With support from

Federal Ministry of Food and Agriculture

by decision of the German Bundestag

German-Ukrainian Agricultural Policy Dialogue

within the National Association of Agricultural Advisory Services of Ukraine

Agrarian Policy Report APD/APB/11/2019

Climate change adaptation policies in agriculture: international experience and opportunities for Ukraine

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Kyiv, December 2019

About the Project "German-Ukrainian Agricultural Policy Dialogue" (APD)

The project "German-Ukrainian Agricultural Policy Dialogue (APD)" has been implemented with the support of the Federal Ministry of Food and Agriculture (BMEL) since 2006 and is currently being implemented until 2021 at its request through the executor of GFA Consulting Group LLC, as well as a consortium consisting of IAK Agrar Consulting, Leibniz Institute for Agricultural Development in Transition Economies and AFC Consultants International. The recipient of the project is the National Association of Agricultural Advisory Services of Ukraine "Dorada". When implementing important measures for the development of the land market, the use of state land and privatization, the APD works in cooperation with the land management company (BVVG). The beneficiary of the project is the Ministry of Agrarian Policy and Food of Ukraine.

The project should support Ukraine in the areas of sustainable agriculture, efficient processing industry and international competitiveness in accordance with the principles of market and regulatory policies taking into account the development potential that arises under the Association Agreement between the EU and Ukraine. To meet this goal, the Project should provide information on German experience, in particular, East German, as well as international European experience in development of agrarian and forestry policy framework, as well as on the organization of relevant agrarian and political institutions.

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Introduction

The Intergovernmental Panel on Climate Change defines agriculture as one of the most vulnerable sectors to climate change and recognizes the role of adaptation measures to minimize the damage[1].

The government of Ukraine has developed the Strategy for Adaptation to Climate Change in Agriculture, Forestry, Fisheries and Hunting of Ukraine until 2030, which is expected to be approved in 2020. The strategy will be implemented through the introduction of specific policy tools to enable development of adaptation technologies and measures and to minimize negative climate change impacts on food security and the competitiveness of Ukraine's agricultural sector.

To support Ukraine's government in designing effective adaptation policies, this policy paper examines successful cases and provides recommendations for potential introduction of similar measures in Ukraine. It describes international experience on implementation of climate change adaptation policies in agriculture by showcasing 10 case studies. These case studies were selected taking into account policy effectiveness as well as relevance for Ukraine's agricultural sector. The author also tried to cover different policy types and options. Although adaptation policies should be context-specific and take into account both national and local priorities, the case studies described cover various policy options available and could serve as a starting point for the development of effective adaptation policies for the agricultural sector in Ukraine.

The paper is structured as follows:

- Section 1 presents information on climate change impacts and risks for the agricultural sector in Ukraine;
- Section 2 defines adaptation policies and presents classification of adaptation policies;
- Section 3 describes the importance of institutional capacities for the implementation of adaptation policies;
- Section 4 briefly outlines the adaptation policy frameworks on global and EU levels and illustrates ten adaptation policies examples from different countries;
- Section 5 presents the interlinkages between adaptation and mitigation policies; and
- Section 6 provides conclusions and recommendations for adaptation policy development in Ukraine.

1 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, https://www.ipcc.ch/report/ar5/wg2/

EXECUTIVE SUMMARY

Negative impacts of climate change on crop and terrestrial food production pose growing risks to the agricultural sector in many regions around the globe, including Ukraine. Climate change leads to a loss of production capacity and a potentially critical decline in yields in a long-term perspective, causes shifting of crop-growing zones from south to north due to increasing temperatures, changes humidity conditions and poses higher drought risks, and results in an increased spread of diseases and pests.

Adaptation policies have the overarching objective of reducing vulnerability to climate change impacts and are developed based on the climate vulnerability assessment and national adaptation strategies. Due to the local specifics and high diversity of climate change impacts, adaptation policy measures are usually country- and sector-specific with agriculture being one of the key sectors targeted by climate adaptation policies.

The key types of adaptation policy options include:

- risk assessment and dissemination of information on climate change risks;
- capacity building on climate adaptation technologies;
- risk management policies;
- financial support for adaptation technologies implementation; and
- public infrastructure and asset investment.

Well-designed institutions, including formal procedures, laws and regulations and informal values, traditions, and codes of conducts are important for mainstreaming of climate adaptation and efficient implementation of adaptation policies. Institutions create the enabling environment, organize policy development processes, ensure horizontal coordination within different authorities, as well as vertical coordination of different stakeholders at national, regional, and local levels. Besides, institutional arrangements ensure monitoring, evaluation and reviewing of adaptation policies implementation.

Examples of adaptation policies implemented or being developed by different countries that could serve as a starting point for the discussion of adaptation policy options for the agricultural sector of Ukraine include:

- agricultural insurance program (Austria);
- drought early warning system for farmers (Germany);
- extreme weather monitoring and risk assessment (Germany);
- drip irrigation subsidies (India);
- seeds subsidies (Kazakhstan);
- Agricultural Drought Management Board (Turkey);
- soil and land database and land information system (Turkey);
- Scotland's farm advisory service (the United Kingdom);

- environmental land management scheme (the United Kingdom);
- countryside stewardship – facilitation fund (the United Kingdom).

Climate change adaptation policies for Ukraine's agricultural sector can be inspired by international examples but should take into account the national context and sector's specifics, including key vulnerabilities, the existing policy framework and governance capacities.

Integration of adaptation aspects into existing agricultural policies, including farm advisory services and state support provision, could be recommended as the first step of adaptation policy development followed by the development of new adaptation-specific policy options.

1 ADAPTATION NEEDS OF THE AGRICULTURAL SECTOR OF UKRAINE

"The largest known economic impact of climate change is on agriculture because of the size and sensitivity of the sector".[2]

The IPCC reports that the effects of climate change on crop and terrestrial food production are evident in several regions of the world with negative impacts of climate trends being more common than positive ones. In particular, crop yields in temperate regions are negatively impacted by extreme daytime temperatures (around 30°C) and increased CO_2 concentration, which enhance the distribution of invasive weeds. At the same time, agronomic adaptation could improve yields on average by the equivalent of approximately 15-18% of current yields, but the effectiveness of adaptation is highly variable.[3]

According to the Technology Needs Assessment report for adaptation in Ukraine, there are various climate change consequences and risks that impact the agricultural sector[4] (see Box 1.).

Box 1. Examples of climate change impacts and vulnerabilities for the agricultural sector of Ukraine

1. An increase in yield of major crops in the short-term period by 2030 but a potential critical decline in yields by 2050.
2. Reduction in productivity due to the lack of adequate technical equipment under scenario of rapid climate change.
3. Shifting crop-growing zonality from south to north, further increase of the vegetation period, and creation of a new thermal zone with a cumulative annual temperature of more than 3400 °C in the South of Ukraine.
4. Change in humidity conditions, intensifying erosion and loss of soil productivity due to the increasing droughts caused by the rapid growth of thermal resources and almost unchanged precipitation levels.
5. Loss of production capacity as a result of migration processes due to adverse climatic phenomena.
6. Increased risk of plants suffering from diseases and pests due to favourable conditions for the active development of many of their pathogens, due to the increase of cumulative winter temperatures.

2 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 9. Rural areas, https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap9_FINAL.pdf

3 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 7. Food Security and Food Production Systems, https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap7_FINAL.pdf

4 Adopted from the report Technology Needs Assessment for Ukraine. Adaptation, https://tech-action.unepdtu.org/country/ukraine/

7. Reducing the adaptive ability and efficiency in all types of living organisms breeding with an agricultural purpose.

8. The transmission of infectious diseases as a result of changing migration routes of wild birds, animals, and insects.

9. The reduction of the gross production of traditional fodder crops and the need for increased production of non-traditional crops (sorghum, triticale, etc.).

10. The mismatch of existing microclimate maintenance systems in the premises for keeping animals in new climatic conditions.

11. Natural disasters (hurricanes, snow, droughts, etc.) causing stress for animals and affecting the efficiency of production.

Key impacts and vulnerabilities to climate change were taken into account by government bodies responsible for the development of the Strategy for Adaptation to Climate Change in Agriculture, Forestry, Fisheries and Hunting of Ukraine until 2030 and will be further considered in the process of development of specific policy and technological adaptation measures for minimizing negative climate change impacts on the food security and competitiveness of Ukraine's agricultural sector.

2 OVERVIEW OF CLIMATE CHANGE ADAPTATION POLICY OPTIONS

The 5th IPCC assessment report defines adaptation to climate change as transitioning from a phase of awareness to the construction of actual strategies and plans. The report suggests that the awareness about the importance of climate change adaptation has raised and the number and types of adaptation responses has increased in both developed and developing countries. National governments typically coordinate adaptation actions in subnational and local levels of government, including the provision of information and policy frameworks, creating legal frameworks, actions to protect vulnerable groups, and, in some cases, providing financial support to other levels of government.[5]

National adaptation strategies developed based on the climate vulnerability assessment often serve as a starting point in adaptation planning. However, specific policy tools are required to move from the planning stage to implementation of adaptation measures.

The IPCC defines adaptation strategies as a general plan of action for addressing the impacts of climate change, including climate variability and extremes, which include a mix of policies and measures that have the overarching objective of reducing vulnerability to climate change impacts.

5 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 15, Adaptation Planning and Implementation, https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap15_FINAL.pdf

In a more detailed version the term "adaptation policy" defines the "*…activities and decisions taken by purposeful public and private actors at different administrative levels and in different sectors, which deals intentionally with climate change impacts, and whose outcomes attempt to substantially impact actor groups, sectors, or geographical areas that are vulnerable to climate change*".[6]

Particular policy measures are usually sector-specific with agriculture being one of the key sectors targeted by climate adaptation policies. It is important to note that such policies could have multiple objectives, such as resource efficiency, economic development or disaster risk reduction, with adaptation being only one of them.

Policies complement and enhance the capacity of farmers to adapt their practices to climate risks. The key role of the public sector is to provide information, knowledge, and tools that will allow farmers access and control climate-related risks. It is important, however, to notify the high uncertainty of future climate change impacts at local level and the risk of maladaptation, which is defined as actions or inaction that may lead to increased risk of the adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare.[7]

The following key types of adaptation policy options are identified based on the reviewed case studies and analysis of the literature on adaptation policies[8]:

- risk assessment and dissemination of information on climate change risks, including access to scientific information, research and development programs, computerized monitoring and decision-support tools;
- capacity building on climate adaptation technologies, including trainings, education, facilitating activities, and incorporating climate change topics in existing advisory services for farmers;
- risk management policies, including early warning systems, insurance mechanisms, and risk reduction through resilience building;
- financial support for climate adaptation technologies implementation, including subsidies, grants, and state support payments;
- public infrastructure and asset investment.

6 Comparing apples and oranges: The dependent variable problem in comparing and evaluating climate change adaptation policies, https://www.sciencedirect.com/science/article/pii/S0959378013001283

7 Adapting Agriculture to Climate Change. A Role for Public Policies, https://www.oecd-ilibrary.org/agriculture-and-food/adapting-agriculture-to-climate-change_5js08hwvfnr4-en

8 The types of adaptation measures have been defined based on the case studies described in section 4, as well as classification used in other studies. See, for instance OECD. Adapting Agriculture to Climate Change. A Role for Public Policies, https://www.oecd-ilibrary.org/agriculture-and-food/adapting-agriculture-to-climate-change_5js08hwvfnr4-en and A typology of adaptation actions: A global look at climate adaptation actions financed through the Global Environment Facility, https://www.sciencedirect.com/science/article/pii/S0959378014000065

Some of the adaptation measures could be economically beneficial for farmers due to their private benefits, while others bring mostly public benefits and require public sector interventions. The OECD defined seven guiding principles for justification of public policies to streamline adaptation actions in the agricultural sector (see Table 1).[9]

Table 1. Guiding principles for public interventions to foster adaptation

Principle 1	Policies contribute to generation of knowledge in order to overcome market failures[10] in knowledge generation (due to high uncertainty in the private benefits) and because knowledge is at least partially a public good. The availability of good quality information, access to innovation and research and development is essential to making the right decisions on adaptation.
Principle 2	Policies facilitate the transfer of knowledge to ensure that the public goods' aspects of new knowledge spill over to the entire economy.
Principle 3	Policies correct market failures related to non-knowledge-related externalities[11] (e.g. support of reduced tillage due to additional public benefits from carbon sequestration).
Principle 4	Policies overcome financial market failures (barriers to access sufficient investments) for adaptation measures requiring considerable amount of investment.
Principle 5	Policies contribute to sharing risks across regions. Examples include policies to enhance agricultural trade and risk sharing measures such as flood control policies.
Principle 6	Policies contribute to overcoming institutional or regulatory market failures.
Principle 7	Policies reduce market failures related to barriers to multi-level, multi-scale collaboration. The success of adaptation will depend on collaboration between different levels of governing bodies, including international

9 OECD. Adapting Agriculture to Climate Change. A Role for Public Policies, https://www.oecd-ilibrary.org/agriculture-and-food/adapting-agriculture-to-climate-change_5js08hwvfnr4-en

10 Market failure defines inefficient distribution of goods and services in the free market (e.g. the price for the goods and services does not reflect the equilibrium of demand and supply). Example of market failures include externalities, monopoly, and information asymmetries.

11 Externality is a cost (negative externality) or a benefit (positive externality) incurred or received by a party due to the impact of external factors, which are not under the control of such party. Example of negative externality is environmental pollution and emissions of greenhouses gases, in particular.

	collaboration and collaboration between multi-level and multi-sectoral bodies.

3 INSTITUTIONAL CAPACITIES AND POLICY COORDINATION

According to the 5th IPCC Assessment Report, the institutional dimension in adaptation governance plays a key role in promoting the transition from planning to implementation of adaptation and mainstreaming adaptation actions.

Lack of institutional capacity along with lack of resources and lack of political awareness are considered as the top three barriers to implementing adaptation policies.[12]

Institutions are composed of tangible formal procedures, laws and regulations and tacit informal values, norms, and traditions that shape expectations and guide actions among actors and organizations. Adaptation planning and implementation follows formal institutions associated with regulations, policies, as well as standards created and enforced by government actors but also requires the participation of informal institutions through interactions among stakeholders.

Existing institutional arrangements often restrict the mainstreaming of climate adaptation. The most commonly emphasized barriers or enablers of institutional change in planning and implementation identified for both developing and developed countries are[13]:

(1) multilevel institutional coordination between different political and administrative levels in society;

(2) key actors, advocates, and champions initiating, mainstreaming, and sustaining momentum for climate adaptation;

(3) horizontal interplay between sectors, actors, and policies operating at similar administrative levels;

(4) political dimensions in planning and implementation; and

(5) coordination between formal governmental, administrative agencies, and private sectors and stakeholders to increase efficiency, representation, and support for climate adaptation measures.

Institutions create the enabling environment for implementing adaptation actions by providing guidelines, incentives, or constraints that shape the distribution of climate

12 Climate policy innovation: The adoption and diffusion of adaptation policies across Europe, https://www.sciencedirect.com/science/article/pii/S0959378014001575#bib0075

13 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter15, Adaptation Planning and Implementation, https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap15_FINAL.pdf

risks, establish incentive structures that can promote adaptation, foster the development of adaptive capacity, and establish protocols for both making and acting on decisions[14].

An effective institutional set-up is important to organize the policy development process with broad stakeholder engagement both at the national and local levels, as climate change impacts and potential adaptation measures could be specific to the regions and localities and broad stakeholder support is required to ensure the implementation of adaptation policies.

Institutional arrangements should ensure horizontal coordination among different ministries, agencies, and departments, as well as vertical coordination of various stakeholders from national (e.g. Ministry of Energy and Environmental Protection, Ministry of Economic Development, business associations, scientific institutions, etc.), regional (e.g. regional state administrations, agricultural holdings, etc.), and local levels (e.g. farmers, municipalities, etc.).

In addition to policy coordination, the institutional arrangements should ensure monitoring, evaluating, reviewing, and adjustment of adaptation planning and implementation. A high level of uncertainty about future region-specific and sector-specific climate change impacts requires a broad range of policy tools and response options as well as mechanisms to adjust national and subnational climate adaptation policies.

4 CLIMATE CHANGE ADAPTATION POLICIES IN AGRICULTURE

4.1 Global level

The key international documents covering climate adaptation-related aspects include the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement. Under the UNFCCC the issues related to agriculture, including adaptation aspects, are discussed within the "Koronivia joint work on agriculture".[15]

Financing of adaptation measures at the global level is ensured via the Adaptation Fund and Green Climate Fund established under the UNFCCC, as well as via programs of multilateral development banks and other international financial institutions. Policy development and revision is also one of the important areas supported by the Global Environmental Facility.

14 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Chapter 14, Adaptation Needs and Options, https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap14_FINAL.pdf

15 Issues related to agriculture, https://unfccc.int/topics/land-use/workstreams/agriculture. The decision on "Koronivia joint work on agriculture" has been adopted on the 23rd Conference of the Parties (COP) to the UNFCCC held in Bonn in 2017 under the presidency of Fiji. In honour of Fiji the decision was symbolically named after the Koronivia Research Station, which is the only agricultural research institution in the country.

Further, the Food and Agriculture Organization of the United Nations has approved a Strategy on Climate Change to enhance capacities of Member Nations on climate change, improved integration of agriculture within the international agenda on climate change, and strengthen coordination.[16]

4.2 EU level

Key aspects related to adaptation policies in the agricultural sector at the EU level are described in the EU Adaptation Strategy.

The EU Adaptation Strategy[17] has been adopted in 2013 with the overall aim to contribute to a more climate-resilient Europe, including enhancing the preparedness and capacity to respond to the impacts of climate change at local, regional, national and EU levels, as well as developing a coherent approach and improving coordination at the various levels of planning and management.

The EU Adaptation Strategy includes eight actions, which aim to foster adaptation actions at the national and local levels, support knowledge sharing for better informed decision-making, and promote adaptation in key vulnerable sectors, including agriculture.

Box. 2. Actions defined in the EU Adaptation Strategy

Action 1: Encourage all Member States to adopt comprehensive adaptation strategies.

Action 2: Provide LIFE programme (Programme for the Environment and Climate Action) funding to support capacity building and step up adaptation action in Europe.

Action 3: Introduce adaptation in the Covenant of Mayors framework.

Action 4: Bridge the knowledge gap, including on information on damage and adaptation costs and benefits, as well as regional and local-level analyses and risk assessments.

Action 5: Further develop Climate-ADAPT as the 'one-stop shop' for adaptation information in Europe (https://climate-adapt.eea.europa.eu/).

Action 6: Facilitate the climate-proofing of the Common Agricultural Policy, the Cohesion Policy, and the Common Fisheries Policy.

Action 7: Ensuring more resilient infrastructure.

Action 8: Promote insurance and other financial products for resilient investment and business decisions.

16 FAO's strategy on climate change, http://www.fao.org/climate-change/our-work/what-we-do/climate-change-strategy/en/

17 EU Adaptation Strategy, https://ec.europa.eu/clima/policies/adaptation/what_en

4.3 National level case studies

This section describes illustrative case studies from selected countries, which could be considered for the development of adaptation policy options for Ukraine.

4.3.1 Austria

Agricultural insurance program

There are two types of agriculture insurance programs: indemnity-based yield insurance and index-based insurance. Most agriculture-related insurance products in high-income countries are indemnity-based. Indemnity-based policies are written against actual losses. By contrast, index-based products are written against physical or econometric triggers, for example, if precipitation levels are below a given threshold over a certain period, claim payments are made. Hence, instead of the loss itself, the insurance pay-outs depend on an index, which serves as a proxy for the losses.[18]

Austria has one of the most comprehensive risk coverages for the agricultural sector in the world and during recent years the government expanded premium subsidies for agricultural insurance, in order to replace ad-hoc compensation for damages caused by insurable weather extremes (e.g. hail, frost, drought). The indemnity-based yield insurance in the country now includes an option for index-based products against certain conditions, such as a reduction in rainfall, rather than actual yield loss.[19]

In response to the 2013 and 2015 drought, as well as extensive frost damage in spring of 2016, the Austrian government amended the law on hail insurance (Hagelversicherungsgesetz), requiring that the existing subsidies for hail and frost insurance were extended to additional weather extremes like drought, excessive rainfall, and storm. The main insurance vehicle for nearly all agriculture-related insurance products is the Austrian Hail Insurance (Österreichische Hagelversicherung VVaG – ÖHV).[20]

The first drought index insurance was introduced for the grassland in 2015. Grassland is normally difficult to insure via indemnity-based yield insurance programs due to the differing number of harvests per year but index-based insurance provides a solution to this. In 2016 and 2017, drought index insurance for corn, winter wheat, and sugar beets also became available, and more products may be added in the future.

18 Subsidized Drought Insurance in Austria: Recent Reforms and Future Challenges, http://pure.iiasa.ac.at/id/eprint/15048/1/2017_Subsidized%20Drought%20Insurance%20in%20Austria%20Wipo.pdf

19 Agricultural drought insurance: Austria as a case study, https://iiasa.ac.at/web/home/research/researchPrograms/RISK/IIASA_drought_insurance_factsheet_AT.pdf

20 Subsidized Drought Insurance in Austria: Recent Reforms and Future Challenges, http://pure.iiasa.ac.at/id/eprint/15048/1/2017_Subsidized%20Drought%20Insurance%20in%20Austria%20Wipo.pdf

The government grants a subsidy amounting to 27.5% of the insurance premiums against damages on agricultural crops due to adverse weather conditions such as hail, frost, drought, storms and heavy or prolonged rainfall, provided that the respective provincial government grants a subsidy equal to the federal level.[21]

Farmers can voluntarily insure crops against a long list of risks by means of an indemnity-based yield insurance known as AGRAR Universal. Index insurance can only be purchased as an extension to an AGRAR Universal package. In case of drought insurance, claims are paid if precipitation remains below the average level for a 10-years period with the following options possible:

(1) during the "short period" of a number of consecutive days with such a precipitation deficit; where 70% or less of the annual average amount of rain fall triggers compensation payments;

(2) during the "full period" of a predetermined vegetation period during which compensations are paid if the precipitation deficit reaches 36% of the 10-year average precipitation.

If the conditions are met in both periods, the period with the higher compensation will be paid. Data from the central Institute for Meteorology and Geodynamics are used for calculating the precipitation deficits and every municipality has its own reference location where precipitation is measured.

Subsidies for agricultural insurance are financed by a disaster fund (Katastrophenfonds), which is set up annually from income, capital yields, and corporate income taxes. The fund is used mostly for risk mitigation before a disaster, for large-scale protection infrastructure, and equipment for fire fighters for example, but also for compensating private households and farmers for damages from natural catastrophes.[22]

4.3.2 Germany

The Drought Early Warning System for Farmers

The German Weather Service (DWD) is responsible for the provision of meteorological information and plays an important role in providing services to the Federal Government and the federal states (Länder) in terms of climate monitoring, including the provision of climate projections for the planning and preparation of adaptation measures. The

21 Bundesrecht konsolidiert: Gesamte Rechtsvorschrift für Hagelversicherungs-Förderungsgesetz, https://www.ris.bka.gv.at/GeltendeFassung.wxe?Abfrage=Bundesnormen&Gesetzesnummer=10006223

22 Agricultural drought insurance: Austria as a case study, https://iiasa.ac.at/web/home/research/researchPrograms/RISK/IIASA_drought_insurance_factsheet_AT.pdf

German Weather Service supports agriculture and forestry with agro-meteorological information in line with the legal mandate set in the Act on the German Weather Service[23].

In 2017, amendments to the Act on the German Weather Service were approved to strengthen the climate-related responsibilities, including the following duties:

- issuance of official warnings about weather phenomena that are related to imminent weather and climate events with a high potential to cause damage;
- the analysis and forecast of meteorological and climatological processes as well as to analyze and project climate change and its impacts;
- the release of meteorological and climatological spatial data and services.

In 2019, the German Weather Service (DWD) has announced the launch of a new long-term forecasting tool that predicts soil moisture up to six weeks in advance and informs about potential drought hazards. The launch of the model was a response to exceptional drought episodes in 2018, which resulted in cereals yield decline, field fires and considerable economic losses. The model predicts soil water content and characterizes water availability for plants allowing farmers to adjust their operations (e.g. application of fertilizers, crop protection agents, etc.). Such predictions will be even more important in the future, as extreme weather conditions are likely to occur more frequently.[24] Water availability in the top 60 cm vertical profile of the soil is calculated using a water balance model, which accounts for precipitation levels, evaporation and water sinks, as well as soil properties and water retention capacity. The DWD model could be used for estimating locations where plants are under water stress and loss of yield could be expected as well as areas with water oversupply.[25] DWD also provides periodic updates with agro-meteorological warnings and conditions information.[26]

Extreme Weather Monitoring and Risk Assessment (EMRA)

The Extreme Weather Monitoring and Risk Assessment (EMRA) system was developed in response to farmers' needs in crop specific and regionally relevant information on extreme weather events.

The research project "Agricultural relevant extreme weather situations and possibilities of risk management" was completed in 2015 and examined the future occurrence of extreme weather conditions and estimated their effects on German agriculture and forestry. Furthermore, adaptation measures were examined and evaluated comparatively.

23 Deutscher Wetterdienst Act (DWD Act), https://www.dwd.de/SharedDocs/downloads/EN/general/dwd_act.pdf?__blob=publicationFile&v=2

24 DWD, https://www.dwd.de/DE/klimaumwelt/aktuelle_meldungen/190326/pk_2019.html

25 DWD, https://www.dwd.de/DE/fachnutzer/landwirtschaft/dokumentationen/agrowetter/Bodenfeuchte.pdf?__blob=publicationFile&v=2

26 DWD, https://www.dwd.de/DE/fachnutzer/landwirtschaft/2_agrarwetter/_node.html and https://www.dwd.de/EN/climate_environment/consultancy/agriculture/amber_node.html

The research project was carried out on behalf of the Federal Ministry of Food and Agriculture (BMEL) by its federal research institutes, the Heinrich von Thünen Institute and the Julius Kühn Institute, in close cooperation with the German Weather Service. In addition, BMEL supports external research institutions that work on specific aspects of the joint project.[27]

Within this project 15 crops and 16 extreme weather events, e.g. drought, heavy rain, late frost, storm, continuous rain were investigated to derive crop specific thresholds and relevant time periods.

The new EMRA project is funded by the Federal Ministry of Food and Agriculture in Germany, started in 2017 and will be completed in 2020. The objectives in EMRA are the following[28]:

- extreme weather monitoring: recording of data (frequency, exposure, damage);
- risk assessment: methods for quantifying extreme weather risks (past, present, future);
- development of a decision support system.

EMRA is in a first step developed for two case study regions and crops, including winter wheat in North-Eastern Germany (Uckermark) and apple orchards in Northern Germany (Altes Land). EMRA identifies relevant crop-specific extreme weather events, warns users and offers crop-specific advice. The EMRA system uses both measured agrometeorological parameters and simulated parameters. Relevant meteorological data such as precipitation, temperature, wind speed, etc. are calculated on a nation-wide grid and provided by the German Weather Service, including climate data, weather forecasts and climate projections for Germany. Soil moisture is simulated by the DWD using the soil information of the Federal Institute for Geosciences and Natural Resources in Germany. The project established a close collaboration with farmers in the study areas to use field observations and feedback to continuously validate and improve the implemented models and features of the EMRA tool. In the long-term, EMRA is designated to be extended to further crops and regions.[29]

The current version of the system is available via a web-interface[30].

27 Project site, https://www.agrarrelevante-extremwetterlagen.de/

28 Project presentation, https://emra.julius-kuehn.de/dokumente/upload/0e6e7_V_DWD_EGU2019.pdf

29 EMRA: A tool for agricultural Extreme weather Monitoring and Risk Assessment, https://meetingorganizer.copernicus.org/EGU2019/EGU2019-12558.pdf

30 EMRA, https://emra.geoway.de/emra/

4.3.3 India

Drip irrigation subsidies

During the last 15 years, the area under drip irrigation has increased from below 0.5 million ha two almost 3.5 million ha. The total potential area for the technology in India is about 20 million ha. The subsidy schemes were driven by water scarcity and the government policy to improve water use efficiency from one side, and the lobbying of business players to expand the market for drip irrigation systems from the other side.[31]

The special purpose vehicle called Gujarat Green Revolution Company was established as a semi-autonomous state corporation under the oversight of the state irrigation department to promote more efficient water resources use and installation of drip irrigation systems in the state of Gujarat.

The subsidy amount varies depending on geographical location, social groups and land holdings. All the farmers are entitled to receive a subsidy of 50% or INR 60,000, whichever is lower; both the national and state governments split the burden by 40% and 10%, respectively. Additional subsidies were paid for farmers in water scarce regions to reduce pressure on groundwater extraction, as well as to marginalized social groups and land holding farmers to enhance the adoption rate. The maximum subsidy amount reached as much as 75% of the total cost or 90,000 per ha (whichever is lower).[32]

The subsidy disbursement scheme includes the following steps[33]:

1. After a request of the farmer, the drip irrigation service provider conducts an estimation of the system design and cost;

2. Following the approval by the farmer, the service provider submits subsidy application accompanied with the design and cost estimate to the Gujarat Green Revolution Company;

3. The farmer pays the share of the system cost (usually 50% of total cost) to the bank account of the Gujarat Green Revolution Company;

4. A three-party agreement is signed and the Gujarat Green Revolution Company pays 25% of the total cost to the service provider to commission the works;

5. After completion of the installation, a trial run, an inspection of the third-party consultancy firm, approval by the farmer and receipt of insurance certificate, the remaining

31 Drip Irrigation for Agriculture Untold Stories of Efficiency, Innovation and Development, 1st Edition Edited by Jean-Philippe Venot, Marcel Kuper, Margreet Zwarteveen, https://books.google.com.ua/books/about/Drip_Irrigation_for_Agriculture.html

32 Incentivizing resource efficient technologies in India: Evidence from diffusion of micro-irrigation in the dark zone regions of Gujarat, https://www.sciencedirect.com/science/article/pii/S0264837718318465

33 Drip Irrigation for Agriculture Untold Stories of Efficiency, Innovation and Development, 1st Edition Edited by Jean-Philippe Venot, Marcel Kuper, Margreet Zwarteveen, https://books.google.com.ua/books/about/Drip_Irrigation_for_Agriculture.html

75% of the total system cost is paid by the Gujarat Green Revolution Company to the drip irrigation system provider.

Applications can be submitted online and are tracked by a unique identification number.

From 2005 to 2016, the subsidy scheme reached 800,000 beneficiaries covering the land area of approximately 1.3 million ha with micro irrigation systems, including 495,000 ha under drip irrigation. The total amount of subsidies issued is about USD 686 million. The subsidy scheme resulted in greater adoption of drip irrigation technology in the state of Gujarat, as well as it triggered additional employment. Micro-irrigation companies were employing a total workforce of about 1,000 field personnel (e.g. engineers, agriculturalists, extension workers), while the agencies for third-party inspections employed 200 inspectors.

Similar subsidy schemes are available in other Indian states.

The Government of India has also established detailed specifications for typical drip systems to ensure that only fully functional systems are subsidized; the subsidies are not available for separate elements of drip irrigation systems.

4.3.4 Kazakhstan

Seeds subsidies

Diversification of crop production along with no till, a distant-pasture system and a pasture-stall system on an industrial basis were identified as the priority adaptation technologies for Kazakhstan within the Technology Needs Assessment project. Implementation of adapted plant varieties will allow for improved productivity, enhanced resilience to drought, pests and diseases, as well as open up new market opportunities. According to the Program for the development of agro-industrial complexes in the Republic of Kazakhstan for 2013-2020 "Agro business-2020," it is planned to develop the crop production industry towards an increase of production volumes based on transferring to moisture- and resource-saving technologies, rational use of agricultural land, cultivation of new and fallow land in the agricultural turnover, continuation of diversification and keeping acreage of crops in line with the established science-based crop rotations. The use of new technologies requires the application of appropriate techniques to ensure rapid seed multiplication of elite seed.

Measures identified to overcome barriers and promote the development of technologies include[34]:

- development of a system of economic incentives for agricultural enterprises adopting plant diversification measures;

34 Barrier Analysis and Enabling Frameworks. Adaptation, https://tech-action.unepdtu.org/country/kazakhstan/

- establishment of a financial fund to promote the development of seed farms and provide farmers with seeds of the highest quality at the expense of internal resources;
- scale up promotion of climate-adapted technologies through subsidies relevant for the regulation of agricultural practices.

The state program of agro-industrial complex development of the Republic of Kazakhstan for 2017 – 2021 defines food security as one of the key objectives. The actions to achieve this goal include incentives for the development of seed production industry in order to supply farmers with high quality seeds and high yielding varieties of agricultural crops. Besides, the program foresees the establishment of a seed industry development fund, which will accumulate part of the costs for elite seeds and first reproduction. It will be used to finance subsidized loan programs and other measures.[35]

To achieve the goals of the program the Ministry of Agriculture has amended the procedure for providing subsidies for seed purchase and the new subsidy scheme has been enforced starting from 2019.

The new subsidy scheme foresees that in spring farmers can receive high quality seeds free of charge based on the approved quantity norms per hectare of agricultural land. After harvest in autumn they pay 30% of seed costs to the special seed industry development fund. Both the norms and maximum prices are approved by state authorities and published in a special electronic system. The state funds are used to cover the cost of seed producers for providing seeds to farmers under the subsidy scheme and partially reimburse the expenses of farmers for seed purchase.

Seeds are provided to farmers or agricultural cooperatives by seed producers or resellers based on an agreement prepared using a typical form. Applications for subsidies are submitted by farmers or seed producers and resellers in electronic form using an e-government system.

The conditions for subsidy provisions include the following:

- registration of the application in electronic subsidy system;
- registration of the information on the applicant in the electronic subsidy system based on the information from state registries;
- confirmation of the costs bared by seed producers or resellers for the distributed seeds based on cross-checking of information from the electronic subsidy system and the electronic system for collection and processing of invoices;

35 State program for the development of the agro-industrial complex of the Republic of Kazakhstan for 2017 - 2021, https://moa.gov.kz/documents/1538732758.pdf

- confirmation of ownership or usage rights for land plots based on cross-checking information from the electronic subsidy system with automated information system of state land inventory;
- registration of electronic field maps in the electronic subsidy system for all fields managed by the farmer (owned or leased).[36]

The introduction of the new subsidy scheme had a positive impact on the development of the seed production industry. For instance, the US company «Baumgartner Agriculture Science and Service» (BASS) and «Kusto Group» from Kazakhstan have announced the establishment of a joint seed production enterprise KAZSEED at the end of 2018. The volume of investment is estimated at USD 25 million during the first year. The task of the enterprise will be to supply local farmers with high quality seeds adapted to local climate conditions.[37]

4.3.5 Turkey

The Agricultural Drought Management Board

The Agricultural Drought Management Board regulation was approved in 2012, aiming at monitoring, performing risk assessments and reducing the effects of agricultural drought[38]. The board got established by the central administration and also at the regional level by provincial administrations.

It consists of the following units:

a) Agricultural Drought Management Coordination Board;

b) Risk Assessment Committee;

c) Monitoring, Early Warning and Forecast Committee;

d) Data flow units;

d) Working groups.

The Board members represent public institutions, universities and non-governmental organizations.

The duties of the Agricultural Drought Management Coordination Board are as follows:

a) to develop and implement an action plan to combat agricultural drought;

b) to coordinate cooperation between institutions and organizations on agricultural drought mitigation measures;

36 Seed development subsidy rules, https://agrobilim.kz/gov_support

37 $ 25 million will be invested by investors in the development of seed production in the Republic of Kazakhstan, https://moa.gov.kz/ru/post/170

38 Regulation on the rules and procedures of the duties and functioning of the Agricultural Drought Management Board, http://www.fao.org/faolex/results/details/en/c/LEX-FAOC119380

c) to examine the reports or suggestions received from the risk assessment committee and to take implementation decisions within the scope of the action plan to combat agricultural drought in the provinces where drought is observed;

d) to monitor, supervise and evaluate the results of the implementation of the agricultural drought action plan;

e) to eliminate financial, administrative, technical and social barriers encountered during implementation of the agricultural drought action plan;

f) to prepare drafts and make proposals for the required laws and regulations.

The Agricultural Drought Action Plan could cover aspects related to water management, agricultural techniques, seed and crop diversity, irrigation techniques, combating diseases and pests, economic and social support, land use plans, etc.

The duties of the Risk Assessment Committee are as follows:

a) to evaluate data from the monitoring, early warning and forecasting committee, and performing risk analysis;

b) to prepare the action report according to the results of the risk analysis and to submit it to the Agricultural Drought Management Coordination Board.

The responsibilities of the Monitoring, Early Warning and Forecasting Committee include the following:

a) to obtain all inventory documents and observation information from public institutions and organizations at a continuous basis;

b) to evaluate the information collected and present warnings and forecasts to the risk assessment committee.

The duties of the data flow units consist of obtaining and presenting the data required and requested by the Monitoring, Early Warning and Forecasting Committee from relevant institutions and organizations. In case there are no observation stations to provide the required data, the establishment of relevant infrastructure shall be considered.

The task of the working groups is to ensure that the relevant experts assigned in the groups have completed the required information on the given subjects within the working discipline and submit them to the committees.

Provincial management boards on agricultural drought are responsible for implementing the decisions of the Agricultural Drought Management Coordination Board and executing the activities of the agricultural drought action plan. Such boards are established under the coordination of a provincial crisis centre and include representatives of provincial authorities, relevant ministries, provincial health directorate, metropolitan or provincial municipalities, district mayors, universities, agricultural chambers, non-governmental organizations, etc. The agricultural drought provincial crisis centre is responsible for the implementation of the decisions of the Agricultural Drought Management Coordination Board, execution of provincial agricultural drought action plan, as well as collection of

regional data on land assets, water resources, and climate. Meetings of the Agricultural drought provincial crisis centre are conducted at least once a year.

Further, there is a Flood and Drought Management Department within the General Directorate for Water Management in the Ministry of Agriculture and Forestry of the Republic of Turkey.[39]

The Soil and Land Database and Land Information System

Development of an information system on soil and land is declared as one of the goals of the Climate change action plan of the republic of Turkey for 2011-2023[40]. The priorities under "Agricultural Sector and Food Security" include developing and expanding research and development, and scientific studies to identify the impacts of climate change on agriculture and to ensure adaptation to climate change. The actions under the 'Soil and Land Database and Land Information System' include:

- addressing climate change impacts in existing Soil and Land Database and Land Information System studies;
- completing soil survey, inventory and mapping studies while taking the effects of climate change into consideration;
- carrying out activities for building a Drought and Flood Information System;
- reviewing the national information systems monitoring the changes in land use types and the compiled data, and identifying, collecting, recording and registering into the database any new data required within the framework of international processes.

The National Soil Information System has been developed within the "National Geographic Soil Productivity and Organic Carbon (TOK) Information Management System (UTF/TUR/057/TUR)" project supported by FAO and carried out by the Soil, Fertilizer and Water Resources Central Research Institute from 2012 to 2015. Within the scope of the project, mapping of the physical (pH, texture, lime, etc.) and chemical (total N, P, Ca, Mg, Mn, Zn, Fe, etc.) soil characteristics of agricultural areas of Turkey has been performed. Besides, 'Organic Carbon Distribution Maps' (%) and 'Carbon Budget Map of Turkey's Soils' (t/ha) were prepared (see example at Figure 1).[41]

39 Flood and Drought Management Department, https://www.tarimorman.gov.tr/SYGM/Menus/62/Flood-And-Drought-Management-Department

40 Climate Change Action Plan for Republic of Turkey, https://webdosya.csb.gov.tr/db/iklim/editordosya/iklim_degisikligi_eylem_plani_EN_2014.pdf

41 National Soil Information System Established, https://arastirma.tarimorman.gov.tr/toprakgubre/News/151/National-Soil-Information-System-Established

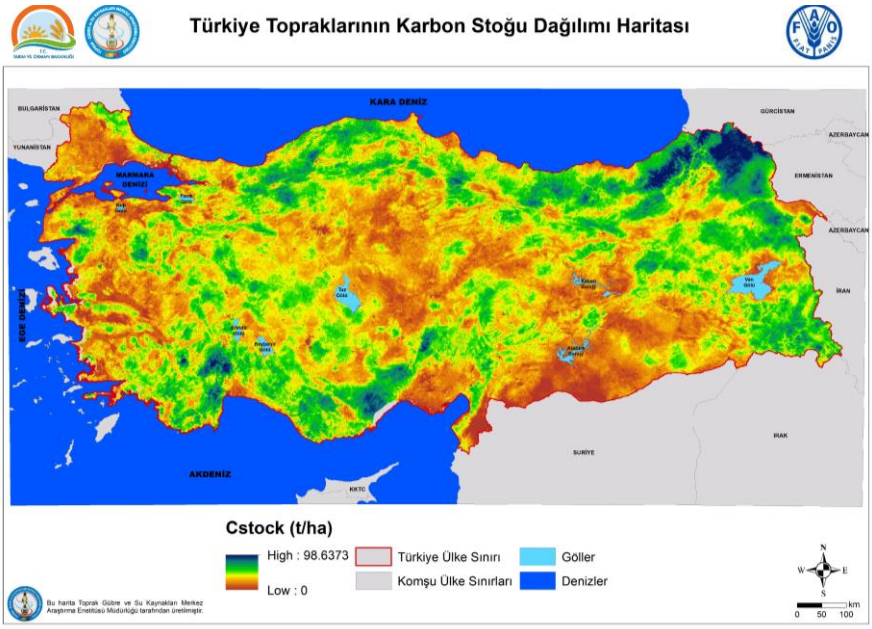

Figure 1. Carbon stock map[42]

The National Land Information System (Ulkesel Toprak Bilgi Sistemi) is available online at the website of the Soil, Fertilizer and Water Resources Central Research Institute.[43]

The initial data were collected within a scientific study aimed at developing a territorial national geographical database for soil organic carbon in topsoil (0-30 cm) in Turkey. In the first stage of the project 7,742 topsoil samples gathered from different research projects in the period of 2008-2009 that represent the national territory and different land uses were analyzed to determine the carbon content of these soils. In the second stage, the digital soil mapping methodology has been used to produce national maps of soil organic carbon based on the relations between known soil data and environmental parameters. The key agricultural regions, including Central Anatolia, South-Eastern part of Turkey and Central part of Aegean, have the lowest soil organic carbon contents. The national soil information system is planned to be updated and improved with incoming works and additional soil samples.[44]

Mapping of soil parameters is performed in coordination with different organizations and scientific institutions, as well as based on broad stakeholder consultations during various meetings and workshops. In particular, a protocol on cooperation for the collection of results of soil sample analysis performed for various reasons was signed by the General

42 Ministry of Agriculture and Forestry, https://www.tarimorman.gov.tr/TRGM/FotografGaleri-isi/T%C3%BCrkiye%20Topraklar%C4%B1n%C4%B1n%20Karbon%20Sto%C4%9Fu%20Da%C4%9F%C4%B1l%C4%B1m%C4%B1%20Haritas%C4%B1.jpg

43 Available at http://85.25.185.76/tgskmae/starter.aspx#dashboard

44 Turkey's National Geospatial Soil Organic Carbon Information System, http://www.fao.org/3/a-b9722e.pdf

Directorate of Combating Desertification and Erosion, the General Directorate of Agricultural Research and Policies (TAGEM), the General Directorate of Forestry, and the General Directorate of State Hydraulic Works.

The work also included digitalization of existing soil maps and data (covering 3 million hectares of land area and 45,000 soil profiles) to create a standardized soil database, which includes information on approvals and annotations present in the original documents. Since 2014, mobile devices and special mobile applications are used to store new data in the soil database.[45]

Many departments working under different General Directorates of the Ministry of Agriculture and Forestry of the Republic of Turkey directly or indirectly produce and use soil data. The soil information system allows for collection of information on soil parameters from different institutions and organizations in a single standardized database, which increases their quality and availability for all stakeholders.[46]

4.3.6 United Kingdom

Scotland's Farm Advisory Service

Scotland's Farm Advisory Service (FAS) is part of the Scottish Rural Development Programme which is co-funded by the EU and Scottish Government, providing information and resources aimed at increasing the profitability and sustainability of farms.[47]

The support provided includes the following services:

- grant application support;
- capacity building and networking events organization;
- subscription service for small farms;
- articles and publications on the website;
- advice line for general inquiries covering a wide variety of topics including cross compliance, water framework directive requirements, climate change and other technical issues.

The Farm Advisory Service is being delivered by SAC Consulting (part of Scotland's Rural College) and Ricardo Energy and Environment on behalf of the Scottish Government under contractual arrangements.

45 Combating decertification and erosion activities in Turkey, https://www.tarimorman.gov.tr/CEM/Belgeler/yay%C4%B1nlar/yay%C4%B1nlar%202017/FAAL%20ING%201000%20AD.pdf

46 Küresel Toprak Paydaşlığı ve Türkiye Toprak Bilgi Sistemi, https://www.tarimorman.gov.tr/TRGM/Lists/Duyuru/Attachments/343/K%C3%BCresel%20Toprak%20Paydasligi%20ve%20T%C3%BCrkiye%20Toprak%20Bilgi%20Sistemi%20Kitabi.pdf

47 Scotland's Farm Advisory Service, https://www.fas.scot/about-us/

Climate change is one of the important topics covered by the Farm Advisory Service, which provides information on both mitigation and adaptation aspects of farm operation.[48]

Information provided on climate change adaptation include:

- practical guidance documents (e.g. on soil testing and visual evaluation of soil structure, advice on increasing organic matter and applying reduced tillage or no-tillage technologies[49]);
- educational video materials (e.g. a video on the impact of heavy rain events, strengthening farm resilience and mitigation measures against soil compaction[50] and a video on climate change projections for the UK[51]);
- educational podcasts (e.g. podcast on cultivation practices and impact of different cultivation methods, including reduced tillage)[52];
- specialized reports (e.g. report on Soil and Organic Materials Analysis from the Soil and Nutrient Network Farms (2016 – 2018)[53]).

The annual Farm Management Handbook, which serves as a comprehensive and up-to-date source of information for farmers, rural professionals, students and consultants, includes a separate section on climate change and the environment.[54]

Through Scotland's Farm Advisory Service Scottish farmers can access farming support for[55]:

- expert consultancy on integrated land management plan development;
- specialist advise;
- mentoring;
- carbon audits.

The overall amount of support provided to a single farm can reach the equivalent of £3,200.

48 Scotland's Farm Advisory Service, https://www.fas.scot/environment/climate-change/

49 Valuing Your Soils Practical guidance for Scottish farmers, https://www.fas.scot/downloads/valuing-soils-practical-guidance-scottish-farmers/

50 Climate Change Impacts: Arable Farms & Intense Rainfall, https://www.fas.scot/publication/climate-change-impacts-arable-farms-intense-rainfall/

51 Video: UK Climate Projections 2018: What it tells us & what we can do, https://www.fas.scot/publication/video-uk-climate-projections-2018-what-it-tells-us-what-we-can-do/

52 Soils and tillage podcast: an interview with soil cultivation consultant, Philip Wright, https://www.fas.scot/publication/soils-and-tillage-podcast-an-interview-with-soil-cultivation-consultant-philip-wright/

53 Soil and Organic Materials Analysis from the Soil and Nutrient Network Farms (2016 – 2018), https://www.fas.scot/publication/report-soil-nutrient-network-farms-2016-2018/

54 Farm Management Handbook 2019/20, https://www.fas.scot/publication/farm-management-handbook-2019-20/

55 Scotland's Farm Advisory Service, https://www.fas.scot/advice-grants/

Integrated Land Management Plans are prepared based on an independent and confidential assessment by experienced farm business advisers accredited by the Farm Business Adviser Accreditation Scotland scheme. The aim of such plans is to identify operational improvements and cost-saving opportunities. The assessments typically include:

- assessment of strengths, weakness, opportunities and threats (SWOT analysis);
- basic habitats, biodiversity and conservation review;
- financial performance analysis;
- cross compliance assessment to highlight risk areas for the business.

The Scottish Government will fund up to 80% (up to a maximum of £1,200) of the cost of consultancy support needed to carry out the Integrated Land Management Plan. The grant is paid directly to the advisory business carrying out the review.

As part of the Integrated Land Management Plan up to two further specialist advice plans on specific issues of concern can be provided to the farmers during the period 2016-2020. The topics of specialist advise can include climate change adaptation and mitigation, resilience planning, soil and nutrient management, biodiversity, habitat and landscape management and more. The government funds 100% of the costs (up to £1,000).

The farmers could also receive support for a carbon audit carried out by an experienced agricultural consultant fully funded by the FAS (up to £500). The carbon audit establishes a farm's carbon footprint, identifies the sources of emissions, benchmarks a farm's performance comparing to others, as well as it highlights possible improvements in operational efficiency. The carbon audit includes a site visit, collection of emission data and performing calculations using the Agricultural Resource Efficiency Calculator (www.agrecalc.com). It is recommended that carbon audits are repeated annually to monitor performance and identify the impact of measures that have been implemented.

As a part of the Farms Advisory Service, there is a special Farming for a Better Climate program that suggests practical tips and ideas to improve business efficiency, reduce greenhouse gas emissions from the farm and help farmers and land managers adapt to a changing climate. Practical ideas, which can be easily developed and adapted to suit most farms, are grouped into five key action areas[56]:

1. Optimising livestock management – to improve livestock productivity through better grazing management and nutrition.

2. Optimising the application of fertilisers and manures – to save through better utilisation of nutrients.

56 Farm Management Handbook 2019/20, https://www.fas.scot/publication/farm-management-handbook-2019-20/

3. Locking carbon into soils and vegetation – to protect soils and improve soil quality for future generations.

4. Using energy and fuels efficiently - to reduce expenditures on fuel and power.

5. Developing renewable energy – to save on purchased energy and earn from surplus energy sold to the national grid and from renewable heat production incentives[57].

The Environmental Land Management Scheme

England's 25 Year Environment Plan foresees measures for improving land use management, including the introduction of a new environmental land management scheme, which envisions a transition from basic payment schemes based on the amount of land owned to outcome-based payments. The introduction of the system is connected with the Brexit and there will be a transition period (seven years, beginning in 2021) to ensure a smooth move from the EU's common agricultural policy to the new environmental land management scheme. The scheme is designed to incentivize and reward land managers to restore and improve natural capital, including mitigation of and adaptation to the effects of climate change, and rural heritage.[58]

Key elements of the new domestic system of the agricultural and environmental policy are described in the draft Agriculture Bill, which is currently under consideration of the parliament.[59]

Currently, there are three direct payment schemes in England stemming from the EU's common agricultural policy: the basic payment scheme, greening and the young farmer payment. However, only a small fraction of subsidies is provided for environmental schemes which bring public benefits such as environmental land management. The Agriculture Bill will provide the legal framework for the United Kingdom to leave the Common Agricultural Policy and establish a new system based on a public money for public goods principle. Payments may encompass (but are not limited to) environmental protection, public access to the countryside and measures to reduce flooding.

Financial assistance may be given to beneficiaries including (but not limited to) farmers, foresters, or those responsible for the management of the land. The list of purposes for and in connection with which the Secretary of State could provide such assistance include[60]:

- delivery of environmental outcomes;

57 Also see an adaptation section on the web-site of the Farming for a Better Climate program, https://www.farmingforabetterclimate.org/adapting-to-climate-change/

58 A Green Future: Our 25 Year Plan to Improve the Environment, https://www.gov.uk/government/publications/25-year-environment-plan

59 Agriculture Bill, https://services.parliament.uk/bills/2017-19/agriculture.html

60 Agriculture Bill Explanatory Notes, https://publications.parliament.uk/pa/bills/cbill/2017-2019/0266/en/18266en.pdf

- public access to and enjoyment of the countryside, farmland and woodland;
- activities undertaken to mitigate or adapt to climate change;
- activities undertaken to prevent, reduce or protect from hazards to, or caused by, the environment;
- starting, or improving the productivity of, agricultural, horticultural or forestry activities.

Environmental outcomes include clean air, clean and plentiful water and thriving plants and wildlife achieved by carrying out environmentally beneficial land and water management activities. It is intended to apply to land and to bodies of water such as ponds, lakes and rivers (excluding the sea) being managed to deliver environmental benefits. One example of how financial assistance may be used is to incentivise planting of trees around farms to help capture ammonia emissions and protect nearby sensitive habitats from damaging nitrogen deposition. This land management activity would contribute to the delivery of clean air and the protection of biodiversity.

Measures to support public access to and enjoyment of the countryside, farmland and woodland could also be accompanied by measures to support understanding of the environmental benefits land can provide. An example of such measures is support to incentivise foresters to provide facilities for educational visits of schools, which encourages pupils visiting natural environments and learning about the environment.

Climate change related measures include, for instance, incentivising peatland restoration, in order to protect the existing carbon store and reduce emissions of carbon dioxide to the atmosphere, as well as measures to reduce flood risks by incentivising good soil management, leading to a reduction in soil compaction.

Financial support could also be used to enable farmers to invest in equipment that would both increase productivity and deliver environmental benefits. This could include providing a grant or loan to enable purchase of precision application equipment for slurry. This equipment would allow the farmer to reduce the quantity of fertilisers used, reducing costs as well as ammonia emissions.

The financial assistance may be provided in any form. The examples included in the Agriculture Bill are grants, loans and guarantees but financial assistance may be given in any other form. This allows for the flexibility to make on-off payments for assistance such as capital items or ongoing payments as part of a longer-term agreement such as the delivery of environmental benefits or other public goods. The Agriculture Bill also allows the Secretary of State to attach conditions to which the financial assistance will be subject.

The Countryside Stewardship – Facilitation Fund

The Countryside Stewardship – Facilitation Fund supports groups of farmers and land managers to improve the natural environment by conducting actions that restore degraded ecosystems. As of February 2018, the fund was providing financial help to 98 groups covering more than 450,000 hectares.[61]

Countryside Stewardship is administered by the Rural Payments Agency on behalf of the Department for Environment, Food and Rural Affairs (DEFRA). Funding is provided for a person or organisation (facilitator) who brings farmers, foresters, and other land managers together to improve the local natural environment at a landscape scale rather than at single-farm scale. It is awarded through a competitive process and facilitation fund agreements with successful applicants last for three years. To qualify for funding, the group will have to undertake activities that are new to them due to cooperating. Facilitators work with a group of land managers to define countryside stewardship priorities, submit applications for land management and capital items, as well as provide other relevant support either by using own expertise or procuring relevant services from other qualified parties.

The maximum funding that could be provided to a facilitator depends on the number of holdings involved in the group and the work planned. For example, the payment for four holdings in the group could be up to £12,000 per year; the maximum amount is £50,000 per year for a group of 80 holdings. The costs include the remuneration for facilitating the cooperation and the direct costs of the project set out in a detailed plan, which should include the transfer of knowledge and expertise.[62]

The following two examples describe natural-based solutions, which are implemented via the countryside stewardship facilitation program and contribute to climate adaptation.[63]

The Stockdalewath Natural Flood Management Group was set up in response to repeated flooding events that have severely affected local homes and properties. The group consists of 14 local farmers and is working closely with local water management authorities to identify and implement appropriate natural flood management[64] (and water quality) measures throughout the area to delay the height and intensity of peak flooding by slowing and storing water within the wider catchment. As many of these measures involve good agricultural management they will also benefit farm businesses

61 Progress in preparing for climate change – 2019 Progress Report to Parliament, https://www.theccc.org.uk/publication/progress-in-preparing-for-climate-change-2019-progress-report-to-parliament/

62 Facilitation fund 2019: Countryside Stewardship, https://www.gov.uk/guidance/facilitation-fund-2019-countryside-stewardship

63 Facilitation fund case studies: Countryside Stewardship, https://www.gov.uk/government/publications/countryside-stewardship-facilitation-fund-case-studies

64 Please, also refer to the Natural Flood Management Measures. A practical guide to farmers, https://thefloodhub.co.uk/wp-content/uploads/2018/11/North-West-NFM-handbook.pdf

while reducing flooding risks. As part of the first phase of the initiative, representatives of water management authorities undertake farm visits and identify sites where natural flood management measures, such as hedgerow restoration (see example in Figure 2), watercourse fencing, and the installation of leaky woody dams will help to 'slow the flow' of rainwater. These measures then were incorporated into a series of multi-annual Countryside Stewardship applications to receive additional funding. Research recently completed by water management authorities that involved modelling flooding in relation to a range of potential natural flood management measures has also found that soil aeration through the two catchments could reduce flooding by up to 8%. The next phase of the Stockdalewath NFM Group activity is going to look at the range of benefits from good soil management.

Figure 2. Hedgerow restoration

Another example is the White Peak Farmers Countryside group (10 farmers covering 1080 ha of land), which is promoting conservation farming. The conservation planning and management activities include:

- a joint grassland action plan (for 200 ha);
- three site restoration plans;
- local seed introduction (5 ha of grassland);
- hedgerow restoration and new planting (1.8 km);
- better protection of 33 ha of priority habitat;
- work for ancient tree heritage.

The activities of the facilitation group included open farm days, meetings, workshops and training activities on topics including grassland management, conservation grazing, wood pasture habitat, and woodland management. The group also promotes its projects via community engagement activities to raise awareness among local people and organisations about such facilitation groups. Projects mentioned on the group's website[65] include developing a wild plant seed exchange to manage restoration projects and seed donor sites, setting up a machinery and contractor ring to provide access to suitable agricultural and specialist operators, as well as monitoring wildlife.

5 INTER-LINKAGES WITH MITIGATION POLICIES

The main goal of adaptation actions is to reduce climate-related vulnerabilities. However, they often result in greenhouse gas emission reduction, also entailing mitigation benefits. Therefore, adaptation policies should be developed along with mitigation policies while taking into account potential inter-linkages and co-benefits.

In practical terms, inter-linkages could be demonstrated based on the results of a technology needs assessment both for adaptation and mitigation technologies for the agricultural sector of Ukraine.

Within the first phase of the Technology Needs Assessment Project funded by the Global Environment Facility, priority technologies for both climate mitigation and adaptation in the agricultural sector of Ukraine were selected based on the experts' evaluations and discussions with local stakeholders. The lists of selected technologies and information on potential policy inter-linkages are provided in Table 2[66].

Table 2. Potential policy inter-linkages in promotion of climate adaptation and mitigation technologies in the agricultural sector of Ukraine

Adaptation technologies	Mitigation technologies	Potential for policy inter-linkages
Drip irrigation in combination with conservation agriculture practices	Conservation tillage technologies (minimum-till, no-till, strip-till, etc.) to enhance the humus content (C-sequestration, reduced fuel consumption)	Policies supporting conservation tillage technologies and accompanying agricultural practices, including state subsidies for specialized agricultural machinery and equipment

65 White Peak Farmers Countryside group, http://www.whitepeakfarmers.org.uk/crbst_15.html

66 Please, refer to the following reports for the detailed description of the priority technologies and the selection methodology overview: Ukraine – Technology Needs Assessment, https://tech-action.unepdtu.org/country/ukraine/

Integrated Pest and Disease Management	Organic agriculture (C-sequestration, avoidance of N_2O emissions from mineral fertilizers, reduced fuel consumption)	Policies supporting organic agriculture practices, including the use of biological pest and disease protection agents for organic agriculture
Development of an agrometeorological early warning system	The use of information and telecommunication technologies (reduced N_2O emissions from mineral fertilizers due to optimized variable N input)	Policies aimed at capacity building activities and knowledge dissemination about the use of data analysis and information and communication technology tools in agriculture
Agroforestry (shelterbelt reconstruction)	The production and use of solid biofuels from agricultural residues (substitution of fossil fuels for energy generation)	-
-	Biogas production from animal faeces/ manure (avoidance of methane emissions and substitution of fossil fuels for energy generation)	-

6 CONCLUSIONS AND RECOMMENDATIONS

Based on the review of adaptation policy case studies from different countries, the following conclusions and recommendations for policy makers responsible for the development of the adaptation policy in Ukraine could be made:

- climate change impacts, including temperature increase, droughts, and extreme weather events, are unavoidable and will be more intense and occur more frequently in the future; therefore, adaptation to climate change should be streamlined in the national policy development process along with climate mitigation policies;
- there are various adaptation policy options, including information dissemination, capacity building, subsidies, and public procurement, which should be adjusted to the national context and the agricultural sector taking into account key climate risks and vulnerabilities, the existing policy framework and government capacities; combination of a set of options would be required to develop an efficient national adaptation policy for the agricultural sector;

- integration of adaptation aspects into the existing agricultural policies, including farm advisory services and subsidies (e.g. direct payments, partial compensation of loans, rural development subsidies, etc.), are recommended as the first step of adaptation policy development for the agricultural sector in Ukraine benefiting from the already available financial resources and organizational structures;
- besides, an analysis of adaptation aspects integration into any new policies, projects or activities receiving public support or financed by public funds (for instance research projects of state scientific institutions) should be performed even if they have other primary objectives (economic development, food security, etc.);
- in parallel, the development of new policy options should be launched, including early warning systems and capacity building programs; broad stakeholder engagement and consultations during the policy formulation process are essential due to local specifics of climate change impacts and potential adaptation measures;
- a proper institutional set-up is essential to ensure vertical integration with subnational and local actions and priorities, as well as horizontal integration via coordination of diverse state authorities and other stakeholders from the agricultural sector; in particular, a policy evaluation framework should be built-in into the policy design to allow monitoring of policy effectiveness and adjustment of policies based on evaluation results and feedback from stakeholders;
- apart from designing policy options, the government should also review existing agriculture-related policies in order to identify measures that could disincentivise farmers' adaptive actions.