery for grain and other crop production. These additional costs amount to 2 billion MNT per reservoir, enabling irrigation for newly cultivated agricultural land. One reservoir is expected to supply water for around 900 hectares.

All required investments are to be covered entirely by the government over an eight-year financing period - double the actual construction timeline - which implies a reallocation of public spending from other areas.

With the expansion of irrigated land, agricultural output is projected to rise by as much as 9 billion MNT annually. Furthermore, the added value of water resources per reservoir is estimated at 3 billion MNT per year. In addition to agriculture, sectors such as mining and hydropower are expected to benefit from the increased water availability. In this scenario, it is assumed that mining activity also grows as a result of improved water access.

Table 3. Assumptions on costs and benefits for the building of water reservoirs

COMPONENT	2026	2027	2028	2029
CUMULATED NUMBER OF DAMS	3	6	9	12
CONSTRUCTION COSTS FOR DAM (BN. MNT PER DAM)	4	4	4	4
INVESTMENT IN MACHINERY FOR GRAIN PRODUCTION, IRRIGATION SYSTEMS ETC. (BN. MNT PER DAM, I.E. 900 HECTARES)	2	2	2	2
INCREASED AGRICULTURAL PRODUCTION P.A. (BN. MNT)	2	5	7	9
IMPROVED WATER SUPPLY BENEFITS MINING PRODUCTION P.A. (BN. MNT)	9	18	27	36

Source: CBA conducted for the GCF funded UNEP/MET implemented project "Building Capacity to Advance National Adaptation Plan Process in Mongolia", see also NCC (2021)

Modelling outcomes and macroeconomic results

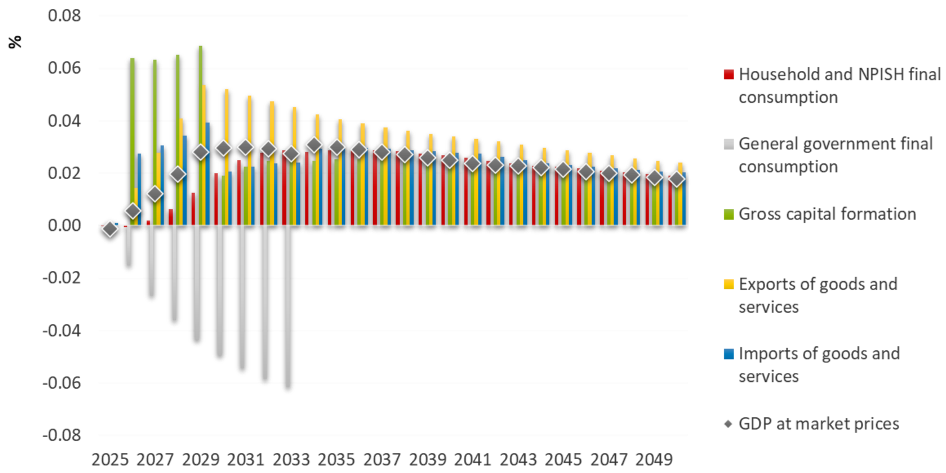
The modelling results for the water reservoir adaptation measure - which includes the construction of twelve reservoirs - indicate a moderate but positive contribution to the economy. While the overall investment is comparatively low, the measure supports sector-specific resilience, particularly in agriculture and mining. The scenario was assessed under a high-emissions climate pathway (used for the CBA) and compared with a baseline. Despite its modest scale, the measure yields tangible benefits, especially in rural water availability and productivity.

Economic growth and GDP impact

Due to the relatively low investment costs, the macroeconomic impact of this measure is limited. Still, the construction of water reservoirs leads to a small but measurable real GDP increase of up to 0.03%, primarily concentrated during the implementation period (2026-2030), when investment contributes up to +0.06% p.a. (see Figure 10).

- Export effects: Improved water access supports agricultural and mining productivity, resulting in a modest increase in exports of up to 0.05% p.a.
- Household consumption: Rises slightly due to minor positive impacts on jobs and income.
- Imports: Increase due to demand for imported machinery and irrigation technology used in reservoir construction.
- Government consumption: Decreases by up to 0.06% p.a. in early years, reflecting budget shifts to finance the measure by reducing other expenditures.

Figure 10. Macroeconomic effect, 2025-2050, in percent



Source: GWS illustration based on E3.mn results

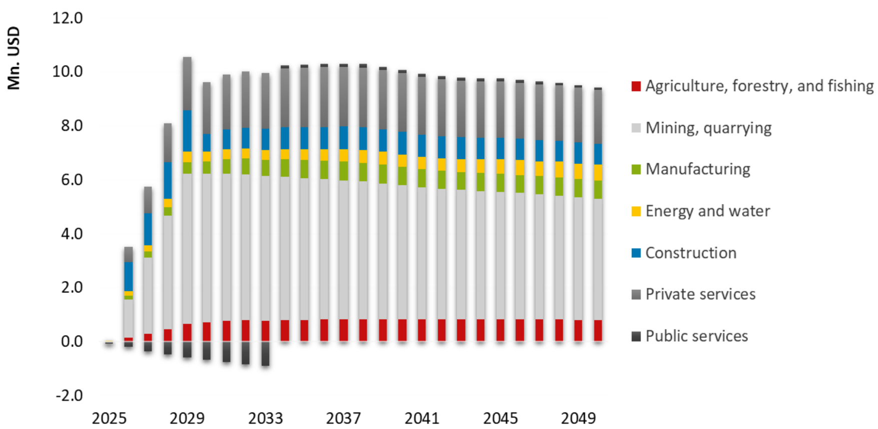
Sectoral economic output

Production gains are primarily concentrated in agriculture and mining, driven by improved water availability. Smaller increases are observed in manufacturing and construction, reflecting secondary investment effects.

- Agriculture and mining: Benefit from increased water security and productivity
- Manufacturing and construction: Rise modestly due to domestic infrastructure activity and related input demand

Overall, total real output increases by up to 10 million USD, or +0.04% per year.

Figure 11. Effects on gross production by economic sectors in constant prices, 2050, Mn. USD



Source: GWS illustration based on E3.mn results

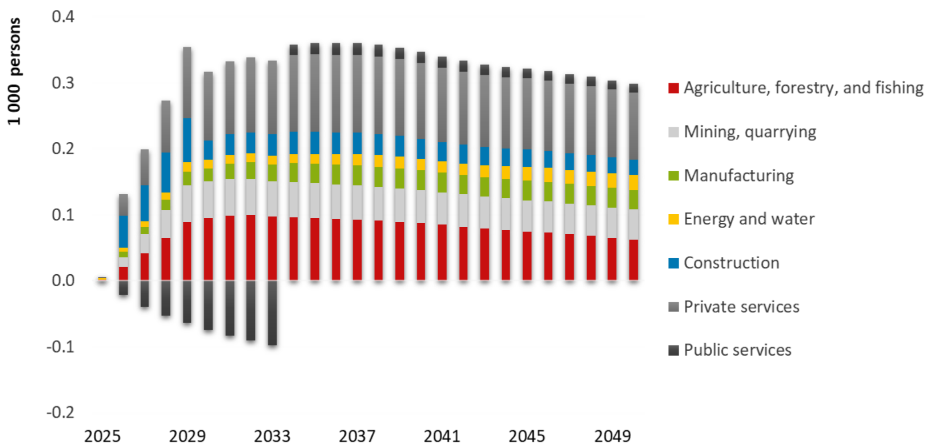
Employment effects

Employment effects mirror sectoral output, with most new jobs concentrated in agriculture and private services, including trade and transport. These sectors are more labour-intensive compared to mining, which is capital-intensive and sees limited employment growth.

- Agriculture and private services: Account for most additional jobs
- Mining: Sees minimal employment gains due to low labour intensity

Total employment rises by up to 400 persons annually, or +0.03% p.a.

Figure 12. Effects on employment by economic activities, 2025-2050, in 1 000 persons / new jobs



Source: GWS illustration based on E3.mn results

Energy demand and GHG emissions

The overall impact on energy consumption and emissions is modest:

- Final energy demand (TFEC) increases by up to 0.03%
- GHG emissions rise by an even smaller margin

This limited environmental footprint reflects the relatively small scale of economic activity and low energy intensity of the measure.

Financing

Given the diversity of water-related challenges in Mongolia - ranging from climate-induced droughts to overexploitation and poor infrastructure - developing a tailored financing strategy for water resource management is particularly complex. Unlike adaptation measures with clearly defined ownership and revenue streams (e.g. agriculture or livestock), water infrastructure such as reservoirs often involves multiple sectors, overlapping mandates, and diffuse end users, making cost recovery and sustainable financing more difficult to design.

Objectives and rationale

The financing approach for water management should prioritise:

- Public goods provision, particularly in the case of reservoirs, retention basins, and canal systems that benefit communities, ecosystems, and multiple sectors
- Resilience co-benefits for agriculture, mining, and rural livelihoods
- Institutional capacity-building to manage water systems at the basin level
- Phased implementation, allowing infrastructure to be deployed in tandem with strengthened governance, monitoring, and maintenance systems

In this context, the full cost of adaptation includes not only the infrastructure investment, but also the costs of coordination, regulatory reform, and long-term monitoring, which are often overlooked in financing models.

Conceptual structure and financing flows

A blended financing model could be explored, but with more cautious application and attention to institutional readiness. The core elements may include:

COMPONENT	INDICATIVE ROLE
PUBLIC INVESTMENT	Primary funding source for reservoir construction and basic infrastructure
INTERNATIONAL CLIMATE AND DEVELOPMENT GRANTS	Support feasibility studies, technical assistance, and ecosystem-based solutions
PERFORMANCE-LINKED TRANSFERS	Possible use to incentivise basin-level planning or improved inter-sectoral coordination
CONCESSIONAL LOANS / PPPS	Only applicable to specific use cases (e.g. mining or irrigation schemes with cost recovery potential)

Financial flows would likely be channelled through the central government, with the MED, MECC or the National Water Committee serving as lead coordinators. Project execution would involve River Basin Organisations (RBOs) and local administrations, supported by technical partners.

Due to the cross-sectoral nature of water investments, effective implementation would require strong coordination with ministries responsible for mining, agriculture, infrastructure, and local development. A dedicated Water Infrastructure Task Force or multi-agency committee could help ensure alignment and prioritisation of investment decisions.

Several challenges limit the feasibility of fully market-based or repayable instruments for this sector:

- Limited cost recovery mechanisms, particularly in rural and non-commercial contexts
- Fragmented institutional responsibilities, creating inefficiencies and unclear ownership over infrastructure
- High operational and maintenance costs for remote or multi-use systems
- Dependence on donor-funded pilots, which may not scale without domestic financial commitment.

As such, a revolving fund or results-based mechanism, as suggested for other adaptation measures, may be difficult to operationalise without a stronger legal and institutional framework for water resource management.

Instead, a phased financing model should be considered, where:

- Initial construction is fully funded by public and/or international sources
- Basin-level water management capacity is built in parallel
- Cost-sharing or recovery options (e.g. for irrigation water, industrial use) are gradually explored where appropriate.

Policy alignment and reinforcement

The proposed approach reflects the critical role of water in Mongolia's climate adaptation and development strategies, and supports the objectives of:

- The Water Law (2012) and its basin-level management mandates;
- The Integrated State Water Resources Management Plan (2013)
- The NAP (Measures 6.9 and 6.7) and NDC Action Plan (Measure 3.3.4)
- Relevant targets under SDG 6 (Clean Water and Sanitation).

However, financing arrangements should be closely tied to governance reforms, ensuring that public investments are not only delivered efficiently, but also maintained and managed sustainably over time.

While water infrastructure is essential for climate resilience, livelihoods, and economic development, it requires carefully designed financing mechanisms that reflect the sector's unique complexity and public-good characteristics. Given the sector's high reliance on public investment, robust institutional coordination and technical capacity are prerequisites for effective and sustainable implementation. Future financing efforts should therefore go hand in hand with governance strengthening, basin-level planning, and investment prioritisation to ensure long-term impact.

Implementation steps

Embedding these policy measures into Mongolia's existing governance structures necessitates a comprehensive, multi-layered approach that combines technical innovation with institutional reforms. The process should be phased and iterative, allowing policymakers and local stakeholders to learn from initial successes and adapt to changing climatic or socio-economic conditions. While significant physical infrastructure investments are required, challenges primarily centre on coordinating across multiple agencies and governance levels:

1. Ensuring that the MECC, MOFALI, and local governors (sums and aimags) effectively collaborate with River Basin Organisations is critical. Fragmentation of responsibilities may lead to overlapping or contradictory policies, hindering efficient resource allocation.

2. The Water Law (2012) provides a framework for water protection and use, but local bylaws may need updating to accommodate expanded retention basins, mandatory flood zone designations, and new management requirements for reservoir systems. Proper alignment with the NAP and the Integrated State Water Resources Management Plan is essential.

3. Local authorities and technical personnel require training to design, build, and maintain the recommended infrastructure. Capacity gaps can be bridged through targeted training programs and international partnerships, such as with the Asian Development Bank's (ADB) ongoing water resilience initiatives.

A phased integration roadmap is recommended, structured around clear institutional roles and progressive capacity-building:

Phase I (Immediate-2 years):

- Identify and categorise critical basins for reservoir construction or expansion, guided by hydrological data and local vulnerabilities.
- Introduce or revise bylaws that facilitate basin-wide planning and streamline permitting processes for new water retention projects.
- Initiate training for local engineers, environmental managers, and authorities with the support of research organisations like the Mongolian Academy of Sciences.

Phase II (2-5 years):

- Expand proven reservoir, marshland, and flood protection systems to other basins with parallel ecological restoration projects (e.g., wetland rehabilitation).
- Strengthen River Basin Organisations to coordinate multi-sectoral water allocation, enforce sanitary zones, and monitor water quality.
- Utilise economic and policy modelling to refine implementation strategies, evaluating cost-effectiveness and monitoring progress in real-time.

Phase III (5+ years):

- Institutionalise the success of early phases by embedding reservoir and wetland management plans into Mongolia's broader climate adaptation and development policies.
- Adopt cutting-edge monitoring systems and innovative water-saving technologies.
- Conduct periodic assessments, integrating the latest hydrological, climate, and socioeconomic data for continuous policy improvement.

Throughout these phases, a national steering committee under the Water Agency or National Water Committee should coordinate efforts, measure compliance, and align with other sectoral strategies:

- Facilitating stakeholder roundtables and supporting joint decision-making among ministries, local authorities, and river basin committees.

- Refining methods to track water usage, gauge reservoir performance, and improve adaptive management across different climate scenarios.
- Advising on incremental policy adjustments based on evolving data from IRIMHE, the Mongolian Academy of Sciences, and local monitoring networks.

With these steps, Mongolia can strengthen its water resource security, support the equitable distribution of a vital resource, and advance long-term resilience against climate change.

Monitoring and evaluation

To ensure the long-term viability of water infrastructure and ecosystem-based interventions, M&E efforts should reflect both physical system performance and institutional progress. Setting **planning benchmarks** - e.g., *at least XY hectares per reservoir supplied with irrigation*, or *ensuring XY% of targeted basins have updated IWRM plans by 2030* - can help clarify priorities and track policy alignment. Given Mongolia's emphasis on integrated resource management, KPIs should be linked to the goals outlined in the NAP. Examples of relevant indicators, all maintained in qualitative or ratio-based form at this stage, include:

Proposed KPIs:

- Number and storage capacity of newly constructed or rehabilitated reservoirs
- Volume of irrigation water delivered per hectare (disaggregated by crop type or zone)
- Stability of river flows or lake levels in monitored basins
- Share of irrigation systems upgraded to water-efficient technologies
- Number of River Basin Organisations (RBOs) actively coordinating basin plans
- Reported incidents of flood damage or water shortages by region
- Frequency and quality of inter-agency data sharing and basin coordination meetings

Monitoring tools:

- Basin-level water accounts and seasonal flow tracking
- GIS-based infrastructure monitoring and satellite-aided water balance analysis
- Periodic household and sectoral surveys on water access and use

Regular progress reports, ideally integrated with the existing National Water Committee or a similar steering body, should track these KPIs. The steering body can engage into development of baseline data sets and refine methodologies for indicator measurement as conditions evolve. Through iterative performance reviews, policymakers can identify areas requiring policy adjustments, additional funding, or further research, ensuring that Mongolia's water management framework remains responsive to both environmental change and socioeconomic demands.

5.4 Forestry

Disclaimer: The forestry sector was not included in the macroeconomic modelling analysis because the sector is not sufficiently relevant in terms of contribution to GDP for identifying macroeconomic impacts. Additionally, there are only limited adaptation strategies to make commercial logging climate resilient. All these aspects were identified through stakeholder consultations and by inspecting available economic data.

Scenario description

Mongolia's forestry sector is under increasing threat from climate change and unsustainable land-use practices. Rising temperatures, shifting precipitation patterns, frequent forest fires, desertification, and pest infestations are accelerating forest degradation. These environmental challenges, coupled with anthropogenic pressures such as illegal logging and unregulated grazing, pose significant risks to the country's fragile ecosystems.

However, due to data limitations and the relatively small share of forestry in overall economic output, it was not possible to quantify all outcomes or integrate forestry measures into economic modelling. Specifically, the absence of sufficient climate damage data and the inability to estimate avoided damages from proposed adaptation measures prevented the calculation of economic impacts. Future improvements in data availability and modelling frameworks may enable robust quantitative analysis.

Mongolia's forests cover approximately 11.8% of the total land area, although different methodologies report a figure as low as 9.1%. The country's forests are divided into:[35]

- Northern boreal forests (85% of total forest cover) spanning 14 aimags and supporting 154,000 forest-dependent households.
- Southern saxaul forests in the Gobi Desert, which play a crucial role in stabilising arid lands and mitigating desertification.

Forests provide critical ecosystem services, including carbon sequestration, water conservation, biodiversity protection, and rural livelihoods. However, mismanagement, underfunding, and lack of institutional coordination have led to significant forest degradation:[36]

- Wildfires affected up to 390,000 ha between 2001 and 2021.
- 1.5 million hectares of forest are degraded and require rehabilitation.
- Mongolia's boreal forests grow at less than half the rate of well-managed boreal forests worldwide, leading to overaged, low productivity stands.

Mongolia has developed a strong legal and policy foundation for sustainable forestry management:[37]

- The Billion Tree National Movement (BTNM), launched in 2021, aims to plant 1.51 billion trees by 2031, contributing to climate adaptation and desertification control.
- The Law on Forest (2012), The Law on Environmental Protection (1995), and The Law on Fire Safety (2015) regulate forest management, protection, and restoration.
- NAP (Measure 7.2) and NDC Action Plan (Measure 3.4.2) align with global climate targets, with a commitment to reduce GHG emissions by 22.7% by 2030.

Despite these efforts, implementation challenges persist, including:

- Forestry programs are underfunded, the BTNM is estimated to cost USD 8.89 billion, but financing gaps hinder progress.
- Low tree survival rates due to poor seedling quality, lack of irrigation, and weak post-planting care.
- Fragmented governance, with overlapping mandates between the MECC, the National Forestry Agency (NFA), and the MoFALI.
- Limited private sector participation, restricting investment in sustainable forestry initiatives and carbon credit markets.
- Given these structural barriers, this policy recommendation focuses on enhancing the capacity of reforestation initiatives and carrying out large-scale afforestation efforts as a key climate adaptation strategy.

Given these structural barriers, this policy recommendation focuses on enhancing the capacity of reforestation initiatives and carrying out large-scale afforestation efforts as a key climate adaptation strategy. Due to data limitations, it was not possible to integrate all identified measures into the modelling. Additionally, no modelling was carried out for selected measures due to the absence of a CBA. Nevertheless, the broader context includes a wide range of potential measures:

- Create seed resources of woody plants resilient to climate change
- Enhance the capacity of reforestation initiatives to plant 'billions' of trees (State Program) and carry out large-scale reforestation
- Integrate Carbon Offset Credits[38]:

[35] Government of Mongolia. (2024). Fourth National Communication of Mongolia to the United Nations Framework Convention on Climate Change.

[36] World Bank. 2024. Investing in Nature as a Climate and Development Opportunity for Mongolia. Washington DC: World Bank

[37] ibid

[38] Carbon offset credits are tradable certificates that represent the reduction of one metric ton of carbon dioxide (CO2) or its equivalent in other greenhouse gases. These credits are used as a mechanism to compensate for emissions produced elsewhere. Essentially, if an entity (such as a company or an individual) produces a certain amount of CO2, they can purchase carbon offset credits to "offset" their emissions by ensuring that an equivalent amount of CO2 is reduced or removed from the atmosphere through various projects.

  - Develop reforestation projects that meet international standards for carbon offset certification
  - Establish robust monitoring and reporting mechanisms to track carbon sequestration
  - Engage local communities and stakeholders in the design and implementation of carbon offset projects

- Implement maintenance and protection of natural forests, improvement of forest health, and increase their living capacity
- Establish sustainable production and utilisation of forest resources, including processing forest waste, dead wood, non-timber products, and logging and processing wood from forest use zones
- Conduct a comprehensive institutional and capacity assessment to propose sectoral reforms, enhance technical skills, and improve forest management planning and mapping at the local level

An immediate priority is to enhance the capacity of large-scale reforestation initiatives and to integrate climate adaptation goals into Mongolia's forestry sector. Improving seedling supply and nursery infrastructure is critical to increasing tree survival rates, especially in the country's harsh climatic conditions. This includes modernising seed collection, processing, and storage facilities, while fostering public-private partnerships that expand regional nurseries. Enhanced post-planting management, including systematic pest control, fire prevention, and remote sensing-based monitoring of newly planted saplings, would further boost the survival of young trees.

Strengthening Mongolia's forestry sector requires a holistic approach that combines improved reforestation capacity, enhanced governance, and sustainable financing mechanisms. While current policies and initiatives provide a strong foundation, their effectiveness depends on addressing persistent gaps in implementation, coordination, and long-term forest management. By integrating these measures, Mongolia can not only mitigate forest degradation but also enhance the sector's contribution to climate adaptation, biodiversity conservation, and rural resilience. The success of these efforts will be reflected in tangible environmental and socio-economic outcomes, including improved forest health, increased carbon sequestration, and strengthened livelihoods for forest-dependent communities.

Expected outcomes (non-quantified)

Enhanced reforestation initiatives promise significant environmental, economic, and social benefits, strengthening Mongolia's ability to combat climate change, support rural livelihoods, and drive sustainable economic growth.

Environmental impact

Large-scale afforestation and reforestation efforts will directly contribute to Mongolia's goal of increasing forest cover to 9 percent by 2030. Expanding forested areas will enhance carbon sequestration, supporting Mongolia's NDC target of reducing greenhouse gas emissions.

In addition to climate mitigation, expanded forests will strengthen ecosystem functions that are crucial for climate adaptation. Healthier forests will play a crucial role in improving water regulation within degraded catchments, particularly in the northern boreal forests that help stabilise Mongolia's hydrological cycle. Enhanced vegetation cover will also help stabilise soils, curbing erosion and slowing land degradation - two pressing issues exacerbated by climate change and unsustainable land use.

The expansion of saxaul forests in arid regions will serve as a natural barrier against desertification or as a natural windbreak, slowing the advance of the Gobi Desert. Additionally, improved forest management will promote biodiversity conservation, safeguarding habitats for endangered species and strengthening ecosystem resilience.

Economic benefits

A well-executed forestry strategy will unlock new green value chains, fostering investment in sustainable wood production and non-timber forest products (NTFPs) such as medicinal plants, nuts, and wild berries.

As demand for eco-friendly materials grows, Mongolia could establish itself as a key supplier of certified, sustainably sourced timber, reducing reliance on imported wood and supporting local industries. Forest restoration initiatives will also stimulate job creation, particularly in rural areas where forestry-related activities offer one of the few viable employment opportunities. Forestry operations - including seedling production, planting, maintenance, and harvesting - can generate year-round employment and build transferable skills for low-income populations.

Additionally, the integration of carbon finance mechanisms, such as reforestation-based carbon credits, could provide performance-based financing, enabling Mongolia to tap into global climate markets and diversify revenue streams.

Social and governance benefits

The involvement of forest user groups, local communities, and private enterprises in reforestation programs will strengthen local governance structures, fostering a sense of ownership and encouraging sustainable land stewardship. Expanding participatory forestry programs will empower forest-dependent households, helping them transition from exploitative land use toward sustainable income-generating activities.

Improved forestry governance will also streamline land tenure rights, increasing legal clarity and reducing informal land use conflicts. Equitable benefit-sharing frameworks and inclusive planning processes will ensure that forest-related gains reach marginalised rural populations.

Educational initiatives on forest conservation, afforestation techniques, and climate adaptation will enhance local capacity, equipping communities with the skills needed for long-term sustainable forest management. Over time, well-managed forests will serve as natural infrastructure, buffering against extreme weather events and safeguarding essential resources such as water, fuelwood, and grazing land for vulnerable households.

Financing

Achieving Mongolia's large-scale reforestation and forest restoration targets requires not only a long-term strategic vision but also a carefully structured, market-compatible financing approach. While the environmental and socio-economic benefits of afforestation are well documented, their realisation hinges on the ability to mobilise both public and private capital, ensure robust monitoring, and create long-term incentives for investment.

Objectives and rationale

The financing framework should pursue a dual objective:

- Enable large-scale afforestation and restoration through targeted public investment and institutional support;
- Leverage market-based mechanisms, especially carbon credits, to attract sustained private sector financing and promote self-sufficiency over time.

To achieve this, the framework must address not only the cost of tree planting and land preparation but also long-term challenges such as maintenance, monitoring, land tenure, and market integration. The establishment of a robust MRV (Monitoring, Reporting, and Verification) system is a foundational requirement for accessing carbon markets and ensuring credibility.

Investment needs and cost drivers

As outlined in the BTNM, estimated implementation costs may reach USD 8.89 billion by 2031, reflecting the scale of the ambition. Key cost categories include:

- Nursery development and seedling propagation (including seed storage infrastructure)
- Afforestation and post-planting maintenance, particularly in arid and semi-arid regions where costs are significantly higher due to harsh growing conditions
- Labour costs, which may be offset through rural employment generation schemes
- Irrigation and fencing, especially in regions vulnerable to drought or grazing pressure
- Monitoring systems and digital tracking platforms, especially for MRV readiness and carbon credit certification.

While costs vary by region and technique, strategic investment in climate-smart forestry practices - including locally adapted species and water-efficient planting methods - can improve cost-effectiveness and resilience over time.

FINANCING SOURCE	INDICATIVE ROLE
PUBLIC INVESTMENT / INTERNATIONAL GRANTS	Seed funding for nurseries, community mobilisation, MRV system development
CARBON FINANCE / VOLUNTARY CARBON MARKETS	Revenue generation mechanism tied to verified sequestration performance
PRIVATE INVESTMENT / IMPACT FINANCE	Afforestation and land restoration projects with long-term yield or co-benefits
RESULTS-BASED PAYMENTS / CLIMATE FINANCE	Disbursed upon verified restoration outcomes and ecosystem service provision

Financing structure and market integration

Given the limitations of the public budget and the long maturation period of forestry investments, a blended and phased financing model is recommended: [see Table above]

A key enabler of private sector engagement is the development of a national MRV system aligned with international carbon market standards (e.g. VERRA, ART TREES). This system should be embedded within Mongolia's forest governance structure and supported by technical assistance during the initial roll-out phase.

In parallel, policy adjustments are needed to address risks related to land tenure, forestry concessions, and licensing, which currently inhibit investor confidence and reduce the feasibility of long-term projects. Strengthening regulatory clarity and streamlining administrative procedures will be essential for mobilising both international and domestic investment.

Implementation should be coordinated by a national entity - potentially the MECC or MED, in collaboration with the National Forestry Agency - responsible for:

- Overseeing project pipelines and financing instruments
- Ensuring MRV compliance and verification readiness
- Facilitating access to international markets and green bond issuances
- Aligning reforestation funding with national strategies and climate targets.

Cooperation with existing multilateral channels (e.g. GCF, GEF, UN-REDD) and domestic financial institutions could also help facilitate green credit lines or blended vehicles for local actors and cooperatives.

This scenario presents both a significant climate opportunity and a complex financing challenge. Unlike traditional adaptation investments, afforestation and forest restoration have the potential to unlock market-based revenue streams through carbon finance - but only if supported by a transparent, well-governed framework and credible MRV infrastructure.

While the public sector will remain a key enabler in the near term, the long-term viability of Mongolia's reforestation efforts depends on its ability to create bankable, investable forestry projects that generate verifiable environmental assets. Strategic public investment, regulatory reform, and the establishment of a strong carbon market interface will be critical to bridging the financing gap and delivering sustainable land use transformation at scale.

Implementation steps

To operationalise Mongolia's large-scale reforestation programme, a phased and institutionally anchored implementation plan is required. The NFA will serve as the primary coordinating and implementing body, in close collaboration with the MECC, the MoFALI, and the MED. This institutional arrangement will help align afforestation with national climate and land-use goals, while also exploring future linkages to ecosystem-based financing opportunities.

While international interest in nature-based carbon solutions is growing, Mongolia's current conditions - limited MRV capacity, long crediting horizons, and regulatory gaps - suggest that carbon finance should be treated as a medium- to long-term opportunity. In the near term, public investment, concessional finance, and performance-based incentives are more appropriate mechanisms for delivering large-scale afforestation.

Implementing a sustainable large-scale reforestation program involves a phased approach.

Phase I (0-2 years) to strengthen the institutions and mobilise resources

- Designate the NFA as the national lead agency for reforestation planning, implementation, and MRV development, with formal coordination roles for MECC, MoFALI, and MED
- Develop uniform technical standards for seed quality, nursery management, and planting protocols
- Upgrade existing state nurseries with irrigation systems, greenhouse facilities, and advanced seed storage
- Pilot community-based nurseries in regions with favourable agro-climatic and social conditions to demonstrate early success and build local ownership.
- Mobilise funding to expand nursery and seedling storage infrastructure through blended public and private channels.
- Launch capacity-building programmes for rangers, forestry engineers, and forest user group (FUG) members on fire prevention, pest control, and GIS-supported forest monitoring
- Phase II (2-5 years) to scale up reforestation and enhance monitoring
- Expand nursery networks to meet increasing demand for climate-resilient seedlings
- Diversify seed sources to improve genetic resilience and adaptability of afforested areas
- Implement tree survival monitoring systems/ Forest and Pasture Management Information System using remote sensing and drones to monitor tree survival rates and forest health, laying the groundwork for MRV capability
- Expand community-led forestry programs and climate-smart reforestation techniques to strengthen practical management, pest control and fire-prevention at the community level
- Introduce domestic incentive mechanisms to encourage private investment in afforestation, including:
    - Performance-based grants for seedling production and post-planting care
    - Access to preferential loans or co-financing for private reforestation efforts on public or leased land
    - Preparatory support for projects that may later qualify for carbon certification or environmental service payments
    - Enable future participation in carbon markets by developing MRV protocols and institutional coordination structures

Phase III (5-10 years) to ensure long-term sustainability and integrate afforestation into Mongolia's economic and land-use policies

- Develop forestry-based value chains, including:
    - Wood processing for sustainable timber markets
    - Non-timber forest products such as medicinal plants, resins, and wild fruits and berries
    - Eco-tourism initiatives to generate revenue from preserved forest areas
- Support regional wood processing clusters through collaboration with MoFALI and private actors. These clusters will:
    - Use sustainably harvested timber from thinning operations
    - Promote bioenergy solutions (e.g., woodchips and residues) as an alternative to coal heating in rural buildings
- Refine regulatory and incentive policy frameworks to ensure:
    - Long-term contractual rights for forest user groups, encouraging sustainable forest management at the community level
    - Clarify policies on benefit sharing and land tenure for afforestation
    - Clarify governance roles for carbon finance, ensuring transparency and alignment with international MRV standards

  - Integrate reforestation outcomes into national green growth and fiscal policy, in coordination with MED
- Establish a national carbon offset market to integrate the reforestation agenda with national economic planning and extend beyond pure conservation goals
- Scale integrated forestry-livelihood programs for long-term community engagement

Monitoring and evaluation

For Mongolia's large-scale afforestation programme, the M&E framework must assess both environmental integrity and economic viability. While long timelines and ecological variability preclude binding targets, indicative benchmarks such as expanding forest cover by 2-3 percentage points by 2030 or ensuring 60% average tree survival rate in pilot reforestation zones, can support realistic planning.

Sample KPIs:

- Area reforested or afforested (ha/year), disaggregated by forest type (boreal, saxaul, etc.)
- Tree survival rates after 1, 3, and 5 years post-planting
- Number of nurseries upgraded and seedlings produced annually
- Verified carbon sequestration potential (where MRV systems are piloted)
- Number of FUGs engaged and hectares under community forest management
- Jobs created in reforestation-related activities (nurseries, planting, monitoring)
- Percentage of afforestation projects supported by MRV or carbon certification frameworks

Regular mid-term evaluations (every 2-3 years) will review tree survival, financing efficiency, institutional effectiveness, and policy alignment with emerging climate scenarios. These reviews will also assess community benefits, job creation, and enforcement of land-use compliance to ensure sustainability across all regions. Integration of field data and satellite monitoring into a central Forest and Pasture Management Information System should also support the tracking and monitoring of above indicators.

6 PRACTICAL APPLICATION OF RESULTS FOR POLICY MAKING

The policy recommendations for resilient agriculture, livestock management, water resource governance, and forestry need to be effectively integrated into Mongolia's broader policy framework. This section outlines the mechanisms through which research findings and quantitative results can guide actionable policies and improve implementation.

Expanding institutional involvement is crucial to ensuring the successful integration of climate adaptation policies across sectors. Effective policy action requires strong inter-agency coordination, structured financial planning, and multi-stakeholder engagement. Additionally, utilising robust economic and energy-environmental models, such as the E3.mn model, can help policymakers assess trade-offs, predict long-term socioeconomic and environmental impacts, and refine adaptation strategies based on evidence-based projections. The following additional key areas outline how Mongolia can institutionalise its climate adaptation strategies to enhance resilience and long-term sustainability.

Table 4. Prioritisation framework for policy integration

POLICY MEASURE	EXPECTED IMPACT	TIMEFRAME	LEADING AGENCIES	CLIMATE RELEVANCE	ECONOMIC RELEVANCE
BUILDING IRRIGATION POINTS AND ENGINEERED WELLS TO IMPROVE WATER AVAILABILITY AND FODDER PRODUCTION	Mitigates rangeland degradation, reduces the vulnerability of herders, improves the productivity and sustainability of the livestock sector	Medium-term (5+ years)	MOFALI, MED, MECC	High	High
IMPLEMENTATION OF DRIP IRRIGATION SYSTEMS AND ECO-SYNTHETIC FILM COVERING TECHNOLOGY	Improves water use efficiency, reduces losses, protects soil health, and enhances agricultural productivity	Medium-term (5+ years)	MOFALI, MED, MECC	High	High
DEVELOPMENT AND UPGRADE OF REGIONAL WATER RETENTION INFRASTRUCTURE	Ensures long-term water availability for agriculture, livestock, and rural communities	Medium-term (5+ years)	MECC, MOFALI, National Water Committee/ Water Agency	High	Moderate
SCALING UP REFORESTATION AND AFFORESTATION INITIATIVES	Enhances carbon sequestration, prevents desertification, and supports biodiversity	Long-term (6-10 years)	MECC, MOFALI, MED, Forestry Agency	High	Moderate

Source: own illustration

Role of the MoF in climate-smart budgeting

- The MoF should implement a climate tagging system to track and optimise spending for climate adaptation and resilience projects across all sectors.
- Budget allocations should prioritise climate-smart investments, ensuring funding is directed toward initiatives that yield both environmental and economic benefits.
- MoF should coordinate with sectoral ministries to align fiscal planning with long-term adaptation and mitigation strategies.
- Establishing dedicated financing mechanisms, such as green bonds or adaptation funds, can help

bridge financial gaps and attract international climate financing.

Strengthening governance and monitoring systems

- Establish a centralised M&E framework to track the effectiveness of policy implementation across sectors.
- Integrate real-time data systems to improve decision-making and resource allocation for climate adaptation efforts.
- Ensure transparency by publishing progress reports on climate adaptation spending and outcomes.
- Develop adaptive governance mechanisms that allow policymakers to respond to emerging climate challenges with evidence-based adjustments.

Successfully integrating climate adaptation policies across agriculture, livestock, water resource governance, and forestry requires a coordinated institutional approach. By leveraging structured financial planning, inter-agency collaboration, and evidence-based modelling tools such as the E3 model, policymakers can develop more targeted and effective adaptation strategies.

Ensuring that budget allocations prioritise climate-smart investments, establishing robust governance and monitoring frameworks, and maintaining transparent reporting mechanisms will be crucial for long-term resilience. With strong institutional engagement and dedicated financing mechanisms in place, Mongolia can effectively mitigate climate risks while promoting sustainable economic growth and environmental protection.

7 CONCLUSION

Developing well-structured adaptation scenarios is essential for integrating climate resilience into Mongolia's economic and development planning. This handbook has outlined a step-by-step approach to scenario formulation, selection, and integration, enabling policymakers, adaptation specialists, and macroeconomic modellers to design evidence-based climate adaptation strategies. By leveraging the E3 model, stakeholders can assess the economic impacts of climate change, quantify the benefits of adaptation measures, and refine policy decisions with a data-driven foundation.

The handbook provides practical guidance on identifying key policy entry points, aligning adaptation measures with national priorities, and incorporating economic modelling into decision-making. Through structured scenario development, policymakers can evaluate trade-offs, prioritise interventions, and justify resource allocation for resilient agriculture, livestock management, water governance, and forestry. The emphasis on institutional coordination, stakeholder engagement, and financial feasibility ensures that adaptation measures are not only technically sound but also implementable within Mongolia's governance framework.

However, challenges such as data limitations, institutional capacity gaps, and financing constraints must be addressed to enhance the credibility and effectiveness of scenario-based planning. To ensure that adaptation scenarios translate into actionable outcomes, it is essential to strengthen climate-smart budgeting, foster inter-agency coordination, and embed clear goal and target-setting within a robust monitoring and evaluation framework.

By embedding scenario development into broader development planning and refining strategies based on evolving climate risks and economic conditions, Mongolia can enhance its adaptive capacity and drive sustainable economic growth. This handbook serves as a resource for stakeholders seeking to implement data-driven, forward-looking adaptation measures that align with national development goals and international climate commitments.