Food and Agriculture Organization of the United Nations

ISSN 2226-6062

ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

WORKING PAPER

72

NDC

REGIONAL ANALYSIS OF THE NATIONALLY DETERMINED CONTRIBUTIONS OF THE COUNTRIES IN SOUTHERN EUROPE, EASTERN EUROPE AND CENTRAL ASIA

Gaps and opportunities in the agriculture sectors

ENVIRONMENT AND NATURAL RESOURCES MANAGEMENT

WORKING PAPER

72

NDC

REGIONAL ANALYSIS OF THE NATIONALLY DETERMINED CONTRIBUTIONS OF THE COUNTRIES IN SOUTHERN EUROPE, EASTERN EUROPE AND CENTRAL ASIA

Gaps and opportunities in the agriculture sectors

Krystal Crumpler, Valentyna Slivinska, Sandro Federici, Mirella Salvatore, Julia Wolf, Alexandre Meybeck and Martial Bernoux

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, 2019

Required citation:

FAO. 2019. *Regional analysis of the Nationally Determined Contributions of the countries in Southern Europe, Eastern Europe and Central Asia − Gaps and opportunities in the agriculture sectors*. 132 pp.

Licence: CC BY-NC-SA 3.0 IGO.

ISBN 978-92-5-131272-8

CONTENTS

TABLES, FIGURES & BOXES

TABLES

FIGURES

BOXES

ACKNOWLEDGEMENTS

This report is the result of a collaborative effort by the Climate and Environment Division (CBC) of FAO. Under the overall leadership of Martial Bernoux (CBC) and Julia Wolf (CBC), the methodology and analysis were prepared by Krystal Crumpler (CBC), Valentyna Slivinska (CBC), Sandro Federici (CBC) and Mirella Salvatore (CBC), with contributing author Alexandre Meybeck (CIFOR/FTA). The authors are especially grateful for the valuable inputs from Reuben Sessa (SP2) and Sophie VonLoeben (SP5) and for the technical support from Mario Bloise (CBC). The authors are appreciative of the close collaboration with the Regional Office for Europe and Central Asia, particularly Tania Santivanez (REU), Dai Yamawaki (OHRJ) and Carmen ArguelloLopez (REUT).

Gratitude is especially owed to a number of peer reviewers from diverse technical areas and backgrounds: Dirk Nemitz (UNFCCC), Maylina St-Louis (CBC), Paola Cardenas (CBC), Paolo Prosperi (CBC), Alessandro Ferrara (CBC), Esther Mertens (FOA), Elizabeth Laval (CBC) and Zitouni Ould-Dada (CBC).

The graphic designer Claudia Tonini is acknowledged for her excellent work.

ACRONYMS AND ABBREVIATIONS

AFOLU	Agriculture, Forestry and Other Land Use
BAU	Business-as-usual
BUR	Biennial Update Report
CH_4	Methane
CO_2	Carbon Dioxide
COP	Conference of the Parties
CSA	Climate-Smart Agriculture
DRR/M	Disaster Risk Reduction and Management
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GHG	Greenhouse Gas
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
LLDC	Land-Locked developing country
LULUCF	Land Use, Land Use Change and Forestry
M&E	Monitoring and Evaluation
MRV	Measurement, reporting and verification
Mt CO_2 eq	Million tons of Carbon dioxide equivalent
N_2O	Nitrous Oxide
NAMA	Nationally Appropriate Mitigation Action
NAP	National Adaptation Plan
NC	National Communication
NDC	Nationally Determined Contributions
NGHGI	National Greenhouse Gas Inventory
NIR	National Inventory Report

SDG	Sustainable development goal
SEECA	Southern Europe, Eastern Europe and Central Asia
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States Dollar
2030 Agenda	2030 Agenda for Sustainable Development

INTRODUCTION

BACKGROUND

The Paris Agreement constitutes a landmark achievement in the international response to climate change, as developed and developing countries alike committed to do their part in the transition to a low-emission and climate-resilient future. Underpinning the Agreement are the (Intended) Nationally Determined Contributions, (I)NDCs,[1] representing the main national policy framework, under the United Nations Framework Convention on Climate Change (UNFCCC), by which Parties communicate their commitment to reducing national greenhouse gas emissions (GHG) and adapting to the impacts of climate change, based on national priorities, circumstances and capabilities, and support needs.

The success of the Paris Agreement rests upon the enhanced ambition of Parties to progressively revise and strengthen their respective mitigation and adaptation plans over time.[2] At the twenty-second Conference of Parties (COP) of UNFCCC, a facilitative dialogue was convened to assess collective efforts made towards achieving the long-term goal of the Agreement, with the view of enhancing pre-2020 ambitions and the provision of means of implementation. In 2023, and every five years thereafter, Parties shall periodically take stock of the implementation of the Agreement to assess the collective progress towards achieving its purpose and long-term goals.[3] The outcome of the global stocktake shall inform Parties in updating and enhancing, in a nationally determined manner, their actions and support in accordance with the relevant provisions of this Agreement, as well as in enhancing international cooperation for climate action.

The Enhanced Transparency Framework provides a foundation for building mutual trust and confidence whereby Parties are expected to report reliable, transparent and comprehensive information on GHG emissions, climate actions and support in accordance with the principle of common but differentiated responsibilities and respective capabilities.[4]

Linked to climate action are the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda, which sets out a vision for a hunger-free, more equitable, sustainable, peaceful and resilient world in 2030. Closing the emissions gap while safeguarding food security and pulling the millions out of extreme poverty can only be achieved in a context of sustainable development, and sustainable development can only be achieved if coupled with a low-emission and climate-resilient future.

Insofar as the agriculture sectors[5] feature prominently in the NDCs of developing countries (FAO, 2016a), **FAO has a critical role to play** in supporting Member Countries to leverage the mitigation and adaptation potential in the agriculture sectors and harness their synergies, while "leaving no one behind."

[1] For the purpose of this document, the (I)NDCs and NDCs are collectively referred to as NDCs.

[2] Article 4.2 of the Paris Agreement.

[3] Article 14 of the Paris Agreement.

[4] Article 13 of the Paris Agreement.

[5] For the purpose of this document, the 'agriculture sectors' comprise crops, livestock, fisheries and aquaculture, and forestry.

OBJECTIVE

FAO recognizes that its goals to eliminate hunger, food insecurity and malnutrition, reduce rural poverty, and make agriculture, forestry and fisheries more productive and sustainable cannot be fulfilled without decisive action on climate change (FAO, 2013a). Building on its longstanding leadership as a provider of technical knowledge and expertise on sustainable food and agriculture, FAO is committed to support member countries prepare for and respond to the adverse impacts of climate change. FAO's Climate Change Strategy outlines its commitment to enhancing the institutional and technical capacities of its Members to plan and implement NDCs; to improving the integration of food security, agriculture, forestry and fisheries within the international climate agenda; and to strengthening the coordination and delivery of FAO's work (FAO, 2017a).

The NDCs present a natural framework for FAO's work on climate change, as they already define, at the highest political level, targets and strategies for responding to the consequences and addressing the causes of climate change.

At COP 22, FAO launched an extensive global analysis of the NDCs, evidencing the significant role of the agriculture and/or Land Use, Land Use Change and Forestry (LULUCF) sector,[6] as 86 and 93 percent of developing countries include the sector in their mitigation and adaptation priorities, respectively (FAO, 2016a). In 2016, FAO assessed the main challenges countries face when moving from NDC planning to implementation and identified five priority areas for international support in the agriculture sectors (FAO, 2016b). At COP 23, FAO launched its first regional NDC analysis on Eastern Africa, as a part of a series of analyses aiming to provide a more in-depth review of mitigation and adaptation priorities, capacities and constraints in the agriculture sectors at the regional level (FAO, 2017b).

The main objective of this report is to provide a regional synthesis of the current climate change mitigation and adaptation commitments in the agriculture sectors of the Southern Europe, Eastern Europe and Central Asia (SEECA) region, as set forth in the NDCs, and to identify opportunities for enhancing mitigation and adaptation ambitions, capturing their synergies and leveraging climate finance and international support options in the region. This analysis builds on FAO's previous regional analysis and enhances its methodology and findings. It aims to guide FAO – and policy makers and practitioners in the region – committed to providing the country support required for accelerating progress on and scaling up NDCs in the agriculture sectors, and ensuring that future commitments are clear, quantifiable, comparable, transparent and ambitious.

The NDCs are the product of a bottom-up process characterized by different national approaches and processes. They vary greatly in terms of format, scale and detail, resulting from differing perspectives, degrees of technical and institutional capacity, biophysical and economic opportunity and political will. For instance, not all countries integrate in their NDC an adaptation component. For these reasons any comparison between them has to be taken with caution. To facilitate the synthesis and analysis of the NDCs in the agriculture sectors, FAO developed a common framework and methodology.

The report is divided into five main chapters:

Chapter 1 describes the framework and methodology used for the study.

Chapter 2 provides an overview of the regional and sub-regional trends driving emission trajectories, climate vulnerabilities, adaptive capacities and food security and nutrition outcomes in the region.

Chapter 3 presents a common framework for the synthesis and analysis of the NDCs in the agriculture sectors. It reflects the heterogeneous nature of country commitments and illustrates regional trends. It analyzes the scope, specificity, measurability and timeline of the mitigation and adaptation contributions in the agriculture sectors. The data informs the gap and opportunity analysis in Chapter 3.

---

6 For the purposes of this document, the Agriculture and LULUCF sectors, as defined by Intergovernmental Panel on Climate Change (IPCC), are also collectively referred to as the "agriculture sectors."

Chapter 4 describes the results of the gap and opportunity analysis of the mitigation and adaptation contributions in the agriculture sectors to support the NDC revision process and ambition-building mechanism of the Paris Agreement. It also assesses the opportunities for capturing mitigation and adaptation co-benefits, as well as leveraging synergies between climate actions in the agriculture sectors and the 2030 Agenda for Sustainable Development.

Chapter 5 addresses what is needed to ensure that the NDCs are clear, quantifiable, comparable, transparent and ambitious in 2020 and future NDC submission cycles. It presents the results of an NDC Ambition Index and a menu of options for enhancing the NDCs in the agriculture sectors around six main pillars of climate action.

CHAPTER 1

CHAPTER

1

METHODOLOGY

1.1 GEOGRAPHIC SCOPE

The SEECA region refers to the composition of geographical regions called Southern Europe, Eastern Europe and Central Asia (UNSD, n.d.).The SEECA region comprises three Annex I Parties to the UNFCCC (Belarus, Ukraine and the Russian Federation) and 11 non-Annex I Parties (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Republic of Moldova, Albania, Bosnia and Herzegovina, Montenegro, Serbia and the Former Yugoslav Republic of Macedonia).

In order to facilitate the analysis and to account for the wide differences across landscapes, climates and rural economies, the SEECA region is often disaggregated into three sub-regions: Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan); Eastern Europe (Belarus, Republic of Moldova, Russian Federation and Ukraine); and Southern Europe (Albania, Bosnia and Herzegovina, Montenegro, Serbia and The Former Yugoslav Republic of Macedonia). Of the 14 countries, half are land–locked developing countries (LLDCs). The assignment of countries or areas to specific groupings is for statistical convenience and does not imply any assumption regarding political or other affiliation of countries or territories by the UN.

1.2 DATA

This analysis is based on the information reported in the INDCs of 3 Parties whom did not ratify the Paris Agreement at the time of this analysis[7] (Kyrgyzstan, Uzbekistan and the Russian Federation) and the NDCs of 11 Parties that ratified the Paris Agreement (Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan, Belarus, Republic of Moldova, Ukraine, Albania, Bosnia and Herzegovina, Montenegro, Serbia and The Former Yugoslav Republic of Macedonia).

Given the bottom-up nature of formulation, the NDCs vary greatly in terms of format, scope and detail, resulting from differing degrees of technical and institutional capacity, biophysical and economic opportunity and political will.

1.3 COMMON FRAMEWORK

A common framework was developed to facilitate the synthesis and analysis of the NDCs in the agriculture sectors. The framework provides a structure for assessing the clarity, measurability, comparability, transparency and ambition of NDCs over time. Each NDC is analyzed within the bounds of this common framework, which allows for comparability across NDCs.

The common framework was based on a stocktaking of the NDCs to quantify and qualify the types of climate change mitigation and adaptation contributions in the agriculture sectors by means of a common set of categories and sub-categories.

Mitigation targets and policies and measures

The mitigation contribution in the agriculture and LULUCF sectors presented in the NDC is characterized by the following categories and sub-categories:

- Type of mitigation contribution;
- Type of land use category and agriculture sub-sector;
- Type of land use and agriculture management activity;
- Type of bioenergy production and use measure; and
- Type of food loss and waste reduction measure.

The general mitigation contribution may be economy-wide, multi-sectoral or uni-sectoral in scope and include either a greenhouse gas (GHG) target, or actions-only. The mitigation contribution in the agriculture and/or LULUCF sector describes the inclusion of a sectoral GHG or non-GHG target and/or set of policies and measures. A GHG target refers to an absolute emissions or intensity reduction relative to a base year or projected baseline. Each policy and measure is associated with one of six land use categories, as defined by the Intergovernmental Panel on Climate Change (IPCC) (IPCC, 2014a), or one of five agriculture sub-sectors (FAOd, n.d.). Each policy and measure is associated with one of 37 types of land use or agriculture management activities.[8] If applicable, each policy and measure is associated with one of four types of food loss and waste reduction measures (FAO, 2017c). If applicable, each policy and measure is associated with one of six types of bioenergy-related mitigation measures (IPCC, 2014a). Those policy and measures that aim to increase bioenergy production and efficient use through actions classified as mitigation in the agriculture sectors are classified, first, as a mitigation policy in the agriculture and/or LULUCF sector, and, secondly, tagged by the type of bioenergy production and/or use. For instance, if a country includes afforestation/reforestation for the production of solid biofuel, the policy and measure is classified as a mitigation policy in

[7] Kyrgyzstan, Uzbekistan and the Russian Federation have not ratified the Paris Agreement as of September 1, 2018.

[8] Elaboration of supply-side mitigation options in IPCC (2014a).

the LULUCF sector and tagged as bioenergy production from forest biomass. Similarly, if a country includes biogas production from manure, the policy and measure is classified as a mitigation policy in the agriculture sector and tagged as bioenergy production from agriculture biomass. Alternatively, if a country includes a policy and measure in the energy sector that calls for increased liquid biofuel production from an unknown agriculture biomass source, the policy and measure is classified as bioenergy production from agriculture.

Table 1 illustrates the categories used to qualify the sectoral mitigation contribution and policies and measures in the agriculture and LULUCF sectors found in the NDCs.

TABLE 1.

QUALIFICATION OF THE MITIGATION CONTRIBUTION IN THE AGRICULTURE AND LULUCF SECTOR

TYPE OF MITIGATION CONTRIBUTION	GHG TARGET (INCLUDED IN GENERAL TARGET) GHG TARGET (ADDITIONAL TO GENERAL TARGET) NON-GHG TARGET (ONLY FOR LULUCF) POLICIES AND MEASURES ONLY SECTOR INCLUDED IN GENERAL TARGET ONLY NO CONTRIBUTION
TYPE OF LAND USE CATEGORIES AND AGRICULTURE SUB-SECTORS	ALL LAND CROPLAND GRASSLAND FOREST LAND WETLANDS ORGANIC SOILS CROPS LIVESTOCK INTEGRATED SYSTEMS BIOENERGY FROM AGRICULTURE BIOENERGY FROM FORESTS
TYPE OF LAND USE AND AGRICULTURE MANAGEMENT ACTIVITY	**CROPLAND OR GRASSLAND** GENERAL CROPLAND MANAGEMENT GENERAL GRASSLAND MANAGEMENT PLANT MANAGEMENT RICE MANAGEMENT NUTRIENT MANAGEMENT TILLAGE/RESIDUES MANAGEMENT FIRE MANAGEMENT SET ASIDE IRRIGATION AND DRAINAGE SUSTAINABLE WATER USE AND MANAGEMENT ANIMAL MANAGEMENT
	LIVESTOCK GENERAL LIVESTOCK MANAGEMENT FEEDING BREEDING AND HUSBANDRY MANURE MANAGEMENT
	INTEGRATED SYSTEMS AGROFORESTRY OTHER MIXED BIOMASS PRODUCTION SYSTEMS
	GENERAL AGRICULTURE GENERAL AGRICULTURE MANAGEMENT SUSTAINABLE AGRICULTURE PRACTICE/APPROACH
	BIOENERGY FROM AGRICULTURE GENERAL BIOENERGY PRODUCTION LIQUID BIOFUEL PRODUCTION BIOGAS PRODUCTION
	FORESTRY GENERAL LAND USE MANAGEMENT REDUCING DEFORESTATION AND FOREST CONSERVATION REDUCING DEGRADATION AND SUSTAINABLE FOREST MANAGEMENT FIRE MANAGEMENT AFFORESTATION/REFORESTATION
	WETLANDS AND ORGANIC SOILS WETLANDS MANAGEMENT AQUACULTURE MANAGEMENT REWET ORGANIC SOILS DRAINED FOR AGRICULTURE
	ALL LAND GENERAL LAND USE MANAGEMENT
	BIOENERGY FROM FORESTS GENERAL BIOENERGY PRODUCTION SOLID BIOFUEL PRODUCTION USE OF ENERGY-EFFICIENT FUELWOOD COOKSTOVES

TYPE OF BIOENERGY PRODUCTION AND USE MEASURE	LIQUID BIOFUEL PRODUCTION SOLID BIOFUEL PRODUCTION BIOGAS PRODUCTION USE OF ENERGY-EFFICIENT FUELWOOD COOKSTOVES NON SPECIFIED BIOMASS FEEDSTOCK
TYPE OF FOOD LOSS AND WASTE REDUCTION MEASURE	SOURCE REDUCTION REUSE RECYCLE RECOVERY

Mitigation baseline and NDC target estimate

The regional 2015 baseline net emissions value is estimated based on aggregated national data reported in the National Greenhouse Gas inventory (NGHGI), Biennial-Update Report (BUR), National Communication (NC), National Inventory Report (NIR) and/or (I)NDC submitted to the UNFCCC. If inventory data is available for the year 2015, country data is used in the aggregation. If inventory data is only available for a year previous to 2015, the 2015 baseline value is linearly interpolated based on: i) historical net emissions value and ii) the counterfactual net emissions value provided by the country in the NDC for 2020, 2025 or 2030. If inventory data is only available for a year previous to 2015 but no counterfactual net emissions value is provided by the country in the NDC, the 2015 baseline value is projected based on: i) historical net emissions value and ii) the average regional rate of change of net emissions, which is used as a proxy.

The 2020, 2025 and 2030 counterfactual net emissions value is based on country data provided in the NDC, or an interpolated value. If the counterfactual net emissions value is not available, the average regional rate of change of net emissions between 2015 and 2030 and the national 2015 baseline value are used to estimate the counterfactual net emissions value for 2025 and 2030.

The 2020, 2025, and 2030 target net emissions value is the absolute value of the product of the 2020, 2025 and 2030 counterfactual net emissions value and the targeted percent reduction for each five-year interval (if available) set by the country in its NDC. If a percent reduction is not available for all five-year intervals, the value is interpolated or extrapolated based on the data available, assuming a linear reduction of net emissions over the implementation period.

The cumulated net emissions reduction at 2030 is based on the difference between the counterfactual net emissions curve and the target net emissions curve from the start to end date, assuming linear NDC implementation over the implementation period.

The aggregated 2015 baseline net emissions value is compared against 2030 counterfactual net emissions and 2030 target net emissions to estimate the percent change of net emissions over the implementation period relative to both scenarios.

Mitigation gap and opportunity analysis

A mitigation matrix was developed (**Annex 1**) **to indicate the impact of each potential policy and measure on respective GHG sink/source categories** (as carbon dioxide (CO_2), nitrous oxide (N2O) and methane (CH4) fluxes), from which over 100 potential mitigation pathways and around 10 potential tradeoffs are generated. It is assumed that each policy and measure aims to reduce net emissions or emission intensity from one or more GHG source categories, or enhance removals in one or more GHG sink categories. The GHG source/sink categories used in this analysis adhere to the 2006 IPCC Guidelines for NGHGIs by integrating country data reported using the Revised 1996 Guidelines into a common GHG profile framework (IPCC, 2006). In general, a policy and measure may generate mitigation synergies or present tradeoffs. For instance, a policy and measure may reduce net emissions in one or more GHG categories and sub-categories, while increasing net emissions in another. The cross-cutting nature of the matrix enables analysis of both mitigation synergies and tradeoffs amongst varying agriculture activities and across multiple land uses, particularly in the context of energy production from biomass.

A mitigation gap analysis is performed at the national, sub-regional and regional levels, **to assess the degree to which sectoral policies and measures in the agriculture sectors address the main sources of sectoral GHG emissions, or "GHG hotspots".** The degree of alignment between the current policies and measures contained in the NDCs in the agriculture and LULUCF sectors and GHG hotspots identified is determined based on the methodology defined in the mitigation matrix. If at least one policy and measure to GHG source/sink category link was made, the mitigation actions planned are considered aligned with (or responsive to) the GHG hotspots reported in respective NGHGIs. A policy and measure gap refers to when there is misalignment between the current policies and measures in the NDC and the GHG hotspots reported in the NGHGI of the country. The gap is quantified at the regional and sub-regional level as the share of countries with a policy and measure gap of total countries per GHG hotspot. The degree of policy alignment is quantified at the regional and sub-regional level as the share of countries with at least one policy and measure that addresses the relevant GHG hotspot. If only a portion of the potential policies and measures are included in the NDC, the mitigation opportunity for improving the NDC through better alignment of existing policies and measures with the GHG hotspots is also indicated at the country level. The list of opportunities, however, is indicative, and not prescriptive, of those potential policies and measures that could generate mitigation benefits in relation to a country's GHG hotspot, conditional to country context.

The results of the gap analysis are based on a bottom-up approach by which the major emission sources, or GHG hotspots, and the degree of alignment of mitigation policies and measures are first identified at the national level and then aggregated at regional level.

Limitations to the analysis include the lack of disaggregated emissions data, such as managed soil emissions, in the design of a more precise mitigation matrix to assess the degree of alignment between emission sources and policy and measure outcomes. For this reason, the set of policies and actions related to each GHG source/sink category are considered potential mitigation opportunities, dependent on country conditions and constraints.

Adaptation baseline analysis

The number and type of observed and/or projected climate-related hazards, impacts, vulnerabilities and risks reported in country NDCs are documented in order to capture the degree of vulnerability, adaptive capacity and resilience to climate change in ecosystems and social systems related to the agriculture sectors.

Observed and/or projected changes in climate-related variables are identified by type. Observed and/or projected climate-related hydro-meteorological, climatological and biological hazards and sub-hazards are identified by type. Observed and/or expected slow onset risk categories (chemical and physical climate-related changes) in terrestrial ecosystems and freshwater resources and marine and coastal ecosystems are identified by type. Climate-related hazard and risk categories are adapted from IPCC (2014b) and EM-DAT (2009). Binary coding (0/1) is employed per country.

Each observed and/or projected climate-driven impact, vulnerability and risk of ecosystems is differentiated by biome, ecosystem, natural resource and one of 23 ecosystem service type impact categories. Impact categories in ecosystems are adapted from TEEB (2010), MEA (2005) and FAO (2014a).

Each observed and/or expected climate-related impact, vulnerability and risk in social systems is differentiated by dimension (socio-economics and well-being, knowledge and capacity and institutions and governance) and one of ten impact categories. Impact categories in social systems are adapted from IPCC (2014b) and FAO (2014a).

Table 2 illustrates the type of observed and/or expected climate-related hazards, slow onset risks and climate-driven impacts, vulnerabilities and risks in ecosystems and social systems.

TABLE 2.

OBSERVED AND/OR PROJECTED CLIMATE-RELATED HAZARDS, SLOW ONSET RISKS, IMPACTS AND RISKS IN ECOSYSTEMS AND SOCIAL SYSTEMS

CHANGES IN METEOROLOGICAL VARIABLES	CHANGES IN ANNUAL MEAN PRECIPITATION AND/OR FREQUENCY AND INTENSITY OF EXTREMES CHANGES IN MEAN SURFACE AIR TEMPERATURE AND/OR FREQUENCY AND INTENSITY OF EXTREMES
CLIMATE-RELATED HAZARDS	EXTREME HEAT DROUGHT FLOOD STORM LANDSLIDES WILD FIRE INVASION BY PESTS AND NON-NATIVE SPECIES IN AGRICULTURE
CLIMATE-RELATED RISKS AND SLOW ONSET EVENTS	**TERRESTRIAL ECOSYSTEMS AND FRESHWATER RESOURCES** SNOW AND ICE MELTING EUTROPHICATION SALINIFICATION AND SALT WATER INTRUSION DESERTIFICATION SOIL EROSION WATER STRESS
	MARINE AND COASTAL ECOSYSTEMS SEA-LEVEL RISE OCEAN ACIDIFICATION SEA SURFACE TEMPERATURE RISE COASTAL EROSION
CLIMATE-DRIVEN BIOME IMPACT CATEGORY IN ECOSYSTEMS	TERRESTRIAL FRESHWATER MARINE ALL BIOMES
CLIMATE-DRIVEN NATURAL RESOURCE IMPACT CATEGORY IN ECOSYSTEMS	LAND AND SOIL WATER ENERGY GENETIC RESOURCES ALL NATURAL RESOURCES
CLIMATE-DRIVEN ECOSYSTEM IMPACT CATEGORY IN ECOSYSTEMS	AGRO-ECOSYSTEM (AND FOOD SYSTEM) DESERT MOUNTAIN INLAND WATER WETLANDS POLAR ICE OCEAN AND COASTAL ZONE ALL ECOSYSTEMS
CLIMATE-DRIVEN ECOSYSTEM SERVICE TYPE IMPACT CATEGORY IN ECOSYSTEMS	PROVISIONING REGULATING SUPPORTING GENERAL ECOSYSTEM SERVICES BIODIVERSITY
CLIMATE-DRIVEN ECOSYSTEM SERVICE TYPE IMPACT CATEGORY IN ECOSYSTEMS	**PROVISIONING** GENERAL FOOD, FIBRE, FUEL AND RAW MATERIALS PROVISION CROPS PROVISION LIVESTOCK PROVISION FISHERIES PROVISION AQUACULTURE PROVISION FORESTRY (NTFPS AND WOOD) PROVISION BIOFUEL PROVISION FIBRE PROVISION FRESH WATER PROVISION GENETIC RESOURCES PROVISION
	REGULATING MODERATION OF EXTREME EVENTS POLLINATION BIOLOGICAL CONTROL EROSION CONTROL WATER PURIFICATION WATER FLOW REGULATION LOCAL CLIMATE AND AIR QUALITY CONTROL
	SUPPORTING PRIMARY PRODUCTION CARBON SEQUESTRATION AND STORAGE NUTRIENT CYCLING AND SOIL FORMATION WATER CYCLING MAINTENANCE OF GENETIC DIVERSITY AND ABUNDANCE HABITATS FOR SPECIES

CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN SOCIAL SYSTEMS	**SOCIOECONOMICS AND WELL-BEING** LOSS OF PRODUCTIVE INFRASTRUCTURE AND ASSETS ADVERSE HEALTH FOOD INSECURITY AND MALNUTRITION RURAL LIVELIHOODS AND INCOME LOSS GENDER INEQUALITY CONFLICT MIGRATION AND DISPLACEMENT POVERTY AND INEQUALITY
	KNOWLEDGE AND CAPACITY LIMITED KNOWLEDGE AND CAPACITY
	INSTITUTIONS AND GOVERNANCE WEAK INSTITUTIONS AND GOVERNANCE

Adaptation priorities and measures

The adaptation component in the agriculture sectors presented in the NDCs is characterized by the following categories and sub-categories:

- Type of adaptation component;
- Type of adaptation priority sectors;
- Type of adaptation cross-sectoral priorities;
- Type of ecosystem, per adaptation measure;
- Type of agriculture sub-sector, per adaptation measure;
- Type of social dimension, per adaptation measure;
- Type of dimension, per social system
- Type of natural resource use and management option in ecosystems;
- Type of management option in agro-ecosystems and food systems;
- Type of intervention option in social systems per dimension;
- Type of bioenergy production and use measure; and
- Type of food loss and waste reduction measure.

The adaptation component in the agriculture sectors describes the inclusion of priority sector(s) and/or measures. Each adaptation priority sector is associated with one or more of six agriculture sub-sectors (FAOd, n.d.). Each adaptation cross-sectoral adaptation priority is associated with one or more of 14 cross-sectoral priorities (FAOd, n.d.). Each adaptation measure in ecosystems is associated with one of seven ecosystems defined by the Economics of Ecosystems and Biodiversity (TEEB, 2010) and Millennium Ecosystem Assessment (MEA, 2005), one of six land use categories, as defined by IPCC (IPCC, 2014a), and one of six agriculture sub-sectors (FAOd, n.d.). Each adaptation measure in agro-ecosystem (and food systems) is associated with one of six agriculture sub-sectors (FAOd, n.d.) and one of 41 management options.[9] Each adaptation measure in ecosystems outside of farming is associated with one of 18 natural resource use and management options.[10] In social systems, adaptation measures are associated with one of 34 intervention areas across three main dimensions.[11] Each adaptation measure in social systems is associated with one of three dimensions (socio-economics and well-being, knowledge and capacity and institutions and governance).[12] If applicable, each policy and measure is associated with one of seven types of bioenergy-related adaptation measures.[13] If applicable, each policy and measure is associated with one of four types of food loss and waste reduction measures.[14] **Table 3** illustrates the categories used to qualify adaptation priority sectors and measures in the agriculture sectors found in the NDCs.

[9] Elaboration of FAO (2013), IPCC (2014b) and FAO, (2017d).

[10] Elaboration of FAO (2013), IPCC (2014b) and FAO (2017d).

[11] Elaboration of FAO (2013), IPCC (2014b) and FAO, (2017d).

[12] Elaboration of IPCC (2014a).

[13] Elaboration of IPCC (2014a).

[14] Elaboration of FAO (2017c).

TABLE 3.

QUALIFICATION OF THE ADAPTATION COMPONENT IN THE AGRICULTURE SECTORS

TYPE OF ADAPTATION COMPONENT	PRIORITY SECTOR(S) AND MEASURES PRIORITY SECTOR(S) MEASURES NO COMPONENT
TYPE OF PRIORITY SECTOR(S)	ALL SUB-SECTORS CROPS LIVESTOCK FISHERIES AND AQUACULTURE BIOENERGY INTEGRATED SYSTEMS FORESTRY
TYPE OF CROSS-CUTTING PRIORITIES	ECOSYSTEMS AND NATURAL RESOURCES WATER LAND AND SOIL OCEANS AND COASTAL ZONES BIODIVERSITY AGRI-FOOD CHAIN FOOD SECURITY AND NUTRITION DISASTER RISK REDUCTION AND MANAGEMENT HEALTH RESILIENT INFRASTRUCTURE GENDER INDIGENOUS PEOPLES POVERTY AND INEQUALITY REDUCTION HUMAN RIGHTS
TYPE OF ECOSYSTEM	AGRO-ECOSYSTEM DESERT MOUNTAIN INLAND WATER WETLANDS POLAR ICE OCEAN AND COASTAL ZONE
TYPE OF AGRO-ECOSYSTEM	ALL SUB-SECTORS CROPS LIVESTOCK INTEGRATED SYSTEMS FORESTRY AQUACULTURE FISHERIES
TYPE OF LAND USE CATEGORY	ALL LAND CROPLAND GRASSLAND FOREST LAND WETLANDS
TYPE OF SOCIAL DIMENSION	SOCIO-ECONOMICS AND WELL-BEING KNOWLEDGE AND CAPACITY INSTITUTIONS AND GOVERNANCE
TYPE OF NATURAL RESOURCE USE AND MANAGEMENT OPTION IN ECOSYSTEMS	**LAND AND SOIL RESOURCES** LAND/SOIL CONSERVATION LAND/SOIL MANAGEMENT, RESTORATION AND REHABILITATION INTEGRATED LANDSCAPE MANAGEMENT COASTAL ZONE MANAGEMENT
	WATER RESOURCES WATER-RELATED ECOSYSTEM PROTECTION AND RESTORATION INTEGRATED WATERSHED MANAGEMENT FLOOD MANAGEMENT WATER AVAILABILITY AND ACCESS WATER STORAGE AND HARVESTING IRRIGATION AND DRAINAGE SUSTAINABLE WATER USE AND MANAGEMENT WATER QUALITY AND POLLUTION MANAGEMENT WATER-USE EFFICIENCY AND REUSE
	ECOSYSTEMS AND GENETIC RESOURCES MANGROVE CONSERVATION AND REPLANTING BIODIVERSITY PROTECTION, CONSERVATION AND RESTORATION PEST AND DISEASE MANAGEMENT ECOSYSTEM MANAGEMENT, CONSERVATION AND RESTORATION

TYPE OF MANAGEMENT OPTION IN AGRO-ECOSYSTEMS (AND FOOD SYSTEMS)	**CROPS** GENERAL CROP MANAGEMENT PEST MANAGEMENT PLANT MANAGEMENT NUTRIENT AND ON-FARM SOIL MANAGEMENT
	LIVESTOCK GENERAL LIVESTOCK MANAGEMENT FEEDING PRACTICES ANIMAL BREEDING AND HUSBANDRY ANIMAL AND HERD MANAGEMENT
	INTEGRATED SYSTEMS AGROFORESTRY OTHER MIXED BIOMASS PRODUCTION SYSTEMS
	FORESTRY AND LAND USE REDUCING DEFORESTATION AND FOREST CONSERVATION REDUCING DEGRADATION AND SUSTAINABLE FOREST MANAGEMENT AFFORESTATION/REFORESTATION PROMOTION OF URBAN AND PERI-URBAN FORESTRY WETLANDS MANAGEMENT REWET PEATLANDS DRAINED FOR AGRICULTURE CROPLAND MANAGEMENT GRASSLAND MANAGEMENT FIRE MANAGEMENT ON GRASSLAND FIRE MANAGEMENT ON CROPLAND FIRE MANAGEMENT ON FOREST LAND
	FISHERIES AND AQUACULTURE FISHERIES MANAGEMENT AQUACULTURE MANAGEMENT FISHERIES AND AQUACULTURE MANAGEMENT
	ENERGY BIOENERGY PRODUCTION BIOENERGY USE ENERGY USE
	AGRI-FOOD CHAIN INPUT PROVISION FOOD LOSS REDUCTION FOOD WASTE REDUCTION VALUE ADDITION CERTIFICATION SCHEMES PAYMENT FOR ECOSYSTEM SERVICES SHIFT CONSUMPTION PATTERNS
	GENERAL AGRICULTURE SUSTAINABLE AGRICULTURE PRACTICES/APPROACH DIVERSIFICATION INTENSIFICATION CSA CONSERVATION AGRICULTURE AGROECOLOGY ECOSYSTEM-BASED ADAPTATION COMMUNITY-BASED ADAPTATION
TYPE OF INTERVENTION OPTION IN SOCIAL SYSTEMS PER DIMENSION	**SOCIO-ECONOMICS AND WELL-BEING** HEALTH INFORMATION AND SERVICES DISEASE MANAGEMENT AND PREVENTION FOOD SECURITY AND NUTRITION INDIGENOUS PEOPLES GENDER EQUALITY AND WOMEN EMPOWERMENT DISPLACEMENT & MIGRATION OF VULNERABLE PEOPLE RESILIENCE AND ADAPTIVE CAPACITY BUILDING RESILIENT INFRASTRUCTURE DECENT RURAL EMPLOYMENT LIVELIHOODS AND ECONOMIC DIVERSIFICATION FARMER COOPERATIVES AND MARKETING STRATEGIES CREDIT AND INSURANCE SERVICES SOCIAL PROTECTION POVERTY REDUCTION
	KNOWLEDGE AND CAPACITY TRADITIONAL KNOWLEDGE RESEARCH & DEVELOPMENT HUMAN RESOURCE TRAINING FOR CLIMATE ACTION AWARENESS RAISING AND EDUCATION HAZARD AND VULNERABILITY MAPPING CLIMATE INFORMATION SERVICES CLIMATE INFORMATION SERVICES IN AGRICULTURE SECTORS EARLY WARNING SYSTEMS EARLY WARNING SYSTEMS IN AGRICULTURE SECTORS
	INSTITUTIONS AND GOVERNANCE DISASTER RISK REDUCTION AND MANAGEMENT INSTITUTIONAL CAPACITY BUILDING FOR CLIMATE ACTION

TYPE OF INTERVENTION OPTION IN SOCIAL SYSTEMS PER DIMENSION	LAW AND REGULATION LAND TENURE REFORM WATER GOVERNANCE INVESTMENT IN AGRICULTURE TRANSPARENCY & ACCOUNTABILITY POLICY MAINSTREAMING AND COHERENCE PARTICIPATORY GOVERNANCE CONFLICT RESOLUTION
TYPE OF BIOENERGY PRODUCTION AND USE MEASURE	LIQUID BIOFUEL PRODUCTION SOLID BIOFUEL PRODUCTION BIOGAS PRODUCTION WOODFUEL AND CHARCOAL PRODUCTION USE OF ENERGY-EFFICIENT FUELWOOD COOKSTOVES ENERGY USE IN AGRICULTURE
TYPE OF FOOD LOSS AND WASTE REDUCTION MEASURE	SOURCE REDUCTION REUSE RECYCLE RECOVERY

Adaptation gap and opportunity analysis

A gap analysis is performed to compare adaptation priorities and measures in the agriculture sectors against the major observed and/or projected climate-related hazards, slow onset risks, impacts and vulnerabilities in ecosystems and social systems reported in country NDCs. The gap analysis assesses the degree to which adaptation priorities and measures in ecosystems and social systems are aligned with, or responsive to, major observed and/or projected climate-related hazards, slow onset risks, impacts and vulnerabilities in ecosystems and social systems.

An adaptation matrix for ecosystems (**Annex 2**) **was developed** to illustrate the cross-cutting and multi-dimensional relationship between climate-related impact categories (climate-related hazards, impacts and vulnerabilities in ecosystems, per vulnerable sector, ecosystem, ecosystem service and natural resource) and adaptation measures (adaptation priority sectors, cross-sectoral priorities and measures in ecosystems, per management activity), from which over 1,000 potential adaptation options and ten potential tradeoffs are generated.

An adaptation matrix for social systems (**Annex 3**) **was developed** to illustrate the relationship between climate-related impact categories (climate-related impacts, vulnerabilities and risks in social systems, per dimension) and adaptation measures (adaptation cross-sectoral priorities and measures in social systems, per intervention area), from which around 75 potential adaptation options are generated.

For each major climate-related impact category in ecosystems and social systems reported in the NDCs, the adaptation component was compared against the potential adaptation options identified in the Adaptation Matrixes to assess the degree of alignment between major climate-related impact categories and current adaptation measures set forth in the NDC. If a country includes at least one adaptation priority or measure in response to a reported climate-related hazard, impact, vulnerability or risk, adaptation is considered aligned. The common metric amongst impact categories and adaption options in ecosystems is the ecosystem service and/or natural resource impacted or supported. A policy gap refers to when there is misalignment between the current adaptation measures presented and the major climate-related impact categories reported in the NDC. The gap is quantified at the sub-regional level as the share of countries with a policy gap per major climate-related impact categories. Policy alignment refers to when at least one adaptation measure in the NDC aims to reduce vulnerability and/or increase adaptive capacity in relation to the major climate-related impact category reported by the country. The degree of policy alignment is quantified at the sub-regional level as the share of countries with at least one adaptation measure that addresses the relevant major climate-related impact category. If only a portion of the potential adaptation measures are included in the NDC, the adaptation opportunity for improving the NDC through better alignment of existing measures with the major climate-related impact category is also indicated at the country level. The list of adaptation opportunities, however, is indicative, and not prescriptive, of those potential adaptation options that could reduce vulnerability and increase adaptive capacity in the agriculture sectors in relation to the impact category identified, conditional to country context.

The bottom-up approach of the analysis aggregates country-level data at sub-regional and regional level to identify commonalities and differences amongst sub-regional adaptation priorities and opportunities.

The gap analysis is limited to the content of the NDCs and performed only for those countries including climate-related hazards, impacts and vulnerabilities in ecosystems and climate-related impacts, vulnerabilities and risks in social systems related to the agriculture sectors and rural livelihoods. Country-level vulnerability assessments and climate impact modeling are beyond the scope of this analysis, but are encouraged for adaptation planning in the context of the NDC. Instead, the analysis provides for a first screening of the type of adaptation priorities and measures reported by countries in relation to the climate-related hazards, impacts and vulnerabilities identified at the country level, creating a framework by which various adaptation options, across ecosystems and social systems, are identified and against which NDCs can be compared and improved over time.

Mitigation and adaptation co-benefits

To understand the degree of alignment between mitigation and adaptation options in the NDCs, the mitigation policies and measures and adaptation measures in the agriculture sectors were mapped against each other.

A mitigation-adaptation co-benefit matrix was developed (**Annex 4**) to codify the links between the mitigation policies and measures identified in **Table 1** and adaptation measures identified in **Table 2**, from which almost 300 potential mitigation-adaptation co-benefit options and 30 tradeoffs were generated in the agriculture sectors. Each mitigation policy and measure may generate one or more adaptation co-benefit, and vice versa. On average, two co-benefits are generated per mitigation-adaptation co-benefit option.

The analysis reflects a two-way process:

1 ***Mitigation-to-adaptation co-benefits***: The total number of adaptation co-benefits per mitigation measure is quantified; and

2 ***Adaptation-to-mitigation co-benefits***: The total number of mitigation co-benefits per adaptation measure is quantified.

The number of mitigation policies and measures with adaptation co-benefits, number of adaptation measures with mitigation co-benefits and number of mutual mitigation and adaptation co-benefits are quantified at the country-level and results are aggregated at sub-regional and regional levels to identify opportunities for leveraging synergies in the agriculture sectors and informing investment options. The degree of alignment refers to the frequency of adaptation or mitigation co-benefits per mitigation or adaptation measure (and does not reflect how much the measure contributes in absolute terms to achieving a particular outcome).

The analysis only covers sector- or land use-specific management activities and excludes general agricultural approaches, such as Climate Smart Agriculture (CSA) or conservation agriculture, to pinpoint concrete climate change mitigation actions with adaptation co-benefits, and vice-versa.

NDC and SDG links

To understand the degree of convergence between "climate actions" in the agriculture sectors communicated by countries in their NDCs and the 17 goals and 169 targets of the 2030 Agenda for Sustainable Development, the sectoral climate actions in the NDCs were mapped against the SDG targets. The variety of climate change mitigation targets, policies and measures and climate change adaptation priorities and measures in the agriculture sectors (collectively referred to as "climate actions") serve as the data points for the analysis.

The climate actions presented under the mitigation contribution of the NDCs were characterized by the following categories:

- Type of mitigation contribution;
- Type of land use category and agriculture sub-sector;
- Type of land use and agriculture management activity;
- Type of bioenergy production and use measure; and
- Type of food loss and waste reduction measure.

Climate mitigation actions refer collectively to the sectoral contribution (target or action-only) and policies and measures. The sectoral mitigation contribution is associated with the climate action "mitigation in the agriculture sector" or "mitigation in the LULUCF sector" only and is not qualified by other sub-categories. **Table 1** illustrates the categories used to qualify climate mitigation actions in the agriculture and LULUCF sectors found in the NDCs.

The climate actions in the agriculture sectors presented under the adaptation component of NDCs were characterized by the following categories:

- Type of adaptation component;
- Type of climate resilience and Disaster Risk Reduction and Management (DRR/M) component;
- Type of adaptation priority sectors;
- Type of adaptation cross-sectoral priorities;
- Type of ecosystem, per adaptation measure;
- Type of agriculture sub-sector, per agro-ecosystem (and food system) adaptation measure;
- Type of natural resource use and management option in ecosystems;
- Type of management option in agro-ecosystems (and food systems);
- Type of dimension area, per social system adaptation measure;
- Type of intervention option in social systems per dimension;
- Type of bioenergy production and use measure; and
- Type of food loss and waste reduction measure.

Climate adaptation actions refer collectively to the sectoral adaptation contribution, climate resilience and DRR/M component, adaptation priority sectors, adaptation cross-sectoral priorities and adaptation measures. The sectoral adaptation and climate resilience and DRR/M component are associated with climate actions "adaptation in agriculture," "climate resilience" and "DRR/M" only and are not further qualified by sub-categories. **Table 2** illustrates the categories used to qualify climate adaptation actions in the agriculture sectors found in the NDCs.

Overall, around 300 potential climate actions (data points) were derived. Binary coding (0/1) was employed to code the number and type of climate actions per country.

A NDC-SDG matrix (Annex 5) was developed to map the convergence between each climate action in the agriculture sectors with one or more SDG targets. The convergence was determined based on a two way process:

1. ***Direct link***: Key word search (e.g. "gender," "poverty") relating NDC climate action and SDG target; and
2. ***Indirect link***: 70 SDG tags identified (e.g. "social protection", "marine ecosystem") and linked to NDC climate action.

A climate action may contribute to one or more SDG targets. The average number of SDG target links generated per climate action is 4. Binary coding (0/1) was employed to quantify the convergence between the climate action and SDG target. The degree of convergence refers to the frequency of climate actions per SDG target (and does not reflect how much NDCs contribute in absolute terms to achieving a particular SDG or SDG target). In general, it is assumed that climate mitigation and adaptation actions in the agriculture sectors imply a transition from a less to more sustainable scenario in terms of economic, social, environmental and governance dimensions. It should be noted that the definition of agriculture under FAO terminology and the 2030 Agenda differs. Within the 2030 Agenda, "productive and sustainable agriculture" (target 2.4) refers to crops and livestock (FAO, 2017d), while sustainable fisheries and aquaculture (target 14.7) and sustainable forestry (target 15.2) are associated with different SDGs. The definition of sustainable agriculture in the context of SDGs encompasses only a portion of FAO's vision for sustainable food and agriculture based on five principles applicable across five sectors: crops, livestock, forestry, aquaculture and fisheries (FAO, 2014a).

Over 1 500 potential climate action-sustainable development synergies and around 50 potential tradeoffs were generated in the agriculture sectors. Using the NDC-SDG matrix, the degree of convergence between NDC climate actions and SDG targets was assessed at the country level. The degree of convergence refers to the frequency of SDG target links per unique climate action. The results were aggregated at sub-regional and regional levels and then transformed into a pie chart to highlight the greatest area of convergence between climate actions in the agriculture sectors.

NDC Ambition Index

An "NDC Ambition" index was developed to measure baseline ambition levels of climate action in the agriculture sectors to inform the NDC review and revision processes leading up to 2020. The NDCs in the agriculture sectors were assessed across six main pillars: mitigation, adaptation, planning, monitoring, reporting and means of implementation. Each pillar is defined by 4 outcome or process-based indicators (**Annex 6**), which are weighted between 0 and 1; the sum of the weights assigned to each indicator within the same pillar equal 1. The methodology includes a scoring procedure, whereby indicators are given scores from 2 to 10, converted from raw quantitative and qualitative data. The scoring system matches the four levels of ambition: low, moderate, high and very high. The country level results are aggregated at sub-regional level. A radar chart is used to visualize the results for easy identification of NDC enhancement areas.

CHAPTER 2

CHAPTER

2

REGIONAL CIRCUMSTANCES

Understanding the environmental, economic and socio-economic variables driving GHG emissions and climate-related vulnerabilities in the region is critical for identifying context-specific mitigation and adaptation options that simultaneously support – rather than limit – food security and nutrition and sustainable development objectives. Indeed, most countries refer to their specific national circumstances when outlining why their NDCs are fair and ambitious.

This section provides an overview of the regional trends driving and conditioning emission trajectories, climate vulnerabilities, adaptive capacities and food security and nutrition outcomes in the region.

2.1 CLIMATE AND NATURAL RESOURCES

Given the diversity across landscapes and ecosystems in the SEECA region, climatic trends and the status of natural resources essential to agriculture and rural livelihoods are analyzed per sub-region to capture variability across and within each sub-region.

Climate varies across the region, with the most predominant climate zones classified as boreal moist (40 percent of total area) and cool temperate dry (19 percent) (**Figure 1**). Central Asia is characterized by a predominantly cool temperate dry (60 percent) climate, with a third of its area under warm temperate dry zones. The largest sub-region, Eastern Europe, is mostly boreal moist (49 percent) with cool temperate moist (18 percent) areas, while the smallest sub-region, Southern Europe, is characterized by cool temperate moist (42 percent) and warm temperate dry (27 percent) climates (JRC, 2010).

The average annual mean temperature ranges from - 40C in Eastern Europe, to 8°C in Central Asia and to 120C in Southern Europe, reaching lows of -240C in Eastern Europe to highs of 240C in Central Asia. Time series data (**Figure 2**) demonstrates an incremental increase in the average annual mean across all three sub-regions in the last 25-year period (FAOa, n.d.).

FIGURE 1.

MAJOR CLIMATE ZONES PER SUB-REGION, BY SHARE OF TOTAL AREA

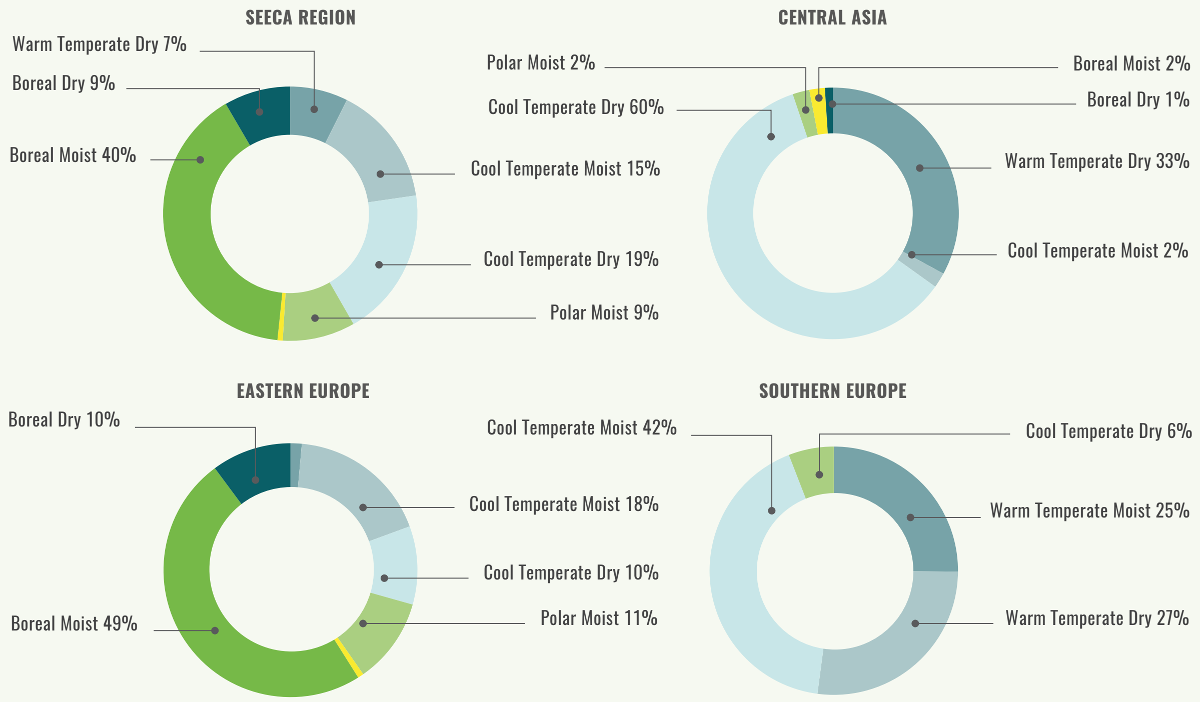
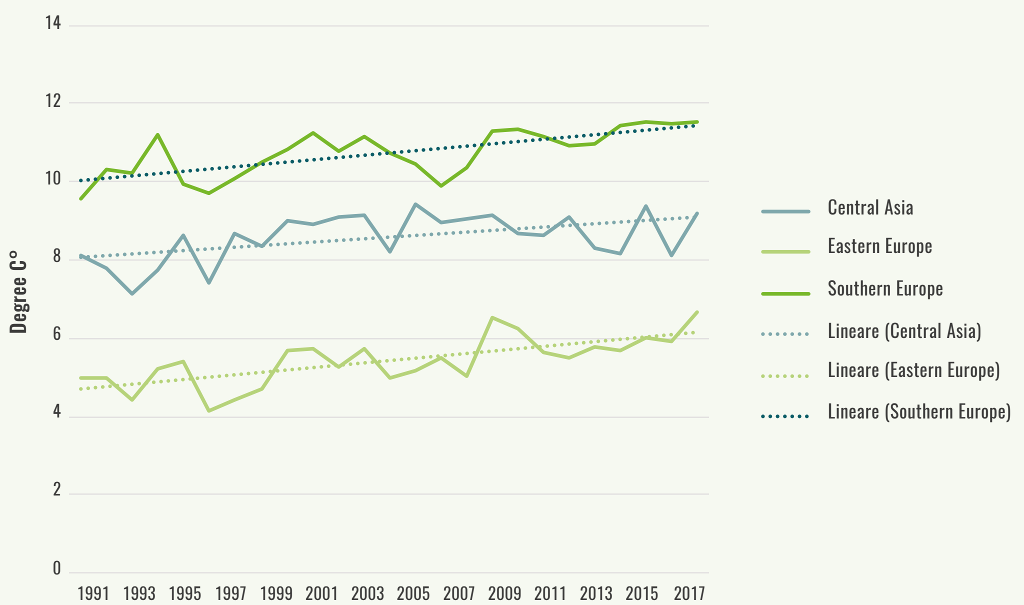


FIGURE 2.

AVERAGE ANNUAL TEMPERATURE (1991-2015), PER SUB-REGION



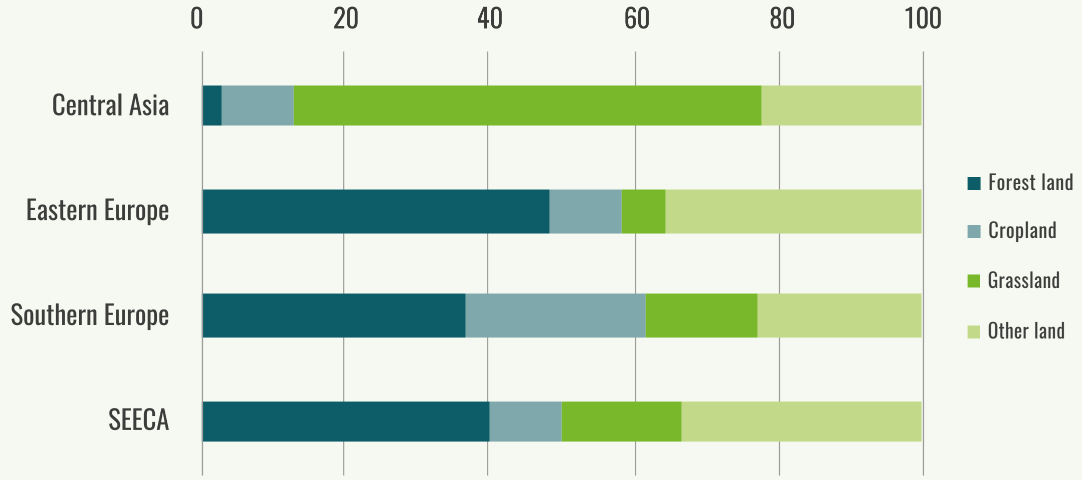
Source: http://sdwebx.worldbank.org/climateportal/index.cfm?page=downscaled_data_download&menu=historical.

Annual precipitation varies across the SEECA region, with Southern Europe receiving the highest amount of average annual rainfall in depth (1040 mm) between 1991 and 2015, more than double that of Eastern Europe (520 mm) and triple that of Central Asia (370 mm) (FAOb, n.d.).

Land area is about 2.3 billion ha, or 17 percent of the world's land. The amount of arable land per capita ranges from 2.3 hectares per capita in Eastern Europe to one in Central Asia and less than half in Southern Europe (FAOa, n.d.). Within each sub-region, land cover patterns vary (**Figure 3**). While Central Asia is largely covered by grassland (65 percent of total area), forest land constitutes the largest land cover in both Southern and Eastern Europe (34 and 48 percent, respectively) (FAOc, n.d.).

FIGURE 3.

DISTRIBUTION OF LAND COVER (2015), PER SUB-REGION



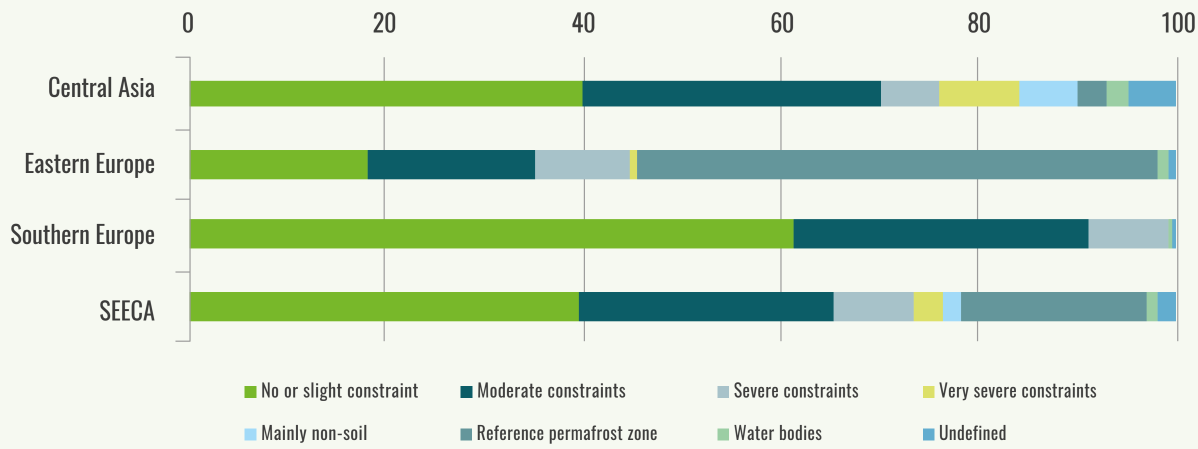
The suitability of land for agriculture is comparable across the region, measured by soil depth and quality (**Figure 4**). **Overall, the majority of land is categorized by soils with no or slight constraints** (40 percent of total area), or high natural fertility, followed by moderate constraints (26 percent), or moderate natural fertility, with only ten percent of land classified as severe or very severely constrained. Central Asia is endowed with the largest area of land classified as severe and very severely constrained for agriculture compared to other sub-regions (FAOa, n.d.).

The distribution of freshwater resources is uneven across the region yet does not generally generate water stress or scarcity at the national level though exists in some areas at the sub-national level though it exists in some areas at the sub-national level. In Central Asia, total annual renewable water resources per capita (3,800 m^3) is three times less than the average observed in Eastern and Southern Europe (11,100 and 10,400 m^3) in 2015. Uzbekistan is the only country exposed to water stress,[15] with total annual resources just below the 1,700 m^3 per capita threshold (FAOb, n.d.).

[15] Refers to per capita water stress threshold defined by UN Water (n.d.).

FIGURE 4.

SHARE OF LAND WITH SOIL CONSTRAINTS (2011), PER SUB-REGION



Source: GAEZ 2011.

Comparable trends are observed in agricultural water use, as sectoral withdrawal represents a low share of total annual renewable resources in Eastern and Southern Europe, but a driver of water stress[16] in Central Asia (60 percent of total withdrawals), reaching over 100 percent of total withdrawals in Turkmenistan and Uzbekistan in 2015 (FAOb, n.d.).

2.2 FARMING SYSTEMS

The diversity of the landscape and natural resource base across the region gives way to varying farming activities and livelihood patterns, as inextricably linked to the biological, physical, economic and cultural environment in which rural populations live. A farming systems approach provides a way to aggregate farm households that have a similar resource base and livelihood pattern, and comparable constraints and opportunities for mitigating climate change and enhancing resilience (FAO and WB, 2001).

Large differences in agro-ecologies are observed amongst farming systems in the SEECA region, ranging from one of the world's most fertile regions in Southeastern Europe, to the poor, water-scarce regions of Central Asia. This agro-ecological diversity, combined with the heterogeneity of political, economic and social conditions in the region, has resulted in the development of a wide variety of farming systems (FAO and WB, 2001).

Based on agro-ecological geo-spatial information combined with socio-economic data, eight major farming systems were identified in the region (**Table 1**) (FAO and WB, 2001). **The dominant farming system is sparse (cold)** (58 percent of total area), **followed by extensive cereal-livestock** (20 percent). The majority of the population lives in the extensive cereal-livestock farming system (33 percent of total population), followed by large-scale cereal-vegetable (23 percent) and pastoral systems (11 percent), all associated with moderate to extensive prevalence of poverty (Oak Ridge National Laboratory, 2010; FAO and WB, 2001). The largest share of cattle is found in the extensive cereal-livestock system (26 percent of total cattle), followed by the large-scale cereal-vegetable system (16 percent) and forest-based livestock system (9 percent) (FAO, 2014b).

[16] Refers to basin-level water stress threshold defined by Luo *et al.* (2015).

TABLE 4.

MAJOR FARMING SYSTEMS IN THE SEECA REGION

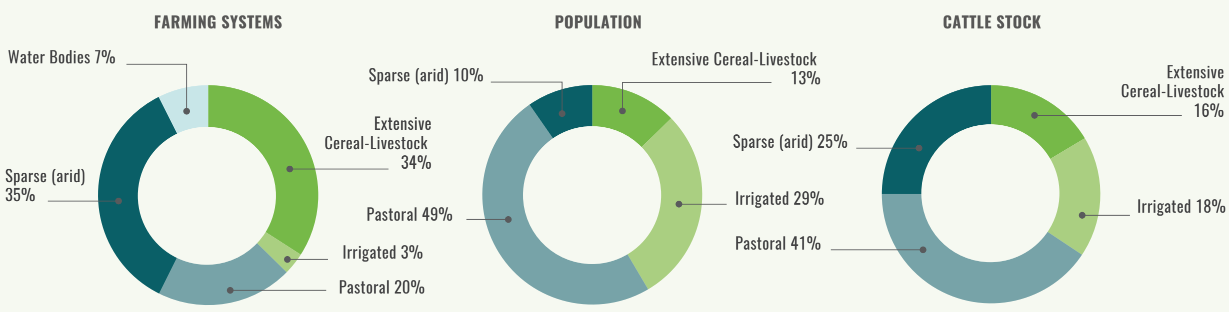
FARMING SYSTEM	TOTAL AREA %	POPULATION %	PRINCIPAL PRODUCTIONS	PREVALENCE OF POVERTY
SPARSE (COLD)	58	8	RYE, OATS, REINDEER, POTATOES, PIGS, FORESTRY	EXTENSIVE
EXTENSIVE CEREAL-LIVESTOCK	20	33	WHEAT, HAY, FODDER, CATTLE, SHEEP	MODERATE-EXTENSIVE
LARGE-SCALE CEREAL-VEGETABLE	5	23	WHEAT, BARLEY, SHEEP AND GOATS	MODERATE
PASTORAL	4	11	SHEEP, CATTLE, CEREALS, FOODER CROPS, POTATOES	MODERATE-EXTENSIVE
FOREST-BASED LIVESTOCK	2	7	FODDER, HAY, CEREALS, INDUSTRIAL CROPS, POTATOES	MODERATE
IRRIGATED	1	9	COTTON, RICE, OTHER CEREALS, TOBACCO, FRUIT, VEGETABLES, OFF-FARM	MODERATE-EXTENSIVE
MIXED	<1	<1	WHEAT, MAIZE, OILCROPS, BARLEY, LIVESTOCK	LOW-MODERATE
HORTI-CULTURE MIXED	1	6	WHEAT, MAIZE, OILCROPS, FRUIT, INTENSIVE VEGETABLES, LIVESTOCK, OFF-FARM INCOME	MODERATE-EXTENSIVE

Source: FAO and WB, 2001; Oak Ridge National Laboratory, 2010; and FAO, 2014b.
Note: Prevalence of poverty refers to number in poverty, not depth of poverty, and is a relative assessment for this region. Water bodies account for 5 percent of the total regional land area.

Within each sub-region the share and type of farming systems differ. In Central Asia (**Figure 5**), **the dominant farming systems are sparse (arid) and extensive cereal-livestock** (34 and 35 percent of total area, respectively), followed by pastoral systems (20 percent). However, the largest share of the population (49 percent of total population) lives in pastoral farming, followed by irrigated systems (29 percent). The greatest number of cattle is found in pastoral systems (41 percent of total cattle), followed by sparse (arid) areas.

FIGURE 5.

DISTRIBUTION OF MAJOR FARMING SYSTEMS IN CENTRAL ASIA, BY SHARE OF TOTAL AREA, POPULATION AND CATTLE STOCK



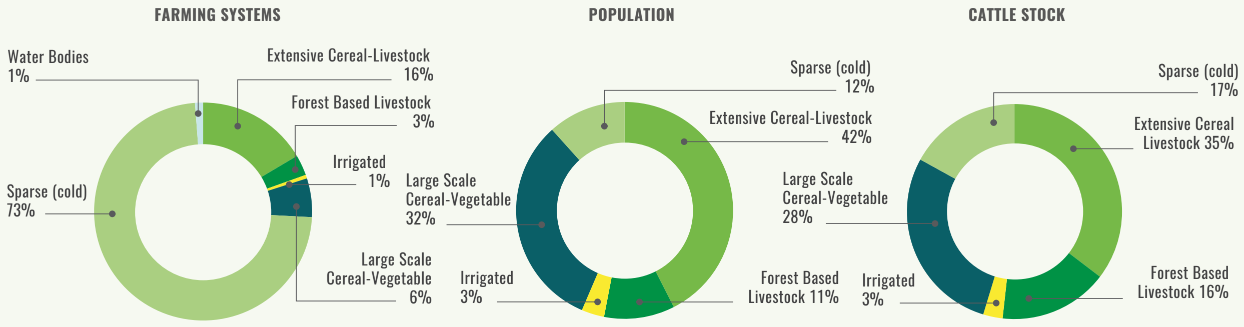
Source: FAO 2001. **Farming systems with share of area less than 1% of the total are excluded from the figure.*

In Eastern Europe (**Figure 6**), **the dominant farming system is sparse (arid)** (73 percent of total area), followed by extensive cereal-livestock (16 percent). However, the largest share of the population (42 percent of total population) lives in the extensive cereal-livestock system, followed by large scale cereal-vegetable farming (32 percent). The greatest number of cattle is found in the extensive cereal-livestock system as well (35 percent of total cattle).

In Southern Europe (**Figure 7**), **the dominant farming system is horticulture mixed** (88 percent of total area), followed by mixed systems (12 percent). The largest shares of the population (79 percent of total population) and of cattle stock (90 percent of total cattle) are found in the horticulture mixed system.

FIGURE 6.

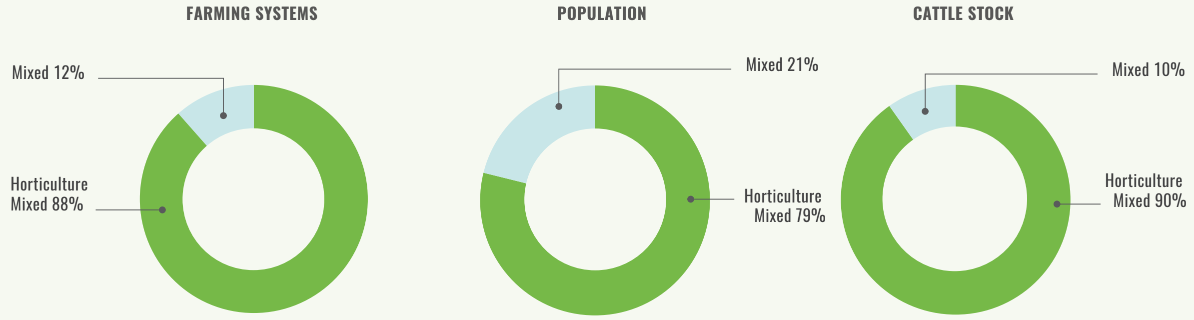
DISTRIBUTION OF MAJOR FARMING SYSTEMS IN EASTERN EUROPE, BY SHARE OF TOTAL AREA, POPULATION AND CATTLE STOCK



Source: LANDSCAN 2010. **Farming systems with share of area less than 1% of the total are excluded from the figure.*

FIGURE 7.

DISTRIBUTION OF MAJOR FARMING SYSTEMS IN SOUTHERN EUROPE, BY SHARE OF TOTAL AREA, POPULATION AND CATTLE STOCK



**Farming systems with share of area less than 1% of the total are excluded from the figure.*

2.3 POPULATION AND RURAL ECONOMY

The total population of 300 million people making up the region today is projected to decline by 2050 (UN DESA, 2017). Slow population growth is mostly driven by Central Asia, while stagnation and negative growth are expected in Eastern and Southern Europe. In Central Asia, the nearly 70 million today are estimated to reach around 90 million in 2050, and up to 100 million in 2100. Conversely, the population of nearly 200 million today in Eastern Europe is expected to fall to around 180 million in 2050, and 160 million in 2100. Similarly, the population of nearly 18 million today in Southern Europe is expected to fall to around 16 million in 2050, and down to 11 million in 2100 (UN DESA, 2017).

The region has experienced contrasting trends of urbanization between 2010 and 2015. In Central Asia, urbanization rates are positive, ranging from 1.5 percent in Uzbekistan to 2.5 percent in Turkmenistan. In Eastern Europe, negative rates are observed in Ukraine and Republic of Moldova, but reach up to almost one percent growth in Belarus. In Southern Europe, negative rates are observed in Bosnia and Serbia, but reach up to 1.8 percent in Albania.[17]

Annual gross domestic product (GDP) growth in the region is higher at 4 percent compared to the worldwidel average (3 percent) and per capita GDP ranks higher than the worldwide average (USD 19 500 to 16 000), with large differences within and across countries (WB, n.d.). Negative GDP growth is observed in Belarus (-2.6 percent), while Uzbekistan reports the highest annual growth in GDP (7.8 percent). The level of GDP per capita in the region is lowest in Tajikistan (USD 3 000) and highest in Kazakhstan (USD 25 300).

Agriculture plays a significant role in the region's economy, accounting for declining average of 12 percent of GDP[18] (WB, n.d.) **and 23 percent of total employment** (ILO, n.d.). The gender-ratio in the agriculture sector varies amongst sub-regions, with an average 104, 150 and 141 male to every 100 females in Central Asia, Eastern Europe and Southern Europe, respectively.[19] Agricultural value added derives primarily from crop and livestock production with contributions of 60 and 40 percent to sectoral GDP. Industrial roundwood production (219 million m^3) is four times greater than that of woodfuel production (46 million m^3), primarily from Eastern Europe (FAOc, n.d.).

2.4 FOOD SECURITY AND NUTRITION

Climate variability and exposure to more complex, frequent and intense climate extremes threaten to erode and reverse the progress made towards ending hunger and all forms of malnutrition. The direct and indirect impacts of climate change are channeled through varying combinations of biophysical, economic and socio-economic feedback channels, affecting the basic and underlying factors that drive food security and nutritional status. Climate variability and extremes will have the strongest direct impact on food availability but cascading impacts will also reduce rural income levels and the ability of households to access food; exacerbate price volatility and influence food markets; and jeopardize the nutritional quality and safety of food produced and consumed (FAO 2016c). The extent to which climate variability and extremes negatively affect people's food security and nutrition situation depends on their degree of exposure to climate shocks and vulnerability to these shocks (FAO, 2018).

In 2017, the average supply of dietary energy out of the average dietary energy requirement estimated for the population was above or almost 100 percent for all countries (FAOc, n.d.). The average supply of protein from animal origin was lowest in Central Asia (42 percent of total protein supply), with higher average shares found in Southern and Eastern Europe (44 and 46 percent, respectively).[20]

However, following recent global trends, the average prevalence of severe food insecurity is on the rise in Eastern[21] **and Southern Europe,** with 24 and 3 percent increases, respectively, between 2014 and 2017. In Central Asia, the share fell by 25 percent in 2017. Currently, the share of total population with severe food insecurity is greatest in Southern Europe (3.9 percent of total population) followed by Eastern Europe (3.4 percent) and Central Asia (2.9 percent). Albania experiences the most severe of food insecurity situations in the region, with one in ten people going a full day without eating multiple times throughout the year.[22]

[17] Refers to 2010-2015 period from UN DESA (2017).

[18] Refers to 2015 data (World Bank, n.d.).

[19] Data refers to year 2015 (ILO, n.d.).

[20] Data refers to year 2010-2012 (FAOc, n.d.).

[21] Data only available for Republic of Moldova.

[22] Data refers to year 2017 (FAOc, n.d.).

Overall, the prevalence of undernourishment in the total population decreased in Central Asia (from 11 to 6 percent of total population) **and remained stable in Eastern and Southern Europe** (<2.5 percent, respectively) at levels below the global average between 2004 and 2017 (FAOc, n.d.). The prevalence of stunting in children under five years of age fell between 2012 and 2017, by 80 percent in Central Asia (to 10.8 percent), by 34 percent (to 7.7 percent) in Southern Europe and has the averaged value of 5 percent in Eastern Europe for 2005 to 2017. In 2017, the prevalence of wasting in children under five averaged 3.5 percent in both Central Asia and Southern Europe (UNICEF *et al.*, 2018).

A simultaneous increase in the prevalence of obesity of the adult population above 18 years of age was observed, reaching up to double the global average in Eastern Europe (25 percent of the population) and well above the global average in Southern Europe (22 percent) and Central Asia (16 percent).[23] The prevalence of overweight in children under the age of five declined between 2012 and 2017 in Central Asia (to 7.4 percent), yet rose to almost three times the global average in Southern Europe (to 18.1 percent), while no range data is available for Eastern Europe.[24]

Climate variability and extremes will impact food security and nutrition outcomes in Central Asia and Southern Europe, where most countries are net importers of cereal, particularly Montenegro (87 percent cereal import dependency ratio).[25] Long-term changes in meteorological variables may negatively impact yields and productivity, while climatic shocks may destabilize food markets in net-exporting regions, such as Eastern Europe.[26]

2.5 GHG EMISSIONS PROFILE

The NGHGI data from the last available year was collected from national reports submitted to the UNFCCC between 2014 and 2018.[27]

The Agriculture, Forestry and Other Land Use (AFOLU) sector[28] represents the second largest share of emissions in the region (15 percent), after the Energy sector (73 percent), followed by the Industrial Processes and Product Use (IPPU) (8 percent) and Waste (4 percent) sectors (**Figure 8**). Excluding removals from the Land Use, Land Use Change and Forestry (LULUCF) sector, emissions from LULUCF (353 Gt CO_2 eq), outweigh those from agriculture (286 Gt CO_2 eq), equal to 8 and 7 percent shares of national emissions, respectively. If removals are considered, the AFOLU sector constitutes a net sink (-428.3 Gt CO_2 eq), as removals in the LULUCF sector outweigh emissions from agriculture and land use combined.

Within the AFOLU sector (Figure 9),[29] the most significant GHG sources are cropland[30] (29 percent), **biomass burning on forest land** (24 percent),[31] managed soils (23 percent)[32] **and enteric fermentation** (18 percent).

[23] Global average prevalence of obesity in adult population over 18 years of age was 13.2 percent in 2016 (WHO, 2017).

[24] Global average prevalence of overweight in children under five years of age was 5.6 percent in 2017 (WHO, 2017).

[25] Kyrgyzstan, Tajikistan, Uzbekistan, Belarus, Albania, Bosnia and Herzegovina, The Former Yugoslav Republic of Macedonia and Montenegro were net cereal importers in 2011-2013 (FAOc, n.d.).

[26] Kazakhstan, Republic of Moldova, Russian Federation, Ukraine and Serbia were net cereal exporters in 2011-2013 (FAOc, n.d.).

[27] Data for Belarus, Kazakhstan, Republic of Moldova, Russian Federation, Ukraine and Uzbekistan sourced from NGHGIs. Data for Albania, Bosnia and Herzegovina, Kyrgyzstan, Serbia, Tajikistan and Turkmenistan sourced from NCs. Data for Montenegro and The former Yugoslav Republic of Macedonia sourced from BURs.

[28] The AFOLU sector refers to the Agriculture and LULUCF sector as defined by IPCC (2006).

[29] The GHG source/sink categories used in this analysis adhere to IPCC (2006) by integrating country data reported using IPCC (1996) into a common GHG profile framework. **Annex 1** illustrates the methodology that links the IPCC (1996) source/sink categories to IPCC (2006) land use categories, carbon pools and non-CO_2 gases.

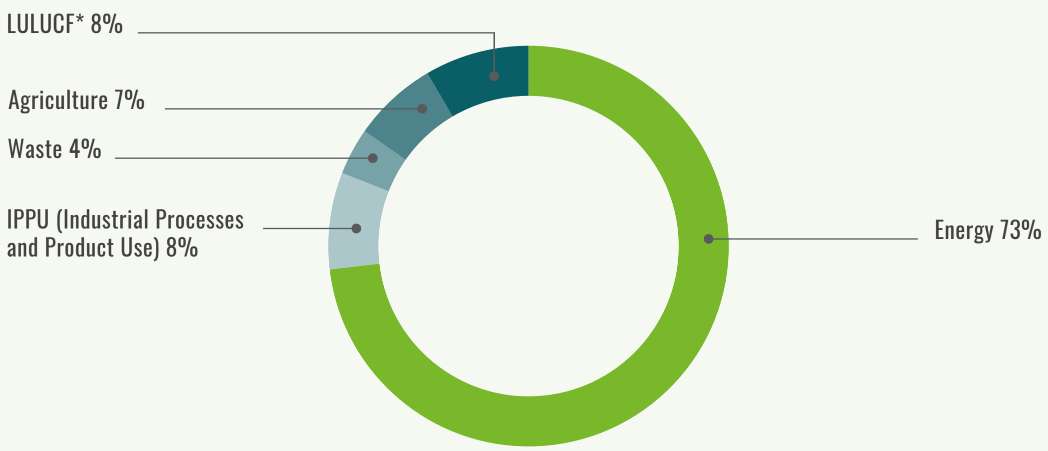
[30] Corresponds to the IPCC (2006) category "Cropland" excluding net CO_2 for "Forest land converted to cropland" and the IPCC (1996) category "CO_2 emissions and removals from soil".

[31] Corresponds to the IPCC (2006) sub-category "Biomass burning" under land use category "Forest land".

[32] Corresponds to the IPCC (2006) categories "Direct and indirect N20 emissions from agricultural", "Liming", "Urea application" and the IPCC (1996) category "Agricultural soils".

FIGURE 8.

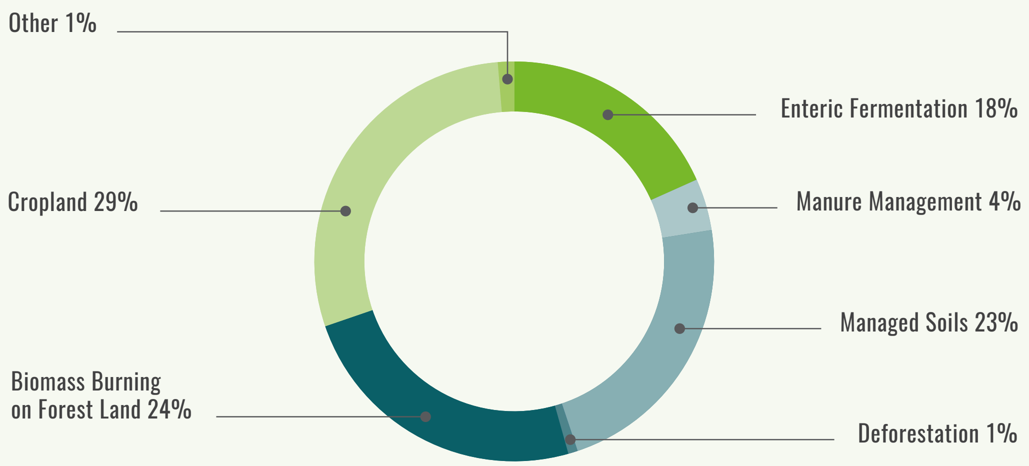
SHARE OF REGIONAL ECONOMY-WIDE EMISSIONS, PER SECTOR



Source: NGHGI, NC, BUR; last year reported.
** The emission categories and sub-categories with a share of less than 1% of the total are excluded from the figure.*

FIGURE 9.

SHARE OF REGIONAL EMISSIONS IN THE AFOLU SECTOR, PER MAJOR CATEGORY



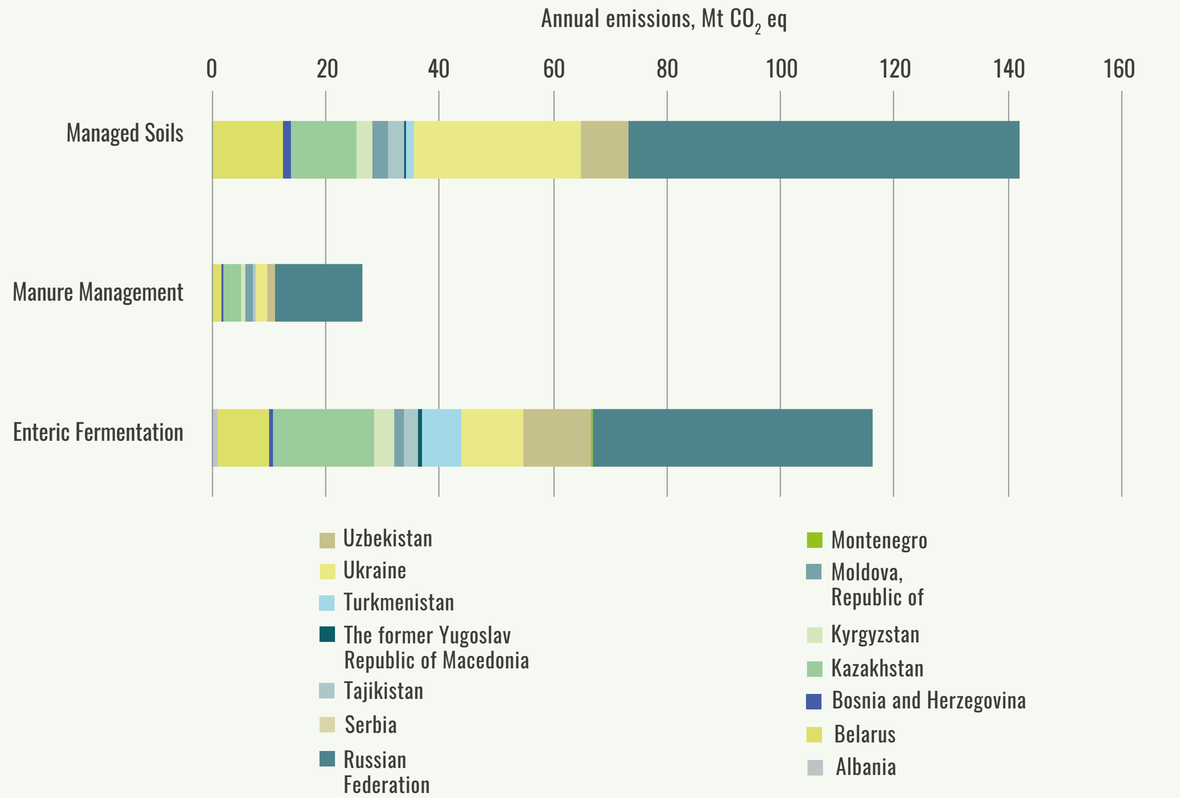
Source: NGHGI, NC, BUR; last year reported.
** The emission categories and sub-categories with a share of less than 1% of the total are excluded from the figure.*

Within the agriculture sector (**Figure 10**), **the largest sources of emissions are managed soils** (50 percent),[33] **enteric fermentation** (41 percent) **and manure management** (9 percent). At the national level, however, the distribution of emission sources (**Annex 7**) varies. For instance, in Albania, enteric fermentation emissions constitute 95 percent of total agricultural emissions, while in Ukraine, managed soils holds a 70 percent share of total agricultural emissions.

[33] Corresponds to the IPCC (2006) categories "Direct and indirect N2O emissions from agricultural", "Liming", "Urea application" and the IPCC (1996) category "Agricultural soils".

FIGURE 10.

SHARE OF REGIONAL EMISSIONS IN THE AGRICULTURE SECTOR, PER MAJOR CATEGORY AND COUNTRY



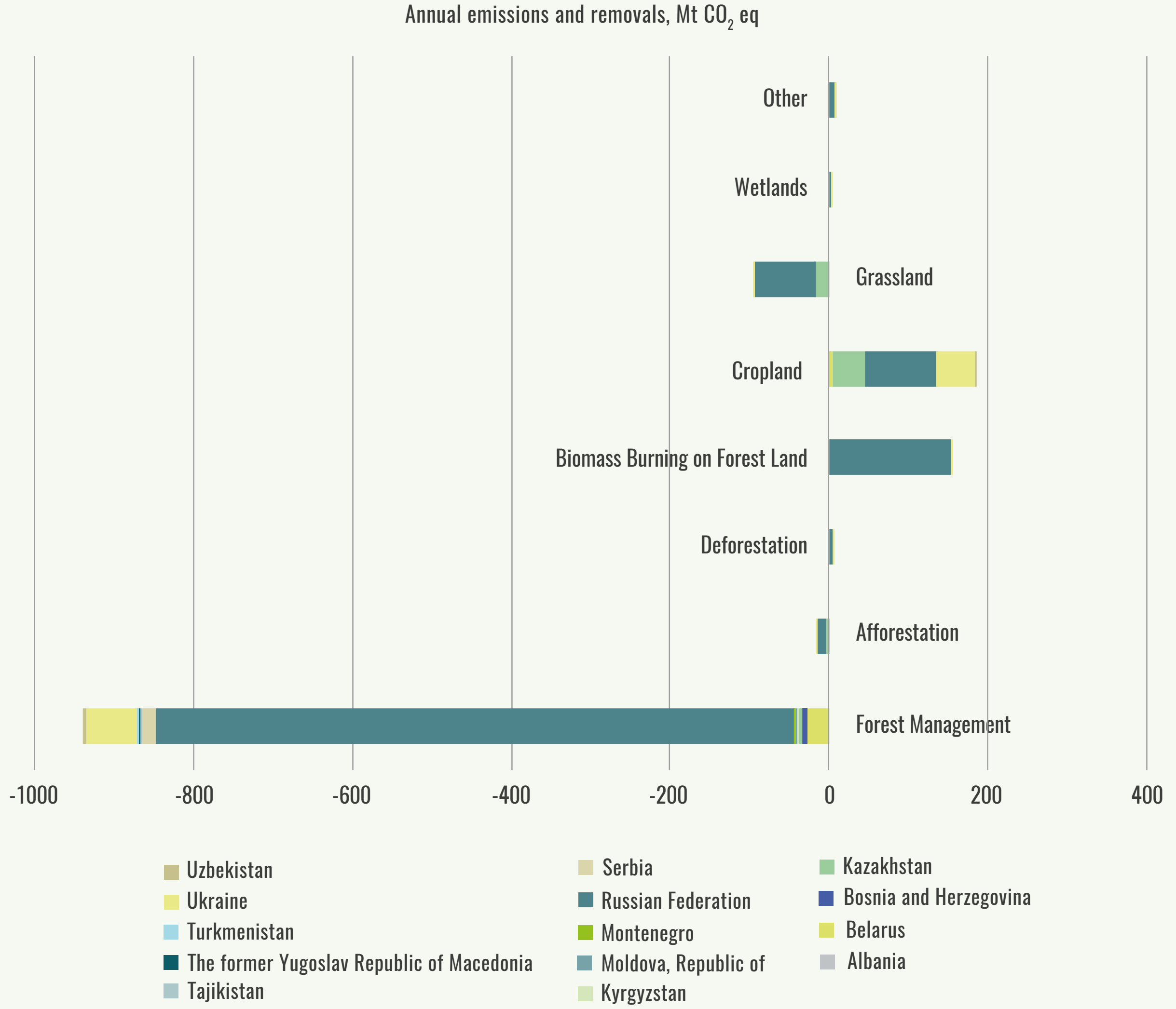
Source: NGHGI, NC, BUR; last year reported.
** The emission categories and sub-categories with a share of less than 1% of the total are excluded from the figure.*

The LULUCF sector (Figure 11) constitutes a net sink at the regional level, mainly from removals by forest management[34] (89 percent) and grassland (9 percent). Excluding removals, however, emissions from cropland represent the greatest source of land use emissions (52 percent), followed by the biomass burning on forest land (43 percent). At the national level, emission sources and sinks vary by land use (**Annex 8**). For example, cropland management is the main source of emissions in Belarus, Kazakhstan, Serbia, Ukraine and Uzbekistan, while biomass burning on forest land is the main source in the Russian Federation, and deforestation in Kazakhstan. On the other hand, forest management contributes to the majority of removals in all countries, except Albania, where afforestation/reforestation constitutes the majority of removals, and Kazakhstan, where grassland acts as the largest carbon sink.

[34] Forest management accounts for total net emissions related to IPCC (2006) land use category "Forest land remaining forest land" and IPCC (1996) category "Changes in forest and other woody biomass," when those categories are a net sink at national level.

FIGURE 11.

REGIONAL EMISSIONS AND REMOVALS IN THE LULUCF SECTOR, PER MAJOR (SUB-) CATEGORY AND COUNTRY



Source: NGHGI, NC, BUR; last year reported.
** The emission categories and sub-categories with a share of less than 1% of the total are excluded from the figure.*

CHAPTER 3

CHAPTER

3

MITIGATION AND ADAPTATION CONTRIBUTIONS IN THE AGRICULTURE SECTORS

In 2015, the landmark Paris Agreement was adopted to address climate change on the basis of equity, and in the context of sustainable development and global efforts to eradicate poverty. The Paris Agreement establishes binding commitments by all Parties to prepare, communicate and maintain a NDC and to pursue domestic measures to achieve them, with each new submission every five years representing a progression on the last to reflect the highest possible ambition from each country.[35]

Article 2 guides mitigation action towards the global goal of keeping warming well below a 2°C increase and calls for efforts to limit this increase to 1.5°C. All countries are encouraged to continue enhancing their mitigation efforts, and move toward economy-wide targets over time, in the light of different national circumstances.

The Paris Agreement promotes climate change adaptation as one of its key goals by enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to contributing to sustainable development. In its aim to achieve a global response to climate change to protect people, livelihoods and ecosystems, the agreement takes into account the needs of developing countries, which are particularly vulnerable to the adverse effects of climate change. Article 7.10 of the Paris Agreement states that each Party should, as appropriate, submit and periodically update adaptation communications, which may include priorities, implementation and support needs, plans and actions, as a component of or in conjunction with other communications or documents, including national adaptation plans (NAPs) and NDCs. The co-benefits of mitigation and adaptation actions are also acknowledged in Article 4.7.

[35] Article 4.3 of the Paris Agreement.

Based on the bottom-up approach of the Paris Agreement, the NDCs vary greatly in terms of content and scope, reflecting the country-driven processes and national visions that will guide global climate action for years to come. By COP24, Parties are expected to develop and adopt modalities, procedures, and guidelines to drive effective implementation of the Paris Agreement.

This section provides a systematic review and synthesis of the agriculture sectors in the three INDCs and 11 NDCs presented by the 14 countries in the SEECA region.[36] It reflects the heterogeneous nature of country commitments and illustrates regional trends. It aims to identify the structural characteristics of the NDCs and to assess the scope, specificity, measurability and timeline of the mitigation contribution in the agriculture sectors and adaptation component related to agriculture, food security and nutrition. The stocktaking exercise can lay the groundwork for an integrated plan-implementation-review cycle at the country level. The data informs the gap and opportunity analysis in **Chapter 3**, which seeks to support countries to enhance their NDCs, as early as 2020, as well as guide the prioritization of international support options.

3.1 MITIGATION CONTRIBUTION

This section presents a synthesis of the mitigation contribution in the agriculture and LULUCF sectors set forth in the NDCs of SEECA region countries. All 14 countries communicated their domestic mitigation contribution to stabilize the global climate under Article 2 of the Paris Agreement.

3.1.1 GHG targets

Thirteen countries (93 percent) set a general GHG target, while one country[37] qualifies its general mitigation contribution in terms of "Action-only" (**Figure 12**). Out of those 13 countries with a general GHG target, five[38] cover all IPCC sectors, eight[39] cover multiple sectors and one[40] covers only one sector. Twelve countries express their GHG target as an absolute reduction of net emissions, while one[41] expresses the reduction in terms of emission intensity per unit of GDP. Nine countries set their GHG target in comparison to an emission level from a specific base year, while four countries[42] set their target against projected baseline emissions under a business as usual (BAU) scenario. **Annex 9** contains a table of national mitigation contributions by scope and type.

Eleven countries[43] include the agriculture sector (79 percent), **eight countries[44] include the LULUCF sector** (57 percent) and eight countries (57 percent) include both sectors (i.e. AFOLU) in their general mitigation contributions (**Figure 13**).

[36] Kyrgyzstan, Uzbekistan and the Russian Federation have not ratified the Paris Agreement as of September 1, 2018.

[37] Turkmenistan.

[38] Kyrgyzstan, Republic of Moldova, Russian Federation, Bosnia and Herzegovina and Serbia.

[39] Kazakhstan Tajikistan, Turkmenistan, Belarus, Ukraine, Albania, Montenegro and The former Yugoslav Republic of Macedonia.

[40] Uzbekistan.

[41] Uzbekistan.

[42] Albania, Bosnia and Herzegovina, Kyrgyzstan and The former Yugoslav Republic of Macedonia.

[43] Albania, Belarus, Bosnia and Herzegovina, Kazakhstan, Republic of Moldova, Montenegro, Russian Federation, Serbia, The former Yugoslav Republic of Macedonia, Turkmenistan and Ukraine.

[44] Albania, Belarus, Bosnia and Herzegovina, Montenegro, Russian Federation, Serbia, The former Yugoslav Republic of Macedonia and Ukraine.

FIGURE 12.

SHARE OF COUNTRIES WITH A GENERAL MITIGATION CONTRIBUTION, BY SCOPE AND TYPE

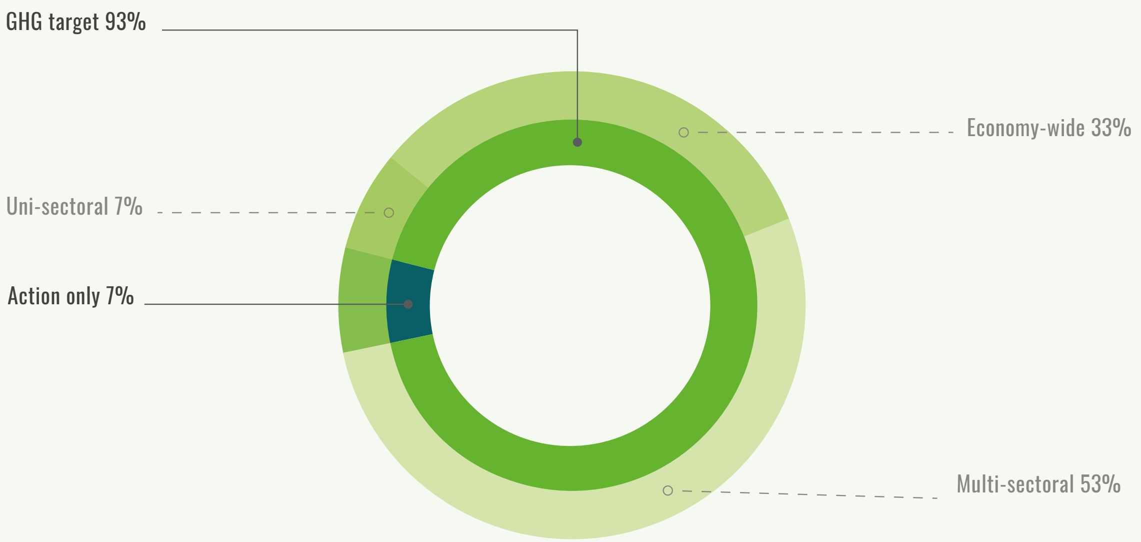
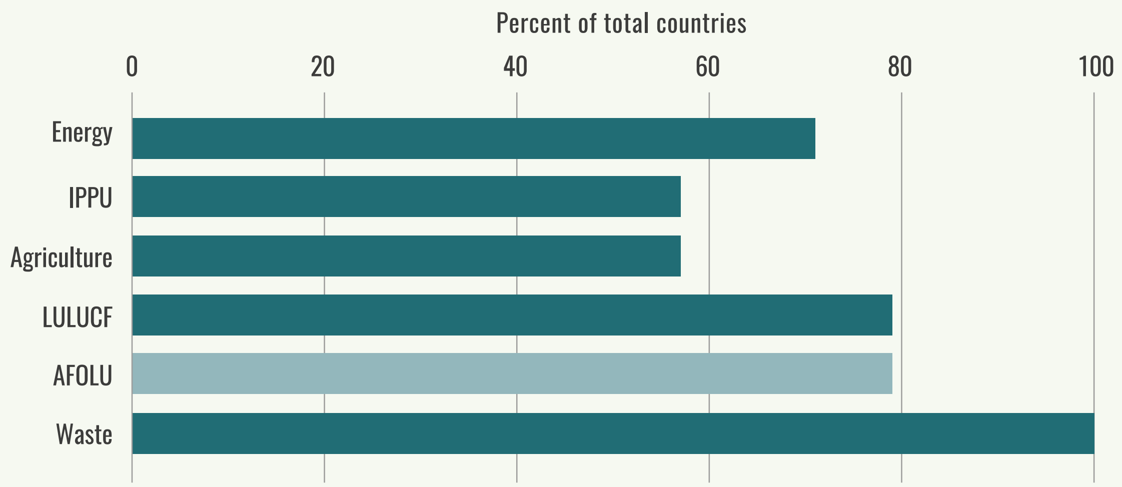


FIGURE 13.

SHARE OF COUNTRIES WITH A GENERAL MITIGATION CONTRIBUTION, BY SECTOR INCLUDED



The type of sectoral mitigation contributions varies by country in terms of detail, measurability and timeline.

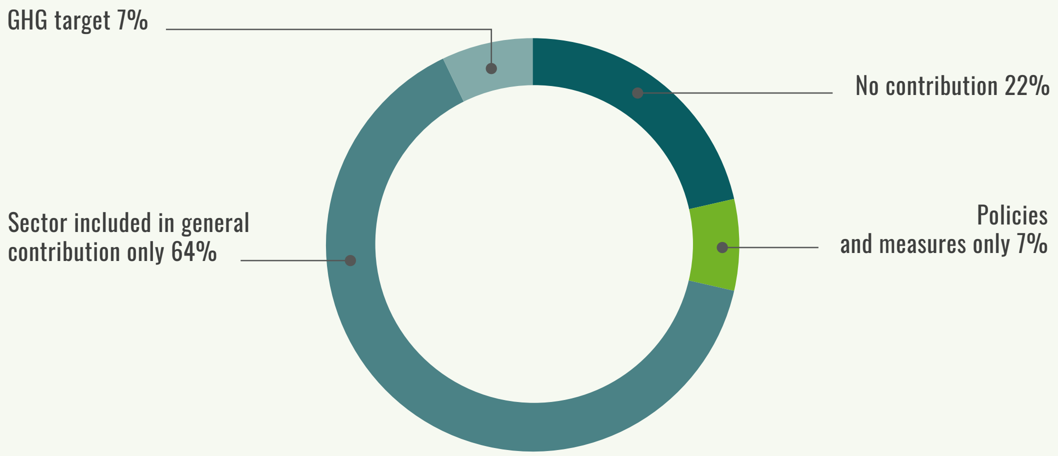
Out of the 11 countries that include the agriculture sector in their general mitigation contribution (**Figure 14**), **only one[45] sets a sectoral GHG target,** expressed as an absolute reduction of net emissions compared to a base year level, one[46] includes a set of mitigation policies and measures.

[45] Republic of Moldova.

[46] Tajikistan.

FIGURE 14.

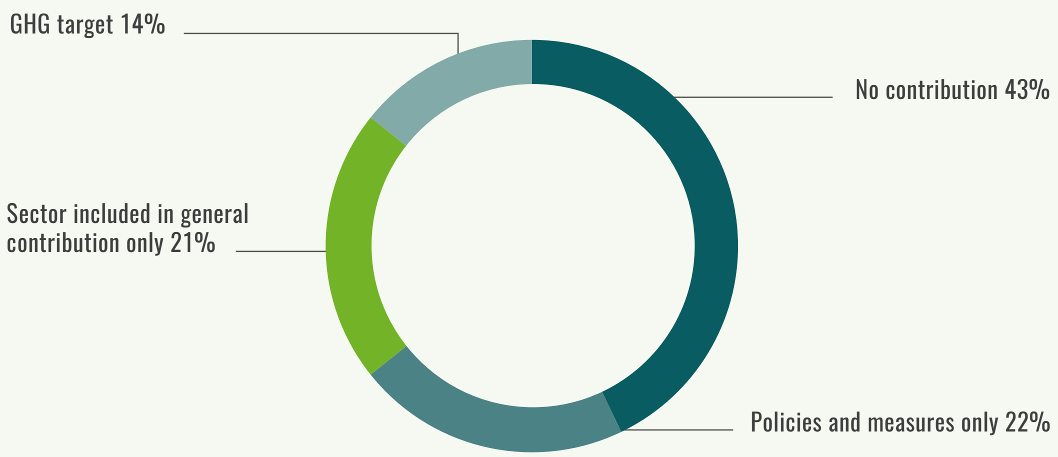
SHARE OF COUNTRIES WITH A MITIGATION CONTRIBUTION IN THE AGRICULTURE SECTOR, BY TYPE



Out of the eight countries that include the LULUCF sector in their general mitigation contribution (**Figure 15**), **two[47] set sectoral GHG targets,** both expressed as an absolute reduction of net emissions compared to a base year level. Three countries[48] include a set of mitigation policies and measure.

FIGURE 15.

SHARE OF COUNTRIES WITH A MITIGATION CONTRIBUTION IN THE LULUCF SECTOR, BY TYPE



[47] Republic of Moldova.

[48] Kazakhstan, Tajikistan and Russian Federation.

3.1.2 Policies and measures

In addition to GHG targets, countries often qualify their sectoral mitigation contribution by a number of policies and measures that aim to reduce net emissions or emission intensity, or enhance carbon sinks, from a particular agriculture activity and/or land use. Policies and measures may or may not be quantified using GHG or non-GHG metrics, such as hectares of land or number of cattle. This section synthesizes the sectoral policies and measures collected from NCs, BURs and the NDCs of SEECA region countries. **Annex 1** contains the methodological matrix for how policies and measures in the agriculture sectors are categorized in relation to corresponding GHG source and sink categories in line with IPCC (1996; 2006).

Overall, the majority of policies and measures have quantified targets (57 percent of measures), most in terms of GHG emission reductions.

Around three-fourths of policies and measures require a combination of domestic and international financial support, while only a small share of policies and measures are unconditional of international support, and an even smaller share are fully conditional on it.

The majority of mitigation policies and measures are supply-side oriented (93 percent of measures), with a small share of demand-side interventions.

Of all measures, the majority target the production phase of agriculture and food value chains (88 percent of measures), followed by small shares of waste, consumption and full value chain measures.

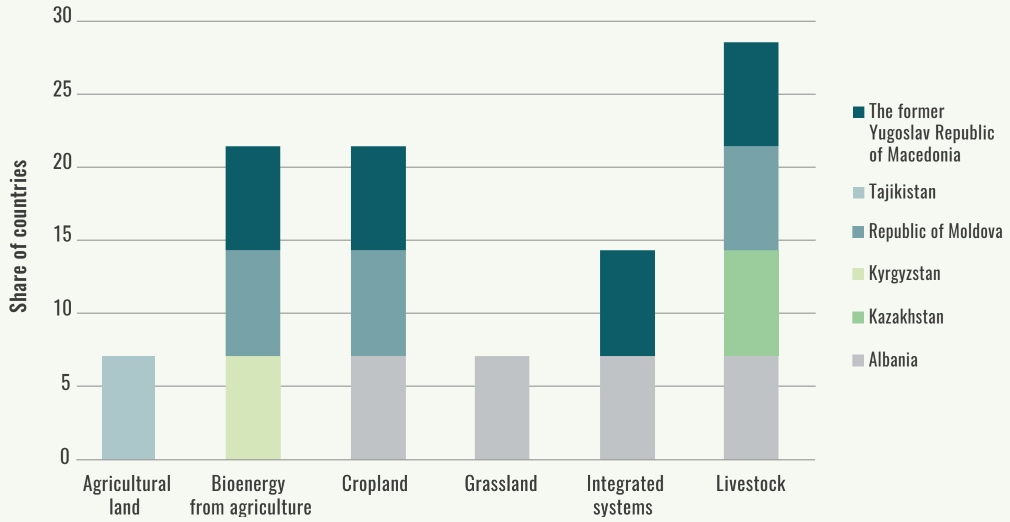
Policies and measures in the agriculture sector

The policies and measures in the agriculture sector were categorized by management activity, agriculture sub-sector and IPCC land use category, and aggregated them into six main sub-sector/land use categories: 1) general agricultural land[49]; 2) cropland; 3) integrated systems; 4) livestock; 5) grassland; and 6) bioenergy from agriculture.

Six countries in the region (43 percent) include at least one policy and measure in the agriculture sector. The majority of these countries have one or more policies and measures targeting livestock management (29 percent of countries), followed by bioenergy production from agriculture and cropland management (21 percent each), integrated systems (14 percent) and grassland and agriculture land management (7 percent each). **Figure 16** illustrates the share of countries in the region with one or more (to avoid bias of representation) policies and measures in the agriculture sector per land use category or sub-sector.

FIGURE 16.

SHARE OF COUNTRIES WITH POLICIES AND MEASURES IN THE AGRICULTURE SECTOR, BY COUNTRY AND LAND USE/SUB-SECTOR

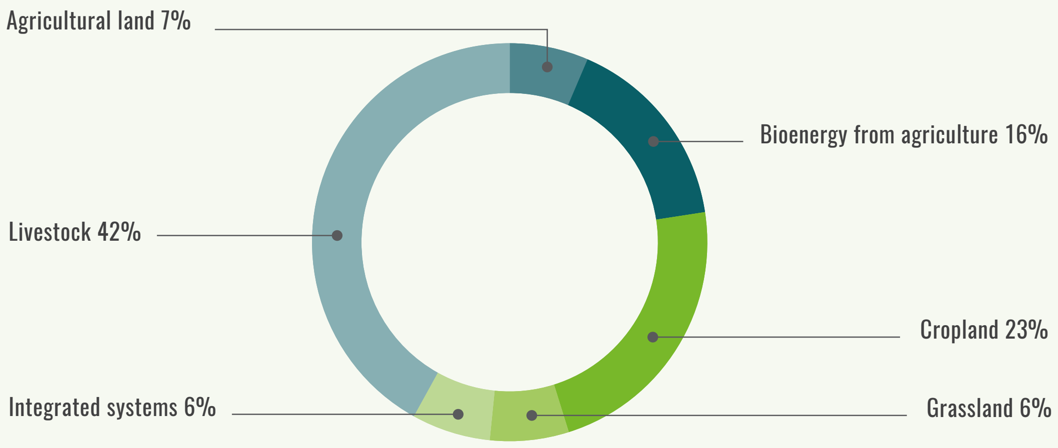


[49] For the purpose of this document, "agricultural land" refers to a combination of cropland and grassland.

The majority of policies and measures in the agriculture sector aim to reduce sectoral emissions through improved livestock management (42 percent of policies and measures), followed by cropland management (23 percent), bioenergy production from agriculture biomass (16 percent) and integrated systems management, grassland management and general agricultural land management (6 percent each). **Figure 17** indicates the distribution of all mitigation policies and measures in the agriculture sector for all countries by land use or sub-sector.

FIGURE 17.

SHARE OF MITIGATION POLICIES AND MEASURES IN THE AGRICULTURE SECTOR, PER LAND USE/SUB-SECTOR



The overall composition of mitigation policies and measures in the agriculture sector for the SEECA region are described by sub-sector and land use category in order of regional priority.

Livestock management

Four countries (29 percent) prioritize mitigation policies and measures in the livestock sector. The majority of policies and measures refer to improved feeding practices (46 percent of policies and measures), followed by improved manure management (38 percent), breeding and husbandry and general livestock management (8 percent, respectively). **Figure 18** illustrates the share of countries in the region with one or more (to avoid bias of representation) policies and measures in the livestock sub-sector and **Figure 18b** indicates the distribution of those policies and measures amongst management activities.

FIGURE 18.

SHARE OF MITIGATION POLICIES AND MEASURES IN THE LIVESTOCK SECTOR, BY MANAGEMENT ACTIVITY

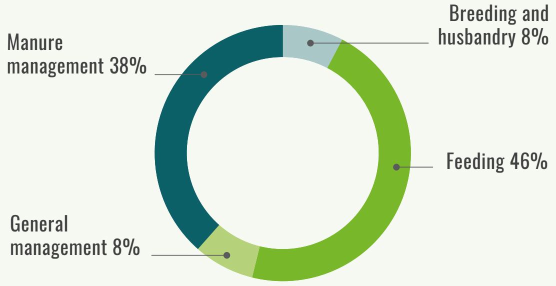
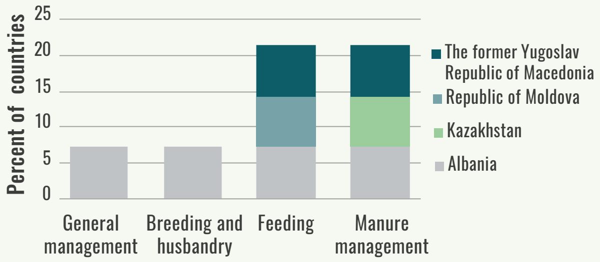


FIGURE 18b.

SHARE OF COUNTRIES WITH MITIGATION POLICIES AND MEASURES IN THE LIVESTOCK SECTOR, BY MANAGEMENT ACTIVITY



FEEDING PRACTICES

Three countries (21 percent) aim to reduce emissions from livestock through improved feeding practices. For instance, the Republic of Moldova prioritizes cattle feeding technologies, such as the inclusion of methane-reducing additives, grape marc and green in cattle rations to reduce annual emissions in the order of 34, 39 and 79 kt CO_2 eq, respectively.[50]

MANURE MANAGEMENT

Three countries (21 percent) aim to reduce emissions from livestock through improved manure management. For instance, the former Yugoslav Republic of Macedonia promotes manure management in dairy and wine farms with expected annual emission reductions of 2.1 and 0.4 kt CO_2, respectively[51] Kazakhstan plans to reduce emissions from manure management through biogas production using 7 percent of livestock manure.[52]

Cropland management

Three countries (21 percent) prioritize mitigation policies and measures on cropland. The majority of policies and measures refer to nutrient management (43 percent), followed by tillage/residue management (29 percent) and general cropland management (28 percent). **Figure 19** illustrates the share of countries in the region with one or more (to avoid bias of representation) policies and measures in the crops sub-sector and **Figure 19b** indicates the distribution of those policies and measures amongst management activities.

NUTRIENT MANAGEMENT

Two countries (14 percent) aim to reduce emissions from cropland through nutrient management. For instance, Albania aims to improve the efficiency of fertilizer and manure use on cropland.[53]

TILLAGE/RESIDUE MANAGEMENT

Two countries (14 percent) aim to reduce emissions from cropland through tillage/residue management. For instance, Albania targets improved agronomic practices that increase yields and generate higher inputs of residues into the soil.[54] The Republic of Moldova plans to implement "mini-till" soil conservation systems that incorporate green manure from crop by-products into the soil, reducing emissions from cropland by 1,472 kt CO_2 by 2030.[55]

FIGURE 19.

SHARE OF MITIGATION POLICIES AND MEASURES ON CROPLAND, BY MANAGEMENT ACTIVITY

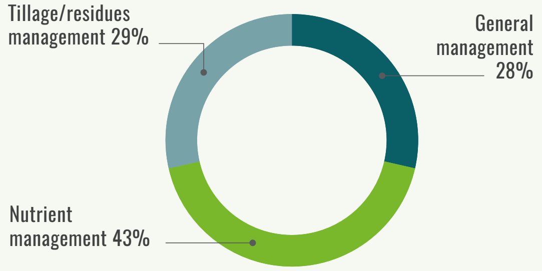
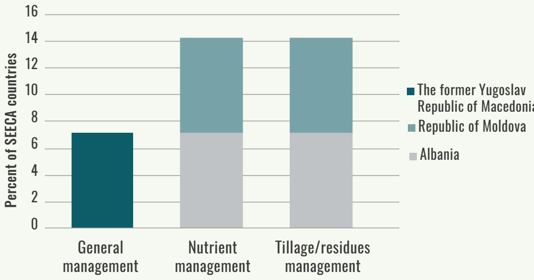


FIGURE 19b.

SHARE COUNTRIES WITH MITIGATION POLICIES AND MEASURES ON CROPLAND, BY MANAGEMENT ACTIVITY



[50] Fourth NC.
[51] First BUR.
[52] First NC.
[53] First NC.
[54] First NC.
[55] Fourth NC.

Bioenergy from agriculture

Two countries (14 percent) prioritize the production of bioenergy from agriculture biomass as a mitigation policy or measure. The majority of policies and measures refer to liquid biofuel production (40 percent), followed by general bioenergy production from agriculture biomass (40 percent) and biogas production (20 percent). **Figure 20** illustrates the share of countries in the region with one or more (to avoid bias of representation) policies and measures targeting bioenergy production from agricultural biomass and **Figure 20b** indicates the distribution of those policies and measures amongst types of bioenergy. **Box 1** details the type of policies and measures..

FIGURE 20.

SHARE OF BIOENERGY-RELATED MITIGATION POLICIES AND MEASURES FROM AGRICULTURE BIOMASS, BY TYPE

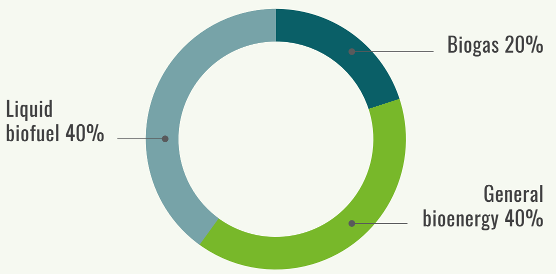
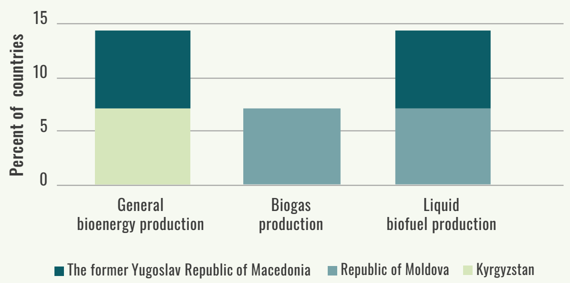


FIGURE 20b.

SHARE OF COUNTRIES WITH BIOENERGY-RELATED MITIGATION POLICIES AND MEASURES FROM AGRICULTURE BIOMASS, BY TYPE



INTEGRATED SYSTEMS MANAGEMENT

Two countries (14 percent) prioritize mitigation policies and measures in integrated agriculture systems. All policies and measures refer to agroforestry production. For instance, the Former Yugoslav Republic of Macedonia aims to reduce agriculture emissions through improved management of perennial grass in orchard and vineyards on inclined terrains with the estimated emission reduction of 8.5 kt CO_2 eq by 2030.[56]

GRASSLAND MANAGEMENT

One country (7 percent) prioritizes mitigation policies and measures on grassland. Polices are equally distributed amongst fire and animal management. Albania is the only country to include grassland-based mitigation, prioritizing fire management and improved animal management through altering the intensity and timing of grazing.[57]

AGRICULTURAL LAND MANAGEMENT

One country (7 percent) prioritizes mitigation policies and measures on general agricultural land. Polices are equally distributed amongst sustainable water use and management and general land management. Tajikistan is the only country to include general agricultural land-related mitigation, including sustainable water use and management.

[56] Second BUR.

[57] First NC.

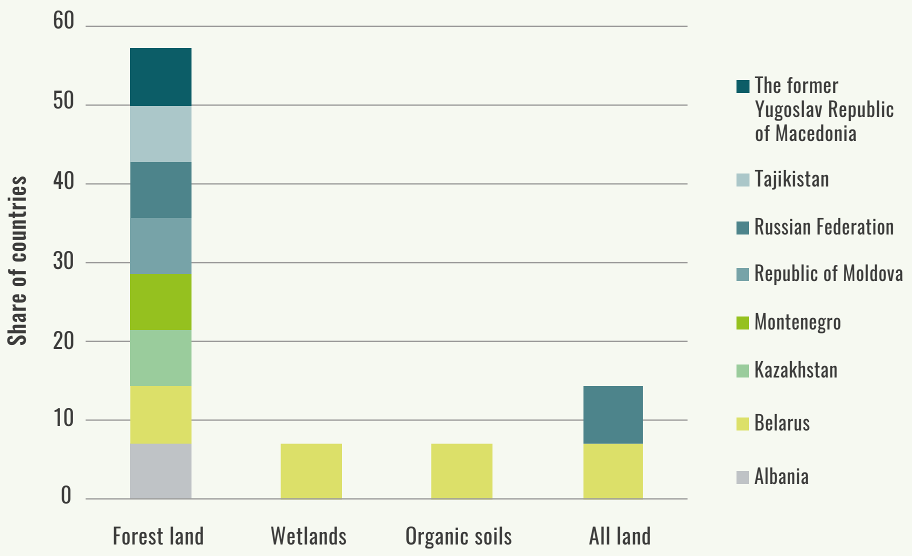
Policies and measures in the LULUCF sector

In the LULUCF sector, policies and measures are categorized by management activity and IPCC land use category, and aggregated into five land uses/sub-sector categories: 1)all land;[58] 2) forest land; 3) wetlands; 4) organic soils; and 5) bioenergy from forests.

Eight countries (57 percent) include at least one policy and measure in the LULUCF sector. The majority of these countries have one or more policies and measures aiming to reduce sectoral emissions or enhance sinks through management activities on forest land (57 percent), followed by all land types (14 percent) and wetlands and organic soils (7 percent, respectively). **Figure 21** illustrates the share of countries in the region with one or more (to avoid bias of representation) policies and measures in the LULUCF sector per land use category.

FIGURE 21.

SHARE OF COUNTRIES WITH POLICIES AND MEASURES IN THE LULUCF SECTOR, BY COUNTRY AND LAND USE



The majority of policies and measures in the LULUCF sector aim to reduce net emission sources and sinks on forest land (69 percent), followed by wetlands (13 percent) and on land in general and organic soils (9 percent each). **Figure 22** indicates the distribution of those policies and measures by land use.

FOREST LAND MANAGEMENT

Fifty-seven percent of countries prioritize mitigation policies and measures on forest land The majority of policies and measures refer to afforestation/reforestation (62 percent), followed by reducing degradation and sustainable forest management and forest restoration (25 percent) and fire (13 percent). **Figure 23** illustrates the share of countries in the region with one or more (to avoid bias of representation) policies and measures on forest land by management activity. **Figure 23b** indicates the distribution of those mitigation policies and measures by management activity.

[58] For the purpose of this document, "all land" refers to forest land and other land uses.

FIGURE 22.

SHARE OF MITIGATION POLICIES AND MEASURES IN THE LULUCF SECTOR, BY LAND USE

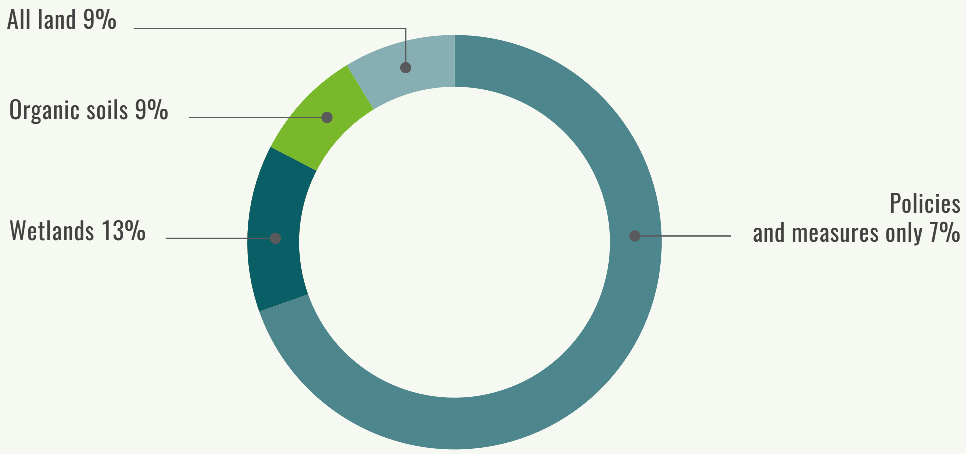


FIGURE 23.

SHARE OF COUNTRIES WITH POLICIES AND MEASURES ON FOREST LAND, BY COUNTRY AND MANAGEMENT ACTIVITY

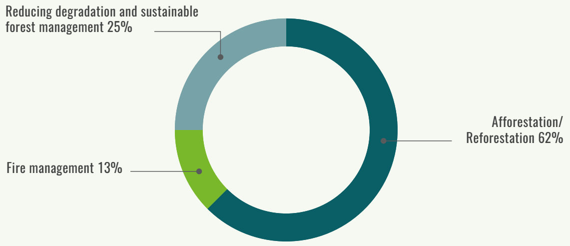
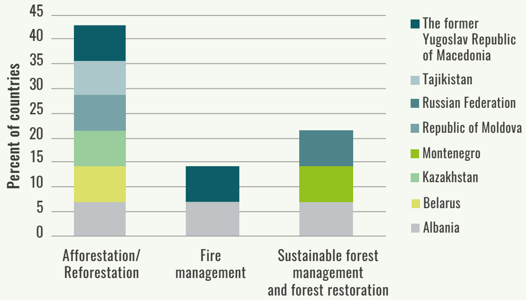


FIGURE 23b.

SHARE OF MITIGATION POLICIES AND MEASURES ON FOREST LAND, BY MANAGEMENT ACTIVITY



Afforestation/reforestation

Forty-three percent of countries prioritize afforestation/reforestation. For instance, Belarus commits to increase forest area from 39 to 41 percent of total national area between 2013 and 2030. Albania promotes the afforestation/reforestation of large timber forests in conjunction with natural regeneration on 500 to 1000 hectares per year.[59] The Republic of Moldova aims to expand areas under forest vegetation by 50.7 thousand hectares between 2020 and 2030, afforesting lands and water-protection belts of the rivers and water basins.[60] The Former Yugoslav Republic of Macedonia aims to enhance carbon removals through the change of quality of forests by afforestation of transitive forest land with an estimated increase in removals by 167 kt CO_2 eq in 2030.[61]

[59] Third NC.

[60] Fourth NC.

[61] Second BUR.

Reducing degradation and sustainable forest management

Twenty-one percent of countries prioritize reducing degradation and sustainable forest management. For instance, Albania promotes forest regeneration, fertilization, choice of species, uneven-aged stand management, reduced forest degradation, longer forest rotations and insect and disease management programs.[62] Montenegro[63] aims to improve sustainable forest management practices and increase the growing stock of commercial forests from 104 million m^3 to 115 million m^3. The Russian Federation references general land use and sustainable forest management policies for mitigation.

Fire management

Fourteen percent of countries prioritize fire management on forest land. Albania[64] and the Former Yugoslav Republic of Macedonia[65] include policies and measures to avoid wildfires and to reduce the amount of area damaged by forest fires.

GENERAL LAND USE MANAGEMENT

Fourteen percent of countries prioritize mitigation on all land types, or general land use management. For instance, Belarus prioritizes the conservation of natural ecosystems, biodiversity, ensuring ecological balance of natural systems, and sustainable use of protected areas covering at least 8.8 percent of territory.[66]

WETLANDS MANAGEMENT

Seven percent of countries prioritize mitigation policies and measures on wetlands. All policies and measures target general wetlands management. For instance, Belarus promotes the rehabilitation of damaged bogs on 10 thousand hectares, and the conservation of open fen mires on 30 thousand hectares, and of floodplain meadows on 40 hectares.[67]

ORGANIC SOILS MANAGEMENT

Seven percent of countries prioritize mitigation policies and measures on organic soils. All policies and measures target the rewetting of organic soils drained for agriculture. Belarus aims to increase the area of restored peatlands to 60 thousand hectares and to reduce the area of degraded reclaimed land with peat soils to 190 thousand hectares.[68]

BOX 1: ENERGY FROM AGRICULTURE AND FORESTS IN THE NDCs

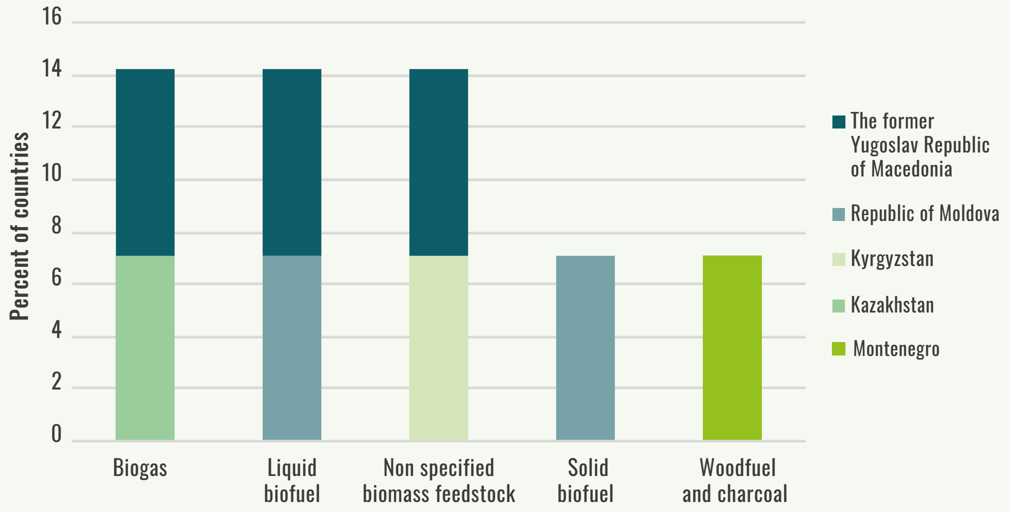
The box presents the role of bioenergy from agriculture and forests as a mitigation policy or measure for countries in the SEECA region. The role of bioenergy as a mitigation pathway is primarily that of mitigation in the energy sector through the substitution of fossil fuels with agricultural and forest biomass. The impact of bioenergy on emissions from agriculture and land use depend on multiple factors, including land use change, fertilizer use and interactions with market demand.

Overall, five countries (36 percent of countries) **include at least one policy or measure related to bioenergy from the agriculture and LULUCF sectors. Countries prioritize equally amongst biogas, liquid biofuel, solid biofuel (including woodfuel and charcoal) production and bioenergy production from non-specified biomass feedstock** (14 percent, respectively). **Figure 24** illustrates the share of countries in the region with one or more (to avoid bias of representation) policies and measures targeting bioenergy production and use from biomass.

62 Third NC.
63 First BUR.
64 Third NC.
65 Second BUR.
66 Third NC.
67 Third NC.
68 Third NC.

FIGURE 24.

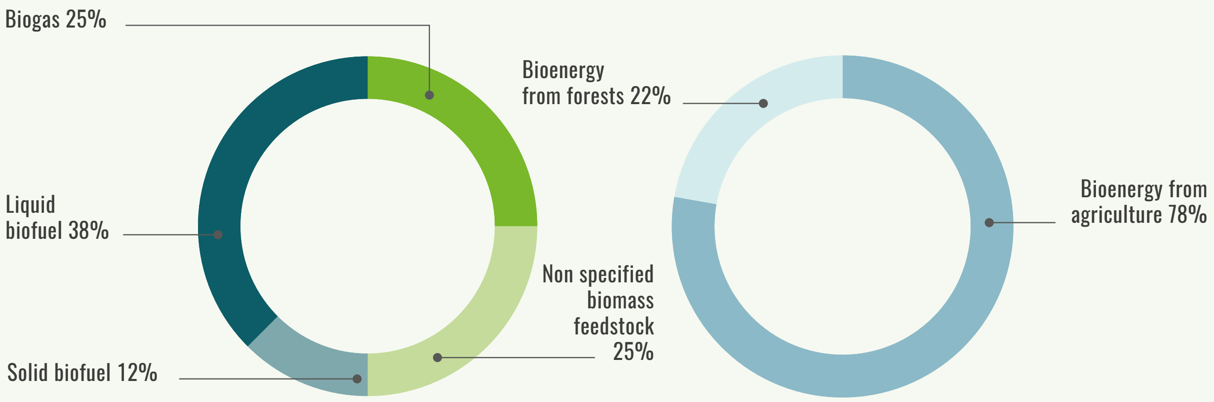
SHARE OF COUNTRIES WITH BIOENERGY POLICIES AND MEASURES FROM AGRICULTURE AND FORESTS, BY COUNTRY AND TYPE OF BIOENERGY



The majority of bioenergy-related policies and measures from agriculture and/or forest biomass relate to liquid biofuel production (33 percent), followed by equal shares of solid biofuel, including woodfuel and charcoal, biogas, and bioenergy production from non-specified agricultural biomass feedstock (25 percent each) and solid biofuel, including woodfuel and charcoal (12 percent). The majority of policies target bioenergy production from agriculture biomass rather than from forest biomass. **Figure 25** indicates the distribution of those policies and measures by type of production and biomass source.

FIGURE 25.

SHARE OF BIOENERGY POLICIES AND MEASURES FROM AGRICULTURE AND FORESTS, BY TYPE OF PRODUCTION AND BIOMASS SOURCE



The distribution of policies and measures related to bioenergy from agriculture and forest biomass in the region is detailed by type of production:

Biogas production

Fourteen percent of countries prioritize biogas production as a mitigation policy and measure from livestock manure. For instance, Kazakhstan plans to cover livestock and poultry farms with biogas facilities (up to 7 percent by 2030).[69] The Former Yugoslav Republic of Macedonia calls for the construction of biogas power plants with an emission reduction estimated at 65 kt CO_2 eq by 2030.[70]

Liquid biofuel production

Fourteen percent of countries prioritize liquid biofuel production as a mitigation policy and measure from agriculture biomass. The Republic of Moldova prioritizes the use of biodiesel and bioethanol as a fuel with a focus on transport.[71] The Former Yugoslav Republic of Macedonia aims to increase the share of biofuel in the overall energy mix to reach 10 percent.[72]

Bioenergy production from non-specified biomass feedstock

Fourteen percent of countries prioritize bioenergy production from non-specified agriculture biomass as a mitigation policy and measure. Kyrgyzstan supports the development of bioenergy but does not specify the type of biomass feedstock.[73]

Solid biofuel production and use

Fourteen percent of countries prioritize solid biofuel production as a mitigation policy and measure on forest land, mostly sustainable woodfuel and charcoal production. The Republic of Moldova prioritizes afforestation for energy crops.[74]

3.2 ADAPTATION CONTRIBUTION

Climate change directly affects the natural resources and ecosystems upon which agricultural production, food systems and rural livelihoods rely. Climate change impacts on food security and nutrition are transmitted through different pathways, and the severity of the impact is determined by climate drivers and risks, and by the underlying vulnerability of ecosystems, agro-ecosystems, rural economies and households (FAO, 2016c).

A key way to moderate, reduce and/or avoid climate-related impacts is to reduce a system's underlying vulnerabilities, strengthen its adaptive capacity and increase its resilience (FAO, 2016d). Adaptation to climate change refers to changes in processes, practices and structures to moderate potential damages from climate change, or to benefit from opportunities associated with such changes. Adaptation in the agriculture sectors signifies modifying agricultural production and socio-economic institutional systems in response to and in preparation for actual or expected climate variability and change and their impacts, to moderate harmful effects and exploit beneficial opportunities. Resilience can be described as the capacity of systems, communities, households or individuals to prevent, moderate or cope with risk, and recover from shocks. Adaptive capacity encompasses two dimensions: the capacity to manage or moderate climate risks (including extreme climatic events), and the capacity to gradually respond to longer-term climate changes (FAO, 2017e).

This section presents a synthesis of the climate-related hazards, impacts and vulnerabilities reported and the adaptation options in the agriculture sectors, as communicated in the NDCs of the SEECA region.

[69] First NC.
[70] Second BUR.
[71] Fourth NC.
[72] Second BUR.
[73] First NC.
[74] Fourth NC.

3.2.1 Climate-related hazards, impacts, and vulnerabilities

In order to contextualize the fairness and ambition of the NDCs, as well as inform adaptation planning, countries often include a description of observed and/or expected climate variability and extremes, as well as cite the climate-related hazards, impacts and vulnerabilities that are already being observed or are expected in the future.

Seven countries[75] in the region (50 percent) included observed and/or projected climate-related hazards, impacts and vulnerabilities in ecosystems and/or social systems in order to inform or contextualize the need for adaptation to climate change.

Climate variability and extremes

Out of those seven countries, five (71 percent) report observed and/or projected changes in meteorological variables, namely variations in mean annual precipitation and surface air temperature and the frequency and intensity of climate extremes. Three countries (43 percent of countries with impacts reported) report observed or projected changes in long-term precipitation trends and/or extreme events, and five countries (71 percent) report changes in temperature trends and/or climate extremes, particularly in Central Asia.

Climate-related hazards

Countries report observed and/or projected climate-related hazards, including hydro-meteorological, climatological and biological processes or phenomenon that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.[76]

The majority of those countries report the occurrence of extreme heat and drought (57 percent of countries with climate impacts, respectively), **amongst observed and/or projected climate-related hazards,**[77] followed by floods and invasion by pests and non-native species (43 percent, respectively) and wild fire and land slides (14 percent, respectively). **Figure 26** illustrates the share of countries, at the sub-regional and regional level, that report observed and/or projected climate-related hazards by type of hazard.

In Central Asia, the most frequent hazards reported are extreme heat and drought (50 percent of countries, respectively), followed by landslides and biological invasion (25 percent). For instance, Turkmenistan reports an increase in the frequency of low water years in its major rivers, the Amu Darya and Murghab.

In Eastern Europe, the Republic of Moldova reports observed and/or projected hazards, including extreme heat, drought, flood and biological invasion. For instance, it references the occurrence of 10 major floods in the past 70 years of its largest rivers, the Dniester and Prut.

In Southern Europe, Serbia reports observed and/or projected hazards, including extreme heat, drought, flood and biological invasion.

Climate-related slow onset risks and events

Countries report observed and/or projected climate-related chemical, biological, and physical changes, leading to slow onset risks and events.[78]

Water stress is most frequently reported amongst observed and/or projected climate-related slow onset risks and events in terrestrial ecosystems and freshwater resources (71 percent of countries with climate impacts), followed by desertification and snow and ice melting (29 percent, respectively). None of the countries in the SEECA region report slow onset risks in marine and coastal ecosystems (half are land locked developing countries), with the exception of Turkmenistan, that reported sea surface temperature rise. **Figure 27** illustrates the share of countries, at the sub-regional and regional level, that report observed and/or projected climate-related risks and slow onset events by type of risk.

---

[75] Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Belarus, Republic of Moldova, and Serbia.

[76] Definition of climate-related hazard adapted from IPCC (2014b) and EM-DAT.

[77] Definition of climate-related hazard adapted from IPCC (2014b) and EM-DAT (n.d.).

[78] Definition of climate-related slow onset risks and events adopted from IPCC (2014b).

FIGURE 26.

SHARE OF COUNTRIES WITH AN OBSERVED AND/OR PROJECTED CLIMATE-RELATED HAZARD OUT OF COUNTRIES HAVING REPORTED HAZARDS, BY HAZARD TYPE

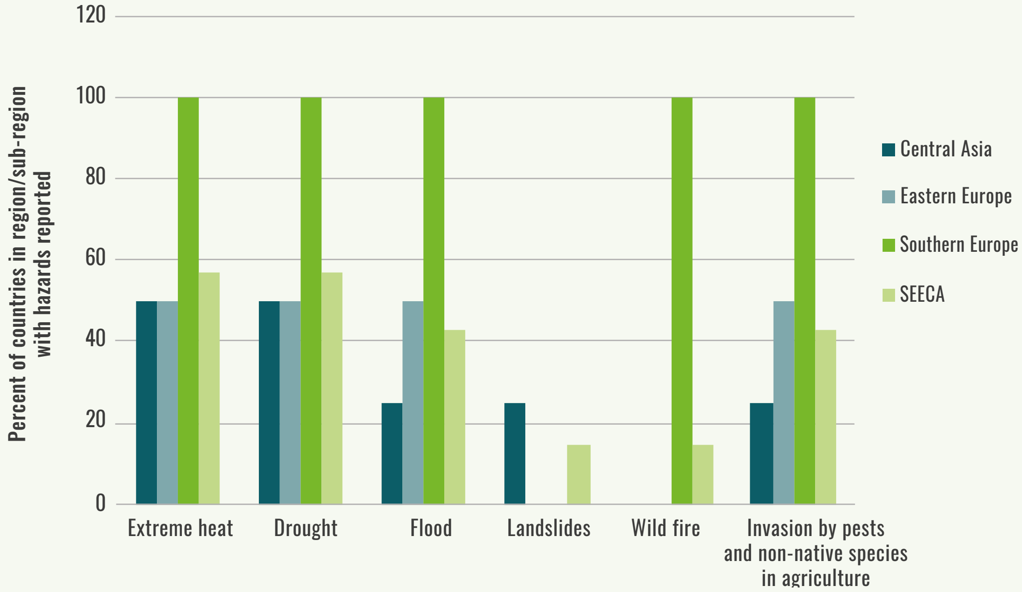
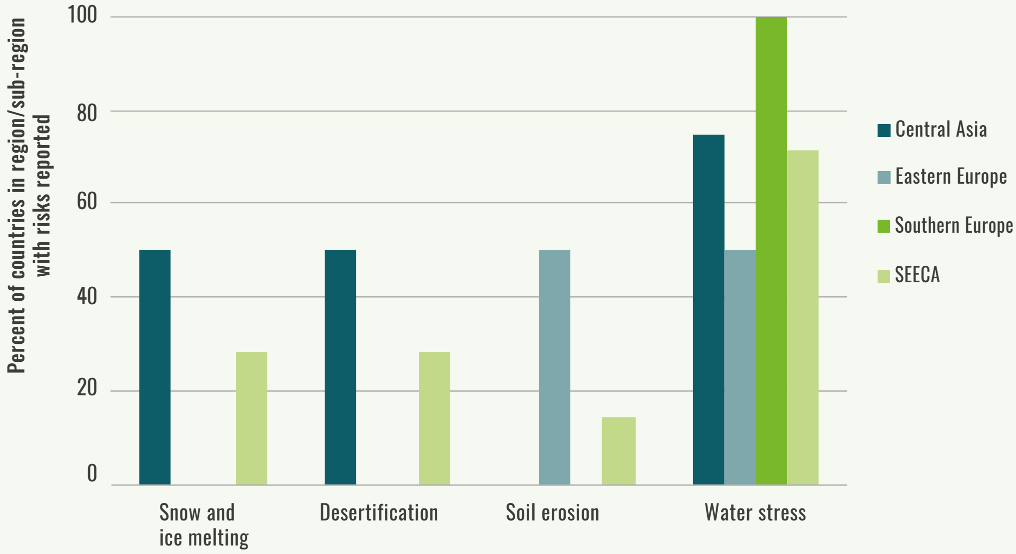


FIGURE 27.

SHARE OF COUNTRIES WITH AN OBSERVED AND/OR PROJECTED CLIMATE-RELATED RISKS AND SLOW ONSET EVENT OUT OF COUNTRIES HAVING REPORTED RISKS, BY RISK TYPE



In Central Asia, the most frequent climate-related risks include water stress (75 percent of countries), followed by desertification and snow and ice melting (50 percent, respectively). For instance, Kyrgyzstan expects decreased water flow under climate change and Turkmenistan reports changes in river flows due to earlier ice melting, particularly in the middle flow of the Amu Darya.

In Eastern Europe, the Republic of Moldova (50 percent of countries) reports water stress and soil erosion as major climate-related risks.

In Southern Europe, only Serbia reports water stress.

Climate-related vulnerabilities

NON-CLIMATIC DRIVERS OF VULNERABILITY

Countries report on the intersecting social, economic, cultural, political and institutional variables, or stressors, that can affect individual adaptive capacity to respond, as well as the level of exposure to climate change, creating new or exacerbating existing vulnerability to climate change.[79]

Overall, poverty and low levels of human development are reported as the largest non-climatic driver of vulnerability (60 percent of countries), followed by political instability and civil conflict (40 percent, respectively). **Figure 28** illustrates the share of countries, at the sub-regional and regional level, that report non-climatic drivers of climate change vulnerability by type of stressor.

For instance, climate change is expected to interact with other pre-existing non-climatic stress factors, including economic and livelihood dependence on agriculture sectors, particularly the reliance on climate sensitive natural resources and environmental goods and services as a source of income and sustenance. In Central Asia, the majority of countries report economic dependence on agriculture sectors as a major driver of vulnerability. Turkmenistan, for example, reports on the key role of the country's mountain ecosystems in water resources generation and biological diversity for agriculture production.

The majority of countries in Central Asia also cite geographical characteristics and topography as non-climatic drivers of vulnerability. For instance, Kyrgyzstan and Tajikistan are mountainous and landlocked countries, dependent on water flow from the high mountain glaciers.

High levels of poverty, as well as conflict, exacerbate vulnerability. For instance, Ukraine describes the 2014-2015 temporary annexation of the Autonomous Republic of Crimea and Sevastopol city by the Russian Federation as an impediment to its economic development. Similarly, Tajikistan reports a sharp increase in poverty between 1992 and 2000, resulting from civil war.

Only Uzbekistan reported high population growth rates as a driver of climate change vulnerability.

CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN ECOSYSTEMS

Countries report observed and/or projected climate-driven impacts, vulnerabilities and risks in ecosystems.[80] The impact of climate change refers generally to the effects of extreme weather and climate events and of climate change on the lives, livelihoods, health, ecosystems, economies, societies, cultures, services, and infrastructure, due to the interaction of climate changes or hazardous climate events occurring within a specific time period and the vulnerability of an exposed society or system. The vulnerability of an exposed system depends on sensitivity and lack of capacity to cope and adapt. The probability of occurrence compounded by the impact, or risk, results from the interaction of vulnerability, exposure, and hazard.[81]

Based on a stocktaking of the reported impacts of climate change on ecosystems in country NDCs (see **Chapter 1**), a set of vulnerable or at-risk ecosystems are identified in the SEECA region, qualified by observed and/or projected climate-related natural resource and ecosystem service impacts.

Seven countries in the region (50 percent) identify at least one observed and/or expected impact, vulnerability and risk induced by climate change in ecosystems. Figure 29 illustrates the share of countries that report one or more observed and/or expected climate-related impact, vulnerability and risk in ecosystems by type of ecosystem.

[79] Definition of non-climatic stressors adapted from IPCC (2014b).

[80] Definition of ecosystems elaborated from MEA (2005).

[81] Definition of impact, vulnerability and risk in ecosystems adapted from IPCC (2014b).

FIGURE 28.

SHARE OF COUNTRIES WITH A NON-CLIMATIC DRIVER OF CLIMATE CHANGE VULNERABILITY OUT OF COUNTRIES HAVING REPORTED STRESSORS, BY STRESSOR TYPE

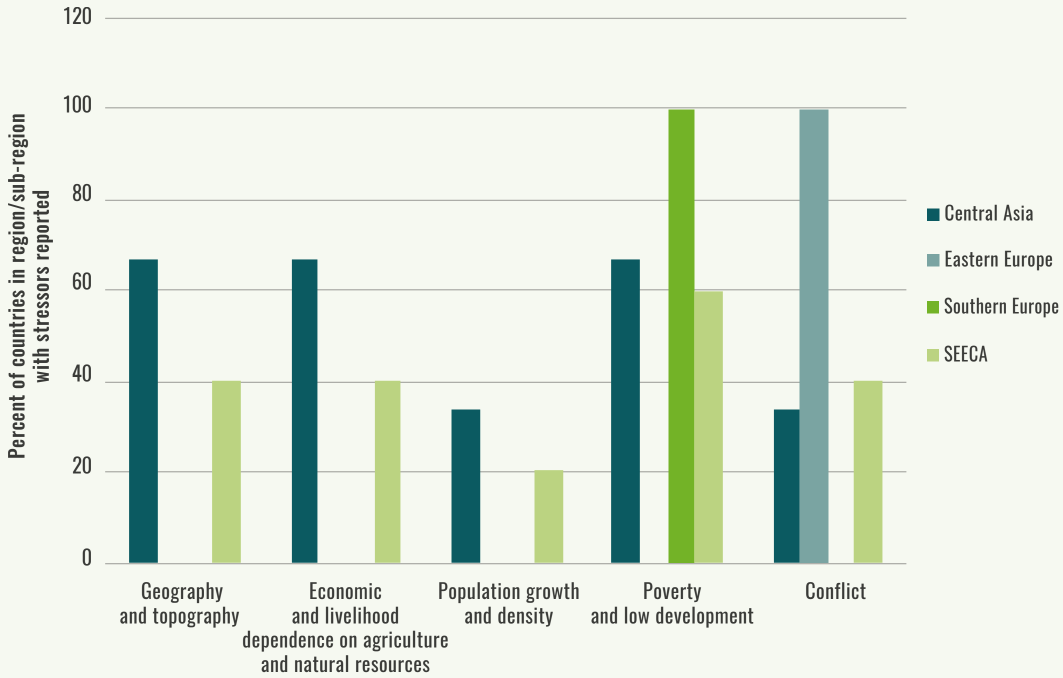
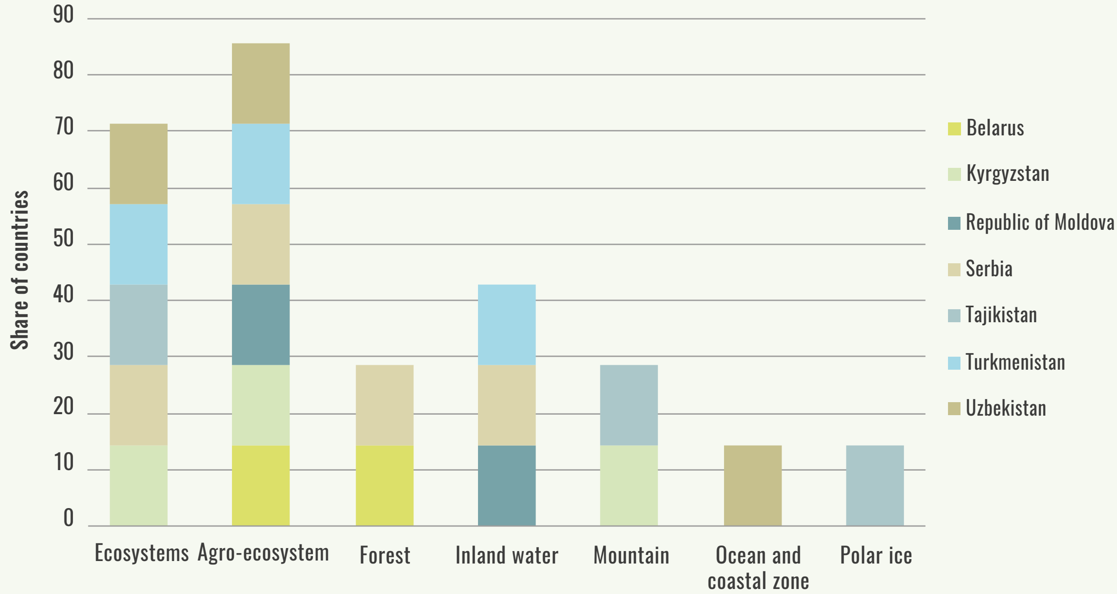


FIGURE 29.

SHARE OF COUNTRIES WITH OBSERVED AND/OR PROJECTED CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN ECOSYSTEMS REPORTED, BY COUNTRY AND ECOSYSTEM TYPE



Of those seven countries, the majority indicate agro-ecosystems as the most vulnerable ecosystem to climate change (86 percent of countries), followed by ecosystems in general (71 percent), inland water (43 percent), mountain and forest ecosystems (29 percent, respectively) and polar ice ecosystems and ocean and coastal zones (14 percent, respectively).

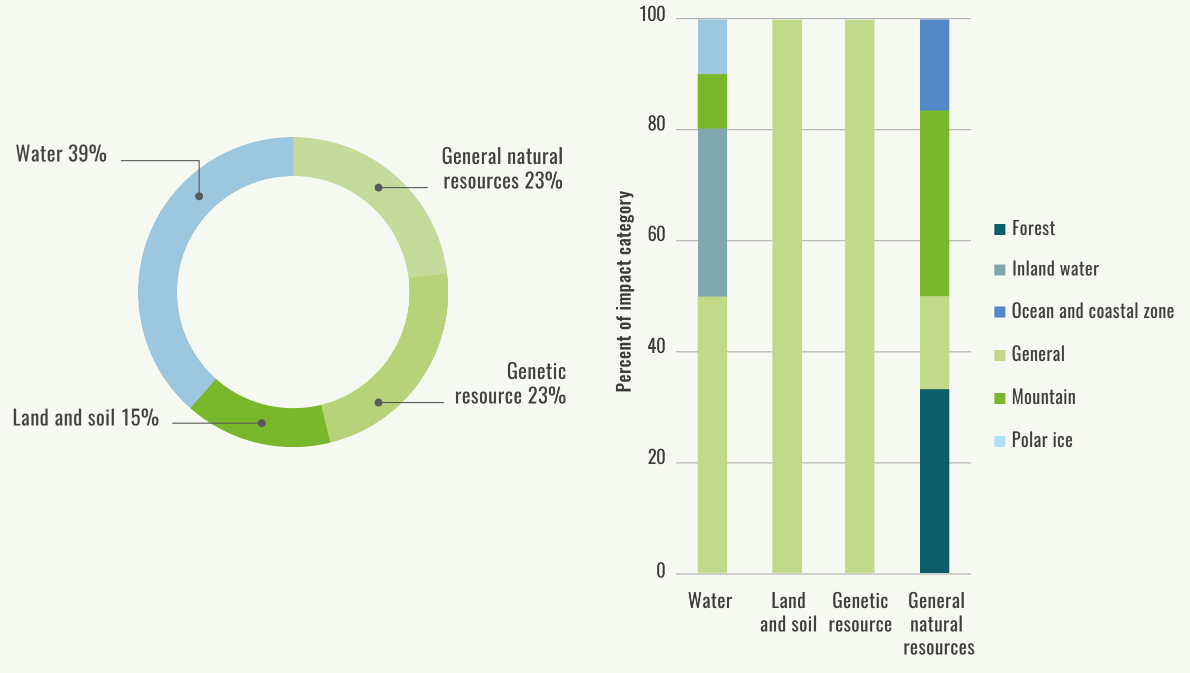
In agro-ecosystems, the majority of countries indicate forestry and crops as the most vulnerable sub-sectors to climate change (71 percent of countries, respectively), followed by the agriculture sector in general (43 percent).

Climate-driven impacts, vulnerabilities and risks in ecosystems vary by natural resource and ecosystem service affected. Figure 30 illustrates the distribution of observed and/or projected climate-related impacts in ecosystems by natural resource impact category.

Water is reported as the most vulnerable natural resource to climate change (39 percent of impacts), **in all ecosystems and particularly inland water ecosystems,** followed by genetic resources (23 percent), all natural resources (23 percent), primarily in mountain and forest ecosystems, and land and soil resources (15 percent). For instance, Tajikistan, Turkmenistan, Uzbekistan, the Republic of Moldova, Kyrgyzstan, and Serbia all report observed and/or expected climate impacts on water resources.

FIGURE 30.

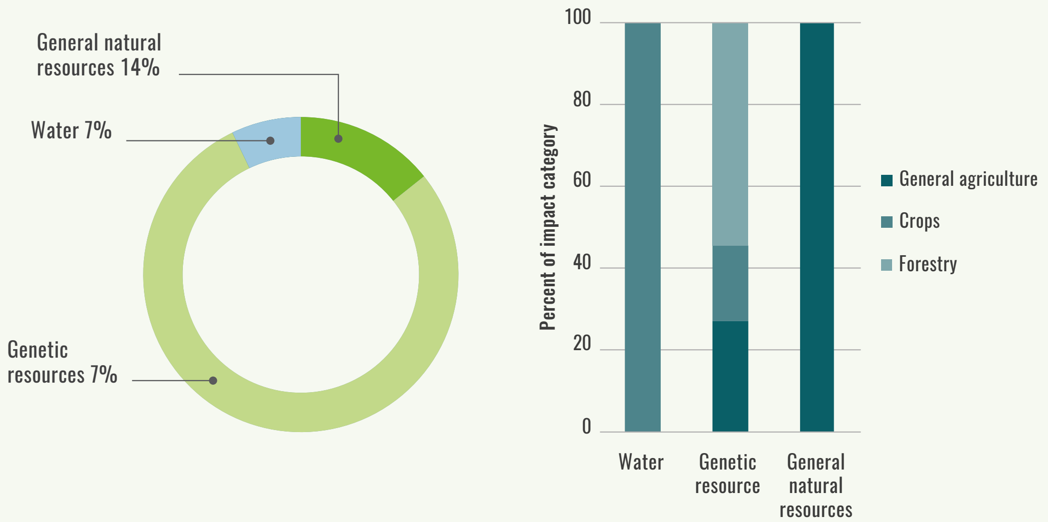
DISTRIBUTION OF OBSERVED AND/OR PROJECTED CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN ECOSYSTEMS, BY NATURAL RESOURCE IMPACT CATEGORY



In agro-ecosystems, genetic resources are considered the most vulnerable natural resource to climate change (79 percent of impacts), primarily in the forestry sub-sector, followed by general natural resources (14 percent) and water resources in the crops sub-sector (7 percent). For instance, Belarus, the Republic of Moldova, Kyrgzstan, Serbia and Turkmenistan report climate-related impacts on forest resources, and Serbia and the Republic of Moldova also report crops as genetic resources most impacted by climate change. Figure 31 illustrates the distribution of observed and/or projected climate-related impacts in agro-ecosystems by natural resource impact category.

FIGURE 31.

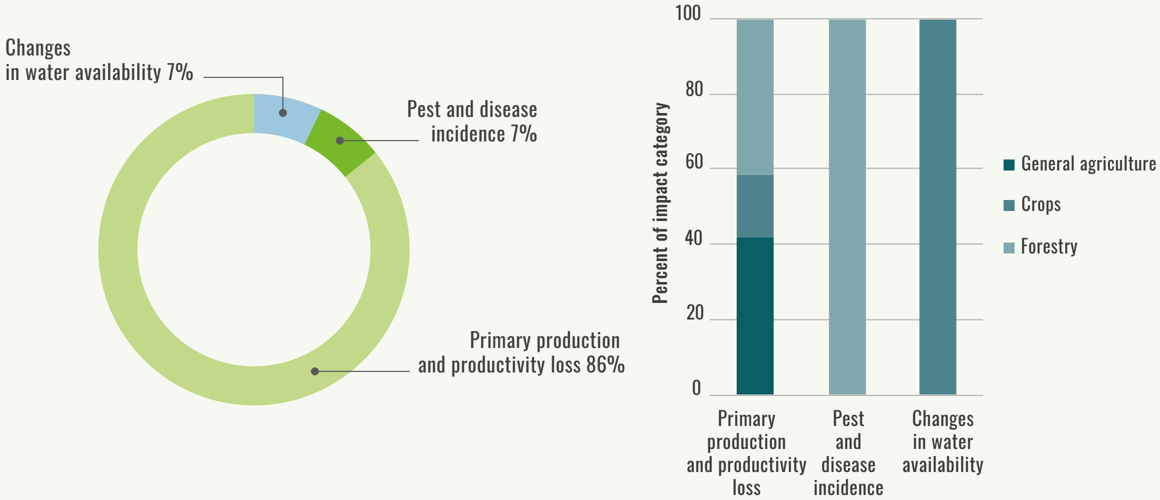
DISTRIBUTION OF OBSERVED AND/OR PROJECTED CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN AGRO-ECOSYSTEMS, BY NATURAL RESOURCE IMPACT CATEGORY



Loss of primary production and productivity (86 percent of impacts) is most frequently reported amongst ecosystem service impacts in agro-ecosystems, primarily in the forestry sub-sector and agriculture in general, followed by pest and disease incidence in forestry (7 percent) and changes in water availability in the crop sub-sector (7 percent). For instance, Serbia reports increased insect invasions in forestry and expected corn crop yield losses of 22 to 52 percent due to changes in plant phenology. Figure 32 illustrates the distribution of observed and/or projected climate-related impacts in agro-ecosystems by ecosystem service impact category.

FIGURE 32.

DISTRIBUTION OF OBSERVED AND/OR PROJECTED CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN AGRO-ECOSYSTEMS, BY ECOSYSTEM SERVICE IMPACT CATEGORY



Amongst impacts in ecosystems outside of farming, the loss of ecosystem, biodiversity and ecosystem goods, functions and services is reported most (43 percent of impacts), **primarily in forest and mountain ecosystems, followed by changes in water availability and quality (29 percent), primarily in inland and forest ecosystems,** biodiversity loss (21 percent), changes in hydrological flow and water cycling (21 percent), primarily in inland water ecosystems, changes in water availability (14 percent) and desertification and land degradation (14 percent). For instance, Kyrgyzstan and Tajikistan report the vulnerability of mountain ecosystems. Serbia and Belarus report the vulnerability of forest ecosystems, particularly that forest fires may transform entire forest ecosystems in Serbia. Turkmenistan reports that changes in river discharge will affect hydrological flow, and Serbia reports it will affect water availability and quality. Turkmenistan and Uzbekistan report increased desertification and land degradation.

CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN SOCIAL SYSTEMS

Five countries in the region (36 percent) **identify at least one observed and/or expected impact, vulnerability and risk induced by climate change in social systems,**[82] generally amongst three main pillars: socio-economics and well-being; knowledge and capacity; and institutions and governance. **Figure 33** illustrates the share of countries that report one or more observed and/or expected climate-related impact, vulnerability and risk in social systems by type.

Overall, the majority of those countries report adverse health as the human dimension most at risk under climate change (80 percent of countries with impacts reported), **followed by food insecurity and malnutrition** (40 percent). None of the countries in the SEECA region report observed and/or projected impacts, vulnerabilities or risks related to other socioeconomic and well-being dimensions, such as heightened gender inequality, poverty or increased migration and displacement, nor do countries report knowledge and capacity impacts or weakened institutions and governance induced by climate change.

In Central Asia, adverse health concerns and food insecurity and malnutrition are most frequently reported (67 percent of countries with impacts reported, respectively) amongst climate-driven risks in social systems, followed by rural livelihood and income loss (33 percent). In Eastern Europe, only Serbia reports adverse health as a major climate-induced risk to social systems. In Southern Europe, the loss of productive infrastructure and assets, and adverse health, are most frequently reported (100 percent, respectively) climate-driven risks.

3.2.2 Adaptation priorities and measures

Adaptation in the agriculture sectors

Eight countries in the region (57 percent) included an adaptation component in their respective NDCs to the UNFCCC in line with the global goal to enhance adaptive capacity and resilience, and reduce vulnerability to climate change, set under Article 7.10 of the Paris Agreement.

Out of the eight countries with an adaptation component, seven[83] **(88 percent) include priority sector(s) and/or measures in the agriculture sectors,** characterized by varying degrees of detail and breadth. Four of those countries (50 percent) include a set of priority sector(s) and measures and three (38 percent) include a set of priority sector(s) for adaptation in the agriculture sectors. Twenty-five percent of countries with adaptation include a long-term adaptation goal. **Figure 34** illustrates the share of countries with an adaptation component and the share of those countries with adaptation in the agriculture sectors.

[82] Definition of impact, vulnerability and risk in social systems adapted from IPCC (2014b).

[83] Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Belarus, Republic of Moldova, and Serbia.

FIGURE 33.

SHARE OF COUNTRIES WITH OBSERVED AND/OR PROJECTED CLIMATE-DRIVEN IMPACTS, VULNERABILITIES AND RISKS IN SOCIAL SYSTEMS OUT OF COUNTRIES HAVING REPORTED IMPACTS, BY IMPACT TYPE

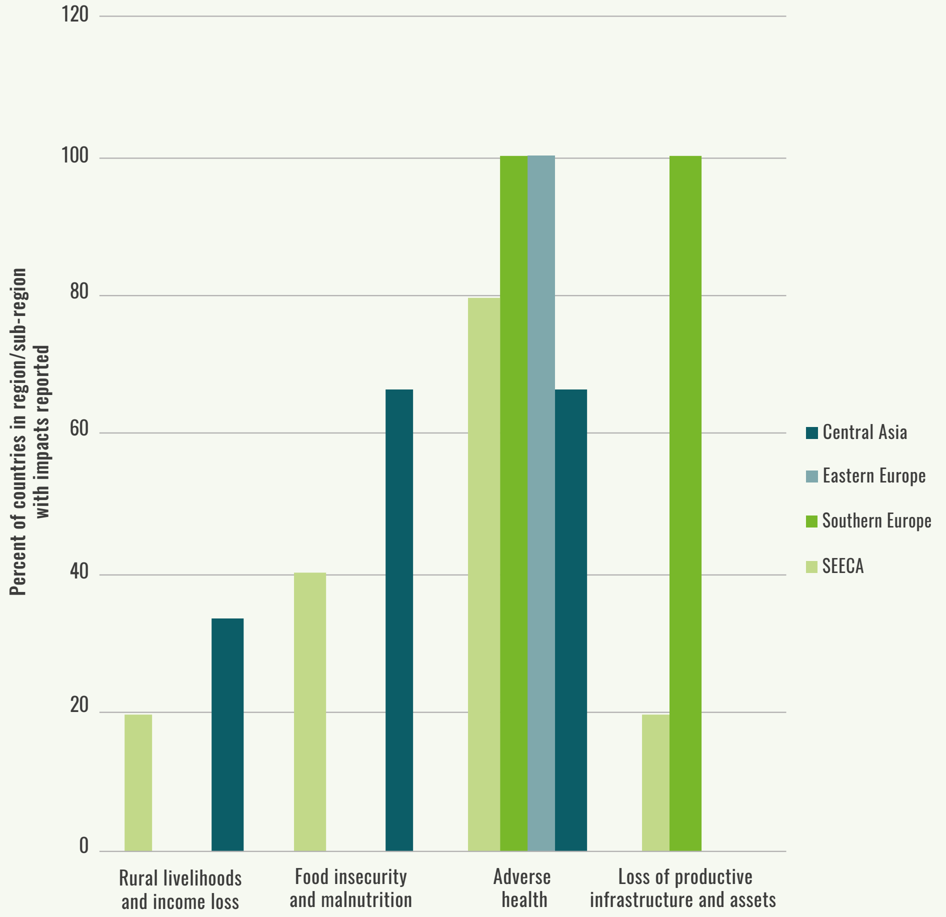
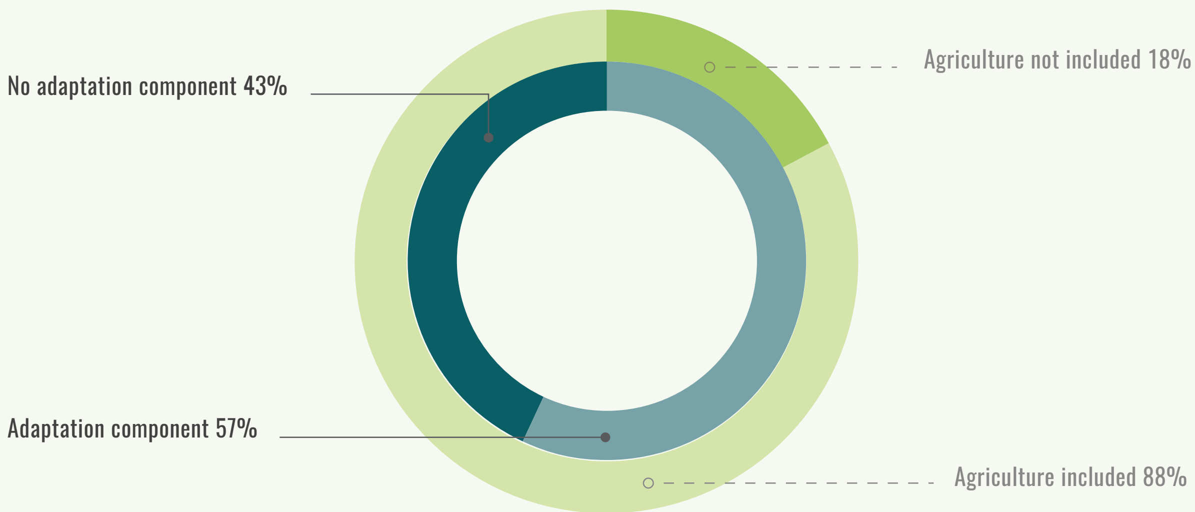


FIGURE 34.

SHARE OF COUNTRIES WITH AGRICULURE IN THE ADPTATION COMPONENT



Priority sectors and cross-cutting priorities

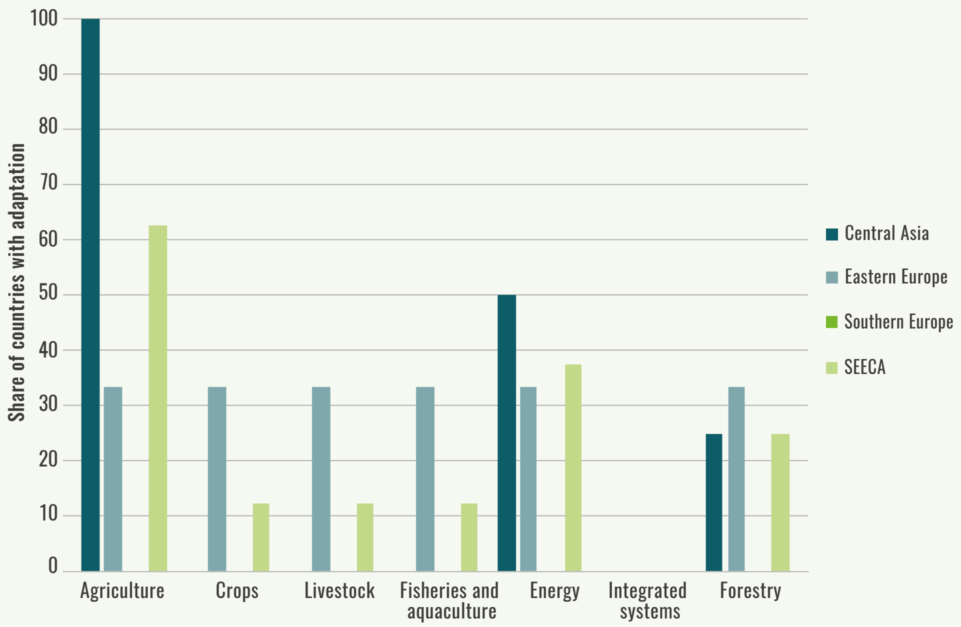
Countries often identify a number of priority (sub-) sectors and cross-cutting priorities in natural and social systems as part of their adaptation strategy in the agriculture sectors.

Amongst priority sectors for adaptation, the majority of countries prioritize the agriculture sector in general (63 percent of countries with adaptation) and the energy sub-sector (38 percent), followed by forestry (25 percent) and crops, livestock and fisheries and aquaculture sub-sectors to an equal degree (13 percent, respectively). **Figure 35** illustrates the share of countries with adaptation that include priorities in the agriculture sectors by sub-sector.

In Central Asia, the majority of countries prioritize the agriculture sector in general (80 percent of countries), followed by the energy and forestry sectors. For instance, Kyrgyzstan identifies the energy and forestry as priority sectors. In Eastern Europe, only the Republic of Moldova prioritizes almost all agriculture sub-sectors, including crops, livestock, fisheries and aquaculture and forestry sub-sectors and the energy sector. None of the countries in Southern Europe identify agriculture as a priority sector.

FIGURE 35.

SHARE OF COUNTRIES WITH PRIORITIES IN THE AGRICULTURE SECTORS, BY (SUB-) SECTOR



Overall, the majority of countries include water resources amongst cross-sectoral adaptation priorities (88 percent of countries with adaptation), followed by biodiversity (63 percent), ecosystems and natural resources (38 percent), land and soil (25 percent) and oceans and coastal zones (13 percent). **Figure 36** illustrates the share of countries with adaptation that include cross-sectoral adaptation priorities by type of natural resource or ecosystem.

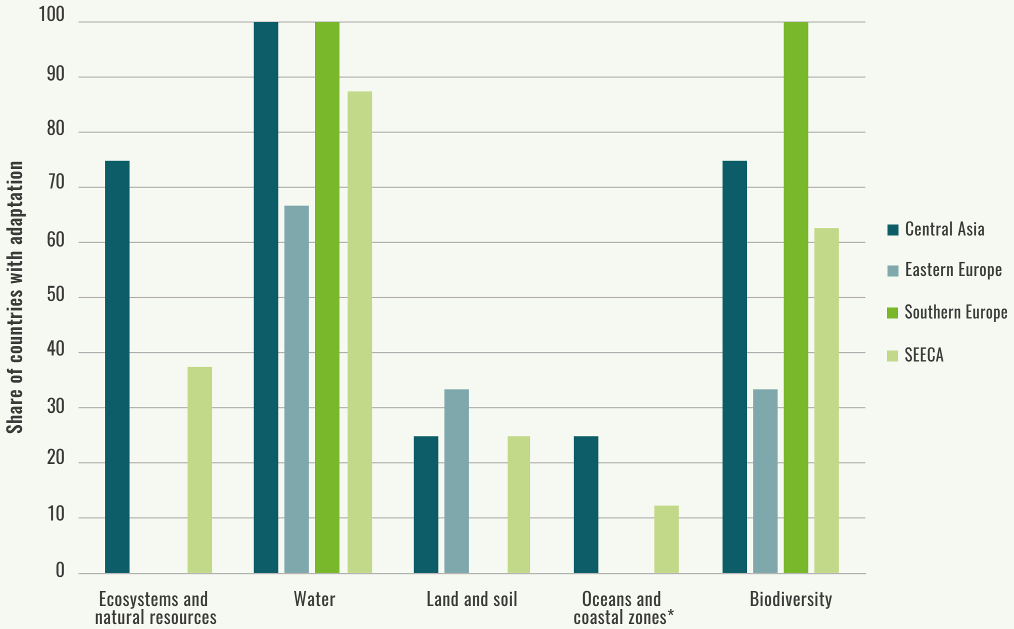
The distribution of priorities varies by sub-region. While Central Asia follows regional trends, Eastern Europe prioritizes water, land and soil and biodiversity, and Southern Europe prioritizes water resources and biodiversity only.

Countries often identify a number of cross-cutting priorities in social systems as part of their adaptation strategy.

Health represents the greatest cross-cutting adaptation priority in social systems amongst countries in the region (63 percent of countries with adaptation), followed by resilient infrastructure (38 percent), Disaster Risk Reduction and Management (DRR/M) (25 percent) and gender equality (13 percent).

FIGURE 36.

SHARE OF COUNTRIES WITH CROSS-SECTORAL PRIORITIES IN ECOSYSTEMS, BY TYPE

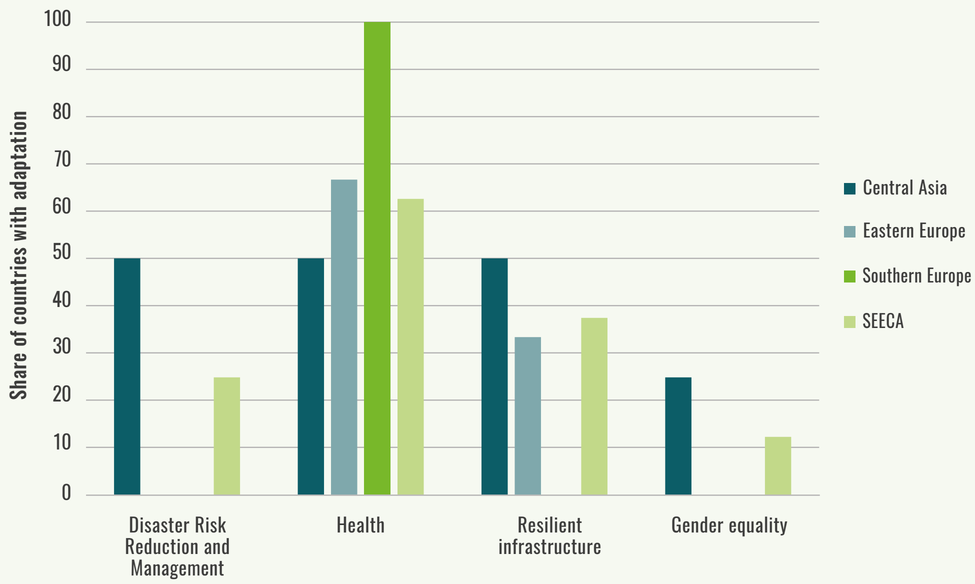


** Seven countries in the SEECA region are classified as landlocked developing countries.*

Conversely, none of the countries in the region prioritize food security and nutrition, poverty and inequality reduction, human rights, indigenous peoples or the agri-food chain as part of their adaptation strategy. **Figure 37** illustrates the share of countries with adaptation that include cross-cutting adaptation priorities in social systems by type.

FIGURE 37.

SHARE OF COUNTRIES WITH CROSS-CUTTING PRIORITIES IN SOCIAL SYSTEMS, BY TYPE



Adaptation measures in ecosystems and social systems

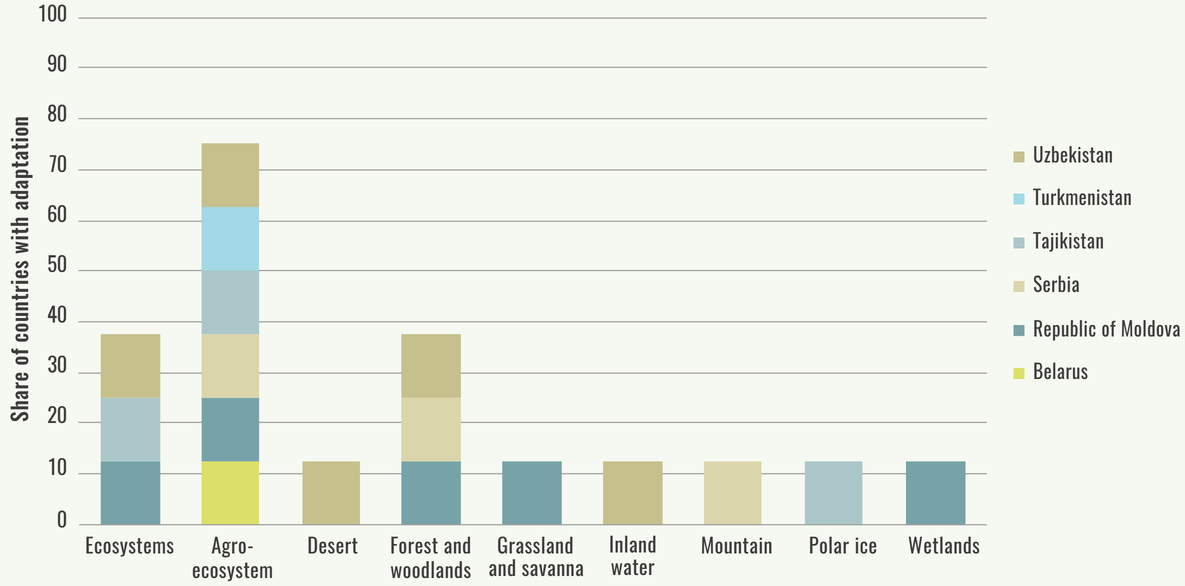
Overall, only one percent of adaptation measures have quantified targets, likely due to the challenges related to measuring adaptation baselines and outcomes at the local and national scale. The majority of measures require a combination of domestic and international financial support (90 percent of measures), while only a small share of policies and measures are fully conditional and an even smaller share are unconditional. Of all adaptation measures, the majority is either supply-side (production) oriented (98 percent of measures), with a small share of demand-side interventions.

ADAPTATION MEASURES IN ECOSYSTEMS

Out of those countries with an adaptation component, six (75 percent) identify at least one adaptation measure in ecosystems. The majority of countries prioritize adaptation in agro-ecosystems (75 percent of countries with adaptation), followed by forest and woodlands and ecosystems in general (38 percent, respectively), and grassland and savanna, inland, mountain, polar ice, wetlands and desert ecosystems (13 percent, respectively). **Figure 38** illustrates the share of countries with adaptation that include one or more (to avoid bias of representation) adaptation measure in ecosystems by type of ecosystem.

FIGURE 38.

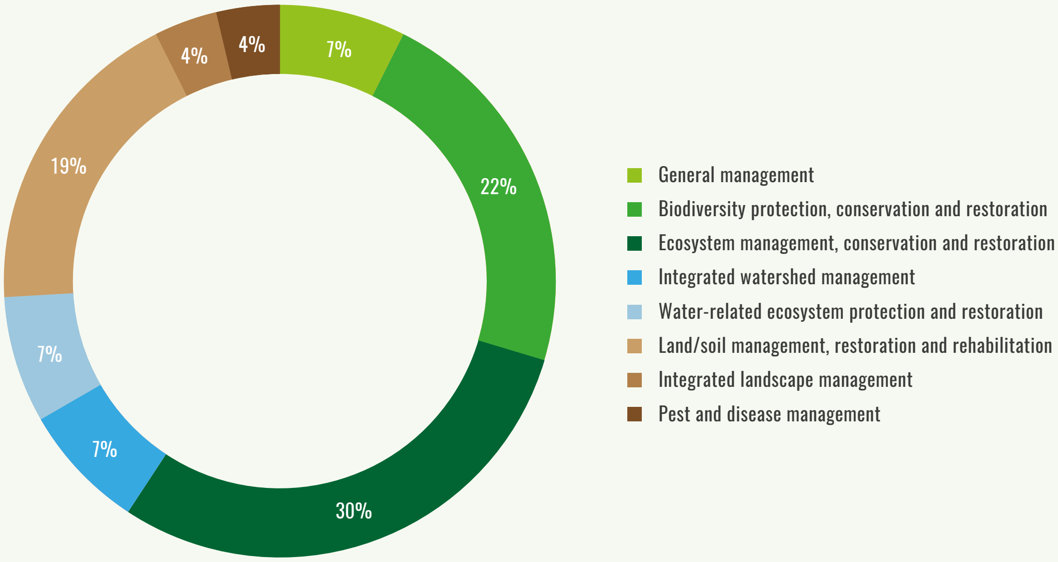
SHARE OF COUNTRIES WITH ADAPTATION MEASURES IN ECOSYSTEMS, BY COUNTRY AND ECOSYSTEM TYPE



Amongst adaptation measures outside of farming systems, ecosystem management, conservation and restoration activities are most frequent (30 percent of measures), **primarily in forest and woodland ecosystems,** followed by biodiversity protection, conservation and restoration (22 percent), in desert, forest and woodlands, inland water and mountain ecosystems, and land/soil management, restoration and rehabilitation (19 percent), in ecosystems in general as well as in forest and woodlands ecosystems. **Figure 39** illustrates the distribution of adaptation measure in ecosystems outside of farming systems, by management activity.

FIGURE 39.

SHARE OF ADAPTATION MEASURES IN ECOSYSTEMS, BY MANAGEMENT ACTIVITY



The overall composition of adaptation measures in ecosystems outside of farming systems for the SEECA region are described by ecosystem type and management activity in order of regional priority:

Ecosystems

Thirty-eight percent of countries with adaptation prioritize adaptation in ecosystems in general. The majority of adaptation measures target land/soil management, restoration and rehabilitation (38 percent of measures), followed by integrated watershed management (25 percent) and pest and disease management, biodiversity protection, conservation and restoration and ecosystem management, conservation and management (14 percent, respectively).

For instance, the Republic of Moldova aims to adopt new technologies addressing soil structure stability and soil treatment for enlarging the active layer of the root zone for greater water uptake, and Uzbekistan plans to combat desertification.

Forest and woodlands ecosystems

Thirty-eight percent of countries with adaptation prioritize adaptation in forest and woodlands ecosystems. The majority of adaptation measures aim to enhance ecosystem management, conservation and restoration (45 percent of measures), followed by biodiversity protection, conservation and restoration, land/soil management, restoration and rehabilitation and general management (18 percent, respectively).

For instance, Uzbekistan includes the restoration of forests in mountain and piedmont areas, and Serbia targets the reduction of biotic and abiotic disturbances through building adaptive capacity of forests.

Desert ecosystems

One country prioritizes adaptation in desert ecosystems, aiming to protect, conserve and restore biodiversity and to manage, conserve and restore desert ecosystems. Uzbekistan promotes the sustainable management of fragile desert ecosystems.

Grassland and savanna ecosystems

One country prioritizes adaptation in grassland and savanna ecosystems, targeting integrated landscape management. The Republic of Moldova aims to maintain grassland landscapes to provide shelter for livestock.

Mountain ecosystems

One country prioritizes adaptation in mountain ecosystems, aiming to protect, conserve and restore biodiversity. Serbia calls for specific measures to preserve endangered forest species in mountain ecosystems.

Inland water ecosystems

One country prioritizes adaptation in inland water ecosystems, aiming to protect, conserve and restore marine biodiversity and to manage, conserve and restore water-related ecosystems. Uzbekistan promotes the conservation and rehabilitation of flora and fauna biodiversity by creating local water bodies in the Priaralie.

Polar ice ecosystems

One country (13 percent) prioritizes adaptation in polar ice ecosystems, aiming to protect and restore water-related ecosystems. Tajikistan calls for monitoring and preservation of the glaciers and water resources in the runoff formation zones.

Wetland ecosystems

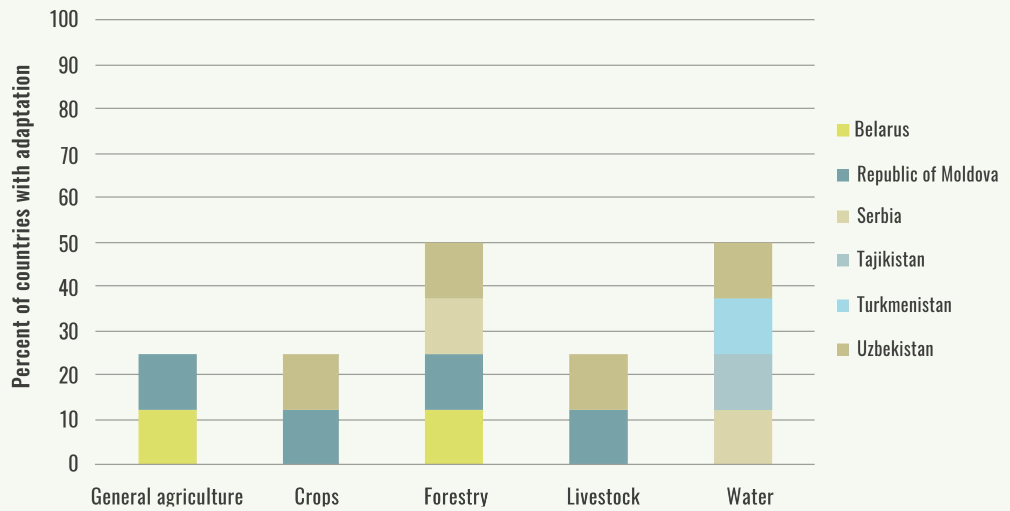
One country (13 percent) prioritizes adaptation in wetland ecosystems, aiming to protect and restore water-related ecosystems. The Republic of Moldova aims to protect wetlands by allowing groundwater recharge and reducing peak discharges downstream.

ADAPTATION MEASURES IN AGRO-ECOSYSTEM AND FOOD SYSTEMS

Six countries (50 percent of countries with adaptation) identify at least one adaptation measure in agro-ecosystem and food systems. The majority of countries prioritize adaptation in the forestry and water sub-sectors (50 percent) followed by livestock, crops and agriculture in general (25 percent, respectively). **Figure 40** illustrates the share of countries with adaptation that include one or more (to avoid bias of representation) adaptation measure in agro-ecosystems by sub-sector.

FIGURE 40.

SHARE OF COUNTRIES WITH ADAPTATION MEASURES IN AGRO-ECOSYSTEMS AND FOOD SYSTEMS, BY COUNTRY AND SUB-SECTOR



Amongst adaptation measures in agriculture and food systems, the majority promote irrigation and drainage (15 percent of measures), followed by afforestation/reforestation and plant management (12 percent, respectively), amongst others.

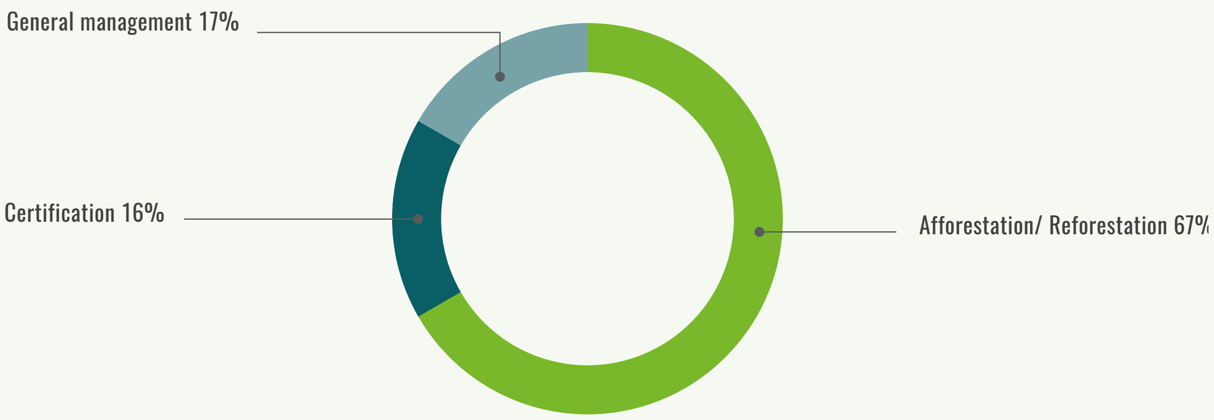
The overall composition of adaptation measures in agriculture and food systems for the SEECA region are described by sub-sector and management activity in order of regional priority:

Forestry

Fifty percent of countries with adaptation prioritize adaptation in the forestry sub-sector. The majority of adaptation measures promote afforestation/reforestation (67 percent of measures), followed by forest product certification schemes and general forest management (17 percent, respectively). **Figure 41** illustrates the distribution of those measures by management activity.

FIGURE 41.

SHARE OF ADAPTATION MEASURES IN THE FORESTRY SUB-SECTOR, BY MANAGEMENT ACTIVITY



Afforestation/reforestation

Thirty-eight percent of countries with adaptation promote afforestation/reforestation as an adaptation strategy. For instance, Uzbekistan plans afforestation in the dried Aral Sea. The Republic of Moldova aims to increase precipitation through the planting of trees.

Forest product certification

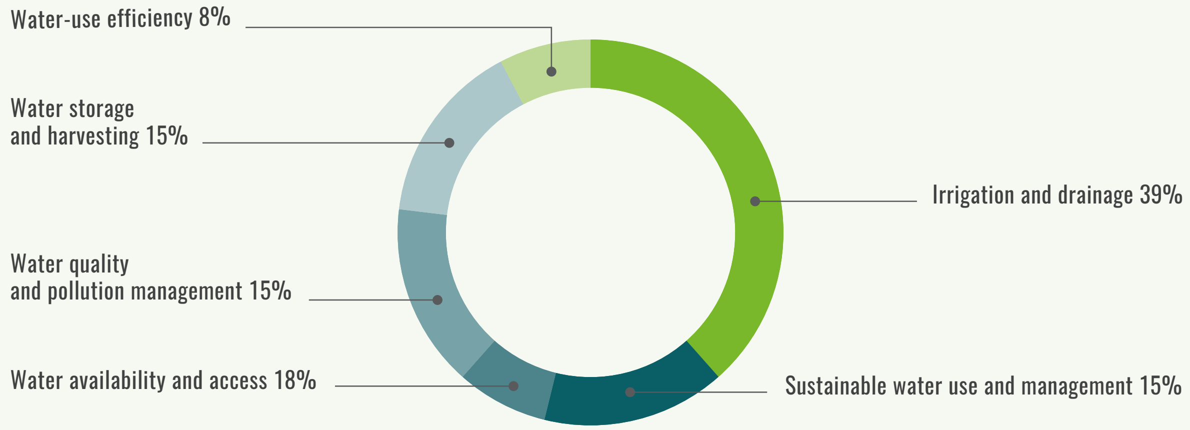
Thirteen percent of countries with adaptation promote the certification of forest products. The Republic of Moldova includes certification schemes of forest products as an adaptation measure.

Water management and use

Fifty percent of countries with adaptation prioritize adaptation in water use and management. The majority of adaptation measures target irrigation and drainage practices (39 percent of measures), followed by water quality and pollution management, water storage and harvesting, and sustainable water use and management (15 percent, respectively), amongst others. **Figure 42** illustrates the distribution of those measures by management activity.

FIGURE 42.

SHARE OF ADAPTATION MEASURES IN WATER MANAGEMENT AND USE, BY ACTIVITY



Irrigation and drainage
Fifty percent of countries with adaptation prioritize irrigation and drainage practices as part of their adaption strategy. For instance, Serbia calls for the use of best available irrigation techniques and cooperation with upstream users.

Water storage and harvesting
Twenty-one percent of countries with adaptation prioritize water storage and harvesting as part of their adaption strategy. For instance, Turkmenistan targets the collection of drainage water into the lake in the Karakum Desert.

Crops

Twenty-five percent of countries with adaptation prioritize adaptation in the crops sub-sector. The majority of adaptation measures target improved plant management (40 percent of measures), followed by nutrient and on-farm soil management and general crop management (20 percent, respectively), amongst others. **Figure 43** illustrates the distribution of those measures by management activity.

Plant management
Twenty-five percent of countries with adaptation prioritize plant management as an adaptation strategy. For instance, Uzbekistan calls for the conservation of germplasm and indigenous plant species and agricultural crops resistant to droughts, pests and diseases.

Nutrient and on-farm soil management
Twenty-five percent of countries with adaptation prioritize nutrient and on-farm soil management as an adaptation strategy. For instance, the Republic of Moldova aims to reduce runoff by implementing no-tillage practices.

Livestock

Twenty-five percent of countries with adaptation prioritize adaptation in livestock. The majority of adaptation measures promote animal breeding and husbandry (67 percent of measures), followed by grassland management (33 percent). **Figure 44** illustrates the distribution of those measures by management activity.

FIGURE 43.

SHARE OF COUNTRIES WITH ADAPTATION MEASURES IN THE CROPS SUB-SECTOR, BY MANAGEMENT ACTIVITY

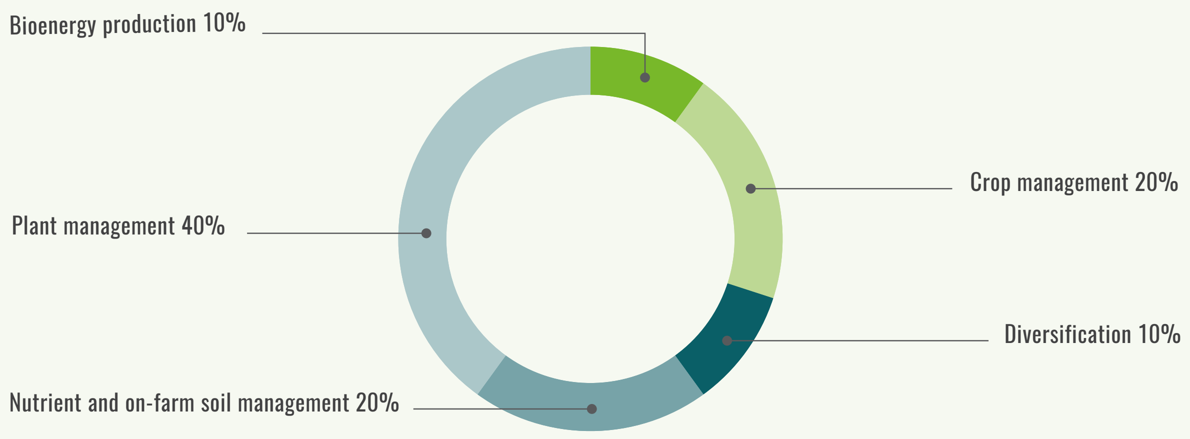
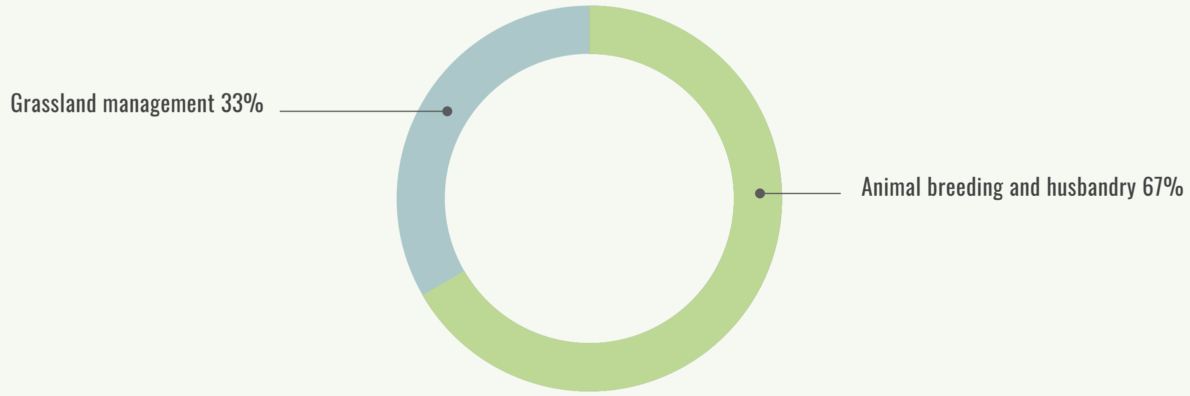


FIGURE 44.

SHARE OF ADAPTATION MEASURES IN THE LIVESTOCK SUB-SECTOR, BY MANAGEMENT ACTIVITY



Animal breeding and husbandry
One country (13 percent) prioritizes animal breeding and husbandry as an adaptation strategy. The Republic of Moldova includes improved breeding and husbandry practices, such as the introduction of heat resistant species, air-conditioning and ventilation systems.

Grassland management
One country prioritizes grassland management as an adaptation strategy. Uzbekistan promotes improved pasture productivity and fodder production in desert and piedmont areas.

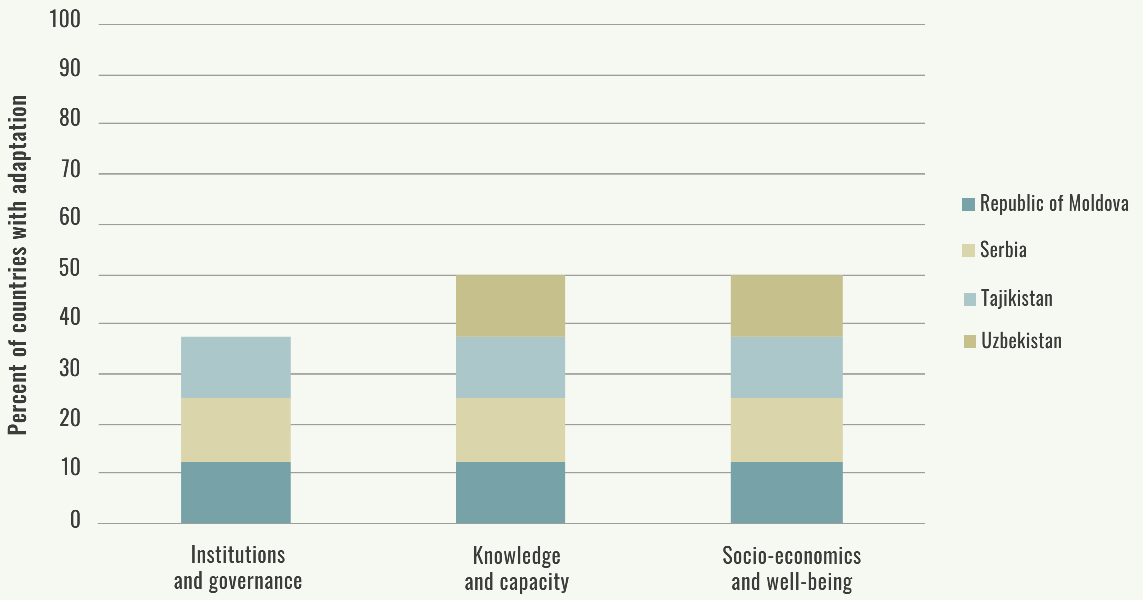
ADAPTATION MEASURES IN SOCIAL SYSTEMS

Adaptation measures in social systems are differentiated along three main pillars: socio-economics and well-being; knowledge and capacity; and institutions and governance.

Out of those countries with an adaptation component, four (50 percent) identify at least one adaptation measure in social systems, primarily around the socio-economics and well-being and knowledge and capacity pillars (50 percent of countries, respectively), followed by institutions and governance (38 percent). **Figure 45** illustrates the share of countries with adaptation that include one or more (to avoid bias of representation) adaptation measure in social systems by pillar and intervention area.

FIGURE 45.

SHARE OF COUNTRIES WITH ADAPTATION MEASURES IN SOCIAL SYSTEMS, BY PILLAR

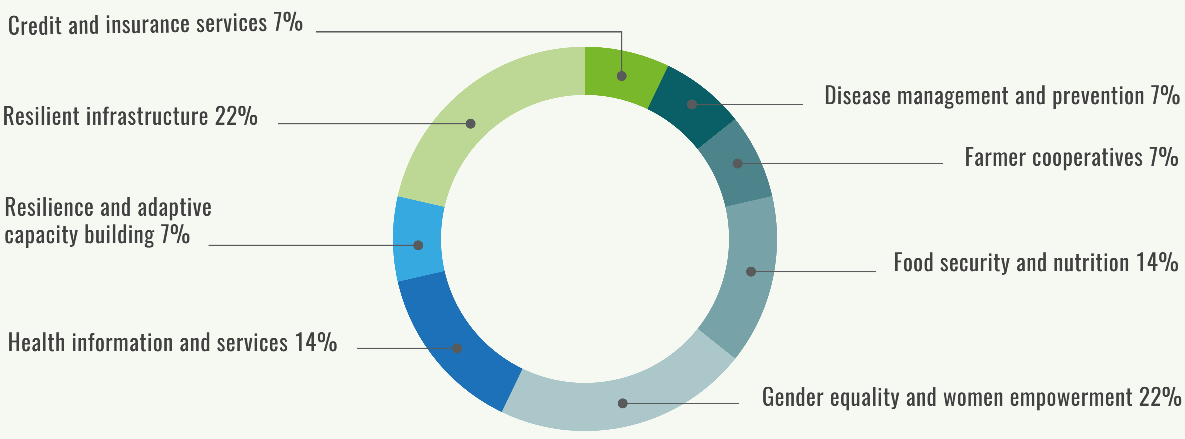


Socio-economics and well-being

Amongst adaptation measures along the socio-economics and well-being pillar, those targeting gender equality and women empowerment are most prominent (22 percent of measures), followed by food security and nutrition and health information and services (14 percent, respectively), amongst others. For instance, Tajikistan calls for the active role of women and civil society on climate-related issues. **Figure 46** illustrates the distribution of those measures by intervention area.

FIGURE 46.

SHARE OF ADAPTATION MEASURES IN SOCIAL SYSTEMS, PER SOCIO-ECONOMIC AND WELL-BEING INTERVENTION AREA



Knowledge and capacity

Amongst adaptation measures along the knowledge and capacity pillar, the majority aim to increase research and development (R&D) (40 percent of measures), followed by awareness raising and education (27 percent) and human resource training for climate action (20 percent), amongst others. For instance, the Republic of Moldova supports research on climate-resilient crop varieties and Serbia focuses research on hydrology and forest resources. **Figure 47** illustrates the distribution of these measures by intervention area.

Institutions and governance

Amongst adaptation measures along the institutions and governance pillar, the majority aim to enhance policy mainstreaming and coherence (41 percent of measures), followed by DRR/M (25 percent) and transparency and accountability and institutional capacity building for climate action (17 percent, respectively), amongst others. For instance, the Republic of Moldova calls for mainstreaming of climate change adaptation into policies, plans and budgetary processes, and Serbia calls for greater inter-sectorial cooperation. **Figure 48** illustrates the distribution of those measures by intervention area.

FIGURE 47.

SHARE OF ADAPTATION MEASURES IN SOCIAL SYSTEMS, PER KNOWLEDGE AND CAPACITY INTERVENTION AREA

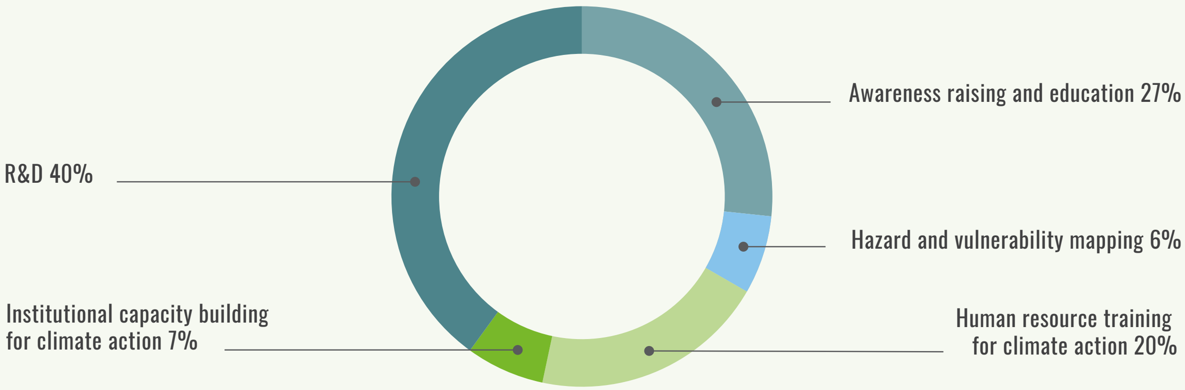
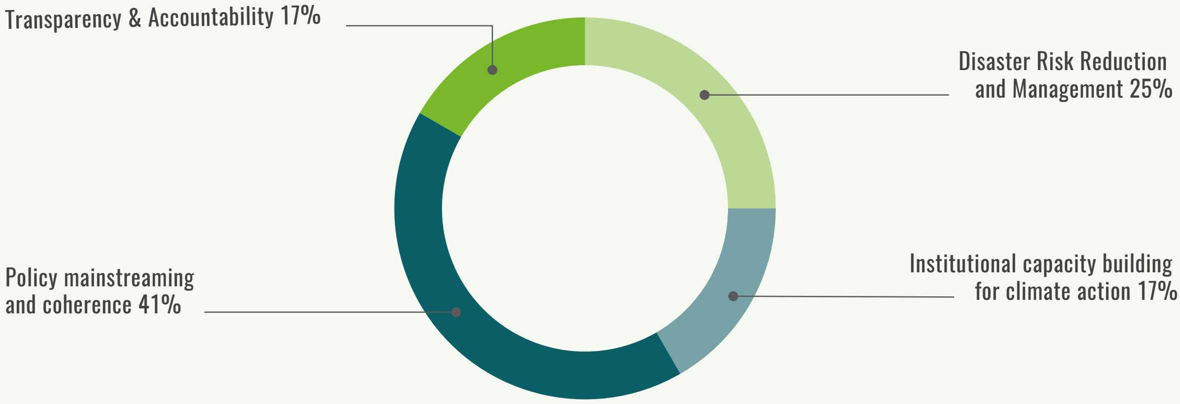


FIGURE 48.

SHARE OF ADAPTATION MEASURES IN SOCIAL SYSTEMS, PER INSTITUTIONS AND GOVERNANCE INTERVENTION AREA



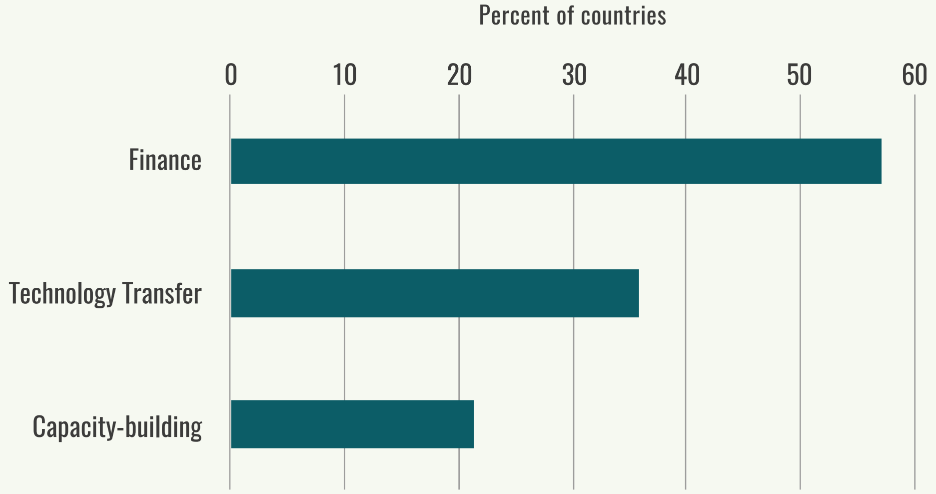
3.3 SUPPORT NEEDS

Article 9, 10 and 11 of the Paris Agreement reiterate the obligations of developed countries to support developing country efforts to build clean, climate-resilient futures through the provision of finance, technology and capacity-building support for climate change mitigation and adaptation. Many of the contributions set forward by the SEECA region countries are conditional, in whole or in part, on support flows from developed countries for effective implementation.

Overall, eight countries express support needs in the form of either technology transfer, capacity development and/or finance for implementation of their respective NDC (**Figure 49**).

FIGURE 49.

SHARE OF COUNTRIES WITH SUPPORT NEEDS FOR NDC IMPLEMENTATION, PER TYPE



3.3.1 Technology transfer

Five countries[84] reference technology costs or needs, primarily in Central Asia, such as the modernization of production based on energy-efficient technologies,[85] innovative technologies for water saving, including broad introduction of drip irrigation systems, or for the protection of littoral and river infrastructure.[86]

3.3.2 Capacity building

Only three countries[87] include capacity building needs, mostly related to the institutional and technical capacity improvements required for building domestic measuring, reporting and verification (MRV) and monitoring and evaluation (M&E) systems, and for national statistics data collection and management. Others indicate capacity and knowledge gaps for adaptation solutions, including rural infrastructure and tenure arrangements.

[84] Kazakhstan, Republic of Moldova, Tajikistan, Turkmenistan and Uzbekistan.

[85] Kazakhstan.

[86] Uzbekistan.

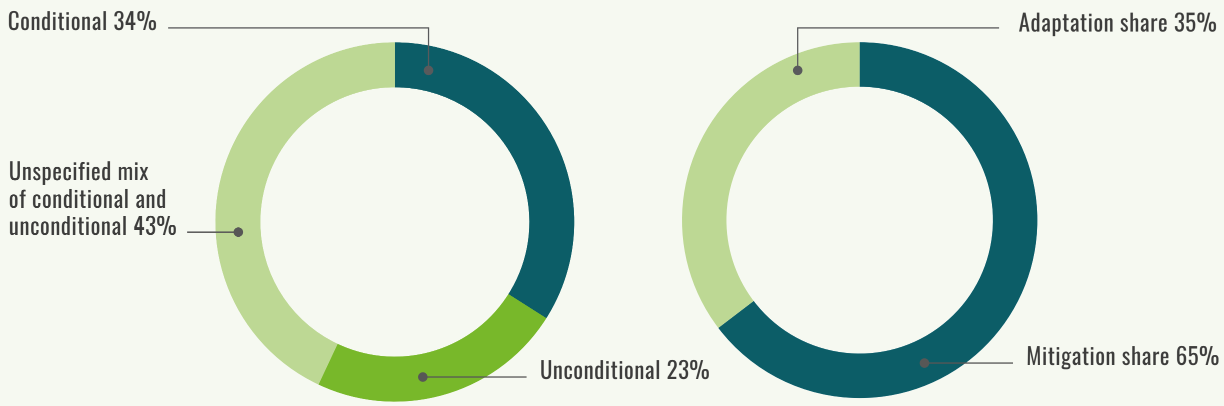
[87] Republic of Moldova, Turkmenistan and Uzbekistan.

3.3.3 Finance

Eight countrie[88]s make their NDCs contingent upon financial support. Of those eight, only five[89] quantify the cost of implementation, which totals 35.4 billion USD, or 0.6 billion USD per year. Of those five countries that report implementation costs, three[90] specify the share contingent upon international financial support, in which 34 percent of total costs are fully conditional, 23 percent unconditional and 43 percent partially conditional to external support. The same three countries disaggregate mitigation and adaptation costs, in which mitigation accounts for 65 percent of total costs and 35 percent for adaptation. **Figure 50** illustrates the share of total finance needs expressed in terms of conditional and unconditional share, as well as adaptation and mitigation share.

FIGURE 50.

SHARE OF TOTAL FINANCIAL RESOURCES FOR NDC IMPLEMENTATION, BY CONDITIONALITY AND MITIGATION AND ADAPTATION SHARE



[88] Bosnia and Herzegovina, Kazakhstan, Kyrgyzstan, Republic of Moldova, Tajikistan, The Former Yugoslav Republic of Macedonia, Turkmenistan and Uzbekistan.

[89] Bosnia and Herzegovina, Kyrgyzstan, Republic of Moldova, The Former Yugoslav Republic of Macedonia and Turkmenistan.

[90] Kazakhstan, Republic of Moldova and Bosnia and Herzegovina..

CHAPTER 4

CHAPTER

4

GAPS AND OPPORTUNITIES IN THE AGRICULTURE SECTORS

This section aims to assess the degree to which the mitigation policies and measures in the agriculture sectors address the major sources of sectoral GHG emissions, and the extent to which the adaptation measures in ecosystems and social systems respond to the major observed and/or projected climate-related hazards, slow onset risks, impacts and vulnerabilities reported.

The results of the mitigation and adaptation "gap" analysis can inform the review and revision of the NDC before the 2020 submission, highlighting the "opportunities" to realign mitigation and adaptation priorities in the agriculture sectors and address the greatest sources of emissions and climate-related vulnerabilities. This section also assesses the opportunities for capturing mitigation and adaptation co-benefits, as well as leveraging synergies between climate actions in the agriculture sectors and the 2030 Agenda for Sustainable Development.

4.1 MITIGATION ANALYSIS

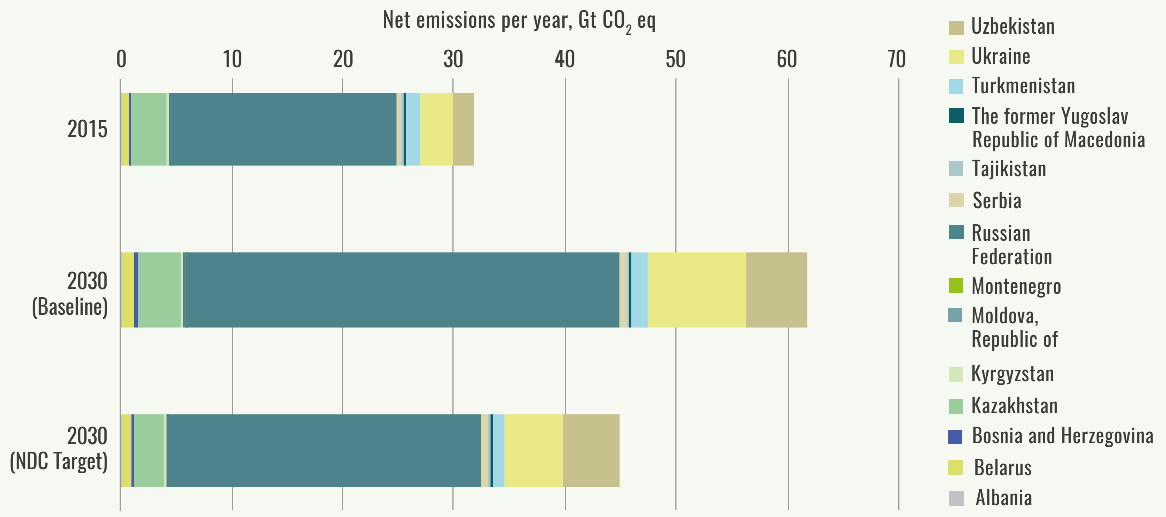
This section first presents the current state of affairs in terms of economy-wide net GHG emissions and compares it to the mitigation scenario set out in country NDCs. The GHG hotspots in the agriculture and land use sectors are identified and serve as the baseline against which the mitigation policies and measures are assessed to find gaps and opportunities of enhancing mitigation ambition in the next round of NDCs.

4.1.1 Baseline emissions and NDC targets

Based on national data reported to the UNFCCC by all 14 SEECA countries between 2014 and 2018,[91] the aggregated economy-wide mitigation target is compared against aggregated 2015 historical net emissions and 2030 baseline net emissions (**Figure 51**).

FIGURE 51.

ECONOMY-WIDE BASELINE EMISSIONS (2030) AND NDC MITIGATION TARGET (2030) FOR ALL SECTORS IN 2030, COMPARED AGAINST HISTORICAL NET EMISSIONS (2015) IN THE SEECA REGION



Without implementation of the NDCs in the SEECA region, total baseline net emissions in 2030 are expected to double those reported in 2015, rising from 3.1 Gt CO_2 eq. in 2015 to 6.2 Gt CO_2 eq. in 2030.

Under NDC implementation, regional net emissions are expected to be reduced by 27 percent in 2030 compared to baseline projected levels, or equal to 4.5 Gt CO_2 eq. in 2030. The net emission reduction is equivalent to approximately -1.7 Gt CO_2 eq. However, when compared against historical values, net emissions are nevertheless projected to increase by approximately 41 percent in 2030 under the mitigation scenario.

In the agriculture sector, only one country[92] communicated an absolute GHG target, with a cumulated net reduction in the Republic of Moldova estimated to be approximately -18 Mt CO_2 eq. over the implementation period of 2021 to 2030.

In the LULUCF sector, only two countries[93] communicated an absolute GHG target, with annual sequestration capacity in Bosnia and Herzegovina to remain constant between 2016 and 2030 at -6,470 kt CO_2 per year, and cumulated removals in the Republic of Moldova to reach -30 Mt CO_2 eq. between 2021 and 2030.

[91] Data for Belarus, Kazakhstan, Republic of Moldova, Russian Federation, Ukraine and Uzbekistan are sourced from NGHGIs. Data for Albania, Bosnia and Herzegovina, Kyrgyzstan, Serbia, Tajikistan and Turkmenistan are sourced from NC. Data for Montenegro and The former Yugoslav Republic of Macedonia are sourced from BUR.

[92] Republic of Moldova.

[93] Bosnia and Herzegovina and the Republic of Moldova.

4.1.2 GHG hotspots

The contribution of the agriculture and LULUCF sector to regional net emissions is significant, at around 14 percent. Achieving the 27 percent reduction in net emissions compared to the baseline in 2030 will depend upon the identification of key emission categories and opportunities for cost-effective mitigation. With 79 percent of SEECA countries committed to mitigation in the agriculture and/or LULUCF sectors, those key GHG source categories are identified to then form the baseline for the gap and opportunity analysis in the next section.

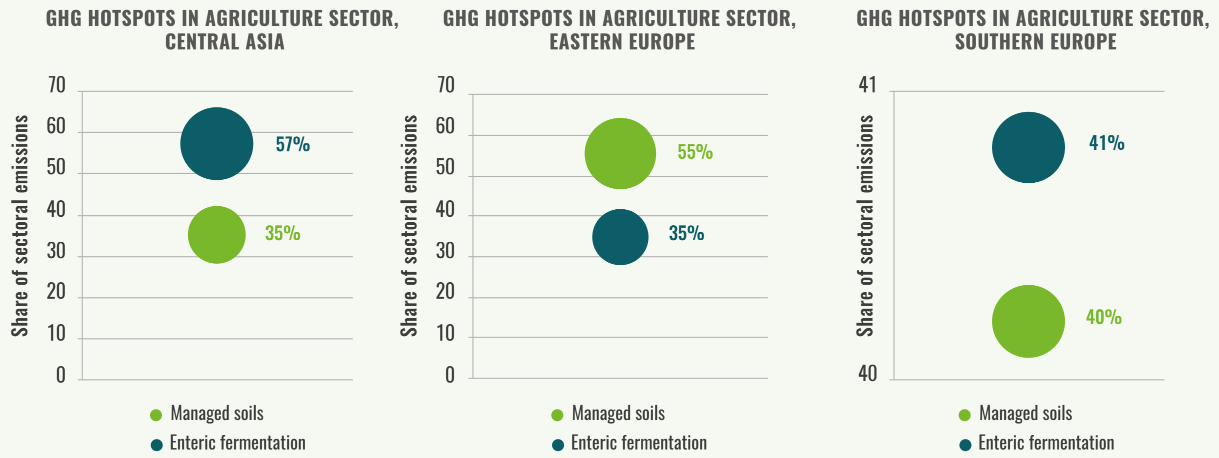
For each country, the first and second[94] largest sources of sectoral emissions, or "GHG hotspots," are identified based on data reported in the NGHGI. The country-level GHG hotspots are then aggregated at sub-regional and regional level to identify trends amongst emissions sources, and account for differences, across sub-regional economies and land covers.

In the agriculture sector, the largest GHG hotspots in the region are emissions from managed soils (50 percent), mostly generated in Eastern Europe, and enteric fermentation (41 percent), predominantly from Eastern Europe and Central Asia.

Figure 52 illustrates the sectoral GHG hotspots in the agriculture sector, at the sub-regional level, in terms of share of sectoral emissions (% : y-axis) as well as sectoral emissions (kt CO_2 eq : size of dot). In Central Asia, with the largest share of land area amongst sub-regions dedicated to extensive cereal-livestock and sparse (arid) systems raising cattle and sheep, the greatest source of emissions is from enteric fermentation, with a 57 percent share of total, followed by those from managed soils at 35 percent. Conversely, in Eastern Europe, emissions from managed soils hold a greater share, 55 percent, than emissions from enteric fermentation at 35 percent, as sparse (cold) farming systems growing rye and oats predominate followed by extensive cereal-livestock raising cattle and sheep. In Southern Europe, enteric fermentation and managed soils generate almost equal shares of sectoral emissions, at 41 and 40 percent, respectively, illustrative of the mixed farming systems characterized by livestock and crop production.

FIGURE 52.

SUB-REGIONAL GHG HOTSPOTS IN THE AGRICULTURE SECTOR

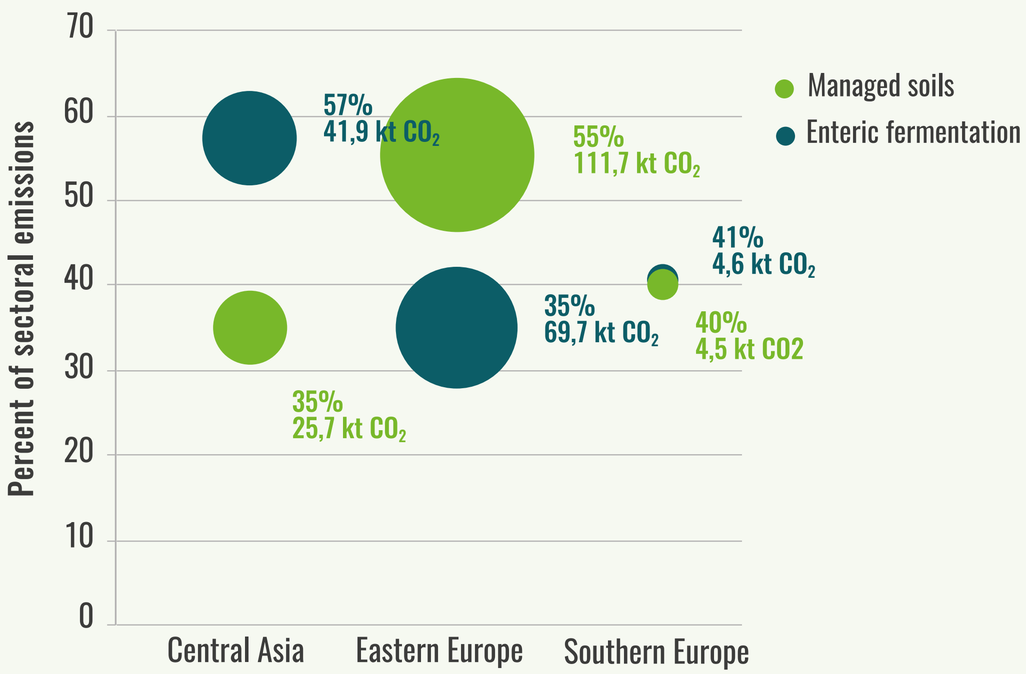


[94] Above a 20 percent share.

While the shares of total emissions attributed to enteric fermentation and managed soils are high amongst all sub-regions, their overall contribution in terms of net emissions varies greatly. Overall, the greatest emission sources in the region are managed soils (50 percent), mostly generated in Eastern Europe, and enteric fermentation (41 percent), predominantly from Eastern Europe and Central Asia. **Figure 53** illustrates the sectoral GHG hotspots in the agriculture sector, at sub-regional level, in terms of share of sectoral emissions (% : y-axis) as well as sectoral emissions (kt CO_2 eq : size of dot).

FIGURE 53.

REGIONAL GHG HOTSPOTS IN THE AGRICULTURE SECTOR

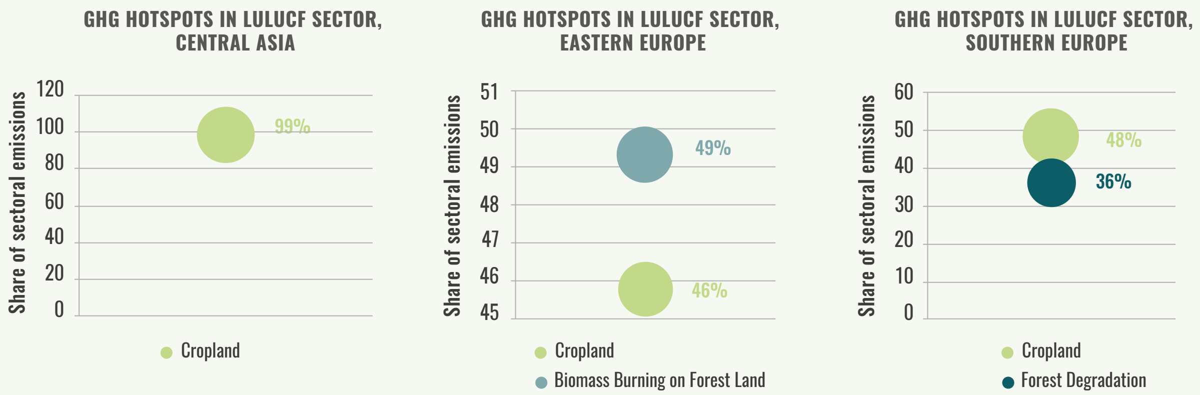


In the LULUCF sector, the largest GHG hotspots in the region are emissions from cropland (52 percent) and biomass burning on forest land (43 percent), generated mostly in Eastern Europe.

Figure 54 illustrates the sectoral GHG hotspots in the LULUCF sector, at the sub-regional level, in terms of share of sectoral emissions (% : y-axis) as well as sectoral emissions (kt CO_2 eq : size of dot). In Central Asia, with less than 5 percent forest cover and three-fourth of land area dedicated to cereal producing farming systems, the emissions from cropland represent 99 percent of sectoral emissions. In Eastern Europe, with 50 percent forest cover and increasing conversion of grasslands to cropland for agriculture production, emissions from biomass burning on forest land and from cropland are relatively equal in size GHG hotspots, with 49 and 46 percent shares of sectoral emissions, respectively. In Southern Europe, where conversion of grassland to cropland for mixed farming is observed, emissions from cropland are predominant with a 48 percent share of total and emissions from forest degradation, at 36 percent, close behind.

FIGURE 54.

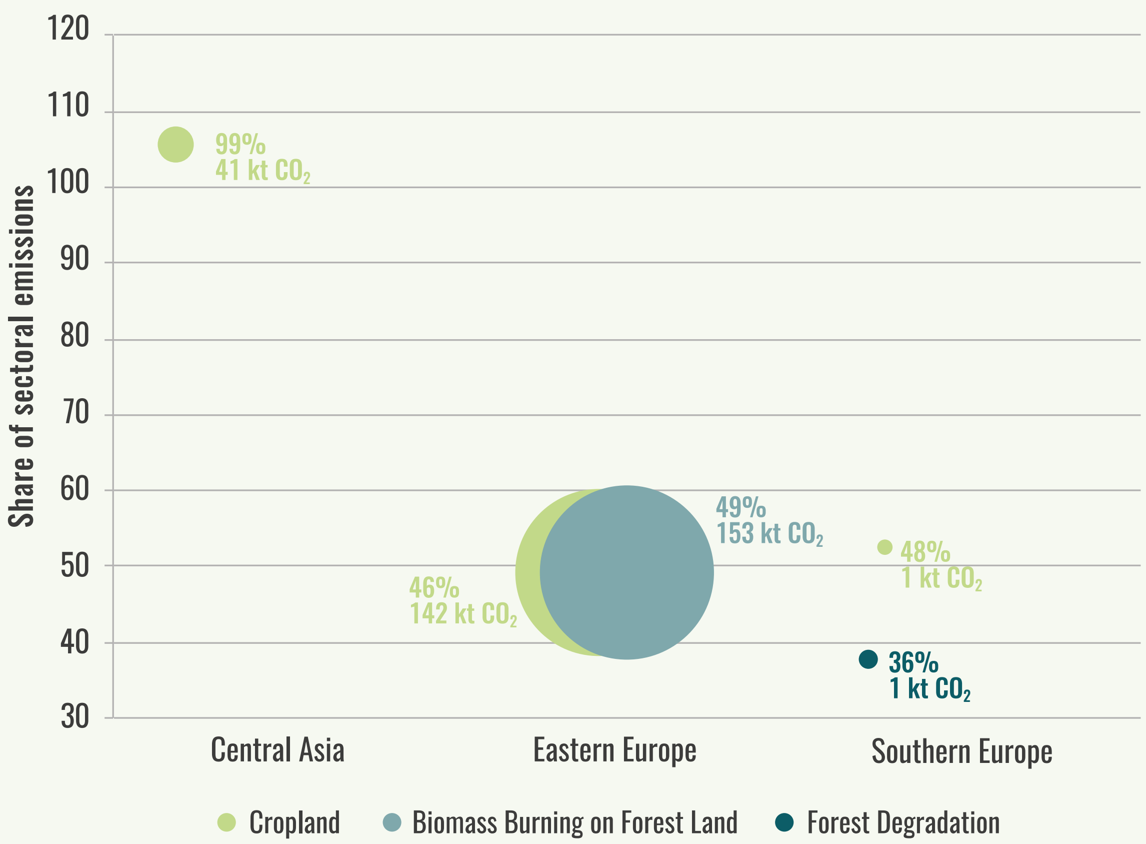
SUB-REGIONAL GHG HOTSPOTS IN THE LULUCF SECTOR



When emissions from the agriculture and LULUCF sector are combined, the largest GHG hotspots in the region are emissions from cropland (29 percent), followed by biomass burning from forest land (24 percent), managed soils (22 percent), and enteric fermentation (18 percent), largely generated in Eastern Europe and Central Asia. **Figure 55** illustrates the sectoral GHG hotspots in the AFOLU sector, at the sub-regional level, in terms of share of sectoral emissions (%:y-axis) as well as sectoral emissions (kt CO_2 eq; size of dot).

FIGURE 55.

REGIONAL GHG HOTSPOTS IN THE LULUCF SECTOR



When emissions from the agriculture and LULUCF sector are combined, the largest GHG hotspots in the region are emissions from cropland, biomass burning from forest land, managed soils and enteric fermentation, with considerable variation across sub-regions. In Central Asia, emissions from enteric fermentation (37 percent), followed by cropland (36 percent) and managed soils (22 percent) represent the largest hotspots in the AFOLU sector. In Eastern Europe, emissions from biomass burning on forest land (30 percent) and emissions from cropland (28 percent) hold the highest shares. In Southern Europe, emissions from managed soils and enteric fermentation hold equal shares (35 percent each). **Figure 56** presents the sectoral hotspots in terms of share of total emission at the sub-regional level.

FIGURE 56.

SUB-REGIONAL GHG HOTSPOTS IN THE AFOLU SECTOR

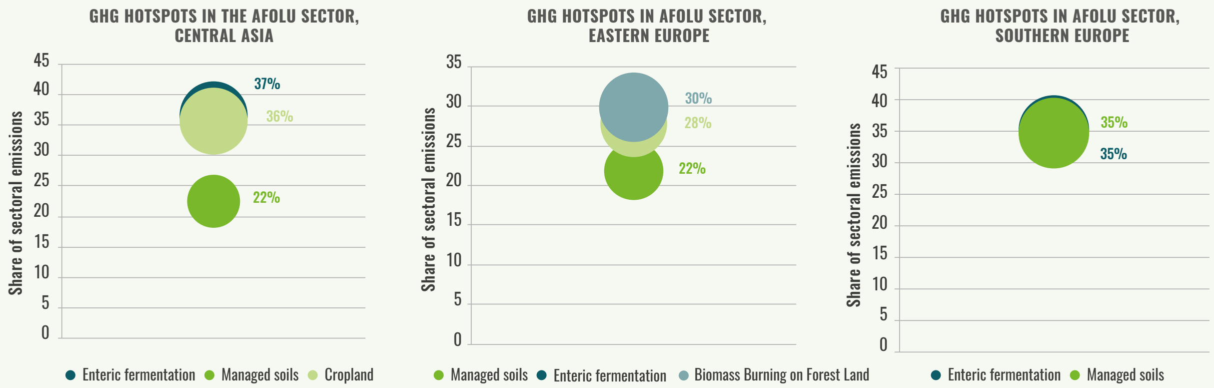
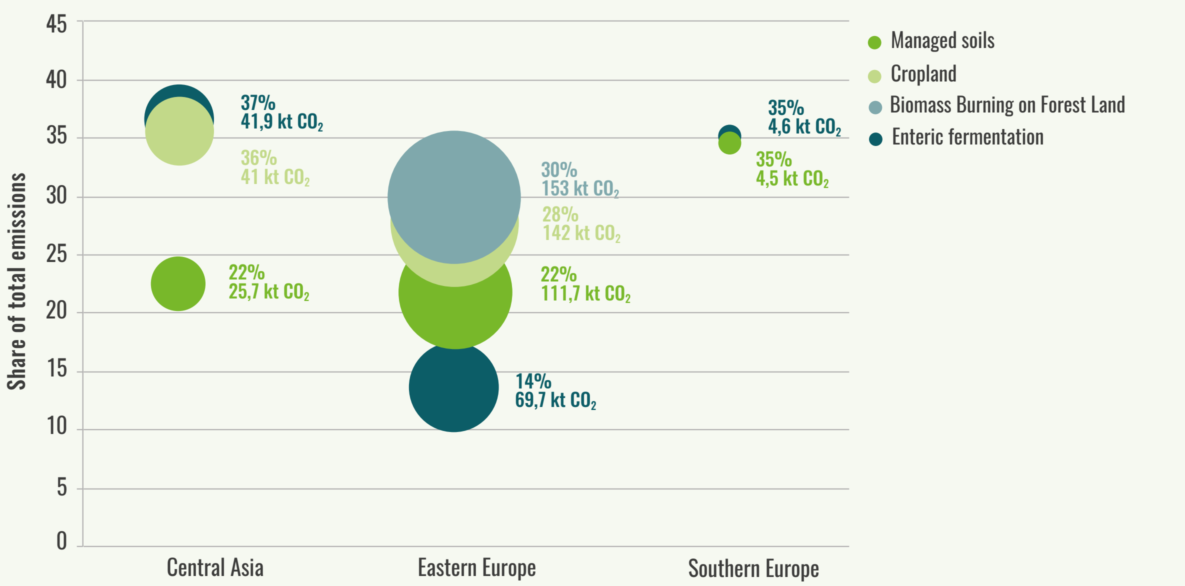


Figure 57 illustrates the GHG hotspots in the AFOLU sector, at the regional level, in terms of share of total emissions as well as net emissions (kt CO_2 eq). Overall, the largest emission sources in the region are, in descending order, cropland (29 percent), biomass burning from forest land (24 percent), managed soils (22 percent), and enteric fermentation (18 percent), largely generated in Eastern Europe and Central Asia.

FIGURE 57.

REGIONAL GHG HOTSPOTS IN THE AFOLU SECTOR



4.1.3 Gaps and opportunities for enhancing mitigation

A gap analysis is performed to assess the degree to which sectoral policies and measures in the agriculture sectors address the main sources of sectoral GHG emissions, or GHG hotspots, to illustrate not only current policy "gaps" but potential "opportunities" for enhancing future NDCs. The degree of alignment between the current policies and measures contained in the NDCs in the agriculture and LULUCF sectors and GHG hotspots identified is determined based on the methodology defined in **Chapter 1** and the mitigation matrix (**Annex 1**).

A policy and measure gap refers to when there is misalignment between the current policies and measures in the NDC and the GHG hotspot reported in the NGHGI of the country. The gap is quantified at the sub-regional level as the share of countries with a policy and measure gap per GHG hotspot (**Table 5**).

Policy alignment refers to when at least one mitigation policy and measure in the NDC aims to reduce emissions or enhance sinks from the GHG hotspot identified in the NGHGI of the country. The degree of policy alignment is quantified at the sub-regional level as the share of countries with at least one mitigation policy and measure that addresses the relevant GHG hotspots.

If only a portion of the potential policy and measures are included in the NDC, the **mitigation opportunity** for improving the NDC through better alignment of existing policy and measures with the GHG hotspots is also indicated at the country level. The list of opportunities, however, is indicative, and not prescriptive, of those potential policies and measures that could generate mitigation benefits in relation to a country's GHG hotspots, conditional to country context.

TABLE 5.

DEGREE OF MITIGATION POLICY ALIGNMENT AND GAPS IN THE NDC

POLICY ALIGNMENT	RANGE OF ALIGNMENT	RANGE OF POLICY GAP
LOW	0 TO 25 PERCENT	76 TO 100 PERCENT
MODERATE	26 TO 50 PERCENT	51 TO 75 PERCENT
HIGH	51 TO 75 PERCENT	26 TO 50 PERCENT
VERY HIGH	76 TO 100 PERCENT	0 TO 25 PERCENT

The country-level results are aggregated at sub-regional and regional levels to identify common trends and differences, and are presented per GHG hotspot and ordered by size of gap found. **Annex 10-11** contain a summary of the country-level gap analysis results and a list of potential mitigation policy and measures, or "opportunities", per GHG hotspot for each country.

Overall, the most significant regional gaps are observed in mitigation policies and measures in the agriculture sectors aiming to reduce net emissions from cropland (100 percent policy gap), enteric fermentation (79 percent) and managed soils (73 percent). **Table 6** presents the results of the mitigation policy gap and opportunity analysis by GHG hotspot in the AFOLU sector for which the size of the policy gap is greater than 10 percent regionally, ordered from largest to smallest policy gap. For each GHG hotspot, its contribution to regional AFOLU emissions is indicated, as well as the share of countries in the region to which the hotspot is associated. The farming systems most related to the GHG hotspot are identified.

TABLE 6.

MITIGATION POLICY GAPS PER GHG HOTSPOT IN THE AFOLU SECTOR (>5 PERCENT OF EMISSIONS) AMONGST SEECA COUNTRIES, ORDERED BY SIZE OF GAP (>10 PERCENT), FROM LARGEST TO SMALLEST

GHG HOTPOT	HOTSPOT SHARE OF AFOLU EMISSIONS %	COUNTRIES WITH HOTSPOT %	MITIGATION POLICY GAP %	RELATED FARMING SYSTEM
CROPLAND	29	57	100	LARGE-SCALE CEREAL-VEGETABLE; EXTENSIVE CEREAL-LIVESTOCK; IRRIGATED; HORTICULTURE MIXED; MIXED; SPARSE (COLD AND ARID)
ENTERIC FERMENTATION	18	100	79	EXTENSIVE CEREAL-LIVESTOCK; PASTORAL; LARGE-SCALE CEREAL-VEGETABLE; FOREST-BASED LIVESTOCK
MANAGED SOILS	22	79	73	LARGE-SCALE CEREAL-VEGETABLE; EXTENSIVE CEREAL-LIVESTOCK; IRRIGATED; HORTICULTURE MIXED; MIXED; PASTORAL

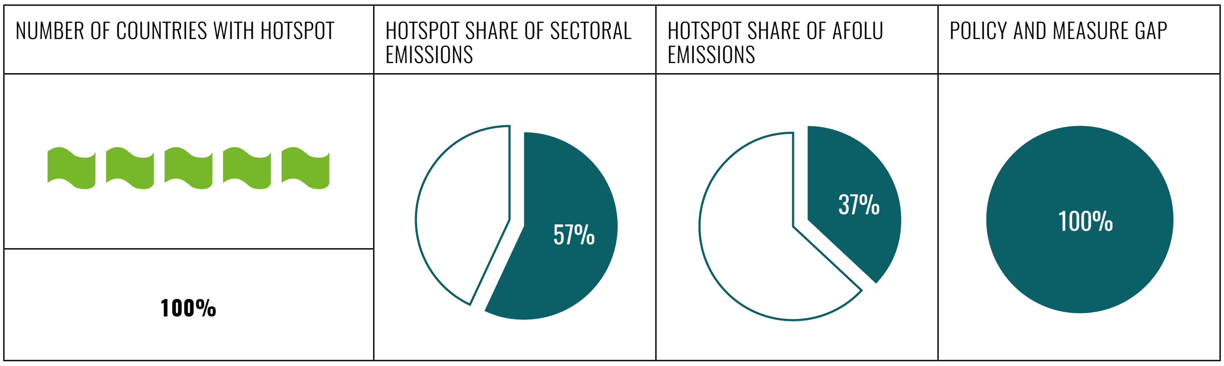
Note: Related farming system based on FAO and WB (2001) and FAO expert consideration.

The sub-regional results are presented below:

CENTRAL ASIA

In Central Asia, the largest gaps are found in the policies and measures aimed at reducing emissions from enteric fermentation and cropland. Emissions from these sources represent the largest GHG hotspots in terms of sectoral and AFOLU emissions. On the other hand, moderate alignment was found in policies and measures targeting emissions from managed soils.

ENTERIC FERMENTATION



CROPLAND

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
40%	99%	36%	100%

MANAGED SOILS

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
80%	35%	22%	50%

EASTERN EUROPE

In Eastern Europe, the largest gaps are found in the policies and measures aiming to reduce emissions from cropland and managed soils. Emissions from cropland and managed soils represent approximately half of sectoral emissions. A low degree of alignment in policies and measures targeting emissions from enteric fermentation is also observed. Conversely, policy and measures are very highly aligned with efforts to reduce emissions from biomass burning on forest land, though the opportunity to include fire management activities is available.

CROPLAND

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
75%	46%	28%	100%

MANAGED SOILS

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
100%	55%	22%	100%

ENTERIC FERMENTATION

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
100%	35%	14%	75%

BURNING BIOMASS ON FOREST LAND

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
25%	49%	30%	0%

SOUTHERN EUROPE

In Southern Europe, the largest gaps are found in policies and measures aiming to reduce emissions from cropland, followed by managed soils and enteric fermentation. Cropland emissions represent almost half of sectoral emissions yet no policy alignment is observed. Moderate policy alignment is found in those targeting managed soils and enteric fermentation, with opportunities to include additional mitigation measures. On the other hand, policy and measures targeting forest degradation are very highly aligned.

CROPLAND

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
60%	48%	7%	100%

MANAGED SOILS

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
60%	40%	35%	67%

ENTERIC FERMENTATION

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
100%	41%	35%	60%

FOREST DEGRADATION

NUMBER OF COUNTRIES WITH HOTSPOT	HOTSPOT SHARE OF SECTORAL EMISSIONS	HOTSPOT SHARE OF AFOLU EMISSIONS	POLICY AND MEASURE GAP
20%	36%	5%	0%

BOX 2: BIOENERGY FROM AGRICULTURE AND FORESTS: MITIGATION SYNERGY AND TRADEOFF ANALYSIS

The impact of bioenergy production and/or consumption on net emissions at large depends on the sustainability of practices and the efficiency of bioenergy systems. A lifecycle assessment of bioenergy, from production to end-use, is necessary to appraise its global warming impact and address equilibrium effects, including indirect land use change (ILUC). If implemented sustainably, bioenergy can result in higher food and energy outcomes, restore soils and reduce land-use competition (IPCC, 2014a).

The impact of bioenergy production and/or consumption on net emissions in the agriculture sectors depends on site-specific conditions and technologies, including: 1) share of bioenergy derived from wastes and residues; 2) the extent to which bioenergy production is integrated with food and fibre production; 3) the extent to which bioenergy is grown on unproductive land; and 4) the quantity of dedicated energy crops and yield. Hence, the mitigation potential of bioenergy lies upon the conservation of land carbon stock, the precise application of fertilizers, the interaction with food markets and the sustainable management of land and water resources (IPCC, 2014a).

Evidence suggests that when bioenergy production is integrated with food production in developing countries, such as through perennial crop rotation schemes, sustainable use of by-products and residues, improved cookstoves, fast growing tree species for woodfuel and small-scale biogas and biopower production, emissions from agriculture and land use may lower and livelihoods and health improve, if coupled with sustainable land management and governance (IPCC, 2014a). The total impact on livelihoods depends on a range of factors beyond terrestrial carbon storage, including distributional effects on income and food security; land tenure and governance; and biodiversity and ecosystem services conservation.

The mitigation matrix in Annex 1 maps the potential interactions between bioenergy and agriculture and land use emission sources and sinks, including synergies and tradeoffs. For instance, the use of forest biomass for energy production may reduce carbon stock on forest land. Conversely, the use of livestock waste for energy production may reduce methane emissions from manure management. The present analysis is indicative, and not prescriptive, of potential synergies and tradeoffs amongst mitigation policies and measures in the agriculture, land use and bioenergy sectors. Ex-ante impact assessment of a specific measure should be performed at the local level and across temporal and spatial scales to ensure tradeoffs are reconciled amongst competing users and across sectors.

Overall, the bioenergy-related policies and measures generate potential tradeoffs with emissions from cropland, managed soils and deforestation across all three sub-regions, while potential synergies between biogas production and reduced emissions from manure management in Eastern Europe are also observed.

4.2 ADAPTATION ANALYSIS

This section first presents the natural resources and ecosystem services supported by the adaptation measures in natural ecosystems set out in country NDCs. The observed and/or projected climate-related hazards, impacts and vulnerabilities in ecosystems reported serve as the adaptation baseline against which the adaptation measures in ecosystems are assessed. Further, the observed and/or projected climate-related risks, impacts and vulnerabilities in social systems reported are also compared against the adaptation priorities and measures in social systems set forth in the NDCs. The analysis aims to identify gaps and opportunities for enhancing mitigation ambition and adaptation options in the next round of NDCs.

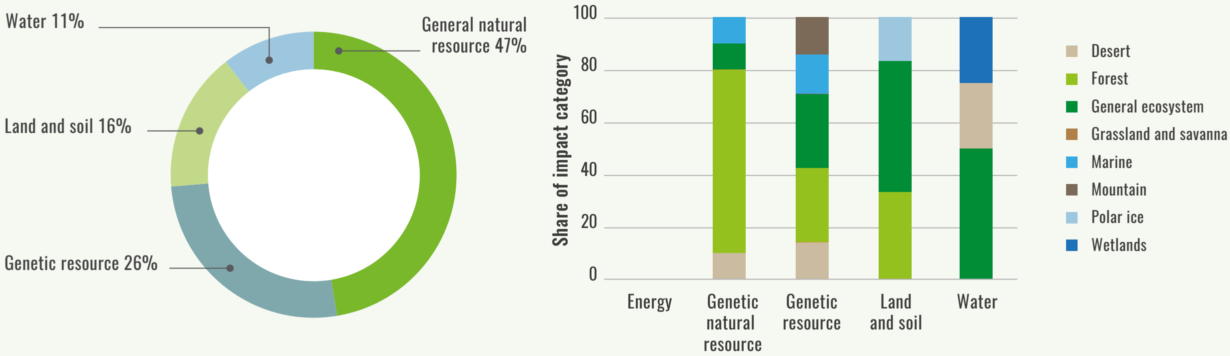
4.2.1 Baseline adaptation

The adaptation measures in ecosystems are qualified by the ecosystem service and natural resource supported. As ecosystem services and natural resources transcend ecosystems and agro-ecosystems, the aggregate impact of adaptation in ecosystems is assessed to account for synergies across ecosystem boundaries.

Amongst adaptation measures in ecosystems outside of farming (**Figure 58**), **the majority support general natural resource use and management** (47 percent of measures), **primarily in forest ecosystems,** followed by genetic resources (26 percent), land and soil resources (16 percent), primarily in forest and grassland and savanna ecosystems, and water resources (11 percent) in wetlands and desert ecosystems.

FIGURE 58.

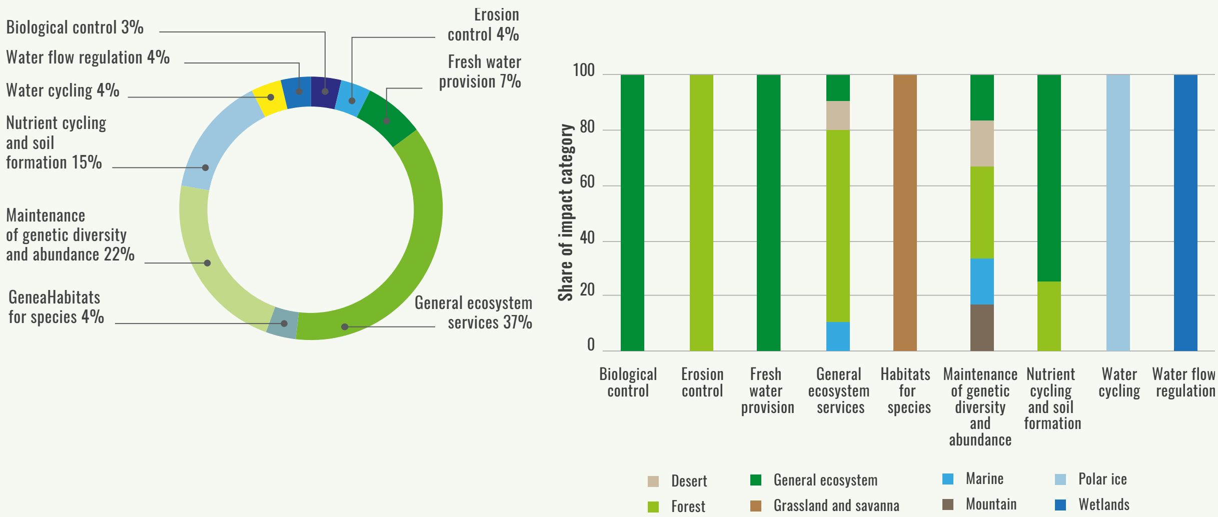
SHARE OF ADAPTATION MEASURES IN ECOSYSTEMS OUTSIDE OF FARMING WITH NATURAL RESOURCE SUPPORT, BY NATURAL RESOURCE TYPE



The majority of adaptation measures are associated with general ecosystem services' support (37 percent of measures), **primarily in forest ecosystems,** followed by the maintenance of genetic diversity and abundance (22 percent), in mountain, marine, desert and forest ecosystems, and nutrient cycling and soil formation (15 percent), primarily in forest ecosystems, amongst others (**Figure 59**).

FIGURE 59.

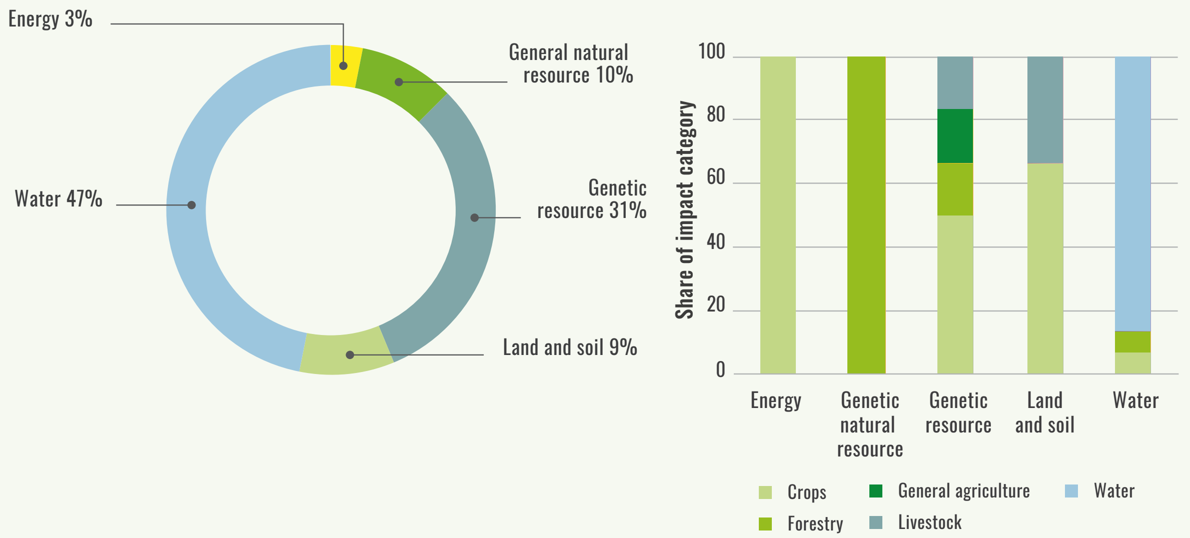
SHARE OF ADAPTATION MEASURES IN ECOSYSTEMS OUTSIDE OF FARMING WITH ECOSYSTEM SERVICE SUPPORT, BY TYPE OF ECOSYSTEM SERVICE



Amongst adaptation measures in agro-ecosystems (Figure 60), **the majority support water resource use and management** (47 percent of measures), followed by genetic resources (31 percent), primarily in the crops sub-sector, general natural resources (10 percent), primarily in forestry, land and soil resources (9 percent), primarily in the crops and livestock sub-sector and energy resources from crops (3 percent).

FIGURE 60.

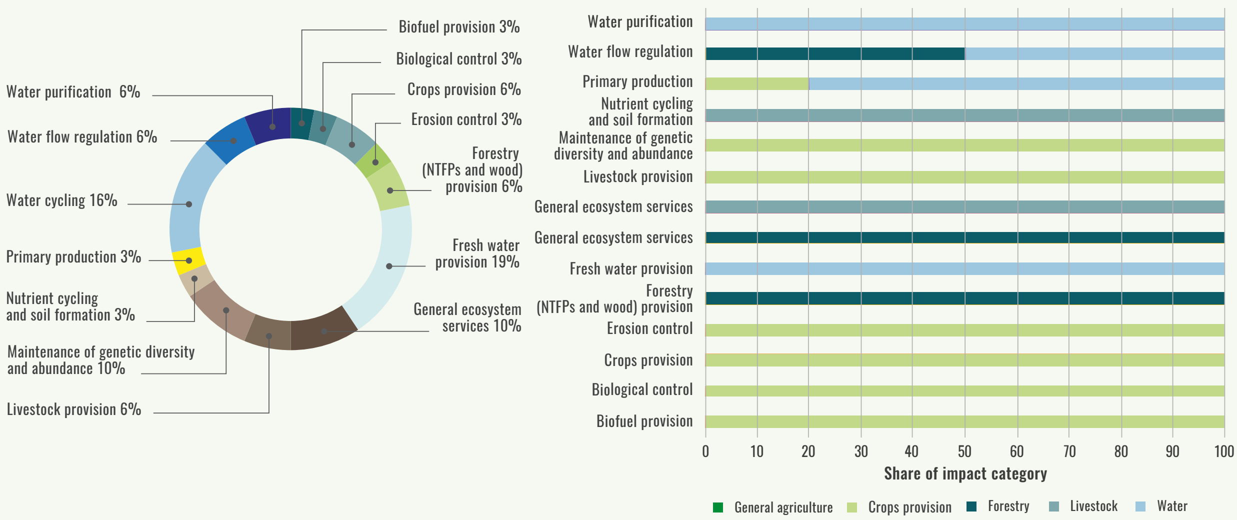
SHARE OF ADAPTATION MEASURES IN AGRO-ECOSYSTEMS WITH NATURAL RESOURCE SUPPORT, BY NATURAL RESOURCE TYPE



The majority of adaptation measures in agro-ecosystems (Figure 11) **support the provision of freshwater** (19 percent of measures), followed by water cycling (14 percent) and maintenance of genetic diversity and abundance (10 percent), primarily in the crops sub-sector, amongst others.

FIGURE 61.

SHARE OF ADAPTATION MEASURES IN AGRO-ECOSYSTEMS WITH ECOSYSTEM SERVICE SUPPORT, BY ECOSYSTEM SERVICE TYPE



4.2.2 Gaps and opportunities for enhancing adaptation

A gap analysis was performed to assess the degree to which adaptation priorities and measures in ecosystems and social systems address major observed and/or projected climate-related hazards, slow onset risks, impacts and vulnerabilities in ecosystems and social systems reported in the NDC. The analysis is based on the adaptation matrices for ecosystems and social systems contained in **Annex 2-3** and the methodology described in **Chapter 1** where are also considered limitations to the analysis.

In ecosystems, the major observed and/or projected climate-related hazards, risks and vulnerabilities reported by each country are identified and compared against the respective adaptation priorities and measured included in the NDC at the ecosystem and/or sectoral, natural resource and ecosystem service level. The country-level results of the gap analysis are aggregated at sub-regional and regional level and presented by major syzstem, sector, natural resource or ecosystem service vulnerability and ordered by the size of policy gap found and share of countries with major impact category.

In social systems, the major observed and/or projected climate-driven impacts, vulnerabilities and risks in social systems reported by each country are identified per dimension (socioeconomics and well-being, knowledge and capacity and institutions and governance) **and compared against respective adaptation priorities and measures included in the NDC.** The country-level results of the gap analysis are aggregated at sub-regional and regional levels and presented by major vulnerability and ordered by size of policy gap and share of countries with major impact category.

A policy gap refers to when there is misalignment between the current adaptation measures presented and the major climate-related impact categories reported in the NDC. The gap is quantified at the sub-regional level as the share of countries with a policy gap per major climate-related impact categories (**Table 2**).

Policy alignment refers to when at least one adaptation measure in the NDC aims to reduce vulnerability and/or increase adaptive capacity in relation to the major climate-related impact category reported by the country. The degree of policy alignment is quantified at the sub-regional level as the share of countries with at least one adaptation measure that addresses the relevant major climate-related impact category.

If only a portion of the potential adaptation measures are included in the NDC, the **adaptation opportunity** for improving the NDC through better alignment of existing measures with the major climate-related impact category is also indicated at the country level. The list of adaptation opportunities, however, is indicative, and not prescriptive, of those potential adaptation options that could reduce vulnerability and increase adaptive capacity in the agriculture sectors in relation to the impact category identified, conditional to country context.

The bottom-up approach of the analysis reflects the country-driven nature of adaptation in the NDCs. **Annex 12**-13 contains the country-level gap analysis results and a list of potential adaptation priorities and measures, or "opportunities", per major impact category for each country.

TABLE 7.

DEGREE OF ADAPTATION POLICY ALIGNMENT AND GAPS IN THE NDC

POLICY ALIGNMENT	RANGE OF ALIGNMENT	RANGE OF POLICY GAP
LOW	0 TO 25 PERCENT	76 TO 100 PERCENT
MODERATE	26 TO 50 PERCENT	51 TO 75 PERCENT
HIGH	51 TO 75 PERCENT	26 TO 50 PERCENT
VERY HIGH	76 TO 100 PERCENT	0 TO 25 PERCENT

Gaps and opportunities in ecosystems

Overall, the largest gaps are found in adaptation priorities and measures aiming to reduce vulnerability and increase adaptive capacity in response to the climate-related hazards, impacts and vulnerabilities observed and/or projected in the crop sector (67 percent gap), followed by forest and mountain ecosystems (50 percent). **Table 8** presents the results of the adaptation policy gap and opportunity analysis by climate-related vulnerability category most frequently reported for which the size of the policy gap is greater than 10 percent regionally, ordered from largest to smallest policy gap. For each climate-related vulnerability category, the share of countries that report the vulnerability is indicated. The farming systems most related to the climate-related vulnerability are also identified.

TABLE 8.

ADAPTATION POLICY GAPS PER CLIMATE-RELATED VULNERABILITY CATEGORY MOST FREQUENTLY REPORTED IN ECOSYSTEMS AMONGST SEECA COUNTRIES (>10 PERCENT OF COUNTRIES), ORDERED BY SIZE OF GAP (>0 PERCENT GAP), FROM LARGEST TO SMALLEST

MAJOR CLIMATE-RELATED VULNERABILITY CATEGORY	COUNTRIES WITH MAJOR IMPACT REPORTED %	ADAPTATION POLICY GAP %	RELATED FARMING SYSTEM
CROPS	21	67	EXTENSIVE CEREAL-LIVESTOCK; LARGE-SCALE CEREAL-VEGETABLE; IRRIGATED; SPARSE (ARID AND COLD);
FOREST ECOSYSTEM	14	50	FOREST-BASED LIVESTOCK
MOUNTAIN ECOSYSTEM	14	50	PASTORAL
GENERAL ECOSYSTEMS	36	40	ALL
GENERAL NATURAL RESOURCES	43	33	ALL
GENETIC RESOURCES	43	33	ALL
INLAND WATER ECOSYSTEM	21	33	WATER BODIES
FORESTRY	36	20	FOREST-BASED LIVESTOCK
GENERAL ECOSYSTEM SERVICES	36	20	ALL

Note: Related farming system based on FAO and WB (2001) and FAO expert consideration.

The sub-regional results are presented below:

CENTRAL ASIA

In Central Asia, four out of five countries[95] identified observed and/or projected climate-related hazards, impacts and vulnerabilities in ecosystems, against which the adaptation priorities and measures in the agriculture sectors are compared at the ecosystem and/or sectoral, natural resource and ecosystem service level.

In Central Asia, the most significant climate-related hazards reported are drought and extreme heat, while the greatest climate-related slow onset risks reported are water stress and desertification. The most vulnerable ecosystems are agro-ecosystems, followed by inland water and mountain ecosystems. The most vulnerable agro-ecosystems are the forestry and crops sub-sectors. The most frequent ecosystem service impact category in ecosystems outside of farming systems reported is freshwater provision, followed by the maintenance of genetic diversity and abundance and nutrient cycling and soil formation. The most frequent ecosystem service impact category in agro-ecosystems reported is forestry (wood and non-timber forest products) and freshwater provision. The most frequent ecosystem service impact category in ecosystems outside of farming systems reported is water flow regulation, primarily in inland water ecosystems. In mountain ecosystems, the most frequently reported is freshwater provision. Overall, the most frequent natural resource impact category reported is water, followed by genetic resources and land and soil resources.

[95] Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

Overall, the largest gaps are found in adaptation priorities and measures aiming to reduce vulnerability and increase adaptive capacity in response to the climate-related hazards, impacts and vulnerabilities observed and/or projected in the crops sub-sector and inland water ecosystems. Moderate policy alignment is observed in adaptation priorities and measures targeting the forestry sub-sector, the provision of forest products and mountain ecosystems. All other major impact categories, including water resources, the maintenance of genetic diversity and abundance and nutrient cycling and soil formation, amongst others, are addressed by current adaptation priorities and measures in the NDCs.

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
CROPS	**20%**	100%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
INLAND WATER ECOSYSTEM	**40%**	100%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
FORESTRY AND FORESTRY PROVISION	**40%**	50%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
MOUNTAIN ECOSYSTEM	**40%**	50%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
WATER RESOURCES	 80%	0%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
MAINTENANCE OF GENETIC DIVERSITY AND ABUNDANCE	 40%	0%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
NUTRIENT CYCLING AND SOIL FORMATION	 40%	0%

EASTERN EUROPE

In Eastern Europe, two out of four countries[96] identified observed and/or projected climate-related hazards, impacts and vulnerabilities in ecosystems, against which the adaptation priorities and measures in the agriculture sectors are compared at the ecosystem and/or sectoral, natural resource and ecosystem service level.

In Eastern Europe, the most significant climate-related hazards reported are drought and invasion by pests and non-native species in agriculture, while the greatest climate-related slow onset risks reported are water stress and soil erosion. The most vulnerable ecosystems are agro-ecosystems, including forests, followed by inland water ecosystems. The most vulnerable agro-ecosystems are the forestry and crops sub-sectors. The most frequent ecosystem service impact category in agro-ecosystems reported is forestry (wood and non-timber forest products) and crops provision. The most frequent ecosystem service impact category reported for ecosystems outside of farming is freshwater provision, primarily in inland water ecosystems. Overall, the most frequent natural resource impact category reported is genetic resources, followed by water.

Overall, the largest gaps are found in adaptation priorities and measures aiming to reduce vulnerability and increase adaptive capacity in response to the climate-related hazards, impacts and vulnerabilities observed and/or projected in forest ecosystems, followed by genetic resources. All other major impact categories, including the crops sub-sectors, the provision of freshwater and inland water ecosystems, are addressed by adaptation priorities and measures in the NDCs, exhibiting very high policy alignment.

[96] Republic of Moldova and Belarus.

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
FOREST ECOSYSTEM	25%	100%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
GENETIC RESOURCES	25%	50%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
CROPS AND CROP PROVISION	25%	0%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
FRESHWATER PROVISION	25%	0%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
INLAND WATER ECOSYSTEM	25%	0%

SOUTHERN EUROPE

In Southern Europe, only one out of five countries[97] identified observed and/or projected climate-related hazards, impacts and vulnerabilities in ecosystems, against which the adaptation priorities and measures in the agriculture sectors are compared at the ecosystem and/or sectoral, natural resource and ecosystem service level.

In Southern Europe, the most significant climate-related hazards reported are drought and invasion by pests and non-native species in agriculture, while the greatest climate-related slow onset risk reported is water stress. The most vulnerable ecosystems are agro-ecosystems, including forest, followed by inland water ecosystems. The most vulnerable agro-ecosystems are the crops and forestry sub-sectors. The most frequent ecosystem service impact category reported in ecosystems outside of farming is maintenance of genetic diversity and abundance and water flow regulation. The most frequent ecosystem service impact category reported in agro-ecosystems is biological control, followed by forestry (wood and non-timber forest products) and crops provision. The most frequent ecosystem service impact category reported in ecosystems outside of farming is freshwater provision, primarily in inland water ecosystems. Overall, the most frequent natural resource impact category reported is genetic resources, followed by water.

Overall, the largest gaps are found in adaptation priorities and measures aiming to reduce vulnerability and increase adaptive capacity in response to the climate-related hazards, impacts and vulnerabilities observed and/or projected in the crop sub-sector. All other major impact categories, including forest and inland water ecosystems, biological control, freshwater provision and genetic resources, are addressed by current adaptation priorities and measures considered very highly aligned in the NDCs.

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
CROPS	**20%**	100%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
FOREST ECOSYSTEM	**20%**	0%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
INLAND WATER ECOSYSTEM	**20%**	0%

[97] Serbia.

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
BIOLOGICAL CONTROL	**20%**	0%

MAJOR CLIMATE-RELATED VULNERABILITY	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED VULNERABILITY	POLICY GAP
GENETIC RESOURCES	**20%**	0%

BOX 3: BIOENERGY FROM AGRICULTURE AND FORESTS: ADAPTATION SYNERGY AND TRADEOFF ANALYSIS

Bioenergy houses significant mitigation potential and can simultaneously support adaptation and resilience outcomes in developing countries if resources are developed sustainably and bioenergy systems are integrated with food production and forest conservation. However, the scientific debate around large-scale deployment of bioenergy that raises concerns around land use change and competition, food security, water resources, biodiversity conservation and livelihoods is unresolved (IPCC, 2014a). While the effects on livelihoods have not yet been systematically evaluated in integrated models, some studies illustrate strong distributional impacts (IPCC, 2014a). Overall, the consequences of bioenergy implementation on ecosystems and livelihoods depend on: (1) the technology used; (2) the location, scales, and pace of implementation; (3) the land category used (forest, grassland, marginal lands, and crop lands); and (4) the business models and practices adopted (IPCC, 2014a). The total impact will be influenced by other factors, including how bioenergy systems integrate with or displace the existing land use and interact with site-specific factors such as governance, land tenure security and labor and financial opportunities, among others.

Evidence suggests that small-scale bioenergy options can provide cost-effective alternatives for mitigating climate change, while at the same time helping advance sustainable development priorities, particularly in rural areas of developing countries (IPCC, 2014a).

The adaptation matrix in natural ecosystems (Annex 2) maps the interaction between bioenergy production from agriculture and forest biomass and the range of ecosystems, ecosystem services and natural resources spanning agriculture and non-agriculture ecosystems, including potential synergies and tradeoffs. For instance, the production of bioenergy from agriculture and forest biomass may enhance the provision of biofuel and energy supply, but may also trigger direct and indirect land use change, exacerbate forest degradation, incentivize increased fertilizer use and exacerbate land degradation in some scenarios. The present analysis is indicative, and not prescriptive, of potential synergies and tradeoffs amongst adaptation measures in the agriculture and energy sectors. Ex-ante impact assessment of specific measures should be performed at the local level and across temporal and spatial scales.

Overall, synergies amongst bioenergy-related adaptation measures in the agriculture sectors are found in the provision of liquid and solid biofuel. Potential tradeoffs associated with bioenergy from agriculture and forests include the provision of crops and forest goods, as well as carbon sequestration and storage, nutrient cycling and soil formation.

Gaps and opportunities in social systems

In the SEECA region, all observed and/or projected climate-related impacts, vulnerabilities and risks in social systems reported are associated with only the first of the three pillars of social dimensions (socio-economics and well-being, knowledge and capacity and institutions and governance) identified in the adaptation matrix (**Annex 3**). As a result, the gap analysis is only related to those adaption priorities and measures associated with socio-economics and well-being in social systems.

Overall, the largest policy gaps are found in adaptation priorities and measures in social systems aiming to reduce vulnerability and increase adaptive capacity in response to observed and/or projected adverse health and food insecurity and malnutrition (50 percent policy gap, respectively). **Table 9** presents the results of the adaptation policy gap and opportunity analysis by climate-related risk category most frequently reported for which the size of the policy gap is greater than 10 percent regionally, ordered from largest to smallest policy gap. For each climate-related risk category, the share of countries that report the risk is indicated. The farming systems most related to the climate-related risk are also identified.

TABLE 9.

ADAPTATION POLICY GAPS PER CLIMATE-RELATED RISK CATEGORY MOST FREQUENTLY REPORTED IN SOCIAL SYSTEMS AMONGST SEECA COUNTRIES (>10 PERCENT OF COUNTRIES), ORDERED BY SIZE OF GAP (>0 PERCENT GAP), FROM LARGEST TO SMALLEST

MAJOR CLIMATE-RELATED RISK CATEGORY	COUNTRIES WITH MAJOR IMPACT REPORTED %	ADAPTATION POLICY GAP %	RELATED FARMING SYSTEM
ADVERSE HEALTH EFFECTS	29	50	ALL
FOOD INSECURITY AND MALNUTRITION	14	50	ALL

Note: Related farming system based on FAO and WB (2001) and FAO expert consideration.

The sub-regional results are presented below:

CENTRAL ASIA

In Central Asia, three out of five countries[98] **identified observed and/or projected climate-related risks in social systems** against which the adaptation priorities and measures set forth in the NDCs are compared.

In Central Asia, the most significant climate-related risk in social systems reported is adverse health, followed by food insecurity and malnutrition and rural livelihoods and income loss.

Overall, the largest gap is found in adaptation priorities and measures in social systems aiming to reduce vulnerability and increase adaptive capacity in response to observed and/or projected rural livelihood and income loss (100 percent policy gap). Moderate policy alignment is observed in adaptation priorities and measures targeting food insecurity and nutrition and adverse health (50 percent gap, respectively).

MAJOR CLIMATE-RELATED RISK	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED RISK	POLICY GAP
RURAL LIVELIHOODS AND INCOME LOSS	 **20%**	100%

[98] Kyrgyzstan, Turkmenistan and Uzbekistan.

MAJOR CLIMATE-RELATED RISK	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED RISK	POLICY GAP
FOOD INSECURITY AND MALNUTRITION	40%	50%

MAJOR CLIMATE-RELATED RISK	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED RISK	POLICY GAP
ADVERSE HEALTH	40%	50%

EASTERN EUROPE

In Eastern Europe, only one out of four countrie[99]s identified observed and/or projected climate-related risks in social systems against which the adaptation priorities and measures set forth in the NDC are compared.

In Eastern Europe, the most significant climate-related risks in social systems reported are the loss of productive infrastructure and assets and adverse health effects.

Overall, no policy gap in social systems is observed. Rather, very high policy alignment is found in adaptation priorities and measures aiming to reduce vulnerability and increase adaptive capacity in response to observed and/or projected adverse health (0 percent policy gap).

MAJOR CLIMATE-RELATED RISK	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED RISK	POLICY GAP
ADVERSE HEALTH	25%	0%

SOUTHERN EUROPE

In Southern Europe, only one out of five countries[100] identified observed and/or projected climate-related risks in social systems against which the adaptation priorities and measures set forth in the NDC are compared.

In Southern Europe, the most significant climate-related risks in social systems are the loss of productive infrastructure and assets and adverse health.

Overall, the largest gap is found in adaptation priorities and measures in social systems aiming to reduce vulnerability and increase adaptive capacity in response to observed and/or projected loss of productive infrastructure and assets and adverse health (100 percent policy gap, respectively).

99 Belarus.

100 Serbia.

MAJOR CLIMATE-RELATED RISK	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED RISK	POLICY GAP
LOSS OF PRODUCTIVE INFRASTRUCTURE AND ASSETS	 **20%**	100%

MAJOR CLIMATE-RELATED RISK	NUMBER OF COUNTRIES WITH MAJOR CLIMATE-RELATED RISK	POLICY GAP
ADVERSE HEALTH	 **20%**	100%

4.3 OPPORTUNITIES FOR LEVERAGING SYNERGIES

The world faces a double challenge of eradicating hunger by 2030 and addressing global climate change at the same time. In 2015, with the adoption of the 2030 Agenda for Sustainable Development and the Paris Agreement, developed and developing countries alike pledged to take ambitious action to end all forms of poverty, fight inequalities, and tackle climate change, ensuring that no one is left behind.

The Paris Agreement rests upon 174 nationally determined contributions (NDCs) that reflect the national climate targets, policies and measures of 201 countries[101], while the SDGs are defined by 17 goals and 169 targets, which need to be translated into national and subnational plans.

The SDGs and NDCs are interlinked (GIZ and WRI, 2018). Both the 2030 Agenda and the preamble of the Paris Agreement acknowledge the intrinsic relationship between climate change, sustainable development and food security. The 2030 Agenda integrates addressing climate change in its 17 goals and refers to the UNFCCC as the primary international forum for negotiating the global response to climate change. Similarly, the Paris Agreement requires parties to embed climate action "in the context of sustainable development" and acknowledges the "fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change."[102]

The challenge is to strike a balance between emission reductions, adaptation and development and poverty reduction priorities, and find policies that co-deliver. Climate change response pathways in developing countries should address the dual need for mitigation and adaptation together, leveraging synergies and reconciling tradeoffs amongst varying objectives. Capturing the co-benefits of mitigation and adaptation in the agriculture sector can also support progress in achieving the objectives of other international agreements, including the Sendai Framework for Disaster Risk Reduction, the United Nations Convention to Combat Desertification and the Convention on Biological Diversity.

Transforming the approach to NDC and SDG implementation from silos to synergies presents an unprecedented opportunity for national governments to leverage progress across both agendas and optimize resources in the path towards low-emissions and climate resilient development.

[101] As of September 1, 2018.

[102] Article 2.1 of Paris Agreement.

This section aims to assess the opportunities for capturing mitigation and adaptation co-benefits within the NDCs, as well as leveraging synergies between climate actions and the sustainable development agenda.

4.3.1 Mitigation and adaption co-benefits

Mitigation and adaptation in agriculture are closely interlinked through a web of feedbacks, synergies, and tradeoffs. Sustainable food and agriculture systems carry the greatest potential for generating synergies across climate change mitigation and adaptation efforts, as well as significant socio-economic and environmental co-benefits (FAO, 2016d). For instance, many land-based mitigation practices that aim to enhance soil carbon will also increase the ability of soils to retain moisture and prevent erosion, which in turn enriches the biodiversity and productivity of cropping systems and enhances resilience to the increasing frequency and severity of droughts and floods under climate change (Rosenzweig and Tubiello, 2007). On the other hand, most categories of adaptation options for climate change have positive impacts on mitigation (IPCC, 2014a). For instance, restoring forest ecosystems also prevents the release of atmospheric CO_2 and enhances carbon stocks. When mitigation and adaptation synergies are captured, such as through agroforestry where trees planted sequester carbon and tree products provide livelihood to communities (Verchot *et al.*, 2007), the joint mitigation-adaptation outcome is greater collectively than their sum individually. The most prominent option found in the scientific literature that delivers mitigation in agriculture while also enhancing resilience to future climate change is the enhancement of soil carbon stocks (Smith and Olesen, 2010).

An integrated landscape approach to the design of climate change adaptation and mitigation options is necessary to evaluate the often competing pressures on land use and their impact on adaptive capacities and resilience to climate variability and change, within or across sectors, in order to capture their synergies and reconcile tradeoffs.

The potential channels by which mitigation and adaptation co-benefits in the agriculture sectors are generated, as well as potential tradeoffs, are here assessed in the mitigation and adaptation measures set forth in country NDCs. A mitigation and adaptation co-benefit matrix was developed (**Annex 4**) to codify the links between the mitigation policies and measures identified in **Table 1** and adaptation measures identified in **Table 2**, from which approximately 300 potential mitigation and adaptation co-benefits and 30 tradeoffs were generated in the agriculture sectors. The degree of convergence refers to the frequency of adaptation or mitigation co-benefits per mitigation or adaptation measure (and does not reflect how much the measure contribute in absolute terms to achieving a particular outcome). The number of policies and measures with mitigation or adaptation co-benefits is quantified at the country-level and results are aggregated at sub-regional and regional levels. The number of policies and measures with "mutual mitigation and adaptation co-benefits," or when the same management activity is reported as a mitigation and adaptation measure, are also quantified at the country level. The results are aggregated at sub-regional and regional levels. When explicit reference to mutual co-benefits is missing in country NDCs, the identification of co-benefits can be critical for driving progress across both mitigation and adaptation agendas and informing investment options in the agriculture sectors.

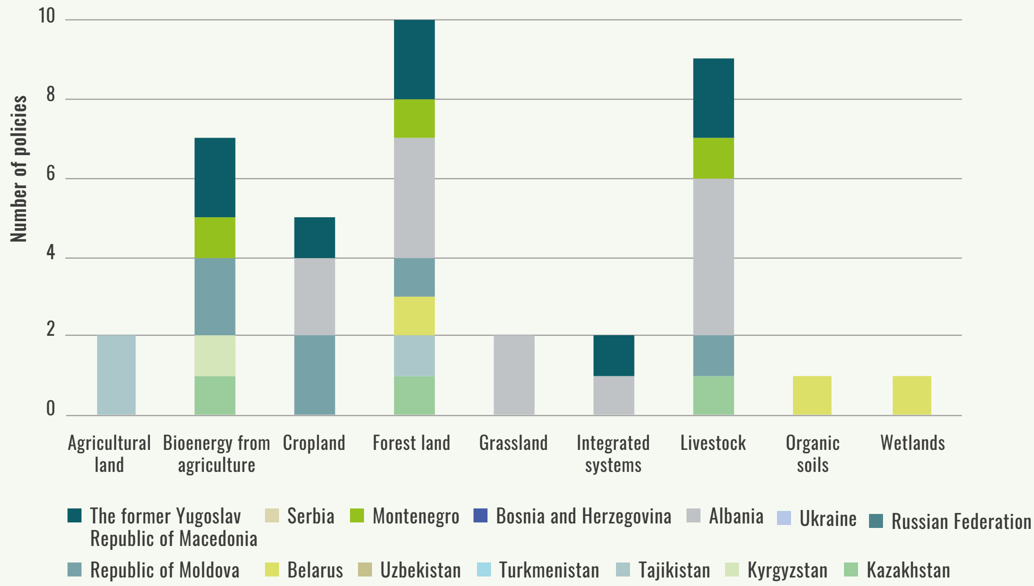
Adaptation co-benefits of mitigation

Overall, the majority of countries include mitigation policies and measures with potential adaptation co-benefits related to forest land, livestock, and bioenergy production from agriculture and cropland management. Albania, the former Yugoslav Republic of Macedonia and the Republic of Moldova include the highest number of mitigation policies and measures with potential adaptation co-benefits. **Figure 62** presents the distribution of mitigation policies and measures with potential adaptation co-benefits across land use categories or agriculture sub-sectors.

Afforestation/reforestation is the most frequently cited mitigation policy and measure with potential adaptation co-benefits found in country NDCs, followed by bioenergy production from agriculture, improved livestock manure management and improved livestock feeding practices, amongst others. Adaptation co-benefits of afforestation/reforestation, for instance, include forest ecosystem management, conservation and restoration and flood management.

FIGURE 62.

NUMBER OF MITIGATION POLICY AND MEASURES WITH ADAPTATION CO-BENEFITS, PER COUNTRY AND LAND USE/ SUB-SECTOR CATEGORY



In Central Asia, the majority of countries include mitigation policies and measures with potential adaptation co-benefits related to afforestation/reforestation, followed by bioenergy production from agriculture and livestock manure management. For instance, reutilization of organic matter, such as manure, can simultaneously reduce methane and nitrous oxide emissions from the otherwise decomposition of manure and generate time and income savings for rural households.

In Eastern Europe, the majority of countries include mitigation policies and measures with potential adaptation co-benefits related to afforestation/reforestation, followed by improved livestock feeding practices, liquid biofuel production, cropland nutrient management, cropland tillage/residue management, biogas production, rewetting organic soils drained for agriculture and wetlands management. For instance, mitigation policies and measures aimed at increasing carbon stocks and soil organic matter, through the addition of organic amendments reduces nitrous oxide emissions from managed soils, contributes to productivity gains and enhances resilience to climate change.

In Southern Europe, the majority of countries include mitigation policies and measures with potential adaptation co-benefits related to afforestation/reforestation, followed by improved manure management, forest fire management, agroforestry, improved livestock feeding practices, and bioenergy production from agriculture, amongst others. For instance, forest fire management aims to prevent or reduce nitrous oxide and methane losses, but also protects, conserves and restores the biodiversity of forest ecosystems.

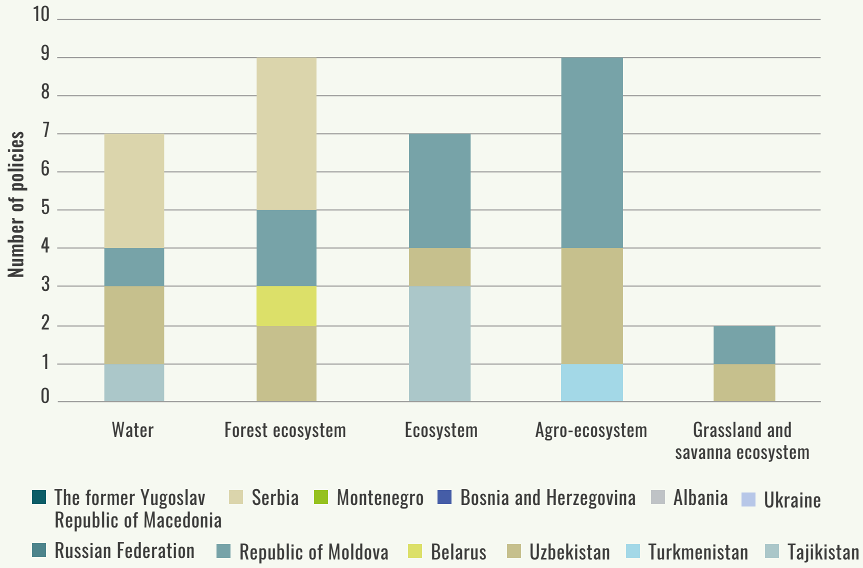
Mitigation co-benefits of adaptation

Overall, the majority of countries include adaptation measures with potential mitigation co-benefits related to agro-ecosystems and forest ecosystems, followed by water resource use and management and grassland and savanna ecosystems management. The Republic of Moldova, Uzbekistan and Serbia include the highest number of adaptation measures with potential mitigation co-benefits. Figure 63 presents the distribution of adaptation measures with potential mitigation co-benefits per ecosystem or natural resource management category.

Afforestation/reforestation is the most frequently cited adaptation measure with potential mitigation co-benefits found in country NDCs followed by irrigation and drainage, ecosystem management, conservation and restoration in forest ecosystems, nutrient and on-farm soil management and plant management, amongst others. Nutrient and on-farm soil management through reduced tillage, for instance, can contribute to enhanced residue retention, reduced nitrogen input into the soils and lower nitrous oxide emissions.

FIGURE 63.

NUMBER OF ADAPTATION MEASURES WITH MITIGATION CO-BENEFITS, PER COUNTRY AND ECOSYSTEM/NATURAL RESOURCE CATEGORY



In Central Asia, the majority of countries include adaptation measures with potential mitigation co-benefits related to irrigation and drainage, followed by diversification, grassland management and afforestation/reforestation, amongst others. For instance, diversification of crop varieties for adaptation can increase nitrogen use efficiency and reduce nitrous oxide emissions from crops.

In Eastern Europe, the majority of countries include adaptation measures with potential mitigation co-benefits related to afforestation/reforestation, followed by animal breeding and husbandry, integrated landscape management in grassland and savanna ecosystems and sustainable forest management and restoration, amongst others. For instance, adaptation measures aimed at improving animal health and tolerance to heat through livestock genetic selection can also increase animal productivity and reduce methane emissions from enteric fermentation.

In Southern Europe, the majority of countries include adaptation measures with potential mitigation co-benefits related to afforestation/reforestation, followed by biodiversity protection, conservation and restoration in forest ecosystems and sustainable water use and management, amongst others. For instance, improved water management on cropland can reduce methane emissions from the decomposition of plant residues, reduce indirect nitrous oxide emissions from the leaching of nitrogen runoff and reduce carbon losses through improved water availability on cropland.

Mutual co-benefits of mitigation and adaptation

Few countries set forth mitigation and adaptation measures generating mutual co-benefits. A mutual co-benefit refers to when the co-benefit of one measure is equal or similar to the outcome of the other measure. Only Tajikistan and the Republic of Moldova present adaptation and mitigation measures with mutual co-benefits. For instance, Tajikistan includes sustainable water use and management as a mitigation policy, as well as integrated watershed management as an adaptation measure. The Republic of Moldova presents multiple opportunities for mutual co-benefits, including bioenergy production as a mitigation and adaptation measure, cropland nutrient management as a mitigation and adaptation measure, tillage/residue management as a mitigation measure and land/soil management, restoration and rehabilitation as an adaptation measure, and afforestation/reforestation as an adaptation and mitigation measure.

Reconciling mitigation and adaptation tradeoffs

Reconciling tradeoffs amongst mitigation and adaptation measures is critical to a sustainable transition towards a low-emissions and climate resilient future. A cross-sectoral and long-term approach is necessary for planning climate change responses that support – and do not limit – multiple objectives.

The greatest potential adaptation tradeoff associated with mitigation policies and measures in the region is negative progress on reducing deforestation and improving forest conservation and nutrient and on-farm soil management due to liquid biofuel production.

4.3.2 Farming-systems approach to climate action

Based on the results of the gap and opportunity analysis, a farming-system approach integrating mitigation and adaptation priorities across agro-ecosystems and rural livelihoods is proposed:

Pastoral systems

Pastoral farming systems are mainly found in the high mountainous areas or adjacent dry zones in Central Asia, covering one-fifth of land area and home to half of the population (FAO and WB, 2001; ORNL, 2010). Herd management is often characterized by overgrazing on mountain pastures due to excessive animal populations and poor pasture management, leading to deterioration of natural vegetation and soil erosion (FAO and WB, 2001). With managed soils and enteric fermentation representing a major GHG hotspot in the sub-region, mountain ecosystems constituting a major climate-related vulnerability and nutrient cycling and soil formation reported as one of the most impacted ecosystem services, improved pasture management could increase soil carbon stocks and reduce soil erosion, while mixed livestock-tree systems could reduce natural hazards, such as floods and landslides, while diversifying production options (IPCC 2014a). Ecosystem management, conservation and rehabilitation in mountain ecosystems could contribute to reducing vulnerability to climate change and enhancing adaptive capacity by preserving the resource base and enhancing the resilience of dependent livelihoods, particularly for the rural poor.

Extensive cereal-livestock systems

The extensive cereal-livestock system is mostly found in the semiarid agro-ecological zones of Central Asia and Eastern Europe, including the Russian Federation and Northern parts of Kazakhstan, Southern parts of Kazakhstan, Turkmenistan and Uzbekistan. These systems occupy one-fifth of total land area in the SEECA region and are home to one-third of its population (FAO and WB, 2001; ORNL, 2010). The traditional steppe-system, now converted to cropping, produces mainly rainfed wheat and barley, some hay and fodder, combined with cattle and sheep grazing. The major constraints to low-emission and climate-resilient agriculture in this system result from variable precipitation patterns combined with strong winds, generating wind erosion and reducing crop yields. Limited access to mineral fertilizers impedes productivity gains. While this system contributes little to emissions from chemical fertilizer use, the conversion to cropping is likely associated with land use emissions. In addition, inadequate and poor-quality equipment for storage, processing, transportation and product handling contributes to heavy post-harvest losses and low prices for producers (FAO and WB, 2001). With crop systems and food insecurity and nutrition reported most frequently amongst climate-related vulnerabilities, soil conservation practices that enable moisture retention during the winter, utilize summer precipitation efficiently, and address serious wind erosion is essential to improving the productivity of grain production. Alternative rotations would provide farmers with greater flexibility and protect the resource base. Given the high degree of vulnerability of agriculture to pest and disease incidence, integrated pest management should be prioritized amongst mitigation and adaptation measures. As an insufficient feed base and poor animal health drive enteric fermentation emissions and contribute to the loss of productive assets, improved livestock management measures, particularly improved feed and animal husbandry, are critical to reducing emission intensity per unit of production and enhancing livelihood strategies in these systems (IPCC, 2014a).

Large scale cereal-vegetable systems

The large scale cereal-vegetable system is mainly found in Eastern Europe, covering 6 percent of total land area and housing one-third of its population (FAO and WB, 2001; ORNL, 2010). This system is typical of the moist, sub-humid agro-ecological zones including parts of Ukraine, the southwest part of the Russian Federation and the Republic of Moldova. The main crops are wheat, barley, maize, sunflower, sugar beets and vegetables, with some cattle. While the soils are among the most fertile, crop yields are often constrained by drought, insufficient annual rainfall and high temperatures during the grain-fill period. While snow and ice melt are the main way of watering in the spring time, early melt and reduction of glaciers will affect water flow and availability, especially in summer months. With a high share of emissions from cropland and managed soils, likely due to urea fertilizer application and conversion to cropland, and freshwater provision as one of the most frequently reported climate-related impacts on ecosystem services, land conservation and soil fertility management that balances water content, enhances soil organic matter and increases landscape biodiversity is critical to mitigation and adaptation in these systems. For instance, deep-rooting crops grown on deep, structurally robust and fertile soils are a highly efficient use of land in this system, as are land conservation schemes that incorporate leguminous crops and pastures with grazing cattle (FAO and WB, 2001).

Irrigated systems

The irrigated farming system is scattered throughout the warmer areas of mostly Central Asia, including Uzbekistan, Turkmenistan and Southwestern Kazakhstan, where irrigation is largely used for cotton cultivation, and some rice. This system occupies 3 percent of total land area in Central Asia but is home to one-third of the population (FAO and WB, 2001; ORNL, 2010). Environmental degradation combined with the drying out of the Aral Sea has contributed to desertification and widespread salinization in these areas. Key to the mitigation and adaptation strategies in this system is improved water management, including water harvesting and storage and improvements in water use efficiency, as well as landscape approaches, including afforestation of dried Aral Sea areas.

Sparse (cold) systems

The sparse (cold) farming system is predominantly found in Russia, occupied by a small agricultural population, where only a small amount of land has been cleared for cropping, interspersed with the tundra and the taiga forests. Agro-ecological and climatic conditions allow only limited cultivation of rye and oats, as well as of potatoes and some vegetables, supplemented by pig raising is some cases. This system is constrained by the short growing season, very low temperatures and poor soils, which are characterized by acidity and intense nutrient leaching (FAO and WB, 2001; ORNL, 2010). Key to mitigation and adaptation strategies in this system is improved crop residue and nutrient management practices that enhance soil organic carbon content, reduce nutrient losses and enhance fertility. With the provision of crops as one of the most frequently reported climate-related impacts on ecosystem services in the sub-region, combined with extensive poverty prevalence, social protection services are also critical to safeguarding food security and nutrition in these systems.

Horticulture mixed systems

Horticulture mixed farming systems cover almost 90 percent of land area in Southern Europe and are home to 80 percent of the population. The average farm size is small and has a diversified production pattern, including wheat, maize, oil crops, fruit and vegetables, combined with cattle, sheep and goats. Cultivation of fruit, nuts and vegetables, partly irrigated or produced in greenhouses, contributes significantly to the value of crop production and household income (FAO and WB, 2001; ORNL, 2010). With high shares of emissions from cropland, enteric fermentation and managed soils, combined with vulnerable cropping systems and pest incidence reported amongst climate-related impacts, key mitigation and adaptation strategies in these systems include better integrated system management by which the inputs and outputs amongst cropping and livestock systems feed into each other in a way that saves resources, increases biodiversity and contributes to the overall sustainability of the food system upon which rural livelihoods depend.

Forest-based systems

The forest-based farming systems are mostly found in the moist sub-humid agro-ecological zones of Eastern Europe, covering 3 percent of total land area and home to 10 percent of the population. Large farms are typical in Belarus, Ukraine and Northwest Russia, characterized by co-operative or corporate ownership, with production focused on fodder, hay, cereals, industrial crops and potatoes (FAO and WB, 2001; ORNL, 2010). With forest ecosystems amongst the most vulnerable and high shares of emissions from the burning of forest biomass, mitigation and adaptation strategies in this system include sustainable forest management, conservation of forest ecosystems and biodiversity and efforts to increase forest area combined with enhanced integration of cropping systems with trees.

4.3.3 NDC and SDG links

The high degree of convergence between the climate and sustainable development agendas[103] suggests that aligning their implementation provides a great opportunity to national and sub-national governments to accelerate progress across both agendas. Aligning planning and budgetary processes would not only maximize scarce resources, enhance capacities and multiply information and technology sharing opportunities but, most importantly, deliver on countries' adaptation and mitigation commitments in a way that advances development and includes the most vulnerable.

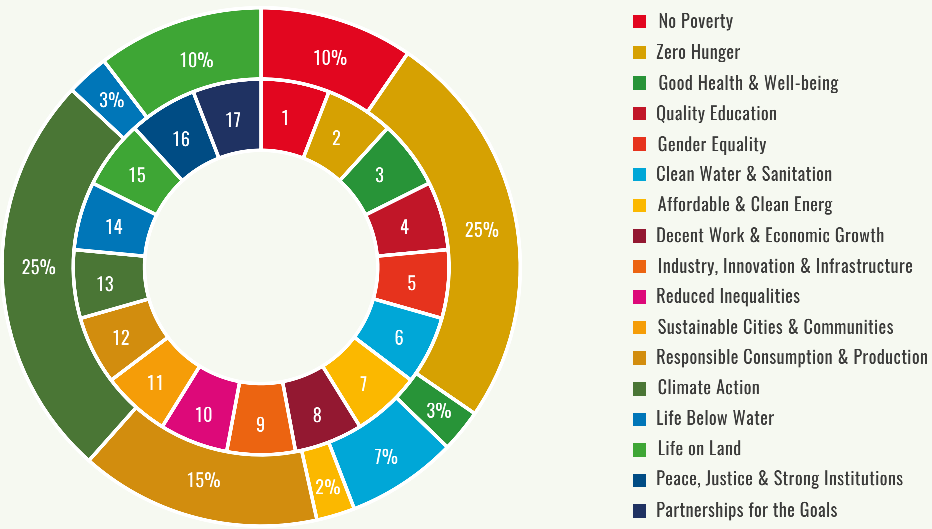
To understand the degree of convergence between "climate actions" in the agriculture sectors communicated by countries in their NDCs and the 17 goals and 169 targets of the 2030 Agenda for Sustainable Development, the sectoral climate actions in the NDCs were mapped against the SDG targets. The variety of mitigation targets, policies and measures and adaptation priorities and measures in the agriculture sectors (collectively referred to as "climate actions") serve as the data points for the analysis. Overall, around 300 potential data points were derived.

A NDC-SDG matrix (Annex 5) was developed to map the alignment between each climate action in the agriculture sectors with one or more SDG targets. A total of 1,500 potential climate action-sustainable development synergies and around 50 potential tradeoffs were generated in the agriculture sectors.

The degree of convergence between NDC climate actions in the agriculture sectors and SDG targets was assessed at the country level. The degree of convergence refers to the frequency of climate actions per SDG target (and does not reflect how much the climate action contributes in absolute terms to achieving a particular SDG target). The results were aggregated at sub-regional and regional levels. **Figure 64** illustrates the area of convergence between climate actions in the agriculture sectors and the SDGs.

FIGURE 64.

DEGREE OF CONVERGENCE BETWEEN CLIMATE ACTIONS IN THE AGRICULTURE SECTORS AND SDGs



[103] Northrop *et al.* (2016) find that climate actions are aligned with 154 of the 169 SDG targets, particularly around energy, forest, land use and agriculture. Conversely, WRI (2018) finds that 49 targets across 13 SDGs contribute to climate mitigation and adaptation, with greatest potential to generate climate action synergies in agriculture, water, food waste and marine and forest ecosystems, amongst others.

Overall, the greatest area of convergence between SEECA region climate actions in the agriculture sectors and the SDGs is found around, in descending order:

- SDG 13 Climate action;
- SDG 2 Zero Hunger;
- SDG 12 Responsible consumption and production;
- SDG 15 Life on Land;
- SDG 1 No Poverty;
- SDG 6 Clean water and sanitation;
- SDG 7 Affordable & Clean Energy;
- SDG 14 Life below water; and
- SDG 3 Good Health & Well-being.

Specifically, the greatest area of convergence is found around the following SDG targets, in descending order:

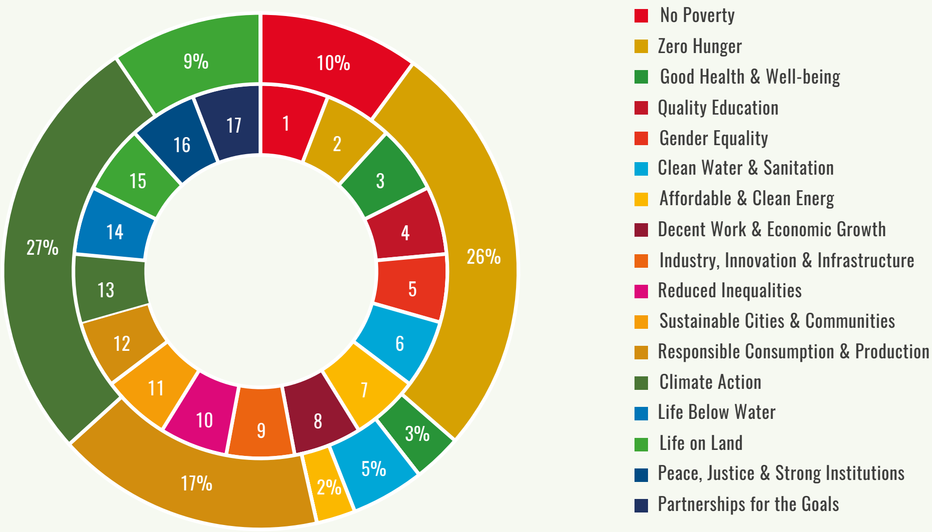
- SDG target 13.2 Integrate climate measures in policy making;
- SDG target 12.2 Efficient use of natural resources;
- SDG target 2.3 Assure agricultural productivity for marginalized;
- SDG target 2.4 Ensure sustainable agriculture systems for climate change;
- SDG target 13.1 Strengthen resilience and adaptive capacity;
- SDG target 1.5 Resilience of poor to climate events; and
- SDG target 15.2 Promote sustainable forests and halt deforestation.

The distribution of major SDG convergence areas is similar across sub-regions, with varying distribution of land, water, and marine ecosystem-related priorities at the target level.

In Central Asia (**Figure 65**), after SDGs 2 and 13, climate actions in the agriculture sectors are most closely aligned with SDG 15 (primarily target 15.1 "Conserve and restore inland ecosystems"), SDG 1 (primarily target 1.5), SDG 12 (primarily target 12.2), SDG 6 (primarily target 6.4 "Increase water-use efficiency across all sectors") and SDG 14 (primarily 14.5 "Conserve coastal and marine areas").

FIGURE 65.

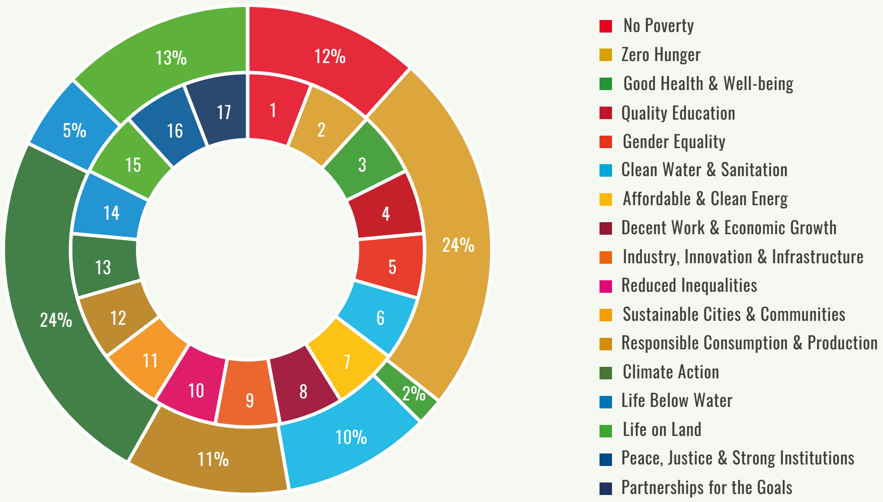
DEGREE OF CONVERGENCE BETWEEN CLIMATE ACTIONS IN THE AGRICULTURE SECTORS AND SDGS FOR CENTRAL ASIA



In Eastern Europe (**Figure 66**), after SDGs 13 and 2, climate actions in the agriculture sectors are most closely aligned with SDG 12 (primarily target 12.2), SDG 1 (primarily target 1.5), SDG 15 (primarily targets 15.2 "Promote sustainable forests and halt deforestation" and 15.3 "Restore degraded land and combat desertification"), SDG 6 (primarily target 6.4 "Increase water-use efficiency across all sectors") and SDG 3 (primarily target 3.1-3, 8 and 9).

FIGURE 66.

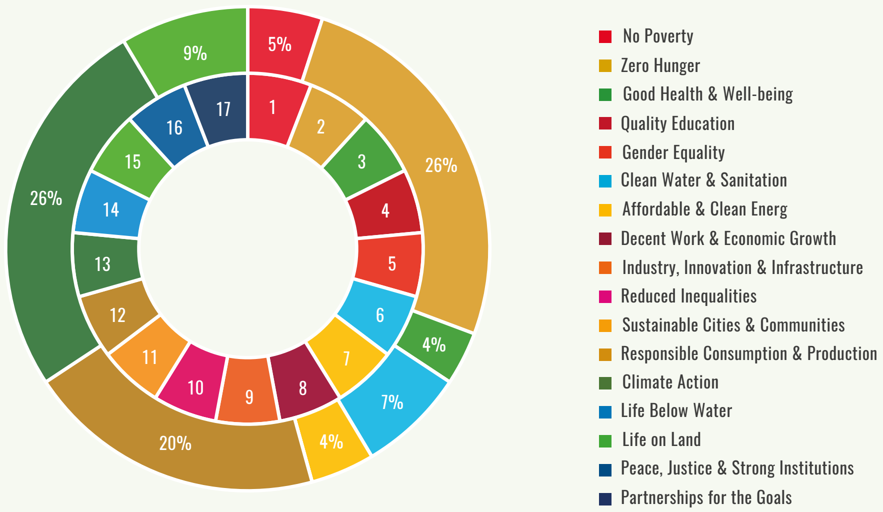
DEGREE OF CONVERGENCE BETWEEN CLIMATE ACTIONS IN THE AGRICULTURE SECTORS AND SDGS FOR EASTERN EUROPE



In Southern Europe (**Figure 67**), after SDGs 2 and 13, climate actions in the agriculture sectors are most closely aligned with SDG 12 (primarily target 12.2), SDG 15 (primarily targets 15.2 "Promote sustainable forests and halt deforestation", SDG 6 (primarily target 6.4 "Increase water-use efficiency across all sectors"), SDG 1 (primarily target 1.5), and SDG 7 (primarily target 7.2 "Increase share of sustainable energy").

FIGURE 67.

DEGREE OF CONVERGENCE BETWEEN CLIMATE ACTIONS IN THE AGRICULTURE SECTORS AND SDGS FOR SOUTHERN EUROPE



CHAPTER 5

CHAPTER

5

ENHANCING NDC AMBITION IN THE AGRICULTURE SECTORS

The Paris Agreement is premised on the expectation that the global response to climate change will be strengthened over time, in light of different national circumstances and in accordance with equity and the principle of common but differentiated responsibilities and respective capabilities. All Parties have the opportunity to communicate new or updated NDCs by 2020, and to do so in future five-year cycles of NDC revision thereafter. Each successive NDC is expected to represent a country's highest possible ambition and a progression beyond the current NDC.[104]

This section presents an "NDC Ambition" index that measures the baseline ambition levels of climate action in the agriculture sectors across six main pillars and presents a menu of options for enhancing the NDCs in the agriculture sectors. The results can support the country-driven NDC review and revision processes leading up to 2020 and future submission cycles.

[104] Article 4.2 of the Paris Agreement.

5.1 BASELINE AMBITION LEVELS

An NDC Ambition Index was developed to assess the comprehensiveness, measurability, comparability, transparency and ambition of the NDCs in the agriculture sectors across six main pillars of climate action: mitigation, adaptation, planning, monitoring, reporting and means of implementation. While the term "ambition" is often not associated with adaptation, as a country-driven process, the index scoring system aims to identify the opportunity for countries, as they enhance their NDCs, to update, strengthen,

and/or elaborate their adaptation content. Each pillar is defined by 4 outcome or process-based indicators (**Table 10**), which are weighted (**Annex 6**) between 0 and 1; the sum of the weights assigned to each indicator within the same pillar equals 1.

TABLE 10.

NDC AMBITION INDEX, PILLARS AND INDICATORS

MAIN PILLAR	INDICATOR	INDICATOR WEIGHT
MITIGATION	TYPE OF MITIGATION CONTRIBUTION IN THE AGRICULTURE SECTOR	0,45
	TYPE OF MITIGATION CONTRIBUTION IN THE LULUCF SECTOR	0,45
	TYPE OF POLICIES AND MEASURES IN THE AGRICULTURE SECTOR	0,05
	TYPE OF POLICIES AND MEASURES IN THE LULUCF SECTOR	0,05
ADAPTATION	TYPE OF ADAPTATION IN THE AGRICULTURE SECTORS	0,4
	TYPE OF CLIMATE-RELATED HAZARDS, IMPACTS AND VULNERABILITIES REPORTED	0,2
	TYPE OF ADAPTATION MEASURES	0,2
	CLIMATE RESILIENCE AND DRR/M PRIORITY	0,2
PLANNING	NAP SUBMITTED AND/OR PROCESS MENTIONED IN NDC*	0,33
	NAMA SUBMITTED AND/OR PROCESS MENTIONED IN NDC*	0
	OTHER CLIMATE PLAN OR STRATEGY MENTIONED IN NDC	0,33
	DRR/M PLAN OR STRATEGY MENTIONED IN NDC	0,33
MONITORING	MRV SYSTEM FOR NDC	0,35
	M&E SYSTEM FOR NDC	0,35
	EARLY WARNING SYSTEM IN PLACE	0,15
	VULNERABILITY ASSESSMENT PERFORMED FOR NDC	0,15
REPORTING	DATE OF LAST GHG INVENTORY	0,25
	TYPE OF IPCC METHOD USED	0,25
	NUMBER OF REPORTS SUBMITTED TO UNFCCC	0,25
	PERIOD OF TIME ELAPSED FROM LAST REPORT SUBMISSION	0,25
MEANS OF IMPLEMENTATION	SUPPORT NEEDS	0,3
	TYPE OF FINANCE	0,3
	DISAGGREGATION OF MITIGATION AND ADAPTATION FINANCE	0,2
	TYPE OF FINANCIAL CONDITIONALITY	0,2

**Only relevant to developing countries. No weight assigned to indicator for SEECA region countries.*

The methodology includes a scoring procedure, whereby indicators are given scores from 2 to 10, converted from raw quantitative and qualitative data (**Annex 6**). The scoring system matches the four levels of ambition: low, moderate, high and very high (**Table 11**). The country level results are aggregated at sub-regional level. A radar chart is used to visualize the results for easy identification of potential NDC enhancement areas.

TABLE 11.

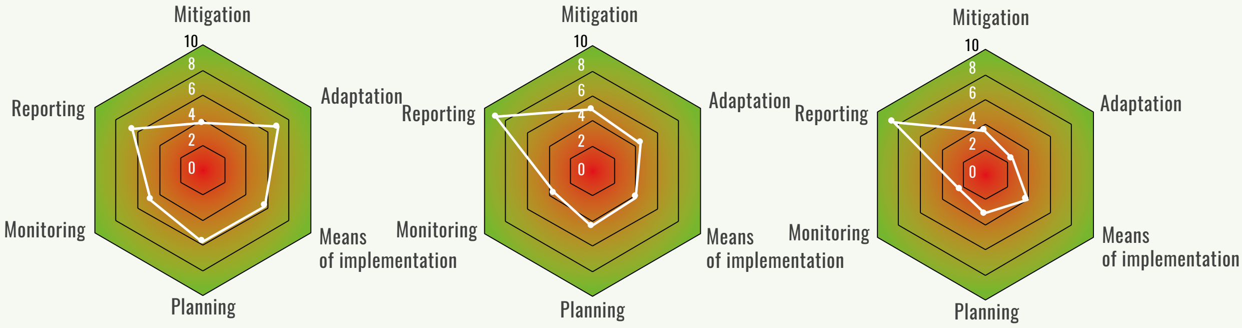
NDC AMBITION INDEX SCORE AND LEVEL

LEVEL	SCORE
LOW AMBITION	2-3.9
MODERATE AMBITION	4-5.9
HIGH AMBITION	6-7.9
VERY HIGH AMBITION	8-10

Overall, the average NDC ambition levels in the agriculture sectors are moderate in Central Asia and Eastern Asia and low in Southern Europe across all six pillars of climate action (**Figure 68**).

FIGURE 68.

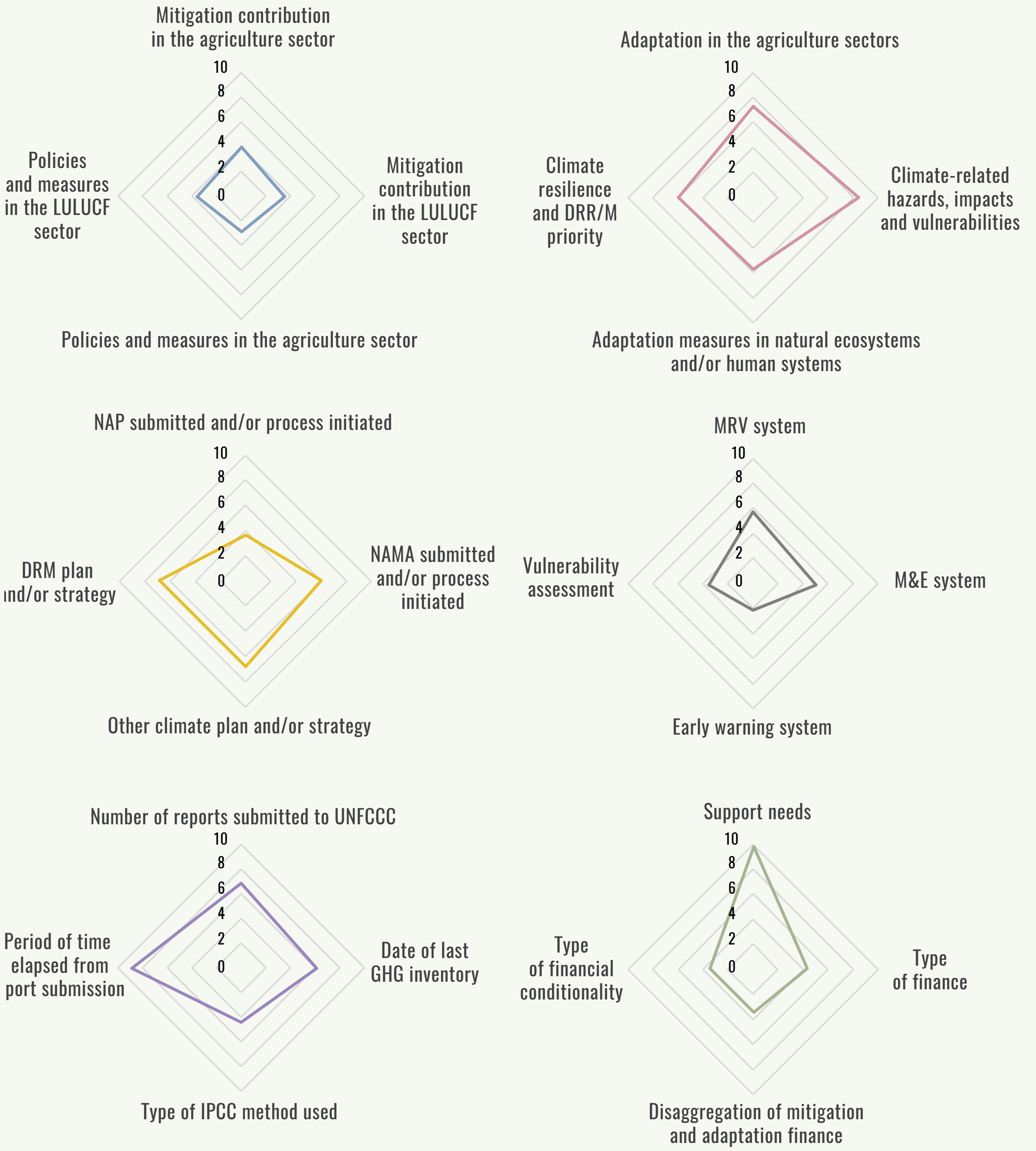
NDC AMBITION INDEX RESULTS, PER MAJOR PILLAR AND SUB-REGION



In Central Asia (**Figure 69**), the comprehensiveness, measurability, comparability, transparency and ambition of the adaptation component and national reporting processes rank high, while the mitigation contribution has a low score in the agriculture sectors. Moderate levels are observed across the means of implementation, planning and monitoring pillars.

FIGURE 69.

NDC AMBITION INDEX RESULTS FOR CENTRAL ASIA, PER PILLAR

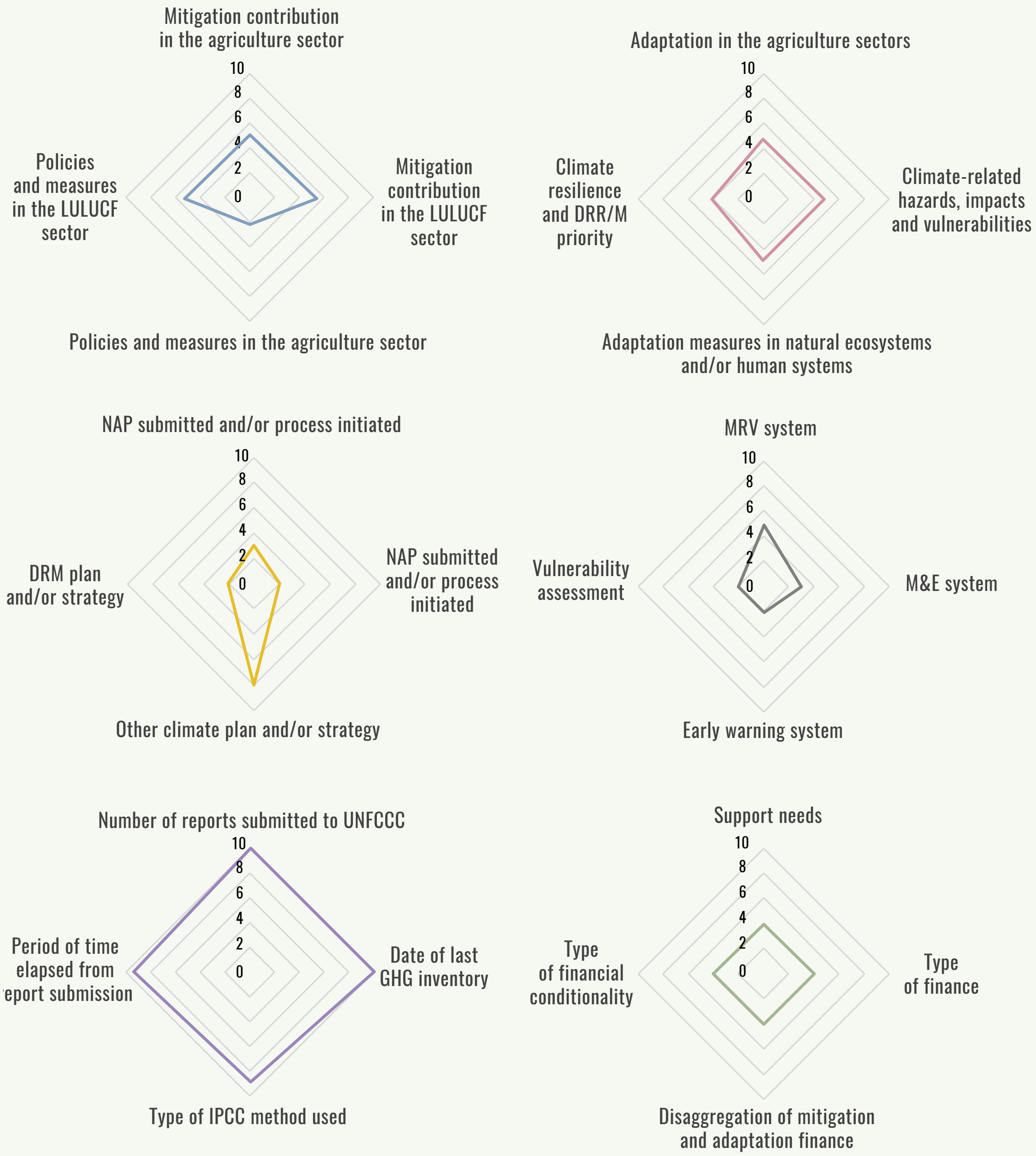


**Only relevant to developing countries. No weight assigned to indicator for SEECA region countries.*

In Eastern Europe (**Figure 70**), the mitigation contribution, adaptation component, and means of implementation rank moderately in terms of comprehensiveness, measurability, comparability and transparency and ambition in the agriculture sectors. On the other hand, national planning processes and monitoring mechanisms in place score low, while the national reporting processes ranks very high.

FIGURE 70.

NDC AMBITION INDEX RESULTS FOR EASTERN EUROPE, PER PILLAR

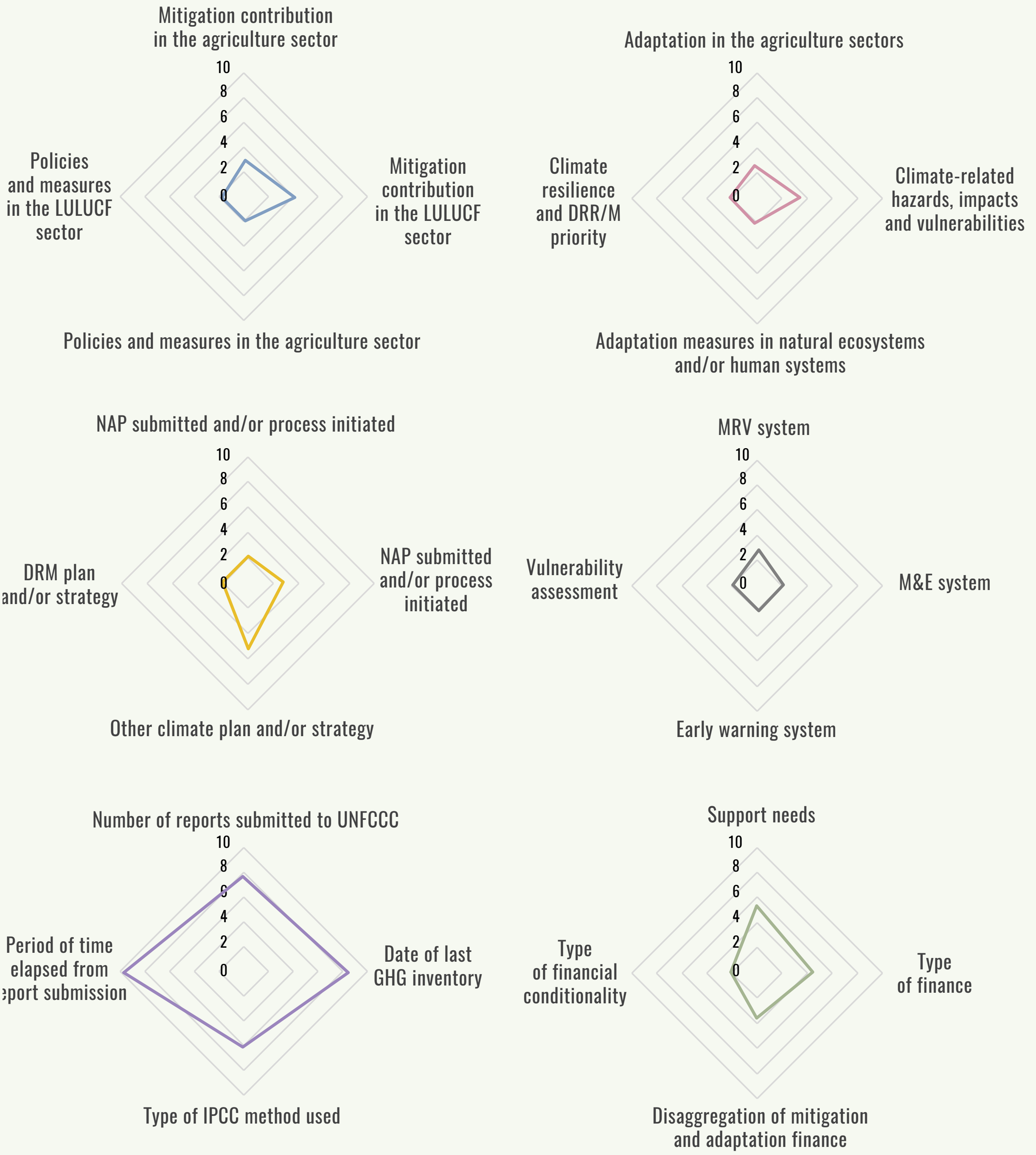


**Only relevant to developing countries. No weight assigned to indicator for SEECA region countries.*

In Southern Europe (**Figure 71**), the comprehensiveness, measurability, comparability, transparency and ambition of the NDCs in the agriculture sector score low across all major pillars with the exception of the national reporting pillar, which ranks very high.

FIGURE 71.

NDC AMBITION INDEX RESULTS FOR SOUTHERN EUROPE, PER PILLAR



**Only relevant to developing countries. No weight assigned to indicator for SEECA region countries.*

5.2 OPTIONS FOR BUILDING AMBITION

5.2.1 Building mitigation ambition

Mitigation lies at the heart of global efforts to achieve the long-term temperature goals set out in Article 2 of the Paris Agreement of holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C. Transforming the NDCs into a concrete set of quantifiable targets and policies is key for translating high-level commitments into actions on the ground.

The menu of options for building mitigation ambition in the agriculture sectors includes the strengthening or adding of a GHG target, non-GHG target, measurable policies and measures and a long-term goal in the agriculture sectors, amongst others, building upon the findings of section 4.1.3. For instance, in Central Asia, areas of potential NDC enhancement are the inclusion of sectoral GHG targets and/or quantified mitigation policies and measures in the agriculture and/or LULUCF sectors. In Eastern Europe, an area of potential NDC enhancement is the inclusion of quantified mitigation policies and measures in the agriculture sector. In Southern Europe, areas of potential NDC enhancement are the inclusion of sectoral GHG targets and/or quantified mitigation policies and measures in the agriculture and/or LULUCF sectors.

5.2.2 Strengthening adaptation options

Adaptation is a key component of the long-term global response to climate change to protect people, livelihoods and ecosystems. Under Article 7.10 of the Paris Agreement, the NDCs present an opportunity for countries to communicate adaptation goals, priorities, actions and needs that are country-driven, gender-responsive, participatory and sensitive to vulnerable groups, communities and ecosystems. Adaptation options should be informed by the best available science and, as appropriate, traditional knowledge, knowledge of indigenous peoples and local knowledge systems, accompanied with a forward-looking vision that integrates sectoral and cross-sectoral adaptation priorities into broader development policies and frameworks. While retaining flexibility of the country-driven process, the content of the adaptation component in the NDCs may often be strengthened to enhance adaptive capacity and resilience, and reduce vulnerability, contributing to the global goal on adaptation.

The menu of options for strengthening adaptation in the agriculture sectors includes conducting a vulnerability assessment and updating or adding climate-related impact information, adaptation priorities, measures and long-term goals, amongst others, building upon the findings of section 4.2.2. In Central Asia, all countries exhibit high levels of adaptation ambition in their respective NDCs. In both Eastern and Southern Europe, areas of potential NDC enhancement are the inclusion of climate-related hazards, impacts and vulnerabilities, the integration of climate resilience and/or DRR/M strategies and approaches and the inclusion of adaptation measures in natural ecosystems and/or social systems.

5.2.3 Aligning national planning processes

Aligning climate change mitigation and adaptation priorities with existing sectoral and cross-sectoral policies and budgets, and vice versa, is necessary for formulating actionable policies and enabling the institutional environment for transformational change, as well as leveraging synergies with sustainable development objectives.

The menu of options for aligning national planning processes for NDC implementation includes the use of cost-benefit analysis for evidence-based policy making, the integration and/or alignment of sectoral and cross-sectoral NAPs, Nationally Appropriate Mitigation Actions (NAMAs)[105] and DRR/M strategies with the NDCs, and vice versa, the alignment of NDC planning and SDG localization processes, the setting of coordination mechanisms amongst key line ministries and aligning regulatory frameworks

[105] Only relevant to developing countries. All SEECA countries are economies in transition.

with the long-term goals of the Paris Agreement, amongst others. For instance, in all regions, areas of potential NDC enhancement are the mainstreaming of NAP processes and DRR/M frameworks within the NDC, and vice versa.

5.2.4 Monitoring mitigation and adaptation progress

Tracking information on GHG emissions and actions to reduce them, as well as on adaptation and on support needs, is a necessary step to ensuring that the knowledge and information gained during implementation can be fed back into a learning process that provides for more effective mitigation and adaptation efforts in the future.

The menu of options for monitoring mitigation and adaptation progress includes the improvement or setting up of M&E and MRV systems to track adaptation, mitigation and support needed and provided in the agriculture sectors, amongst others. For instance, in Central Asia, an area of potential NDC enhancement is the inclusion of vulnerability assessment information. In Southern and Eastern Europe, an area of potential NDC enhancement is the setting up of an M&E system to monitor adaptation progress over time.

5.2.5 Enhancing the transparency of reporting

The Enhanced Transparency Framework of the Paris Agreement is expected to build mutual trust and confidence, and to promote effective implementation by providing: i) a clear understanding of climate change action, including clarity and tracking of mitigation and adaptation progress; and ii) clarity on support provided and received. According to the Article 13 of the Paris Agreement, all Parties shall report National Greenhouse Gas Inventories (NGHGI) and progress made in implementing and achieving NDC, as well as all Parties should, as appropriate, report climate change impacts and adaptation. Also, other Parties that provided support should report the financial, technology transfer and capacity-building support provided. Under the same Article, developing country Parties should report the financial, technology transfer and capacity-building support needed and received. The transparency framework shall provide flexibility in the implementation of the provisions of this Article to those developing country Parties that need it in the light of their capacities. The modalities, procedures and guidelines for the enhanced transparency framework is currently being negotiated under the Ad hoc Working Group on the Paris Agreement.

The menu of options for enhancing the transparency of NDC reporting includes updating the methodology used to report the NGHGI and mitigation progress, the inclusion of information on climate change impacts and adaptation progress, support needed and received and the alignment of NDC reporting and SDG follow-up and review processes, amongst others. For instance, in Central Asia, an area of potential NDC enhancement is the updating of the methodology used for reporting NGHGIs in the AFOLU sector. Both Southern and Eastern Europe exhibit very high ambition levels under this pillar.

5.2.6 Accelerating the means of implementation

The provision of financial, technological and capacity-building support to developing countries is necessary to enable and accelerate national climate action, particularly in the agriculture sectors where stakeholders are in the hundreds of millions and often the most vulnerable to climate change. Early evidence suggests that the provision of climate finance, technology transfer and capacity-building can enhance pre-2020 ambition levels and lay a solid foundation for enhanced post 2020 ambition (UNFCCC, 2018).

The menu of options for accelerating the provision of support includes the review and synthesis of capacity-building, technological and financial gaps and needs in the agriculture sectors and the alignment of sectoral investment plans and budgets with NDC support needs, amongst others. For instance, in Central Asia, an area of potential NDC enhancement is the disaggregation of finance needs by conditional/unconditional and mitigation/adaptation shares. In Eastern Europe, an area of potential NDC enhancement is the inclusion of support needs for NDC implementation. In Southern Europe, an area of potential NDC enhancement is the inclusion of finance needs for NDC implementation.

5.3 KEY FINDING AND CONCLUSIONS

The agriculture sectors in the region contribute to over 600 million tons of CO_2 eq per year to global GHG emissions, with the majority of emissions generated from land use in Eastern Europe and Central Asia. Amongst agricultural emissions, enteric fermentation and managed soils constitute the highest shares of sectoral emissions across all sub-regions. Similarly, the greatest shares of emissions from LULUCF are associated with conversion to cropland across all sub-regions, the burning of forest biomass in Central Asia and forest degradation in Southern Europe.

Without implementation of the NDCs, total baseline net emissions in 2030 are expected to double those reported in 2015. Even with implementation of the NDCs, net emissions are expected to increase by approximately 41 percent in 2030. Only one country (Republic of Moldova) and two countries (Republic of Moldova and Bosnia and Herzegovina) set specific GHG targets in the agriculture and LULUCF sectors, respectively. However, 79 percent and 57 percent of countries in the region include the agriculture and LULUCF sectors in their mitigation commitments.

Identifying actions that co-deliver on mitigation and adaptation is critical to achieving climate action at scale, while ensuring that "no one is left behind." Overall, 88 percent of countries with an adaptation component in their commitments prioritize the agriculture sectors. Indeed, countries recognize the multiple transmission pathways by which climate change directly and indirectly impacts agricultural production, food systems and rural livelihoods.

Amongst observed and/or projected climate-related hazards and slow onset events, extreme heat, drought and water stress are the most reported in the region, followed by floods and invasion by pests and non-native species. The loss of ecosystem, biodiversity and ecosystem goods, functions and services is reported as the ecosystem service most affected by climate-induced physical and chemical changes, primarily in forest and mountain ecosystems.

Undermining the capacity to adapt are the non-climatic stressors driving vulnerability, particularly poverty and low levels of human development. When climate impacts combine with low adaptive capacity and high degrees of vulnerability, adverse health and food insecurity and malnutrition outcomes are most expected amongst climate-related risks in social systems.

The results of the gap and opportunity analysis point to a set of priority actions that can accelerate progress on both mitigation and adaptation in the agriculture sectors, leverage their synergies and deliver sustainable development co-benefits:

1. ENHANCE FOREST COVER AND MANAGE FORESTS SUSTAINABLY

Agro-ecosystems, particularly forestry and the crops sub-sector, are considered the most vulnerable to climate change. Almost 90 percent of countries in the region prioritize adaptation in the agriculture sectors, particularly around forestry. At the same time, 60 percent of countries prioritize mitigation options on forest land. Across mitigation and adaptation options, afforestation/reforestation is the most prevalent, as increases in above and below ground biomass can sequester carbon from the atmosphere on one hand and prevent erosion and reduce floods on the other. With floods and landslides amongst the most reported climate-related hazards in all sub-regions, as well as pests and diseases incidence in forests amongst observed and/or expected climate impacts, it is not a surprise that ecosystem management, conservation and restoration activities in forest and woodland ecosystems is the most prioritized adaptation measure outside of farming systems. Enhancing forest cover in combination with sustainable forest management can address the GHG hotspots, climate-related vulnerabilities and policy gaps identified in the region, including forest degradation (Southern Europe), forest biomass burning (Eastern Europe), vulnerable forest ecosystems (all sub-regions) and pests and diseases incidence in forest ecosystems (Southern Europe).

2. INCREASE SOIL ORGANIC MATTER AND REDUCE EROSIONY

Emissions from managed soils and cropland, primarily from synthetic fertilizers, manure left on pasture and land use change, constitute major GHG hotspots in all sub-regions. Constrained by salinization, contamination and soil organic matter decline (FAO, 2015), cropping systems are reported as the most vulnerable sub-sector to climate change, next to forestry. With soil erosion reported amongst climate-related slow onset risks and events in terrestrial ecosystems, particularly in Eastern Europe, along with changes in water availability on cropland reported amongst the greatest impacts on ecosystem services, it is no surprise that land/soil management, restoration and rehabilitation is often prioritized amongst adaptation options. Critical to supplying clean water, preventing desertification and providing resilience to floods and drought, soil makes up the greatest pool of terrestrial organic carbon, contributing to climate change mitigation (FAO, 2018).

While deforestation and land use change, largely brought about by rising food needs, is a major cause of soil depletion and conversion to cropland around the world, FAO (2016d) demonstrated that increasing agricultural production does not have to come at the expense of forests. An integrated approach that places sustainable soil management principles within a broader landscape context can address the GHG hotspots, climate-related vulnerabilities and policy gaps identified in the region, including emissions from managed soils (all sub-regions), emissions from cropland conversion (all sub-regions), soil erosion (Eastern Europe) and the provision of crops at risk (Central Asia and Southern Europe).

3. PROTECT WATER RESOURCES AND COMBAT DESERTIFICATIONY

Water is reported as the most vulnerable natural resource to climate change in all ecosystems and particularly inland water ecosystems. Amongst climate-related slow onset events, water stress is reported the most and by all sub-regions, with desertification reported particularly in Central Asia. The provision of freshwater is considered the ecosystem service most vulnerable to climate change in the pastoral, mountain ecosystems upon which almost half the population of Central Asia depends for their sustenance and livelihoods. Early snow and ice melt is contributing to changes in hydrological flow and water availability, especially in the summer months. The majority of countries with adaptation include water resources amongst cross-sectoral adaptation priorities, with irrigation and drainage as the most frequently promoted adaptation option. Improved water management practices can reduce nitrous oxide emissions from leaching and volatization and enhance water uptake ratios for better plant productivity, as improved storage and harvesting practices can reduce gendered burdens and enhance resilience to natural- and human-induced disasters. The sustainable management and development of water resources and the protection of aquatic biological resources can address the GHG hotspots, climate-related vulnerabilities and policy gaps identified, including water stress (all sub-regions), vulnerable inland water ecosystems (Central Asia) and desertification (Central Asia).

4. REDUCE ENTERIC METHANE AND IMPROVE PASTORAL LIVELIHOODSY

Ruminants represent an important productive asset and livelihood strategy to smallholders throughout the region, as an integral part of all farming systems, mostly pastoral and extensive. At the same time, emissions from enteric fermentation constitute a major GHG hotspot across all sub-regions. While the livestock sector is prioritized most amongst mitigation options, particularly improved feeding practices, only Eastern Europe includes livestock amongst adaptation priorities. However, increased pests and diseases incidence, particularly vector-borne diseases, are cited frequently amongst observed and/or projected climate-related impacts in agro-ecosystems.

Ruminant production systems with low productivity use more energy to produce each unit of animal product than those with high productivity. The strong correlation between increases in animal productivity and reductions in enteric methane emissions offers large opportunities for low-cost mitigation and widespread social and economic benefits (FAO, 2016e). Improving feed quality can be achieved through improved grassland management, improved pasture species, forage mix and greater use of supplements, preferably locally available, as animal health and husbandry as well as breeding can contribute to the efficiency of livestock systems, while supporting food security and nutrition. Reducing overgrazing, restoring grasslands and caring to animal health can address the GHG hotspots, climate-related vulnerabilities and policy gaps identified in the region, including emissions from enteric fermentation and managed soils (all sub-regions), invasion of pests and non-native species (all sub-regions) and vulnerable mountain ecosystems (Central Asia).

5. PROVIDE HEALTH INFORMATION AND SERVICES

Adverse health effects are reported as the greatest observed and/or expected climate-related risk in social systems. Climate extremes often directly affect human health through changes in temperature and precipitation and natural hazards, increasing the risk of disease. Disease interferes with the body´s ability to absorb nutrients, which can negatively affect the nutritional status of adults and children (FAO, 2018). Over 60 percent of countries with adaptation place health as the greatest cross-cutting adaptation priority in social systems. Promoting climate information services, early warning systems and research and development is critical to preventing hazards and ensuring food safety, as is better access to health care and services to manage infectious and non-communicable diseases. Improved availability of and access to health and information services can address climate-related risks and policy gaps identified in the region, including adverse health risks (all sub-regions).

6. PROMOTE HEALTHIER DIETS

While inadequate or unbalanced consumption patterns, lacking in macronutrients or essential micronutrients, fell between 2012 and 2017, one in four adults above 18 years of age in Eastern Europe are obese, and one in five are obese in Southern Europe. However, only Central Asia references food insecurity and nutrition as a climate-related risk. Inexpensive, high-calorie, low-nutrition foods, combined with metabolic adaptation to food deprivation, contribute to overweight and obesity (FAO, 2018). When climate extremes and variability combine with poverty, market instability, environmental degradation and migration, climate change threatens to exacerbate all forms of food insecurity and malnutrition. Integrating food security and nutrition considerations into broader climate, agriculture and development strategies is critical to addressing the climate-related risks and policy gaps identified in the region, including poverty (all sub-regions) and food insecurity and nutrition (Central Asia).

7. BUILD RESILIENCE AND PROMOTE GENDER EQUALITY

With economic dependence on agriculture and high levels of poverty amongst the key non-climatic drivers of vulnerability reported in the region, natural hazards and disasters threaten to impede progress on poverty, hunger and malnutrition reduction. Amongst governance and institutional adaptation measures in the region, DRR/M and policy mainstreaming and coherence are most prevalent, while knowledge and capacity-related adaptation measures focus on R&D and awareness raising. Improving access to knowledge, technologies and services for those most at risk, as well as enhancing institutional and technical capacities at all levels to deliver DRR is necessary to addressing the loss of productive infrastructure and assets observed in Southern Europe and rural livelihood and income losses projected in Central Asia under climate change. Bringing together multiple stakeholders from government services to local authorities to farmers and others, as well as integrating DRR/M in agricultural interventions, poverty reduction and climate change strategies, and strengthening the governance framework for early warning and action are key to tackling the underlying drivers of vulnerability and building adaptive capacities.

Gender equality and women empowerment play a major role in the region’s approach to adaptation, as the most prioritized option for improving socio-economic situations and well-being. Priority actions for building resilience can address the multiple climate-related hazards, vulnerabilities and risks in ecosystems and social systems, and policy gaps, identified in the region, including floods, drought and water stress (all sub-regions), vulnerable agro-ecosystems (all sub-regions), poverty (Central Asia and Southern Europe), loss of productive infrastructure and assets (Southern Europe) and rural livelihood and income losses (Central Asia).

8. LEVERAGE CLIMATE ACTION SYNERGIES WITH THE SDGs

The high degree of convergence between the climate and sustainable development agendas suggests that aligning their implementation provides a great opportunity to national and sub-national governments to accelerate progress across both agendas. Overall, the greatest area of convergence between SEECA region climate actions in the agriculture sectors and the SDGs is found around SDG target[106] 12.2, 2.3, 2.4, 1.5 and 15.2.

Conclusion

The agriculture sectors represent a unique opportunity for regional and national stakeholders to leverage the mitigation and adaptation potential of agriculture and land use, while accelerating progress on sustainable development. However, change will only come about if supported by enabling policies and institutional arrangements, capacity and knowledge gaps are closed, actors are engaged and investments are aligned. By highlighting the gaps in the coverage of mitigation and adaptation in the agriculture sectors, as well as illustrating opportunities for enhancing climate action ambitions in the next round of NDCs, this analysis can serve as an important roadmap for informing policies and directing future investments in support of low-emission, climate-resilient and inclusive agriculture and food systems in the region.

[106] After SDG 13 "Climate Action".

BIBLIOGRAPHY

A. Dixon J., Gulliver A. and Gibbon D. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. Rome, FAO.

Deutsche Gesellschaft für internationales Zusammenarbeit (GIZ) and World Resources Institute (WRI). 2018. Connecting the Dots: Elements for a Joined-Up Implementation of the 2030 Agenda and Paris Agreement. Bonn and Washington, DC. (also available at: https://www.transparency-partnership.net/system/files/document/GIZ-WRI%20Study%20Connecting%20the%20Dots.pdf)

Emergency Events Database (EM-DAT). 2009. EM-DAT [online] Brussels. www.emdat.be

FAO and World Bank. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. Rome and Washington. (also available at http://www.fao.org/3/a-ac349e.pdf)

FAOa. Global Agro-Ecological Zones (GAEZ) [online]. Rome. [Cited 28 September 2018] http://www.fao.org/nr/gaez/en/

FAOb. AQUASTAT. Online Database (available at http://www.fao.org/nr/water/aquastat/main/index.stm). Rome.

FAOc. FAOSTAT. Online Statistical Database (available at http://faostat.fao.org/). Rome.

FAOd. FAO TERM Portal. (available at http://www.fao.org/faoterm/en/)

FAO. 2011.The State of the World's Land and Water Resources for Food and Agriculture: Managing systems at risk. Rome. (also available at: http://www.fao.org/docrep/017/i1688e/i1688e.pdf)

FAO. 2013a. Our Priorities: FAO Strategic Objectives. Rome. (also available at http://www.fao.org/docrep/018/mi317e/mi317e.pdf)

FAO. 2013b. Climate-Smart Agriculture: Sourcebook. Rome. (also available at http://www.fao.org/3/a-i3325e.pdf);

FAO. 2014a. Building a Common Vision for Sustainable Food and Agriculture: Principles and Approaches. Rome. (also available at http://www.fao.org/3/a-i3940e.pdf)

FAO. 2014b. Mapping the Global Distribution of Livestock. PLoS ONE 9(5): e96084 [online]. [Cited 28 September 2018]. http://dx.doi.org/10.1371/journal.pone.0096084. Robinson T.P., Wint G.R.W., Conchedda G., Van Boeckel T.P., Ercoli V., *et al.* 2014.

FAO. 2015. *Status of the World's Soil Resources*. Rome. (also available at: http://www.fao.org/3/a-i5199e.pdf)

FAO. 2016a. *The Agriculture Sectors in the Intended Nationally Determined Contributions: Analysis*. Rome. (also available at http://www.fao.org/3/a-i5687e.pdf)

FAO. 2016b. The Agricultural Sectors in Nationally Determined Contributions (NDCs): Priority Areas for International Support. Rome. (also available at http://www.fao.org/3/a-i6400e.pdf)

FAO. 2016c. *Climate change and food security: risks and responses*. Rome. (also available at http://www.fao.org/3/a-i5188e.pdf)

FAO. 2016d. *The State of Food and Agriculture 2016: climate change, agriculture and food security*. Rome.

FAO. 2016e. *Reducing enteric methane for improving food security and livelihoods*. Rome. (also available at: http://www.fao.org/3/a-i5902e.pdf)

FAO. 2017a. FAO Strategy on Climate Change. Rome. (available at http://www.fao.org/3/a-i7175e.pdf)

FAO. 2017b. Regional Analysis of the Nationally Determined Contributions of Eastern Africa: Gaps and opportunities in the agriculture sectors. Environment and Natural Resources Management, Working Paper 67. Rome. (also available at http://www.fao.org/3/a-i8079e.pdf)

FAO. 2017c. Save Food for a Better Climate: Converting the Food Loss and Waste Challenge into Climate Action. Rome. (also available at http://www.fao.org/3/a-i8000e.pdf)

FAO. 2017d. *SDG Indicator 2.4.1. Percentage of Agricultural Area under Productive and Sustainable Agriculture*. [online] Methodological Concept Note prepared for the FAO expert meeting in Rome, Italy, April 3-5, 2017. [Cited 27 September 2018] http://www.fao.org/3/a-br903e.pdf

FAO. 2017e. Tracking adaptation in agricultural sectors: Climate Change Adaptation Indicators. Rome. (also available at http://www.fao.org/3/a-i8145e.pdf)

FAO. 2018. The State of Food Security and Nutrition in the World: Building Climate Resilience for Food Security and Nutrition. Rome. (also available at http://www.fao.org/3/I9553EN/i9553en.pdf)

FAO. 2019 (Forthcoming). *Enhancing NDCs ambition in the agriculture sectors: A menu of options*. Rome.

Fransen T., Northrop E., Mogelgaard K. and Levin K. 2017. Enhancing NDCS by 2020: Achieving the Goals of the Paris Agreement. Working Paper, November 2017. Washington, DC, World Resources Institute.

International Labour Organization (ILO). ILOSTAT. Online Database (available at http://www.ilo.org/ilostat /faces/wcnav_defaultSelection;ILOSTATCOOKIE= vhQwBIXjP9yfHoAS98EKMbwa7UhJ1Qf77lt9S68nwlZ98I5U1ht9!1254440622? _afrLoop=1464882109201520&_afrWindowMode=0&_afrWindowId=nu ll#!%40%40%3F_afrWindowId%3Dnull%26_afrLoop%3D1464882109201520%26_afrWindowMode%3D0%26_adf .ctrl-state%3D1dtqumbjvj_4)

Integrated Food Security Phase Classification (IPC). (Forthcoming). IPC Technical Manual 3.0.

Intergovernmental Panel on Climate Change (IPCC). 1996. Revised Guidelines for National Greenhouse Gas Inventories. (available at https://www.ipcc-nggip.iges.or.jp/public/gl/invs1.html)

IPCC. 2006. Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan (also available at https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/0_Overview/V0_0_Cover.pdf)

IPCC. 2014a. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. [Core Writing Team, R.K. Pachauri and L.A. Meyer, eds]. Geneva, Switzerland.

IPCC. 2014b. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. [V.R. Barros, C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken,P.R. Mastrandrea and L.L. White, eds]. Cambridge, UK, and New York, USA, Cambridge University Press

Joint Research Centre (JRC). 2010. Climatic Zone.In: European Soil Data Centre. Joint Research Centre [online] [Cited on 28 September 2018] https://esdac.jrc.ec.europa.eu/projects/renewable-energy-directive

Luo Y., Wang J., Liu B., Wang Z., Yuan Y. and Yue T. 2015. Effect of Yeast Cell Morphology, Cell Wall Physical Structure and Chemical Composition on Patulin Absorption. PlosONE, 10(8): e0136045 [online]. [Cited 28 September 2018]. https://doi.org/10.1371/journal.pone.0136045

Millennium Ecosystem Assessment (MEA). 2005. Ecosystems and Human Well-being: Synthesis. Washington, DC, Island Press.

Northrop E., Biru H., Lima S., Bouye M. and Song R. 2016. Examining the Alignment between the Intended Nationally Determined Contributions and Sustainable Development Goals. Working Paper, November 2016. Washington, DC, World Resources Institute.

Oak Ridge National Laboratory (ORNL). 2010. LandScan: Geographic Information Science and Technology [online]. [Cited on 28 September 2018] https://landscan.ornl.gov/

Rosenzweig C. and Tubiello F. N. 2007. Adaptation and Mitigation Strategies in Agriculture: an Analysis of Potential Synergies. Mitigation and Change Adaptation Strategies for Global, 12: pp. 855-873.

Smith P. and Olesen J. E. 2010. Synergies between the mitigation of, and adaptation to climate change in agriculture. *Journal of Agricultural Science*, 148: pp. 543-552.

The Economics of Ecosystems and Biodiversity (TEEB). 2010. Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB. (also available at http://doc.teebweb.org/wp-content/uploads/Study%20and%20Reports/Reports/Synthesis%20report/TEEB%20Synthesis%20Report%202010.pdf

United Nations Department of Economic and Social affairs (UN DESA). 2017. *World Population Prospects 2017* [online]. New York, USA. https://esa.un.org/unpd/wpp

United Nations Children's Fund (UNICEF), World Health Organization (WHO) and International Bank for Reconstruction and Development/World Bank. 2018. *UNICEF, WHO, World Bank Group Regional and Global Joint Malnutrition Estimates. May 2018 Edition* [online]. [Cited on 22 October 2018] https://data.unicef.org/topic/nutrition, www.who.int/nutgrowthdb/estimates, https://data.worldbank.org

UNICEF. 2018. Infant and Young Child Feeding: Exclusive breastfeeding, Predominant breastfeeding. In: *UNICEF Data: Monitoring the Situation of Children and Women* [online]. [Cited on 22 October 2018] https://data.unicef.org/topic/nutrition/infant-and-young-child-feeding

United Nations Framework Convention on Climate Change (UNFCCC). 2016. Adoption of the Paris Agreement. Decision 1/CP.21. Paris.

UN Water. Coordinating the UN's work on water and sanitation. [online] [Cited on 24 October 2018] http://www.unwater.org/water-facts/scarcity/

Verchot L. V., Van Noordwijk M., Kandji S., Tomich T., Ong C., Albrecht A., Mackensen J. 2007. Climate change: linking adaptation and mitigation through agroforestry. Mitigation and Adaptation Strategies for Global Change, 12(5): pp. 901-918.

WHO. 2017. Global Health Observatory (GHO) [online]. [Cited on 22 October 2018] http://apps.who.int/gho/data/node.main.A900A?lang=en

World Bank (WB). World Bank Open Data. Washington. (available at https://data.worldbank.org/)

Building on FAO's global study of the Nationally Determined Contributions (NDCs) in the agriculture sectors, the Climate and Environment Division (CBC) is developing a series of regional-level analyses of the NDCs to identify the current baselines, gaps and opportunities for enhancing regional mitigation and adaptation ambitions in the agriculture sectors. This report aims to guide FAO – and policy makers and practitioners in the region – committed to providing the country support required for accelerating progress on and scaling up NDCs in the agriculture sectors, and ensuring that future commitments are clear, quantifiable, comparable, transparent and ambitious.

The agriculture sectors in in the Southern Europe, Eastern Europe and Central Asia represent a pivotal opportunity for simultaneously leveraging the mitigation potential of the region, while enhancing adaptive capacity and food security outcomes through a transition to more sustainable agriculture and land use. However, change will only come about if supported by appropriate policies, institutional arrangements, capacity development and finance mechanisms. By highlighting the gaps in the coverage of mitigation and adaptation actions in the agriculture sector, as well as illustrating opportunities for enhancing climate ambitions in the next round of NDCs, this analysis can serve as an important roadmap for directing future investment and international support toward low-emission, climate-resilient and inclusive agriculture systems in the region.

Climate and Environment Division (CBC) Publications

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS (FAO)
WWW.FAO.ORG

ISBN 978-92-5-131272-8 ISSN 2226-6062

9 789251 312728

CA3141EN/1/02.19